Trade Liberalization and Poverty: A CGE Analysis of the 1990s Experience in Africa and Asia

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Foreword

Very seldom in my experience does research produce cross-country findings based on comparable methods, particularly in an area as complex as the impacts of trade liberalization. And while much has been written about trade liberalization, empirical results based on comprehensive robust methods are relatively rare. This volume, stemming from the work and discussions of research teams in seven countries of Asia and Africa, provides special insight into a subject that has been at the center of debate about globalization for the past decade and more. Countries differ, and 'particular attention is paid to identifying how the specific characteristics of each country – initial tariff structure, trade patterns, relative factor endowments, production patterns, income sources and consumption patterns of the poor, etc.' – shape the results. At the same time, some broad conclusions hold, and among these are lessons which are surprising and important:

- Trade liberalization increases welfare and reduces poverty marginally.
- Trade liberalization is pro-urban and may increase rural poverty.
- Industrial output increases relative to agriculture as a result of a stronger export response and greater input cost savings.
- Relative wages increase, returns to capital fall.
- Nominal income tends to fall most in rural areas.
- Nominal consumer prices fall more in industry than agriculture or services.
- Cost of living effects vary among countries and among rural and urban populations.

This volume also underlines the fact that trade liberalization does not take place in isolation. In particular, when tariffs are reduced, governments must either compensate for the loss of tax revenue by raising other taxes, or reduce expenditures. The main findings are based on 'revenue neutral' simulations, where loss of tariff revenue is recovered by an increase in sales tax. Alternatively, using a direct (income) tax to recover lost tariff revenue 'does not significantly alter the overall welfare effects; which are still marginally positive in most countries. Poverty, on the other hand, even if marginally, now increases instead of decreasing in most countries. Moreover, rural and urban relative gains are often changed and more pronounced than with a sales tax.'

To borrow again directly from the synthesis chapter, 'As this detailed analysis based on disaggregated large-scale CGE models shows, trade liberalization is more complicated than policy makers may want to admit, with numerous complex and opposing impacts on these economies that channel through the output, factor and product markets to influence household income and consumer prices. The main contribution of this volume is to point out some general trends and to explain carefully on what factors the poverty impacts of trade liberalization "depend".' Both in designing trade liberalization measures and in considering compensations for those who lose, the ability of policy analysts and policy makers to understand these factors is crucial.

The other principal contribution of this work is that its methods have been innovative in the field, combining the strengths of CGE models in capturing the complex interconnections among an economy's product and factor markets with the strengths of household surveys in examining distribution and poverty. The result, as you delve into the country cases, is a rare look into a major dimension of 'globalization and poverty.'

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Executive Director
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Introduction

As recently as fifteen years ago, development economists were not interested in poverty or income distribution issues. At that time, the principal concern was macroeconomic stabilization and efficiency analysis. The underlying assumption was that poverty is simply a symptom of underdevelopment. In this perspective, growth alone would enable the poorest of the poor to escape malnutrition, lack of education, infant mortality, while at the same time becoming active stakeholders in an economically prosperous society. This consensus held that appropriate macroeconomic management – that is, fiscal and external balance – coupled with a massive withdrawal of the State and widespread privatization, would lead to accelerated investment and rapid growth. How the benefits of growth would be distributed among the population was not a major concern and there was little preoccupation with the social acceptability of the proposed policies. Multiple episodes of "food riots" were but one consequence[1].

During the 1990s, this illusion vanished as a result of the failures of the policies put forth by the so-called "Washington consensus." International organizations, including the World Bank (WB) and the International Monetary Fund (IMF), finally acknowledged the fact that GNP per capita was not the only criterion of development success. In policy and academic circles, concern for poverty and inequality[2]

[1] For example, when the price of a loaf of bread tripled suddenly in Tunisia, a raging population descended into the streets of Tunis and the government responded with a curfew and the placing of army tanks at strategic points of the city (just as one of the editors of this book landed at the airport!).

[2] Issues relating to the measurement of inequality in income distribution have been an area of economic research since the origins of this discipline. However, discussions were mostly limited to academic or political issues, as economists believed that income distribution could be considered as a political matter unrelated to basic economic issues.

has come to fore such that, nowadays, not a single international development conference does not feature the fight against poverty in its agenda.

This book gathers together research seeking to understand the consequences, for poverty and income distribution, of episodes of major trade liberalization in a variety of African and Asian countries. It is unique in that the country studies are all led by researchers who live and work within the country they analyze. Scientific support is provided by a group of economists from Université Laval (Quebec, Canada) in the context of the Poverty and Economic Policy (PEP) research network (www.pep-net.org). Launched in 2002 with funding from the International Development Research Centre (IDRC), PEP aims to establish an international network of researchers in developing countries with the expertise, resources and reputation to contribute to and influence national and international academic and policy debates on poverty. In particular, it seeks to better understand the causes and consequences of poverty, propose pro-poor policies and programs, improve the measurement and monitoring of poverty, strengthen local research capacities on poverty issues, as well as develop new concepts and techniques for poverty analysis.

This book focuses in particular on the last of these objectives. The first part of the book provides a general overview of the links between trade and poverty, as well as the analytical techniques used in the country applications, which constitute the second part of the book. The simple computable general equilibrium (CGE) model presented in Chapter 1 provides an overview of the multiple channels through which trade reforms affects poverty. This core model underlies the country-specific models developed in the second half of the book. Chapter 2 reviews the broader literature to present what is known from other attempts to explain the linkages between trade and poverty. As this literature is vast, the focus is on the most relevant CGE-based studies. Key to any CGE analysis are the modeling choices and key parameters used to characterize the behaviour of economic agents: consumers, producers, international trade, etc. These choices are laid out explicitly in chapter 3, both to allow the reader to better understand the bases for these critical assumptions and to serve as a guide to future research in the area.

The second part of the book presents a series of country studies covering a wide variety of Asian and African countries: Bangladesh, Benin, India, Nepal, Pakistan, Philippines, Senegal, and Vietnam. Every effort was made to ensure that these country studies were comparable and that all differences observed reflect differences in the structure or behaviour of agents in each economy, rather than differences in philosophy of the individual research teams. These countries differ substantially, not only between Africa and Asia, but also according to their level of development, their international trade patterns and their initial trade policy. This allows us to draw broader conclusions concerning the poverty impacts of trade liberalization in a final synthesis chapter that compare and contrast the country-level findings. Particular attention is paid to similarities and differences in the actual implementation of trade liberalization in the different countries – the role of quantitative restrictions, the initial level and structure of protection, accompanying measures, the structure of trade (which sectors compete with imports and which sectors export) and the structure of the economy (where do the poor draw their income, how do their consumption patterns differ, etc.) – to show how these differences crucially determine the ultimate poverty impacts. Based on this analysis, general conclusions are drawn with respect to the key factors in managing trade liberalization and designing appropriate accompanying measures.

Acknowledgements

Country papers presented in this book are drawn from studies conducted in the Micro Impacts of Macro and Adjustment Policies (MIMAP) program of the International Development Research Centre (IDRC). General chapters were begun under the MIMAP program and completed in the context of the Poverty and Economic Policy (PEP) Research Network, which is financed by the Government of Canada through the International Development Research Centre (IDRC) and the Canadian International Development Agency (CIDA), and by the Australian Agency for International Development (AusAID). We sincerely thank Marie-Hélène Cloutier and Ismaël Fofana for excellent research assistance. We also acknowledge helpful comments from them and from André Martens, Marie-Claude Martin and Randy Spence. We would also like to thank PEP staff - Aissatou Diop, Awa Diop, Evelyne Joyal and Sonia Moreau - for their essential contributions to the publication of this volume.

What's going on?
A core model and framework for interpretation

John Cockburn, Bernard Decaluwé
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Summary

We construct a simple CGE model - representative of the core structure of the models in this book - to analyze the impacts of trade liberalization on poverty. This model is then used to carry out several simulations with alternative accompanying measures designed to compensate for the lost tariff revenue. The simulation results are then interpreted in terms of the various income and consumption channels through which trade liberalization and its accompanying measures influence poverty and, more generally, income distribution. Conclusions are then drawn with respect to the key considerations in the design of trade liberalization policies.

Introduction

Large-scale trade liberalization can constitute a substantial and complex shock, affecting practically all aspects of a country's economy: trade, production, consumption, state revenues, balance of payments, capital flows and wage rates, etc. Under these conditions, sorting out the resulting impacts on poverty can be a daunting task. In this chapter, we show how a simple computable general equilibrium (CGE) model can be used to distinguish the numerous channels linking trade liberalization to poverty and inform the design of appropriate accompanying measures.

This "core" model incorporates the principal characteristics of most of the models used in the country studies presented in the second half of this book. Of course, country models vary in the degree and nature of disaggregation (households, factors, sectors, commodities) and in the specific functional forms chosen. However, we will see that the most important differences in terms of determining the poverty impacts can be traced to the structure of the underlying economies themselves, in particular the initial tariff structure, sectoral import and export shares, sectoral factor intensities, and household income and consumption patterns. Data used in this model are fictive and chosen with a view to emphasizing the principal mechanisms that appear, to varying degrees, in each of the country studies.

We begin with a brief description of the salient characteristics of the economy (section 2), before presenting the model equations (section 3) and interpreting the simulation results (section 4).

BASIC STRUCTURE OF THE ECONOMY

As they are at the core of our poverty analysis, we begin by describing our modeling of households (2.1). We then trace back to the production factors that generate household income (2.2). This in turn leads us to a discussion of the model production activities (2.3). Trade liberalization also affects poverty through its impact on the prices of consumer goods, which are either imported or produced locally (2.4). Finally, we examine the government, which must replace lost tariff revenue through other sources of revenue (2.5)

Households

As discussed in chapter 1, there are three main methods of decomposing household categories in CGE models: by income level, by socio-economic group or by using microsimulation methods. However, as we are interested in studying the channels linking trade liberalization to poverty, we opt here for a socio-economic categorization of households. We distinguish four categories of households with quite different sources of income and consumption patterns:

- Rural households with little or no land (rural landless)
- Rural households with medium or large land ownership (rural landed)

- Urban households with little or no education (urban uneducated)
- Urban households with completed primary education (urban educated)

This illustrative model reflects a particularly poor country in which average yearly income is roughly $US 365, or a dollar a day (Table 1). The rural landless are poorest, followed by the urban uneducated. The urban educated are least poor.

The sources of income vary significantly between household type, which has important distributive and poverty consequences when we examine the impacts of trade liberalization. The rural landless derive the vast majority of their income from wage work, whereas land rent presents the main source of income for the rural landed. The urban educated derive most of their income from their capital investments and also receive substantial dividends ("private transfers"). Public and foreign transfers are negligible in this model.

Table 1: Sources of household income

	Rural		Urban	
	Landless	**Landed**	**Uneducated**	**Educated**
Average income ($US)	200	500	350	900
Population (millions)	3	1	2	0.75
Income sources	**Percentages**			
- Wage income	87	33	91	21
- Capital income	4	8	8	60
- Land rent	9	58	0	0
- Public transfers	0	1	1	0
- Private transfers	0	0	0	19
- Foreign transfers	0	0	0	0
Total	**100**	**100**	**100**	**100**

The four categories of households also differ in terms of their uses of income (Table 2). Only the urban educated and, to a lesser extent, the rural landed have positive (but low) savings. These two categories of households also face slightly higher direct tax rates, which the rural landless practically avoid altogether. This implies that an increase in direct taxes to compensate lost tariff revenues affects the poor less if the direct tax structure is maintained. In terms of consumption, rural households, particularly the landless, devote a larger share of their consumption to agricultural goods, primarily food. Agricultural shares are also higher for the poorest (rural landless and urban uneducated) in each location. Correspondingly, the share of consumption of industrial (mainly manufactured) goods is lower among the poor and among the rural households. The share (although not the level) of consumption devoted to services varies little between household categories. Differences in agriculture and industry consumption shares imply that changes in the consumer prices of these goods, resulting from trade liberalization, have quite different impacts on each household category.

Table 2: Uses of household income

	Rural		Urban	
	Landless	Landed	Uneducated	Educated
Consumption - agriculture	50	39	34	17
- industry	29	30	35	49
- services	21	25	27	22
Direct taxes	1	4	3	5
Savings	0	3	0	8
Total	**100**	**100**	**100**	**100**

Factors of production

In table 1, we saw that the four household categories received substantially different shares of their income from the three factors of production: labor, capital and land. Consequently, the impact of trade liberalization on the remuneration of these factors has important effects on income distribution and poverty. To understand this, we need to examine from which sectors each factor of production receives its remuneration. In this model, labor is remunerated primarily by the agriculture and service sectors, whereas capital income is derived mainly from industry and land is used only in agriculture (Table 3). If trade liberalization leads to an expansion of the agricultural sector for example, the return to land relative to other factors - particularly capital - should increase, to the benefit of rural landholders.

Table 3: Sectoral factor remuneration and factor market shares.

	Agriculture	Industry	Services	Public sector	Total
Labor	10000	2300	9600	3950	**25850**
percent	39	9	37	15	**100**
Capital	1865	6975	3700		**12540**
percent	15	56	30		**100**
Land	5960				**5960**
percent	100				**100**
Total Value added	17825	9275	13300	3950	44350
percent	40	21	30	9	100
Labor	56	25	72	100	**58**
Capital	11	75	28		**28**
Land	33				**14**
Total=value added	**100**	**100**	**100**	**100**	**100**

Production activities

In order to determine the sectoral impacts of trade liberalization, we need to look at a number of factors, including:

- The initial tariff structure on competing imports;
- Elasticities of substitution in demand between local goods and competing imports ($\boldsymbol{\varepsilon}_m$);
- Elasticities of substitution in supply between domestic and export sales ($\boldsymbol{\varepsilon}_x$);
- Initial sectoral import and export shares;
- The structure of indirect taxes, if these are used to offset lost tariff revenues; and
- The changes in the factor remuneration, since these also feed back in general equilibrium according to the sectoral factor intensities presented in table 3.

It is the industrial sector that is by far the most protected under the initial tariff structure in this model (Table 5). As imported goods are fairly close substitutes for local goods (ε_m=1.5), industrial imports should increase substantially under trade liberalization. The industrial sector also has the highest initial import share, implying that this import competition will considerably reduce demand for locally-produced industrial goods. As we impose a fixed current account balance (fixed inflow of foreign capital), the increase in imports will lead to a devaluation of the real exchange rate and an increase in exports. The agricultural sector, which has the highest export share, stands to benefit most from this. Furthermore, the industrial sector is subjected to the highest sales tax. Thus, if the fall in tariff revenues is compensated by an increase in sales taxes that maintain this same structure, the industrial sector would be further penalized.

Consumption

Impacts on household consumption mostly depend on household consumption shares and import penetration in each sector (Table 5). In effect, consumer prices are a weighted average of the

Table 5: Sectoral supply and demand characteristics

SECTORS	Taxes		Elasticities		Sectoral shares	
	Tariff	Sales tax	e_m	e_x	Imports	Exports
Agriculture	5	5	1.5	1.5	12	28
Industry	25	12	1.5	1.5	39	7
Services	0	4	1.5	1.5	9	11

	Tariffs	Elasticities		Sectoral shares			Ratios	
		ε_m	ε_x	Value added	Imports	Exports	Imports/ Cons'n	Exports/ Output
Agriculture	5	1.5	1.5	40	17	67	12	28
Industry	25	1.5	1.5	21	71	11	39	7
Services	0	1.5	1.5	30	12	22	9	11
Non-tradable	0	0	0	9	-	-	-	-
ALL	-	-	-	**100**	**100**	**100**	**22**	**17**

corresponding import prices and domestic producer prices. Therefore, changes in consumer prices are somewhere between the changes in import and domestic producer prices. Therefore, if import and domestic price changes are more important in industry, the variation in the industrial consumer price would also normally be more important. Moreover, which households are principally affected by consumer price changes depends on their respective consumption patterns. In our case, a change in the consumer price of agricultural goods should affect rural and poor households the most while changes in the consumer price of industrial goods should principally influence the urban and richest households. Variations in the consumer price of services should have an almost equal effect on every household.

Table 5: Consumption shares and import penetration

SECTORS	Imports/ Consumption	Consumption shares			
		Rural		Urban	
		Landless	Landed	Uneducated	Educated
Agriculture	12	47	32	32	13
Industry	39	31	38	39	61
Services	9	22	30	29	26
Total	22	100	100	100	100

Government

When liberalizing trade through the elimination of import tariffs, government import revenue decreases. In this model, tariffs represent 25.5 percent of government income. We therefore anticipate the need to compensate for governmental income decline following trade liberalization. It is clear from table 6 that the percentage increase in indirect taxes required to compensate lost tariff revenue would be smaller than the percentage increase in household income taxes.

Table 6: Government revenues

	Value	Income shares (percent)
Tariffs	2,694	25.5
Export taxes	90	0.8
Indirect taxes	5,251	49.7
Direct taxes on households	1,230	11.6
Direct taxes on firms	1,295	12.3
Total	10,560	100.0

The choice of the specific compensation mechanism will influence the final results. As indirect tax rates are especially high in industry, a uniform sales tax increase would have considerable impact on industrial consumer prices.

Table 7: Sectoral tax rates (percent)

Sectors	Tariffs	Export taxes	Indirect taxes
Agriculture	5.0	1.3	5.3
Industry	25.0	–	12.1
Services	–	–	3.6

On the other hand, a uniform direct tax increase would affect urban households more significantly, as they already face 4 and 5 percent income tax rates (Table 8).

Table 8: Households tax rates (percent)

Households	Direct taxes rates
Rural landless	0.7
Rural landed	2.5
Urban uneducated	4.0
Urban educated	5.0

MATHEMATICAL MODEL STRUCTURE

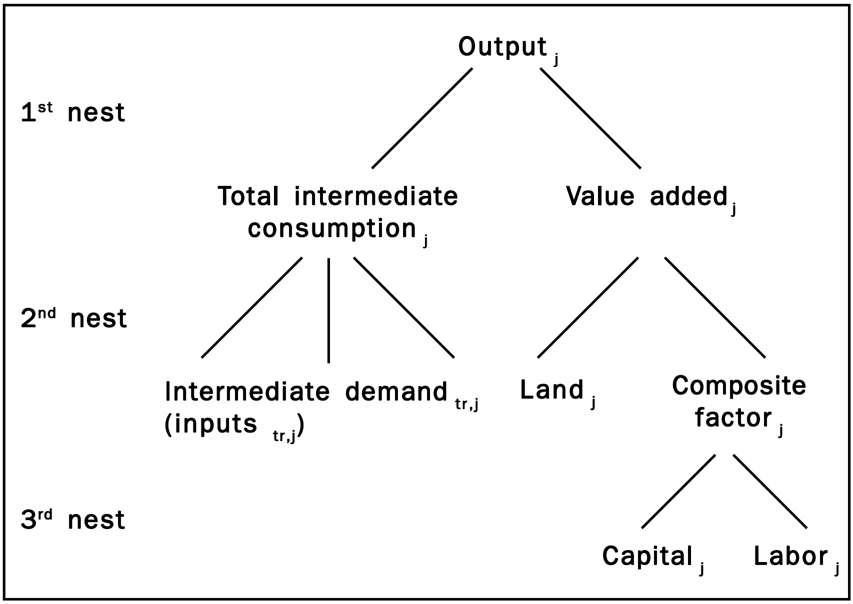
As a CGE model is a system of non linear equations solved simultaneously, it is necessary to have a clear understanding of all model equations in order to be able to adequately analyze simulation results. In this section, detailed explanations of each equation used in the model are presented with the aim of developing this indispensable comprehension of the basic model. The section is divided into 7 subsections: production (3.1), income and savings (3.2), demand (3.3), prices (3.4), international trade (3.5), equilibrium conditions and closures (3.6) and extensions (3.7).

A model is composed of variables, equations and parameters. In order to have a unique solution, a necessary condition is that the model be square, which means that it must contain the same amount of independent equations as endogenous variables. Some variables must consequently be fixed (exogenous) for this purpose and this determines the model closures discussed in section 3.6. New variables and parameters are defined explicitly when appearing for the first time in the text, but sets are defined implicitly (and explicitly in the Annex). Our notation distinguishes between parameters (lower-case Latin or Greek letters), exogenous variables (upper-case Latin letters with a bar on top) and endogenous variables (upper-case Latin letters without a bar; the only exceptions are rates of returns to factors as well as the exchange rate, which are in lower case Latin letters). Numbers at the right of the equations indicate the number of equations of this type in the model given the number of elements in the sets over which they are defined.

Production

Production is set in a perfect competition context. As a consequence, producers are assumed to maximize profits subject to their technology constraints, taking the prices of output, input and factors as given. We adopt a multi-stage production function as show in figure 1.

Figure 1: Multi-stage production function



In the first stage (equation 1), sectoral output of each activity *j* is a combination of value added and total intermediate consumption, which are characterized as strict complements according to a Leontief function.

1. $$XS_j = \min\left[\frac{CI_j}{io_j}, \frac{VA_j}{v_j}\right] \qquad 4$$

where

XS_j	=	Production of activity *j* (volume);
CI_j	=	Intermediate consumption by activity *j* (volume);
VA_j	=	Value added of activity *j* (volume);
io_j	=	Input volume necessary to produce one unit of product *j*;
v_j	=	Value-added coefficient of activity *j*.

The second stage specifies, in all tradable sectors *tr* (subdivided into agricultural (*agr*) and non agricultural (*nag*) sectors, where the latter includes industry and market services), value added as consisting of labor and capital except in agriculture, where it also includes land. These production factors are substitutes in value added according to a one- or two-level nested constant elasticity of substitution (CES) function. In the agricultural sector, a composite factor (an optimal mix of labor and capital defined at the third stage) and land combine to generate value-added.

$$2.\quad VA_{nag} = A^{kl}_{nag}\left[\alpha^{kl}_{nag} LD_{nag}^{-\rho^{kl}_{nag}} + \left(1-\alpha^{kl}_{nag}\right)\overline{KD}_{nag}^{-\rho^{kl}_{nag}}\right]^{-1/\rho^{kl}_{nag}} \qquad 2$$

$$3.\quad VA_{agr} = A^{cl}\left[\alpha^{cl} CF^{-\rho^{cl}} + \left(1-\alpha^{cl}\right)\overline{LAND}^{-\rho^{cl}}\right]^{-1/\rho^{cl}} \qquad 1$$

$$4.\quad CF = A^{kl}_{agr}\left[\alpha^{kl}_{agr} LD^{-\rho^{kl}_{agr}} + \left(1-\alpha^{kl}_{agr}\right)\overline{KD}_{agr}^{-\rho^{kl}_{agr}}\right]^{-1/\rho^{kl}_{agr}} \qquad 1$$

where

LD_j	=	Labor demand in activity *j* (volume);
$\overline{KD}_{tr}$	=	Capital demand in activity *tr* (volume);
CF	=	Composite factor demand in agriculture (volume);
$\overline{LAND}$	=	Land demand in agriculture (volume);
A^{kl}_{tr}, A^{cl}	=	Scale coefficient for CES functions linking labor to capital (in sectors *nag)* and composite factor to land (in sectors *agr),* respectively;
α^{kl}_{tr}, α^{cl}	=	Share parameter for CES functions linking labor to capital (in sectors *nag)* and composite factor to land (in sectors *agr),* respectively;
ρ^{kl}_{tr}, ρ^{cl}	=	Substitution parameter for CES functions between labor and capital (in sectors *nag)* and between the composite factor and land (in sectors *agr),* respectively ($-1 < \rho < \infty$).

From these specifications, land, labor and capital demands are obtained. The optimal mix of production factors is influenced by the elasticity of substitution, initial shares and especially relative prices of the factors considered.

5. $$\overline{\text{LAND}} = \left(\frac{1-\alpha^{cl}}{\alpha^{cl}}\right)^{\sigma^{cl}} \left(\frac{rc}{rl}\right)^{\sigma^{cl}} CF$$ 1

6. $$LD_{tr} = \left(\frac{\alpha_{tr}^{kl}}{1-\alpha_{tr}^{kl}}\right)^{\sigma_{tr}^{kl}} \left(\frac{r_{tr}}{w}\right)^{\sigma_{tr}^{kl}} \overline{KD}_{tr}$$ 3

where

r_{tr}	=	Rate of return to capital in activity *tr*;
rl	=	Rate of return to agricultural land;
rc	=	Rate of return to composite factor;
w	=	Wage rate;
$\sigma_{tr}^{kl}, \sigma^{cl}$	=	Substitution elasticity for CES functions between labor and capital (in sectors *nag)* and between the composite factor and land (in sectors *agr)*, respectively $(0 < \sigma < \infty)$ and $\sigma = 1/(\rho + 1)$.

Unlike the value added in the market sectors, value added in the non-market service sector *ntr* is exclusively generated by labor, the sole production factor in this sector.

7. $$VA_{ntr} = LD_{ntr}$$ 1

Consequently, labor demand in this sector is simply expressed as the difference between production value and the cost of intermediate consumption, divided by the wage rate.

8. $$LD_{ntr} = \frac{P_{ntr}\,\overline{XS}_{ntr} - \sum_{tr} Pc_{tr}\,DI_{tr,ntr}}{w}$$ 1

where

P_{ntr} = Producer price of good *ntr;*
Pc_{tr} = Consumer price of composite good *tr;*
$DI_{tr,ntr}$ = Intermediate consumption of good *tr* in activity *ntr* (volume).

The second stage of the production function indicates that the individual intermediate inputs in total intermediate consumption are strict complements according to a Leontief function. In other words, zero-value substitution elasticities are assumed for intermediate inputs among each other.

9. $CI_j = io_j \, XS_j$ 4

10. $DI_{tr,j} = aij_{tr,j} \, CI_j$ 12

where

$DI_{tr,j}$ = Intermediate consumption of good *tr* in activity *j* (volume);
$aij_{tr,j}$ = Input-output coefficient.

Intermediate inputs are provided by the domestic market and are a composite of domestic and imported products.

Income and savings

Income and savings equations are defined for each category of agents in the domestic economy: households, firms and the government.

Household income (Equation 11) is composed of returns to labor, capital and land, as well as governmental transfers[1] and dividends received from firms.

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[1] Governmental transfers are indexed by the general price index in order to have a model homogenous of degree zero in prices.

$$11.\ YH_h = \lambda_h^w \cdot w \sum_j LD + \lambda_h^r \sum_j r_{tr}\, \overline{KD}_{tr} + \lambda_h^l \cdot rl \cdot \overline{LAND} + Pindex \cdot \overline{TG}_h + \overline{DIV}_h \quad 4$$

where

YH_h	=	Household *h*'s income;
$\overline{DIV}_h$	=	Dividends paid to household *h*;
$\overline{TG}_h$	=	Public transfers to household *h*;
Pindex	=	GDP deflator or price index;
λ_h^w	=	Share of total labor income received by household *h*;
λ_h^r	=	Share of total capital income received by household *h*;
λ_h^l	=	Share of total land income received by household *h*.

Household *h*'s disposable income (Equation 12) is equal to its total income less direct income taxes, while household *h*'s savings (Equation 13) are proportionate to its disposable income and vary (by means of variable *ADJ*) to ensure the savings-investments balance[2].

$$12.\ YDH_h = YH_h - DTH_h \quad 4$$

$$13.\ SH_h = ADJ \cdot \psi_h \cdot YDH_h \quad 4$$

where

YDH_h	=	Household *h*'s disposable income;
DTH_h	=	Receipts from direct taxation on household *h*'s income;
SH_h	=	Household *h*'s savings;
ADJ	=	Adjustment variable for household *h*'s savings;
ψ_h	=	Household *h*'s propensity to save.

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[2] Details of the investment-saving closure will be given in subsection 3.6.

Firms derive income solely from returns to capital and land, as shown in equation 14.

$$14.\ YF = \lambda^{rf} \sum_{tr} r_{tr}\, \overline{KD}_{tr} + \lambda^{lf} \cdot rl \cdot \overline{LAND} \qquad 1$$

where

YF	=	Firm income;
λ^{rf}	=	Share of total capital income received by firms;
λ^{lf}	=	Share of total land income received by firms.

Their savings are residually determined after the payment of dividends to households and to the rest of the world, as well as the payment of direct taxes to the government.

$$15.\ SF = YF - \sum_{h} \overline{DIV}_{h} - \bar{e} \cdot \overline{DIV}^{row} - DTF \qquad 1$$

where

SF	=	Firm savings;
DTF	=	Receipts from direct taxation on firm income;
$\bar{e}$	=	Exchange rate;
$\overline{DIV}^{row}$	=	Dividends paid to the rest of the world.

Dividends are exogenous. It is clear that this particular hypotheses is not necessary realistic and that other options are possible. If, for example, the representative firm plans to invest and increase their capital stock and if they do not have the opportunity to borrow on the financial markets they could decide to save a large part of their operational surplus and distribute the residual as dividends. On the other hand, the pressure of the financial market could also push the firms to pay a normal rate of interest on their borrowed capital.

Government behavior is relatively simple. Tax revenues form the totality of its income.

$$16.\ YG = \sum_{tr} TI_{tr} + \sum_{tr} TIE_{tr} + \sum_{tr} TIM_{tr} + \sum_{h} DTH_{h} + DTF \qquad 1$$

where

YG	=	Government income;
TI_{tr}	=	Receipts from indirect taxes on good tr;
TIE_{tr}	=	Receipts from taxes on export tr;
TIM_{tr}	=	Receipts from import duties on product tr.

Tariffs, export taxes, household and firm income taxes are modeled as a fixed proportion of the value of imports, exports, household and firm income, respectively (see equation 18-21). In accordance with equation 17, indirect taxes are applied to domestic sales of local production, evaluated at producer prices, and imports, evaluated at their domestic prices, i.e. including tariffs.

$$17.\ TI_{tr} = (tx_{tr} + CTC) \cdot \left[P_{tr} XS_{tr} - Pe_{tr} EX_{tr} + (1 + tm_{tr}) \cdot \bar{e} \cdot \overline{Pwm_{tr}} M_{tr} \right] \qquad 3$$

$$18.\ TIM_{tr} = tm_{tr} \cdot \bar{e} \cdot \overline{Pwm_{tr}} M_{tr} \qquad 3$$

$$19.\ TIE_{tr} = te_{tr} Pe_{tr} EX_{tr} \qquad 3$$

$$20.\ DTH_{h} = tyh_{h} YH_{h} \qquad 4$$

$$21.\ DTF = tyf \cdot YF \qquad 1$$

where

tx_{tr}	=	Tax rate on good tr;
tm_{tr}	=	Tariff rate on good tr;
te_{tr}	=	Tax rate on export tr;
tyh_{h}	=	Direct tax rate on household h's income;
tyf	=	Direct tax rate on firm income;
CTC	=	Uniform compensatory sales tax rate;

P_{tr}	=	Producer price of good *tr;*
Pe_{tr}	=	Domestic price of exported good *tr*;
$\overline{Pwm}_{tr}$	=	International price of import *tr* in foreign currency;
Ex_{tr}	=	Exports of good *tr* (volume);
M_{tr}	=	Imports of good *tr* (volume).

Government savings correspond to its residual income after current government consumption and fixed transfers payments to households are subtracted.

$$22.\ \overline{SG} = YG - G - Pindex \sum_h \overline{TG}_h \qquad 1$$

where

SG	=	Government savings;
G	=	Public expenditures (value).

Demand

Demand on different markets are composed of public and private demand. Private demand includes consumption by households, intermediate consumption by activities, and investment. Public demand consists of government consumption and public investment.

It is assumed that households maximize a Stone-Geary utility function, which entails a linear expenditure system (LES)[3] as the resulting first order condition. Demand for product *tr* by household *h* is given by:

$$23.\ Pc_{tr}C_{tr,h} = \underbrace{Pc_{tr}c^{min}_{tr,h}}_{\text{Minimum spending}} + \underbrace{\gamma_{tr,h}\left(CTH_h - \sum_h Pc_{tr}c^{min}_{tr,h}\right)}_{\text{Discretionary spending}} \qquad 12$$

where

$\gamma_{tr,h}$	=	Marginal share of good *tr* in total household consumption;

[3] The name linear expenditure system refers to the fact that expenditure on individual commodities is a linear function of total consumption.

$c^{min}_{tr,h}$ = Minimum consumption of good *tr*;
$C_{tr,h}$ = Household *h*'s consumption of good *tr* (volume)
CTH_h = Household *h*'s total consumption (value).

and total consumption (Equation 24) is equal to household disposable income less savings.

$$24.\ CTH_h = YDH_h - SH_h \qquad 4$$

This system is particularly appropriate to welfare analysis as minimum and discretionary consumptions are distinguished. Minimum consumption $\left(c^{min}_{tr,h}\right)$ is the volume of each product that the representative consumer must consume to maintain a certain minimal standard of living. This volume is fixed and indexed by *h* to allow differences in this minimum between household categories (e.g. between rural and urban households). Discretionary consumption, on the other hand, is determined endogenously as the difference between total household consumption and minimum consumption. The equivalent variation measure of welfare changes for the LES function is thus based on discretionary income:

$$25.\ EV_h = \left(CTH_h - \sum_{tr} Pc_{tr} c^{min}_{tr,j}\right) \prod_{tr} \left[\frac{\overline{Pco}_{tr}}{Pc_{tr}}\right]^{\gamma_{tr,h}} - \left(\overline{CTHO}_h - \sum_{tr} \overline{Pco}_{tr} c^{min}_{tr,j}\right) \qquad 4$$

where[4]

EV_h = Equivalent variation for household *h*;
$\overline{CTHO}_h$ = Household *h*'s initial total consumption (value);
$\overline{Pco}_{tr}$ = Initial consumer price of composite good *tr*.

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[4] $\overline{CTHO}_h$ and $\overline{Pco}_{tr}$ are considered here as parameters.

Given that the model is static, investments do not influence the capital stock of activities and thus do not play any role in determining production levels. Investment only plays a role as part of final demand. If the composition of investment differs from private consumption patterns, any modification of the relative importance of these two consumption components in final demand would influence market equilibrium and, consequently, commodity prices. Investment demand by sector of origin is a fixed share of total investment.

26. $INV_{tr} = \dfrac{\mu_{tr} IT}{Pc_{tr}}$ 3

where

μ_{tr} = Share of the value of good *tr* in total investment demand;
INV_{tr} = Investment demand for good *tr* by sector of origin (volume);
IT = Total investment (value)

It is therefore assumed that the μ_{tr} sum to one and that there is a unitary substitution elasticity among different commodities composing investment. Total investment value is equal to the total investment volume multiplied by the investment price index (see Equation 39).

27. $IT = \overline{ITVOL} \cdot Pinv$ 1

where

$ITVOL$ = Total investment (volume);
$Pinv$ = Investment price index

Total intermediate demand for commodity *tr* is simply the sum of input demands from all sectors of the economy.

28. $DIT_{tr} = \sum_{j} DI_{j}$ 3

where

DIT_{tr} = Total intermediate demand for good *tr* (volume).

In this simple model, government (public) consumption is restricted to non-market services. Moreover, the government consumes the entire production of these non-market services so that public expenditure equals the total value of non-market services produced.

29. $G = \overline{XS}_{ntr} P_{ntr}$ 1

Prices

Since each activity's total revenue is equal to the total payments to factors (value added) and intermediate inputs, equation 30 characterizes the value-added price.

30. $Pv_{j} = \dfrac{P_{j} XS_{j} - \sum_{tr} Pc_{tr} DI_{tr,j}}{VA_{j}}$ 4

where

Pv_{j} = Value added price for activity *j*.

In the base model, capital is sector-specific and labor is mobile among different sectors. Capital returns (equations 31-32) is thus also specific to the sector employing it while there is a single wage rate in the economy. Equation 33 characterizes the rate of return to the composite factor:

31. $r_{nag} = \dfrac{Pv_{nag} VA_{nag} - w\, LD_{nag}}{\overline{KD}_{nag}}$ 2

$$32.\ r_{agr} = \frac{rc \cdot CF - w\, LD_{agr}}{\overline{KD}_{nag}} \qquad 1$$

$$33.\ rc = \frac{PV_{agr} VA_{agr} - rl \cdot \overline{LAND}}{CF} \qquad 1$$

These factor returns are determined by the equality of marginal costs and marginal revenues for each production factor in agricultural and non-agricultural activities (i.e. perfect competition).

Because of the existence of indirect taxes, we distinguish prices at factor cost and at market prices. Market prices of locally produced goods sold on the domestic market (equation 34) are equal to prices paid to local producers (at factor cost) augmented by the indirect tax rate:

$$34.\ Pd_{tr} = (1 + tx_{tr})\, Pl_{tr} \qquad 3$$

where

Pd_{tr} = Domestic price of good *tr* including taxes (market price);
Pl_{tr} = Domestic price of good *tr* excluding taxes (price at factor cost).

For international trade, the small country assumption is adopted. Consequently, world prices of imports and exports are determined on the world market and are fixed for the country that is modeled. Transforming these world prices into local currency is performed using a conversion coefficient called – with all due restrictions – the nominal exchange rate (*e*). The fiscal system also introduces some additional differences between world prices in local currency and their corresponding domestic prices. Equation 35 establishes the relationship between world import prices in foreign currency terms and the corresponding domestic market price, i.e. the price paid by domestic consumers for imported commodities. This relation is determined by the exchange rate and indirect taxation including both tariffs and domestic taxes.

$$35.\ Pm_{tr} = (1 + tx_{tr})(1 + tm_{tr}) \cdot \overline{e} \cdot \overline{Pwm_{tr}} \qquad 3$$

where

Pm_{tr} = Domestic price of imported good *tr*.

The price received by producers when selling their production on the export market is, in conformity with equation 36, equal to the world price converted in local currency terms and discounted by the export tax rate. In other words, export taxes **reduce** the domestic price received by local producers for exported products relative to the corresponding world price.

$$36.\ Pe_{tr} = \frac{\overline{e} \cdot \overline{Pwe_{tr}}}{1 + te_{tr}} \qquad 3$$

where

$\overline{Pwe_{tr}}$ = World price of export *tr* in foreign currency.

The composite (consumer) price ensures the equilibrium between total commodity supply, from local or foreign origins, and the sum of its domestic demand. It represents a weighted average of domestic prices and import prices taking into account the compensatory sales tax:

$$37.\ Pc_{tr} Q_{tr} = (1+CTC) \cdot [Pd_{tr} D_{tr} + Pm_{tr} M_{tr}] \qquad 3$$

where

Q_{tr} = Demand for composite good *tr* (volume);
D_{tr} = Demand for domestic good *tr* (volume).

The same logic is followed in defining the average producer price over sales on domestic and foreign markets (equation 38). It corresponds to a weighted average of the local price (at factor cost) and export price.

38. $P_{tr} XS_{tr} = Pl_{tr} D_{tr} + Pe_{tr} EX_{tr}$ 3

Given the assumption of fixed value shares of individual goods in total investment demand, the price of this aggregate is:

39. $\text{Pinv} = \prod_{\text{tr}} \left(\frac{\text{Pc}_{\text{tr}}}{\mu_{\text{tr}}} \right)^{\mu_{\text{tr}}}$ 1

Finally, a general price index (equation 40) is defined as the GDP deflator or, in other words, as the sum of value-added prices weighted by the shares of value-added of each activity in total GDP.

40. $\text{Pindex} = \sum_{\text{j}} \delta_{\text{j}} \text{Pv}_{\text{j}}$ 1

where

δ_j = Share of activity *j* in total value added.

International Trade

On one hand, local producers can allocate total production between export and domestic markets. On the other hand, local consumers can choose between locally-produced and imported goods. Producer or consumer choices are essentially determined by variations in the domestic and international prices of the corresponding products.

Allocation of production between exports and domestic sales (equation 41) is based on a constant elasticity of transformation function (CET).

$$41.\quad XS_{tr} = B^{e}_{tr}\left[\beta^{e}_{tr}EX_{tr}^{\kappa^{e}_{tr}} + \left(1-\beta^{e}_{tr}\right)D_{tr}^{\kappa^{e}_{tr}}\right]^{\frac{1}{\kappa^{e}_{tr}}} \qquad 3$$

where

B^{e}_{tr} = Scale coefficient of the CET function;

β^{e}_{tr} = Share parameter, relative to exported volume, of the CET function;

κ^{e}_{tr} = Transformation parameter of the CET function $\left(1 < \kappa^{e}_{tr}\right)$.

The hypothesis of finite transformation reflects the belief that products sold on the domestic market and those that are exported by a same sector are not necessarily identical. In the agriculture sector, for example, the local product could be cassava and the export good cotton. Finite elasticity of transformation between these two products, corresponding to the strict concavity of the production possibility curve, simply expresses that it becomes more and more difficult, with a certain amount of arable land and/or capital, which is fixed in the short to medium term, to "produce" more cotton and less cassava or the inverse. Total profit maximization of producer *j* thus requires that:

$$42.\quad EX_{tr} = \left[\left(\frac{Pe_{tr}}{Pl_{tr}}\right)\left(\frac{1-\beta^{e}_{tr}}{\beta^{e}_{tr}}\right)\right]^{\tau^{e}_{tr}} D_{tr} \qquad 3$$

where

τ^{e}_{tr} = Transformation elasticity and $\tau^{e}_{tr} = 1/\left(\kappa^{e}_{tr} - 1\right)$.

Equation 42 establishes the optimal mix, from the producer viewpoint, between the volumes of production supplied to the domestic market and to the foreign market. Keeping in mind that the transformation elasticity is positive, it clearly shows that the ratio of exports to domestic sales $\left(EX_{tr}/D_{tr}\right)$ increases (decreases) with the rise (fall) in the relative price for sales on the foreign market

(Pe_{tr}/Pl_{tr}). Moreover, it is assumed that for every exported product the country is confronted by an infinitely price-elastic world demand. Practically, this means that national producers have absolutely no difficulties to sell on the world market at the world price.

Consumer choice between imports and local goods is captured by a constant and finite elasticity of substitution function (CES)[5] as seen in equation 43. It is as if the composite consumer good is "produced" using two "inputs", namely the imported and the locally produced substitute.

$$43.\ Q_{tr} = A_{tr}^{m}\left[\alpha_{tr}^{m} M_{tr}^{-\rho_{tr}^{m}} + \left(1-\alpha_{tr}^{m}\right) D_{tr}^{-\rho_{tr}^{m}}\right]^{\frac{-1}{-\rho_{tr}^{m}}} \qquad 3$$

where

A_{tr}^{m}	=	Scale coefficient of the CES function;
α_{tr}^{m}	=	Share parameter of the CES function;
ρ_{tr}^{m}	=	Substitution parameter of the CES function.

Expenditure minimization leads to equation 44 characterizing import demand of product *tr*.

$$44.\ M_{tr}^{m} = \left[\left(\frac{Pd_{tr}}{Pm_{tr}}\right)\left(\frac{\alpha_{tr}^{m}}{1-\alpha_{tr}^{m}}\right)\right]^{\sigma_{tr}^{m}} D_{tr} \qquad 3$$

where

σ_{tr}^{m} = Substitution elasticity and $\sigma_{tr}^{m} = 1/\left(\rho_{tr}^{m}+1\right)$.

Since the elasticity of substitution is positive, it clearly establishes that the ratio of imports to domestic sales M_{tr}/D_{tr} grows (falls) when the price of the domestic product relative to its import substitute Pd_{tr}/Pm_{tr} rises (drops).

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[1] This function is often called an « Armington » function following its introduction in 1969 by Paul Armington.

Equilibrium, exogenous variables and closures

The manner in which the model balances, or closes, is of tremendous importance. Equilibrium must be ensured on the product market, the labor market, foreign trade, the government budget and investment-savings balance.

Equation 45 illustrates the equilibrium of total resources in composite product *tr* available on the domestic market and its uses: intermediate (inputs) and final (household consumption and investment) demand. In this case, the equilibrating variable is the composite price as mentioned previously.

45. $Q_{tr} = DIT_{tr} + \sum_{h} C_{tr,h} + INV_{tr}$ 3

Equilibrium for non-market services is already specified in equation 29 since the entire non-market service output is consumed by the government.

The base model is conceived for short- to medium-term perspectives. Consequently, labor is perfectly mobile between sectors, whereas capital and land are fixed (or sector specific). Total supply of each factor is considered as fixed while demand is variable. On the labor market, equation 46 imposes equality between total supply and demand for labor.

46. $\overline{LS} = \sum_{j} LD_{j}$ 1

where

$\overline{LS}$ = Total labor supply (volume).

As capital and land are sector specific (exogenous), equilibrium for these factors need not be explicitly modeled. Implicitly, it is assumed that demand for capital and land in each sector must equal its sector-specific supply. Variation in the returns to factors ensure satisfaction of these constraints for mobile and sector-specific production factors.

Foreign savings (equation 47) expressed in foreign currency is, by definition, equal to the current account deficit. The fixed current-account balance hypothesis forces the difference between foreign currency spending (imports, net returns to foreign-owned capital and land and net dividends distributed to the rest of the world) and earnings (exports) of the country to be preserved. Dividends paid to the rest of the world and, because of the small country assumption, international prices of imports and exports are all exogenous. The nominal exchange rate acts as the "numeraire" and its value is thus set equal to one[6].

$$47.\ \overline{CAB} = \sum_{tr} \overline{Pwm}_{tr} M_{tr} + \frac{\lambda^{row} \sum_{tr} r_{tr} \overline{KD}_{tr}}{\overline{e}} \qquad 1$$

$$+ \frac{\lambda^{lrow} rl \cdot \overline{LAND}}{\overline{e}} + \overline{DIV}^{row} - \sum_{tr} \overline{Pwe}_{tr} EX_{tr}$$

where

λ^{row}	=	Share of capital income received by foreigners;
λ^{lrow}	=	Share of land income received by foreigners;
$\overline{CAB}$	=	Current account balance.

Equilibrium of foreign trade is reached through flexibility of the price index and the resulting adjustments in the real exchange rate.

The government budget (see equation 22) must also be balanced at all times. In the base model, public savings, consumption and transfers are fixed, whereas government revenue is variable and adjuste by variations in the compensatory sales tax rate (*CTC*).

The final equilibrium condition concerns investment and savings (equation 48). Foreign and national savings together finance total domestic investment.

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[6] A numéraire is necessary to have a model that is homogenous of degree zero in prices, i.e. a model in which doubling of the value of the numéraire doubles all prices but leaves all real quantities unchanged.

$$48.\ IT = \sum_{h} SH_{h} + SF + \overline{SG} + \bar{e} \cdot \overline{CAB} \qquad 1$$

Investment in volume is considered exogenous. This illustrates a situation where policy-makers aim at a certain objective of investment volume (e.g. public infrastructure, equipment expenditures, etc.) to be realized. As the investment price index *Pinv* is determined by the model, nothing guarantees that total savings available in the economy (i.e. the sum of savings of every domestic institution plus foreign savings in local currency terms) equals the investment objective. Foreign and public savings are exogenous, firm savings are endogenous and flexible households savings explicitly clear this balance (through *ADJ* in equation 13). In other words, this is a case of "investment-driven" savings.

We have now defined all 131 equations of the model. Since the model satisfies Walras' law, one equation is redundant and can be dropped. To verify this condition, we introduce an additional variable called "LEON" (referring to Walras' first name) that we pose equal to

$$49.\ LEON = Q_{ser} - DIT_{ser} - \sum_{h} C_{ser,h} \qquad 1$$

and introduce into the version of equation 45 defined for the market services sector. Consequently, this new variable serves as a check variable. If every equation is satisfied and a general equilibrium solution is found, it must be nil.

We therefore have 131 independent equations, 25 exogenous variables, and 131 endogenous variables.

Extensions

Numerous variants on the basic model are possible in order to illustrate different economic contexts. Among these are different government budget closures, different labor market specifications, finite export demand, etc.

Compensation of the public budget

Government budget equilibrium can be attained using other compensatory tax than a sales tax, such as a direct tax on household income or a production tax. In both cases, the adjustment variable on sales tax is set to zero and another adjustment (endogenous) variable is defined.

To use the income tax as the compensatory mechanism, a variable *TYR* simply has to be included in the direct income tax specification. Equation 20 then becomes[7]

$$20^*. \quad DTH_h = TYR_h \cdot tyh_h \cdot YH_h \qquad 4$$

where

TYR = Uniform compensatory tax rate on household income

In the production tax case, an additional tax receipt should appear in government income and the new compensatory tax must also affect production value. In other words, equations 16, 17 and 38 are modified in the following manner:

$$16^*. \quad YG = \sum_{tr} TI_{tr} + \sum_{tr} TIE_{tr} + \sum_{tr} TIM_{tr} + \sum_{h} DTH_h + DTF + CTX \cdot \sum_{tr} P_{tr} XS_{tr} \qquad 1$$

$$17^*. \quad TI_{tr} = tx_{tr} \left[(1 + CTX) \cdot P_{tr} XS_{tr} - Pe_{tr} EX_{tr} + (1+tm_{tr})\bar{e} \cdot \overline{Pwm}_{tr} M_{tr} \right] \qquad 3$$

[7] In several models of part II we define equation (20) as *DTH = (TYR+tyh)YH an additive term and not a multiplicative one in order to avoid an increase in a distortionary tax system.*

$$38^*.\ (1 + CTX) \cdot P_{tr} XS_{tr} = Pl_{tr} D_{tr} + Pe_{tr} EX_{tr} \qquad 3$$

where

CTX = Uniform compensatory tax rate on production.

Factor markets

If a long term point of view is adopted, capital should be considered mobile. Starting from the basic model, the easiest way to introduce capital mobility is to bring in two new equations (50 and 51) and two additional variables ($\overline{KS}$ and *rf*) as well as to define each as an endogenous variable. Since capital demand in sector *tr* is endogenous, the equilibrium equation 50 is added to guarantee that demand equals supply on the capital market:

$$50.\ \overline{KS} = \sum_{tr} KD_{tr} \qquad 1$$

where

$\overline{KS}$ = Capital supply in the economy

Moreover, equation 51 imposes a uniform rate of return on mobile capital:

$$51.\ r_{tr} = rf \qquad 4$$

where

rf = Uniform return rate on capital.

Overall, we still have a fully identified system of equations since we have added five independent equations and five endogenous variables (KD_{tr} and rf).

Moreover, on the labor market, workers could be segmented into different groups, e.g. skilled and unskilled workers. This would add a new step to the multi-stage production function: the combination of the two types of labor to form composite labor. In the case where a constant elasticity of substitution (CES) function is chosen, the following equation must be added:

$$52.\ \mathrm{CL} = \mathrm{A}_{\mathrm{j}}^{\mathrm{ll}}\left[\alpha_{\mathrm{j}}^{\mathrm{ll}}\mathrm{LDNQ}_{\mathrm{j}}^{-\rho_{\mathrm{j}}^{\mathrm{ll}}} + \left(1-\alpha_{\mathrm{j}}^{\mathrm{ll}}\right)\mathrm{LDQ}_{\mathrm{j}}^{-\rho_{\mathrm{j}}^{\mathrm{ll}}}\right]^{-1/\rho_{\mathrm{j}}^{\mathrm{ll}}} \qquad 4$$

where

CL_j	=	Composite labor (volume) used in sector *j*;
$LDNQ_j$	=	Unskilled labor demand by sector *j*;
LDQ_j	=	Skilled labor demand by sector *j*;
$\mathrm{A}_{\mathrm{j}}^{\mathrm{ll}}$	=	Scale coefficient of the CES function;
$\alpha_{\mathrm{j}}^{\mathrm{ll}}$	=	Share parameter of the CES function;
$\rho_{\mathrm{j}}^{\mathrm{ll}}$	=	Substitution parameter of the CES function.

This would in turn bring about two supplementary demand equations for labor. The first, equation 53, determines the optimal mix between skilled and unskilled labor for each activity as a function of their wage rates.

$$53.\ \mathrm{LDNQ} = \left[\left(\frac{\alpha_{\mathrm{nag}}^{\mathrm{kl}}}{1-\alpha_{\mathrm{nag}}^{\mathrm{kl}}}\right)\cdot\left(\frac{\mathrm{wq}}{\mathrm{wnq}}\right)\right]^{\sigma_{\mathrm{j}}^{\mathrm{ll}}}\mathrm{LDQ}_{\mathrm{j}} \qquad 4$$

where

wnq	=	Unskilled wage rate,
wq	=	Skilled wage rate,
$\sigma_{\mathrm{j}}^{\mathrm{ll}}$	=	Substitution elasticity and $\sigma_{\mathrm{j}}^{\mathrm{ll}} = 1/\left(\rho_{\mathrm{j}}^{\mathrm{ll}}+1\right)$.

The second represents aggregate labor demand by activity *j* and is a function of, among other things, the average wage rate for the two types of labor used in the sector:

$$54.\ CL_j = A_j^{kl\left(\alpha_j^{kl}-1\right)} \left\{ \left[\left(\alpha_j^{kl} Pv_j \right) \big/ w_j \right]^{\alpha^{kl}} \right\} VA_j \qquad 4$$

where

w_j = Average wage rate.

This average wage rate is defined in equation 55:

$$55.\ w_j = \left[wnq\, LDNQ_j + wq\, LDQ_j \right] \big/ CL_j \qquad 4$$

As we would now have two types of labor and thus two labor markets, equilibrium on the labor markets would necessitate two equations instead of only one. Equation 46 is thus divided in two and becomes:

$$46^*.\ \overline{LSNQ} = \sum_j LDNQ_j \qquad 1$$

$$46^{**}.\ \overline{LSQ} = \sum_j LDQ_j \qquad 1$$

where

$\overline{LSNQ}$ = Total skilled labor supply;

$\overline{LSQ}$ = Total unskilled labor supply;

Finally, household labor income (in equation 11) should also be separated in order to distinguish its origins:

$$11^*.\ YH_h = \lambda_h^{wnq} \cdot wnq \sum_j LDNQ + \lambda_h^{wq} wq \sum_j LD +$$
$$\lambda_h^r \sum_j r_{tr}\, \overline{KD}_{tr} + \lambda_h^l \cdot rl \cdot \overline{LAND} + Pindex \cdot \overline{TG}_h + \overline{DIV}_h \qquad 4$$

where

λ_h^{wnq} = Share of unskilled labor income received by household h;

λ_h^{wq} = Share of skilled labor income received by household h;

In the process of segmenting the labor market, we replaced five endogenous variables (LDQ_j and w) in the basic model with 18 new endogenous variables ($LDNQ_j$, LDQ_j, wnq, wq and w_j) and five equations with 18 new equations. Consequently, the model is still square.

External trade

It is feasible to relax the small country hypothesis used in the basic model by including a finite elasticity export demand function. Indeed, the unlimited ability of producers to sell their product on foreign markets might be too strong a hypothesis in many cases. A finite demand elasticity implies that domestic producers would need to reduce their prices in order to increase their sales on the world market.

In order to reflect this reality, one must distinguish between two types of prices on foreign markets: (1) $Pfob_{tr}$, the border price effectively paid by foreign customers on foreign markets; (2) $\overline{Pwe}_{tr}$, the exogenous world price corresponding to an average of border prices, for commodity *tr*, demanded by each exporting country.

As a consequence, in equation 36, as well as in equation 47, this endogenous border price for exports must take the place of the fixed export price.

$$36^*. \quad Pe_{tr} = \frac{\overline{e} \cdot Pfob_{tr}}{(1 + te_{tr})}, \qquad 3$$

$$47^* \quad \overline{CAB} = \sum_{tr} \overline{Pwm}_{tr} M_{tr} + \frac{\lambda^{row} \sum_{tr} r_{tr} \overline{KD}_{tr}}{\bar{e}} + \frac{\lambda^{lrow} rl \cdot \overline{LAND}}{\bar{e}}$$

$$+ \overline{DIV}^{row} - \sum_{tr} Pfob_{tr} EX_{tr} \qquad 1$$

where

$Pfob_{tr}$ = Border price of exports *tr*,

Furthermore, an explicit export demand function must be specified:

$$EXD_{tr} = \overline{EXDO}_{tr} \left(\overline{Pwe}_{tr} / Pfob_{tr} \right)^{\varepsilon^e_{tr}} \qquad 3$$

where

EXD_{tr} = Export demand for commodities *tr* (volume);

$\overline{EXDO}_{tr}$ = Initial export demand for commodities *tr* (volume);

ε^e_{tr} = Price elasticity of demand for exports *tr*, $0 < \varepsilon^e_{tr} < \infty$.

Thus, the higher the value of the elasticity, the higher the influence of the relative price $\overline{Pwe}_{tr} / Pfob_{tr}$.

Export supply is modeled exactly as in the basic model (see Equation 42) and must now meet the newly specified export demand. A last equation must therefore be included in the model to enforce equilibrium conditions:

$$EX_{tr} = EXD_{tr}, \qquad 3$$

where border prices act as the equilibrating variables.

In this case, we added six endogenous variables ($Pfob_{tr}$ and EXD_{tr}) and the same number of equations (export demand by each sector *tr* and equilibrium conditions for exports) so that this modified version of the basic model now includes 137 independent equations and 137 endogenous variables.

SIMULATION RESULTS

Now that we understand the structure of the model, we are ready to analyze the impact of trade liberalization in this fictive economy. More precisely, we will look at the influence of the elimination of tariffs on resource allocation (4.1), factor markets (4.2), household income (4.3), consumption (4.4) and finally, on welfare (4.5).

Resource allocation

Table 9 presents the effect of trade liberalization on imports and exports, sectoral output, and domestic sales. Considering our definition of import prices, we observe that the elimination of tariffs leads to an identical absolute reduction in import prices. Import prices fall most in industry, where initial tariffs were 25 percent, while they are only 5 percent in agriculture and nil in the two service sectors (Table 5). Overall, import prices decrease by 16 percent since industrial imports form the major part of total imports.

Table 9: Effect of trade liberalization on imports and exports, sectoral output and domestic sales (percent change)

	Volume changes				Price changes			
	Imports	Dom. sales	Exports	Output	Imports	Dom. sales	Exports	Output
Agriculture	-3.9	-1.3	9.0	1.7	-4.8	-6.4	0.0	-4.6
Industry	11.8	-5.3	12.1	-4.0	-20.0	-10.6	0.0	-9.8
Market services	-8.6	-0.5	8.3	0.5	0.0	-5.5	0.0	-4.9
Non-market services	-	-	-	0.0	-	-	0.0	-5.7
ALL	**6.8**	**-2.3**	**9.2**	**-0.3**	**-16.0**	**-7.5**	**0.0**	**-6.1**

In response to this fall in import prices, total demand for imports increases by 6.8 percent. As a consequence, local producers are confronted with a reduction in domestic demand, which leads to a drop in the price for domestic sales. Yet, as average import penetration rates (Imports/Consumption) in the economy as a whole are quite low, the decline in the volume (2.3 percent) and price (-7.5 percent) of domestic sales are less significant than the changes in the corresponding import volume (6.8 percent) and price (-16.0 percent).

Since the current account balance is fixed, the increase in overall imports can only be financed by an increase in overall exports, which reaches 9.2 percent. These exports are easily sold on foreign markets because of the infinite elasticity of export demand. Because international prices are fixed, the 6.7 percent decrease in the domestic price index (equivalent to the average change in value-added price for all sectors in Table 10) implies that the real exchange rate (*e/Pindex*) rises. This increase is sufficient to allow exports to attain the required level. In effect, producers reorient part of their production to the export market in reaction to falling domestic prices.

At the sectoral level, given the higher initial tariff rate and the higher import penetration rate in the industrial sector, the import volume response and the reduction in domestic sale prices is greater in the industrial sector. At the same time, imports decrease in the other tradable sectors: agriculture and services. This can be explained in part by the fixed current account balance as discussed above. In the tradable services sector, this is a consequence of consumers switching from imports to cheaper local goods given the general fall in domestic prices. In the agricultural sector, it results from the greater reduction in domestic sales prices relative to the decline in import prices.

The export response is greater in the industrial sector given stronger import competition on the domestic market. However, as initial export shares are higher in the agricultural and tradable services sectors, the export response is such that total agricultural and tradable service production rise relative (as well as in absolute terms) to industrial output. The net impact on the output of services is small since this sector only reacts to the appreciation of the real exchange rate (it has no tariff in the initial situation).

Since there is no export demand specified in the basic model, export prices are exogenous. Combining these fixed export prices with falling domestic sales prices results in falling total output prices, which hit the industrial sector particularly hard. The output price of services falls in a similar magnitude as the agricultural output price.

Therefore, in terms of resource allocation, higher initial tariffs on industrial imports translate into greater reductions in import prices, domestic prices and output prices for the industrial sector, relative to the agricultural and tradable services sectors. Moreover, it is the agricultural sector that benefits most from the resulting export expansion, such that agricultural output rises relative to industrial output.

Factor markets

In our fictive economy, following trade liberalization, higher initial tariff rates on industrial imports leads to a fall in output prices that is greater for the industrial sector than for agriculture and services. The manner in which this fall in output prices translates into factor price changes will determine the variation in household incomes. Generally speaking, we would expect that factors used intensively in sectors with falling relative value added prices would see their relative factor prices decline.

Table 10: Effect of trade liberalization on value-added and factor prices (percent change

	Change in		Factor shares in VA			Change in price of:		
	VA price	VA	Labor	Capital	Land	Labor	Capital	Land
Agriculture	-4.6	1.7	56.1	10.5	33.4	-5.4	-3.5	-3.5
Industry	-13.2	-4.0	24.8	75.2	-	-5.4	-15.6	0.0
Services	-5.3	0.5	72.2	27.8	-	-5.4	-5.0	0.0
Non-tradable	-5.4	0.0	100.0	-	-	-5.4	-	-
ALL	**-6.7**	**0.0**	**58.3**	**28.3**		**-5.4**	**-10.7**	**-3.5**

Value-added prices in agriculture and services fall in roughly the same proportion as output prices in these sectors. In industry, the fall in the value-added price is more important than the fall in output price because of the associated fall in output volume. Value-added prices decline most in industry, followed by the two services sectors.

Because of our hypothesis on factor mobility, variations in prices of sector-specific capital differ among sectors (capital is sector-specific) while variations in the wage rate are uniform (labor is assumed to be mobile). Variations in returns to capital closely mimic changes in the value-added price of the corresponding sector. Furthermore, as capital is used intensively in industry, the average change in the rate of return to capital is closer to the variation in the value-added price in this particular sector. As services are the principal source of labor payments, wage rates closely follow the changes in the value-added price of these sectors. Because value-added prices in the agricultural sector fall less than in the industrial or services sectors as a result of trade liberalization, average returns to agricultural sector-specific capital and land also tend to fall less than returns to services and industrial capital, as well as wage rates. Returns to land thus rise relative to almost all other factors (except agricultural capital), reflecting the weak fall in agricultural value-added prices.

In summary, trade liberalization leads to an increase in the relative price of land and agricultural sector capital, as value-added prices in this sector are the least affected by the fall in competing import prices. Value-added prices in the industrial and services sector tend to fall relative to the agricultural sector, which explains why the returns to industrial sector capital and labor tend to decline the most with trade liberalization.

Income

Since nominal returns to all production factors drop as a result of trade liberalization, a 6.0 percent fall in nominal household income is observed.

Table 11: Effect of trade liberalization on household income

	Change in rate			Share in total income			Contribution to change in income		
	Rural	Urban	All	Rural	Urban	All	Rural	Urban	All
Labor	-5,4	-5,4	-5,4	68,9	59,8	63,8	-3,7	-3,2	-3,5
Capital	-10,7	-10,7	-10,7	5,6	31,1	19,8	-0,6	-3,3	-2,1
Land	-3,5	-3,5	-3,5	25,6	0,0	11,4	-0,9	0,0	-0,4
Other income	0,1	0,0	0,0	0,0	9,1	5,1	0,0	0,0	0,0
TOTAL				**100,0**	**100,0**	**100,0**	**-5,2**	**-6,6**	**-6,0**

Urban households experience a larger nominal income reduction than rural households despite the fall in the relative returns to labor, which is a relatively more important source of income for rural households. This is mainly due to the greater reliance of urban households on capital returns, which experience the greatest decline following trade liberalization. Also, rural households benefit, at the expense of urban households, from the relative increas in returns to land.

Rural households are thus relative winners in terms of income because of their extremely low dependency on capital income and their relatively important reliance on land income, the winner among production factors when it comes to trade liberalization.

Consumption

The analysis in the preceding section suggests that trade liberalization is pro-rural in terms of its impacts on nominal income. However, by reducing the prices of imports and local goods, trade liberalization also reduce consumer prices. These impacts may differ between households according to their consumption patterns. It is the net impact of these income and consumer price effects that ultimately determine the welfare and poverty impacts of trade liberalization.

Table 12: Effect of trade liberalization on consumer prices

	Import share of cons'n	Compen-satory sales tax	Change in prices			Share in total consumption			Contribution to change in PCI		
			Imports	Dom. sales	Con-sumer	Rural	Urban	All	Rural	Urban	All
Agriculture	11.9	4.5	-4.8	-6.4	-2.0	47.5	28.5	37.3	-1.0	-0.6	-0.8
Industry	39.4	4.5	-20.0	-10.6	-11.2	29.7	44.9	37.9	-3.3	-5.0	-4.3
Market services	8.7	4.5	0.0	-5.5	-0.8	22.8	26.6	24.8	-0.2	-0.2	-0.2
Non-market services	-	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
TOTAL	21.9	4.5	-16.0	-7.5	-5.7	100.0	100.0	100.0	-4.5	-5.8	-5.2

We note in table 12 that consumer prices fall on average by 5.7 percent as a result of trade liberalization. Consumer prices for industrial goods fall substantially more – 11.2 percent – than for agricultural goods and services, reflecting the high initial tariff rate and high import penetration ratio in the industrial sector.

It is worth noting that consumer price variations in agriculture are lower than both import and domestic price changes. This reflects the presence of the compensatory sales tax. Indeed, given that this compensatory tax is positive, consumer prices are increased or, in this case, their reduction is cushioned. Changes in before-tax consumer prices, however, still are between – weighted averages of – the corresponding domest and import price changes.

In our fictive economy, rural households devote a larger share of their total consumption to agricultural goods, whereas urban households consume relatively more industrial goods. Consequently, urban households benefit more than rural households from the fall in the relative consumer prices of industrial goods, resulting in a larger reduction in their consumer price index. Thus, we can say that trade liberalization, even if pro-rural in terms of income, is quite pro-urban in terms of consumption.

Poverty and welfare

Results shown in table 13 indicate that the welfare impact of "pure" trade liberalization differs between rural and urban households.

Overall welfare effects, as measured by equivalent variations (EV), are negligible (0.6 percent). Welfare increases for urban households while the effect is marginally negative for rural households.

Table 13: Effect of trade liberalization on households' welfare (percent change)

	Income	CTH*	CPI**	EV
Rural	-5.2	-4.7	-4.5	-0.2
Urban	-6.6	-4.7	-5.8	1.2
All	**-6.0**	**-4.7**	**-5.2**	**0.6**

* CTH: Households' total consumption

** CPI: Consumer Price Index

There are two main channels linking trade liberalization to household welfare and poverty: income effects and consumer price effects. To examine these effects, we show variations in income and consumer price changes. We also show the variation in the total consumption of households since the savings-investment closure chosen in the model implies that household savings vary to ensure the savings-investment balance. Compensation for lower public savings following the loss of tariff revenues is supported by urban and rural households, in proportion to their initial savings rates. As mentioned in section 1, savings rates are higher for urban households. Therefore, even though income falls more for urban households, their savings also fall more than rural households, such that the net impact on total consumption is, coincidentally, identical.

The generally positive welfare effect of trade liberalization is a consequence of a greater reduction in consumer prices than in total consumption. Welfare effects of trade liberalization favor urban households over their rural counterparts despite greater nominal income reductions among urban households because of the significantly greater fall in the consumer price index for urban households as well the savings effect.

ANNNEX: SUMMARY OF THE MATHEMATICAL STRUCTURE

a) Equations

Production	Number of equations
1. $XS_j = \min\left[\frac{CI_j}{io_j}, \frac{VA_j}{\nu_j}\right]$	4
2. $VA_{nag} = A^{kl}_{nag}\left[\alpha^{kl}_{nag} LD_{nag}^{-\rho^{kl}_{nag}} + \left(1-\alpha^{kl}_{nag}\right)\overline{KD}_{nag}^{-\rho^{kl}_{nag}}\right]^{-1/\rho^{kl}_{nag}}$	2
3. $VA_{agr} = A^{cl}\left[\alpha^{cl} CF^{-\rho^{cl}} + \left(1-\alpha^{cl}\right)\overline{LAND}^{-\rho^{cl}}\right]^{-1/\rho^{cl}}$	1
4. $CF = A^{kl}_{agr}\left[\alpha^{kl}_{agr} LD^{-\rho^{kl}_{agr}} + \left(1-\alpha^{kl}_{agr}\right)\overline{KD}_{agr}^{-\rho^{kl}_{agr}}\right]^{-1/\rho^{kl}_{agr}}$	1
5. $VA_{ntr} = LD_{ntr}$	1
6. $CI_j = io_j\, XS_j$	4
7. $DI_{tr,j} = aij_{tr,j}\, CI_j$	12
8. $\overline{LAND} = \left(\frac{1-\alpha^{cl}}{\alpha^{cl}}\right)^{\sigma^{cl}}\left(\frac{rc}{rl}\right)^{\sigma^{cl}} CF$	1
9. $LD_{tr} = \left(\frac{\alpha^{kl}_{tr}}{1-\alpha^{kl}_{tr}}\right)^{\sigma^{kl}_{tr}}\left(\frac{r_{tr}}{w}\right)^{\sigma^{kl}_{tr}} \overline{KD}_{tr}$	3
10. $LD_{ntr} = \frac{P_{ntr}\overline{XS}_{ntr} - \sum_{tr} Pc_{tr} DI_{tr,ntr}}{w}$	1

Income and savings

11. $YH_h = \lambda_h^w \cdot w \sum_j LD + \lambda_h^r \sum_j r_{tr} \overline{KD}_{tr} + \lambda_h^l$ 4

$\cdot rl \cdot \overline{LAND} + Pindex \cdot \overline{TG}_h + \overline{DIV}_h$

12. $YDH_h = YH_h - DTH_h$ 4

13. $SH_h = ADJ \cdot \psi_h \cdot YDH_h$ 4

14. $YF = \lambda^{rf} \sum_{tr} r_{tr} \overline{KD}_{tr} + \lambda^{lf} \cdot rl \cdot \overline{LAND}$ 1

15. $SF = YF - \sum_h \overline{DIV}_h - \bar{e} \cdot \overline{DIV}^{row} - DTF$ 1

16. $YG = \sum_{tr} TI_{tr} + \sum_{tr} TIE_{tr} + \sum_{tr} TIM_{tr} + \sum_h DTH_h + DTF$ 1

17. $\overline{SG} = YG - G - Pindex \sum_h \overline{TG}_h$ 1

18. $TI_{tr} = tx_{tr} \left(P_{tr} XS_{tr} - Pe_{tr} EX_{tr} \right) +$ 3

$tx_{tr} \left(1 + tm_{tr} \right) e\, Pwm_{tr} M_{tr}$

19. $TIM_{tr} = tm_{tr} \cdot \bar{e} \cdot \overline{Pwm}_{tr} M_{tr}$ 3

20. $TIE_{tr} = te_{tr} Pe_{tr} EX_{tr}$ 3

21. $DTH_h = tyh_h YH_h$ 4

22. $DTF = tyf \cdot YF$ 1

Demand

23. $CTH_h = YDH_h - SH_h$ 4

24. $Pc_{tr} C_{tr,h} = \underbrace{Pc_{tr} c_{tr,h}^{min}} + \underbrace{\gamma_{tr,h} \left(CTH_h - \sum_h Pc_{tr} c_{tr,h}^{min} \right)}$ 12

$$25.\ G = \overline{XS}_{ntr} P_{ntr} \qquad 1$$

$$26.\ INV_{tr} = \frac{\mu_{tr} IT}{Pc_{tr}} \qquad 3$$

$$27.\ IT = \overline{ITVOL} \cdot Pinv \qquad 1$$

$$28.\ DIT_{tr} = \sum_{j} DI_{j} \qquad 3$$

Prices

$$29.\ Pv_{j} = \frac{P_{j} XS_{j} - \sum_{tr} Pc_{tr} DI_{tr,j}}{VA_{j}} \qquad 4$$

$$30.\ r_{nag} = \frac{Pv_{nag} VA_{nag} - w\ LD_{nag}}{\overline{KD}_{nag}} \qquad 2$$

$$31.\ r_{agr} = \frac{rc \cdot CF - w\ LD_{agr}}{\overline{KD}_{nag}} \qquad 1$$

$$32.\ rc = \frac{PV_{agr} VA_{agr} - rl \cdot \overline{LAND}}{CF} \qquad 1$$

$$33.\ Pd_{tr} = (1 + tx_{tr})\ Pl_{tr} \qquad 3$$

$$34.\ Pm_{tr} = \left(1 + tx_{tr}\right)\left(1 + tm_{tr}\right) \cdot \overline{e} \cdot \overline{Pwm}_{tr} \qquad 3$$

$$35.\ Pe_{tr} = \frac{\overline{e} \cdot \overline{Pwe}_{tr}}{1 + te_{tr}} \qquad 3$$

$$36.\ Pc_{tr} Q_{tr} = \left(1 + CTC\right) \cdot \left[Pd_{tr} D_{tr} + Pm_{tr} M_{tr}\right] \qquad 3$$

$$37.\ P_{tr} XS_{tr} = Pl_{tr} D_{tr} + Pe_{tr} EX_{tr} \qquad 3$$

$$38.\ Pinv = \prod_{tr} \left(\frac{Pc_{tr}}{\mu_{tr}}\right)^{\mu_{tr}} \qquad 1$$

$$39.\ Pindex = \sum_{j} \delta_{j} Pv_{j} \qquad 1$$

International Trade

40. $XS_{tr} = B^e_{tr}\left[\beta^e_{tr} EX_{tr}^{\kappa^e_{tr}} + \left(1-\beta^e_{tr}\right) D_{tr}^{\kappa^e_{tr}}\right]^{\frac{1}{\kappa^e_{tr}}}$ 3

41. $EX_{tr} = \left[\left(\frac{Pe_{tr}}{Pl_{tr}}\right)\left(\frac{1-\beta^e_{tr}}{\beta^e_{tr}}\right)\right]^{\tau^e_{tr}} D_{tr}$ 3

42. $Q_{tr} = A^m_{tr}\left[\alpha^m_{tr} M_{tr}^{-\rho^m_{tr}} + \left(1-\alpha^m_{tr}\right) D_{tr}^{-\rho^m_{tr}}\right]^{\frac{-1}{-\rho^m_{tr}}}$ 3

43. $M^m_{tr} = \left[\left(\frac{Pd_{tr}}{Pm_{tr}}\right)\left(\frac{\alpha^m_{tr}}{1-\alpha^m_{tr}}\right)\right]^{\sigma^m_{tr}} D_{tr}$ 3

44. $\overline{CAB} = \sum_{tr} \overline{Pwm}_{tr} M_{tr} + \frac{\lambda^{row} \sum_{tr} r_{tr} \overline{KD}_{tr}}{\bar{e}} + \frac{\lambda^{lrow} rl \cdot \overline{LAND}}{\bar{e}} + \overline{DIV}^{row} - \sum_{tr} \overline{Pwe}_{tr} EX_{tr}$ 1

Equilibrium

45. $Q_{tr} = DIT_{tr} + \sum_h C_{tr,h} + INV_{tr}$ 3

46. $\overline{LS} = \sum_j LD_j$ 1

47. $IT = \sum_h SH_h + SF + \overline{SG} + \bar{e} \cdot \overline{CAB}$ 1

48. $EV_h = \left(CTH_h - \sum_{tr} Pc_{tr} c^{min}_{tr,j}\right) \prod_{tr}\left[\frac{\overline{Pco}_{tr}}{Pc_{tr}}\right]^{\gamma_{tr,h}} - \left(\overline{CTHO}_h - \sum_{tr} \overline{Pco}_{tr} c^{min}_{tr,j}\right)$ 4

Total: 131

B) Endogenous variables

			Number of variables
XS_{tr}	=	Output of activity *tr* (volume)	3
VA_j	=	Value added for activity *j* (volume)	4
CI_j	=	Total intermediate consumption by activity *j* (volume)	4
LD_j	=	Activity *j* demand for labor (volume)	4
CF	=	Composite agricultural capital-labor factor (volume)	1
YH_h	=	Household *h*'s income	4
YDH_h	=	Household *h*'s disposable income	4
YF	=	Firm income	1
YG	=	Government income	1
SH_h	=	Household *h*'s savings	4
SF	=	Firm savings	1
TI_{tr}	=	Receipts from indirect taxes on *tr*	3
TIE_{tr}	=	Receipts from taxes on export *tr*	3
TIM_{tr}	=	Receipts from import duties on *tr*	3
DTF	=	Receipts from direct taxation of firm income	1
DTH_h	=	Receipts from direct taxation of household *h*'s income	4
ADJ	=	Adjustment variable for household's savings	1
CTC	=	Uniform compensatory tax rate on sales	1
IT	=	Total investment	1
Q_{tr}	=	Demand for composite good *tr* (volume)	3
D_{tr}	=	Demand for domestic good *tr* (volume)	3
$C_{tr,h}$	=	Household *h*'s consumption of good *tr* (volume)	12

CTH_h	=	Household *h*'s total consumption (value)	4
G	=	Public expenditures 1	
EV_h	=	Equivalent variation for household *h* 4	
INV_{tr}	=	Investment demand for good *tr* (volume)	3
$DI_{tr,j}$	=	Intermediate consumption of good *tr* in activity *j* (volume) 12	
DIT_{tr}	=	Intermediate demand for good *tr* (volume)	3
w	=	Wage rate	1
r_{tr}	=	Rate of return to capital in activity *tr*	3
rl	=	Rate of return to agricultural land	1
rc	=	Rate of return to composite agricultural factor	1
P_i	=	Producer price of good *i*	4
Pv_j	=	Value added price for activity *j*	4
Pd_{tr}	=	Domestic price of good *tr* including taxes	3
Pl_{tr}	=	Domestic price of good *tr* (excluding taxes)	3
Pc_{tr}	=	Consumer price of composite good *tr*	3
Pe_{tr}	=	Domestic price of exported good *tr*	3
Pm_{tr}	=	Domestic price of imported good *tr*	3
$Pinv$	=	Price index of investment	1
$Pindex$	=	GDP deflator	1
EX_{tr}	=	Exports of good *tr* (volume)	3
M_{tr}	=	Imports of good *tr* (volume)	3

Total: 131

C) Exogenous variables

			Number of variables
CAB	=	Current account balance	1
DIV_h	=	Dividends paid to household *h*	4
DIV^{ROW}	=	Dividends paid to the rest of the World	1
$ITVOL$	=	Total investment (volume)	1
KD_{tr}	=	Demand for capital in activity *tr* (volume)	3
$LAND$	=	Land supply (volume)	1
LS	=	Total labor supply (volume)	1
Pwe_{tr}	=	World price of export *tr*	3
Pwm_{tr}	=	World price of import *tr*	3
TG_h	=	Public transfers to household *h*	4
XS_{ntr}	=	Output of activity *NTR* (volume)	1
e	=	Exchange rate	1
SG	=	Government's savings	1
			Total: 25

D) Parameters

Production functions

A_j = Scale coefficient (Cobb-Douglas production function)

$aij_{tr,j}$ = Input-output coefficient

α_j = Elasticity (Cobb-Douglas production function)

io_j = Technical coefficient (Leontief production function)

v_j = Technical coefficient (Leontief production function)

CES function between capital and labor

A_{tr}^{kl} = Scale coefficient
α_{tr}^{kl} = Share parameter
ρ_{tr}^{kl} = Substitution parameter
σ_{tr}^{kl} = Substitution elasticity

CES function between composite factor and land

A_{tr}^{cl} = Scale coefficient
α_{tr}^{cl} = Share parameter
ρ_{tr}^{cl} = Substitution parameter
σ_{tr}^{cl} = Substitution elasticity

CES function between imports and domestic production

A_{tr}^{m} = Scale coefficient
α_{tr}^{m} = Share parameter
ρ_{tr}^{m} = Substitution parameter
σ_{tr}^{m} = Substitution elasticity

CET function between domestic production and exports

B_{tr}^{e} = Scale coefficient
β_{tr}^{e} = Share parameter
κ_{tr}^{e} = Transformation parameter
τ_{tr}^{e} = Transformation elasticity

LES consumption function

$\gamma_{tr,h}$ = Marginal share of good *tr*
$c_{tr,h}^{min}$ = Minimum consumption of good *tr*

Tax rates

te_{tr}	=	Tax rate on exports *tr*
tm_{tr}	=	Tariff rate on good *tr*
tx_{tr}	=	Sales tax rate on good *tr*
tyh_h	=	Direct tax rate on household *h*'s income
tyf	=	Direct tax rate on firm income

Other parameters

δ_j	=	Share of activity *j* in total value added
λ_h^l	=	Share of total land income received by household
λ^{lf}	=	Share of total land income received by firms
λ^{lrow}	=	Share of total land income received by foreigners
λ_h^r	=	Share of total capital income received by household *h*
λ^{rf}	=	Share of total capital income received by firms
λ^{row}	=	Share of total capital income received by foreigners
λ_h^w	=	Share of total labor income received by household *h*
ψ_h	=	Propensity to save
μ_{tr}	=	Share of the value of good *tr* in total investment

E) Sets

$i, j \in I = \{AGR, IND, SER, NTR\}$	All activities and goods (*AGR*: agriculture, *IND*: industry, *SER*: services, *NTR*: non-tradables services)
$tr \in TR = \{AGR, IND, SER\}$	Tradable activities and goods
$nag \in NAG = \{IND, SER\}$	Non-agricultural tradable activities and goods
$h \in H = \{RP, UP, RR, UR\}$	Households (*RP*: rural poor, UP: urban poor, *RR*: rural rich, *UR*: urban rich)

Welfare, Poverty and Distribution Effects of Trade Liberalization: A Review of the CGE Literature[1]

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Introduction

In response to increasing concern regarding the poverty impacts of trade liberalization, an extensive literature has been rapidly developing in recent years, excellent reviews of which are provided by Bannister and Thugge (2001). In this chapter we focus exclusively on the considerable CGE modeling contribution to this debate. This literature is characterized by its careful attention to the multiple aspects of the trade liberalization-poverty link and the efforts to model and thus understand its underlying mechanisms. Based on a deeper understanding of these mechanisms, it is hoped that trade liberalization and accompanying policies can be designed to better protect the poor and to ensure that they share in the benefits of increased trade.

There are two basic mechanisms through which trade liberalization influences poverty[3]. On the income side, through its

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[3] To lighten the text, we refer only to poverty impacts of trade liberalization throughout, although most of the analysis applies also to equality and, more generally, the distributional impacts of trade liberalization, as we will see further on.

impacts on resource allocation and, consequently, factor remunerations, trade liberalization affects household income. Households stand to benefit if they own factors that are used intensively in, or are specific to, expanding sectors. On the consumption side, macroeconomic shocks modify the structure of consumer prices, favoring those households that consume relatively more goods with declining prices. The combination of income and consumption effects ultimately determines how poverty evolves.

However, trade liberalization generally requires the use of compensatory taxes to replace lost tariff revenue. These compensatory mechanisms also have important income and consumption effects of their own that may even outweigh the direct effects of trade liberalization.

From this discussion, it becomes clear that the nature of trade liberalization, the structure of the economy in question, and the behavior of economic agents can all strongly influence the impacts on poverty. In this chapter, we review how these mechanisms have been modeled and the results obtained in the CGE literature. We first examine the design of policy simulations before turning our attention to model structure and, ultimately, empirical results.

Policy simulations

The definition of a trade liberalization scenario involves several components. First, one must define what exact trade liberalization measures take place and to which sectors they apply. Most scenarios must also deal with the issue of fiscal balance and the identification of compensatory taxes to replace lost tariff revenue. Finally, the modeler must identify the key mechanisms for re-establishing equilibrium, commonly referred to as model closure. We discuss each of these issues in turn in the sub-sections below and report the main characteristics in Table 1.

Table 1 : Policy simulations, government-compensating mechanisms and macro closures

				Simulations							Government budget adjustment								Macroeconomic closures							
Studies	Year	Country	Model Type	Tariff elimina –	Quota elimina –	Tariff Reduction	Quota Reduction	Restricted to	Restricted to	Others	Fixed revenue	Fixed spending	Fixed saving	Tax mecha	Distortionary	Lump-sum	Others	Residual sav	Fixed Invest	Public savings	Firm savings	Hh savings	Foreign sav	Others	Fixed Savings	Others
Bautista & Thomas	2000	Zimbabwe	S		X	X				X	X	X		II	II			I							X	
Bautista & al.	1998	Zimbabwe	S			X	X				X	X	II	II				I							X	
Cockburn	2001	Nepal	S	X							X	X	X	X			X		X							
Cogneau & al.	1996	Cameroon	D							X				?	?		?		X				X			
Cogneau & Tapinos	1995	Morocco	D recursive	X	X			X	X	X	X	X	X	X	X								X			X
Cororaton	1998	Philippines	S			X												X	X							
Chan & al.	1999	Vietnam	S	X							X			X	X	X										X
Chia & al.	1992	Ivory Coast	S	X							X			X	X										X	
Chisari & Romero	1995	Argentina	D						X	X	X			X	X											I) I fixed II) Inv vary
Cogneau & Robillard	2000	Madagascar	S							X	X			X	X										X	
Decaluwé & al.	1999	African econ	S			X						X						X	X						X	
De Melo & Robinson	1980	Colombia	S						X	X	X	X	X	X			X		X			X				
Devarajan & Van der Mensbrugghe	2000	South Africa	S	X	X						I	I-II	I	I-X	I-X			II	II	II		II			I	
Dorosh	1994	Madagascar	D recursive	X	X					X	X	X		?				X							X	
Harrison & al.	2000	Turkey	S	X	X?					X	X			X	X					?	?	?	?			X I fixed, VAT vary
Hertel & al.	2000	5 countries	MC	X	X?						?		?	?												
Ianchovichina & al.	2001	Mexico	D, MC	X									X						X				X			Regional I must equal global I which in turn must equal the sum of regional S. S included in static utility function (ELES)
Lee Harris	2001	Mexico	S	X	X					X	X	X		X	X		X		X		X	X				Gov expenditure, real I, Foreign S fixed.

Table 1 (continued)

Löfgren	**1999**	Morocco	S			X					X	X	X	X	X				X			X				
Löfgren	**2001**	Egypt	D	X						X	X			X	X		X	?				(1) X			(2) X	1) I fixed, Gov S fixed share of GDP, direct tax rates adjust (uniformly across hh cat), foreign S fixed
McMahon	**1990**	Kenya	D	X				X		X	X			X	X										X	
Montaud	**2000**	Burkina Faso	S			X				X	X			X	X		X								X	
Narayan & al.	**1987**	India	D		X						X			X	X		X		X	X						
Radelet	**1993**	Gambia	S			X				X				?	?		?								X	
Storm	**1999**	India	S	X	X					X	X	X	X	X	X										X?	
Sinclair & al.	**2000**	Indonesia	S			X					X	X			?			X	X	X			X			Foreign borrowings vary to balance budget
Wang & Zhai	**1998**	China	D	X		X					I-II	I-II	I	I	I-II	I-II		II		II					X	
Wobst	**2001**	Tanzania	S	X	X					X	X			X	X		X		X		X					
Yang & Huang	**1997**	China	S			X		X	X		X	X		X	X			X?	X				X		X?	Current account balance adjust, I vary, Capital stock (exogenous), Gov S residual from its revenue after consumption.

Trade Liberalization

Trade liberalization is generally modeled as a reduction or elimination of trade restrictions throughout the economy. However, in some cases, these changes are restricted to specific sectors such as manufacturing or agriculture. Generally these restrictions are in the form of tariff reductions although some authors have also modeled the elimination or reduction of quotas and other quantitative restrictions[4].

Government revenue/expenditure adjustment

In defining trade liberalization scenarios, it is important to determine if and how the government compensates for any loss in tariff revenues. In revenue-neutral simulations, government revenue is fixed through the endogenous determination of a compensatory tax. For pure tax theory analysis, the compensatory tax should be non-distortionary, generally via lump-sum transfers. While this type of analysis is interesting to isolate the specific effects of the trade liberalization itself, we know that in reality developing country governments must choose among a limited number of highly distortionary tax instruments, primarily taxes on production, income, value-added or consumption. As these compensatory taxes have important poverty impacts of their own, one of the underlying themes of the studies presented in the second part of this volume is the importance of the government adjustment mechanisms in determining the eventual poverty effects of trade liberalization.

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[4] Although we recognize that simultaneous changes in aspects of the policy environment other than trade liberalization can enhance its effectiveness in promoting equity and poverty reduction, in order to correctly identify the central transmission channels of trade liberalization impact on poverty, we restrict our evaluation to straightforward trade liberalization simulations. For further analysis, the interested reader should directly refer to the cited articles where numerous additional simulations or combinations of trade liberalization with complementary reforms are explored (e.g. land redistribution toward poor households, reduced marketing margins[4], etc.).

In a number of studies (see Table 1), government revenue is not fixed. In these cases, either government spending or government savings must fall as a result of declining tariff revenues. To the extent that the impacts of variations in government spending on poverty are not taken into account, it is preferable to fix government spending and let government savings fall. As a result, savings are considered as residual of fixed public consumption based on varying revenue. In a few instances, the government deficit is maintained constant so that government spending has to vary to equilibrate public budget.

Endogenous government spending possibly implies distortionary welfare effects on households that are generally not taken into account. Different households consume different amounts of public services and utilities and are thus affected differently by variations in public spending. Therefore, allowing government spending to fluctuate would be acceptable only if household consumption of public services such as education and health is modeled properly, which, to our knowledge, has never be done in a static context[5]. An alternative to this modeling exercise used in some studies[6] assumes that government spending simply takes the form of transfers to households. In this context, the model will effectively capture the poverty effects of variations in government spending only if these transfers adequately reflect the variation in the consumption of public goods by each category of households.

Model closure

Macroeconomic closure, a necessary constraint not considered in the optimizing decisions of any micro agent in static models,

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[5] For a dynamic example of models with education and health supply and demand, see Jung and Thorbecke (2001), Dorosh (1994). Maisonnave and Decaluwe (2008)

[6] For example, in Chan, Ghosh and Whalley (1999) government savings are nonexistent and the entire revenue is directly transferred to households. Harris (2001) looks at the effect of a system of direct payments to farmers. Using GTAP, Ianchovichina, Nicita and Sologa (2001) assume government spending to be a constant share of income and a portion of tax revenue is always transferred to the private household, leading to changes in both private spending and savings.

requires the maintenance of the investment-savings balance at all times.[7]

Investment is either endogenously or exogenously determined. Usually, real investment (i.e. investment in volume) is maintained at a constant level to avoid dealing with inter-temporal welfare issues and to isolate the analysis from the interaction between trade policies and growth via changes in the level of investment. Indeed, this is the case in most models surveyed. Obviously, if investment increases (falls), this entails future income gains (losses) that must be considered along with the static income changes. Therefore in a static model, investment should be at a steady state such that it just covers capital depreciation. Thus, in principle, a net increase in investment will entail an increase in the steady state capital stock. These adjustments are generally made in dynamic models as we will see further on (Section 5.1).

a) Investment-driven Savings

With investment-driven savings, which is the non-classical but most commonly used macro closure, the investment volume is fixed. When the investment volume is fixed, the value of investment is subject to nominal variations (due to changes in the aggregate investment price) so that the realization of the investment-savings equilibrium is not automatically guaranteed. Consequently, using this type of closure, some parameters such as the savings rates of specific agents must adjust for nominal investment to equal total available savings.

There are generally four types of savings: foreign, household, firm and public savings. Typically, foreign savings are maintained constant in foreign currency as it is assumed that the steady state value of these savings is not affected by the shock in question. In these cases, the real exchange rate (or the price index) is the equilibrating variable of the trade deficit. Where foreign savings are

[7] For a detailed presentation of closure rules see Decaluwe and Martens (1988)

allowed to vary, this actually introduces a second shock into the system. Endogenous foreign savings implies that part or all of the difference between national savings and aggregate investment is closed through a net capital inflow, or flexible trade balance. Most of the time, however, household savings rates are assumed to adjust in order to maintain the fixed investment level. This can be interpreted as forcing households to adjust their consumption now rather than in the future. It gives a better measure of the impact of the shock on households within a static model. Others consider that government savings adjust via variations in the (effective) tax rates imposed on private institutions[8].

Alternatively, one could maintain fixed savings rates and, in "Kaldorian" fashion, allow the distribution of income to adjust in order to validate the exogenously specified real investment. One could also, in "Keynesian" fashion, allow the level of employment to vary in order to generate the income required to produce a sufficient amount of real savings to finance the real investment level[9]. Finally, using a closure *à la* Johansen, one could endogenize both government spending and savings and maintain a balance between aggregate investment and aggregate savings that way.

b) Savings-driven Investment

Savings-driven investment, the "classical" macro closure, implies that total investment value (i.e. nominal investment) adjusts to the available level of savings. When investment is endogenous, total savings (and hence investments) are determined by applying exogenous savings rates to the income of each institution in the

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[8] Harrison, Rutherford and Tarr (2000), Löfgren (2001), Wang and Zhai (1998), Harris (2001)

[9] Taylor et al. (1980) uses both the Kaldorian and Keynesian mechanism. In one of their simulations, changes in the aggregate price level cause the real wage to adjust so as to yield the employment (and output) needed (Keynesian effect). Additionally, this change in real wages shifts income between low and high savers (Kaldorian effect).

economy. Total investment is then determined by savings behavior and is also, as a consequence, a function of the distribution of income among the different households, firms and the government (assuming that their savings rates differ).

While being a valid closure on paper, as mentioned earlier, endogenous investment can greatly influence the welfare and poverty results obtained from the model. In a dynamic sense, varying investment leads to a variation in future welfare depending on future uses of these different investment levels. Therefore it is generally not considered to be the most appropriate modeling specification for poverty analysis.

c) Other savings-investment closures

An unusual savings-investment closure is to assume that households consume all their income[10], which is equivalent to considering neither savings nor investment (when firms and government also spend all of their incomes) and to assume household disposable (post-tax) income to be devoted entirely to consuming goods available on the commodity market. In this context, a negative shock on government revenue directly affects household disposable income via a decline in public transfers. As in the case where household savings rates adjust to maintain a fixed investment level, this closure is better suited to the analysis of the impact of the shock on households.

Another[11] atypical closure is to combine fixed nominal investment with a transactions demand for money[12] that enters the household budget equation as part of savings. Given an exogenous specified money supply, the aggregate price level adjusts to equate

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[10] Chan, Ghosh and Whalley (1992).

[11] See Adelman and Robinson (1988).

[12] In Decaluwe and Nsengiyumva (1993, 1994) and Souissi and Decaluwe (1996) the authors introduce a full set of assets and analyse the interaction between the financial sector and the real side of the economy.

the demand for money (real balance) with the specified supply. In effect, the aggregate price level is the equilibrating variable to achieve saving-investment equilibrium: changes in the aggregate price level influence both real savings and investment. Investment could also be considered as a fixed share of domestic absorption[13], which implies that external shock will affect investment, consumption, and savings simultaneously. Finally, when household consumption is based on an extended linear expenditure system (ELES), savings enters household utility functions. Consequently household savings levels are determined endogenously as a result of their utility-maximising behavior (Ianchovichina, Nicita and Sologa, 2001; p.9, and Howe, 1975). Recently however, Lemelin and Decaluwe (2007) have shown that even with an extended linear expenditure system the savings rate is still a fixed proportion of income.

Model structure and results

Most CGE models share the same basic structure involving households, firms, government, factors, branches, goods, and the Rest of the World. The principal way to differentiate models is by the manner in which these accounts are disaggregated and the underlying behavior of economic agents is modeled. In this section, we examine model structure (see Table 2) and results in the literature (see Annex 1). Following the framework set out in chapter 1, we trace the impacts of trade liberalization as it channels through sectoral production, to factor remuneration and, finally, to household income. We then turn our attention to the consumption effects, before examining the ultimate impacts on poverty.

External sectors

Considering the trade liberalization aim of the CGE models reviewed here, logically the aspect of primary importance is the treatment of foreign trade.

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[13] Löfgren (2001), and San, Löfgren, and Robinson (2000).

a) Disaggregation

Import and export good categories usually have a one-to-one correspondence with branches of activities (section 3.2) and consumption goods categories (section 3.5), which are themselves equivalent to, or an aggregation of, the branches of the input-output table underlying the model. Some authors also enrich their models by explicitly including some non-tradables (non-importables, non-exportables, or both) sectors[14].

b) Behavior

Most researchers adopt the now standard Armington (1969) approach in modeling import demand. In this framework, imports and domestically produced goods are CES-imperfect substitutes that together constitute composite consumption goods. Demands for these goods are determined in order to minimize expenditures subject to this imperfect substitutability[15]. Likewise, the supply of domestic output towards export and domestic markets is determined so as to maximize profit subject to imperfect substitution between sales in these two markets, expressed by a CET function[16]. These assumptions of imperfect substitutability and transformability give the domestic price system a certain degree of independence from world prices and dampen import responses to changes in the producer environment. It

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[14] For example, see Chan, Ghosh and Whalley (1992), Adelman and Robinson (1988), Dervis, De Melo and Robinson (1982),

[15] Even if rarely used in a trade liberalization context, some authors (Bourguignon, De Melo and Suwa (1991), Cogneau et al (1996) primarily interested in devaluation suppose that parts of imports are noncompetitive on local markets- meaning that these commodities are not produced at all within the country - so that substitution possibilities away from imports are limited in the short term and a fixed part of the local demand is served by imports.

[16] A notable exception is found in De Melo and Robinson (1980), who assume the ratio of exports to domestic production to be a decreasing function of the ratio of the domestic prices to the export prices. An asymmetric logistic function with inflection point at base-year export ratio, upper and lower asymptote of 1 and 0 respectively is adopted as the functional form for the export supply function.

Table 2 :Model structure, disaggregation and behavior

Studies	Year	Country	International trade			Production			Factors															
			EXP supply	IMP demand	EXP demand/ IMP supply	# Sectors	Output X= f (CI, VA)	VA= f (L, C, T)	LABOR: # groups	-Qualification	-Rural-urban	-Types of work	-Others	Unemployment	Fixed wage	Intersectoral labor	Endogenous labor	National migration	Land differentiated	CAPITAL: #groups	-Rural-urban	-Agriculture or not	-Others	Intersectoral capi
Bautista & Thomas	2000	Zimbabwe	CET	CES		36	IO	CES	4	X	X	X			X	X			X	4		X	X	
Bautista & al.	1998	Zimbabwe	CET	CES		36	CES	CES	2	X					X	X			X	2				X
Cockburn	2001	Nepal	CET	CES		45	IO	CES	2	X			X			X			X	3		X		X
Cogneau & al.	1996	Cameroon	CET	CES&fixed		?	IO	CES	3			X		X	X	X		X	X	3			X	X
Cogneau & Tapinos	1995	Morocco	?	?	ED	6	?	?	3				X	X	X	?		X	?	?				X
Cororaton	1998	Philippines	CET	CES		34	IO	CES	2			X				X				2				
Chan & al.	1999	Vietnam	CET	CES		9	CES	CES	1							X				1				
Chia & al.	1992	Ivory Coast	Homogenous	CES		15	IO	CES	3	X		X								2		X		X
Chisari & Romero	1995	Argentina	?	Fixed		21	IO	CD	2				X	?		X				2			X	X
Cogneau & Robillard	2000	Madagascar	CET	CES	ED?	3	IO	CD	3			X		?		X			X	4	X			X
Decaluwé & al.	99-2001	African ecn	CET	CES		6	IO	CES	2	X									X	3		X		X
De Melo & Robinson	1980	Colombia	Asymmetric logistic function	CES	ED?	8	IO	CD	3	X		X				X			X	2				X
Devarajan & Van der Mensbrugghe	2000	South Africa	CET	CES		34	CES ?	CES	13	X			X	X						1				T
Dorosh	1994	Madagascar	CET	CES	ED	27	IO	CES	3	X							X		X	6		X	X	X
Harrison & al.	2000	Turkey	CET	CES		54	IO	CD?	8			X				X				2		X		X
Hertel & al.	2000	5 countries	?	?		7	?	?	2	X				?		?			X	2				?
Ianchovichina & al.	2001	Mexico	Perfect substitutes	CES		29	IO	CD	2	X									X	2			X	?
Lee Harris	2001	Mexico	CET	CES		21	IO	CES	8	X		X	X					X	X	9			X	X
Löfgren	1999	Morocco	CET	CES		41	IO	CES	5	X	X	X				T			X	10	X			X
Löfgren	2001	Egypt	CET	CES		9	IO	CES	2	X									X	2				
McMahon	1990	Kenya	CET	CES		15	IO	CES	2		X							X	X	3			X	
Montaud	2000	Burkina Faso	CET	No substitution		5	IO	CES	2	X										2		X		X
Narayan & al.	1987	India	?	?		10	IO ?	?	?										X	4			X	
Ra delet	1993	Gambia	Other	CES		8	IO	CD	3		X		X							1				X
Storm	1999	India	Other	CES	ED	9	IO	CD	2		X				X	X			X					X
Sinclair & al.	2000	Indonesia	Perfect substitutes	CES		18	IO	CES	8				X			?			?	5			X	?
Wang & Zhai	1998	China	CET	CES		22	CES?	CES	3	X		X							X	2			X	
Wobst	2001	Tanzania	CET	CES		56	IO	CES	5			X				X			X	2?				X
Yang & Huang	1997	China	CET	CES	IS,ED	59	IO	CES	3		X	X				X		X	X	3	X			X

Table 2: Model structure, disaggregation and behavior (continued)

Studies	Households														Consumption		Welfare etc.		
	# groups	Income levels categories	Microsimulation	Socio-economic categories	Rural-urban	Production factors	Ag or not	Types of work	Formal-informal	Ethnic group	Ethnic group	Geo situation	Within-group distribution	# commodities	Function	Own consumption	Welfare measures	Inequality measures	Poverty Measures
Bautista & Thomas	5	X		X	X			X					N	27	LES	X	I		
Bautista & al.	5	X		X	X	X	X						N	27	CD	X	I		
Cockburn	3		X	X							X		x	48	LES			GAL	HC
Cogneau & al.	3			X	X	X			X		X		?		?				
Cogneau & Tapinos	6			X	X	X									?			T	HC
Cororaton	10	X													?			G	?
Chan & al.	5	X													Nested CES		EVCV		
Chia & al.	7			X				X							CD		EV		
Chisari & Romero	5	X													?		EV	G	
Cogneau & Robillard	2		X	X	X										LES	X		T	FGT
Decaluwé & al.	6			X	X	X							X		LES				FGT
De Melo & Robinson	6			X	X	X	X						X		LES			GL	HC
Devarajan & Van der Mensbrugghe	24	X		X						X					ELES		C	G	HC
Dorosh	8				X		X				X				LES		I		
Harrison & al.	40	X		X	X										Nested CES		EV	GA	HC
Hertel & al.	100	X													AIDADS (LES)		EVCV	GQ	FGT
Ianchovichina & al.	10	X	X											29	CDE	N	EVCV	GT	FGT
Lee Harris	15	X		X							X				LES		EVI		
Löfgren	4	X		X	X										LES		I		
Löfgren	6	X		X	X										LES		C	T	
McMahon	16			X	X	X					X				LES		EV		
Montaud	8			X				X					X		LES		I		FGT
Narayan & al.	10	X		X	X								X		LES		I	G	
Radelet	3			X					X						CD		I		
Storm	7			X	X	X									LES		I		
Sinclair & al.	10			X?	X	X	X	X							CD				
Wang & Zhai	12	X		X	X									22	ELES	N	EV	G	
Wobst	4			X	X		X								LES				
Yang & Huang	6			X	X						X				LES		EV		

provides a continuum of tradability and allows the possibility of two-way trade (cross-hauling) at the sectoral level.

Domestic prices of exported and imported goods are assumed to be equal to their corresponding world prices, adjusted for any import tariffs or export subsidies that apply. World prices are typically considered to be exogenous – the so-called ‘small-country assumption’ – where world export demand and import supply are assumed to be infinitely elastic with respect to the country analyzed. In other words, domestic demand and supply conditions have no discernible influence on world market equilibrium. This assumption of an infinitely elastic export demand equation is more and more frequently rejected recognizing that a large number of underdeveloped countries cannot increase their market share on the world market without a competitive reduction in their export price with respect to the price of competitors.[17] However, the small country assumption is also relaxed – although less frequently – where a country is assumed to have some influence over the world price of a given good (some form of monopoly power on the international market). In these cases, import supply and export demand functions are introduced to the model and world prices for the country’s traded goods are determined endogenously.

When quantitative import restrictions are modeled, this leads to a difference between desired imports (M*) and actual imports (M) i.e. M = bM* where b is the quantity rationing rate on a sector’s imports. The domestic price of sectoral imports is generally unaffected by supply scarcity under an assumption of fixed price rationing[18].

c) Results

As we would expect, imports generally increase as a result of trade liberalization. The import response of a given good increases

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[17] For a detailed discussion of this assumption see for example Decaluwe, Martens and Savard (2001)

[18] Dervis et al. (1982), Bautista, Löfgren and Thomas (1998), Bousselmi, Decaluwe, Leduc, Monette (1991)

with the size of tariff reductions, degree of substitutability to domestic goods as defined by the Armington elasticity values, and the initial share of imports in the domestic consumption of this good. This can be seen by examining the import demand function derived from the Armington assumption (see Dervis, De Melo and Robinson, 1982):

$$M = (\delta / (1- \delta)) \sigma (Pd / Pm) \sigma D$$

where M represents imports, D symbolizes domestically produced and consumed goods, Pm and Pd are the corresponding prices, σ is the Armington substitution elasticity and δ is the fixed Armington share parameter.

Where tariff reductions are uniform (at least among the specifically targeted sectors), including the case of complete trade liberalization (100% tariff reduction), the goods that face the highest initial tariffs generally experience the greatest import response. The degree of import response can also be affected to some extent by the general equilibrium changes in domestic prices, which will be discussed in the next section.

Moreover, with fixed foreign savings, since trade liberalization generally leads to real exchange rate depreciation, an increase in import demand must be matched by increasing exports. This rise in exports is obviously amplified when, as mentioned in section 2.1, trade liberalization also includes a reduction in or elimination of export taxes. In this case, the direct gain in competitiveness in international market tends to further increase the amount of local production going toward export markets. The magnitude of the export response, analogous to the import response, depends on the size of export tax reductions, degree of transformability between domestic and export markets as defined by the CET elasticity values, the initial share of exports in the domestic production of this good, the real exchange rate, and some general equilibrium effects. When the foreign demand price elasticity is low, the magnitude of export response will be proportional to the magnitude of the export price decrease. On the other hand if the price elasticity of demand is infinite (the small country assumption) the same reduction of domestic price will lead to a larger increase in export volume.

Branches of production

a) Disaggregation

The disaggregation of branches is to a large extent determined by the existing input-output table. However, where there are choices, the model should seek to capture the important characteristics of the shock considered and the structure of the economy itself. In the case of trade liberalization, an initial examination of the proposed tariff changes should guide the disaggregation of branches. Branches with particularly high or low tariff changes should be distinguished if they represent a substantial share of domestic production or consumption. Furthermore, branches with quite different factor intensities should be distinguished in order to capture the income link. Finally, goods that are consumed to a large extent by one or several household categories should be distinguished.

In the CGE literature, the number of branches varies from as few as three to as many as several dozen. Agriculture, Industry and Services are distinguished in virtually all models[19]. Among agricultural branches, it is common to distinguish cash and subsistence crops. As tariff levels tend to be high and differentiated within the manufacturing sector prior to liberalization, many models put substantial effort into the disaggregation of this sector. Some authors, who are more interested in the trade impacts on the agricultural sectors, focus instead on the disaggregation of this sector[20]. In the service sector, public services are generally separated out, as are public utilities (electricity, water, etc.).

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[19] Except Cogneau and Robillard (2000) who consider agriculture, informal and formal activities, these are also not distinguished in Bautista and Thomas (2000).

[20] Löfgren, and Robinson (2000), Akinboade (1998), Lee Harris (2001), Decaluwe and Souissi (1996), Bautista, Löfgren and Thomas (1998), Bautista and Thomas (2000), Storm (1999).

b) Behavior

Production behavior is generally modeled as single-or multiple-level Leontief, Cobb-Douglas and/or CES functions of intermediate inputs and primary factors (see 3.3). The choice of functional forms and their estimation/calibration is discussed in chapter 3. In a few models[21], marketing margins represent a real cost associated with the distribution of products from their point of production or port of importation to the point of purchase[22]. In other words, the producer price differs from the consumer price of the goods in question by the amount of trade and transport costs. To obtain the marketing margin per unit quantity of product, the marketing margin rate for each product type is multiplied by the composite consumption good price for "trade and transport".

Most models reviewed are set in the context of perfect competition, which means that producers are price takers in both input (factors are paid their marginal products) and output markets. Most of these models also considered constant returns to scale in the production process. The assumptions of perfect competition and constant returns to scale are altered by invoking features of imperfect competition and increasing returns to scale. However, imperfect competitive behavior and increasing returns to scale have been modeled in different ways.

In one approach (e.g. Cox and Harris, 1985), the industry rationalization effects of trade reforms are discussed. In this type of model the firm's perceived demand elasticity is treated as constant in the short run. Other market structure variables such as the number of firms, marginal cost (or unit variable cost) and profits are determined endogenously. The increasing returns to scale are assumed to stem

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[21] Bautista and Thomas (2000) and Bautista, Löfgren and Thomas (1998), for example.

[22] For example, in agriculture, marketing margins can represent high transport costs related to poor roads, isolated areas, limited transport equipment, etc. In the manufacturing sector, it can be linked to a high-risk environment due to unreliable delivery schedules, and deficiencies in contract enforcement.

from the presence of fixed costs. Fixed costs are usually calculated using available econometric estimates of the minimum efficient scale of production and cost savings achieved. The latter parameter depicts the decline in cost that would result if a firm were to expand its output from the actual level to the efficient scale of production. Additional gains from trade reforms appear to come from industry rationalization effects that are the exit of inefficient firms and a reduction in unrealized scale economies.

In another approach (e.g. Devarajan and Rodrik, 1991, Cockburn, Decaluwe and Dostie, 1996 and Cockburn, Decaluwe and Dostie,1999), the pro-competitive effects of trade reforms are explained. In this type of model all the market structure variables, including the firm's perceived demand elasticity, are endogenous. The market structure variables that characterize imperfect competition are marginal costs, the number of domestic firms, the excess profit condition and the market demand elasticity for domestic goods. Increasing returns to scale are also assumed to stem from the fixed cost part of the total cost. In this case, extra gains appear to originate from both the pro-competitive effect and industry rationalization effects.

Another way to relax this assumption of is to include some price rigidities within a dynamic context. In the context of output price rigidity, a specific sector could have a certain power to resist a decline in the profit level in the case of inflation. Specifically, one attributes to some sectors a downward rigidity in prices. One assumes that producers fix a minimum price for each period that depends on their production cost and the anticipated level of inflation. Consequently, if demand is insufficient, they prefer to adjust their quantities instead of lowering their prices.

c) Results

The domestic production response to trade liberalization depends on a number of factors. Generally speaking, sectors with relatively low (high) initial levels of protection and those with high (low) export shares tend to expand (contract) as a result of trade liberalization. In other words, when liberalizing trade we expect a shift from non-tradables to tradables, a demand shift from locally produced goods toward imported goods, and a supply shift from producing goods for local markets to producing goods for the export market.

Firstly, effective protection rates explain a good part of expansion and contraction results by combining the negative impact from import competition and the positive impact from cheaper intermediate consumption. On one hand, import tariff reduction (or elimination) renders imports cheaper. Increased import competition in highly protected sectors tends to reduce local demand for domestically produced goods. This translates into a contraction of these industries and an expansion of sectors with lower initial protection rates. On the other hand, following liberalization, sectors with an initially low rate of effective protection experience a fall in their production costs and thus face a possibility of expansion. Note that an analysis of effective protection rates often explains some results that seem, at first, counterintuitive[23].

As an excellent demonstration of the importance of effective protection rates, McMahon (1990) compares tariff reduction for goods according to their end-use. Conclusions then depend on the resulting effective rates of protection in each sector. Those with higher rates contract in relative terms. Hence, when tariffs on final goods are eliminated, domestic firms still have to pay the tariffs on their intermediate goods but now face stiffer competition on final goods so that output in all sectors decrease, with manufacturing output

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[23] For example, when De Melo and Robinson (1980) simulate the imposition of tariffs on manufacturing, while the relative output price of manufactures increases, output decreases. This is because input costs for manufacturing activities rise more than the output prices of manufactured goods. Similarly, Storm (1999) reports that even if the absolute tariff rate of manufacturing is more important than that of agriculture, when all restrictions are removed agricultural and non-agricultural production both increase because overall input costs decrease sufficiently.

decreasing more than agricultural output since the latter uses less intermediate goods. When tariffs on intermediate goods are eliminated, production costs of domestic firms decline, yet they receive the same amount of protection for final goods, so that manufacturing production increases the most (it uses more intermediate inputs and benefits from the higher level of tariffs on final goods) and industrial production of agricultural or manufacturing intermediate goods decrease minimally. When tariffs on manufactured investment (capital) goods are eliminated, the most important effect is the increased competition facing domestic producers of capital goods so that labor-intensive building and construction production decreases. Finally, when tariffs on final *and* intermediate goods are eliminated, production of the informal sector and smallholders falls. The former does not use imports and now faces stiffer competition, while the latter also faces more competition and receives only indirect benefits from the lower manufacturing prices.

In most models[24] developing countries initially promote industrialization, so manufacturing activities benefit from the most protection via high import tariffs or quotas. Thus, with trade liberalization, the first effect is a shift from manufacturing towards agriculture and/or services. For example, in Indonesia, Turkey, Zimbabwe, China and Madagascar, authors[25] report a rise in imported substitutes for previously protected manufactured goods and, consequently, a decline in domestic prices and output levels of those sectors. Freed-up resources then feed an expansion of the agricultural sector[26]. Moreover, sectors benefiting from lower input prices expand

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[24] See, for example, Yang and Huang (1997), Wang and Zhai (1998), Sinclair, Blake & Sugiyarto (2000), Harrison, Rutherford and Tarr (2000), Dorosh (1994), Bautista and Thomas (2000), Bautista, Löfgren and Thomas (1998).

[25] Harrison et al. (2000), Sinclair, Blake and Sugiyarto (2000), Dorosh (1994), Bautista and Thomas (2000), Bautista, Löfgren and Thomas (1998), Yang and Huang (1997), Wang and Zhai (1998).

[26] Principally export crops in Dorosh (1994) and trade, food processing and hotel-restaurant in Harrison, Rutherford and Tarr (2000) and Sinclair, Blake and Sugiyarto (2000).

even more. In China[27], the decline in equipment and fertilizer prices also explains the significant gain in agricultural sectors.

Second, by reducing *export* restrictions[28] and/or allowing freer entry to imports, trade liberalization also generally leads to a real exchange rate depreciation (when the external current account balance is fixed), which leads to an expansion in the export-oriented sectors as they benefit from improved relative prices in international markets. In most models reviewed here, the majority of exports generally come from agricultural sectors. This feature adds to the gains of agricultural sectors in situations where there was an initial pro-manufacturing protection bias. Furthermore, this export promotion can partly explain the differential results among agro-industries with similar initial and final effective protection rates. Following trade liberalization, export-oriented production (such as commercial farms) should increase more significantly than production focused on local markets (such as smallholder farms or subsistence crops) [29].

Third, general equilibrium effects such as variations in relative factor prices also influence production due to differential sectoral factor intensities. Household income and the rest of the economy can also have a strong effect on resource allocation. Actually, indirect effects on sectors of changes in investment or intermediate demands sometimes provide the best explanations for some production variations. For example, in a study for Turkey[30], production of mining, gas, metal, electricity, and transport sectors declined following the decrease in intermediate demand from manufacturing activities after increased import competition. Moreover, if the reduction or removal of tariffs induces a decrease in the price of investment goods[31] or an increase in tax revenue (when government revenue is fixed)[32], it can

[27] Wang and Zhai (1998).

[28] Chia, Whaba and Whalley (1992), Cogneau and Tapinos (1995).

[29] See Bautista and Thomas (2000), Bautista, Löfgren and Thomas (1998).

[30] Harrison, Rutherford and Tarr (2000).

[31] Devarajan and Van der Mensbrugghe (2000).

[32] Dorosh (1994).

indirectly promote an increase in real investment and, consequently, an increase in output of industries that rely heavily on these investments (e.g. transportation and construction).

Finally, when it is distortionary, the compensation mechanism adopted may have even stronger impact on resource allocation for some or all sectors rather than the trade liberalization shock itself[33].

Factors of production

a) Disaggregation

The disaggregation of factors should aim to capture the transmission of sectoral shocks to household income. It is important to take account of differences in the structure of factor endowments among household categories. For example, the fact that the poor derive a large share of income from unskilled labor, whereas the rich derive more income from capital and skilled labor, suggests that a disaggregation of these factors is important. Consideration should also be given to the factor intensities of the branches of production, particularly if these branches are affected quite differently by trade liberalization. Consequently, differential impacts on the agricultural sector imply that the separation of the factor land and, possibly, water[34] would be important.

Labor is generally disaggregated on the basis of skills/education, type of job (e.g. production labor, professional, administrative labor, white collar, blue collar, etc.) or location (e.g. urban vs. rural). Where data permits, some models go further. For example, Taylor and al. (1980) consider 6 types of workers, 4 types of employers (receiving capital earnings from 23 sectors) but also 23 types of self-employed

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[33] Decaluwe & Souissi (1991)

[34] While we find a specification of water as a factor of production in models aiming at analyzing, for example, water pricing (in Decaluwé et al, 1999), none of the models on trade liberalization reviewed specified this factor.

proprietors (one for each sector). Except in some cases[35], capital is either sectorally disaggregated or completely aggregated. Numerous models distinguish land, which is specific to agricultural sectors. Land is sometimes further disaggregated according to its characteristics (e.g. whether irrigated or not)[36].

Furthermore, a sectoral disaggregation of factors is required where these factors are considered to be immobile, particularly in the case of short-run models/simulations such as the Ricardo-Viner specific factors model in the international trade literature. For example, with sector-specific capital, a sectoral disaggregation of capital is necessary. When labor is immobile between urban and rural sectors (or formal and informal sectors), urban and rural labor (informal and formal) income must be distinguished. When a factor is mobile among certain activities but is constrained to these, remuneration of this factor is determined through supply-demand equations that are independent of factor market conditions elsewhere in the economy.

b) Behavior

Factor demand equations are normally derived directly from the producer profit maximization problem, subject to the functional form chosen for the production function. Total factor supplies are generally assumed fixed, although some models introduce endogenous labor supply through a labor-leisure tradeoff[37]. Sectoral factor supplies are either fixed, where factors are immobile, or variable, where factors are reallocated so as to equalize rates of factor return between sectors.

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[35] When emphasis is put on a rural-urban or agriculture-industry dichotomy, capital is sometimes disaggregated in two categories and is mobile within but immobile among these aggregated sectors.

[36] Harris (2001), Morrisons (1991), San, Löfgren, and Robinson (2000).

[37] Fontana, Wood and Dorosh (2001). In their model, Cogneau & Robillard (2000) also modeled the labor market by using a discrete labor allocation model which includes leisure.

Land is generally fixed at initial levels[38]. In some rare cases, land use is variable and can be allocated among the various agricultural sectors according to its marginal value-added in those sectors[39] or modeled by including a land allocation model based on Nerlovian adaptive response[40]. In the latter approach crop production follows a two-step procedure after first determining the total gross cropped area: the crop wise area allocation is determined and then the yield level is established. Yields depend on fertilizer use, which, in turn, is a function of fertilizer and crop prices.

Most models assume perfect mobility of labor between sectors. However, in a number of short-run models, a certain degree of labor immobility is introduced. For example, rural workers can be assumed to be tied to the agricultural sector but mobile within agricultural sub-sectors. Correspondingly, urban workers are then assumed to be only mobile between non-agricultural sectors. In the literature, capital is generally assumed to be immobile between sectors in the short run and mobile in the long run. On some occasions, modelers depart from the neo-classical assumption in allowing a particular factor market not to clear. Several authors introduce labor market rigidities, such as unemployment, or wage rigidities in the form of minimum wage or unionized behavior and government control[41].

These specifications are interesting in that they allow studies of the effect of trade liberalization on the unemployment rate. We generally encounter mixed labor markets[42] where, for some types

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[38] McMahon (1990).

[39] In Bautista and Thomas (2000), land is required to stay within crop sectors only and land market segmentation between smallholder and large-scale commercial farm is assumed. Within each farming system, land is allocated among the various crop sectors according to its marginal value-added in those sectors.

[40] Narayan, Parikh and Srinivasan (1987), Storm (1999).

[41] Cogneau et al. (1996), Storm (1999), San, Löfgren, and Robinson (2000), Yeldan (1998), Devarajan et al. (1999). Atypically, Morisson (1991) specifies a real wage resistance modeled by a Philip curve.

[42] See for example Akinboade (1998), Devarajan and Van der Mensbrugghe (2000), Radelet (1993).

of labor, an unlimited supply at a fixed nominal wage can be assumed, so that the level of employment is determined endogenously by the demand for labor. For their part, other types of labor can be assumed to follow a neoclassical closure with a fixed supply of each factor categories, so that market wage is determined endogenously in a situation of full employment (or fixed unemployment).

In some cases, minimum wage requirements artificially raise the real wage for specific labor types, resulting in excess labor supply[43] but with no unemployment. Given the exogenous wage rate, labor employment is also demand-determined. However, subtracting employed laborers in the rigid sectors from the fixed total supply yields the supply of other labor types. In fact, scarcity of jobs forces many laborers to work in the lower-paying sectors, labor demand being determined by their marginal products, and the market-clearing wage rate being inevitably lower than the exogenously-determined rigid-sector wage rate.

In some models, the existence of labor market rigidities for the urban/formal sector has been contrasted with flexible labor market for the rural/informal sector to assess welfare implications of such rigidities[44]. In addition to wage rate rigidity and unemployment following the 'wage curve' literature, the efficiency wage argument (or trade union bargaining) has also been invoked to adjust the labor market[45]. Since an inverse relationship exists between the unemployment rate and wage level in this case, firms are forced to increase wages in periods of low unemployment due to higher bargaining power of the trade unions. Obviously, factor mobility has important consequences for poverty analysis, given the allocation mechanisms discussed below.

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[43] Bautista and Thomas (2000) for unskilled formal workers in the non-agricultural sector.

[44] Sinclair et al (2000).

[45] Carneiro and. Arbarche (2002).

Another alternative factor market specification is the inclusion of migration. This generally refers to urban-rural migration so that labor is only considered to be partially immobile between the urban and rural sectors. This is an intermediate case, between mobility and immobility. When trying to integrate internal migration, most CGE models use the Harris-Todaro formulation[46] that implies a required movement of labor to bring about equality between the rural wage and the expected urban wage.

c) Results

Sectoral reallocations following trade liberalization (see section 3.2) are important for factor remuneration results since they follow directly from the resulting variations in factor demands. When import competition pushes down producer prices in a number of sectors, remuneration of most factors declines. However, by focusing on the distributional analysis of trade liberalization, we are primarily concerned with *relative* variations in factor remuneration and hence with the relative variation in producer prices and in producer demand for factors.

Generally, when agricultural (non-agricultural) activity slows down compared to non-agricultural (agricultural[47]) activity[48], demand

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[46] See Harris, Cogneau and Tapinos (1995), Cogneau et al (1996); Likewise, McMahon (1990) considered a rural-urban migration equation similar to the Fields modification of the standard Todaro equation, in which a portion of the labor force will migrate each year if the weighted average of formal and informal sector wages is higher than the rural wage. These weights depend on the changes in informal and formal sector employment in a given year, not on the absolute levels of employment. The only exception is Adelman and al. (1979) who explicitly modeled rural-urban migration as a function of rural-urban income differentials, with an upper limit on the possible annual rate of migration. Löfgren (1999) considered two alternative settings to model migration. 'Flexible' settings which are applicable for a longer term frame allow migration of laborers between skill categories. "Rigid' settings relevant for a shorter time frame disallow migration. See also Karam and Decaluwe (2007) where both domestic and international migration determined simultaneously the different wage rates.

[47] Storm (1999), Devarajan and Van der Mensbrugghe (2000)..

[48] Sinclair, Blake and Sugiyarto (2000), Yang and Huang (1997), Cogneau and Tapinos (1995), Harrison, Rutherford and Tarr (2000), Bautista and Thomas (2000).

for agricultural factors declines (rises) so that their remunerations decrease (increase) and, for comparable reasons, non-agricultural and/ or services remunerations increase (decrease). If agricultural production expands principally because of an increase in exports[49], we observe the biggest increase in remuneration of factors in export-oriented farms and the smallest increase in remuneration of factor in smallholder farms or subsistence food croppers (supplying domestic markets). Employment effects, when modeled[50], follow the same direction and smooth the wage effect.

However, the expansion of a sector can have differential effects on the factors it employs. In effect, how an expansion (contraction) of a sector affects relative factor returns depends on the degree of factor mobility, the sectoral shares of factor demand (i.e. factor intensity of the production activity), and the substitution elasticity between capital and labor.

In a two-good, two-factor economy, the Stolper-Samuelson's theorem states that when the relative price of a capital-intensive good increases, the relative remuneration of capital (labor) increases (decreases). We then generally observe that capital- (labor-) intensive goods are "friends" with certain types of capital (labor) used in their production process. However, since most simulations reviewed are taking place in a multiple good-multiple factor context, the results reported are much less evident. Indeed, each good is then a "friend" for some factors and an "enemy" for others, meaning that if the price of this good increases, the price of the "friend" factor rises and price of the "enemy" factor declines.

For example, when the output level of a capital-intensive sector such as mining, metal, gas, electricity, transport, etc. decreases, capital returns decrease more than labor returns[51]. On the contrary, when capital-intensive output increases, returns to capital rises relative to

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[49] Bautista and Thomas (2000), Chia, Whaba and Whalley (1992).

[50] Cogneau and Tapinos (1995).

[51] Harrison, Rutherford and Tarr (2000).

wages[52]. When labor-intensive industries contract[53], employment levels and labor returns decline considerably. On the other hand, when labor-intensive industries expand[54], production worker wages and non-agricultural incomes in rural and urban areas increase. Finally, since agriculture is generally labor-intensive in the different countries studied, agricultural wages increase more than capital returns following an agricultural gain.

In some models, factor mobility also plays a dominant role. When capital is fixed (sector-specific), theory says that an increase in the price of capital-intensive goods can increase the remuneration of labor in these sectors. More labor would then go into the expanding sectors and would in turn increase capital returns in this sector and reduce it in the others (as a result of relative rarity effect). Corresponding effects are observed in most models[55]. Fixed factors in contracting (expanding) sectors lose (gain) while mobile factors gain or lose, depending on the induced factor demand from the sectors, since they can move from contracting to expanding sectors.

For example, Decaluwe et al (1998) consider land as fixed capital and include two types of mobile labor. Therefore, when commercial agriculture and mining output increase while subsistence agriculture and industrial output decrease, returns to land in commercial agriculture sector increase while returns to land in the subsistence agricultural sector decrease. Moreover, remuneration of the two types of labor (skilled and unskilled) declines since industrial and

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[52] Bautista and Thomas (2000), However, in Devarajan and Van der Mensbrugghe (2000), labor wins over capital since mining, metals, transportation, and construction are modeled as relatively more labor-intensive.

[53] Harrison, Rutherford and Tarr (2000), Cogneau and Tapinos (1995).

[54] Wang and Zhai (1998), Yang and Huang (1997).

[55] Ianchovichina, Nicita and Sologa (2001), Yang and Huang (1997), Bautista and Thomas (2000), Bautista, Löfgren and Thomas (1998), Devarajan and Van der Mensbrugghe (2000), Dorosh (1994), Harrison, Rutherford and Tarr (2000), Cogneau and Tapinos (1995), Chia, Whaba and Whalley (1992), Storm (1999), Montaud (2000), DeMelo and Robinson (1980), McMahon (1990).

subsistence agriculture sector reduces the demand for them, and wages must decrease for other sectors to be able to employ them. In Cockburn (2001), the biggest losers are agricultural capital and land remuneration, which are fixed factors in agricultural sectors where prices decline. The relative gains of non-agricultural capital can be at least partly explained by its increased scarcity when labor from agricultural sectors move in. In Harrison, Rutherford and Tarr (2000), the displacement of labor freed by declining manufacturing sectors and moving to services sectors results in a labor wage decline since its supply increased relatively.

Finally, a special factor remuneration effect occurs with the elimination of quotas[56] because trade liberalization eliminates rental incomes received by some agents (government or capitalist households) due to rent-seeking activity.

Households

a) Disaggregation

Traditionally, CGE models examine how a given shock (e.g. trade liberalization) affects the welfare (e.g. equivalent variation) of different categories of households in a representative agent framework. The number of different categories is usually between five and ten, although they can range to over a hundred in some rare cases[57]. Two criteria are commonly used to define household categories: income level and socio-economic group (SEG).

Given the objective to analyze income distribution, it is not surprising that many modelers define household categories directly in terms of income level (e.g. quintiles, deciles). However, this approach is likely to bring together households with quite different characteristics of which none are particularly well represented by the representative agent. For example, even if they have similar incomes,

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[56] See Dorosh (1994).

[57] For example, see Hertel, Preckel and Cranfield (2000).

we would not expect the households of a rural farmer and an urban unskilled worker to be affected in the same way if trade liberalization primarily concerns the manufacturing sector. By combining these two types of households in a given income percentile, the results will reflect a weighted average of their possibly opposing effects and thus transmit very little information on the actual impacts on one or the other. Some models first distinguish rural and urban households and then adapt an income-level decomposition of households within each region. Yet the problem of heterogeneity remains. For example, the rural poor generally include both small landowners and hired laborer households, two categories of households that are likely to be affected very differently by trade liberalization. Furthermore, income level categorization raises problems due to the endogeneity of its basic criteria. In effect, after trade liberalization (or, for that matter, any shock altering the distribution of income), a household initially classified as part of the poorest decile can benefit from an important income gain that would allow it to be regarded as part of a higher decile. After simulation decile categories can be reversed and lose all of their meaning.

A socio-economic categorization of households brings together households that share some essential characteristics, particularly in terms of their income sources and underlying physical and human capital endowments. Households can be grouped together according to the production factors they own, the type of work they do such as agricultural or non-agricultural work and/or professional, production, blue or white collar occupation, their geographic location, their formal or informal sources of income, their ethnic groups, their skill level or a combination of these.

This approach makes it possible to trace the effects of trade liberalization through the various income and consumption channels that links it to poverty. Obviously, practically any SEG categorization of households will imply some heterogeneity in terms of income levels. In this context, there is no clear relationship between the impacts on the welfare of a given category of household and the incidence of poverty within the category and, *a fortiori*, in the economy as a whole[58]. As nationally-representative household surveys have become quite common, it is possible to gather information on income distribution within socio-economic categories in order to derive poverty results. CGE simulation results are used to estimate the change in mean incomes, while higher order moments are assumed to be constant. To render the intra-SEG income distribution smooth and continuous, several authors estimate a corresponding log-normal[59] or beta[60] distribution for each household category, although non-parametric approaches are preferable[61].

Microsimulation resolves the heterogeneity problems within SEG or income categories of households by either directly integrating a representative survey of households within the CGE model[62] or by linking a CGE model to a microsimulation model by transmission of prices and factor demands[63]. The microsimulation methodologies are summarized by Savard (2003, 2005). There are three variants of micro-household models, each of which have been applied in practice.

The first is to extend the number of household groups to however many households are captured in the household survey underpinning the SAM and database. So if the sample consists of 5000 households then there are effectively 5000 household groups. The model equations significantly increase and there is a corresponding need to adjust the household data for consistency, but beyond that, this kind of model has only a dimensional difference. However, the significant gain is that for poverty analysis it is no longer necessary to assume parametric income distributions or to assume constant (within group) variances. Decaluwe, Dumont and Savard (1999) provide an early example of

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[58] This assumes that poverty is measured in terms of (or proxied by) income.

[59] De Melo and Robinson (1980, 1982), , Narayan, Parikh and Srinivasan (1987), Adelman and Robinson (1988), De Janvry, Sadoulet and Fargeix (1991).

[60] Decaluwé et al. (1999) (2005) , Boccanfuso, Decaluwe and Savard (2003, 2008).

[61] Savard (2005).

[62] Cockburn (2001).

[63] Cogneau and Robillard (2000), Ianchovichina, Nicita and Sologa (2001).

this modeling approach: their study was based on an artificial dataset. Cockburn (2001) provided one of the first applications of this kind of model - for Nepal. Cororaton (2003) applied this approach in a model for the Philippines. Bussolo and Round (2005) also applied this in a model for Ghana, and they showed that, in comparison with a parametric (RH) approach, the poverty results were similar. Both the directions and the magnitudes of effect of impacts on poverty of different household groups due to exogenous shocks were broadly similar. [64]

A second extension is what Savard (2005) refers to as the top-down/bottom-up (TD/BU) bi-directional approach. In this case the CGE model is linked to a microsimulation household model. It captures a feedback effect coming from the HH microsimulation model. The most significant finding in Savard's comparison of the "representative household" approach and TD/BU in a model for the Philippines is the quite markedly different poverty outcomes. The changes in the poverty headcount ratios turn out to be quite dissimilar. This contrasts with the very similar results that emerge from the RH and TD/BU approaches in terms of macroeconomic and sectoral levels. The modeling approach is therefore quite crucial for poverty and inequality analysis.

A third extension in this field relates to the sequential micro-simulation models. Bussolo and Lay (2005), in the case of Columbia, used a method that combined a micro-simulation model and a standard CGE model in a sequential fashion. It was found that trade liberalization could substantially contribute to improve the poverty situation. Abstracting from simultaneous additional shocks and labor supply growth, the beginning of the 1990s tariff abatement seemed to have accounted for a very large share of the total reduction in poverty recorded, especially in the rural areas, from 1988 to 1995. Distributional impacts also differed fundamentally between rural and urban areas,

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[64] Tongeren (1994, 1997), Decaluwé, Dumont and Savard (1999), Cogneau and Robillard (2000), Cockburn (2001), Savard (2003).

and aggregate net results, such as the change in the poverty ratio (headcount), could conceal important flows in and out of poverty.

b) Behavior

Households receive income from their factor endowments, from dividends and from foreign and public transfers, and pay income taxes at a fixed average rate. Household savings and consumption behavior is discussed further on.

c) Results

In static models, household endowments are a fixed share of the total fixed factor supply. Therefore, it is generally quite straightforward to deduce the change in household income from the variation in the remuneration of each factors supplied.

Consumption

a) Disaggregation

Consumption behavior also strongly influences the poverty impacts of trade liberalization. To the extent that household categories have different consumption patterns, trade liberalization-induced variations in relative consumer prices will affect household purchasing power differently. Generally speaking, consumption goods have a one-to-one correspondence with the branches of activity discussed in the previous section. Note that when some goods are non-tradable, some consumption goods are a composite of domestic and foreign production while others are purely domestic. Thus the disaggregation of branches should also aim to capture differences in consumption patterns between household categories.

Some models also allow for the possibility that a given sector produces several different consumption goods, generally through a CET formulation[65]. Others differentiate similar products emanating

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[65]Decaluwe, Dissou and Robichaud (2000).

from different production sectors[66]. They then assume imperfect substitutability between the same commodities coming from the different sectors.

b) Behavior

Household total consumption/savings behavior is generally modeled as a simple fixed-average savings propensity. It is worth noting that a small variation in the saving propensity might be necessary to maintain the investment-savings balance as mentioned in section 2.3 a) although this generally does not affect the qualitative results. Household consumption of specific goods is portrayed, in most cases, by Stone's Linear Expenditure System (LES) consumption functions, characterized by minimum consumption levels. The traditional alternative is a Cobb-Douglas formulation, which imposes constant consumption budget shares in the face of price variations (i.e. unitary income and price elasticities). In some rare cases[67], authors use a Houthakker's direct addi-log utility function (which implicitly includes savings). Finally, models using Extended Linear Expenditure System explicitly allow leisure to be included in the household utility function. In chapter 3, we discuss these functional forms and their estimation/calibration in more details.

Despite its importance, particularly for the poor in developing countries, only a few models consider own consumption behavior. This specification is necessary if one wants to take into account the heterogeneity of the producers and the interactions likely to exist between production and consumption decisions where markets are imperfect. In these cases, home-consumed goods are valued at producer prices while marketed goods are valued at purchaser prices.

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[66] For example, to capture the dualistic aspect of agriculture in Zimbabwe, Bautista & Thomas (2000) differentiate between 9 agricultural commodities produced by large-scale commercial and smallholders' farms.

[67] Taylor et al. (1980) and Adelman and Robinson (1988). The former justify this choice by its easily interpreted elasticities.

The amount of own consumption is generally assumed not to change from the benchmark[68].

c) Results

Only a few models take serious account of consumption effects. Chan, Ghosh and Whalley (1992) emphasize differences in consumption patterns of households across taxed and non-taxable commodities as an explanation for their results. Using their Vietnamese model, they note a negative impact from trade liberalization on those households (generally low-income) who spend a significant fraction of their income on previously non-taxed (domestic) goods and positive impact on those households (generally richer) who spend a larger fraction of their income on previously high-taxed (imported) goods. As a consequence, they find that the two poorest groups lose and the richest groups gain. Cockburn (2001) suggests that sectoral consumer prices reflect changes in import prices, changes in local sales by domestic producers, and the share of import in local consumption. They also reflect changes in consumption tax. The fall in import price is generally greatest where initial tariffs and import intensities are highest.

Other authors mention that higher (lower) food prices have adverse (favorable) effects on the poor[69], that capitalists who consume a large amount of imported goods are sometimes advantaged[70], that if the agriculture consumption price decreases sufficiently then every household real income increases[71] and that real incomes of urban households increase partly because of the fall in industrial consumer price[72].

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[68] Arndt and Tarp (2000), Bautista and Thomas (2000), Bautista, Löfgren and Thomas (1998), Wobst (2000), Löfgren (2001), Tarp and Tarp (2004). Exceptionally, Cogneau and Robillard (2000) explicitly model agricultural households as producers.

[69] Storm, Ianchovichina, Nicita and Sologa (2001) and Yang and Huang (1997),

[70] Mc Mahon, Ianchovichina, Nicita and Sologa (2001)

[71] Yang and Huang (1997).

[72] Yang and Huang (1997).

Nevertheless, in most cases, as mentioned by Harrison, Rutherford and Tarr (2000) - who decompose the impact on overall household welfare - it is the source of income and not the pattern of expenditure that is driving the adverse impact on average households. This is the case even if, as an exception, higher vehicle prices affect rich households much more than poor, so that exempting motor vehicles from tariff elimination removes the adverse effect on poor households of the high increase in VAT necessary to compensate for the lost tariff on cars. Cockburn (2001) also reaches a similar conclusion when he finds that there is a strong consumption payoff from trade liberalization but that it is approximately the same for all households.

Welfare, poverty and distributional effects

One might think of three types of indicators needed to analyze trade liberalization properly. First, it would probably be appropriate to include an indicator of variation in the welfare of households and overall welfare in the economy, even if this result would certainly not be enough to irrevocably judge the specific policy. Then, one could wish to look at an inequality or distributional indicator. Finally, one could also be interested in a poverty indicator. Consider each of these in turn.

a) Welfare

Indices

Most models use equivalent variations (EV), which have the advantage of a constant comparison point, unlike compensating variations (CV), which are also sometimes used. Formally, to aggregate CVs or EVs across households there is an implicit assumption that utility is comparable between households and that utility functions are money metric. This very strong assumption underlies all such computations of welfare aggregates and, implicitly, inequality and poverty. The other half of the models employs indicators such as variation in real income, real consumption, and/or real savings.

Results

As it involves removing a distortion, trade liberalization should, in theory, generally have a positive effect on the overall welfare of an economy. This results from gains in production and consumption efficiency. Most empirical studies reviewed in this section reach this conclusion. Other studies find no aggregate welfare effect or do not focus on this aspect[73]. But one caveat in assessing results is to examine carefully the *ceteris paribus* assumptions, and in particular the setup in terms of closure rules[74] and market structure. For example, it is not difficult to generate significant welfare gains when the fixed foreign savings constraint is relaxed. Analogously, inclusion of imperfect competition and increasing returns to scale creates additional sources of distortion. It is generally found that gains from trade liberalization are significantly higher in models with imperfection compared to the models which assume perfect competition. Factors such as reduction of profit margins and output expansion due to realization of economies of scale are the major sources of extra gains from trade liberalization[75].

The distribution of welfare gains across household groups depends essentially on the structures of factorial income distribution (i.e. linking value added of activities to the factor returns) and personal income distribution (i.e. associating changes in factor returns to incomes of the household groups). Trade liberalization usually promotes unprotected agricultural activities and less restricted unskilled labor intensive light manufacturing activities by reallocating resources from the protected activities. Household groups who generate a relatively larger share of their incomes from agriculture and labor intensive manufacturing activities tend to benefit more when the economy is liberalized.

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[73] For instance, Cockburn (2001) found no aggregate welfare effects in Nepal. Gains for urban households were dissipated by losses of the rural households.

[74] The importance of this point is discussed in details in Bussolo and Round (2002).

[75] For an excellent survey see Richardson (1988).

It is generally observed that poor households reside in rural areas, drawing a major part of their income from labor and capital factors employed in agriculture. Under these conditions, the distribution of welfare gains accrue more to rural and poor households than the rich or urban household groups when agricultural activities expand following trade liberalization. This is a clear and unambiguous result. However the distribution of welfare gains across household groups or between rich and poor households is less clear when incomes and/ or prices move in different directions after a liberalization shock.

b) Inequality

Indices

Regarding income distribution, the Gini coefficient is adopted in most models because of its widespread use and, as a consequence, its comparability. The Theil index is also often used as an indicator of inequality because of its decomposition properties, which makes it possible to consider the respective contributions of within- and between-group inequality to total inequality[76] The Atkinson indicator has also been used[77].

Results

In country studies reviewed, poor households are usually concentrated in rural areas. Therefore, when urban households are better off than rural households following trade liberalization, overall (or rural-urban) inequality generally increases. Most of the time, within

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[76] As stated in Cogneau and Robillard (2000)

[77] As an exception, because Narayan, Parikh and Srinivasan (1987) consider that following a shock, "the number of persons within a class with fixed limits of real expenditures changes but also the average real expenditure of persons in each class (and the average for all classes) shifts somewhat," they decided to use the Willig and Bailey(1981) approach to take both shifts into account in comparing distributions. So, they analyze inequality within a general social welfare function that covers the complete range of social welfare functions from Rawlsian to Hicksian compensation criterion.

rural areas, the poorest households are smallholders and landless laborers while in urban areas they are found in informal or unskilled households categories. Therefore when these groups gain in relative terms, we generally observe a decrease in rural or urban inequality according to whichever index is used.

The resulting impacts of trade liberalization on overall equity are quite divided. Using a density function, the Atkinson, Gini coefficient or comparison between groups (EV), half of the studies report overall inequality increases[78] because poor households lose compared to the rich, and the other half reports overall inequality decreases because the inverse occurs[79].

Based on a socio-economic disaggregation of households, some authors[80] explain an increase in inequality by the more important gain accruing to urban households compared to rural households. Others[81] explain it by the fact that wealthy rural and urban households win over poor rural and urban households. For his part, using quintiles disaggregation, Chan (1992) finds the two lowest quintiles lose while the richer quintile gain and that even if poor categories benefit more than the rich, inequality indices show little worsening.

De Melo and Robinson (1980), Yang and Huang (1997) and Cogneau and Tapinos (1995) explain the decrease in inequality by the rise in income share going to rural households compared to that going to urban households. Other researchers base their explanation on the increase in incomes of poor households in general (rural and urban) compared to rich rural and urban households. This is the case in Wang and Zhai (1998) where impacts on households primarily depend on the importance of production worker wages as a source of income. Decaluwe, Martens, Patry and Savard (2001) find that

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[78] Cockburn (2001), Yang and Huang (1997), Chan (1992, Bautista and Thomas (2000), Harrison, Rutherford and Tarr (2000), Ianchovichina, Nicita and Sologa (2001).

[79] DeMelo and Robinson (1980), Yang and Huang (1997), Wang and Zhai (1998), Decaluwé et al. (1999), Devarajan and Van der Mensbrugghe (2000).

[80] Cockburn (2001), Yang and Huang (1997).

[81] Bautista and Thomas (2000), Harrison, Rutherford and Tarr (2000).

incomes decrease least for landless households and most for urban skilled households. Finally, Devarajan and Van der Mensbrugghe's (2000) original analysis of ethnic inequality in South Africa demonstrated that trade reform will most likely improve the average welfare of black households and reduce that of white households.

Another interesting issue is within-group inequality. It can vary quite significantly from overall inequality as well as provide an explanation for it. For example, in Devarajan and Van der Mensbrugghe (2000) analysis of ethnic inequality in South Africa, the two measures go in totally different directions. On one hand, they report a decrease in overall inequality because black households (among which poverty is more severe) benefit more than white households given their relative gain in labor incomes from expanding sectors. On the other hand, the black group's inequality increases because poor black households receive most of their income from transfer payments so that their ability to reap employment benefits is limited while the white group's inequality decreases since poor whites are less affected by direct tax increases necessary to compensate for reduced tariff revenues.

Conventionally, however, authors are primarily concerned with rural and urban within-group inequality. Yang and Huang (1997) note that, in rural areas, agriculture wages, on which poor households rely more heavily, increase more than returns to agricultural capital so that poorer households gain more than wealthier households and rural inequality decreases. In urban households, wealthier households gain more than poorer households principally because of the consumption effect. Wealthier households consume more manufactured and imported goods, whose prices decrease relatively, and less agricultural goods, whose prices increase relatively, thus raising urban inequality. In summary, rural inequality is mentioned as increasing in Cockburn (2001), Bautista and Thomas (2000), Yang and Huang (1997), Sinclair, Blake and Sugiyarto (2000), Harrison, Rutherford, and Tarr (2000) and as decreasing in Wang and Zhai (1998), Yang and Huang (1997), Yang and Huang (1997) while urban inequality increased in Cockburn

(2001), Bautista and Thomas (2000), Harrison, Rutherford, and Tarr (2000), Yang and Huang (1997), Storm (1999) and decreased in Wang and Zhai (1998), Yang and Huang (1997) and is unaffected in Yang and Huang (1997).

c) Poverty

Indices

In this category, we present the Foster-Greer-Thorbecke (FGT) class of poverty indices[82]. These are additively decomposable poverty indices which allows for an in-depth analysis of poverty. The FGT decomposes into three principal indices - the head count index, poverty gap and severity of poverty - all of which depend on the definition of the poverty line. The most frequently used of these indices[83] is the head count index or poverty rate. It corresponds to the share of the population living below the poverty line; its disadvantage is that it does not inform about the degree of poverty of this share of the population. The poverty gap measures the average distance of household from the poverty line and therefore communicates a sense of poverty depth. The third indicator, the squared poverty gap (or poverty severity index), measures the severity of poverty by being sensitive to inequality between the poor[84].

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[82] Used in itself by Adelman and Robinson (1988), Cogneau and Robillard (2000), Hertel, Preckel and Cranfield (2000), Ianchovichina, Nicita and Sologa (2001), Decaluwe et al. (2000)

[83] Adelman et al. (1979), Adelman and Robinson (1988), Cogneau and Tapinos (1995), Cogneau and Robillard (2000), De Melo and Robinson (1980), Devarajan and Van der Mensbrugghe (2000), Harrison, Rutherford and Tarr (2000), Hertel, Preckel and Cranfield (2000), Logfren (2001a),

[84] It is worth mentioning that Montaud's (2000) original analysis of poverty is based on a theoretical concept of vulnerability. He defines vulnerability as the ability to adjust of different groups in facing risks of poverty. This capacity depends on each household's possession of three different types of capital: human capital (skilled or unskilled labor), physical capital (agricultural or non-agricultural) and social capital. The latter should be regarded as a household's social network but is concretely included in the CGE as public and private (between households) transfers.

Implementation of the FGT measure requires a specification of distribution of income (or expenditure) within each household group. Two approaches are used in this context. The first approach is to estimate distribution of each household group directly from the household survey data. The second approach suggests that the distribution can be approximated by a function and then deriving the parameters characterizing the functional form using household survey data (Bussolo and Round, 2002). Applications of different approaches used to model income distribution and poverty in CGE models were explored further by Boccanfuso, Decaluwe and Savard (2003 and 2007). The feasibility of using eight functional forms, seven parametric and one non-parametric, has been discussed by them. The result suggests no single form is appropriate in all cases since features of samples and subgroups play a critical role. The choice of functional form should be guided by the best fit distribution.

Furthermore, the analysis is sometimes more qualitative in the sense that authors only mention if the poorer group(s) have gained or lost out from the shock. But in reviewing results of trade liberalization on poverty using CGEs, there are a few discernible general outcomes. Results depend crucially on the model structure and closures, replacement taxes, and any other contingent policies, such as price stabilization schemes (Storm, 1999).

Overall poverty declines in Decaluwe, Martens, Patry and Savard (2001), in Ianchovichina, Nicita and Sologa (2001), De Melo and Robinson (1980), Cogneau and Tapinos (1995), Chia, Whaba and Whalley (1992), while rural and urban poverty increases in Storm (1999). Storm explains his results by the fact that urban capitalists and urban workers gain from an increase in returns to non-agricultural factors and do not lose much from higher food prices since food is a small share of their consumption. Large farmers gain from an increase in agricultural exports incomes, whereas urban marginal are unaffected and landless laborers and small farmers lose since they are net buyers of food and their incomes are almost unaffected.

The role of remittances in the context of Pakistan has been assessed by Rizwana and Kemal (2002). Trade liberalization accompanied by declining remittances increases urban poverty but reduces rural poverty reflecting the greater role of remittances for the urban household groups compared to their rural counterpart.

Cockburn's results are obtained using a CGE-microsimulation model where poverty decreases in urban areas (since the urban poor gain more than the urban non-poor) and increases in rural areas, particularly among moderately poor as opposed to the very poor. More precisely, ‘’’*Terai* ‘’ poor gain and non-poor lose while ‘’Hills/ mountains’’ poor are unaffected by reforms and non-poor lose.

Poverty effects of income transfer programs are examined for Ghana by Bussolo and Round (2002). Using a log normal distribution function under short and long run closures, they look at four alternative financing schemes; corporate tax, direct tax, indirect tax, and tariffs. The results underscore the significance of both closure rules and the compensating schemes for poverty results. Under the long run scenario, effects on poverty are highest when the transfer program is financed by corporate tax. This is followed by tariff, indirect tax, and direct tax. The long run allows demand-led output expansion by using the slack capacity. The GDP expansion dominates other impacts of tariffs and indirect tax increases. In the short run, however, due to factor immobility, when tariffs and indirect taxes were raised to fund the transfer program, inefficiency effects dominated and output contracted.

Extensions

Changes in world import/export prices

A few authors were interested in evaluating the impact of a variation in world prices of imports or exports in general (Hertel and Winters, 2006; Dorosh, 1994; Cogneau and Robillard, 2000; Bourguignon, De Melo and Suwa, 1991) or of some specific products such as rice or mining products (Razzaque, Raihan and Ahmed, 2006, Storm, 1999, Dorosh, 1994; Decaluwé, Martin, Leduc and Bousselmi, 1994). When the price of an exported product increases, there is a rise in exports of this product and a decrease in its availability that leads to an increase in its domestic price. Winners are the households that can reap the benefits from the increased output and the increased producer prices and those whose real incomes are less hurt by the rise in consumer price of the product.

With a 20 percent increase in the world price of rice, Storm (1999) found that rural landless and all urban income groups lose real income while incomes of every other rural group increase. For an increase in mining export prices, Dorosh (1994) finds that the big winners are the urban rich since they reap most of the benefits of higher dividends earned in the sector. In the opposite direction, Chisari and Romero (1995) found that a 5 percent fall in export prices results in an increase in real income and a worsening of income distribution following a counter-intuitive rise in the value-added index. In their case this can be explained by the decrease in domestic interest rates that promotes agricultural and mining exports.

Most of the aforementioned studies assume *ad hoc* changes in the world prices of imports and exports and introduce them as shocks in the respective country CGE models. In contrast, in an edited volume by Hertel and Winters (2006), 12 country studies used the GTAP global model to generate the changes in world prices of exports and imports due to different multilateral trade liberalization scenarios (especially the Doha scenarios), and plugged those as external shocks in the respective country models. A similar approach was adopted by Raihan and Razzaque (2007) in examining the implications of global trade liberalization for the macroeconomy and poverty in Bangladesh. They found that, being a net importer of agricultural products, Bangladesh would suffer from welfare losses and its poverty situation would deteriorate.

Other external trade shocks such as changes in marketing margins, foreign borrowing level, export levels allowed, etc.

In this category, we can think principally of reduced marketing margins or transaction costs (Löfgren (2001), Adelman et al. (1979), Arndt and Tarp (2000), Tarp and Tarp (2001)) and of overall or specific productivity growth (Adelman et al., Arndt et al. (2000) Wobst (2001-02), Tarp and Tarp (2001)).

A reduction in marketing costs narrows the spread between producer and purchaser prices, raising the former and lowering the latter: Both producers and consumers normally gain, and overall welfare increases. In experiments by Arndt et al. (2000), Arndt and Tarp (2000) and Lofgren (2001), there is an increase in overall welfare and the gains are spread evenly across the economy. Exports increase (an increase in prices received by domestic export suppliers) slightly more than imports (a decline in prices paid by domestic users) and there is a slight appreciation of the real exchange rate to restore equilibrium. All factors gain, especially agriculture labor since agricultural sectors had the highest trade margins before the shock. However, the agriculture labor gain is somewhat counterbalanced by the relatively higher cost of living for rural households with significant increase in the value of home consumption resulting from the increased producer prices. In Tarp and Tarp (2001), gains are less evenly spread. They find that the shock benefits urban households with agricultural occupations gaining the most because of the increase in relative agricultural wages and of the relative decline in market prices. Also, rural agricultural households gain more than urban non-agricultural households since an improvement in marketing margins favors agriculture (where margins are higher). The difference in the results between studies might simply be explained by the difference in household categories since Arndt et al. (2000) and Arndt and Tarp (2000) only consider two groups of households (rural and urban) and Löfgren (2001) six (rural-urban and by income level) while Tarp and Tarp (2001) considered twelve groups emphasizing agricultural and non-agricultural sources of income and location, in addition to a rural-urban categorization.

Productivity growth has a positive production impact on the sector experiencing this growth and so lowers the product price, but has a negative impact on this sector's factor remuneration. For example, Tarp and Tarp (2001) considered a uniform 30 percent increase in agricultural productivity and finds that there is an increase in welfare. Regarding the distribution effects, a decline in the agricultural terms of trade (compared to industry) leads to a decline in the agricultural wage. In the opposite case, non-agricultural wages and returns to capital experience a strong improvement resulting from lower agricultural prices and household supply of agricultural goods that lead to a switch in demand toward non-agricultural goods and services. Moreover, some benefits from this shock work through lower prices of home and marketed consumption of agricultural goods. So, rural non-agricultural households benefit the most since they receive most of their income from non-agricultural wages and capital returns and they have relatively high agricultural consumption shares. Arndt et al. (2000) conducted a similar analysis and also found that the relative and absolute position of farmers deteriorated. Moreover, overall distribution deteriorates in their case because the unfavorable rural effects dominate.

In another paper, Wobst (2000) compares the impacts of productivity growth in agriculture. He concludes that average household gains are positive, but that farmers gain much less and rural farmers actually lose.

The two shocks combined (reduced marketing cost and increased agricultural productivity) simulated by Arndt et al. (2000) and Tarp and Tarp (2001) lead to even bigger increases in overall welfare. Moreover, lowering marketing costs somewhat improves the worsening in the agricultural terms of trade caused by the increase in supply, which is in turn due to the increase in agricultural productivity. Both rural and urban households gain significantly as the returns to all factors (agricultural, non-agricultural wages and capital rent) increase.

Bhasin and Obeng (2006) examined the impact of trade liberalization - in which lost tariff revenue was compensated by increased foreign borrowing - on the poverty and income distributions of various categories of households. The study showed that tariff elimination accompanied by an increase in foreign borrowing would reduce the incidence, depth, and severity of poverty, whereas the elimination of export duties accompanied by an increase in foreign borrowing would increase the incidence, depth and severity of poverty.

Models incorporating non-market activities and gender

In recent years, a few CGE models have been extended to incorporate leisure and home produced goods in analyzing household labor supply decisions. Generally, these models assume that home-produced goods are close substitutes to market goods. Fontana and Wood (2000), Fontana (2001 and 2002) and Fofana, Cockburn and Decaluwe (2003) built CGE models to analyze the effects of macroeconomic policies on female work in the market and at home.[85] They explicitly assume that leisure and home-produced goods are produced by sectors that behave in much the same way as market sectors. In general, they find that trade liberalization increases female work and income, and could have perverse consequences on female leisure and household dependents. Raihan et al (2006) develop a dynamic gender model and used data from a time-use survey to estimate household time spent on market work, home production, leisure and 'extra-leisure'. Under a trade liberalization scenario, it appeared that the short-run impacts on household decisions to allocate time between market and non-market activities were different from long-run impacts.

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[85] See also Cockburn, Fofana, Decaluwe, Chitiga and Mabugu (2007), and Fofana, Cockburn, and Decaluwe (2006)

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Table 3: Results

Studies	Simulations	International trade and sectoral reallocation	Factor of production	Incomes and consumption	Welfare, poverty and inequality
Bautista et al. Zimbabwe 1998	I) Removal of quotas, reduction of tariffs to a uniform 10% & dismantling of foreign exchange controls	As a consequence of the marked real exchange rate depreciation, exports expand significantly. Production in large-scale commercial (LSC) farming (heavy export orientation) and non-agricultural exporting sectors	N/A	Largest proportional benefits accrue to the two farm households linked large-scale commercial farming. Urban households also show large income gains due to the induced growth in exports of and in domestic expenditure for non-agricultural products. Smallholders benefit the least.	Aggregate real disposable income of households increase significantly (4%). Equity impact is unfavorable since smallholder households account for about 4/5 of the poor.
	II) Idem I + compensatory incomes taxes on firms, LSC owner & high income urban households	Exports and imports both expand more increases.	N/A	With compensatory taxes (+3%), households income effects remain positive, except for high-income urban households (whose tax payment increases). Largest gains accrue to LSC farm-worker, low income urban and smallholders and smallest to LSC farm-owners. High-income urban households lose.	Aggregate real disposable income of households increase less compared to I (0.66%) following the imposition of compensatory income taxes.Better equity impact since smallholders gain.
Bautista & Thomas Zimbabwe 2000	I) Removal of quotas, reduction of tariffs to a uniform 10% & dismantling of foreign exchange controls	Significant increase in agricutural production (9,5%) implying an anti-agri bias of existing trade restictions. LSC farm production increases more (11%) than smallholder production (6%), owing to its greater export orientation.	N/A	Larger income gains accrue to LSC farm households than to smallholders. High-income urban households benefits more that their low-income counterparts.	Aggregate real disposable income of households increases (3,7%)Negative equity impact since the lowest gains accrue to smallholders (representing 4/5 of the poor) and urban low-income.
	II) Idem I + removal of maize price penalty to maize producers and price subsidy to grain millers.	Further increase GDP, and especially agricultural GDP (10,7%)	N/A	Incomes of smallholders, LSC farm-workers and low-income urban households rise while that of the more affluent LSC farm owners and high-income urban households are not affected significantly.	Aggregate real disposable income of households increases further (3,8%)Equity impact is positive.
	III) Idem II + compensatory income taxes on firms & two richest households	Increase in GDP is similar to II since incomes are mainly redistributed.	N/A	The two household groups (rich) whose income tax rates are raised lose while income of poorer household are not affected significantly (vs II).	Aggregate household income gains are lower due to the compensatory income tax.Even better equity impact.

Table 3 (continued)

Studies	Simulations	International trade and sectoral reallocation	Factor of production	Incomes and consumption	Welfare, poverty and inequality
Chan & al. Vietnam 1999	Replacing tariffs & sales tax by an equal yield indirect tax while keeping agriculture outside the replacement base.	Imports of export oriented industries (highest initial tariff (29,8%)) and of agriculture (high initial tariff (17%)) increase. Relative price of both branches falls. Exports of agricultural products fall since increase in domestic production is not large enough to meet increased local demand. Exports of export oriented industries also fall marginally. Exports of goods produced by import oriented industries increase while imports fall following the rise in domestic prices of these goods.	N/A	Because agriculture is outside replacement VAT base, relative price of agricutural goods falls resulting in a strong comsumption substitution in favor of these products.Large negative effects against the lowest two quintiles and large positive effects for the richer groups caused by differences in household expenditures patterns across taxed and nontaxable commodities.	Overall positive welfare gain.Sharp redistribution against those with lower income and spending a significant fraction of their income on previously non-taxed products and in favor of those spending larger fractions of their income on previously highly taxed products; especially the richer households.
Cockburn Nepal 2001	Removal of all tariffs with compensatory uniform consumption tax (no distortion in relative consumption prices)	Clear sectoral reallocation of resources from mining and manufacturing sector, where initial tariff and import shares were relatively high, in favor of the hotel/restaurant, trade, and transport/ communication (high export shares) with the other sectors remaining unaffected. Consumer prices fall most in initially protected agricultural sector and the initially moderately protected but import-intensive manufacturing sectors, although differences are small.	As agricultural output prices decline the most (4%), agricultural capital and land (exclusively agricultural factors) are the biggest losers particularly in urban region where agricultural production declines the most. For similar reasons, remuneration of unskilled labor (primarily employed in agriculture) decreases. Decline is smaller for urban unskilled labor not linked so tightly to agriculture but also employed in construction, banking/real estate, transport/ communication and manufacturing. Wage rate of skilled labor, employed primarily in government services, decreases (2,3%) as output price of this sector decreases (2,5%). Non-agricultural capital is the biggest relative winner.	Terai and hill/mountain households, deriving most of their income from unskilled labor and land which undergoes largest remuneration declines, have a more substantial loss in nominal income than urban households, receiving 1/3 of their income from non-agricultural capital.While urban households consume a smaller share of agricultural goods than *Terai* or Hill/mountain households (65% vs 79%), they consume more manufacturing goods (19% vs 13-15%). Consequently, there is practically no differential impacts on the consumer price indices of the three households.	No aggregate welfare effects. Urban households are big winners having greater endowment of non-agricultural capital and lesser dependency on income from land and unskilled labor while *Terai* and hills/mountains lose. Poverty falls in urban areas and increases in rural areas, particularly among the moderately poor (the very poorest being relatively unaffected). Overall income inequality increases since absolute impact whether it is positive (in urban areas) or negative (in rural areas) increases with the level of income.

Table 3 (continued)

Studies	Simulations	International trade and sectoral reallocation	Factor of production	Incomes and consumption	Welfare, poverty and inequality
Cogneau & Tapinos Morocco 1995	I) Progressive (5 years) removal of all tariffs & immediate elimination of quotas and tariffs applied by ROW (equivalent to 8% increase in world price of agriculture) with no fiscal compensation or devaluation	Exports (5,3%) and imports (11,7%) increase.	N/A	N/A	Increased inequalities (Theil:+5,1%) Reduction in poverty (1,7%).No significant reduction in unemployment.
	II) Idem I with fiscal compensation & devaluation (5% in 5 years)	Overall decrease in GDP because of capital immobility and monetary effects (devaluation). Reallocation of resources from industry (facing the more important import competition) towards agriculture (liberalization promoting its exports). Exports (9,5%) and imports (7,9%) increase.	Imperfection on factor markets and on financial markets limits beneficial effect of resources reallocation. Agricultural revenue and employment increases.	Even though increased indirect taxes affect their buying power, real incomes of poorest households, deriving most income from agriculture, increase.	Inequalities decrease (Theil:-8%). No significant poverty reduction (-0,2)
	III) Idem I with fiscal compensation & 8% increase in world price of labor intensive industrial products - part of Morocco's exportations	General growth gain (2,1%). Exports (8,7%) and imports (13,8%) increase. Exchange rate depreciates less (+1,8% instead of +3,6%) Agricultural export increase less (26% instead of 43%) and textiles export increase of 12% instead of decreasing by 3%.	Factor reallocation is less in favor of agriculture and unemployment in urban area does not increase.	Fiscal compensation (indirect taxes) rises by 75%.	Inequalities decrease less (4,2%). Reduction in poverty (2,2%).
Decaluwé, Patry, Savard 1999 (and 1998)	50% tariffs reduction on all imports	Reduced domestic price of imports competing with traditional agriculture (-5,06%) and industry (-10,01%) induces decline in demand for those domestic production and forces branches to increase exports (respectively 2% & 2,5%). Since exports do not completely absorb falling domestic demand, they respectively reduce production by 1% and 0,2%. Resource released from these branches allows higher production of all other sectors, except	Fall in almost all the primary factor prices (skilled labor being employed mostly in public services and mining, unskilled in agricultural and services sector, and land in agricultural sectors only. Decline is especially important for (specific) capital return in traditional agriculture and mining. As an exception, (specific) capital return in export agriculture and in services increases.	Decrease in factor price affects all households income negatively. Large landowners has the largest decrease (1,7% because of capital return in export oriented agriculture) and rural households has the smallest income decrease (1,21%) since their income is mostly dependent on unskilled labor. Urban low income, mostly dependent on unskilled labor and urban high income and capitalist households whose income is principally based on capital payments are somewhere in between. Fall in	All headcount ratios improve meaning that the shift in poverty line (following consumption prices decline) is greater than incomes decline. Relative decrease in poverty is highest for large landowners (5,4%) and smallest for rural households (1,0%). All income gap decreases with the smallest improvement for rural (2,0%) and urban hjgh-income (1,1%) and highest for urban low-income households (7.8%).Poverty severity is reduced for all except urban high (+1,0%)

Table 3 (continued)

Studies	Simulations	International trade and sectoral reallocation	Factor of production	Incomes and consumption	Welfare, poverty and inequality
		mining (-1,37%) facing smaller intermediate demand coming from industrial production and smaller investment demand.		consumption price of all goods reduces the poverty line.	households with the largest reduction for urban low-income (-9,8%).
De Melo & Robinson Columbia 1980	50% tariff imposition on manufacturing sector	Price of imports in the manufacturing sectors rises (24%). Net prices in the manufacturing sectors decrease because intermediate goods costs rise. Higher prices for domestic manufacturing products also leads to decline in relative net and gross agricultural price.	Changes in net prices lead to a decline in manufacturing factor remuneration and agricultural factor remuneration.	Although agricultural wages fall, there is a slight increase in rural workers' net real income because new tariff collections result in a proportional income transfer to all households (increasing their income). Moreover, lower agricultural price increases relative real income of groups, such as rural labor, that consume relatively more agricultural goods.	Slight decline in the share of agricultural groups in poverty.Rural poverty decrease (0,8%). Urban poverty increase (1,1%). Total poverty decrease (1,7%). Inequality decreases slightly (Gini: 0,2%)
Devarajan & Van der Mensbrugghe South Africa 2000	I) Removal of all trade barriers (fixed fiscal deficit & capital immobility)	Gain in real GDP (0,7%) due mainly to higher employment of unskilled black workers. Consumer price deflator declines by 6,8% (relative to unchanged world price). Imports (11%) and exports (9,5%) rise. Important prices decline in sectors with highest initial trade barrier such as consumer goods (31%), capital goods (34% bec of transportation equipment), agriculture (12%) and intermediate goods (13%). Increase in competitiveness of export-oriented mining industries and basic metals leads to largest increase in output. Transportation and construction industries grow because real investment rises following the sharp drop in the price of investment goods (recall the high tariff on transport equipment).	Total employment increase (1%) especially employment of unskilled black workers. Blacks' labor remuneration increases principally because of their association with mining (19%) and construction (6%).	Black households gain income (through increased employment) as they derive a significant part of their income from export-oriented mining, basic metals, transportation and construction industries (registering large increase in output). Poorest blacks gain less since important shares of their incomes are transfer payments (assumed fixed) and their ability to reap the employment-related benefits is thus limited. Richer whites lose income since they pay higher direct taxes needed to replace lost tariff revenues while this almost does not affect poor whites. CPI of the higher income households fall more than CPI of lower income households within the same ethnic group and CPI for black households declines more (food prices declines more) than CPI for white.	Black households better off than white households. Among blacks, higher income households are better off. Poorest gain minimum and the first other two quintiles stand to lose. Among whites, there's no uniform pattern: Poorest have the most to gain and the 9th deciles loses most.Overall income distribution improves modestly (Gini: 0,62 to 0,59) but worsens within some groups (notably among the poorest).

Table 3 (continued)

Studies	Simulations	International trade and sectoral reallocation	Factor of production	Incomes and consumption	Welfare, poverty and inequality
	II) Idem I (fixed fiscal deficit & perfect capital mobility)	Assumption amplifies the quantity changes and dampens the price changes relative to the base experiment. For instance, gold output rises 51,2% substantially increasing the gains to blacks (3,4% instead of 2,5%)	N/A	N/A	Basic result remained unchanged: On average black households benefit and white households lose (or do not benefit as much)
	III) Idem I (fixed real investment & capital immobility)	Leads to slight increases or less of a decline in the consumer-goods sectors, owing to greater demand from wealthier whites.	N/A	N/A	Milder decline in whites' welfare (direct tax do not have to rise as much). Positive impact on consumer-goods sectors overcomes losses for black households from the fact that real investment is unchanged - so that welfare of black households improves by a slightly higher amount.
Dorosh Madagascar 1994	Removal of quotas (implicit tariff) on manufacture; tariff reduction to uniform 19,3% (fixed foreign savings)	Real GDP increase (3-7%). Imports of manufactured goods rise by (15,4% in year 1) and domestic production of manufactured goods fall by 2,5%. The real exchange rate depreciates (12% in year 1 and 18% in year 6). Exports (7%), especially export crops and import (5,9%) increase. Revenues from tariffs and export taxes increase, so government revenues rise (9,3%) in real term adding to total savings and enabling additional investment (19% in year 1) heavily concentrated in urban areas (largely construction services and to a lesser extent domestic industrial goods) so that industrial output (including construction) grows.	Demand by the industrial sectors for highly and moderately skilled labor increases so that real wage increases. Return to formal sector capital also increases. When aggregate demand increases, because of high unemployment of unskilled labor and high supply elasticity of many non-traded goods and services, unskilled employment increases.	Apart from those households that suffer a loss of rents, all households enjoy significant gains in real incomes. Urban households with skilled labor gain most from the surge in investment spending. Non-rent incomes, especially dividends, of urban high income households rise (24%) but are compensated by the elimination of quota rents and their real income decline (12%). Incomes of urban middle-income households rise (4,5%). Rural per capita incomes rise (2,6%-4,3%) and small farmers on the East Coast who produces export crops gain the most (4,3-8,2%).	Total income increases (1 to 3,8%). Improved income distribution (gain in equity). Big winners are urban middle income, small farmer East Coast, large farm rural high-income and losers are urban high-incomes. Redistribution of income away from those capturing quota rents and boosting incentives to produce tradable goods, an important income source in rural areas where 90% of the poor are.
	Idem I (with a 20% reduction in foreign savings)	Depreciation of exchange rate is higher than in I (15,3% in year 1). Smaller capital inflows reduce the funds available for investment compared with those in I, but because of the increase in government tax revenues, investments still increase by 16,6%.		With less of a boost in earning in the construction sectors, urban incomes increase less dramatically than in I. Real incomes of urban middle-income households increase less (3,8%). With reduced capital inflows, small farmers on the East Coast have smaller gain in	Improved incomes distribution (gain in equity). Similar reasons as in I.

Table 3 (continued)

Studies	Simulations	International trade and sectoral reallocation	Factor of production	Incomes and consumption	Welfare, poverty and inequality
				real income compare to I (4,2-8%) because the greater real exchange rate depreciation raises real prices of export crops.	
Harrison & al. Turkey 2000	Removal of all tariffs & export subsidy (compensatory VAT)	Manufacturing sector is protected relatively heavily and is negatively affected. Tariff which produced the greatest adverse impact on poor households is on motor vehicles since it represents imports purchased primarily by high income households, hence the poor do not bear the cost of this import tariff. Tariff revenue from it are high and when remove, VAT replacement must be high.	The most important factor for poor households is production labor whose relative price declines (2,9%) following adverse effects on manufacturing sector, employing production labor intensively. Furthermore, when tariff are removed on motor vehicles sector, using intensively unskilled labor, increased competition drives down unskilled labor returns.	Using comparison of uniform or not consumption pattern and uniform or not factor shares of different households, conclusion is that for the poor the source of income (and tax) and not consumption is driving the adverse impact relative to average households. Income of poor households declines following decline in production and unskilled labor remuneration declines.	Aggregate welfare increases but the two poorest rural households and the four poorest urban households lose from the reform. It also hurts the richest urban and rural households. It is the middle class, especially in the rural areas, that gain the most.
Ianchovichina & al. Mexico 2001	Removal of all tariffs (for NAFTA members)	Given the relatively small rates of protection, there is only a small effect in terms of price and quantity.Most prices decline, except meat and services. Quantities domestically consumed move accordingly, with larger surges in sectors where prices dropped more (especially food prices).	Factor returns for land and natural resources decrease (3%) while returns to capital and labor (skilled more than unskilled) increase by 1% and 1,5%	Average income increased by about 1%. Rich households, obtaining a large share of income from skilled labor and capital, gain more than poor ones (in %), endowed with more unskilled labor (influencing income positively) and land (affecting income negatively). Overall price index decreases, especially due to food prices. Consuming a larger share of food products, poor households gain more than the rich, for whom discount on food and manufacture products is compensated by higher price of services, making the price of their consumption basket almost unchanged.	Gain in welfare across all households. Combining income and consumption effect, poor benefits less than rich households. Minimal increase in inequality (Gini & Theil) However, similar increases in real income translate into larger increases in welfare for the poor than the rich. Poverty lines are reduced following the decline in prices.Reduction in headcount (0,5%) and in poverty incidence.

Table 3 (continued)

Studies	Simulations	International trade and sectoral reallocation	Factor of production	Incomes and consumption	Welfare, poverty and inequality
Sinclair & al. Indonesia	20% reduction of all tariffs	Increase the amount of foreign trade and availability of products in the domestic economy which stimulates production activities (increase GDP) except outputs of highly protected sectors such as chemical, paper and metals which decrease. Trade balance and government deficit worsen as imports increase more than exports.	Increased employment level	Household income and consumption increase. Urban households and farmers' income increase in absolute and relative levels.	Overall welfare improves (increases in the total domestic absorption and household real consumption). Favorable impacts on income distribution of rural households (reduction in the household income ratio of top to bottom groups) even though their incomes decrease. Urban income distributions slightly worsen. Urban areas benefit most as their relative income is also increased (measured by income share).
Storm India 1999	Progressive (5 years) removal of all tariffs and restrictions (import tariffs, quotas, export bans, licensing requirements…) and input subsidies in agriculture (mainly fertilisers) are gradually abolished.	Agricultural production costs increase following elimination of subsidies. With unchanged output prices, this provide strong disincentive to using fertilisers (and complementary modern inputs) slowing down yield growth. Even with highest initial protection, agricultural output prices increase since export taxes are removed and agricultural export increase significantly. Because crops output price increases, input cost and prices in non-agricultural sectors also increase. Crops price raises farmers' investments. Final import demand for non-agricultural goods increase over time.	N/A	Income increase for every group but to a different extent: Landless laborers (3,3%), Small farmers (3,4%), Medium farmers (4,7%), Large farmers (5,8%), Urban workers (5,6%), Urban marginals (4,6%), Urban capitalists (4,4%). The biggest winners are large and medium farmers because of the increased agricultural exports.Moreover, relative price changes hurt the lower-income groups (more dependent on food) more than the higher-income groups.	Large and regressive distributional changes: real income growth of landless laborers and small farmers, who are net buyers of food and whose incomes are imperfectly indexed to inflation, is below real income growth of other groups.Real income contraction of the lower-income groups implies a rise in rural and urban poverty and a restricted access to food by these groups.
Wang, & Zhai China 1998	I) 50% reduction of all tariff (6 diff types compensatory mechanism: 1) lump-sum replacement tax that reduces government transfers to households, 2) progressive household income tax, 3) value-added	Increase production in labor-intensive industries.Trade expansion under almost all the tax replacement policies investigated is smaller than in the case of no replacement tax, except valued-added tax. The results follows from the export value-added tax rebate mechanism (i.e. when VAT increases, the export rebate tax increases at the same time) encouraging domestic firms to engage in trade. However, the	Wages of production workers increase the most because of advantages of producing labor-intensive commodities that use production workers intensively. Hence, the demand for these workers increases relatively more than for other factors. When additional tax distortions are present, professional workers gain	Poorest households depend on government transfers, if they are reduced (1), this has the most negative impact for them.In all scenarios, low-income urban households gain relatively more than high-income urban households (except with 1) and rural households gain relatively more than urban households. These results follow from the large share of income coming from production worker whose wages	Aggregate welfare of households improves but distribution of gains among households is quite different under alternative government revenue replacement policies. 1) Gini +; Poorest in rural and urban lose because poor depends heavily on transfers. Greater benefit for high income households. 2) Greatest increase in real absorption, Gini - the most; only richest urban households lose. 5) Similar efficiency

Table 3 (continued)

Studies	Simulations	International trade and sectoral reallocation	Factor of production	Incomes and consumption	Welfare, poverty and inequality
	tax on domestic products, 4) uniform sales tax on final demand, 5) corporate income tax i.e. tax on capital and 6) no government tax replacement (spending adjust)	greatest increase in exports also comes with the lowest efficiency gains.	more while land and agricultural labor gain less, except in the case of uniform sale tax. Government transfers reductions generate the smallest increase in returns to land and agricultural laborers, but the largest increase in capital return and wages of both production and professional workers.	increase in rural areas (compare to urban) and for low-income urban households (compare to high-income urban).	gains as 2) but the reduction of inequality is much smaller. 3) Lowest efficiency gains because it distorts production incentives.3-4-5) All households gain and with 4), in rural areas, distribution is more favorable for low and middle income households.
	II) Uniform tariff (raising the same revenue as in the preceding case)?		Return to land and agricultural labor increase more than in I.Across the different tax replacement choices, government transfers reductions generates the smallest increase in returns to land and agricultural laborers, but it produces the largest increase in capital accumulation and wages of both production and professional workers.		Aggregate welfare position of households improves in all cases but the distribution of gains among households varies with government revenue replacement policies: Gini decreases more than in I because land and agricultural labor constitute the major income sources for rural low-income households. Because urban households rely heavily on capital, wage of production and profession workers, government reduction in transfers is the only case of income disparities.
Yang & Huang China 1997	30% reduction of all ad valorem tariff	As initial tariffs on industry are higher than those on agriculture and those on capital intensive-goods are higher that those on labor intensive-goods, it results in a greater contracting effect on industrial and capital-intensive sectors, concentrated in urban areas, compare to labor-intensive goods sectors, forming a large part of rural industries' output.Real investment declines (0,8%) as a results of the falling absorption of capital goods whose output contracts more than other goods.	Contraction of urban output means that demand for urban factors of production falls and return to urban factor falls. Nominal incomes of urban households decline but their real incomes still increase as a result of rises in real factor returns. As sectoral composition of factor incomes for the three urban households is similar, normal incomes for them increase similarly. However, as poorer urban	Nominal incomes of urban households decline but their real incomes still increase as a result of rises in real factor returns. As sectoral composition of factor incomes for the three urban households is similar, normal incomes for them increase similarly. However, as poorer urban households consume more agricultural goods, whose prices have risen relative to industrial goods, they benefit less than wealthier households.	Overall welfare increase. All households benefits. Welfare (EV) of rural households is three times higher than urban's. Rural-urban equality improves (real consumption and saving for rural households increase more than for urban households following expansion of rural and contraction of urban output). As poorer rural households incomes rely more on agriculture than wealthier rural households, the favorable effect on agriculture tends to improve rural income distribution. Although every urban household

Table 3 (continued)

Studies	Simulations	International trade and sectoral reallocation	Factor of production	Incomes and consumption	Welfare, poverty and inequality
			households consume more agricultural goods, whose prices have risen relative to industrial goods, they benefit less than wealthier households.		benefits, income distribution worsens. Contrary to rural households, impact on urban household welfare is more linked to their consumption. Richer urban households benefit more than poorer urban ones.
	30% tariff reduction on all agricultural goods only	Given the mild protection for the agricultural sector, the impact is rather small. Non-agricultural production increases, agricultural products prices decrease, agricultural production contracts.	Farm income (factor remuneration) falls as agricultural production contracts, but non-farm incomes (factor remuneration) from rural industries rise as resources are drawn from farming to industrial activities.	Prices of agricultural commodities decline as tariffs fall, raising real income levels of households. Wealthy households obtain a large portion of their income from non-agricultural activities so they benefit from the increased non-farm incomes and from agricultural prices decline more than they lose following farming income decline. This is not the case for the other 2 (poorer) categories of rural households, relying considerably on agricultural incomes, whose incomes decrease. Urban incomes increase.	Small impact on overall welfare. Rural-urban inequality increases (most gains accruing to urban households). Rural inequality increases (two poorest rural households lose and wealthiest rural household wins as a results). All urban households benefit from agricultural liberalisation, but income distribution is hardly affected. In terms of real consumption, poorer urban households tend to benefit more than wealthier urban ones but their real savings tend to increase marginally less due to their slightly smaller increases in normal incomes.
	30% tariff reduction on all industrial goods only	More resources are available for the expansion of agricultural and rural industry.	As a result of rural sectors' expansion, rural income (factor remuneration) increases.	Real consumption of urban households has to decrease slightly if poorest urban households are to maintain their savings as a proportion of their total income.Even if it may appear that rural households do not have much to gain, results show that there is a considerable economy-wide effect on rural incomes. This is the case despite strict control over mobility of factor between rural and urban.	All households benefits (EV) with rural households benefiting the most. Urban-rural inequality decreases. Even poorest rural households gain almost as much as wealthiest urban households. Rural inequality decreases. Compared with sim I, wealthiest rural household gain less, indicating that agricultural liberalisation actually benefits this household category. On the other hand, the two poorest rural households benefit from maintaining current agricultural protection. Urban inequality increases compared to I. Benefits to urban households are much smaller than if agricultural tariffs are reduced as well (from 38% to 92% less).

Functional Forms and Parametrization of CGE Models

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Abstract

This study focused on the choice of functional forms and their parametrization (estimation of free parameters and calibration of other parameters) in the context of CGE models. Various types of elasticities are defined, followed by a presentation of the functional forms most commonly used in these models and various econometric methods for estimating their free parameters. Following this presentation of the theoretical framework, we review parameter estimates used in the literature. This brief literature review was carried out to be used as a guideline for the choice of parameters for CGE models of developing countries.

Keywords: Trade liberalization, Poverty, elasticities, functional forms, calibration, Computable General Equilibrium (CGE) model

Introduction

The construction of a Computable General Equilibrium (CGE) models is usually based on a social accounting matrix (SAM) that describes the initial state of the economy. The implementation of CGEMs relies on the principle of calibration, given that a model is actually characterized by various functional forms that illustrate consumption and production-related behaviors. Calibration therefore consists in determining the numerical values of the various parameters of functions compatible with the equilibrium of the initial SAM. In some cases, information contained in the SAM is inadequate for the calibration of all parameters. When forms such as the constant elasticity of substitution or linear expenditure system are selected, estimates of other parameters, such as the elasticity of substitution or the income elasticity, may be required for calibration. The values attributed to these parameters can be postulated or based on econometric estimations. Where such estimations are not available for the countries concerned, assumptions derived from literature on elasticities estimated for a country with similar characteristics can be applied. However, the choice of these free parameters is critical, given that it seriously affects the findings of the model.

The present study has a dual objective consisting, on the one hand, in defining the theoretical framework of parameters involved in most CGEMs and, on the other hand, in presenting a number of elasticity estimates available in the literature concerning developing countries. Section 2 of this chapter is devoted to the definition of demand elasticities. Section 3 presents the functional forms commonly used in CGE models and discuss methods for calibrating their non-free parameters. Section 4 deals with techniques for econometrically estimating the free parameters in these functions. We then turn our attention in section 5 to reviewing parameter estimates obtained econometrically or through personal judgment in a wide variety of developing countries, which we hope will serve as a reference for future models.

Elasticities: Definitions

Economic theory distinguishes a number of elasticities, each measuring the percentage variation in one variable (e.g. consumer demand for bread) to a variation in another variable (e.g. the price of bread or household income). In this section, we present the notions of price elasticity, income elasticity and elasticity of substitution.

Own Price Elasticity

Own price elasticity assesses the variation in the demand for a commodity that results from a variation in the price of the latter.

Consumer demand is the result of the maximization of utility subject to a budget constraint. With the demand curve presenting a decreasing slope, the own price elasticity is negative. Considering that C_i represents the quantity demanded of commodity i and p_i is the price of the commodity, ε_p, the own price elasticity reads as follows:

$$\varepsilon_p = \frac{\partial C_i / C_i}{\partial p_i / p_i} = \frac{\partial C_i}{\partial p_i} \frac{p_i}{C_i}$$

Table 1 describes various special cases. In the two first cases, the demand function is represented by a straight line, which is horizontal when the price elasticity is infinite and vertical when the price elasticity is nil. In the event of an intermediary case where the absolute value of the price elasticity is unitary, the variation in demand will be proportionate to the price variation. On the other hand, when the absolute value of the elasticity is greater (less) than unity, a change in the price will result in a demand variation that is more (less) than proportional.

Table 1: Characteristics of demand

Price Elasticity value	Characteristics of demand
$\varepsilon_p = -\infty$	Perfectly elastic
$\varepsilon_p = 0$	Perfectly inelastic
$\varepsilon_p = -1$	Unitary elasticity
$\varepsilon_p < -1$	Elastic
$-1 < \varepsilon_p < 0$	Inelastic

Cross Price Elasticity

For each pair of commodities i and j, cross price elasticity is defined as follows:

$$\varepsilon_{pc} = \frac{\partial C_i / C_i}{\partial p_j / p_j} = \frac{\partial C_i}{\partial p_j} \frac{p_j}{C_j}$$

Cross price elasticity of demand assesses the variation in the demand for commodity *i*, which results from the variation in the price of commodity j. Where the cross price elasticity is positive, the two commodities are said to be substitutes. On the contrary, where negative, an increase in the price of the commodity j will result in a drop in the demand of commodity *i*, and the two commodities are said to be complementary. Cross price elasticity is nil for commodities which are neither substitutes nor complements.

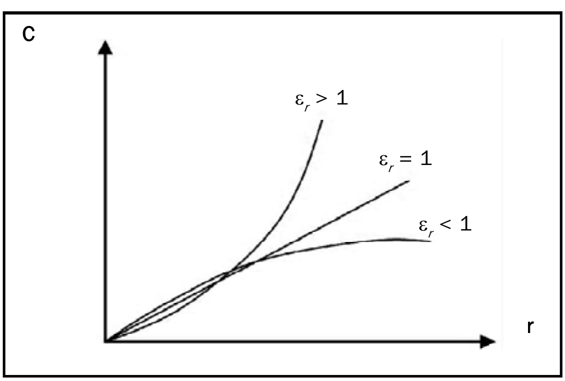
Income Elasticity

The income elasticity assesses the variation in the demand for a commodity *i*, following a variation in income *r* referred to as:

$$\varepsilon_r = \frac{\partial C_i / C_i}{\partial r / r} = \frac{\partial C_i}{\partial r} \frac{r}{C_j}$$

According to the value of the income elasticity, we can distinguish three groups of commodities. Income elasticity is superior to one for luxury goods and inferior to one for normal goods. For inferior goods, the value of ε_r is negative; any increase in income **reduces** the demand for the this commodity. Figure 1 illustrates the link between the demand (Y or ordinate axis) and the income (X or abscissa axis). The curves represented are known as Engel's curves.

Figure 1. The Engel's curve



Source: *Sadoulet and de Janvry, 1995*

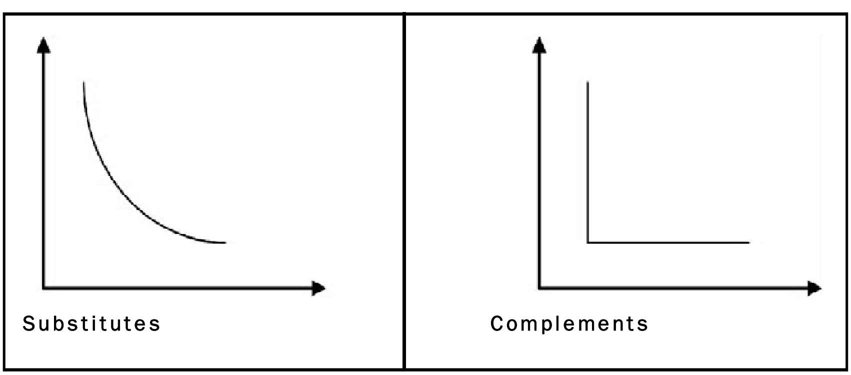
Elasticity of Substitution or Transformation

Unlike the preceding elasticities, which pertain only to demand, elasticities of substitution and transformation apply equally to supply decisions. On the demand side, the elasticity of substitution between two commodities, *i* and *j*, measures the variation in the relative demand for the two commodities resulting from a variation in their relative price. Considering the derivative of the log of these variables (∂ln), the elasticity of substitution reads as follows:

$$\varepsilon_s = \frac{\partial \ln\left(X_i / X_i\right)}{\partial \ln\left(p_j / p_i\right)} \qquad 0 \leq \varepsilon_s < \infty$$

If the elasticity of substitution is nil, the two commodities are considered to be perfect complements (Figure 2), whereas if it is infinite, the two commodities are considered to be perfect substitutes. When this elasticity is comprised between these two extremes, the products considered to be imperfect substitutes. The value of the elasticity of substitution determines the curvature of the indifference curve (rather than the slope) in the case of a utility function, and the isoquant in the case of a production function. Similar expressions are obtained in the case of the elasticity of substitution between factors in a production

Figure 2. Substitutes and complements



Functional Forms in CGE Models

Various factors guide the choice of functional forms in CGE models. In general, the function chosen should be continuous and homogeneous of degree zero and result in a system of demand in conformity with the Walras Law (Shoven and Whalley, 1984). These conditions are used to help ensure equilibrium and ease the analysis of variations in the prices resulting from economic policies. Besides, the choice of behavioral functions in the construction of CGE models depends on the characteristics of the sectors or products under study and consequently on the values of the various related elasticities. These restrictions require that the choice of functional forms be limited to functions such as the Cobb-Douglas (C-D) function, the constant elasticity of substitution function (CES) or the linear expenditure system (LES). More flexible functional forms such at the translog function may be used, but present a number of analytical difficulties.

Here, we present the functional forms most commonly used in CGE models. The calibration method[1] is presented each time. Although these different functions may also be used on the production side, attention here is focused on the modeling of systems of demand.

The Cobb-Douglas (C-D) Function

With a Cobb-Douglas utility function, the consumer's demand is obtained as the solution to the following maximization program:

$$\begin{aligned} &\text{Max} U = \prod C_i^{\alpha_i} \\ &s.t. \ \Sigma p_i C_i = R \ \ and \ \ \Sigma \alpha_i = 1 \end{aligned}$$

with R - total income. The consumption of each commodity i reads:

$$C_i = \frac{\alpha_i R}{p_i}$$

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[1] Hansen and Heckman (1996) discuss the empirical fundamentals of calibration. A review on the principles of calibration and its use in modeling is presented by Dawkins et al (2001).

Values for the various elasticities presented above can be derived from this demand function and provide information on the restrictions of the C-D function. Price and income elasticities, as well as the elasticity of substitution between each pair of goods, are all equal to one, whereas the cross price elasticity is nil. Despite these assumptions, which may be perceived as very strong and unrealistic, many authors resort to the C-D function given that it can be easily calibrated and does not require outside estimates of free parameters (Box 1).

Box 1: The calibration of a Cobb-Douglas function

> With a C-D utility function, the only unknown parameter is the budgetary share of the consumption of each commodity in the overall consumption. Considering the income, the consumption and prices provided by the SAM, the computation of the share of each good in overall consumption income (total expenditure) is a simple inversion of the demand equation: $\alpha_i = \frac{p_i C_i}{R}$ where the p_i are normalized to one in the base year.

However, such restrictions are rarely observed in empirical estimates (Shoven and Whalley, 1992). In order to relax some of these restrictions, one may choose some more flexible functional forms, which we now explore.

The Constant Elasticity of Substitution (CES) Function

The constant elasticity of substitution (CES) function allows for non-unitary, but constant, price elasticities and non-nil, but constant, substitution elasticites. The consumer's utility maximization program is as follows:

$$\text{Max}U = \Sigma\left[\alpha_i C_i^{(z-1)/z}\right]^{z/(z-1)}$$
$$s.t.\ \Sigma p_i C_i = R \ and\ \Sigma\alpha_i = 1$$

The demand function for each commodity reads: $C_i = \dfrac{\alpha_i^{\varepsilon}}{p_i^{\varepsilon}\left[\Sigma\alpha_i^{\varepsilon} p_i^{1-\varepsilon}\right]}$

where α_i is the share parameter and ρ the substitution parameter defined as follows: $\varepsilon_s = \dfrac{1}{1+\rho}$, with $0 < \varepsilon_s < \infty$ and $-1 < \rho < \infty$ where ε_s is the constant elasticity of substitution between all pairs of commodities. Where $\rho \to \infty, \varepsilon_s \to 0$ the two goods are perfect complements and where $\rho = -1, \varepsilon_s \to \infty$, they are perfect substitutes. Own price elasticity and income elasticity are both derived from the demand function C_i:

$$\varepsilon_p = -\varepsilon_s - \alpha_i^{\varepsilon}\left(1-\varepsilon_s\right) p_i^{1-\varepsilon_s}\left[\Sigma\alpha_i^{\varepsilon} p_i^{1-\varepsilon_s}\right]^{-1} \qquad \varepsilon_r = 1$$

When budgetary shares are low, own price elasticity is close to the negative of the elasticity of substitution. The CES function thus avoids the unit price elasticity constraint imposed by the C-D function. The income elasticity is unitary, as in the case of the C-D function. The CES function implies an identical elasticity of substitution for all pairs of commodities.[2]

Box 2 presents the CES function applied in various contexts. This function is the most commonly used function for modeling international trade in CGE models in order to capture the widely observed phenomenon of cross-hauling. The CES function can also represent imperfect substitution between factors of production in value added.

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[2] The constant elasticity of substitution assumption in the case of a production function with several factors may be relaxed by using a more general functional form known as the homogenous or homothethic constant elasticity of substitution ratio (CRESH), Hanoch (1971).

Box 2: Implementation of the CES function

The **Armington (1969) assumption** of imperfect substitutability between two products of different origins implies that total domestic demand Q_i is a CES function:

$$Q_i = A_i \left[\alpha_i M_i^{-\rho} + \left(1 - \alpha_i\right) D_i^{-\rho}\right]^{-\frac{1}{\rho}}$$

with D_i as demand for the locally manufactured good, M_i as the demand for the imported imperfect substitute, A_i a scale parameter and the elasticity of substitution given by $\varepsilon_s = \dfrac{1}{1+\rho}$. The maximization problem is to minimize cost: $PQ_iQ_i = PD_iD_i + PM_iM_i$ subject to the Armington function.

We obtain the relative demand for imported versus local goods as a function of their relative prices:

$$\frac{M_i}{D_i} = \left[\frac{PD_i}{PM_i}\,\frac{\alpha_\iota}{1+\alpha_\iota}\right]^{\varepsilon_s}$$

Given price normalization, the volumes of demand for both domestic and imported products are directly provided by the SAM. The only parameters to be calibrated therefore are the share and scale parameters. For a given external estimate of the elasticity of substitution, the share parameter is easily computed by inverting the above import demand equation. The scale parameter is then obtained by simple inversion of the Armington function.

Similarly, **export supply** may be represented, depending on the destination, by a constant elasticity of transformation (CET) function that takes a form similar to that of the CES:

$$X_i = B_i \left[\alpha_i E_i^{-\varphi} + \left(1 - \alpha_i\right) E_i^{-\varphi}\right]_i^{-\varphi}$$

with $\varepsilon_t = \dfrac{1}{\varphi + 1}$ as the elasticity of transformation, $-\infty < \varphi < -1$ and $-\infty < \varepsilon_t < 0$. Export supply resulting from the maximization of profits to the producers reads as follows:

$$\frac{D_i}{E_i} = \left[\frac{PE_i}{PD_i}\frac{1-\alpha_i}{\alpha_i}\right]^{\varepsilon_t}$$

This same process may be applied for the calibration of the CET. For a given ε_t, by normalizing prices, distributive parts of the export offer function are derived.

Finally, we can capture imperfect substitution between **factors of production** with a CES value added function:
$VA_i = CES\ (K_i, L_i)$

The relative demand for the two factors reads:

$$\frac{K_i}{L_i} = \left[\frac{w_i}{r_i}\frac{\alpha_i}{1-\alpha_i}\right]^{\varepsilon_s}$$

with w_i and r_i respectively representing the wage rate and the rate of return to capital. By normalizing these two rates, the elasticity of substitution α_i is obtained.

The C-D function presented in paragraph 3.1 stands as a special case of the CES function with an elasticity of substitution equal to one. Both functional forms impose unit income elasticity, an assumption that some people would not consider. Indeed, unit income elasticity implies that the budget shares of each good do not vary with the level of income. In order to go beyond this restriction, choosing the linear expenditure system may be helpful.

The Linear Expenditure System (LES)

The Stone-Geary[3] function also known as the linear expenditure system or LES, does not assume unit income elasticity. This function can be expressed alternatively as a variant of the C-D function or the CES function (Shoven and Whalley, 1992). By introducing a term which represents minimal or subsistence consumption $C_{\min i}$ of each commodity i in a C-D function, the LES demand function is obtained as the result of the following utility maximization problem:

$$\text{Max}\, U = \prod \left(C_i - C_{\min i}\right)^{\alpha_i}$$
$$s.t. \sum p_i C_i = R \;\; and \;\; \sum \alpha_i = 1$$

The resulting demand for the consumption of commodity i is the sum of the minimal and discretionary components:

$$C_i = C_{\min i} + \frac{\alpha_i}{p_i}\left[R - \sum p_j C_{\min j}\right]$$

The term $R - \sum p_j C_{\min j}$ is known as supernumerary or residual income. It represents the income available after satisfaction of minimal consumption. With the introduction of the minimal consumption level, the Engel's curve ceases to be represented by a straight line passing through the origin and the income elasticities are no longer unitary:

$$\varepsilon_{ri} = \frac{\alpha_i R}{p_i C_i}$$

Own price elasticities are: $\varepsilon_{pi} = \dfrac{\left(1 - \alpha_i\right) C_{\min i}}{C_i} - 1$

One problem arising in using a LES function is the need for several free parameters in the calibration process, as explained in Box 3.

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[3] Stone (1954).

Box 3: Calibration of a linear expenditure system

The calibration of a LES function is not as easy as that of a C-D function or a CES function as minimal consumption levels must also be determined. Two methods can be adopted depending on the availability of estimates for each of the free parameters:

Case 1: Estimates of income and price elasticities available

In this case, we first calibrate the discretionary consumption budget shares:

$$\alpha_i = \frac{\varepsilon_i p_i C_i}{R}$$

where the initial levels of consumption of each good and overall income are observed and initial prices are normalized. Then, the minimal consumption levels can be calibrated from the price elasticity equation:

$$C_{\min i} = \frac{\left(1+\varepsilon_p\right) C_i}{1-\alpha_i}$$

Case 2: Estimates of income elasticities and Frisch parameters

Frisch (1959) parameters measure the ratio of total to discretionary consumption[4]:

$$Frisch = -\frac{R}{R - \sum p_j C_{\min j}}$$

---

[4] De Melo and Tarr (1992) and Sadoulet and de Janvry (1995).

Substituting this parameter into the demand equation, we calibrate minimal consumption levels:

$$C_{\min i} = C_i + \frac{\alpha_i}{p_i}\left(\frac{R}{Frisch}\right)$$

where $\alpha_i = \dfrac{\varepsilon_i p_i C_i}{R}$.

The Expanded Linear Expenditure System (ELES)

The LES demand function may be expanded to take into account savings behavior in the utility function. Lluch (1973) introduces the Stone-Geary function into a program of inter-temporal utility maximization under a wealth constraint of households. Howe (1975) shows that the extended linear system of expenditure (ELES) is obtained simply from a static program meant to maximize the Stone-Geary's function with savings considered as a good whose minimal consumption level is nil.

By considering the LES function from the previous section and introducing savings (S), the ELES function is obtained in the following manner:

$$u = \prod \left(C_i - C_{\min i}\right)^{\alpha_i} S^{\beta}$$
$$U = \ln u = \sum \alpha_i \ln\left(C_i - C_{\min i}\right) + \beta \ln S \qquad avec \sum \alpha_i + \beta = 1$$

The consumer's welfare maximization program reads:

$$\text{Max}\, U = \sum \alpha_i \ln\left(C_i - C_{\min i}\right) + \beta \ln S$$
$$s.t.\ p_i C_i + S = R \ \ and\ \sum \alpha_i + \beta = 1$$

The resulting demand functions for consumption and savings read:

$$C_i = C_{\min i} + \frac{\alpha_i}{p_i}\left[R - \sum p_j C_{\min j}\right]$$

$$S = \beta\left(R - \sum p_j C_{\min j}\right)$$

Consumption demand is similar to the one obtained with the LES function. The following income and direct price elasticities are obtained based on the consumption demand equation:

$$\varepsilon_r = \frac{\alpha_i R}{p_i C_i}$$

$$\varepsilon_p = \frac{(1-\alpha_i)C_{\min i}}{C_i} - 1$$

Calibration of this function is outlined in Box 4.

Box 4: Calibration of an ELES function

This method was developed by Burniaux and Van der Mensbrugghe (1991). It is based on matrix computation and can be applied with the GAMS software. Discretionary budget shares are first calibrated from the income elasticity equation:

$$\alpha_i = \frac{\varepsilon_r p_i C_i}{R}$$

We then rewrite the consumption demand function in matrix form:

$$[C] = [IC_{\min}] + [\mathrm{A}R] - [\mathrm{AP}C_{\min}]$$

$$[C] = [I - \mathrm{AP}]\,[C_{\min}] + [\mathrm{A}R]$$

where:

$[I]$: Identity matrix (nxn)
$[\mathrm{A}]$: Diagonal matrix of α_i terms
$[\mathrm{P}]$: Transposed matrix of prices (normalized)
$[C]$: Total consumption matrix
$[C_{\min}]$: Minimal consumption matrix

Through matrix inversion, we calibrate minimal consumption levels:

$$[C_{\min}] = [I - \mathrm{AP}]^{-1} + [C - \mathrm{A}R]$$

The Almost Ideal Demand System (AIDS)[5]

Proposed by Deaton and Muellbauer (1980), this system gives an approximation of the first order of any demand system and meets the conditions of the traditional axioms in consumer theory. It is easy to aggregate all the consumers, and Engel's curves are not necessarily straight. It can be simply estimated without non linear estimation techniques. Moreover, it makes it possible to test demand homogeneity and symmetry assumptions by using linear constraints on parameters. This system results from a set of preferences known as *PIGLOG*[6]. It is represented in the form of expenditure share functions ω_i:

$$\frac{p_i C_i}{R} \equiv \omega_i = \alpha_i + \sum \gamma_{ij} \ln p_j + \beta_i \ln \frac{R}{P}$$

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[5] Almost ideal demand system

[6] Price independent generalized linear log, Deaton and Muellbauer (1980)

where P is the price index. The change in prices is captured by the parameter γ_{ij} and that of real expenditure by the parameter β_i. The AIDS system implies the following conditions:

$$(1)\ \sum \alpha_i = 1, \quad \sum_i \gamma_{ij} = 0, \quad \sum \beta_i = 0$$

$$(2)\ \sum \gamma_{ij} = 0 \qquad (3)\ \gamma_{ij} = \gamma_{ji}$$

Condition (1) guarantees additivity, condition (2) ensures the homogeneity of the demand function and condition (3) ensures symmetry. From the demand function are derived the following price and income elasticities:

$$\varepsilon_P = -1 + \frac{\gamma_{ij}}{\omega_i} - \beta_i$$

$$\varepsilon_r = -1 + \frac{\beta_i}{\omega_i}$$

The calibration of the AIDS function also requires estimates of various parameters (Box 5).

Box 5: Calibration of the AIDS system parameters

The demand elasticities derived from this system read:

$$\varepsilon_P = -1 + \frac{\gamma_{ij}}{\omega_i} - \beta_i \quad \text{and} \quad \varepsilon_r = 1 + \frac{\beta_i}{\omega_i}$$

If estimates of these elasticities are available, then the other parameters are calibrated as:

$$\beta_i = \left(\varepsilon_r - 1\right)\omega_i$$

$$\gamma_{ij} = \left(\varepsilon_p + \beta_i + 1\right)\omega_i$$

hence $\alpha_i = \omega_i - \sum \gamma_{ij} \ln p_j - \beta_i \ln \frac{R}{P}$

Econometric Estimates of Free Parameters

In this section, econometric methods used in the empirical estimations of various elasticities will be presented. These methods follow from the form of the demand function, which depends on the different functional forms selected. They are applicable both to the demand for consumer goods and the demand for production factors. As noted earlier, the C-D function is fully calibrated from the initial SAM and requires no free parameter estimates.

The Constant Elasticity of Substitution (CES) Function

The calibration of the CES function requires an outside estimate of the elasticity of substitution. Three methods of estimation are presented. The first one is commonly applied to international trade and the last two are applied to the demand for production factors.

a) Ordinary Least Squares (OLS) Method

The first method for estimating the elasticity of substitution is based on the first order conditions from the consumer welfare maximization program. Applied to international trade, the elasticity of substitution between local goods and imported products may be obtained from the import demand function. This function is written without indices as follows:

$$\ln\left(\frac{M}{D}\right) = \varepsilon_s \ln\left(\frac{\alpha}{1-\alpha}\right) + \varepsilon_s \ln\left(\frac{PD}{PM}\right)$$

A linear regression model is obtained by adding a random error (u) and replacing $\varepsilon_s \ln\left(\frac{\alpha}{1-\alpha}\right)$ by a constant:

$$\ln\left(\frac{M}{D}\right) = a + \varepsilon_s \ln\left(\frac{PD}{PM}\right) + u$$

This equation can be used to estimate for each commodity in a CGE model by OLS, assuming that the time series data meets the usual conditions. In practice, a variable reflecting the overall level of economic activity, such as the gross domestic product (GDP), is generally introduced in order to take into account the effect of the pressure on demand.

$$\ln\left(\frac{M}{D}\right) = \alpha_0 + \varepsilon_s \ln\left(\frac{PD}{PM}\right) + \alpha_1 \ln\left(GDP\right) + u$$

where M is the import volume index, D is the volume index of domestically-consumed local goods, PD is the ex-factory consumer price index for domestically-consumed local goods including sales taxes, PM is the import price index including all tariffs and sales taxes.

A similar method can be adopted in the case of the producer's decision between export and domestic sales. We can estimate the constant elasticity of transformation between the commodities based on the following export supply equation:

$$\ln\left(\frac{E}{D}\right) = b + \varepsilon_t \ln\left(\frac{PE}{PD}\right) + v$$

Note that if the "small country" assumption is relaxed, a foreign export demand function will need to be introduced and its finite export demand price elasticity will need to be estimated

b) Non-Linear Methods

Other methods for estimating the elasticity of substitution have also been examined in production theory. Here we assume a stochastic CES value added function of capital and the labor:

$$VA_i = A_i \left[\alpha_i K_i^{-\rho} + \varepsilon_t \ln\left(1 - \alpha_i\right) L_i^{-\rho}\right]^{-\frac{1}{\rho}} + u_i$$

Several methods for estimating elasticities of substitution have been used in this context, of which two are explored here. The first method is based on the minimization of the squares of the error term u_i:

$$\text{Min} \sum_{i=1}^{n} \left(VA_i - A_i \left[\alpha_i K_i^{-\rho} + (1-\alpha_i) L_i^{-\rho} \right]^{-\frac{1}{\rho}} \right)^2$$

If the disturbance terms are multiplicative[7], then the expression to minimize reads as follows:

$$\sum_{i=1}^{n} \left(\ln VA_i - \ln A_i + \frac{1}{\rho} \ln \left[\alpha_i K_i^{-\rho} + (1-\alpha_i) L_i^{-\rho} \right] \right)^2$$

Non linear methods may be adopted using various econometric software packages.

c) Taylor Approximation

The second method is based on the approximation of the CES by the Taylor's series. If the value added function is written in the form:

$$\ln VA = \ln A - \frac{1}{\rho} f(\rho)$$

with $f(\rho) = \ln\left[\alpha_i K_i^{-\rho} + (1-\alpha_i) L_i^{-\rho} \right]$, Taylor's logic near $\rho = 0$ (which corresponds to $\varepsilon_s = 1$, $\varepsilon_s = \frac{1}{1+\rho}$) takes the following general form:

$$f(\rho) - f(0) = \rho f'(0) + \frac{1}{2} \rho^2 f''(0) + \ldots$$

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[7] $VA_i = A_i \left[\alpha_i K_i^{-\rho} + (1-\alpha_i) L_i^{-\rho} \right]^{-\frac{1}{\rho}} * u_i$

By neglecting the higher order terms, the equation to estimate reads as follows[8]:

$$\text{In } VA_i = \ln A_i + \alpha_i \ln K_i + (1-\alpha_i)\ln L_i - \frac{1}{2}\rho\alpha_i(1-\alpha_i)\left(\ln\frac{K_i}{L_i}\right)^2$$

The last term, relating to the capital-labor ratio, constitutes the difference with the log-linear regression of a C-D function. It implies that the substitution elasticity is different from one.

It is obvious that these estimation methods are also valid for the cases of a CES function representing the composite consumption of domestic goods and imports. As a matter of fact, various approaches exist in literature (Devarajan et al., 1999) and the success of each depends on data availability and quality.

The Linear Expenditure System (LES)

The use of a linear expenditure system entails the following elasticities:

$$\varepsilon_r = \frac{\alpha_i R}{p_i C_i}$$

$$\varepsilon_p = \frac{(1-\alpha_i)C_{\min i}}{C_i} - 1$$

Such elasticities are easy to compute from estimates of the parameters of the demand function. These parameters are estimated by taking into account the system of the LES equation demands to which we add random errors:

$$p_i C_i = p_i C_{\min i} + \alpha_i \left[R - \sum p_j C_{\min j}\right] + u_i$$

This multivariate simultaneous equations model can be estimated

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[8] For a more detailed explication, refer to Wallis (1979) and Sadoulet and de Janvry (1995).

using Seemingly Unrelated Regression Equations (SURE) or Full Information Maximum Likelihood (FIML) methods (Sadoulet and de Janvry, 1995). The objective is to simultaneously estimate all the equations, taking into account existing interdependencies due to the fact that the same variable (such as residual income) is present in all equations and errors in different equations are correlated.

Another way to obtain convergent estimates consists in proceeding by iteration. This procedure is based on the assumption that for a given α_i, the LES equations are linear in $C_{\min i}$ and vice-versa. In fact, these equations can be written in the following forms:

$$p_i C_i - \alpha_i R = C_{\min i}\left(p_i - \alpha_i p_i\right) - \sum_j C_{\min j}\left(\alpha_j p_j\right) + u_i$$

$$p_i C_i - p_i C_{\min i} = \alpha_i \left[R - \sum p_j C_{\min j}\right] + u_i$$

These two equations are linear in $C_{\min i}$ and α_i, respectively. The iterative procedure used to converge involves two steps. We begin with a value for α_0 and estimate $C_{\min i}$ using an OLS regression of the first system. With this value of $C_{\min i}$, α_i is then estimated with an OLS regression of the second system. This iteration procedure is continued until stable values are obtained for both α_i and $C_{\min i}$. The demand functions are thus totally specified.

The Almost Ideal Demand System (AIDS)

The demand elasticities for the AIDS model are computed on the basis of estimates of the parameters of its demand function. To do so, a stochastic element is introduced in the demand function to obtain the following simultaneous equations model (Sadoulet and de Janvry, 1995):

$$\omega_i = \alpha_i + \sum \gamma_{ij} \ln p_j + \beta_i \ln \frac{R}{P} + u_i$$

where P is the consumer price index and ω_i is the budget share of commodity i in overall consumption expenditure. An OLS regression can be used to estimate this system on an equation by equation basis. However, since the equations are interrelated, it is preferable to use methods such as SURE or FIML. The endogenous variables are the budget shares, while prices and real income are exogenous.

A Brief Review of Free Parameter Estimates for Developing Countries

There is no doubt that the choice of free parameters is an important element in CGE analysis of economic policies-related shocks. These parameters critically determine the magnitude of response to different exogenous shocks. A good example of a CGE model based on econometric estimates of all parameters is provided by Abdelkhalek and Dufour (1997) and (1998). In addition, they develop methods to construct confidence intervals for all endogenous variables in a CGE model given the variance of their parameter estimates.

However, most CGE models are based on fairly arbitrary estimates of these parameters. In fact, the difficulty in gathering data necessary for the econometric estimation of these parameters prompts modelers either to "borrow" these values from other studies conducted on countries with similar characteristics, or to base them on their personal judgment as "guess-estimates". In some cases, the choice of the values of these elasticities is made on the basis of a "consensus" reached by researchers.

To explore the robustness of their results with respect to their parameter estimates, many modelers subsequently conduct sensitivity tests on their parameter estimates. Pagan and Shannon (1985) and Harrison and Vinod (1992) develop different methods for conducting sensitivity tests. Criticisms of these approaches by Jorgenson (1984) and McKitrick (1998) prompted some modelers to use more flexible functional forms. However this adds some analytical complexity[9].

The objective here is to provide a (non exhaustive) database of

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[9] Perroni and Rutherford (1998) compare different flexible forms that could be used in CGE models.

estimates for developing countries of the free parameters required for the most commonly used functional forms. To this effect, several sources of data have been assembled on trade elasticities and elasticities of substitution between labor and capital, as well as demand elasticities and Frisch parameters. Table 2 presents the sources that have been used for the purposes of this brief review.

Trade Elasticities

By trade elasticities, we refer to the Armington elasticities of substitution between imported and local goods (Armington elasticities), as well as CET elasticities of transformation between exports and local sales (CET elasticities). Some researchers have econometrically estimated these trade elasticities for developing countries, as illustrated by studies in the following four countries: Ecuador, Morocco, the Philippines and Brazil. These estimates are made in the context of a CGE model, except in the case of Brazil, and described in the first sub-section below. Note that the choice of sectors vary from one study to another, which explains the many empty cells in this table. We then present a number of studies in which trade elasticities are based on personal judgment. Finally, to avoid problems of data availability, Arndt et al (2001) recently implemented the entropy approach in computing these elasticities for Mozambique.

a) Econometric Estimations

Sadoulet and Roland-Holst (1989), in constructing a CGE model for Ecuador and in order to better capture the response of the economy to the variations in the terms of trade and exchange rates, conduct econometric estimations of Armington and CET elasticities for 30 sectors. Estimations are based on data obtained from the Ecuadorian National Accounting Sources covering the 1965-1987 period. These authors have paid particular attention to the modeling of imports as Ecuador experienced serious imports restrictions during the 1982-1987 period. Armington elasticities vary from 0.20 (Tobacco and Wood sectors) to 1.80 (Livestock, Forestry and Fishing). CET

Table 2: Sources and countries for elasticity data

	Country	Period	Elasticities	Table	Disaggregation Sectors/Products
Trade Elasticities					
Dervis et al.(1982)	Turkey	n.a	Armington	T8.2 p263	(19)
Sadoulet and Roland-Holst (1989)	Ecuador	1965-87	Armington, CET	TA.3.1, TA.3.4	(30)
Devarajan et al.(1993)	Indonesia	n.a	Armington, CET	T3 p57	(18)
-	Cameroon	n.a	Armington, CET	T5 p59	(11)
Roland-Holst et al. (1994)	Mexico	n.a	Armington, CET	T2.7 p.67	(26)
Abdelkhalek (1996)	Morocco	1980-92	Armington, CET	A-III pp.53-72	(24)
Kapuscinski and Warr (1999)	Philippines	mid 70,late 80	Armington	T4 p.21	(33)
Lofgren (2001)	Egypt	n.a	Armington, CET	TA.5 p.46	(9)
Arndt et al. (2001)	Mozambique	1992-1996	import, export	T2 p.26	(6)
Tourinho et al. (2003)	Brazil	1986-2001	Armington		(28)
Elasticities between factors					
Kemal et al. (1981)	Pakistan*	1959-60,1969-70	substitution(L,K)	T3 p.11	(16)
Pohit et al.(2001)	India	1988-89,1989-90	substitution(L,K)	T6 p.73	(23)
Demand Elasticities					
Deaton (1989)	Java	n.a	income,price	T1 p. 203	(11)
Sadoulet and De Janvry (1995)	India	1951-68	income,price	T2.2 p.48	(4)
-	Ghana	1953-70	income,price	T2.2 p.48	(3)
Ravelosoa et al.(1999)	Madagascar	1993-94	income,price	T8 p.22,T9 p.23	(17)
Weerahewa and Nawaratna (2001)	Sri Lanka	1969-72	price	T2 p.5	(8)

* Comparison with India, Argentina and Bangladesh.

elasticities were estimated for most sectors. For the remaining sectors, they were set equal to those in other sectors. CET elasticities vary from 0.36 (Basic Minerals) to 2.79 (Milling). These values are all presented in Table 3.

Kapuscinski and Warr (1999) estimate Armington elasticities for 33 sectors in the context of a CGE model. Estimations are based on data obtained from the Philippines National Statistics Office and other institutions. For most of the goods, such data cover the period running from the mid-1970s to the late 1980s. The econometric techniques used here draw from three models, namely the Ordinary Least Squares (OLS), Partial Adjustment Model (PAM) and the Error Correction Models (ECM). For their CGE model, the authors selected the estimates obtained through the ECM method. Estimated Armington elasticities, which are presented in Table 3, vary from 0.2 for "Metal products" to 4.1 for "Sugar".

Abdelkhalek (1996) estimated Armington and CET elasticities in a CGE model constructed by the OECD for the Moroccan economy. The estimations are based on data obtained from various ministries for the 1980-1992 period.[10] Abdelkhalek selected 24 sectors and, for each sector, different specifications (7 for imports and 6 for exports) were explored using OLS regressions. Armington elasticities vary from 0.19 for "Rice" to 3.44 for "Textiles" and. The author stresses that, in several cases, import demand is only weakly influenced by prices given that imports serve structurally as a complement to local production so as to meet domestic demand. CET elasticities are significantly negative for most sectors, except "Petroleum", "Non-metallic mineral products" and "Electrical equipment". In order to explain these exceptions, the author suggests that import restrictions and problems of access to foreign markets are responsible for the fact that export shares do not necessarily follow price fluctuations. Table 3 presents the estimates obtained with the author's preferred specification.

Tourinho et al. (2003) estimate Armington elasticities for 28

[10] Ministry of Foreign Trade, Direction of Statistics, Ministry of Commerce, Industry and Crafts, and the Trade Office.

Table 3: Econometrically estimated trade elasticities

	Ecuador Sadoulet/R-H		Philippines Kapuscinski	Morocco Abdelkhalek		Brazil Tourinho
	Armington	Exports (CET)	Armington	Armington	Exports (CET)	Armington
AGGREGATE*	**0.27**	**12.69**	**0.73**	**0.26**	**0.89**	**N.A**
PRIMARY			**3.71**			
Corn				3.17		
Maize				0.81		
Rice			1.03			
Banana and other fruits and nuts			0.72			
Vegetables	0.43	0.56				
Other agriculture	1.80					
Livestock			0.33			
Hogs			1.39			
Chicken and poultry products			1.32			
Other livestock	1.80		1.06			
Fishing	1.80	0.87	0.82			
Forestry	0.24		0.65		0.87**	0.82
Oil, coal and gas				0.68		
Metal ore mining				1.19		
Non-metallic mineral	1.32	1.92	1.11			
Other mining						
INDUSTRY			**0.61**			
Rice and corn milling	0.30	2.37	4.10			
Sugar			0.75			
Milk and dairy products	1.62	2.50				3.47
Meat and fish			1.37			2.22
Oils and fats	1.10	2.79	0.72			
Milling			0.11	1.31		0.96
Other food	0.69		0.32	0.49		
Beverage	0.20		0.32	0.49		
Tobacco	0.83	1.48	0.65	3.44		1.82
Textiles and knitting mills			0.24	0.54		1.72
Garments	0.83	1.48	0.24	0.79		
Leather						0.57
Footwear	0.20	2.49		1.05		2.73
Wood	0.17	0.40	0.60	0.88		0.54
Paper			0.55			0.23
Coal and petroleum products	0.67	0.64		0.45		1.24

Chemicals						0.52
Pharmaceutical and medical industries						0.56
Fertilizers and other chemical industries				0.48		1.18
Rubber				0.48		1.12
Plastic			0.58	1.30	0.29	0.76
Non metallic minerals products	0.46	0.36		1.60		
Basic metals			0.24	0.95		0.22
Metal products & non-electrical machinery	0.94	0.64	1.76	0.57		1.78
Machinery						0.23
Electronic equipment				0.53	0.03	0.16
Electrical equipment			2.00	1.05		4.95
Transport equipment	0.94	0.64	1.04	1.03		2.46
Other manufacturing						
SERVICES	**0.75**	**2.50**				
Trade	0.96	2.50				
Transport and communication	0.75	1.00				
Financial services	0.30	1.00				
Other services	0.27	12.69	0.73	0.26	0.89	N.A

Note: Built from sources in Table 2. * import/export taken from Devarajan et al. (1999). ** only petroleum

Brazilian industries using quarterly data collected during the 1986-2001 period by the "Fundação Centro de Estudos de Comércio Exterior" and the "Fundação Getúlio Vargas". The authors obtained statistically significant estimates for 25 sectors that vary from 0.16 to 4.95.

b) Personal Judgment

This section reviews elasticities estimated on the basis of personal judgment, rather than econometric analysis, in the context of various CGE models implemented in developing countries. Omission has been made of studies in which the authors arbitrarily set the same values for CES and CET elasticities in all sectors.

Dervis et al. (1982), for purposes of simulation of the reduction of tariff restrictions in Turkey using a CGE model, determine intervals of Armington elasticities as part of their sensitivity tests (Table

4). The superior limits of these intervals are simply equal to the inferior limit multiplied by three. The inferior limits vary between 0.25 and 2.00.

Devarajan et al. (1993), using their 123 CGE model, analyze the impact of terms of trade shocks on the real exchange rate and the trade balance. They applied this model to Cameroon and Indonesia by choosing Armington and CET elasticities from the literature. In the case of Cameroon, they set Armington and CET elasticities equal in each sector with values varying between 0.4 and 1.5. For Indonesia, the two types of elasticities have different values comprised between 0.4 and 2.

Roland-Holst et al. (1994) build a CGE model for three countries (USA, Canada and Mexico) and 26 sectors in order to analyze the impact of integration in North America. For the Armington elasticities for Mexico between domestic goods, imports from the USA and Canada, and imports from the rest of the world, the authors base their estimates on a study by Sobarzo (1992) for the same countries. These elasticities vary from 0.46 for "Other manufacturing" to 2.25 for "Agriculture". CET elasticities, varying between 0.12 ("Garments") and 3.78 ("Agriculture"), are drawn from Reinert and Roland-Holst (1991), who estimated these parameters for the USA and applied them to both Canada and Mexico.

Löfgren (2001) simulates the impact of different development strategies on growth and poverty in Egypt using a recursive dynamic CGE model. Drawing from his literature review, Löfgren (1994) selects values for Armington elasticities that vary from 0.9 to 2.4. His CET elasticities are equal to 1.5, except for Agriculture (3).

c) Entropy methods

As already mentioned, in many developing countries we lack sufficient time series data to econometrically estimate the various elasticities commonly used in CGE models. Such data, when they exist, are often unreliable and the length of the series is often very short. To address this problem, Arndt et al. (2001) have developed a

Table 4: Trade elasticities based on personal judgment

SECTORS	Turkey Dervis	Cameroon	Indonesia Devarajan		Mexico Roland-Holst		Egypt Löfgren	
	Imports (CES)	CES/CET	Imports (CES)	Exports (CET)	Imports (CES)	Exports (CET)	Imports (CES)	Exports (CET)
PRIMARY								
Agriculture	2.00-6.00		0.60	0.60	2.25	3.78	2.40	3.00
Forestry		0.40			0.78	1.05		
Mining	0.33-1.00							
Petroleum					0.58	0.89		
Other mining			0.90	0.60				
INDUSTRY								
Food	0.75-2.25	1.25	0.90	1.20	1.00	0.75	0.90	1.50
Beverages			0.90	1.20	0.72	0.49		
Tobacco					1.00	0.78		
Textiles	0.75-2.25		0.90	0.60	1.02	0.39	0.90	1.50
Garments	0.75-2.25				0.80	0.12		
Leather			0.90	0.60	1.06	1.16		
Wood	0.75-2.25		0.90	0.60				
Paper	0.33-1.00		0.90	2.00	0.73	0.42		
Chemicals	0.33-1.00		0.60	0.50	0.70	0.36		
Petroleum products	1.50-4.50							
Rubber & plastics	0.33-1.00				0.76	0.27		
Non metallic minerals products	0.33-1.00	0.75	0.60	2.00	0.82	0.21		
Basic metals	0.33-1.00		0.60	0.60	0.71	0.42		
Metallic products	0.33-1.00		0.60	0.60	0.59	0.54		
Non-electrical machinery	0.75-2.25		0.60	0.60	0.69	0.37		
Electrical machinery	0.75-2.25		0.60	0.60	0.70	0.31		
Transport equipment	0.75-2.25				0.67	1.01		
Other manufacturing					0.46	0.41	0.90	1.50
SERVICES								
Transportation			0.40	0.40	1.20	1.10	0.90	1.50
Public administration								1.50
Services	0.75-2.25	0.40	0.40	0.40			0.90	1.50
Trade			0.40	0.40	1.20	1.10		

Note: Built from sources in Table 2.

new approach for the estimation of free parameters in CGE models. It is the maximum entropy approach, which is based on information theory and makes it possible to estimate parameters even with a limited amount of data. It is similar to the Jorgenson (1984)'s econometric approach, in that it uses past information, and the "validation and calibration"[11] approach, since the model can reproduce past events.

Table 5 presents the results obtained through the application, by Arndt et al (2001), of the maximum entropy method in Mozambique. The Armington elasticities are comprised between 0.57 and 5.54 and the CET elasticities vary from 0.33 to 2.84.

Table 5: Trade elasticities for Mozambique

	Armington	CET (export)
Food	5.54	0.72
Cash crops	0.69	2.20
Fish		0.74
Processed Food	0.57	0.33
Manufactures	0.87	0.56
Services	1.85	2.84

Source: Arndt et al. (2001), Table 2, p.26

Elasticities of Substitution between Labor and Capital

In the case of the elasticities of substitution between labor and capital in the value added function, we present estimates from two econometric studies covering four developing countries: Pakistan, Argentina, Bangladesh and India (Table 6).

Pohit et al. (2001) conduct an econometric estimation of the elasticities of substitution between labor and capital for 23 sectors of the Indian economy in the context of a CGE analysis. This estimation

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[11] Devarajan and Robinson (2002) explain the difference between the maximum entropy approach, which may be used for estimating and updating SAMs (cross entropy), and the validation principle, which seeks to test the ability of the model to explain past events.

is made for two distinct years (1988-89 and 1989-90), on the basis of data from the Annual Survey of Industries (ASI). The authors' objectives are to check if the values of the elasticities of substitution between capital and labor tend to change from one year to another and to test, for each sector, the C-D functional form as compared to the CES form. The elasticities vary from 0.58 to 2.26. These values presented in Table 6 appear in bold when the assumption of a C-D function between capital and labor is ruled out.

Kemal et al. (1981) estimate the elasticities of substitution

Table 6: Elasticities of substitution between labor and capital

	India Pohit et al.		Pakistan	Argentina Kemal et al.	Bangladesh
	1988-89	1989-90			
Food manufacturing			0.09	0.28	0.37
Tobacco processing			1.7	0.22	0.6
Textiles	**0.58***		20.52	0.26	0.34
Wearing Apparel	1.02				
Leather Prod.	1.07		0.56	1.00	0.64
Wood Prod	0.79	**0.62**			
Paper	0.91	1.23	0.05	0.21	0.48
Print and publishing		0.95	2.66	0.87	0.50
Chemicals		1.40	0.29	0.03	0.32
Petrol and related product	1.62	**2.26**			
Rubber products	1.20		0.79	0.16	0.36
Non metal Mineral Prod	0.90	1.09			0.54
Glass and Glass Prod.	0.65	0.93			
Iron and Steel	**0.56**				
Non ferrous Metals	0.96	1.50			
Metal Products	0.62	0.79	0.21		
Non electrical machinery	0.89	**0.64**	0.81	0.10	0.53
Electrical machinery		**0.56**			
Transport Equipment		1.08		0.05	0.38
Misc. Manufacturing	0.59	0.80	1.37		
Trans, Stor, Commu.	0.88	0.91			

Source: *Pohit et al. (2001) Table 6 p.73 and Kemal et al. (1981) Table 3 p.11.*
*: The values in bold correspond to cases where the C-D function assumption has been ruled out.

between labor and capital for 16 manufacturing sectors in Pakistan, using data from the "Census of Manufacturing Industries" that covers the period from 1956-1960 to 1969-1970. They use a CES production function and a variable elasticity function of substitution (VES) that takes into consideration capital intensity. They compares the elasticity values obtained from OLS regressions in Pakistan with estimates from studies in Argentina, Bangladesh and India[12]. Given that Pohit's et al. (2001)'s estimations of these elasticities for India are more recent, Table 6 only presents the values for Pakistan, Argentina and Bangladesh. Kemal et al. conclude that elasticities of substitution are generally low in developing countries and reflect the lack of local technological development.

Demand Elasticities

We complete this review with an examination of estimates of demand elasticities in the literature. Estimates of Frisch parameters, drawn from Hertel et al. (1997), are presented in Table 7.

Table 7: Frisch parameters

	Frisch parameter
Indonesia	-5.42
Philippines	-5.08
India	-7.57
Mexico	-2.94
Brazil	-3.34
Middle East and North Africa	-3.54
Sub-Saharan Africa	-5.85

Source: Hertel et al. (1997)

However, in the case of developing countries, most studies focus primarily on income and price elasticities of demand for food products (Table 8).

Adelman and Timmer (1980)[13] estimate the price and income

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[12] Rehman (1973) for Bangladesh, Katz (1969) for Argentina and Diwan and Gujarati (1968) for India.

Table 8: Demand elasticities from econometric estimation

	India		Ghana		Sri Lanka	Java		Madagascar	
	Sadoulet and de Janvry				Adelman	Deaton			
	income	price	income	price	price	income	price	income	price
Food grains	0.49	-0.34							
Total cereals	0.79	-0.50	0.71	-2.32					
Rice	0.94	-0.75	0.71	-1.25	-0.29	0.52	-0.42	0.47	-0.77
Wheat	1.06	-0.22				1.67	-0.69		
Maize						0.09	-0.82		-0.53
Cassava			0.82	-0.64		0.16	-0.33		-0.30
Other tubercle									-0.53
Coffee								0.53	
Roots						0.88	-0.95		
Industrial crop									-0.87
Vegetables						0.63	-1.11	1.18	-0.63
Pulses					-0.71	0.89	-0.95	0.85	-0,40
Fruit						1.46	-0.95	0.59	-0.91
Coconut					-1,00				
Breeding								1.55	-0.65
Meat					-1.83	2.39	-1.09		
Oils								1.50	-0.85
Fishing								1.00	-1.10
Fresh fish						1.30	-0.76		
Dried fish						0.63	-0.24		
Bread					-1.14			1.49	-0.73
Beverages								1.41	-0.57
Tobacco								1.24	-0.73
Other foods								1.20	-0.62
Non food								1.41	-0.95

Note: Built from sources in Table 2

elasticities in Sri Lanka for eight food products and three categories of households classified on the basis of income levels. The data are obtained from the 1969-1970 "Socio-economic Survey of Sri Lanka" and the 1973 "Survey of Consumer Finance". Only price elasticities, which are highest in the case of "bread and Meat", are presented.

Deaton (1989) estimate price and income elasticities for Java using data obtained from the "Central Bureau of Statistics, Indonesia" on 11 food products. The author presents the income elasticities related to two demand components: quantity and quality. These two components have been merged in order to obtain income elasticities of demand[14]. Price elasticities are lower for basic commodities. Income elasticities are higher than one for products such as wheat, fruit, meat and fish, which are regarded as luxury goods.

Sadoulet and de Janvry (1995) present estimates of elasticities of the demand for several countries and commodities. Table 8 presents the values of these elasticities for India and Ghana as drawn from Scandizzo and Bruce (1980) and Sullivan et al. (1988).

Ravelosoa et al (1999) estimate the price and income elasticities of demand for 17 categories of commodities and six types of Malagasy households. The estimation is essentially based on an AIDS model and data drawn from the Permanent Household Survey conducted by the Institut National de la Statistique (INSTAT) during the one year period running from March 1993 to April 1994. Income elasticities vary from 1.55 for "Breeding" to 0.47 for "Rice", which is a staple food. As for price elasticities, the most sensitive products include "Fishing" (–1.1), followed by "non-food products" (–0.95) and "Fruit" (-0.91).

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[13] Reported by Weerahewa and Nawaratna (2001).

[14] Deaton (1989) p.202-203 and Sadoulet and de Janvry (1995) p. 49.

Conclusion

This study focused on the choice of functional forms and their parametrization (estimation of free parameters and calibration of other parameters) in the context of CGE models. Various types of elasticities are defined, followed by a presentation of the functional forms most commonly used in these models and various econometric methods for estimating their free parameters. Following this presentation of the theoretical framework, we review parameter estimates used in the literature. This brief literature review was carried out to be used as a guideline for the choice of parameters for CGE models of developing

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Welfare and Poverty Impacts of Tariff Reforms in Bangladesh: A General Equilibrium Approach

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Abstract

This paper examined welfare and poverty impacts of trade liberalization in Bangladesh. By using a computable general equilibrium model based on a social accounting matrix, an empirical investigation of the transmission channels linking trade liberalisation to the rest of the economy was carried out by conducting three simulations. In the first two simulations full tariff removal was accompanied by respective increase in production tax rates and income tax rate to ensure revenue neutrality. Third simulation resembles the actual tariff reforms undertaken in the country. This entailed the decline in both the spread and effective average duty rates, thereby reducing the mean rates and variance.

The patterns of welfare losses are progressive for rural households but regressive for urban households in the first two simulations. In the third simulation, a clear regressive pattern is observed among the urban households but it is ambiguous for the rural households. Rural poverty declined due to tariff-income tax reforms and tariff rationalization but worsened in the case of tariff-production tax reforms. Except for the second simulation, the urban poverty headcount, gap and severity all worsen in other

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two simulations. This confirms that the benefits of tariff rationalization accrue more to the urban rich households compared to their poorer counterparts.

Keywords: Trade liberalization, Poverty, Bangladesh, Computable General Equilibrium (CGE) model

Introduction

Bangladesh began to reverse its initially restrictive trade regime during the mid-1980s by undertaking comprehensive programmes of stabilisation, economic reforms and trade liberalisation. The belief was that such a strategy would: 1) release some of the impediments that hinder the country's small domestic market; 2) increase foreign direct investment; 3) facilitate technology transfers; 4) create marketing networks; and 5) bring in much-needed managerial and technical skills.

Trade liberalisation brings about both benefits and costs to a developing country such as Bangladesh. Thus, maximizing the net gains from trade essentially depends on how well the country 'manages' the process to its own advantage by strengthening the domestic economy, removing the structural bottlenecks, and improving policy regimes and institutional capabilities. Two decades have passed since the mid 1980s reform agenda, and evidence shows that the economic benefits from trade liberalisation have been realised sooner than that of other reforms. However, the extent to which the benefits have been realised remains a matter of controversy. Some studies suggest that Bangladesh gained relatively little from the trade reforms of the 1990s (Mujeri 2002).

Studies undertaken thus far have failed to adequately assess the poverty and income distributional impacts of trade liberalisation. This raises a number of important issues related to social goals such as: Does trade liberalisation promote equity? How does it affect poverty? Are specific policy interventions needed to make trade liberalization equitable?

To address all these concerns, this paper assessed the economy wide, poverty, and income distributional impacts of trade liberalization in Bangladesh. By using a computable general equilibrium (CGE) model based on a social accounting matrix (SAM) framework, an empirical investigation of the transmission channels linking trade liberalisation to the rest of the economy, including households was carried out. The rationale behind the use of this framework is that it is widely accepted as a template for policy analysis. This approach captures general equilibrium adjustments by allowing interactions of all agents in the economy, thereby making it possible to analyze both the macro and micro impacts of government policies.

The paper is organised as follows: the following section discusses the major changes in the external sector due to liberalisation, and provides a brief overview of economic structure and the poverty situation in Bangladesh. A third section outlines the main features of the underlying SAM and the CGE model followed by a discussion of the policy simulation results and concluding observations.

Changes in Trade Policy, Economic Structure and Poverty in Bangladesh: An Overview[1]

Trade Policy Changes

The main objective of the reforms undertaken during the last three decades was to liberalise the country's foreign trade and foreign exchange regimes by lowering tariff rates, removing quantitative restrictions, streamlining import procedures, introducing tax reforms, and instituting export promotion measures. The major changes were the following:

- Dismantling of both tariff and non-tariff barriers: tariff bands were narrowed and import procedures simplified.
- Replacement of twenty-four slabs of import duty rates in 1980s by only 4 slabs in 2000.
- Reduction in the highest customs duty rate from 350 percent in 1992 to 37.5 percent in 2000. Consequently, the mean

[1] This section has drawn from Khondker and Mujeri (2005)

tariff rate declined from 114 percent in 1989 to 22 percent in 1999, while the weighted mean tariff rate fell to 19 percent.

- Reduction in the number of commodities under the four-digit code subject to quantitative restrictions from 550 in 1987 to 124 under the Import Policy of 1997-2002. In 1992, about 12 percent of around 10,000 tariff lines were subject to quantitative restrictions. This further declined to less than 4 percent by 1999. At present, less than 0.5 percent of imports, mainly in the textile category, are subject to quantitative restrictions.
- Replacement of the multiple exchange rate system by a unified exchange rate in 1992. At the same time, the domestic currency (Taka) was pegged to a currency-weighted basket. This was undertaken in order to liberalise the foreign exchange market.

A policy of creeping devaluation has been followed since 1992 to maintain exchange rate flexibility and export competitiveness within a more market-determined exchange rate regime. The Taka was also made convertible for all current account transactions.

Implementation of export promotion measures to diversify the export base, improve export quality and stimulate higher value added exports, as well as to develop the backward linkages of industries.

Implementation of additional measures such as: special bonded warehouses, export processing zones, duty drawback, rebate on insurance premiums, income tax rebates, export credit guarantees, export incentives for non-traditional industrial products, establishment of an export promotion fund, provision for value added tax (VAT) refunds, tax holidays, and allowing exporters to retain foreign exchange from export earnings.

Changes in Economic Structure and Poverty

This section highlights the transformations of the Bangladesh economy during the last two decades. These include: changes in the structure of trade, value added, employment, wages, poverty, and inequality.

As a result of the trade policy reforms, Bangladesh's global economic integration increased rapidly during the 1990s. Consequently, the GDP to trade ratio increased with the share of foreign trade (exports and imports) in GDP rising from around 20 percent in the early 1980s to 33 percent in 2000. Import volume and value increased by 21 percent and 11 percent respectively compared with the 4 percent decline in volume and the 4 percent increase in value during the 1980s. Export volume and value increased by 15 and 11 percent respectively in the 1990s compared with an average annual growth of around 1 percent in volume and 8 percent in value during the 1980s.

There were other significant changes in the country's economic structure since the last decade. Agriculture's share in GDP declined to about 25 percent in 2000 from 30 percent in 1990, while the share of manufacturing correspondingly increased from 21 percent in 1990 to 26 percent in 2000, due mainly to impressive manufacturing exports performance. The share of services remained stable at roughly 50 percent.

The average GDP growth rate increased from less than 4 percent during the period 1980-90, to more than 5 percent between the period 1995-2000. In general, this suggests that higher growth was achieved during the period of liberalisation. As a result, the growth in GDP per capita accelerated during the 1990s. This can be attributed to increased economic and reduced population growth.

The unemployment rate doubled to 3.7 percent during 1991-2000, relative to 1.9 percent prior to the period. A more serious concern, however, was the high rate of underemployment reflecting the fact that more than 35 percent of those who were employed worked less than 35 hours a week. By the end of the 1990s, around 39 percent of the total labour force was either underemployed or unemployed.

Poverty data suggests that per capita real GDP growth helped alleviate the poverty situation in the 1990s. During this period, the annual rate of poverty reduction was registered at around 1 percent. Although both urban and rural poverty have declined, the poverty incidence of the former remained higher than the latter. Overall, the poverty situation in the 1990s contrasted starkly with that of the early 1980s. This is because poverty incidence declined at quite a slow rate in the early 1980s. For instance, the national poverty headcount rate only declined from 58.5 percent in 1983/84 to 57.1 percent in 1988/89, implying a mere 0.23 percent annual rate of decrease. During the 1990s however, the rate of decrease was 1.05 percent for urban areas and less than 0.1 percent for rural areas, or an unweighted average decrease of 0.56 percent for the entire country.

The Gini index of consumption expenditure remained relatively unchanged between the early 1980s and 1992. However, it rose sharply from 32 percent in 1992 to 37 percent in 2000. Likewise, rural inequality in consumption expenditure also increased from 26 percent to 30 percent. Thus, income inequality trends remained the same as a result of the deterioration in income distribution for both rural and urban areas. Furthermore, inequality increased rather sharply during the early 1990s, which coincided with the period of rapid trade liberalisation.

Trade Liberalization and Poverty: Transmission Channels

Identifying the transmission channels that link trade liberalization and poverty is quite complex. This is because, apart from assessing the specific impact on the domestic economy, the heterogeneity of the poor is an issue in itself. Since the poor differ among themselves, this implies that the effects of trade liberalisation may differ among them. As such, there will be gainers and losers, and any measure of net impact is difficult to arrive at. Moreover, the gains and losses are likely to have a significant time dimension so that the short run stress on particular groups of the poor may be more than compensated for in the longer run. As a result, the static effects of trade liberalisation are likely to be different in many respects from its dynamic consequences.

In the present study, we focus on main channels through which trade liberalisation influences poverty outcomes in Bangladesh. Since poverty outcomes are manifested and measured at the household level, we concentrate on how the meso-environment facing the households, particularly the poor households, are affected by the forces of trade liberalisation.[2]

For instance, the direct effect of trade liberalisation through the price channel depends on how resulting changes in the prices of importables not only affect the prices faced by households, but also the prices of other commodities. Thus, several dimensions of the channel determine the nature of the impact (e.g. nature of the domestic market and its underlying institutions and importance of the imported commodities and foreign trade in general).

Similarly, changes in production structure as a result of trade liberalisation will affect wages and levels of employment depending upon the characteristics of the labour market and the relative flexibility of wages and employment. Changes in government revenue and expenditure patterns and their impacts on the poor depend on several factors e.g. extent of revenue loss due to trade liberalisation, forms of taxation introduced to maintain revenue neutrality, etc.

Outline of the Methodology

The general methodology is based on a framework that is capable of examining the consequences of certain policy changes on the economy as a whole, while at the same time allowing for an analysis of the poverty and distributional impacts at the household level. To accomplish this, we construct a Computable General Equilibrium (CGE) model.

Calibrating the CGE Model

The CGE model is numerically calibrated to the 1995/96 Social Accounting Matrix (SAM). The main sources of information for the SAM are:

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[2] Although intra-household distribution has significant implications for the gender aspects of the poverty impacts of trade liberalization, the scope of the paper is restricted to household-level impacts.

- 1993/94 Input-output table prepared by the Bangladesh Institute of Development Studies (BIDS 1998);
- Household Expenditure Survey 1995/96 by the Bangladesh Bureau of Statistics (BBS, 1998a);
- Labour Force Survey (LFS) by the Bangladesh Bureau of Statistics (BBS, 1998b); and
- National Income Estimates by the Bangladesh Bureau of Statistics (BBS, 2001).

Accounts: The 1995/96 SAM identifies the economic relations through *four types of accounts*: (i) production activity accounts for 26 sectors; (ii) 7 factors of production with 6 different types of labour and one capital; (iii) current account transactions among 3 main institutional agents - households and unincorporated capital, government and the rest of the world; and (iv) one consolidated capital accounts to capture the flows of savings and investment by institutions and sectors respectively.

Activity: The activity account is represented by 26 producing activities. These were derived from the 79 sectors of the 1993/94 input-output table. Due to lack of adequate information, the distinction between activity and commodity is not made, and hence they are synonymous.

Households: An important feature of the SAM for 1995/96 is the disaggregation of households into 7 groups. The household groups differ with respect to employment status, income levels, and expenditure patterns. Pyatt and Thorbecke (1976) have suggested location, sociological, and wealth criteria to classify household groups[3]. In this study, location (rural-urban), land ownership, occupational status, and level of education information as contained in the HES 95/95, were used for household classification.

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[3] For instance, the location criterion which distinguishes a household as urban or rural is useful since it captures many aspects of duality. Depending on this distinction, individuals with otherwise similar characteristics may be paid different wages, have different job opportunities and employment expectations and generally be subject to different sets of parameters in their socio-economic behaviour (Pyatt et al, 1984).

Labour: The SAM for 1995/96 also accounts for disaggregation of labour into 6 groups based on gender and skill level of the workers. This labour classification is used to examine the consequences of policy measures on "factorial" income distribution. The labour classification was based on information on education level and gender. The disaggregation of factors, households, activities and institutions in the SAM and model is given in Table 1.

Table 1: Disaggregation and description of factors, institutions and households

Set	Description of Elements
Factors of Production	
Labour (6)	**Female**: 3 categories according to skill levels (low, medium and high)Low: 0-V class; Medium: VI-X class; and High: X Plus
	Male: 3 categories according to skill levels (low, medium and high)Low: 0-V class; Medium: VI-X class; and High: X Plus
Capital (1)	1 type only
Institutions	
Households (7)	**Rural** *Agriculture*: 3 categories according to land ownership Labourer household: 0-0.49 ha; Small Farmers: 0.5-2.49, Large Farmers: >2.5 ha.
	Rural *Non-Farm*: 1 category according to occupation
	Urban: 3 categories according to the level of education of the household head: Low Skilled: 0-V class; Medium Skilled: VI-X class; and Professional: X +
Others (2)	Government
	Rest of the World
Activities	
Agriculture (7)	**Crops** *Non-traded*: Aman and Boro
	Crops *Traded*: Grains and Commercial Crop
	Non-crops *Non-traded*: Forestry
	Non-crops Traded: Livestock and Fish
Industries (12)	**Food Processing** *Traded*: Rice Milling, Ata and Flour, Other Food and Tobacco
	Textiles *Traded*: Clothing, Read Made Garments and Leather.
	Others *Traded*: Chemical, Fertilizer, Petroleum Products, Machinery and Miscellaneous Industries
Services (6)	*Non-Traded*: Construction, Gas, Trade, Social, Public Administration, Financial Service and Other Services

Describing the CGE model for the study

A CGE model captures the detailed accounts of the circular flows of receipts and outlays in an economy. In addition, it satisfies the equilibrium conditions for all markets simultaneously and is thus useful in analysing associations between various agents of the economy.

In line with most CGE models, the model used in this study was solved in a comparative static mode, thereby providing an instrument for controlled policy simulations and experiments. The solution of each simulation presents complete sets of socio-economic, meso-, and macro-level indicators such as activity/commodity prices, household incomes and expenditures, factor demand and supplies, gross domestic products, exports and imports, and household poverty situation. The model is calibrated to the SAM to exactly reproduce the base year values[4].

Production Structure: A nested production structure is used for each sector. At the top level, real value added and intermediate inputs are combined via a Constant Elasticity Substitution (CES) production to produce gross output. The value added is a CES aggregate of seven types of factor inputs, which includes capital and six different categories of labour inputs. The composite intermediate input is composed of domestic and imported intermediates.

Demand Structure: The structure of demand is composed of demand for private and public consumption expenditure, investment and exports. Private consumption demand is specified by a Cobb-Douglas function, which is combined with a nested CES function of composite products. The distribution of investment by sector is modeled using a fixed-coefficient specification. A Leontief specification applies to both domestically produced and imported investment. The formulation of investment is purely static: there is no link between increased savings today and additional investment

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[4] In the calibration procedure, most of the model parameters are estimated endogenously keeping the various elasticity values fixed.

in a subsequent time period. Thus, the dynamic impacts of capital accumulation as well as intertemporal features are not considered here. Total government expenditure is assumed exogenous. The distribution of government expenditure by sector is modeled using a fixed-coefficient specification. Export demand is specified by a downward sloping world demand for exports.

System Constraints and Equilibrium Conditions: There are four constraints in the system. The real constraint refers to domestic commodity and factor market, while the nominal constraint represents two macro balances: the current account balance of the rest of the world and the savings-investment balance.

Commodity. Sectoral supply is a composite of imports and output sold in the domestic market. Composite demand, on the other hand, includes final demands (i.e. private and public consumption expenditure and investment) and intermediate input demand. Variations in sectoral prices assure equilibrium between sectoral supply and demand.

Factor Market. It is generally assumed that total quantities of factors supplied are fixed and hence variations in the factors returns (i.e. wages and rents) ensure equilibrium between factor demand and supply. This specification implies full mobility of factors across producing activities. However, given the comparative static nature of the analysis, full mobility specification is adopted for the seven types of factors (six types of labour and one capital). Factors with variations in their returns (e.g. wages and rental values) ensure equilibrium in the factor market.

Current Account Balance. The inflows (transfers to and from domestic institutions) are fixed but imports and exports are determined endogenously in the model. Foreign savings is fixed, while the nominal exchange rate is the numeraire.

Savings-investment equilibrium. The model treats investment decisions as given and hence savings adjusts to ensure equality to the fixed value of investment. To do so, the propensity to save of households is selected as the adjustment variable.

Table 2: Summary of model features

Labour is mobile across producing activities, whereas capital is sector-specific
Primary factor supplies are exogenous and fixed
The world prices of imports are exogenous invoking the small country assumption
On the export side, Bangladesh is assumed to have some market power invoking endogeneity of domestic and world price of Bangladeshi exports
Current account balance or deficit is fixed
Imports and domestically produced goods are imperfect substitutes
Output produced for domestic and export market reflects differences in quality
Savings of domestic institutions adjust to equate given investment
Nominal exchange rate acts as the numeraire
Excess demand conditions are satisfied

Salient Features of the Base Scenario

The main features of the Bangladesh economy at the base case are depicted in Table 3. The table shows sectoral tariff rates, value added shares, imports and exports shares by sectors, proportions of imports and exports to sectoral outputs, and elasticity of export demand (ex) and CES function (em).

The import duty rates range from as low as 2 percent to as high as 47 percent. In general, most manufacturing activities pay higher duties than activities in the agriculture sectors. The highest import duty rate is in the petroleum sector (i.e. 47 %), followed by other food (37%), clothing (24%), chemical (21%) and machinery (18%), while, the lowest duties are paid by tobacco (2%), ready-made garments (2.9%) and rice milling (3.4%) sectors. Thus, the above tariff structure suggests that tariff elimination will likely lead to an increase in imports from the heavily protected sectors.

The structure of production reveals that the contribution of agriculture, manufacturing and services activities in total value added are 22, 31 and 47 percent, respectively. Moreover, it is worth noting that trade and other services sectors, when combined, account for about 34 percent of total value added (see Appendix Table A2 for product and factor market details).

Table 3: Salient features of base scenario

	Tm	Em	ex	V_i/V	M_i/M	E_i/E	M_i/Q_i	E_i/Q_i
Aman Paddy		1.8	3.0	3.90				
Boro Paddy		1.8	3.0	4.44				
Grains	16.51	1.8	3.0	0.38	1.65		34.63	
Commercial crops	7.18	1.8	3.0	4.28	2.94	0.33	5.99	0.40
Livestock		1.8	3.0	4.48	0.92	0.09	1.99	0.12
Fish		1.8	3.0	2.16		7.73	0.00	15.59
Forestry		1.8	3.0	2.68				
AGRICULTURE				**22.32**				
Rice Milling	3.43	1.8	3.0	6.07	0.22		0.18	
Ata and Flour	12.16	1.3	1.6	0.50	0.02		0.17	
Other Food	37.42	1.3	1.6	1.67	3.30	4.88	8.83	7.82
Leather		1.3	1.6	0.63	0.11	11.05	0.90	53.49
Clothing	24.42	1.3	1.6	3.89	9.00	12.20	16.03	13.02
Ready Made Garment	2.96	1.3	1.6	3.00	0.54	60.84	1.40	94.67
Tobacco	2.04	1.3	1.6	0.64	0.04		0.55	0.01
Chemical	20.98	1.3	1.6	0.60	9.44	0.20	64.39	0.81
Fertilizer	0.08	1.3	1.6	0.30	1.12	0.73	17.48	6.83
Petroleum	47.15	1.3	1.6	0.89	3.85	0.32	36.53	1.84
Machinery	17.88	1.3	1.6	1.60	27.91	0.49	91.44	0.96
Miscellaneous Ind.	6.69	1.3	1.6	2.38	38.93	1.14	129.16	2.27
Construction				5.63				
INDUSTRY				**30.59**				
Utility				2.81				
Trade Services				22.93				
Social Services				3.96				
Public Administration				2.69				
Financial Services				6.08				
Other Services				11.44				
SERVICES				**47.09**				
Total (100.00)	**15.33**			**100.00**	**100.00**	**100.00**	**8.41**	**5.04**

Four sectors - miscellaneous industry (38.9%), machinery (27.9%), chemical (9.4%) and clothing (9%) - account for more then 80 percent of the total imports. As a percent of sectoral output, import volumes are also substantial for heavily protected sectors such as miscellaneous industry (129%), machinery (91%), chemical (64%) and petroleum (37%).

In the same vein, more than 90 percent of exports originate from four sectors: ready-made garments (60.8%), clothing (12.2%), leather (11%) and fish (7.7%). The ready-made garments sector has the highest export-to-output intensity at 95 percent, followed by leather, fish and clothing sectors at 53, 16 and 13 percent respectively.

On the whole, the above analysis of the structure of the Bangladesh economy suggests that the impact of tariff elimination on the economy may likely be channeled to the four major importing sectors as a result of variations in import volumes, demand for primary factors, and value added.

Simulation Design

Three simulations were conducted to analyse the impacts of trade reforms in the context of the Bangladesh economy:

- **Simulation 1:** All tariffs are eliminated. The pre-simulation government budgetary position is maintained. That is, the reduction in government revenue (arising from loss of tariff revenues) is compensated by an increase (by 55 percent) in existing production taxes, and through the imposition of new taxes on the construction sector.
- **Simulation 2:** Full tariff removal, with the decline in government revenues compensated by increasing (by almost 300 percent) the income tax rates of households (e.g. non-farm, medium-skilled and professional), and levying income taxes on large farmer households, such that the pre-simulation budgetary position of the government is maintained.

- **Simulation 3:** Change in tariff rates in a way that resembles the actual tariff reforms undertaken in the country. This entailed the decline in both the spread and effective average duty rates, thereby reducing the mean rates and variance. The foregone government revenue is compensated by the imposition of new taxes on the construction sector.

Simulation Outcomes

To better understand the economy-wide impacts of tariff reduction, the simulation results are reported in terms of price, volume, income, consumption, and welfare impacts.

Price and Volume Effects

The immediate impact of tariff elimination is through changes in import prices. The changes in domestic import prices then influence other prices, thereby resulting in the reallocation of resources, changes in household incomes and variations in consumption expenditures. The prices and volume effects of tariff elimination are presented in Table 4.

As expected, the domestic price of imported commodities decreases as a result of tariff elimination, leading to an increase in import volumes. Under *simulation 1,* the domestic import prices of all imported commodities decreased, with the greatest reduction observed among products with relatively higher initial import duty rates. In spite of this, the reduction in the domestic prices of imports did not necessarily translate into increased imports. This is because the changes in import volumes depend on the change in the relative price of imports to domestic goods. Nonetheless, in the case of heavily protected sectors, the fall in import prices was relatively larger than the fall in domestic prices, thereby leading to higher demand for imports and lower demand for domestic products. As a result, increased import volumes are observed for the most heavily protected sectors: petroleum (33.6%), chemical (9.0%), clothing (20.7%), other food (26.7%), grains (6.5%), and machinery (2.8%).

Table 4: Effects of trade liberalization on sectoral prices and volumes

SIMULATION 1									
Sectors	**Tm**	**PM_i**	**M_i**	**PD_i**	**D_i**	**PE_i**	**E_i**	**P_i**	**Q_i**
Aman Paddy				-10.3	-0.4			-10.3	-0.4
Boro Paddy				-10.3	-0.3			-10.3	-0.3
Grains	16.5	-14.2	6.5	-10.3	-1.7			-11.4	0.6
Commercial crops	7.2	-6.7	-6.7	-10.2	0.0	-4.0	12.9	-10.0	-0.4
Livestock			-17.0	-10.2	0.8	-4.1	13.5	-10.1	0.5
Fish				-11.6	0.9	-4.7	15.5	-11.6	0.9
Forestry				-10.5	-2.4			-10.5	-2.4
Rice Milling	3.4	-3.3	-11.1	-10.1	-0.1	-3.6	19.0	-10.1	-0.1
Ata and Flour	12.2	-10.8	0.7	-10.8	0.7				
Other Food	37.4	-27.2	26.7	-9.6	-2.3	-3.5	5.8	-11.9	0.7
Leather			-12.2	-13.2	4.1	-7.2	12.7	-13.0	3.7
Clothing	24.4	-19.6	20.7	-10.1	4.4	-6.1	10.6	-12.0	7.3
Ready Made Garment	3.0	-2.9	-9.6	-16.0	9.2	-10.3	19.0	-13.5	5.1
Tobacco	2.0	-2.0	-2.9	18.1	-23.8	18.3	-23.6	18.0	-23.7
Chemical	21.0	-17.3	9.0	-3.4	-11.0	2.5	-3.9	-9.5	-3.1
Fertilizer	0.1	-0.1	-11.0	-9.5	1.3	-4.8	8.2	-8.1	-0.7
Petroleum	47.2	-32.0	33.6	-3.1	-15.8	4.6	-6.9	-14.0	-1.7
Machinery	17.9	-15.2	2.8	-4.5	-12.9	2.5	-3.8	-10.0	-5.3
Miscellaneous Ind.	6.7	-6.3	-4.1	-6.8	-3.4	-2.1	3.5	-6.5	-3.8
Construction				1.3	-3.9			1.3	-3.9
Utility				-4.7	-3.6			-4.7	-3.6
Trade Services				-10.5	-1.0			-10.5	-1.0
Social Services				-10.2	0.0			-10.2	0.0
Public Administration				-9.2	-0.7			-9.2	-0.7
Financial Services				-9.9	-1.1			-9.9	-1.1
Other Services				-9.9	-0.5			-9.9	-0.5

SIMULATION 2									
Sectors	**Tm**	**PM_i**	**M_i**	**PD_i**	**D_i**	**PE_i**	**E_i**	**P_i**	**Q_i**
Aman Paddy				-11.0	-1.4			-11.0	-1.4
Boro Paddy				-11.3	-1.3			-11.3	-1.3
Grains	16.5	-14.2	4.5	-11.2	-1.6			-12.1	0.1
Commercial crops	7.2	-6.7	-8.0	-11.0	0.2	-4.3	14.2	-10.7	-0.3
Livestock			-19.9	-11.0	-1.2	-4.0	13.2	-10.8	-1.6
Fish				-12.7	-0.6	-4.8	16.0	-12.7	-0.6
Forestry				-11.2	2.9			-11.2	2.9
Rice Milling	3.4	-3.3	-14.1	-11.1	-1.7	-3.6	11.8	-11.1	-1.8
Ata and Flour	12.2			–10.8	0.7	-10.8	-1.3	-11.6	-0.2
Other Food	37.4	-27.2	22.3	-12.4	-2.2	-4.8	8.1	-14.2	0.4
Leather			-17.1	-16.0	2.3	-8.0	14.2	-15.8	1.9
Clothing	24.4	-19.6	18.4	-12.5	6.1	-7.7	13.7	-13.9	8.3
Ready Made Garment	3.0	-2.9	-13.6	-18.8	9.1	-11.6	21.9	-15.8	4.0
Tobacco	2.0	-2.0	-13.8	-10.8	-2.6	-4.1	7.0	-10.8	-2.6
Chemical	21.0	–17.3	7.1	-12.6	-0.5	-5.7	9.8	-14.6	2.6
Fertilizer	0.1	-0.1	-14.0	-12.8	2.7	-6.8	11.9	-10.9	-0.1
Petroleum	47.2	-32.0	27.1	-12.6	-8.4	-3.0	5.0	-19.6	2.1
Machinery	17.9	-15.2	7.6	-12.6	3.2	-7.1	12.5	-13.9	5.4
Miscellaneous Ind.	6.7	-6.3	-3.7	-11.1	3.7	-6.4	11.3	-8.4	-0.6
Construction				-11.2	7.0			-11.2	7.0
Utility				-11.3	1.2			-11.3	1.2
Trade Services				-11.5	0.1			-11.5	0.1
Social Services				-11.1	-1.8			-11.1	-1.8
Public Administration				-11.1	0.5			-11.1	0.5
Financial Services				-11.1	-2.3			-11.1	-2.3
Other Services				-11.0	-2.9			-11.0	-2.9

SIMULATION 3									
Sectors	**Tm**	**PM_i**	**M_i**	**PD_i**	**D_i**	**PE_i**	**E_i**	**P_i**	**Q_i**
Aman Paddy				-1.5	0.4			-1.5	0.4
Boro Paddy				-1.7	0.5			-1.7	0.5
Grains	16.5	-7.7	0.3	-1.7	1.5			-3.5	1.8
Commercial crops	7.2	0.3	2.4	-1.4	0.7	-0.7	2.1	-1.3	0.5
Livestock			2.1	-1.5	0.7	-0.7	2.2	-1.5	0.6
Fish				-1.8	0.5	-0.8	2.4	-1.8	0.5
Forestry				-1.5	0.4			-1.5	0.4
Rice Milling	3.4	3.9	8.0	-1.5	0.3	-0.6	1.8	-1.5	0.3
Ata and Flour	12.2	-4.2	3.2	–2.6	1.1				1.2
Other Food	37.4	16.2	0.4	-2.0	0.2	-0.8	1.3	-3.8	2.0
Leather		15.2	6.9	-2.4	1.4	-1.5	2.5	-2.1	1.0
Clothing	24.4	-7.4	8.8	-2.1	1.2	-1.4	2.2	-3.1	2.5
Ready Made Garment	3.0	11.9	4.2	-2.5	2.6	-2.0	3.3	0.3	1.1
Tobacco	2.0	12.9	5.9	-1.0	0.2	-0.4	0.6	-1.0	0.3
Chemical	21.0	-8.7	6.3	-2.8	2.1	-0.5	0.9	-5.3	1.3
Fertilizer	0.1	10.4	2.3	-2.8	3.4	-2.4	4.0	-0.9	0.8
Petroleum	47.2	24.9	8.2	-3.1	8.1	1.5	2.4	10.9	2.7
Machinery	17.9	-6.3	1.8	-3.2	2.8	-0.6	0.9	-4.7	0.5
Miscellaneous Ind.	6.7	7.9	7.2	-0.8	4.5	-1.8	3.0	4.1	2.3
Construction				1.7	1.5			1.7	1.5
Utility				-1.8	0.9			-1.8	0.9
Trade Services				-1.7	0.6			-1.7	0.6
Social Services				-1.5	0.1			-1.5	0.1
Public Administration				-1.0	0.3			-1.0	0.3
Financial Services				-1.4	0.2			-1.4	0.2
Other Services				-1.3	0.3			-1.3	0.3

Tm: initial tariff rate; PM(PD,PE,P): Import (Domestic, Export, Producer) Price; M(D,E,Q): Volume of imports (domestic sales, exports, production).

As for other imports, the volume of imports declined despite the import price reduction. As mentioned earlier, changes in relative prices of domestic sales and imported commodities partly explain these outcomes. In the case of ready-made garments for instance, the fall in import price of 2.9 percent vis-a-vis the 16 percent fall in domestic prices resulted in an increased demand for domestic products (movement of factors in those sectors also ensured higher supply) and a reduced demand for imported substitutes. This pattern holds for all imported commodities that registered a fall in import demand even with the complete elimination of tariffs. These outcomes can also be partially attributed to the fixed balance of payments constraint. The domestic demand for some of these imported goods rose because of increased imports in other sectors and the fixed BOP specification.

The relationship between the domestic price of imports and import volumes observed in the *first simulation* is also found in the case of the *second simulation*, although the magnitudes of variation are somewhat different. In the *third simulation*, tariff rates were rationalized such that the new rates (see Table A1) are higher for some consumer goods (such as rice milling, other food, clothing, ready made garments and miscellaneous products) and a few intermediate goods (e.g. commercial crops, petroleum and fertilizer). Compared to the base case, this brought about an increase in prices of these imports and consequent substantial fall in their import volumes. The new volumes, however, were lower for other imported products when compared with their base values. This is due to a reduction in the price of imports among these products.

In order to keep the balance of payments fixed against the backdrop of increased imports, exports from Bangladesh must increase. To accomplish this, Bangladeshi exporters must lower their prices in the world market. Hence, the decline in export prices results in an increase in Bangladeshi exports. *In simulation 1*, the greatest export increase is observed for ready-made garments (18.9%, where export price fell by 10.3%), fish (15.5%, where export price fell by 4.7%), livestock (13.5% where export price fell by 4.1%), commercial crops (13.5%, where export price fell by 3.9%), and leather (12.7%, where export price fell by 7.2%). In contrast, export volumes decrease in sectors whose export price increased: tobacco (-23.6% where export price rose by 18.3%) chemical (-3.9%, where export price rose by 2.5%), and machinery (-3.8%, where export price rose by 2.5%).

In the case of the *second simulation,* an increase in exports is observed across all sectors. Bangladesh can only increase its share in the world market if it lowers its export prices, which is also observed in the results. As expected, the largest price fall (11.6%) is observed for ready-made garments with the corresponding highest export increase (21.9%) for that sector. On the other hand, the smallest fall in export price (2.9%) and volume (4%) is observed for the petroleum sector. Trends in export volumes and prices in the *third simulation* were similar to the case of simulation 1. Since the magnitude of export price movements was smaller in the second simulation, the changes in export volumes were relatively smaller in this case compared to the first simulation.

In the *first and second simulations,* the decline in both domestic import and domestic sales prices resulted in the fall of composite prices for all products, consequently leading to a rise in consumption. However, households were unable to take full advantage of this price fall because of the decrease in their nominal income. As a result, consumption of most products declined, while that of a few others increased (e.g. other food, leather products, clothing and ready-made garments, etc.). In contrast, the reduction in domestic import and domestic sales prices led to a decline in composite prices for all commodities, together with an increase in the demand for composite commodities under the *third simulation*.

Factor Movements and Impacts on Value added

Movements of primary factors and the corresponding changes in value added by sectors are reported in Table 5. As expected, full tariff elimination, along with an increase in consumption taxes (in the case of simulations 1 and 3), results in a resource allocation from

Table 5: Factor movements and value added by sectors

				Simulation 1			Simulation 2			Simulation 3		
	L_i/K_i	wL_i/wL	rK_i/rK	¶KD_i	¶LD_i	¶VA_i	¶KD_i	¶LD_i	¶VA_i	¶KD_i	¶LD_i	¶VA_i
Aman Paddy	1.6	5.2	2.8	0.11	-0.24	-0.11	-1.76	-1.78	-1.78	0.30	0.05	0.14
Boro Paddy	1.3	5.4	3.6	0.18	-0.17	-0.02	-2.04	-2.05	-2.05	0.04	-0.21	-0.10
Grains	1.5	0.5	0.3	-1.11	-1.18	-1.16	-2.30	-2.11	-2.19	-2.01	-2.21	-2.13
Commercial crops	0.5	3.2	5.2	0.71	-0.02	0.45	0.02	-0.28	-0.09	0.66	0.34	0.55
Livestock	1.1	5.1	3.9	1.52	-0.03	0.68	-1.45	-2.32	-1.92	0.49	0.05	0.25
Fish	0.1	0.4	3.7	3.45	2.28	3.40	1.17	1.07	1.16	0.44	0.13	0.41
Forestry	0.3	1.5	3.7	-2.24	-2.05	-2.19	2.31	2.69	2.41	-0.61	-0.77	-0.65
Rice Milling	0.0	0.6	10.8	0.74	-0.19	0.70	-2.18	-2.55	-2.20	0.09	-0.26	0.08
Ata and Flour	0.0	0.0	0.9	0.30	0.41	0.31	-1.61	-1.23	-1.59	-0.61	-0.79	-0.62
Other Food	0.2	0.6	2.6	-1.28	-1.24	-1.28	-2.83	-2.50	-2.78	-0.87	-1.07	-0.91
Leather	0.2	0.3	0.9	9.54	9.65	9.56	7.38	7.81	7.46	1.15	0.96	1.11
Clothing	1.1	4.4	3.5	5.38	5.27	5.32	5.24	5.49	5.37	0.38	0.16	0.26
Ready Made Garments	0.8	2.9	3.1	18.47	14.93	16.87	18.85	16.60	17.84	2.29	1.61	1.99
Tobacco	*0.4*	*0.4*	*0.9*	-22.92	-23.39	-23.04	-2.54	-2.70	-2.60	0.33	0.03	0.26
Chemical	*1.7*	*0.8*	*0.4*	-9.29	-9.51	-9.52	-3.19	-2.94	-3.03	-4.03	-4.25	-4.17
Fertilizer	0.8	0.3	0.3	4.29	4.18	4.21	0.63	1.02	0.81	1.33	1.12	1.23
Petroleum	*0.1*	*0.2*	*1.5*	-15.52	-15.38	-15.51	-10.53	-10.19	-10.50	-10.10	-10.25	-10.11
Machinery	*0.3*	*0.9*	*2.2*	-11.63	-11.54	-11.61	0.28	0.69	0.39	-5.31	-5.49	-5.35
Miscellaneous Ind.	0.7	2.0	2.7	-0.93	-1.28	-1.07	3.65	3.68	3.66	5.40	5.13	5.30
Construction	0.5	3.8	7.2	-2.62	-2.54	-2.59	6.30	6.66	6.41	-1.38	-1.56	-1.44
Utility	0.2	1.1	4.3	-3.03	-3.14	-3.05	0.30	0.73	0.38	0.26	0.04	0.22
Trade Services	3.6	38.8	9.2	-0.72	-0.63	-0.65	-0.97	-0.61	-0.68	0.16	-0.02	0.02
Social Services	1.0	4.4	3.6	0.73	0.09	0.40	-2.25	-2.12	-2.19	0.00	-0.28	-0.15
Public Administration	4.2	4.7	1.0	1.64	1.393	1.44	0.03	0.35	0.28	0.94	0.70	0.74
Financial Services	0.3	3.4	8.4	-0.55	-0.69	-0.59	-2.71	-2.30	-2.60	0.24	0.01	0.18
Other Services	0.6	9.3	13.3	0.67	-0.04	0.43	-3.26	-3.40	-3.31	0.39	0.09	0.28
Total		100.0	100.0									

previously protected sectors towards un-protected and less taxed sectors. Thus, both labour and capital factors are released from the protected sectors (such as petroleum, chemical, other food and machinery sectors) to relatively less protected (ready-made garments and commercial crops) or un-protected sectors (leather, fish and livestock). As a result of these factor movements, the value added of the protected sectors declined, whereas the value added of less protected and un-protected sectors increased. An exception to this was clothing in that, despite being a heavily protected sector, its value added increased to meet the increased input demand of the expanding ready-made garments sector.

Furthermore, due to tariff elimination and rationalization, the composite and, to a lesser extent, the general price indices decline. This fall in the general price level induces a subsequent reduction in the nominal wage and rental rate of capital. As a result, sectoral output (value added) declined in all simulations relative to the base scenario[5] (Table A3).

Income Effects

The initial distribution of household income from wages, capital and other sources (e.g. remittances and transfers) is presented in Table 6. This table also shows the post-simulation changes in household income from the above-mentioned sources.

Agriculture labour households received income only from wages, while small farm and non-farm households garner more than 55 percent of their income from wage sources. On the other hand, large farm households received almost 67 percent of their income from capital returns. The factorial income distribution pattern of the rural household groups suggests that a fall in wage income will likely affect the poor household groups (i.e. labour, small and non-farm) more than the rich household groups. Similarly, a decline in capital income

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[5] The real wage and real return to capital were, however, positive, implying that sectoral real income was higher under the tariff elimination simulation than in the base case.

Table 6: Income profiles of household groups

	Simulation 1														
		Income share %							Income Change						
	Change	LAB	Small	Large	NFHH	WLSKL	WSKL	PROF	LAB	Small	Large	NFHH	WLSKL	WSKL	PROF
Wage	**-9.6**	100.0	57.0	32.3	55.6	60.7	26.1	27.4	-10.4	-10.2	-10.4	-10.0	-10.2	-7.5	-8.7
Capital	**-10.6**	0.0	42.2	66.5	41.9	37.4	63.6	67.0	0.0	-10.6	-10.4	-10.6	-10.6	-10.6	-10.6
Other Income	**0.0**	0.0	0.8	1.3	2.5	1.9	10.3	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**-10.1**	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-10.4	-10.4	-10.4	-10.2	-10.3	-9.5	-10.0
Change in Direct Taxes									0.0	0.0	0.0	11.1	0.0	10.6	11.1
Net Change in Nominal Income									-10.4	-10.4	-10.4	-10.2	-10.3	-9.5	-10.0
	Simulation 2														
		Income share %							Income Change						
	Change	LAB	Small	Large	NFHH	WLSKL	WSKL	PROF	LAB	Small	Large	NFHH	WLSKL	WSKL	PROF
Wage	**-9.9**	100.0	57.0	32.3	55.6	60.7	26.1	27.4	-10.8	-10.7	-10.4	-10.4	-10.5	-7.9	-9.2
Capital	**-10.8**	0.0	42.2	66.5	41.9	37.4	63.6	67.0	0.0	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8
Other Income	**0.0**	0.0	0.8	1.3	2.5	1.9	10.3	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**-10.8**	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-10.8	-10.8	-10.8	-10.8	-10.9	-10.9	-10.9
Change in Direct Taxes									0.0	0.0	“-”	-72.0	0.0	-72.3	-75.6
Net Change in Nominal Income									-10.8	-10.8	-13.1	-12.4	-10.9	-16.3	-15.5
	Simulation 3														
		Income share %							Income Change						
	Change	LAB	Small	Large	NFHH	WLSKL	WSKL	PROF	LAB	Small	Large	NFHH	WLSKL	WSKL	PROF
Wage	**-1.6**	100.0	57.0	32.3	55.6	60.7	26.1	27.4	-1.2	-1.3	-1.5	-1.3	-1.4	-3.1	-2.2
Capital	**-1.1**	0.0	42.2	66.5	41.9	37.4	63.6	67.0	0.0	-1.3	-1.3	-1.1	-1.2	-0.8	-1.1
Other Income	**0.0**	0.0	0.8	1.3	2.5	1.9	10.3	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**-1.3**	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-1.2	-1.3	-1.3	-1.2	-1.3	-1.3	-1.3
Change in Direct Taxes									0.0	0.0	0.0	1.5	0.0	1.2	1.3
Net Change in Nominal Income									-1.2	-1.3	-1.3	-1.2	-1.3	-1.3	-1.3

is likely to hurt the rich household groups more than the poor household groups.

In the case of urban households, both the professional and skilled worker household groups generate more than 60 percent of their income from capital returns. The low skilled household group received only 38 percent of their incomes from capital factor. Once again a fall in capital income would have deleterious impacts on professional and skilled worker household groups (i.e. rich), in contrast to low skilled household groups (i.e. poor).

In the *first simulation, a*s a result of the decline in labour and capital factor returns, income from both wages and capital returns register a sharp decline from the base values. Wage and capital income decrease by 9.6 and 10.6 percent respectively, leading to a 10.1 percent fall in overall income. Since the direct tax rates remain the same, resulting changes in direct tax payments are small. Note that a positive (negative) value indicates a reduction (rise) in the income taxes paid and therefore has a positive (negative) impact on net income.

In the *second simulation*, wage, capital, and total factor income decline by 9.9, 10.8 and 10.8 percent, respectively. This reduction in factor income translates into a decline in income for all household groups. However, since the direct tax rates were significantly raised among existing income tax paying household groups (i.e. non-farm, medium-skilled and professional), and new taxes were imposed on large farmer household groups, the resulting changes in direct tax amounts were significant. This resulted in a substantial fall in net income across the four household groups.

In the case of the *third simulation*, the fall in factor returns was smaller than that of the first two simulations, with 1.6 and 1.2 percent reductions in wage and capital income, respectively. As a result, overall income fell by 1.31 percent.

Consumption Effects

The consumption patterns of the seven representative household groups are presented in Table 7. All other poor household groups

Table 7: Consumption patterns by household group

	Simulation 1		Simulation 2		Simulation 3		Consumption Share (%)						
	¶P_i	¶Q_i	¶P_i	¶Q_i	¶P_i	¶Q_i	Labour	Small	Large	NFHH	WLSKL	WMSKL	PROF
Aman Paddy	-10.3	-0.4	-11.0	-1.4	-1.5	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Boro Paddy	-10.3	-0.3	-11.3	-1.3	-1.7	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grains	-11.4	0.6	-12.1	0.1	-3.5	1.8	0.1	0.2	0.2	0.1	0.1	0.1	0.0
Commercial crops	-10.0	-0.4	-10.7	-0.3	-1.3	0.5	4.5	5.7	5.8	3.6	3.0	2.7	4.4
Livestock	-10.1	0.5	-10.8	-1.6	-1.5	0.6	2.6	3.2	5.1	3.6	5.1	6.7	6.8
Fish	-11.6	0.9	-12.7	-0.6	-1.8	0.5	3.6	4.6	4.5	3.9	3.4	3.2	2.2
Forestry	-10.5	-2.4	-11.2	2.9	-1.5	0.4	4.4	4.4	3.5	3.7	2.8	1.7	0.5
Rice Milling	-10.1	-0.1	-11.1	-1.8	-1.5	0.3	*47.5*	*30.1*	*15.0*	*33.3*	*28.4*	*18.9*	*7.2*
Ata and Flour	-10.8	0.7	-11.6	-0.2	-2.6	1.2	1.8	1.4	0.8	1.4	1.1	0.8	0.5
Other Food	-11.9	0.7	-14.2	0.4	-3.8	2.0	3.7	5.7	6.7	4.2	4.0	4.6	4.2
Leather	-13.0	3.7	-15.8	1.9	-2.1	1.0	0.3	0.8	0.9	0.7	0.7	1.1	1.7
Clothing	-12.0	7.3	-13.9	8.3	-3.1	2.5	4.8	5.8	6.1	5.4	5.4	5.7	4.9
Ready Made Garment	-13.5	5.1	-15.8	4.0	0.3	1.1	0.4	0.5	0.5	0.4	0.4	0.5	0.4
Tobacco	18.0	-23.7	-10.8	-2.6	-1.0	0.3	2.9	2.9	2.3	2.4	2.1	2.0	1.1
Chemical	-9.5	-3.1	-14.6	2.6	-5.3	1.3	1.0	1.1	1.0	1.1	1.3	1.0	0.5
Fertilizer	-8.1	-0.7	-10.9	-0.1	-0.9	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Petroleum	-14.0	-1.7	-19.6	2.1	10.9	2.7	0.3	0.3	0.3	0.4	1.1	1.1	0.6
Machinery	-10.0	-5.3	-13.9	5.4	-4.7	0.5	0.4	0.6	0.9	0.8	0.8	0.8	0.5
Miscellaneous Ind.	-6.5	-3.8	-8.4	-0.6	4.1	2.3	3.0	7.3	13.2	5.4	4.8	5.2	5.1
Construction	1.3	-3.9	-11.2	7.0	1.7	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Utility	-4.7	-3.6	-11.3	1.2	-1.8	0.9	0.4	0.6	0.5	0.7	1.6	2.1	1.9
Trade Services	-10.5	-1.0	-11.5	0.1	-1.7	0.6	2.6	*5.2*	*7.5*	*7.8*	*8.2*	*12.1*	*21.9*
Social Services	-10.2	0.0	-11.1	-1.8	-1.5	0.1	1.2	2.1	3.7	2.4	2.3	3.8	3.5
Public Administration	-9.2	-0.7	-11.1	0.5	-1.0	0.3	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Financial Services	-9.9	-1.1	-11.1	-2.3	-1.4	0.2	6.2	*7.1*	*8.5*	*7.4*	*7.9*	*9.8*	*11.5*
Other Services	-9.9	-0.5	-11.0	-2.9	-1.3	0.3	8.3	*10.4*	*13.1*	*11.4*	*15.6*	*16.2*	*20.6*
Total							*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	*100.0*

(i.e. agriculture labourer, small farm, non-farm), except the low skilled worker households, spend more than 50 percent of their disposable income on food items, especially on rice and wheat. On the other hand, rich household groups spend roughly 40 percent of their disposable income on food items. Similarly, their expenditure on services also accounts for about 40 percent of disposable income. It can also be observed that rich household groups spend more income on imported commodities compared with their poor counterparts.

The consumption patterns of the household groups can be summarized as follows:

- lower prices for food items will likely benefit the poor households more than the rich households;
- lower prices for services will likely benefit the rich households relative to poor households; and
- lower prices for imports will also likely benefit the rich households compared with their poor counterparts.

Welfare Effects

The concept of efficiency or welfare serves as a starting point for any policy analysis. This is because, unlike a pure theoretical approach where only an ordinal measure of alternative states is examined, applied policy analysis employs measures of welfare that allows the comparison of changes in welfare arising from certain policy changes.

Changes in nominal income, consumer price indices (CPI) and equivalent variations (EV) are shown in Table 8. Changes in nominal income for each of the seven household groups are found to be negative. This resulted from the reduction in sectoral nominal wages and returns to capital, which in turn were brought about by the fall in sectoral incomes. Among all households groups, the decline in nominal income was relatively higher for rural households than for urban households.

Table 8: Impacts on welfare of household groups

Welfare Indicators	Household Groups						
	Rural				Urban		
	Labour	Small	Large	Non-Farm	WLSKL	WMSKL	Professional
Simulation 1							
Change in nominal income	-10.4	-10.4	-10.4	-10.2	-10.3	-9.5	-10.0
Change in consumer price index	-9.4	-9.3	-9.3	-9.5	-9.5	-9.6	-9.8
Equivalent variation	-0.9	-1.8	-2.3	-1.9	-1.3	0.5	-0.3
Simulation 2							
Change in nominal income	-10.8	-10.8	-13.1	-12.4	-10.9	-16.3	-15.5
Change in consumer price index	-11.4	-11.4	-11.3	-11.4	-11.5	-11.5	-11.5
Equivalent variation	0.7	1.6	-5.3	-3.7	1.8	-16.9	-25.1
Simulation 3							
Change in nominal income	-1.3	-1.3	-1.3	-1.3	-1.3	-1.2	-1.3
Change in consumer price index	-1.6	-1.4	-1.3	-1.5	-1.6	-1.6	-1.5
Equivalent variation	0.3	0.2	-0.5	0.7	0.6	0.8	1.0

In order to identify the net impact of tariff elimination, the change in nominal income must be compared with the change in consumer price index. In general, the change in the consumer price index indicates a fall for all groups.

By jointly considering the income and price effects, it is possible to capture the welfare impacts through the EV measure. Except for medium-skilled households, the EV is negative for all household groups under *simulation one*. This is a manifestation of the fall in consumption. Furthermore, the values of the EVs of rural households suggest relatively larger losses for the well-off groups (e.g. large farmer and non-farm) when compared with the poor household groups (e.g. labour and small farmer). This pattern, however, is reversed in urban areas, with the EV of poor (i.e. worker low skilled) falling more than that of rich household groups (e.g. medium-skilled and professional). It also appears that welfare losses are larger for rural households compared to their urban counterparts.

In the case of the *second simulation,* the reduction in income among the four relatively rich households is substantially larger than the reduction in their respective CPIs, leading to a decline in their EVs. This results from the imposition of new income taxes on large farm households, together with the increase in existing income tax rates. On the other hand, the EVs of the three other poor household groups were found to be positive, implying that the patterns of welfare changes are progressive. This outcome also suggests that ensuring neutrality of government through income tax changes, rather than indirect tax replacement, is a desirable option.

In the *third simulation*, the larger decline in CPI values outweighed the nominal income fall leading to a positive change in consumption and EV values for all of the seven representative household groups. The values of the EVs indicate larger gains for urban households compared to rural households. Among urban household groups, the gains represent a clear regressive pattern. However, the gains of rural household groups do not provide a clear conclusion, although there is some tendency toward a progressive pattern.

In summary, the changes in welfare indicate the following patterns:

- The welfare losses of tariff elimination (simulations 1 and 2) are larger for rural household groups relative to their urban counterparts. The patterns of losses are progressive for rural household groups but regressive for urban household groups.
- The patterns of welfare changes are progressive when government revenue is maintained constant by increasing income taxes (e.g. second simulation). Losses are large for rich household groups, while gains are modest for poor household groups.
- The main observations are that the welfare gains of tariff rationalization (e.g. third simulation) are moderate and accrue more to the urban household groups than the rural household groups. For urban household groups, a clear regressive pattern is observed, but the pattern is mixed for the rural household groups.

Poverty Incidence

The FGT (Foster et al, 1984) class of poverty measures was utilized to evaluate the effects on poverty among both rural and urban households. Our poverty analysis follows the method developed by Decaluwé et al (1999), which requires: (a) explicit proposition of income distribution formulation corresponding to each household group's characteristics; and (b) postulation of a unique and constant basket of basic needs based on a poverty line whose monetary value is altered by endogenously determined commodity prices. Following this methodology, the derivation of poverty profiles for the representative household groups is depicted as follows:

The income distribution formulation depends on the "minimum" and "maximum" incomes and on the skewness of the distribution. The "Beta" distribution function is used to represent the characteristics of the household groups. The implementation of the "Beta" distribution requires minimum and maximum incomes within each of the household groups and values of shape and skewness parameters (i.e. p and q) of the distribution. The reported minimum and maximum incomes and estimates values of p and q parameters for rural and urban locations are reported in Table 9.

The derived distribution has been used to assess poverty impacts. It is assumed, following a policy change, the intra-group distributions shift proportionally due to mean income change in order to retain constancy of intra-group distributions. That is, if the mean income changes by a factor k, the income of each household within each household group changes by the same factor k. Similarly, the minimum and maximum income of each household group will also vary. Income effects of simulations are provided in Table 9.

The per capita income of each household group is compared with the poverty line to derive poverty profiles. Two poverty lines applicable for rural and urban locations have been defined to capture price and other characteristics. The poverty lines are determined by a basket of quantities of commodities reflecting basic needs. Although the basket remains invariant under different simulations, commodity price changes alter the monetary values of poverty lines. For instance, a rise in commodity prices will shift the poverty line to the right (compared to the base case) and vice versa.

In the base case almost 53 percent of rural populations was poor, compared to around 28 percent for urban areas. This indicates that the incidence of poverty is significantly higher in rural areas.

The impact of tariff elimination and rationalization is transmitted through changes in the incomes of the representative household groups and commodity prices. Income and price changes alter the minimum and maximum incomes within each household group, as well as the rural and urban poverty lines. The estimated post-simulation values of the minimum and maximum incomes and the poverty lines are reported in Table 9. The changes in the values of minimum and maximum incomes and poverty lines are significantly different under the base and simulation scenario. The estimated income and price values are then incorporated in the FGT formulation to

Table 9: Poverty incidence by location

	Income (Tk per capita per month)				Population	Beta		*Poverty Incidence*		
	Minimum	Maximum	Mean	Poverty Line	Share (%)	p	q	Headcount P_0	Gap P_1	Severity P_2
Rural										
Base	17.0	9140	697	650	78.7	2.9	37	53.5	19.7	9.9
Simulation 1	15.2	8194	625	585	78.7	2.9	37	+0.5	+0.7	+0.8
Simulation 2	15.2	8164	625	566	78.7	2.9	37	(-3.8)	(-4.7)	(-5.3)
Simulation 3	16.8	9021	670	637	78.7	2.9	37	(-0.6)	(-0.9)	(-1.2)
Urban										
Base	73.0	26533	1359	725	21.3	1.7	33	28.7	0.1	0.1
Simulation 1	66.0	23898	1224	653	21.3	1.7	33	+1.1	+3.9	+4.3
Simulation 2	66.0	23822	1220	631	21.3	1.7	33	(-4.3)	(-1.4)	(-1.6)
Simulation 3	72.0	26194	1342	716	21.3	1.7	33	+0.1	+0.1	+0.1

derive the post-simulation poverty profiles. The impacts are summarized below:

The incidence of rural poverty, as measured by the headcount ratio, increased by 0.5 percentage points under *simulation one*. This suggests that around 0.5 percent of the population would slip into poverty as a result of the complete elimination of tariffs with a compensatory adjustment in production taxes. In contrast, rural poverty decreased quite substantially (i.e. 3.8%) in the case of the *second simulation*. This is due to the positive consumption/welfare variation of the two rural household groups (labour and small farmer) to which the majority of rural households belong. Similarly, the rural poverty situation also improved under the *third simulation* (e.g. headcount dropped by 0.59 %). This is attributed to the consumption increase of most rural household groups. Moreover, the other two measures of poverty (poverty gap and severity) suggest that these also improve for the rural poor in the second and third simulations.

On the other hand, urban poverty was observed to have deteriorated under first and third simulations, with the largest increase in the first simulation. These results suggest that some households have slipped into poverty, whereas those who were initially poor have, in general, become relatively more impoverished (as indicated by the poverty gap and severity). In the second simulation, urban poverty is reduced by 4.3 percent due to the consumption increase among low skilled households (who account for 70% of urban households). Similarly, the reduction in the poverty gap (1.4%) and severity (1.6%) suggest an improved poverty situation for those who are still poor.

The main observation is that rural poverty, as measured by headcount ratio, is observed to decline due to tariff-income tax reforms (i.e. simulation 2) and tariff rationalization (i.e. simulation 3). Furthermore, the poverty gap and severity have also improved in rural areas. In contrast, the rural poverty situation worsened in the case of tariff-production tax reforms (i.e. simulation 1).

Finally, the urban poverty headcount has worsened (i.e. first and third simulations). The poverty gap and severity have also increased, implying that the benefits of tariff rationalization accrue more to urban rich household groups than to their poorer counterparts. Under the second simulation, urban poverty has improved, and the improvement in the poverty gap and severity resulted in a better poverty profile for the urban poor.

Concluding Observations

Three simulations were conducted to assess the welfare and poverty impacts of tariff reforms on the seven representative household groups using EV and FGT measures. These are the main findings:

Welfare Effects

Welfare losses are larger for rural household groups relative to their urban counterparts (e.g. first simulation). The patterns of losses are progressive for rural household groups but regressive for urban household groups. The patterns of welfare changes are progressive when neutrality of government revenue is ensured by increasing income tax (e.g. second simulation). Losses are large for rich households, while gains are moderate for poor household groups. The main observations are that the welfare gains of tariff rationalization (e.g. third simulation) are moderate and accrue more to the urban household groups than the rural households. A clear regressive pattern is observed among the urban household groups, but the pattern is ambiguous for the rural household groups.

Poverty Incidence

The prime observation is that rural poverty, as measured by the headcount ratio, declines due to tariff-income tax reforms (simulation 2) and tariff rationalization (simulation 3). Similarly, the gap and severity among the rural poor improve, indicating a better poverty profile. In contrast, the rural poverty situation worsened in the case of tariff-production tax reforms (simulation 1).

The urban poverty headcount, gap and severity all worsen in the first and third simulations. This confirms that the benefits of tariff rationalization accrue more to the urban rich household groups compared to their poorer counterparts. Under the second simulation, urban poverty improves.

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Table A1: Tariff rates under various simulations

Sectors	Base Rate	Simulation 1	Simulation 2	Simulation 3
Grains	0.165	0.00	0.00	0.0750
Commercial crop	0.072	0.00	0.00	0.0750
Rice Milling	0.034	0.00	0.00	0.0750
Ata Milling	0.122	0.00	0.00	0.0750
Other Food	0.374	0.00	0.00	0.1519
Tobacco	0.020	0.00	0.00	0.1519
Clothing	0.244	0.00	0.00	0.1519
Ready Made Garment	0.030	0.00	0.00	0.1519
Chemical	0.210	0.00	0.00	0.1046
Fertilizer	0.001	0.00	0.00	0.1046
Petroleum Product	0.472	0.00	0.00	0.1046
Machinery	0.179	0.00	0.00	0.1046
Miscellaneous Industry	0.067	0.00	0.00	0.1046
Adjustment in Indirect Tax Rate		***55 percent (existing sectors) & Construction sector by 11%***		***Construction sector by 3%***
Adjustment in Direct Tax Rate			Non-farm: 2.7 (300%) Large farmer: 2.7 WMSL: 2.7 (300%) Professional: 2.7(300%)	
Average	*0.153*			*0.110*
Maximum	*0.472*			*0.152*
Minimum	*0.001*			*0.075*
Standard Deviation	*0.144*			*0.032*
Variance	*0.021*			*0.001*

Note: Direct tax rates refer to rates based on total personal income bases and not taxable income base which is substantially lower than the base of personal income due to various types of exemptions, deductions, credit etc. known as “tax loop holes”. Figures in parentheses denote increase in rates over the base values.

Table A2: Production and factor market

	Gross output	Share %	VAL/GO	VAL Share %	Capital Share	Labour Share	Total	Factor Share (%)	
								Labour	Capital
Aman Paddy	100.9	3.34	59.7	3.90	38.26	61.74	100.00	5.20	2.78
Boro Paddy	127.1	4.20	54.0	4.44	43.61	56.39	100.00	5.41	3.61
Grains	12.1	0.40	47.7	0.38	40.19	59.81	100.00	0.48	0.28
Commercial crops	125.0	4.13	52.8	4.28	65.50	34.50	100.00	3.19	5.22
Livestock	117.9	3.90	58.7	4.48	46.83	53.17	100.00	5.14	3.91
Fish	75.6	2.50	44.2	2.16	91.24	8.76	100.00	0.41	3.68
Forestry	81.6	2.70	50.7	2.68	74.36	25.64	100.00	1.48	3.71
Rice Milling	321.7	10.64	29.1	6.07	95.67	4.33	100.00	0.57	10.81
Ata and Flour	23.6	0.78	32.6	0.50	95.52	4.48	100.00	0.05	0.89
Other Food	95.0	3.14	27.1	1.67	84.09	15.91	100.00	0.57	2.62
Leather	31.5	1.04	30.7	0.63	80.25	19.75	100.00	0.27	0.94
Clothing	142.8	4.72	42.0	3.89	48.09	51.91	100.00	4.35	3.48
Ready Made Garment	98.0	3.24	47.2	3.00	55.43	44.57	100.00	2.88	3.09
Tobacco	20.1	0.67	48.8	0.64	73.82	26.18	100.00	0.36	0.88
Chemical	37.3	1.23	24.8	0.60	37.73	62.27	100.00	0.81	0.42
Fertilizer	16.3	0.54	28.4	0.30	54.24	45.76	100.00	0.30	0.30
Petroleum	26.8	0.89	51.4	0.89	90.26	9.74	100.00	0.19	1.50
Machinery	77.6	2.57	31.8	1.60	74.94	25.06	100.00	0.86	2.23
Miscellaneous Ind.	76.7	2.53	48.0	2.38	60.48	39.52	100.00	2.03	2.68
Construction	234.1	7.74	37.1	5.63	68.66	31.34	100.00	3.81	7.20
Utility	54.6	1.80	79.7	2.81	81.72	18.28	100.00	1.11	4.28
Trade Services	571.1	18.88	62.0	22.93	21.54	78.46	100.00	38.84	9.20
Social Services	83.3	2.75	73.4	3.96	49.04	50.96	100.00	4.35	3.61
Public Administration	59.5	1.97	69.8	2.69	19.05	80.95	100.00	4.70	0.95
Financial Services	166.7	5.51	56.4	6.08	74.36	25.64	100.00	3.37	8.43
Other Services	248.1	8.20	71.2	11.44	62.41	37.59	100.00	9.28	13.30
Total	3024.9	100.00		100.00	53.68	46.32	100.00	100.00	100.00

Table A3: Factor returns and factor income by sectors

	Simulation 1				Simulation 2				Simulation 3			
	¶PVA_i	¶FY_i	¶r_i	¶w_i	¶PVA_i	¶FY_i	¶r_i	¶w_i	¶PVA_i	¶FY_i	¶r_i	¶w_i
Aman Paddy	-10.49	-10.59	-10.53	-10.63	-10.82	-12.40	-12.40	-12.40	-1.315	-1.18	-1.12	-1.21
Boro Paddy	-10.51	-10.53	-10.47	-10.57	-10.82	-12.65	-12.65	-12.65	-1.324	-1.42	-1.38	-1.46
Grains	-10.60	-11.63	-11.62	-11.63	-10.89	-12.84	-12.87	-12.81	-1.337	-3.43	-3.39	-3.46
Commercial crops	-10.47	-10.07	-9.99	-10.22	-10.76	-10.84	-10.81	-10.90	-1.346	-0.81	-0.77	-0.87
Livestock	-10.13	-9.52	-9.27	-9.74	-10.54	-12.26	-12.12	-12.38	-1.262	-1.01	-0.93	-1.08
Fish	-10.59	-7.56	-7.54	-7.72	-10.82	-9.79	-9.78	-9.84	-1.398	-0.99	-0.98	-1.09
Forestry	-10.65	-12.61	-12.62	-12.56	-10.88	-8.74	-8.76	-8.64	-1.389	-2.03	-2.02	-2.06
Rice Milling	-10.60	-9.98	-9.97	-10.24	-10.82	-12.78	-12.77	-12.88	-1.406	-1.33	-1.33	-1.43
Ata and Flour	-10.63	-10.35	-10.35	-10.14	-10.84	-12.26	-12.26	-12.17	-1.411	-2.03	-2.03	-2.03
Other Food	-10.63	-11.77	-11.77	-11.74	-10.86	-13.34	-13.35	-13.25	-1.396	-2.29	-2.28	-2.34
Leather	-10.64	-2.09	-2.10	-1.99	-10.87	-4.22	-4.24	-4.09	-1.392	-0.29	-0.28	-0.31
Clothing	-10.59	-5.83	-5.82	-5.85	-10.90	-6.12	-6.16	-6.08	-1.342	-1.08	-1.05	-1.12
Ready Made Garment	-9.82	5.40	5.88	4.81	-10.32	5.68	5.98	5.30	-1.222	0.74	0.84	0.62
Tobacco	-10.53	-31.14	-31.11	-31.26	-10.80	-13.12	-13.11	-13.17	-1.364	-1.12	-1.09	-1.20
Chemical	-10.53	-18.97	-18.92	-19.00	-10.92	-13.63	-13.67	-13.59	-1.322	-5.43	-5.38	-5.46
Fertilizer	-10.61	-6.84	-6.84	-6.82	-10.93	-10.21	-10.26	-10.13	-1.353	-0.13	-0.12	-0.14
Petroleum	-10.63	-24.50	-24.50	-24.46	-10.85	-20.21	-20.22	-20.13	-1.405	-11.38	-11.37	-11.41
Machinery	-10.64	-21.02	-21.02	-21.00	-10.89	-10.54	-10.57	-10.45	-1.385	-6.67	-6.65	-6.71
Miscellaneous Ind.	-10.54	-11.50	-11.45	-11.56	-10.83	-7.57	-7.57	-7.57	-1.349	3.87	3.91	3.82
Construction	-10.64	-12.96	-12.96	-12.94	-10.89	-5.18	-5.21	-5.10	-1.379	-2.80	-2.78	-2.84
Utility	-10.61	-13.34	-13.33	-13.36	-10.87	-10.54	-10.56	-10.42	-1.39	-1.17	-1.15	-1.23
Trade Services	-10.67	-11.25	-11.27	-11.24	-10.99	-11.60	-11.69	-11.58	-1.322	-1.31	-1.26	-1.32
Social Services	-10.43	-10.07	-9.97	-10.16	-10.86	-12.82	-12.83	-12.80	-1.324	-1.47	-1.43	-1.51
Public Administration	-10.51	-9.22	-9.16	-9.23	-10.99	-10.74	-10.83	-10.72	-1.289	-0.56	-0.49	-0.57
Financial Services	-10.60	-11.13	-11.12	-11.16	-10.89	-13.21	-13.24	-13.12	-1.378	-1.20	-1.18	-1.26
Other Services	-10.48	-10.10	-10.03	-10.22	-10.79	-13.75	-13.73	-13.77	-1.342	-1.06	-1.03	-1.12

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Trade Policy and Poverty in Benin: A General Equilibrium Analysis

Epiphane Adjovi
Bernard Decaluwé
Véronique Robichaud

Abstract

Economic and financial crisis in Benin since 1980s led the government to embark on a process of economic reforms in 1991. These reforms sought to remedy the fiscal and trade imbalances in order to accelerate economic growth. Trade policy reform was given priority. Import bans and quotas were eliminated, import duties abolished and a compensatory tax on commodities sold in the domestic market instituted. This study analyzes the effects of the trade policy reforms using a computable general equilibrium (CGE) model and household survey data. Results show that these reforms are more beneficial to households in urban areas, but contribute to worsening poverty conditions of the most poor in rural areas. If liberalization policies target better strategies aimed at fighting poverty, or at least not deteriorating the situation, they need to be designed in a way that they do not worsen the poverty conditions of the most destitute in society.

Introduction

Since the early 1980s, Benin has faced a devastating economic and financial situation. This crisis, which reached its

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peak in 1989, was characterized by severe decreases in final demand, collapse in per capita income, and a general decline in the fiscal and trade balances. In essence, growth was negative; investment declined significantly; the consolidated State budget showed a deficit of more than 51 billion CFA francs; and the trade and current balances seriously deteriorated, while the debt ratio reached 43.5% of exports.

Due to these conditions, Benin embarked on a process of economic adjustment and adopted numerous liberalization and reform measures needed to remedy the fiscal and trade imbalances in order to accelerate economic recovery. As is customary with Structural Adjustment Programs (SAPs), the measures implemented mainly focused on trade policy reforms, due to their impact on government revenues and their effects on overall supply which improves the structure of industrial incentives. Reforms began with the elimination of measures intended to ban imports or fix quotas on imports that constituted a significant source of distortion in the economy. Since the protection of economic sectors was to be achieved through import tariffs alone, tariff reforms were initiated in 1991, and. implemented in two stages.

Following the abolition of all quantitative restrictions, reforms were undertaken to replace existing tariff policies, which were judged to be ineffective. These reforms aimed at putting in place a rational system of tariff protection, while ensuring an adequate level of revenues.

Finally, with its other partners in the Economic and Monetary Union of West Africa (UEMOA), Benin was committed to the establishment of a customs union whose objectives were the complete abolition of internal tariff barriers, and the institution of a Common External Tariff (CET). With regard to this tariff, the customs duty, which replaced the fiscal duty, retained the same rates, except for the 15% rate. In this regard, the main difference between the CET and the old tariff was the categorization of products[1].

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[1] Attribution of rates to each product

Taking into account the ongoing debate on trade policy reforms, it might be thought that in Benin the above measures would not lead to the desired distribution of income and poverty. Trade liberalization can however be expected to affect the poor through:

- changes in the prices of tradable goods, and access to new products;
- changes observed in the domain of employment and relative wages;
- economy vulnerability to external shocks;
- incentives to invest and to innovate; and
- the impact of foreign trade on tax revenues.

In Benin's case, the central issue is whether or not tax and tariff reforms would favourably influence the incomes of the poor and lead to improved equity in the distribution of income. The main objective of this study is to analyze the effects of the complete abolition of import duties and the institution of a compensatory tax on commodities sold on the domestic market. The study used a computable general equilibrium model (CGE) and data from two household surveys conducted during the period 1999-2000.

The use of CGEs in studying the impact of economic reforms on income distribution dates back to the 1980s. Studies in this category included those by Adelman and Robinson (1979), Dervis, de Melo, and Robinson (1982), and the Social Dimension of Development (SDD) version of CGEs developed for Benin by the INSAE, with the technical support of CIRPEE of Université Laval.

The remainder of the paper is organized as follows: section 2 presents background information on trade liberalization and poverty in Benin. A brief literature review on the various ways in which poverty is taken into account in CGEs and the specifications of the model used here is presented in section 3. Simulations and analyses conducted, as well as the results are presented in section 4. Section 5 concludes.

Trade Liberalization and Poverty in Benin

Description of Tariff and Tax Reforms in Benin

In this context, numerous economic liberalization and reforms were adopted to adjust internal and external imbalances, and to accelerate economic growth. Among the reforms implemented, trade policy was given priority, beginning with the elimination of import bans and quotas, which were an important source of distortion in the economy. Tariff reform in Benin was carried out in two stages. The first stage began in 1991, and the second after the CFA franc devaluation in 1994. These two phases of tax reform were aimed at transforming tariffs into an incentive instrument for industry, while at the same time ensuring an adequate level of public revenues. In 1991, the goal was to simplify the existing tariff structure, which was characterized by a multitude of very specific taxes. This simplification helped scale down the number of taxes levied on imports from sixteen to six, and reduced the number of specific taxes. At the end of this first stage, only two taxes (radio and television taxes) remained, and were consolidated under "Other Taxes". The taxes, however, have never been enforced. On the other hand, most of the specific taxes were converted into *ad valorem* taxes, which were combined with the fiscal tariff. This tax was composed of 18 different rates, varying from 0% to 63%.

To complete the reform, the second stage was implemented. This stage had two objectives, namely, completing tax simplification, and rationalizing the fixing of rates. It should be noted that adjustments effected in 1994 only affected the fiscal tariff. To reduce the complexity of the tariff structure, the number of fiscal tariff rates was brought down from eighteen to five. Moreover, uniformity was introduced and variations in the interval of rates were drastically reduced, dropping between 0% and 20%. Another adjustment effected during the second stage was the abolition of the commodity price list, which remained in use after the first stage, as well as the "Other Taxes", whose content was converted into *ad valorem* taxes and included in the fiscal tariff.

These trade liberalization measures changed the landscape of the national economy. In effect, tariff reforms brought about a reduction in the tax ratio on imports. The theoretical level of taxation declined from 33% during the period 1983-1990 to 30% during the period 1991-2001. Reductions in the level of theoretical taxation induced an increase in the real tax ratio; from 16.6% in 1983-1990, it increased to 17.6% during the period 1991-2001.

The contribution of foreign trade to growth became increasingly significant with the extensive opening up of the economy. During the economic crisis that preceded the reforms, GDP growth was weak and its annual average fluctuated around 1.9%, and even became negative in 1989. With the advent of the democratic revival, which marked the recovery of the economy in the aftermath of the reforms, the GDP began increasing at an annual average rate of 4.8% between 1991 and 2001. The degree of openness to trade also increased from 60.9% to 63.7% during this period.

Evolution of foreign trade

In general, imports and exports witnessed a drop in volume and registered negative growth rates in the order of -3.8% and -0.6%, respectively, during the period of economic and social crisis (1983-1990). With the implementation of reforms and subsequent economic recovery (1991-2001), an increase in both imports and exports was evident, with average growth rates of 14.0% and 14.7%, respectively. The advent of structural reforms during the period 1994-2001 was followed by stronger growth in both imports and exports compared to that witnessed during the previous period; annual average rates of growth increased from 14.3% to 16.1%, respectively.

In terms of value, the annual growth rate for imports rose from -3.8% during 19891990 to 15.3% during 1991-2001. As for exports, they increased from a negative rate of -0.6% during the crisis to 2.6% in the recovery period, and then soared to 16.0% following the implementation of reforms (table 1).

Table 1: Evolution of external trade

	Average annual rate of growth (%)		
	Period	1983-1990	1991 –2001
Imports	In value	-3.8	15.3
	In volume	-3.8	14.0
Exports	In value	-0.6	16.0
	In volume	-0.6	14.7

Source: INSAE/SEC, SCN

Table 2 shows the trade structure for imports. Foodstuff had the largest share in the total value of imports during both the 1983-1990 and 1991-2001 periods, amounting to 33.4% and 19.6% respectively. Thus, in value terms, Benin increasingly imported investment goods and mineral products and less of food stuff. On the other hand, textiles and cotton imports showed an appreciable decrease from 28% between 1983 and 1990 to 17% between 1991 and 2001.

Table 2: Structure of imports

Structure of Imports						
Period	Foodstuffs	Cotton, textiles	Investment goods	Mineral products	Chemical products	Others
1983-1990	33.4	28.0	13.7	16.6	8.0	0.3
1991-2001	19.6	17.1	17.6	18.1	10.2	17.4

Source: SEC/INSAE

As for the structure of exports, the analysis reveals that Benin's main export product is cotton (table 3). During the two periods cotton's export share in the total export revenue increased from 51.3% to 80.6%. The share of revenue from energy products decreased drastically from 26% in the period 1983-1990 to 3.2% in the period 1991-2001. Generally, Benin's export products are not diversified; they basically consist of primary agricultural products. Thus, Benin's export structure has seen no real dynamism or impetus.

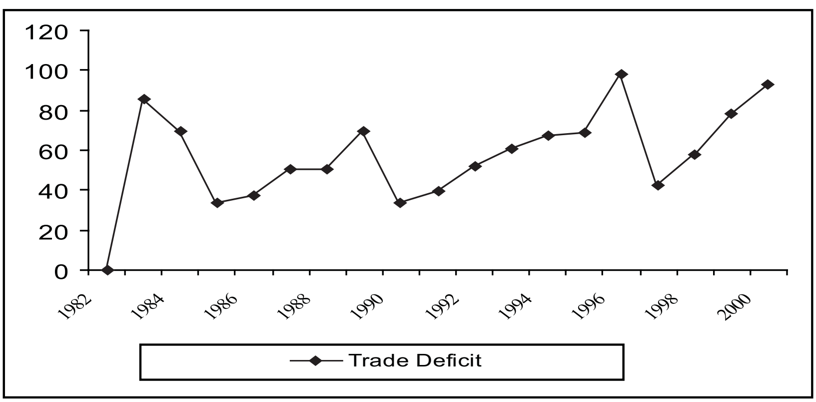
Table 3: Structure of exports

Structure of exports					
Period	Cotton	Foodstuffs	Energy products	Others	Total
1983-1990	51.3	2.6	26.0	20.1	100.0
1991-2001	80.6	5.9	3.2	10.3	100.0

Source: INSAE/SEC

Further analysis of Benin's import and export revenues reveals that it has experienced a persistent deficit in its trade balance. During the economic and social crisis of 1983-1990, a serious deterioration in export revenues weighed heavily on the trade balance, making the trade balance deficit reach a level of 10% of GDP. The recovery and restructuring period (1991-2001) was marked by declining deficits, as a result of a surge in exports. This downward trend in the balance of trade deficit was more noticeable between 1998 and 2001 (3.7%), despite a drop in export receipts (Figure 1).

Figure 1: Evolution of trade deficit in Benin (1983 – 2001)



Benin's poverty profile

To establish the poverty profile, two types of studies were used. These included light household surveys (LHS) in urban areas and surveys on living conditions (SLC) in rural areas. In this context, a poor household was defined as one whose annual expenditures per adult equivalent are lower than the poverty line. This poverty line varies according to area of residence. In the rural areas the per capita poverty line increased from 42,075 CFA francs in 1994-1995 to 51,413 CFA francs in 1999-2000, whereas in urban areas it increased from 48,629 CFA francs in 1994-1995 to 91,705 CFA francs in the period 1999-2000.

Three poverty indicators were calculated to determine Benin's poverty profile. They include the headcount index, which captures the incidence of poverty or the proportion of poor people within a population (P_0), the poverty gap, which captures the depth or intensity of the poverty phenomenon (P_1), and the squared poverty gap, which captures the severity of poverty and the extent of inequality among the poor (P_2).

In Benin since 1995, the incidence of poverty has remained statistically stable. Over the period 1999-2000, 29.6% of the population was considered as poor, compared to 28.9% in 1995. Despite this stability, the severity of poverty has risen, pointing to increasing inequality among the poor. In other words, even though the proportion of poor households has not changed significantly, poor households were more stricken by poverty in 1999 than in 1995.

In Benin poverty is more of a rural than an urban phenomenon. In rural areas, poverty incidence was 31.2% in 1999. The depth and severity of poverty were 8.5% and 3.4%, respectively, in 1999-2000. In urban areas, the proportion of poor people was 24.6% in 1999, and the depth and severity of poverty were 9.5% and 5.4%, respectively. Hence, there is a positive correlation between the degree of urbanization and poverty.

Although the depth and severity of rural poverty have not changed significantly over this period, they have increased by 5% in urban areas. An increase in the depth and severity of poverty in the urban areas between the two periods suggests that impoverishment has become more pronounced in urban households, even though the proportion of poor people have remained unchanged. Inequality in the distribution of household income, therefore, seems to have increased between 1995 and 2000.

Beyond the monetary aspects of poverty, it is important to look at the evolution of non-monetary poverty, which deprives the poor of the satisfaction of certain basic needs such as access to education, healthcare services, drinking water, food, survival, and the ability to make decisions about events affecting their personal lives. This aspect of poverty is measured by the Human Development Index (HDI) developed by the United Nations Development Program (UNDP). This indicator attempts to quantify certain forms of destitution in four basic areas of human life: the capacity to live longer and in good health; knowledge (education); economic means; and participation in social life. Thus, according to the HDI country ranking, Benin is classified as one of the 15 least developed countries in the world. Benin's poor ranking is due primarily to the low rate of literacy among adults, and the low level of per capita income.

Comprehending the phenomenon of poverty through its determinants provides the essential elements for targeting actions aimed at reducing poverty efficiently. This type of study demonstrates that the determinants of poverty in Benin basically concern household socio-economic characteristics. The results of these studies vary slightly from one area to another. Yet, whether in rural or urban areas, the main determinants of poverty frequently noted are, among others, large size of households, low level of schooling, and the gender of the household head.

In essence, poverty increases with household size. Households with more than six members display poverty incidences twice as high as those with three members, in both urban and rural areas. Moreover, the effect of household size on the incidence of poverty seems more perceptible in the urban area where the rate of poverty for households with six members or more is four times that of households comprising three members. In addition, the poorest households are those with household heads aged 35 years and above. Similar tendencies are also observed in the depth and severity of poverty. Furthermore, households whose heads have some level of schooling are usually less poor than those whose heads have no schooling at all, and this result is verified in urban and rural areas alike.

The Model

A Brief Survey of CGEs in Benin

Work on general equilibrium models in Benin essentially began in 1993. Since then, a series of studies focusing on various areas have been carried out using this tool.

Regarding analyses done on the impact of trade liberalization measures, we may cite the study by Adjovi and Sinzogan (1997), which involves a simulation of the 1991 tariff reforms in Benin. On the impact that economic policy had poverty, there are two main studies. The Modeling Cell at the National Institute of Statistics and Economic Analysis (INSAE), in collaboration with CIRPÉE of University of Laval in Canada, developed a Social Dimension of Development (SDD) version of the Institute's CGE. This version's survey results listed households as being poor and non-poor, based on budget consumption.

In another study, Adjovi (2002) analyzed the impact of the allocation of public spending on poverty in Benin. In effect, Benin has received external support in the context of the Heavily Indebted Poor Countries (HIPC) initiative, which, in principle, is intended to contribute to the implementation of actions likely to lead to a reduction in poverty. The main objective of the study was to determine the impact of alternative uses of public funds allocated to relieve poverty in Benin. Unlike other studies, the model used in the study took into account three kinds of labour markets; informal, formal (or modern), and the civil service. Following Savard and Adjovi (1998), this study explicitly integrated unemployment in the model, and introduced education and health externalities.

Features of the Model

The model in the current study focuses on the labour market by first taking the informal, formal and civil service (government) labour markets into consideration. In the government sector, the output is a Leontief function of intermediate consumption, and concerns civil servants' labour only. In the other sectors, the model is modified through addition of a composite labour variable, which in turn is combined with capital in the value-added function. Unemployment is taken into account in the model, including those workers laid off from the public and parastatal sectors, as well as students waiting to join the formal job market after completing their studies. Finally, following Subramanian (1994) and Dorosh (1994), an endogenous labour supply is introduced into the model in such a way that the labour force would increase (decrease) if the informal real wage increase (decreases) relative to the initial wage.

Calibrating the Model

To solve the system, the model's parameters need to be chosen or calibrated. The unemployment rate in the base year is 12.6%, as provided by the 1995 Employment Observatory Statistics. The absorption rate of laid-off workers by the informal sector is 80%, a figure taken from Maldonado (1994). Other parameters were calibrated to reproduce the base year in the usual manner. The elasticity of substitution used in foreign trade functions were drawn from Savard et al. (1994).

Findings

In order to illustrate the impact that trade liberalisation may have on both income distribution and poverty, a simulation was performed on the effects of a total and unilateral elimination of customs tariffs. In order to make up for the loss of revenue resulting from the abolition of import customs duties, a compensatory consumption tax was introduced. The liberalisation of foreign trade consequently had no effect on public deficit.

Global Analysis

The elimination of customs tariffs leads to a fall in import prices, which in turn reduces the consumer and producer prices of local competing goods. Understanding the magnitude of these repercussions requires an analysis of the initial situation, and especially initial tariff levels, the rate of import penetration and the level of substitution between local and imported products by sector of activity. To this effect, table 4 shows the initial situation in terms of import taxes and the structure of the various markets.

The data reveal that two sectors, notably industrial crops and tradable services have near-zero initial tariff rates and very low levels of imports and exports. On the contrary, all other sectors are heavily protected, with tradable services, food industries and modern industries dominating the import and export markets.

Table 4: Initial structure of the economy in Benin

Sectors	Tariff	Value added share	Import share	Export share	Import penetration rate	Export intensity
Food crops	15.8	36.9	2.0	4.9	2.1	3.7
Industrial crops	0.3	4.9	1.0	1.2	6.4	5.5
Food industries	14.7	1.6	26.6	23.1	65.5	62.5
Agriculture and handicraft	14.7	4.3	2.9	0.5	6.8	1.0
Modern industries	21.0	4.4	56.5	13.9	58.1	26.8
Other small-scale industries	18.0	5.2	5.4	0.1	11.2	0.1
Tradable services	0.0	42.8	5.6	56.3	4.2	24.7
Total	17.5	100.0	100.0	100.0	19.6	17.0

Source: Authors' computations.

Impacts on prices and production

Table 5 shows the percentage changes in the major endogenous variables included in this study. The elimination of customs duties leads to a general drop in import prices (PMi), which in turn is reflected in the price of goods sold in the local markets PDi), and finally in producer prices (Pi). Naturally, the two most protected sectors, "modern industries" and "other small-scale industries", saw the greatest drop in import prices and, consequently, in domestic prices (by 7.9% for modern industries and 5.2% for other small-scale industries), as local producers are compelled to reduce their prices in the domestic market in order to remain competitive. Similarly, since food industries faced increased import competition (12.8% drop in the PMi), and given the level of substitutability between local and foreign products, there was an equally significant domestic price drop in this sector (6.9%).

In terms of impacts on import volumes, the largest increases were in sectors that combined a considerable drop in import prices with a high level of substitutability between local and imported goods: small-scale industries (8.6%), agriculture and handicrafts (6.9%) and food crops (6.6%). On the whole, imports increased by 3.6%. However, it is worth mentioning that there was a drop in the volume of imports for sectors with an initial rate of customs duties equal or close to zero – industrial crops and tradable services – where import volumes decreased by 3.4% and 4.6%, respectively. Two factors explain these decreases. On the one hand, since the balance of payments was fixed, an increase in imports for some of these goods had to be compensated by a reduction in imports for other goods, and/or by an increase in exports. On the other hand, the general drop observed in domestic prices led to a reduction in imports for these products.

Table 5: Impacts on prices, production and foreign trade

Sectors	Import prices	Import volumes	Domestic sales	Domestic prices	Export volumes	Output	Producer prices
Food crops	-13.6	6.6	-1.4	-4.9	2.7	-1.2	-4.7
Industrial crops	-0.3	-3.4	0.2	-4.2	2.3	0.3	-4.0
Food industries	-12.8	2.6	-3.3	-6.9	3.2	0.8	-2.6
Agriculture and handicraft	-12.8	6.9	-2.5	-3.5	0.6	-2.5	-3.4
Modern industries	-17.3	4.3	-5.4	-7.9	1.8	-3.5	-5.8
Other small-scale industries	-15.2	8.6	-1.8	-5.2	3.0	-1.8	-5.2
Tradable services	0	-4.6	0.1	-5.8	6.9	1.8	-4.3
Total	-14.9	3.6	-1.4	-5.4	5.0	-0.2	-4.4

Source: Authors' computations.

Increased competition from imports made the local market less attractive for domestic producers. Both domestic demand and prices dropped, except in the case of industrial crops and tradable services, which registered slight increases of 0.2% and 0.1%, respectively. Under these circumstances, the only choice left for producers was to turn to the export markets, which became relatively more profitable. Moreover, as highlighted earlier, external constraints led to real exchange rate depreciation such that the increase in imports was compensated by a similar increase in exports. Considerable increases in exports are witnessed in the tradable services, food industries and food crops sectors. However, for modern industries, export effects are not very significant, in spite of considerable reductions in domestic prices. This weak reaction was essentially due to the fact that the sector employs only one variety of workers (formal workers), and can consequently not easily increase its production, given the limited availability of this category of workers. On the whole, there was a 5% increase registered in the volume of exports.

The overall impact on domestic production, resulting from the simultaneous increase in exports and fall in domestic sales, was very small (-0.2%). The three booming sectors, which could be coined as the "winning" sectors in the liberalisation process, are, undeniably, tradable services (1.8%), food industries (0.8%) and industrial crops (0.3%). The sector that lost most in terms of production was modern industries, which registered a drop of 3.5%. It is obvious that the tradable service and industrial crops sectors, the two least protected sectors, suffered the least from tariff reductions. These sectors also benefited from reductions in the cost of their raw materials and production factors, especially labour, thus allowing some improvement in their competitive position on foreign markets. Although the agriculture and handicraft industry sector suffered the counter effect of tariff decreases, it was less affected than the modern industries sector, for example, since a great part of its production was already export-oriented. The export intensity coefficient for the food industry exports was 62.5%, while only 26.8% for the modern industries sector (table 4). The food industry sector suffered less than the modern industries sector, as its level of dependency vis-à-vis the domestic market was much lower, even though their initial levels of customs duties were very close.

Impacts on factor remunerations

Table 6 show the impact that remuneration has on production factors. Since the formal salary rate is exogenous, and given that there are no informal workers in the food industry and modern industry sectors, the drop in product prices and the value added to these sectors will be fully reflected in capital remuneration. On the other hand, activities in the food industries, industrial crops and tradable services sectors are growing, and this mitigates the drop in capital outputs, as the lowest decreases have been registered in these three sectors.

Table 6: Factor remunerations

Sectors	dPi	dPVA	dVAi	wLi/wL	riKi/rK	dwt	dri
Food crops	-4.7	-5.3	-1.0	40.9	38.0	-3.8	-7.2
Industrial crops	-4.0	-3.7	0.3	6.7	3.5	-3.8	-3.4
Food industries	-2.6	-3.9	0.8	0.0	1.5	0.0	-3.0
Agriculture and handicraft	-3.4	-7.3	-2.5	4.5	4.7	-3.8	-11.1
Modern industries	-5.8	-10.2	-3.5	0.0	6.4	0.0	-13.7
Other small-scale industries	-5.2	-5.2	-1.8	5.5	5.7	-3.8	-6.8
Tradable services	-4.3	-3.0	1.8	42.3	40.3	-3.2	-1.6
Total*	-4.4	-3.9	0.0	100.0	100.0	-2.7	-5.3

Source: Authors' computations.

Impacts on household income

The impact of these changes on household income is quite significant and depends on household income sources. Table 7 shows that the incomes of all households decreased, a trend more pronounced in rural area households (-5.5%) than in urban area households (-3.1%). The evolution of income in rural households could be explained by the considerable amount of work done by household members who provide the main source of income (79.0%), as compared to households in urban areas (47.4%), whose incomes are derived from various sources. Even though the drop observed in the capital income is greater than that in labour, and households in urban areas derive a much greater portion of their income from this source, the overall drop in income in urban areas is less than that seen in rural area households. A greater diversification in sources of income would make urban households less vulnerable to the consequences of a widespread drop in the remuneration.

Table 7: Impact of factor remunerations on income

	Change in remuneration rate		Revenue share		Impact on income	
	Urban	Rural	Urban	Rural	Urban	Rural
Labour	-2.7	-2.7	47.4	79.0	-1.3	-2.1
Capital	-5.3	-5.3	36.7	19.8	-2.0	-1.1
Other sources of income	0.0	-1.9	16.0	1.2	0.1	-2.3
Total	-	-	100.0	100.0	-3.1	-5.5

Source: Authors' computations.

In order to grasp the impact of unilateral liberalization on welfare, a comparison must be made between the drops in income and the cost of living, followed by the price drops for imported goods. The evolution of the consumer price index as well as that of final demand composite prices will obviously be the key element in the diagnosis made here. It could be immediately assumed that those households that allocate a large proportion of their consumption budget to products highly subjected to competition with imported goods would witness a more appreciable drop in the cost of living. The last two columns in table 8 show how prices are distributed, depending on whether consumers live in rural or urban areas. The observation made is that households in urban areas proportionately consume more tradable services (29.1%), and mostly products from modern industries (18.3%) than the households in rural areas which, on the contrary, use a large portion of their own budget in buying products from the food industry and handicraft sectors.

Table 8: Impact on consumer prices

Sectors	Mi/Qi	dPMi	dPDi	dPCi	Rural	Urban
Food crops	2.1	-13.6	-4.9	-1.5	33.1	30.3
Industrial crops	6.4	-0.3	-4.2	-0.4	1.6	0.9
Food industries	65.5	-12.8	-6.9	-8.1	7.0	7.6
Agriculture and handicraft	6.7	-12.8	-3.5	-0.6	33.3	4.8
Modern industries	58.0	-17.3	-7.9	-11.4	5.8	18.3
Other small-scale industries	11.2	-15.2	-5.2	-3,0	5.7	9.0
Tradable services	4.2	0	-5.8	-2.6	13.5	29.1
Total	19.6	-14.9	-5.4	-4.3	100.0	100.0
Variation of the consumer prices index					-2.4	-4.1

Source: Authors' computations.

As shown in the table the drop in handicraft product prices was practically zero, while the drop for manufactured product prices was 11.4%, the sharpest of all the products. Even though the drop in food industry prices is not negligible (-8.1%), it does have the same impact on household consumer purchases, since the rural and urban households allocated the same proportion of their budget to them. On an aggregate level, and given consumption structures within each of the above environments, it can be seen that consumer prices decreased more in the urban areas (-4.3%) than in the rural areas (-2.4%).

When measured in terms of equivalent variation, urban area households' welfare improved by 2.0%, while that of rural area households it deteriorated by 3.0% (table 9). For households in urban areas, the nominal drop in income was less significant than that for consumer prices, whereas the reverse was true for rural area households. The entire population saw a drop in its well-being (-0.3%), given that the rural population is larger than the urban population.

Table 9: Household welfare

	Urban	Rural	All
Change in the nominal income (%)	-3.1	-5.5	-4.2
Change in the consumer price index (%)	-4.1	-2.4	-3.2
Equivalent variation (%)	2.0	-3.0	-0.3

Source: Authors' computations.

Trade liberalization, therefore, enhances the well-being of households in the urban areas, yet has a rather unfavourable effect on households in rural areas, and on the entire population. Can this assessment be verified in terms of the impact on poverty? The Foster-Greer-Thorbecke (FGT) indicators, and notably those relating to poverty incidence (P_0), depth (P_1) and severity (P_2), will be used to answer this question.

The initial indices of poverty level computed from household surveys conducted in urban and rural areas reveal that the incidence of poverty is markedly higher in the rural areas than in urban areas; the proportion of poor people living in rural areas is estimated at 38.9%, whereas it is only 32% in the urban areas (table 10). A very important divergence between urban and rural areas can also be seen in the depth and severity of poverty (FGT1 and FGT2) indicators.

Table 10: Poverty indicators (Foster-Greer-Thorbecke (FGT))

	Poverty line	Initial	Simulated	Variation	Initial	Simulated	Variation	Initial	Simulated	Variation
Urban	113,740.0	32.0	30.0	-4.9	11.0	10.5	-4.8	5.6	5.3	-4.9
Rural	74,294.0	38.9	39.8	2.4	10.9	11.2	3.1	4.3	4.5	3.8
Total	94, 017.1	35.4	35.0	-1.0	11.0	10.59	-1.0	5.0	4.9	-1.2

Source: Authors' computations

The number of poor people within the entire population is much lower since the liberalization policy was implemented. However, some opposing trends can be observed in the urban and rural areas. A decline in all these indicators is observed in the urban areas, where the incidence, depth and severity of poverty dropped by 4.9%, 4.8%

and 4.9%, respectively. On the contrary, the situation of households in the rural areas is deteriorating, where the incidence, depth and severity of poverty increased by 2.4%, 3.1% and 3.8%, respectively.

On the whole, it can be concluded that trade liberalization has a serious impact on both income distribution and poverty. However, the impact on the poorest people living in urban areas is a positive one, whereas in the rural areas the situation of the abandoned populations continues to deteriorate.

Conclusion

Based on the findings presented, it is important to note that a total and unilateral abolition of import duties and taxes, and the institution of a compensatory consumption tax are more beneficial to households in urban areas than to those in rural areas. Moreover, these reforms contribute to worsening poverty conditions of the poorest people in the rural areas. It is, therefore, important to acknowledge that if liberalization policies target to develop better strategies aimed at fighting poverty, or at least not worsening the situation, they must be designed with great caution, as they could very well lead to a worsening of the poverty condition of the most destitute in society, and even to social upheavals, and finally shatter the economic benefits derived from the elimination of international trade distortions.

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The Impact of Trade Liberalization on Household Welfare and Poverty in India

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Abstract

A 28-sector, 3-factor and 9-household group Computable General Equilibrium (CGE) model for India is constructed to analyze the impacts of Tariff and Non-tariff Barriers (NTBs) on the welfare and poverty of socio-economic household groups. A general cut in tariffs leads to a decrease in overall welfare and reduction in poverty, which urban households are in a relatively better position to address. The choice of a fiscal compensatory mechanism with indirect tax on domestic consumption does not substantially change the pattern of impact except that it increases overall poverty in the economy. On the other hand, quota reductions on agriculture and food products result in a gain in welfare and a bigger reduction of poverty, with rural households doing better than urban households.

Keywords: Computable general equilibrium (CGE) model, microsimulations, international trade, poverty, India.

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Introduction

In the face of serious internal and external imbalances, many developing countries, including India, have recently gone through a variety of structural adjustment programs. For India, major policy changes took place in the beginning of the 1990s. The biggest challenge of India's economic reform program has been the liberalization of its trade sector. Before the 1990s, India's trade policy regime was marked by a high level of tariff and non-tariff barriers, notably quantitative restrictions and various types of import licenses. To make India's trade more competitive internationally, policy makers have been struggling to keep trade restrictions to a minimum.

Although the macro implications of these reforms have been studied, their impacts at the household level, which are of great concern to any society, are not well analyzed. Given the heterogeneity of India's population and household groups, the impacts of trade reforms on their welfare and poverty are not expected to be uniform. Furthermore, although India has had an impressive record of growth since the late 1980s, it still faces massive challenges in terms of poverty and inequality.

A World Trade Organisation (WTO) directive has forced the Indian government to focus on the elimination of import barriers in several key sectors. On April 1st 2001, the government announced its Export-Import Policy (EXIM-Policy), which removed quota restrictions from the remaining 715 goods covered. Major products in this list include food products and motor vehicles.

In this paper, a computable general equilibrium (CGE) model is constructed in order to analyze the impact of major trade reform issues, viz. the removal of non-tariff barriers (NTBs) and reduction of tariffs on the income, consumer prices, welfare, and poverty levels of different household categories. The poverty line is endogenized in the model to take account of changes in consumer prices.

The paper is divided into five sections. Section 2 portrays the Indian economy and highlights trade policy changes. The CGE model and benchmark data are discussed in Section 3. Simulation results are analyzed in Section 4. Concluding remarks are given in the last section.

The Indian Economy, Trade Liberalization and Poverty

The Indian Economy and Policy Reforms

Since the 1960s, India has experimented with various policies in response to economic shocks in the context of a planned economy. For example, the impact of the unprecedented drought of 1965-67 on real GDP growth and the balance of trade was minimized through orthodox policies. However, there was a high level of inflation - almost 14-15 percent per year - because of loose fiscal and monetary policies. From 1967 to 1973, a number of changes were introduced. Export promotion measures, aiming to counteract the effect of the economy's first devaluation in 1966, together with import restrictions, improved the trade balance and ultimately led to a trade surplus in 1972-73. During this period, the growing public deficit was financed by money creation. There were two shocks in the 1970s: A prolonged agricultural slump from 1972 to 1976, followed by the first oil crisis.

The post-1973 period may be characterized as a period of orthodox stabilization. The foreign exchange constraint was the main problem on the demand side. A world recession in 1980-81 followed the oil shock in 1979-80. Foreign aid did not come easily because of adjustment policies that were underway in other countries. The 1979-80 period saw a rise in the fiscal deficit, which was again financed largely by money creation. India then approached the International Monetary Fund (IMF) and the liberalization process took place in a more systematic manner. Fiscal adjustments were made in order to finance the deficit through both domestic and foreign borrowing. Additionally, the eighties were the most turbulent period in the world's foreign exchange markets: there was a sharp appreciation of the US dollar such that the Rupee underwent a 35% depreciation against the US Dollar between 1980 and 1985.

In spite of all these policies, there was a worsening of fiscal and current account balances due to unchecked government expenditure. The increasing fiscal deficit was financed through borrowing and money creation. This eventually forced policy makers to conduct demand management in order to ease spiraling inflation, particularly by controlling money supply and toning down public spending. However, this austerity program came primarily through a reduction in its capital expenditure. The principal method for reducing the current account deficit during the second half of the eighties was to manage the rupee's depreciation. Consequently, from 1985 to 1990, the nominal and real effective exchange rates depreciated by nearly 50 and 30 percent respectively.

The carryover crisis from the late eighties, together with the Gulf war in the beginning of 1990s, pushed the Indian economy to an unprecedented level of crisis. This took the form of (a) high (two-digit) inflation, (b) acute balance of payments disequilibrium, (c) huge fiscal deficits and (d) a rapid increase in external debt. With the objective of improving efficiency, productivity and global competitiveness, both macro and microeconomic reforms were introduced in the country's industrial, trade and financial policy regimes.

For a long period, Indian industries were characterized by inefficiency, high costs and uneconomical means of production with pervasive government control. The industrial policy of 1991 abolished industrial licensing while another major achievement was the abolition of the special permission needed under the Monopolistic and Restrictive Trade Practices Act (MRTP, 1969) for any investment and expansion. In response to the huge losses of public sector units (PSUs), the government took major steps to divest and restructure them. With the objective of addressing fiscal imbalances, reforms included correcting present irrationalities in the tax policies and a more cost-effective management of expenditure. Expenditure reform in India is crucial in view of high government spending and deficit. Agriculture and social sectors account for the majority of government subsidies targeting fertilizer, food, credit, higher and elementary education, etc. In agriculture, there was a shift in the allocation of public expenditure from subsidies to the creation and maintenance of infrastructure. Food subsidies, under the Public Distribution System (PDS), were revamped to target the poorest segments of the population.

Both direct and indirect tax reforms were introduced with the objective of widening the tax base, increasing enforcement and equity, and developing a globally competitive economy. Direct tax rates were reduced. Reductions in customs duties, along with changes in excise taxes, played a crucial role in moderating domestic prices. Nevertheless, government revenue collection, as a percentage of GDP, remained stable in the late nineties. Sales taxes and excise duties contributed the most to government revenue and experienced the highest growth rate. Customs revenue, as a percentage of GDP, remained more or less stable. Overall, the growth rate in government revenue collection increased until 1995-96, followed by a drastic reduction in 1997-98 and again in 1998-99 (Table 1). This was, again, mainly due to fluctuations in the customs and excise collections.

The major restructuring of the indirect tax system involved a reduction in excise duties even at the risk of losing substantial amount of revenue. The argument in support of this reform was that it would lead to greater efficiency in production, which would contribute to economic growth. Excise duties on major consumption goods were reduced. Broadly speaking, necessities of life like food, pharmaceuticals and footwear, as well as capital goods, are either exempt or bear a low rate of excise duties, semi-luxuries are moderately taxed, and luxuries support high tariff rates

Table 1: Percentage Change and Share of Different Taxes in Government Revenue

	1993-94	1994-95	1995-96	1996-97	1997 98	1989 99	1999 -00
Share of GDP at factor cost							
Income & Corporation Tax	2.46	2.83	3.01	2.97	2.67	3.00	3.23
Customs duties	2.84	2.93	3.35	3.46	2.89	2.64	2.82
Union Excise Duties	4.06	4.09	3.77	3.64	3.45	3.29	3.57
Sales Tax	3.60	3.63	3.34	3.41	3.28	3.22	3.46
Others	2.66	2.69	2.96	2.68	3.04	2.85	3.11
Total Revenue	15.61	16.17	16.42	16.17	15.33	15.00	16.19
Share of total government revenue							
Income & Corporation Tax	15.73	17.48	18.30	18.40	17.42	20.00	19.97
Customs duties	18.20	18.12	20.40	21.42	18.87	17.59	17.42
Union Excise Duties	25.99	25.26	22.93	22.50	22.51	21.94	22.05
Sales Tax	23.07	22.47	20.37	21.11	21.37	21.45	21.34
Others	17.01	16.66	18.00	16.58	19.83	19.02	19.22
Total Revenue	100	100	100	100	100	100	100

Source: Government of India, 1999.

One perennial problem of the Indian excise system has been the taxation of raw materials and intermediate inputs and the resulting cascading effect on the prices of final products. Imposing a value added tax (VAT) minimizes distortions. In India, the VAT has been introduced in the form of a modified value added tax (MODVAT), which provides for complete reimbursement of excise duties paid on raw materials and intermediate inputs used at various stages of production of final goods. Initially, the MODVAT scheme covered only a few items, but it has gradually been extended to a wide range of final manufacturing goods. Beginning in 1994-95, input tax credits were extended to capital goods.

In its ideal form, a VAT is collected on the basis of value added at each stage of production and distribution. Since the cumulative effect of input taxation is absent under a VAT, the impact of this tax on production cost is limited. By avoiding distortionary cost escalation, it promotes the competitiveness of domestic industries in the world market. However, its operation has certain limitations in a developing country like India. In principle, a VAT should be imposed at a uniform rate at all stages of production and distribution, so that tax credit claims can be made easily. However, the MODVAT tends to be regressive. To ensure progressiveness, one needs to impose special excise duties on selected luxury items without the advantage of tax credits. On the other hand, exemptions should be extended to necessities only.

A sales tax is normally an ad valorem levy imposed on consumers. In many cases, producers also come in its ambit if it applies to intermediate inputs. In India, there are a large number of sales tax rates and, in most cases, commodities that are subject to sales tax are also subject to excise duties. Some state governments have tried to reduce sales tax rates on some of the important commodities such as capital goods and intermediate goods. In order to lessen distortions, the number of tax rates was reduced. States have also attempted to extend sales taxes to services in order to increase their revenue. Recently, there has been considerable progress towards the equalization of sales tax rates across states.

Income tax is a tax on aggregate incomes from various sources. Before the start of the reform process the Indian income tax system was very complicated with many different rates. Subsequently, personal income tax rates were restructured with lower taxes, fewer rates and higher exemption limits. The maximum marginal individual income tax rate was reduced from 56% in 1991-92 to 40% in 1994-95; currently it is at 30%. It could be argued that these changes have led to "Laffer-type" revenue effects; i.e. a reduction in tax rates resulting in an increase in revenue. Currently, attempts are being made to bring most income earners under the umbrella of income tax. Reductions in income tax would leave households with more disposable income and thus generate more consumption demand and more savings in the economy.

The Indian economy showed a recovery in its growth rate after the downturn in 1997 when it was only 4.8 percent (GDP), mainly due to the Asian Crisis. It was 6.6 percent in 1998-99, 6.4 percent in 1999-00 and 6.0 percent in 2000-01. Despite this near stagnancy in growth rates for two consecutive years, the Indian economy has shown remarkable resilience in the context of a substantial rise in the international price of crude oil. The slowdown in growth could chiefly be attributed to a decline in the growth of the service sector and slow growth in agriculture.

Recent Trade Reforms

In the pre-reform period, India's trade was marked by heavy reliance on quantity restrictions (QRs) and high import tariffs and surcharges aimed to protect local producers and contain the balance of payment deficit. Until the 1970s, India followed restrictive trade policies in order to regulate the current account deficit. In the process, it relied more on quantitative restrictions than on tariffs. A move towards the liberalization of India's trade policy regime was made during the late 1970s and gained momentum during the latter half of the 1980s. In the mid-1980s, there were many important policy changes that took place in almost all sectors of the economy: industrial, foreign trade, monetary and long term fiscal policy (LTFP). Various committees, such as those led by Government of India in 1978, 1984 and 1985 emphasized two major points: (i) the need to develop an efficient system to render exports less costly and more profitable; and (ii) the need to move away from a discretionary system of quantitative import controls to a system based on tariffs. The LTFP envisaged an eventual removal of import licensing on all imports except consumer goods and also proposed a simplification of the complex tariff structure. Quantitative restrictions were gradually removed and tariffs reduced.

Although QRs were not removed, they were simplified. A number of items for capital and intermediates goods became freely importable under Open General Licenses (OGL). According to some trade experts, as there were no domestic substitutes for items listed under the OGL, lifting of these QRs had little impact on import competition with domestic production (Srinivasan, 1998). Various types of licenses were issued in the pre-reform period: (a) Open General License, (b) Automatic License, (c) Supplementary Import License, and (d) Imports License for government-owned agencies.

The beginning of 1991 was marked by a trend towards more liberal trade policy with the objectives of export-led growth, improved efficiency and competitiveness. The QR coverage was 94 percent for agricultural and 90 percent for manufactured intermediate and capital goods (Chadha et *al.*, 2003). As a result, India's import-weighted average tariff was as high as 87% in 1989-90. The rapid increase in import tariffs in the latter half of the 1980s led to inefficient resource allocation. The Tax Reforms Committee proposed that the import-weighted average duty rate should be reduced to 45% in 1995 and further to 25% by 1998-99 (Government of India, 1993). It was suggested that average tariff rates on imports of intermediate and capital goods should be brought down drastically from 103 and 91, respectively, in 1989-90 to 30 in 1998-99. It was further suggested that additional protection might be given to new industries and new technologies.

Table 2: Proposed Tariff (Import Weighted Average)

	Import Weight	1989-90 1990	1995-96 1996	1998-1999
Agricultural products	0.03	46	20	15
Coal, crude oil, natural gas	0.16	54	34	25
Other mineral products	0.03	20	15	10
Manufactured products	0.78	98	49	25
Consumers goods	0.07	89	60	50
Intermediate goods	0.47	103	45	30
Capital goods	0.24	91	55	30
Import Weighted Average	1.00	87	45	25

Source: Government of India, 1993.

These policy reforms led to the reduction of the average (unweighted) applied tariff rate from 125% in 1990-91 to 35% in 1997-98. The import-weighted average rate was reduced from 87% in 1990-91 to 20% in 1997-98. The highest rate of duty declined from 335% in 1990-91 to 45% in 1997-98 and to 40% in 1999-00. The highest protective customs tariff rate was scaled down further to 35% in 2000-01. It is noted that tariffs on consumer goods were drastically reduced as compared to tariffs on intermediate and capital goods.

Table 3: Tariff Structure of India (percent)

	1990-1991	1993-1994	1995-1996	1996-1997	1997-1998	1999-2000	2000-2001
Average unweighted (whole economy)	125	71	41	39	35		
Average weighted (whole economy)		87	47	25	22	20	
Consumer goods	153	86	36	33	25		
Intermediate goods	77	42	22	19	18		
Capital goods	97	50	29	29	24		
Maximum tariff rate	355	85	50	52	45	40	35

Source: *As quoted by Chadha et al., 2003. Government of India, 2000*

With respect to non-tariff barriers, the coverage of the Open General License was extended and the restricted list was cut drastically. There is a negative list of items, which does not fall under OGL. The negative list of imports consists of (i) prohibited items: items not permitted to be imported, (ii) restricted items: this includes consumer goods and special import licenses (SIL); and (iii) canalized items. The first stage of India's reforms after 1991 continued to focus on the manufacturing sector while the agricultural sector was largely ignored. The share of value added in the manufacturing sector protected by QRs declined from 90 to 36 percent by May 1992 (Pursell, 1996). The corresponding decline was much smaller in agriculture, declining from 94 to 84 percent by May 1995. The import of 40 percent of agricultural products was still restricted since these were classified as consumer goods. The import of some restricted items was liberalized by permitting their imports through freely transferable Special Import Licences (SILs). SIL coverage has been extended systematically since April 1999, freeing various items by transferring them from restricted classification to the SIL list and from the SIL list to the OGL list. Various items have also been de-canalized. Some of the newly freed categories, which were in the most restricted groups, were agricultural products and consumer goods.

Table 4: Different Types of NTBs on India's Imports

Types of NTBs or Free Imports	1998-99		1999-00	
	Products No. of	% Share	Products No. of	% Share
Free	7213	70.2	8170	79.3
NTBs	3068	29.8	2134	20.7
Prohibited	59	0.6		
Restricted	2831	27.5		
Consumer goods	1379	13.4		
Actual User	56	0.54		
SIL	676	6.57		
Other	721	7		
Canalized	177	1.7		
SIL	47	0.04		
Other	130	1.3		
TOTAL	10281	100	10304	100

Source: *Mehta and Mohanty, 1999.*

It is estimated that, in 1998-99, there were no NTBs on 7,213 products out of 10,281 products at the 10-digit HS-ITC level (Mehta, 1999). The number of products on the 'Restricted items' list represented 27.5 percent of the total, while only 1.7 percent of products were 'canalized' (Table 4). With India's Export-Import (EXIM) Policy for 1999-00, 957 products were added to the free list, while only 2,134 products were subjected to some type of NTB. According to the estimation of an index of the coverage ratio of NTBs by different sections (21 commodity groups) of the HS classification for 1998-

99, more than 90 percent of India's imports of manufacturing goods are not subjected to any type of NTB (Appendix-III).

It is believed that India has been maintaining QRs on imports on balance of payments grounds. However, the United States of America filed a case with the WTO Dispute Body (DSB) against these QRs in May 1997. The DSB ruled against India and found that India's QRs on imports were not justified on these grounds. It recommended that India bring its import regime into conformity with WTO agreements to phase out these QRs by 2001. Of the 2,714 import lines at the eight-digit level of the HT-ITC classification on which such QRs were applied in 1997, the Government has been unilaterally liberalizing these imports. The EXIM Policy 2001 declared that QRs on the last batch of 715 items had been removed.

A 20% devaluation of the rupee in July 1991 and the introduction of Exim licenses also marked the beginning of trade policy reform. These licenses were allotted to exporters as import entitlements against the value of exports and were freely tradable. In 1992, this system was replaced by a dual exchange rate mechanism with partial convertibility. In 1993, the economy moved into a unified exchange rate system. Since 1992, import licensing had been virtually abolished. In order to stimulate exports, a value-based advance license was introduced to permit duty-free imports of necessary raw materials and intermediate inputs up to a given share of export values. The Export Promotion of Capital Goods (EPCG) scheme was further liberalized to allow imports of capital goods at reduced customs duty rates.

India's International Trade

Trade policy reforms have helped to strengthen export performance and to improve competitiveness. Exports in US dollars experienced a significant recovery in 1999-00, attaining 13.2 percent, after negative growth in 1998-99 (Table 5). Although the value of imports has gone up substantially, growing by 2.2 percent in 1998-99 and 11.4 percent in 1999-00 due primarily to an increase in

Table 5: Structure and growth of India's main commodity exports and imports (US$)

Exports	Composition of Trade				Percent change in trade			
	1994-95	1997-98	1998-99	1999-00	1994-95	1997-98	1998-99	1999-00
I. Agricultural Products	16.05	18.93	18.17	14.62	4.93	-3.45	-8.93	-8.89
II. Ores and Minerals	3.75	3.03	2.69	2.41	11.27	-9.49	-15.80	1.49
III. Manufactured goods	77.49	75.83	77.64	78.39	22.50	7.85	-2.84	14.28
Leather products	6.12	4.73	5.00	4.09	23.94	3.17	0.24	-7.36
Chemical products	7.43	9.06	8.75	8.57	32.33	17.83	-8.32	10.90
Rubber Products	2.35	1.99	1.85	1.76	18.24	3.89	-11.95	8.15
Plastic Products	1.82	1.47	1.42	1.56	42.39	-4.65	-8.28	24.44
Machinery	13.32	15.24	13.44	13.20	15.47	7.53	-16.35	11.17
Readymade Garments	12.46	11.07	13.14	12.77	26.90	3.27	12.61	10.02
Textiles	11.56	12.44	11.21	11.30	42.26	7.36	-14.48	14.04
Handicrafts	17.09	15.27	17.85	20.31	12.63	12.47	10.92	28.78
Other Manufacturing	5.34	4.56	4.99	4.83	11.61	0.89	3.82	9.51
IV. Petroleum Products	1.58	1.01	0.27	0.08	4.80	-26.77	-74.66	-66.44
V. Others	1.12	1.20	1.23	4.50	9.96	23.69	-2.36	312.32
Total	100	100	100	100	18.40	4.59	-5.11	13.19

***Source**: Compact Disc of Handbook of Statistics on Indian Economy, Reserve Bank of India (2001)*

Table 5 (cont.) Structure and growth of India's main commodity exports and imports (US$)

Imports								
Bulk Imports	39.51	35.65	31.21	39.55	24.23	-9.62	-10.55	30.55
I. Petroleum, Crude and Products	20.69	19.68	15.10	25.39	3.03	-18.65	-21.62	63.82
II. Bulk Consumption goods	3.99	3.58	5.95	4.87	250.20	22.19	70.16	-9.10
III. Other Bulk Items	14.83	12.40	10.16	9.30	40.13	0.55	-16.25	4.38
Fertilizer	3.67	2.69	2.54	2.82	27.42	22.54	-3.60	28.78
Non-ferrous metals	2.51	2.22	1.41	1.10	49.81	-16.76	-35.09	-8.96
Iron and Steel	4.06	3.43	2.51	1.92	46.36	3.68	-25.16	-5.14
Others	4.59	4.06	3.70	3.46	41.08	-2.47	-6.81	-0.83
Non-Bulk Imports	60.49	64.35	68.79	60.45	22.19	11.63	7.49	-3.09
IV. Capital Goods	26.66	23.61	23.74	18.05	22.35	-1.27	2.74	-19.81
V. Export Related Items	15.06	16.66	16.82	18.36	-1.62	12.63	3.15	25.30
Pearls, precious stones	5.69	8.06	8.87	10.94	-38.14	14.26	12.51	42.97
Textiles	1.15	0.98	1.08	1.08	44.31	13.97	11.80	0.81
Others	8.23	7.62	6.87	6.34	54.62	10.79	-7.86	6.35
VI. Other Imports	18.77	24.07	28.22	24.04	32.74	18.95	11.36	-4.64
Total Imports	100	100	100	100	22.95	6.01	2.18	11.38
Balance of Payments (% of GDP)					-1.00	-1.40	-1.00	-0.90
Tariff Collection Rates (%)					30.17	26.29		

Source: *Compact Disc of Handbook of Statistics on Indian Economy, Reserve Bank of India (2001).*

international crude oil prices, the current account deficit was contained at 0.9 percent of GDP in 1999-00. Growth in exports was mainly driven by a substantial increase in India's principal exports: handicrafts, textiles and 'chemicals and allied products'. However, the export of agricultural products, which also represents a significant share (14.8 percent) of India exports, fell for two consecutive years.

On the other hand, 'petroleum, crude and products' constituted the major share of imports followed by capital goods and 'pearls and precious stones'. There has been a particularly significant rise in import of crude oil and 'pearls and precious stones'. The sharp increase in export-related imports like 'pearls and precious stones' could be attributed to the heightened sales overseas of gems and jewelry during this period. However, import of capital goods declined by 19.81 percent in 1999-00 and its share also declined from 23.74 percent to 17.09 percent in the same period. This could reflect a declining investment demand in the economy.

Recent poverty trends

Since 1991, the beginning of the era of full pace economic reform, there has been a great deal of debate in India about the possible impact of these policies on the poor. If one looks at the head count poverty ratio for rural and urban India since 1983, it can be seen that rural poverty has always been higher than urban poverty (Table 6). Approximately 80 per cent of the total poor live in rural areas. In the pre-reform period until 1990, both rural and urban poverty declined. There has generally been a reduction in poverty throughout both the rural and urban areas. However, the reduction was sharp between 1993-94 and 1999-00 largely due to an increase in GDP growth rate, which many believe was induced by economic reforms in the 1990s.

Table 6: Poverty Head-count ratio for Rural and Urban from 1983 to 1995-96 and 1999-00

Year	Rural	Urban
1973-74	56.4	49.0
1977-78	53.1	45.2
1983	45.7	40.8
1987-88	39.1	38.2
1993-94	37.3	32.4
1999-00	27.8	23.6

Source: Government of India (2003) The Economic Survey 2002-2003 (New Delhi: Government of India, Ministry of Finance).

The Model

The model has 28 production activities and three factors of production, viz. labor, land and non-land capital (Appendix I). Households, the private corporate sector, the public sector and government are the agents. Households are classified into four rural categories and five urban categories (Appendix II).

Other than the distinction between land and non-land capital, the key distinguishing feature of this model, as compared to the other models in this volume, is the inclusion of import quota restrictions. When there are quota restrictions on the import of a commodity, its domestic price rises in response to increased demand, as supply of the imported good in domestic market remains unchanged. Prices on the domestic market thus depend on the demand elasticity of substitution between domestic and imported goods. Government administers the auctioning of quota licensing to importers. The price of the license is competitively determined by the difference between price of the good in the domestic market and its price in the international market, which is expressed as the tariff equivalent. This generates a rent that becomes part of government revenue.

However, there is an exception in the case of the import of petroleum products. About 98 percent of these imports are under quotas, which are canalized through government agencies. Any shortage of domestic petroleum supply relative to domestic demand is compensated by increased imports. Government fixes the import price on the domestic market, which, at times, could be lower than the world price. To avoid the complications of modeling this mechanism, we assume that there is no rent on these imports in the benchmark. It is assumed that import demand is endogenously determined in the model and import price in the domestic market is exogenously fixed.

Calibration and the Benchmark Equilibrium

The Social Accounting Matrix (SAM) gives the benchmark equilibrium for the model. The SAM used for the present study is based on Pradhan, Sahoo and Saluja, 1999. The economy is classified into 28 production sectors to take care of important economic activities. Out of 28 sectors, ‘construction’, ‘electricity’, ‘education’ and ‘health’ are not importable sectors. Sectors that are not engaged in exporting activities are ‘crude oil and gas’, construction’, electricity’, ‘education’ and ‘health’.

’Food-grains’ has been separated from the rest of the agriculture sector for its vital role in poverty. Coal and lignite, and crude oil and natural gas are the two components of the primary energy sector. This sector requires higher investment in exploration and also, due to high domestic demand, a substantial amount of it is imported.

The manufacturing sectors are divided in such a way that capital goods are separated from consumer items like ‘food articles and beverages’, ‘textiles’, etc. to take care of investment. Because of rapid economic development, ‘cement and other non-metallic mineral products’, which are basically inputs to the construction sector, are very important. Their growth gives a fillip to the crucial housing sector as well. ‘Fertilizers’ as a sector has a big role to play in influencing agriculture, particularly with respect to the recent debate concerning the withdrawal of fertilizer subsidies.

‘Petroleum products’ are kept separately as these are byproducts of one of the important energy sectors, ‘crude oil and natural gases’. They are also crucial energy sectors whose prices have been, until recently, administered by the government and have strong impacts on the economy. Even now, the market does not have a very big role in determining their prices. Moreover, their prices have recently gone up dramatically in international markets. Construction' is a highly labor intensive sector. 'Electricity' is an important sector, with important linkages in the economy. 'Infrastructure services' and 'financial services' have been kept as separate sectors as they play important roles, particularly in the context of liberalization. 'Health' and 'education' are mainly public goods and also influence welfare. Expenditure in these sectors by government, private institutions and individuals is considered as investment in human capital.

Households are classified according to their principal sources of income. There are four rural and five urban occupational household groups. We note that 56% of rural income comes from agriculture while 97% of urban income comes from non-agricultural activities (Table 7). However, there are substantial differences among household

Table 7: Sources of income for household groups (as a percentage of Total income)

HH Categories	Agriculture	Non Agriculture	Total
Rural			
Self Employed in Agriculture	87.12	12.88	100
Self Employed in Non-agriculture	12.87	87.13	100
Agriculture Wage Earners	88.52	11.48	100
Non-agriculture Wage Earners	10.32	89.68	100
Other households	12.53	87.47	100
Total	55.66	44.34	100
Urban			
Agriculture Households	74.91	25.09	100
Self Employed in Non-agriculture	0.95	99.05	100
Salaried Earners	0.90	99.10	100
Non-agriculture Wage Earners	2.19	97.81	100
Other Households	1.03	98.97	100
Total	2.46	97.54	100
GRAND TOTAL	32.14	67.86	100

Source: Pradhan & Roy (2003)
Note: The SAM used for this model, rural self-employed in non-agriculture and rural non-agricultural households are combined into one group as "rural artisans".

groups within each of these areas. While rural agricultural households derive almost 90% of their income from agriculture, the rest of the

Table 8: Benchmark Parameters[1]

	CES Import Elasticity	CET Export Elasticity	CES Production Elasticity	Average Tariff Collection*
Food grains	1.1387	0.92	0.78	
Other agriculture (no quota)	1.1387	0.92	0.78	0.1792
Other agriculture (with quota)	1.1387	0.92	0.78	0.1740
Crude oil	1.6195	0	1.1	0.0006
Other mining	1.6195	0.92	1.54	0.0186
Food articles (no quota)	1.1345	1.16	0.58	0.0471
Food articles (with quota)	1.1345	1.16	0.58	0.0445
Textiles (no quota)	3.082	2.49	0.77	0.1812
Textiles (with quota)	3.082	2.49	0.77	0.1824
Traditional manufacturing	2.8021	1.2	1.01	0.3139
Petroleum products (with quota)	2.0022	0.69	1.85	0.9961
Petrochemicals	5.6926	1.06	1.17	0.2998
Fertilizer (no quota)	2.6171	0.69	0.73	0.0118
Fertilizer (with quota)	2.6171	0.69	0.73	0.0116
Other chemical products	2.6171	0.69	0.73	0.3597
Non-metallic goods	2.8079	1.04	1.05	0.6627
Basic metals	1.4319	5.42	0.64	0.2588
Metallic products	3.6993	0.68	1.02	0.4145
Capital goods (no quota)	2.3484	1.32	0.98	0.3185
Capital goods (with quota)	2.3484	1.32	0.98	0.3334
Miscellaneous. manufacturing	1.9225	1.64	0.77	0.6551
Construction	0	0	1.1	
Electricity	0	0	2.26	
Infrastructure services	2.145	0.92	1.45	
Financial services	2.145	0.92	1.65	
Education	0	0	1.08	
Health	0	0	1.08	
Other services	2.145	0.92	1.08	
Total				**0.3092**

Source: *Chadha, et al. (1998). CET elasticities of substitution for exports are considered to be same as CET export demand elasticities. CES elasticities of substitution for imports are considered to be same as CES import demand elasticities. Also, some figures in the table are guesstimates. *Authors own estimation.*

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[1] Benchmark parameters are given for 23 sectors. Because of a lack of detailed information, the sectors with quota are created as a proportion of their import shares in the original import sectors. We assume that their behavioural parameters are the same as those in their original sectors.

rural household groups get almost 90% of their income from non-agricultural activities. Also, urban agricultural households derive 75% of their income from agriculture, whereas all other urban household categories derive almost all income from non-agricultural sources.

The tariff rates used in the benchmark are the actual collection rates, i.e. ratio of total value of import duties including additional duties to the value of imports. For the computation of the tariff equivalent due to non-tariff barriers, rent generated is computed using the wedge between value of imports of a sector on the domestic market and its value on the international market. There are six importing sectors which involve quota restrictions, viz. 'agriculture products other than food-grains', 'food and food articles', 'textiles', 'petroleum products', 'fertilizer', and 'capital goods' (Table 9). Imports of each of these sectors are divided into two parts - one that comes through quota restriction and the other that is freely imported. Out of these six sectors, imports of 'petroleum products' are fully canalized through government agencies. It is assumed that this sector does not generate any rent.

Table 9: Benchmark quota rent and non-tariff barriers (in 1994-95)

	Rent as a % of Import	% of import under NTBs
Agriculture other than food-grains (S3)	24	23
Food and food articles (S7)	26	39
Textiles (S9)	30	36
Petroleum products (S11)	0	98
Fertiliser (S14)	38	55
Capital goods (S20)	3	29

***Source**: Authors' own calculations based on McDougall et al., 1998. The latter gives the price wedges of different imported commodities, i.e. difference between value of imports at the domestic market price and value of the same at the world price (in dollar terms).*

In the linear expenditure system (LES) demand functions, the values of marginal budget shares and minimum consumption parameters have been estimated with the help of micro household data taken from MIMAP-India Household Survey (1996), conducted by the National Council of Applied Economic Research (Pradhan and Roy, 2003), New Delhi. In the benchmark, the minimum consumption parameters are calibrated with the use of these budget shares and the 'supernumerary income ratio'[2] for each household.

Policy Simulations

This paper attempts to capture the poverty and welfare impacts resulting from India's recent sweeping trade reforms.

The main objectives of the trade reforms have been to accelerate the growth of the economy by removing the distortions. The policy changes have undoubtedly impacted on the households by affecting their income and consumption levels, and hence, their welfare and poverty. In order to look into the above issues, the following simulation exercises have been carried out in the model[3].

SIM1: Complete removal of import tariffs across the board without any compensating mechanism regarding government revenue.

SIM2: Quota restrictions on imports of 'other agriculture not inclusive of food grains' (S3) and 'food and food articles' (S7) are relaxed, i.e. their import quota limits are increased by 40 per cent; no compensating mechanism with respect to government revenue.

SIM3: Complete removal of import tariffs and an increase in the uniform indirect tax rate on domestic demand to keep government revenue constant.

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[2] The supernumerary income ratio measures the amount of available spending power that consumers have over and above the minimum consumption level. For details see Taylor, 1990.

[3] Results of the simulations are given in the Annex tables.

Completely doing away with import tariffs in **SIM1** makes imports cheaper, leading to an inflow of more imports. Lower import prices reduce the relative demand for domestic goods. The degree of change depends on the import elasticity of substitution, import intensity of the sector and the base line tariff. It is expected that sectors with high import intensity and high demand elasticity of import vis-à-vis domestic goods would experience a greater increase in imports. However, it also depends on the tariff base of the sector. Sectors with higher tariffs respond more to the reduction in tariff rate. Sectors like 'traditional manufacturing' (S10), 'finished petrochemicals' (S12), 'other chemicals' (S15), 'non-metallic products' (S16), 'metallic products' (S18) and 'other miscellaneous industries' (S21) have shown a significant rise in imports because of their high CES elasticity and high tariff base (see Table A1-sim1). It is also expected that a high import intensity, i.e. high share of imports relative to domestic consumption, will encourage a rise in imports when tariffs fall. Crude oil and natural gas' (S4), 'other mining and quarrying' (S5), 'non-quota food products' (S6), 'petroleum products' (S11), and all the service sectors have a small response to tariff reductions because of either low import intensity or a very low tariff base[4]. Sectors faced with import quotas, i.e. 'other agriculture' (S3), 'food products' (S7), 'textiles' (S9), 'petroleum products' (S11), 'fertilizer' (S14), and 'capital good' (S20) show no gain at all in the volume of imports. With fixed foreign exchange reserves, resources are drawn from these sectors in order to finance imports in other more responsive sectors.

With our assumption of a fixed current account, a decline in overall imports leads to a depreciation of the real exchange rate, which encourages exports. It again depends on the elasticity of transformation between the supply of goods to the domestic and export markets as well as export-intensity, i.e. the ratio of exports to domestic supply. Exports from most sectors increase, notably for 'basic metals' (S17) and 'textiles' (S8 and S9), which have high export elasticities.

The lower cost of imports is expected to reduce domestic production due to lower domestic demand. However, this does not happen for some industrial sectors (from S4 to S13) because of their increase in local demand and also in exports, which is the consequence of the overall decline in purchase prices. The fall in import prices results in a decrease in production prices because of lower input prices. The rest of the sectors, including agriculture and services, lose their comparative advantage due to tariff removal. Change in the production activities in the economy results in a reallocation of factors of production. All the factors of production suffer from a decline in their remuneration, notably non-land capital (see Table A2-sim1). There is an overall decline in factor remuneration. All household groups suffer heavily in terms of declining nominal incomes (see Table A3-sim1). This is mainly because of the contraction in the major domestic sectors and fall in prices.

The welfare impacts on the different household groups depend on their real consumption, which is affected by the composite prices of the commodities as well as their disposable income. There is an across-the-board decline in these prices. The largest decline is observed in industrial products because of their relatively high composition of imports. Consumer price indices for different household groups, which determine the real consumption of households, also decline (see Table A4-sim1). Equivalent variations, as a measure of welfare, decrease for all rural and urban household groups except rural 'agriculture labour' and 'other household' groups, and urban 'agriculture household' and 'other household' groups (see Table A5-sim1). Though there has been a decline in consumer prices, there is an overall welfare loss for rural as well as urban households in the economy due to the overwhelming impact of the fall in their net disposable income. The drop in household disposable income is the result of a decrease in relative factor rewards and government transfers to households. Government loses revenue due to tariff removal and hence, there is a squeeze in transfer payments to households. However, the poverty ratio eases up for both rural and urban household groups. This decline could be attributed to the larger impact of the decrease in consumer prices, which reduces the poverty line.

Given the undistorted income distribution, the lowering of the poverty line pushes the marginal households out of poverty. Households in the rural areas gain more in terms of the increase in welfare and decrease in poverty than urban households following the complete removal of import tariff.

In Simulation 2 (**SIM2**), reducing quota restrictions on 'agricultural products' (S3) and 'food and food articles' (S7) implies allowing more imports of these goods into the domestic market. The import intensities are low for agricultural products and food articles (see Table A6-sim2). This implies that demand for agricultural products is more biased towards those domestically produced in the base year. However, a shift in import demand also depends upon the elasticity of substitution in local demand between domestically produced and imported goods. As elasticity of substitutions are more than onet and almost the same for both S3 and S7, with relaxing of import restrictions on these items, domestic demand for their imports goes up significantly and almost equally. With more availability of hitherto quota-restricted goods, there is a fall in the domestic production of these goods.

In order to model the imposition of quota restrictions, tariff equivalents, which are equal to the difference between domestic and international prices, are imposed on the importers in the model. When quotas are relaxed, this tariff equivalent, otherwise known as rent, decreases in both these sectors significantly. This, in fact, reduces the cost of imports. Hence, composite prices, i.e. prices faced by consumers, of these goods decline. Due to the relatively high import share of food articles (S7), import prices decline more in this sector than in other agriculture (S3). This leads to a significant decline in the composite price of food articles (see Table A9-sim2). Significantly lower import prices for these items, and their linkage to the other sectors in the economy, results in a decline in domestic purchaser prices and producer prices in almost all sectors (see Tables A6-sim2 and A9-sim2).

With exogenously given foreign savings, an increase in imports of these goods leads to a depreciation of the exchange rate, i.e. domestic currency becomes cheaper in terms of the US dollar. Imports are withdrawn from the rest of the sectors to finance quota imports. There is overall increase in exports due to depreciation (see Table A6-sim2). Agriculture sectors suffer from the decline in production due to high imports in these sectors. However, industry and service sectors generally increase production due to lower domestic input prices as well as an increase in exports.

The lower cost of production, reflected in the value added prices, results in a lowering of remuneration to all factors of production (see Table A7-sim2). However, labour and land suffer relatively more from the lowering of factor rewards due to the shrinkage of domestic agricultural activities. Hence, we might expect that rural household groups would be worst hit. However, there is a marginal rise in other income due to the rise in transfer income from government to households (see Table A8-sim3). The rise in government revenue, as a result of increased domestic activities, contributes to the increase in transfer payments to households. In general, rural and urban household groups almost equally suffer in terms of the decline in nominal disposable income.

It is observed that the effect of the reduction in quantitative restrictions on imports of food and agricultural items is positive on the households. Welfare is based on the real consumption of households, which is affected by the change in consumer price indices. There has been a decline in consumer price indices for all household groups (see Table A10-sim2). The decline is greater for rural households due to the lower purchaser prices of agricultural products, which in turn is a result of the relaxation of quotas to the domestic market. Welfare increases for almost all household groups except for the rural 'agricultural self-employed'. In fact, welfare increases marginally more for rural households. Poverty ratios decline more in the rural area than in the urban areas. This is a result of the dominant role of the decrease in consumer prices over the decline in relative income due to quota removal. Only the 'agricultural self-employed' and 'agricultural labour' households groups, in rural areas, the 'salaried class' in urban areas experience a decline in poverty.

In Simulation3 (**SIM3**), tariffs are removed completely and there is an increase in domestic indirect taxes to compensate for the loss in government revenue. In this case, the pattern of results is quite similar to Simulation1 (see Tables A11-sim3 to A15-sim3). But factor prices decline more than due to a rise in the cost of production following the compensatory increase in the indirect tax (see Tables A2-sim1 for Simulation 1 and A12-sim3 for Simulation 3). Despite the decline in prices, welfare is reduced for all household groups, even more than the reduction in Simulation 1 (see Tables A5-sim1 for Simulation 1 and A15-sim3 for Simulation 3). However, unlike the first simulation, poverty ratios increase for all household groups (see Table A15-sim3). Here, the decline in income dominates the decrease in consumer prices to raise the poverty ratio. Also, unlike the first simulation, households in rural areas experience a larger decline in welfare and a larger increase in poverty than urban households.

Conclusion

In the Indian economy, trade policies significantly affect the prices, demands and growth in the economy. They affect the welfare and the poverty of household groups directly as well as indirectly. This paper is confined to some policy issues pertaining to non-tariff barriers (NTBs) on imports of agricultural products as well as on 'food and food articles', and import liberalisation through a general tariff reduction. Though our policy simulation regarding quota restrictions is confined to agriculture and food products only, quota reductions on these sectors are in line with the EXIM policy of India, 2001. Trade liberalisation, both in tariffs and in non-tariffs, promotes exports and hence, export-led growth. Overall welfare decreases in the case of a removal of tariff but increases for quota relaxation. However, poverty declines in both cases. Rural areas are in a better position than their urban counterparts in terms of welfare improvement. Both disposable income and consumer prices decline in both scenarios, but the decline in welfare is attributed to the dominant role of the change in income and the decline in poverty to the fall in prices.

When we allow for a compensatory increase in indirect taxes along with tariff removal, overall poverty increases and welfare declines. In this case, rural household groups suffer more than urban households. Another policy implication emerging from our simulations is in the case of tariff elimination, where the removal of quota restrictions could be a pre-requisite step in order to have a more positive price effect on the economy, which could lead to higher welfare gains for households.

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ANNEX

The whole Indian economy is divided into 28 sectors, 5 primary sectors, 18 secondary sectors and 5 service sectors.

Agricultural Sectors

S1. Food grains (Tradable)
S2. Other agriculture (Tradable, no quota)
S3. Other agriculture (Tradable with quota)

Industries

S4. Crude oil and natural gas (non-exported, but importable)
S5. Other mining and quarrying: Coal and lignite, Iron ore and other minerals (Tradable)
S6. Food products and beverages (Tradable, no quota)
S7. Food Products and beverages (Tradable with import quota)
S8. Textiles (Tradable, import quota)
S9. Textiles (Tradable with import quota)
S10. Other traditional manufacturing goods, viz. wood, paper and leather products (tradable)
S11. Petroleum products (Tradable with import quota)
S12. Finished petrochemicals (Tradable)
S13. Fertiliser (Tradable, no quota)
S14. Fertiliser (Tradable with import quota)
S15. Other chemicals (Tradable)
S16. Non-metallic products: cement and other non-metallic mineral products (Tradable)
S17. Basic metal industries including iron and steel (Tradable)
S18. Metallic products (Tradable)
S19. Capital goods (Tradable, no quota)
S20. Capital goods (Tradable with import quota)
S21. Other miscellaneous manufacturing industries (Tradable)
S22. Construction (non-tradable)
S23. Electricity (non-tradable)

Service Sectors:

S24. Infrastructure services: gas and water supply, trade, transport, hotel and restaurants (Tradable)

S25. Financial services: banking and insurance (Tradable)

S26. Education (non-tradable)

S27. Health (non-tradable)

S28. Other services (Tradable, due to the Information Technology sector)

Households

A. Rural Households

1. RAGSLF: Rural Agricultural Self-employed)
2. RAGLAB: Rural Agricultural Labour
3. RNAG: Rural Non-agricultural Labour)
4. ROTH: Rural Other Households

B. Urban Households

1. UAG: Urban Agricultural Households
2. UNAGSLF: Urban Non-agricultural Self-employed
3. USALARY: Urban Salaried Class
4. UNAGLAB: Urban Non-agricultural Labour (casual labour)
5. UOTH: Urban Other Households

Symbol	Variables	Symbol	Variables
CES	Armington elasticity	EXi/EX	Sectoral export share
CET	CET elasticity	EXi/XSi	Share of exports in local production
dDi	Change in local demand for domestic production	KDi/KD	Sectoral share of composite capital
dEXi	Change in export volume	KDi/VAi	Sector-wise share of composite capital in value added
dMI	Change in import volume	KFi/LFi	Sector-wise ratio of composite capital to labour
dPCi	Change in consumer price	KLDi/KDL	Sectoral share of land capital
dPDi	Change in producer prices for local sales	KLDi/LFi	Sector-wise ratio of land capital to labour
dPDi	Change in producer prices for local sales	KLDi/VAi	Sector-wise share of land capital in value added
dPi	Change in price of composite local production	KNDi/KND	Sectoral share of non-land capital
dPMi	Change in import price	KNDi/LFi	Sector-wise ratio of non-land capital to labour
dPVi	Change in price of composite local production	KNDi/VAi	Sector-wise share of non-land capital in value added
dQi	Change in local demand in volume	LDI/LD	Sectoral share of labour
dRKi	Change in rate of return to composite capital	LDi/VAi	Sector-wise share of labour in value added
dRLDi	Change in rate of return toland capital	Mi/M	Sectoral import share
dRNDi	Change in rate of return to non-land capital	Mi/Qi	Share of imports in local demand
dVAi	Change in local value added	Mi/Qi	Share of imports in local consumption
dVAi	Change in local value added	nLDi/nLD	Sectoral land remuneration share
dW	Change in wage rate	riKi/rK	Sectoral capital remuneration share
dXS	Change in local production volume	VAi/VA	Sectoral value-added share
ETA	Export price elasticity wit respect to world demand	wLi/wL	Sectoral labor remuneration share

A1-sim1: Complete removal of import tariff across the board

Sectors	Sectoral shares					Volume Changes				Price Changes	
	VAi/VA	Mi/M	Exi/EX	Mi/Qi	EXi/Xsi	dMi	dDi	dEXi	dXSi=dVAi	dPDi	dPi
S1	0.60	1.54	0.48	1.21	-10.60	1.45	6.04	1.51	-10.54	-10.49	-6.42
S2	1.99	2.95	1.03	1.51	-3.92	1.58	6.41	1.65	-11.12	-11.05	-6.80
S3	0.62	0.88	1.08	1.51	0.00	1.55	6.39	1.62	-11.12	-11.05	-6.80
AGRICULTURE	**3.21**	**5.36**	**0.86**	**1.41**	**-4.53**	**1.54**	**6.30**	**1.60**	**-10.93**	**-10.87**	**-6.67**
S4	10.58	0.00	49.75	0.00	-3.23	4.03	0.00	4.03	-4.63	-4.63	-2.38
S5	8.91	1.33	34.98	7.40	-5.95	0.98	2.90	1.12	-5.05	-4.91	-2.60
S6	2.12	4.41	4.98	9.74	-7.40	0.74	5.99	1.23	-8.95	-8.55	-5.08
S7	1.47	2.82	5.36	9.74	0.00	0.54	5.89	1.04	-8.96	-8.55	-5.08
S8	1.37	14.76	2.31	20.17	-2.19	0.66	10.99	2.59	-7.80	-7.07	-3.99
S9	0.79	8.30	2.36	20.18	0.00	0.62	10.96	2.55	-7.80	-7.07	-3.99
S10	2.29	4.99	7.17	14.32	11.08	-1.87	3.63	-1.12	-7.29	-6.67	-3.74
S11	8.78	1.34	25.38	4.89	-4.82	1.20	1.60	1.22	-2.97	-2.94	-1.51
S12	1.33	1.80	5.67	7.46	29.04	-2.30	2.27	-1.97	-6.48	-6.12	-3.42
S13	1.04	0.04	13.27	0.51	-9.17	3.34	3.59	3.34	-5.30	-5.30	-2.90
S14	1.40	0.04	14.59	0.52	0.00	1.86	2.84	1.86	-5.31	-5.30	-2.90
S15	13.41	6.08	16.48	8.14	10.94	-3.82	0.10	-3.51	-7.01	-6.35	-3.56
S16	0.83	9.16	4.92	36.13	49.26	-3.00	2.03	-1.24	-6.89	-5.02	-2.70
S17	10.91	3.50	14.12	4.98	3.65	-2.13	15.23	-1.39	-5.53	-5.37	-2.96
S18	0.93	1.53	3.08	4.92	34.50	-2.44	0.76	-2.28	-5.92	-5.67	-3.12
S19	12.46	4.07	11.42	4.01	12.55	-1.51	3.41	-1.32	-6.06	-5.92	-3.25
S20	4.52	1.67	10.18	3.99	0.00	-0.46	3.96	-0.29	-6.04	-5.92	-3.25
S21	6.02	3.74	27.26	18.73	21.91	-6.47	2.24	-4.95	-7.01	-5.89	-3.23
S22	0.00	0.00	0.00	0.00	0.00	-0.21	0.00	-0.21	-6.56	-6.56	-3.61
S23	0.00	0.00	0.00	0.00	0.00	-2.68	0.00	-2.68	-4.49	-4.49	-2.35
INDUSTRY	**89.17**	**69.59**	**10.11**	**8.00**	**4.15**	**-1.10**	**5.95**	**-0.57**	**-6.43**	**-6.14**	**-3.41**
S24	5.44	21.75	1.76	6.64	-11.26	-0.18	2.46	-0.01	-5.33	-5.16	-2.74
S25	0.58	0.42	0.91	0.66	-10.32	-0.71	1.84	-0.69	-4.63	-4.62	-2.37
S26	0.00	0.00	0.00	0.00	0.00	-0.96	0.00	-0.96	-4.03	-4.03	-2.05
S27	0.00	0.00	0.00	0.00	0.00	-0.56	0.00	-0.56	-6.49	-6.49	-3.47
S28	1.59	2.87	1.34	2.37	-18.00	-4.55	0.93	-4.43	-6.84	-6.70	-3.66
SERVICES	**7.62**	**25.05**	**1.37**	**4.33**	**-12.69**	**-1.28**	**2.27**	**-1.13**	**-5.58**	**-5.45**	**-2.90**
Total	**100.00**	**100.00**	**5.51**	**5.47**	**2.35**	**-0.60**	**5.02**	**-0.31**	**-7.11**	**-6.88**	**-3.91**

Source: Initial tariff rates, tm are computed from SAM for India, Pradhan, Sahoo and Saluja (1999).

A2-sim1: Complete removal of import tariff across the board

Sectors						Volume Changes				Price Changes	
	dPVAi	dVAi	Ki/Li	LDi/Li	Ki/Ldi	WLi/WL	rKi/rK	nLDi/nLD	dW	dr	dn
S1	-12.26	1.51	0.28	0.82	0.34	9.44	3.24	31.38	-4.47	-2.80	-8.05
S2	-12.25	1.65	0.27	0.82	0.34	15.98	5.46	52.84	-4.47	-2.80	-8.05
S3	-12.25	1.62	0.27	0.82	0.34	4.77	1.63	15.78	-4.47	-2.80	-8.05
AGRICULTURE	**-12.25**	**1.60**	**0.28**	**0.82**	**0.34**	**30.20**	**10.34**	**100.00**	**-4.47**	**-2.80**	**-8.05**
S4	-4.44	4.03	2.46			0.58	1.79		-4.47	-2.80	
S5	-4.46	1.12	2.42			0.71	2.14		-4.47	-2.80	
S6	-4.85	1.23	1.56			0.73	1.42		-4.47	-2.80	
S7	-4.85	1.04	1.56			0.47	0.90		-4.47	-2.80	
S8	-5.64	2.59	0.70			2.37	2.07		-4.47	-2.80	
S9	-5.64	2.55	0.70			1.33	1.16		-4.47	-2.80	
S10	-5.30	-1.12	0.98			1.15	1.41		-4.47	-2.80	
S11	-4.14	1.22	3.68			0.11	0.50		-4.47	-2.80	
S12	-4.02	-1.97	4.47			0.22	1.21		-4.47	-2.80	
S13	-4.27	3.34	3.06			0.09	0.34		-4.47	-2.80	
S14	-4.27	1.86	3.06			0.11	0.41		-4.47	-2.80	
S15	-4.30	-3.51	2.96			0.98	3.59		-4.47	-2.80	
S16	-4.98	-1.24	1.35			0.56	0.95		-4.47	-2.80	
S17	-4.65	-1.39	1.94			0.90	2.17		-4.47	-2.80	
S18	-5.38	-2.28	0.91			0.99	1.12		-4.47	-2.80	
S19	-5.54	-1.32	0.77			4.00	3.83		-4.47	-2.80	
S20	-5.54	-0.29	0.77			1.65	1.58		-4.47	-2.80	
S21	-5.09	-4.95	1.21			0.95	1.44		-4.47	-2.80	
S22	-6.61	-0.21	0.20			9.57	2.43		-4.47	-2.80	
S23	-4.53	-2.68	2.22			1.47	4.06		-4.47	-2.80	
INDUSTRY	**-5.32**	**-0.57**	**0.96**			**28.95**	**34.51**		**-4.47**	**-2.80**	
S24	-4.92	-0.01	1.45			18.02	32.56		-4.47	-2.80	
S25	-4.49	-0.69	2.31			3.48	10.02		-4.47	-2.80	
S26	-3.44	-0.96	25.66			0.22	6.89		-4.47	-2.80	
S27	-6.40	-0.56	0.28			5.23	1.84		-4.47	-2.80	
S28	-6.56	-4.43	0.22			13.91	3.84		-4.47	-2.80	
SERVICES	**-5.21**	-1.13	**1.08**			**40.86**	**55.15**		**-4.47**	**-2.80**	
Total	**-7.37**	**-0.31**	**0.80**	**0.25**	**3.26**	**100.00**	**100.00**	**100.00**	**-4.47**	**-2.80**	-8.05

Note: Aggregation of volumes of value added (VA) is done by Laspeyres method.

A3-sim1: Complete removal of import tariff across the board

Household groups	Rate	Income share (100%)											All
		Rural					Urban						
		Ragslf	Raglab	Rnag	Roth	Total	Uag	Unagslf	Usalary	Unaglab	Uoth	Total	
Non-land capital	-9.03	25.08	1.50	36.47	11.64	21.33	42.34	67.57	19.20	39.11	66.42	40.84	30.00
Land capital	-8.99	36.82	0.70	14.60	4.95	20.40	12.85	0	0	0	0	0.33	11.48
Composite capital	-8.99	61.90	2.20	51.07	16.59	41.73	55.18	67.57	19.20	39.11	66.42	41.17	41.48
Labour	-8.91	26.25	88.05	39.50	73.46	47.62	31.02	19.96	74.08	52.34	11.41	48.62	48.07
Remittance		0.25	1.08	0.64	2.76	0.91	5.28	4.32	2.34	0.87	13.18	3.90	2.24
Other income		11.61	8.67	8.79	7.20	9.74	8.52	8.14	4.38	7.68	8.99	6.31	8.21
Total		100	100	100	100	100	100	100	100	100	100	100	100
Direct Tax rate		0.009	0.000	0.042	0.057	0.023	0.041	0.046	0.051	0.000	0.052	0.046	0.033
Saving		0.312	0.065	0.323	0.237	0.0002	0.276	0.401	0.303	0.198	0.353	0.0004	0.0003
Household groups		Income change											
		Rural					Urban						
		Ragslf	Raglab	Rnag	Roth	All	Uag	Unagslf	Usalary	Unaglab	Uoth	All	Total
Non-land capital		-0.08	-0.23	-0.13	-0.38	-0.17	-0.57	-0.46	-0.33	-0.16	-1.31	-0.45	-0.29
Land capital		-0.04	-0.18	-0.08	-0.33	-0.12	-0.53	0	0	0	0	-0.41	-0.25
Composite capital		-0.05	-0.21	-0.11	-0.36	-0.15	-0.56	-0.46	-0.33	-0.16	-1.31	-0.45	-0.28
Labour		0.05	-0.10	0.01	-0.24	-0.03	-0.44	-0.33	-0.2	-0.03	-1.18	-0.32	-0.16
Remittance		-	-	-	-	-	-	-	-	-	-	-	-
Other income		-0.03	-0.18	-0.08	-0.33	-0.14	-0.52	-0.41	-0.28	-0.11	-1.26	-0.56	-0.35
Total		-8.96	-8.82	-8.91	-8.69	-8.88	-8.51	-8.61	-8.73	-8.89	-7.82	-8.62	-8.76
Direct Tax rate		-8.97	0.00	-8.97	-8.93	-8.95	-8.98	-9.00	-8.93	0.00	-9.01	-8.96	-8.96
Saving		-6.55	-6.41	-6.51	-6.26	-6.49	-6.08	-6.18	-6.31	-6.48	-5.34	-6.17	-6.33
Disposable Income		-8.96	-8.82	-8.91	-8.68	-8.88	-8.49	-8.60	-8.72	-8.89	-7.77	-8.60	-8.76
Net Income (CTH)		-10.05	-8.99	-10.06	-9.43	-9.72	-9.41	-10.21	-9.76	-9.48	-9.10	-9.81	-9.75

A4-sim1: Complete removal of import tariff across the board

Sectors	Share M/Q	Change in sales tax	dPM	dPD	dPC	Consumption shares							
						RAGSLF	RAGLAB	RNAG	ROTH	UAG	UNAGSLF	USALAY	UNAGLAB	UOTH
S1	0.48	-9.21	0.00	-10.54	-10.49	15.62	25.62	17.57	20.99	13.42	7.67	11.64	12.28	7.90
S2	1.03	-9.71	-6.67	-11.12	-11.07	20.04	17.23	18.80	17.03	23.77	21.31	10.19	24.98	8.69
S3	1.08	-9.74	-9.91	-11.12	-11.09	5.99	5.15	5.62	5.09	7.10	6.36	3.04	7.46	2.59
AGRICULTURE	**0.86**	**-9.69**	**-6.66**	**-10.93**	**-10.88**	**41.65**	**48.00**	**41.99**	**43.11**	**44.30**	**35.34**	**24.88**	**44.72**	**19.19**
S4	49.75	-0.39	-0.03	-4.63	-2.31									
S5	34.98	-4.14	-0.80	-5.05	-3.56	0.01	0.01	0.02	0.01	0.02	0.03	0.05	0.03	0.03
S6	4.98	-8.26	-1.92	-8.95	-8.57	5.17	5.79	6.58	5.55	6.36	5.80	5.44	6.69	7.85
S7	5.36	-8.46	-8.52	-8.96	-8.92	3.33	3.71	4.21	3.55	4.08	3.71	3.49	4.28	5.03
S8	2.31	-7.21	-6.94	-7.80	-7.77	4.79	6.18	5.11	7.50	4.35	4.42	7.11	4.75	3.74
S9	2.36	-7.25	-7.62	-7.80	-7.79	2.70	3.48	2.88	4.22	2.45	2.49	4.00	2.67	2.10
S10	7.17	-9.07	-11.31	-7.29	-7.63	1.18	0.72	1.01	0.80	0.81	1.07	1.09	0.76	1.07
S11	25.38	-1.90	0.00	-2.97	-1.94	0.76	1.15	0.97	1.61	1.06	1.38	2.24	1.52	1.41
S12	5.67	-8.88	-10.98	-6.48	-6.79	0.56	0.28	0.56	0.38	0.30	0.39	0.54	0.28	0.44
S13	13.27		-0.52	-5.30	-4.62									
S14	14.59		-4.64	-5.31	-5.16									
S15	16.48	-11.39	-12.26	-7.01	-8.22	2.09	0.99	1.94	1.33	1.07	1.65	1.97	1.10	1.89
S16	4.92	-10.00	-20.24	-6.89	-7.87									
S17	14.12	-7.83	-9.44	-5.53	-6.23									
S18	3.08	-8.37	-13.78	-5.92	-6.22	0.14	0.70	0.40	0.93	0.71	0.96	1.52	1.04	0.98
S19	11.42	-7.49	-11.25	-6.06	-6.75	22.50	16.20	19.74	14.41	18.41	24.09	24.06	17.29	23.53
S20	10.18	-6.48	-6.23	-6.04	-6.07	1.68	1.20	1.47	1.05	1.36	1.78	1.76	1.27	1.74
S21	27.26	-13.74	-19.33	-7.01	-11.69	2.38	3.03	3.15	5.65	4.69	5.75	8.18	4.75	15.39
S22	0.00	-6.77		-6.56	-6.56									
S23	0.00	-7.05		-4.49	-4.49	5.58	5.01	4.83	5.02	5.47	5.28	5.64	4.67	9.40
INDUSTRY	**10.11**	**-6.77**	**-4.82**	**-6.43**	**-6.59**	**24.92**	**25.41**	**27.68**	**28.66**	**23.82**	**25.45**	**31.63**	**25.62**	**28.35**
S24	1.76	-5.51	0.00	-5.33	-5.24	22.50	16.20	19.74	14.41	18.41	24.09	24.06	17.29	23.53
S25	0.91		0.00	-4.63	-4.59	1.68	1.20	1.47	1.05	1.36	1.78	1.76	1.27	1.74
S26	0.00	-4.95		-4.03	-4.03	2.38	3.03	3.15	5.65	4.69	5.75	8.18	4.75	15.39
S27	0.00			-6.49	-6.49	1.28	1.16	1.14	2.10	1.95	2.30	3.85	1.68	2.40
S28	1.34	-11.08	0.00	-6.84	-6.74	5.58	5.01	4.83	5.02	5.47	5.28	5.64	4.67	9.40
SERVICES	**1.37**	**-7.80**	**0.00**	**-5.58**	**-5.51**	**33.43**	**26.60**	**30.34**	**28.22**	**31.88**	**39.21**	**43.48**	**29.66**	**52.46**
Total	**5.51**	**-7.39**	**3.97**	**-7.11**	**-7.11**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
	Change in household consumer price index					**-8.24**	**-8.49**	**-8.26**	**-8.23**	**-8.24**	**-8.49**	**-8.26**	**-8.23**	**-8.33**

A5-sim1: Complete removal of Import tariff across the board

	Rural					Urban						All
	Ragslf	Raglab	Rnag	Roth	Total	Uag	Unagslf	Usalary	Unaglab	Uoth	URBAN	
Change in disposable income	-8.96	-8.82	-8.91	-8.68	-8.88	-8.49	-8.60	-8.72	-8.89	-7.77	-8.60	-8.76
Change in CTH	-10.05	-8.99	-10.06	-9.43	-9.72	-9.41	-10.21	-9.76	-9.48	-9.10	-9.81	-9.75
Change in CPI	-9.75	-9.53	-9.71	-9.59	-9.67	-9.56	-9.62	-9.68	-9.49	-9.76	-9.65	-9.66
Change in EV/YHO	-0.21	0.57	-0.25	0.14	-0.03	0.13	-0.37	-0.04	0.03	0.47	-0.10	-0.06
Change in poverty head-count	-0.34	-0.79	-0.39	-0.31	-0.48	-0.39	-0.31	-0.35	-0.39	-0.34	-0.35	
Change in CPI agriculture	-	-	-	-	-9.15	-	-	-	-	-	-9.16	-9.15
Change in CPI industries	-	-	-	-	-10.83	-	-	-	-	-	-10.53	-10.71
Change in CPI services	-	-	-	-	-9.35	-	-	-	-	-	-9.39	-9.37

Note: (1) Net disposable income is disposable income net of savings
(2) CPI is the consumer price index
(3) Welfare is in terms of equivalent variation as a percent of income

A6-sim2: 40% quota reduction for sector S3 and sector S7

Sectors	Sectoral shares					Volume Changes				Price Changes	
	VAi/VA	Mi/M	Exi/EX	Mi/Qi	EXi/Xsi	dMi	dDi	dEXi	dXSi=dVAi	dPDi	dPi
S1	0.70	1.51	0.55	1.15	2.40	0.86	-0.17	0.85	1.32	1.31	0.94
S2	2.18	2.89	1.11	1.42	2.90	1.18	-0.09	1.16	1.49	1.47	1.08
S3	0.88	0.86	1.51	1.43	40.00	0.67	-0.34	0.66	1.49	1.47	1.08
AGRICULTURE	**3.76**	**5.26**	**0.99**	**1.33**	**9.63**	**1.00**	**-0.15**	**0.98**	**1.43**	**1.42**	**1.03**
S4	11.18	0.00	51.27	0.00	0.33	1.47	0.00	1.47	-0.79	-0.79	-1.05
S5	9.68	1.37	36.35	7.25	0.12	1.29	0.95	1.26	-0.69	-0.72	-0.97
S6	2.40	4.38	5.42	9.20	2.49	1.83	0.66	1.72	0.50	0.40	0.10
S7	2.09	2.78	7.35	9.26	40.00	0.44	-0.02	0.40	0.44	0.40	0.10
S8	1.45	14.06	2.36	18.55	1.28	1.92	1.24	1.80	-0.21	-0.27	-0.56
S9	0.80	7.91	2.33	18.54	0.00	1.96	1.26	1.82	-0.21	-0.27	-0.56
S10	2.09	5.06	6.33	13.64	-0.28	0.73	0.59	0.72	-0.37	-0.38	-0.66
S11	9.42	1.39	26.36	4.85	0.13	1.12	0.67	1.10	-0.45	-0.47	-0.63
S12	1.03	1.85	4.24	7.15	-1.98	0.66	0.63	0.66	-0.48	-0.49	-0.74
S13	1.17	0.04	14.64	0.51	-0.47	1.01	0.70	1.01	-0.57	-0.57	-0.79
S14	1.43	0.04	14.69	0.51	0.00	1.02	0.71	1.02	-0.57	-0.57	-0.79
S15	12.15	6.35	14.44	7.86	-1.44	-0.11	0.11	-0.09	-0.50	-0.47	-0.72
S16	0.56	9.41	3.19	35.04	-1.82	0.13	0.43	0.23	-0.70	-0.59	-0.83
S17	10.66	3.23	13.34	4.32	-0.63	0.22	1.81	0.29	-0.61	-0.60	-0.83
S18	0.70	1.60	2.21	4.76	-1.19	0.95	0.71	0.94	-0.59	-0.62	-0.85
S19	11.19	4.14	10.00	3.83	-0.86	0.63	0.74	0.64	-0.64	-0.63	-0.89
S20	4.61	1.69	10.09	3.83	0.00	0.56	0.70	0.56	-0.64	-0.63	-0.89
S21	4.98	3.84	22.11	17.49	-1.17	0.12	0.62	0.21	-0.68	-0.62	-0.88
S22	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.06	-0.55	-0.55	-0.82
S23	0.00	0.00	0.00	0.00	0.00	2.33	0.00	2.33	-0.68	-0.68	-0.92
INDUSTRY	**87.60**	**69.14**	**9.60**	**7.51**	**0.33**	**0.81**	**0.79**	**0.81**	**-0.46**	**-0.46**	**-0.71**
S24	6.20	22.30	1.95	6.48	-0.82	0.57	0.58	0.57	-0.65	-0.64	-0.91
S25	0.65	0.43	0.99	0.64	-1.74	-0.05	0.34	-0.05	-0.80	-0.79	-1.06
S26	0.00	0.00	0.00	0.00	0.00	0.97	0.00	0.97	-0.81	-0.81	-1.07
S27	0.00	0.00	0.00	0.00	0.00	1.00	0.00	1.00	-0.67	-0.67	-0.97
S28	1.79	2.86	1.53	2.35	-9.68	-8.28	-3.91	-8.18	-0.71	-0.60	-0.88
SERVICES	**8.64**	**25.59**	**1.52**	**4.25**	**-2.86**	**-1.41**	**0.06**	**-1.35**	**-0.69**	**-0.66**	**-0.93**
Total	**100.00**	**100.00**	**5.38**	**5.21**	**0.36**	**0.13**	**0.55**	**0.15**	**-0.13**	**-0.14**	**-0.43**

Source: Initial tariff rates, tm are computed from SAM for India, Pradhan, Sahoo and Saluja (1999).

A7-sim2: 40% quota reduction for sector S3 and sector S7

Sectors						Shares			Price Changes		
	dPVAi	dVAi	Ki/Li	LDi/Li	Ki/Ldi	WLi/WL	rKi/rK	nLDi/nLD	dW	dr	dn
S1	1.77	0.85	0.19	0.78	0.25	9.95	2.36	31.39	-0.71	-0.87	5.35
S2	1.76	1.16	0.19	0.77	0.25	16.86	3.98	52.93	-0.71	-0.87	5.35
S3	1.76	0.66	0.19	0.77	0.25	5.00	1.18	15.69	-0.71	-0.87	5.35
AGRICULTURE	**1.77**	**0.98**	**0.19**	**0.77**	**0.25**	**31.81**	**7.53**	**100.00**	**-0.71**	**-0.87**	**5.35**
S4	-0.82	1.47	2.58			0.55	1.77		-0.71	-0.87	
S5	-0.82	1.26	2.58			0.68	2.19		-0.71	-0.87	
S6	-0.80	1.72	1.60			0.72	1.44		-0.71	-0.87	
S7	-0.80	0.40	1.60			0.46	0.91		-0.71	-0.87	
S8	-0.76	1.80	0.72			2.32	2.09		-0.71	-0.87	
S9	-0.76	1.82	0.72			1.31	1.18		-0.71	-0.87	
S10	-0.78	0.72	1.03			1.15	1.46		-0.71	-0.87	
S11	-0.84	1.10	4.00			0.10	0.51		-0.71	-0.87	
S12	-0.84	0.66	4.71			0.21	1.25		-0.71	-0.87	
S13	-0.83	1.01	3.16			0.08	0.33		-0.71	-0.87	
S14	-0.83	1.02	3.16			0.10	0.41		-0.71	-0.87	
S15	-0.83	-0.09	3.05			0.99	3.75		-0.71	-0.87	
S16	-0.79	0.23	1.42			0.56	0.98		-0.71	-0.87	
S17	-0.81	0.29	1.99			0.90	2.23		-0.71	-0.87	
S18	-0.77	0.94	0.95			1.00	1.19		-0.71	-0.87	
S19	-0.76	0.64	0.80			4.01	4.00		-0.71	-0.87	
S20	-0.76	0.56	0.80			1.63	1.63		-0.71	-0.87	
S21	-0.79	0.21	1.26			0.98	1.54		-0.71	-0.87	
S22	-0.71	0.06	0.21			9.52	2.53		-0.71	-0.87	
S23	-0.82	2.33	2.45			1.44	4.40		-0.71	-0.87	
INDUSTRY	**-0.78**	**0.81**	**1.00**			**28.71**	**35.78**		**-0.71**	**-0.87**	
S24	-0.80	0.57	1.55			17.44	33.59		-0.71	-0.87	
S25	-0.82	-0.05	2.48			3.33	10.29		-0.71	-0.87	
S26	-0.87	0.97	26.90			0.21	7.03		-0.71	-0.87	
S27	-0.72	1.00	0.30			5.25	1.94		-0.71	-0.87	
S28	-0.71	-8.18	0.23			13.25	3.83		-0.71	-0.87	
SERVICES	**-0.78**	**-1.35**	**1.15**			**39.48**	**56.69**		**-0.71**	**-0.87**	
Total	**-0.01**	**0.15**	**0.80**	**0.25**	**3.26**	**100.00**	**100.00**	**100.00**	**-0.71**	**-0.87**	**5.35**

Note: Aggregation of volumes of value added (VA) is done by Laspeyres method.

A8-sim2: 40% quota reduction for sector S3 and sector S7

Household groups	Rate	Income share (100%)											
		Rural					Urban						All
		Ragslf	Raglab	Rnag	Roth	Total	Uag	Unagslf	Usalary	Unaglab	Uoth	All	
Non-land capital	-0.57	25.08	1.50	36.47	11.64	21.33	42.34	67.57	19.20	39.11	66.42	40.84	30.00
Land capital	-0.89	36.82	0.70	14.60	4.95	20.40	12.85	0	0	0	0	0.33	11.48
Composite capital	-0.89	61.90	2.20	51.07	16.59	41.73	55.18	67.57	19.20	39.11	66.42	41.17	41.48
Labour	-0.64	26.25	88.05	39.50	73.46	47.62	31.02	19.96	74.08	52.34	11.41	48.62	48.07
Remittance		0.25	1.08	0.64	2.76	0.91	5.28	4.32	2.34	0.87	13.18	3.90	2.24
Other income		11.61	8.67	8.79	7.20	9.74	8.52	8.14	4.38	7.68	8.99	6.31	8.21
Total		100	100	100	100	100	100	100	100	100	100	100	100
Direct Tax rate		0.009	0.000	0.042	0.057	0.023	0.041	0.046	0.051	0.000	0.052	0.046	0.033
Saving		0.312	0.065	0.323	0.237	0.0002	0.276	0.401	0.303	0.198	0.353	0.0004	0.0003

Household groups		Income share (100%)											
		Rural					Urban						
		Ragslf	Raglab	Rnag	Roth	All	Uag	Unagslf	Usalary	Unaglab	Uoth	All	Total
Non-land capital		0.14	0.06	0.07	0.05	0.10	0.04	-0.01	0.04	0.03	-0.06	0.01	0.06
Land capital		-0.18	-0.26	-0.25	-0.27	-0.22	-0.29	0	0	0	0	-0.31	-0.26
Composite capital		-0.05	-0.04	-0.02	-0.04	-0.06	-0.04	-0.01	0.04	0.03	-0.06	0.01	-0.03
Labour		0.07	-0.01	0.01	-0.01	0.03	-0.03	-0.08	-0.03	-0.03	-0.13	-0.05	-0.01
Remittance		-	-	-	-	-	-	-	-	-	-	-	-
Other income		0.10	0.02	0.03	0.01	0.04	-0.01	-0.05	-0.01	-0.01	-0.11	-0.04	0.00
Total		-0.71	-0.63	-0.64	-0.62	-0.67	-0.61	-0.56	-0.61	-0.60	-0.51	-0.58	-0.63
Direct Tax rate		-0.61	0.00	-0.61	-0.63	-0.62	-0.60	-0.59	-0.62	0.00	-0.58	-0.61	-0.61
Saving		-0.35	-0.27	-0.29	-0.26	-0.32	-0.25	-0.20	-0.25	-0.25	-0.15	-0.22	-0.27
Disposable Income		-0.71	-0.63	-0.65	-0.62	-0.67	-0.61	-0.56	-0.61	-0.60	-0.50	-0.58	-0.63
Net Income (CTH)		-0.87	-0.65	-0.82	-0.73	-0.79	-0.74	-0.80	-0.76	-0.69	-0.70	-0.76	-0.78

A9-sim 2: 40% quota reduction for sector S3 and sector S7

Sectors	Share M/Q	Change in sales tax	dPM	dPD	dPC	Consumption shares RAGSLF	RAGLAB	RNAG	ROTH	UAG	UNAGSLF	USALAY	UNAGLAB	UOTH
S1	0.55	2.18	0.00	1.32	1.32	14.97	25.01	17.25	20.60	13.27	7.73	11.56	12.35	7.90
S2	1.11	2.65	0.00	1.49	1.47	20.01	16.93	18.35	16.57	23.08	20.75	9.87	24.33	8.38
S3	1.51	1.84	-6.67	1.49	0.78	5.99	5.06	5.49	4.96	6.90	6.20	2.95	7.28	2.51
AGRICULTURE	**0.99**	**2.44**	**-2.04**	**1.43**	**1.31**	**40.97**	**47.00**	**41.08**	**42.12**	**43.25**	**34.69**	**24.38**	**43.96**	**18.79**
S4	51.27	0.83	0.00	-0.79	-0.38									
S5	36.35	0.56	0.00	-0.69	-0.45	0.020	0.038	0.023	0.055	0.028	0.035	0.053	0.038	0.036
S6	5.42	2.43	0.00	0.50	0.47	5.504	5.813	6.535	5.560	6.315	5.710	5.348	6.612	7.680
S7	7.35	0.91	-25.03	0.44	-2.24	3.613	3.765	4.216	3.602	4.123	3.725	3.486	4.318	5.013
S8	2.36	1.74	0.00	-0.21	-0.21	5.172	6.250	5.129	7.542	4.381	4.379	7.049	4.736	3.680
S9	2.33	1.77	0.43	-0.21	-0.18	2.905	3.514	2.884	4.242	2.462	2.462	3.964	2.663	2.068
S10	6.33	0.38	0.00	-0.37	-0.34	1.276	0.727	1.003	0.806	0.817	1.064	1.089	0.758	1.055
S11	26.36	0.59	0.00	-0.45	-0.29	0.827	1.183	0.992	1.641	1.110	1.443	2.328	1.595	1.460
S12	4.24	0.26	0.00	-0.48	-0.45	0.612	0.287	0.557	0.385	0.303	0.394	0.538	0.280	0.443
S13	14.64		0.00	-0.57	-0.48									
S14	14.69		-0.18	-0.57	-0.48									
S15	14.44	-0.63	0.00	-0.50	-0.39	2.020	0.995	1.972	1.336	1.224	1.507	1.963	1.062	1.744
S16	3.19	-0.56	0.00	-0.70	-0.66									
S17	13.34	-0.36	0.00	-0.61	-0.50									
S18	2.21	0.41	0.00	-0.59	-0.57	0.827	0.895	0.999	1.264	0.769	0.988	1.581	1.091	1.006
S19	10.00	0.00	0.00	-0.64	-0.56	21.153	16.548	19.753	14.650	18.871	24.640	24.421	17.746	23.910
S20	10.09	-0.08	-0.41	-0.64	-0.61	1.584	1.226	1.473	1.070	1.405	1.834	1.795	1.307	1.778
S21	22.11	-0.55	0.00	-0.68	-0.44	2.455	3.060	3.266	5.710	4.715	5.920	8.260	4.876	15.695
S22	0.00	-0.50		-0.55	-0.55									
S23	0.00	1.65		-0.68	-0.68	5.241	5.087	4.838	5.063	5.545	5.356	5.673	4.751	9.464
INDUSTRY	**9.60**	**0.50**	**-4.82**	**-0.46**	**-0.48**	**27.17**	**25.89**	**28.32**	**29.23**	**24.25**	**25.21**	**31.59**	**25.65**	**27.93**
S24	1.95	-0.08	0.00	-0.65	-0.64	21.15	16.55	19.75	14.65	18.87	24.64	24.42	17.75	23.91
S25	0.99		0.00	-0.80	-0.79	1.58	1.23	1.47	1.07	1.40	1.83	1.79	1.31	1.78
S26	0.00	0.16		-0.81	-0.80	2.46	3.06	3.27	5.71	4.72	5.92	8.26	4.88	15.70
S27	0.00			-0.67	-0.69	1.42	1.18	1.27	2.15	1.97	2.35	3.88	1.71	2.43
S28	1.53	-8.95	0.00	-0.71	-0.72	5.24	5.09	4.84	5.06	5.55	5.36	5.6 7	4.75	9.46
SERVICES	**1.52**	**-3.77**	**0.00**	**-0.69**	**-0.69**	**31.85**	**27.10**	**30.60**	**28.64**	**32.50**	**40.10**	**44.03**	**30.39**	**53.28**
Total	**5.38**	**-0.17**	**3.97**	**-0.13**	**-0.19**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
	Change in household consumer price index					**0.20**	**0.31**	**0.19**	**0.22**	**0.24**	**0.08**	**-0.12**	**0.26**	**-0.26**

A10-sim2: Relaxing quota restriction on 'other agriculture' and 'food and food products' by 40 percent

	Rural					Urban						All
	Ragslf	Raglab	Rnag	Roth	Total	Uag	Unagslf	Usalary	Unaglab	Uoth	URBAN	
Change in disposable income	-0.710	-0.630	-0.645	-0.623	-0.668	-0.606	-0.562	-0.608	-0.604	-0.504	-0.584	-0.631
Change in CTH	-0.872	-0.655	-0.816	-0.734	-0.791	-0.743	-0.802	-0.764	-0.693	-0.700	-0.764	-0.780
Change in CPI	-0.828	-0.844	-0.856	-0.832	-0.838	-0.872	-0.837	-0.781	-0.882	-0.845	-0.813	-0.827
Change in EV/YHO	-0.029	0.180	0.027	0.072	0.035	0.093	0.021	0.013	0.155	0.092	0.033	0.034
Change in poverty head-count	-0.340	-0.400	0.000	0.000	-0.237	0.000	0.000	-0.180	0.000	0.000	-0.099	
Change in CPI agriculture	-	-	-	-	-0.846	-	-	-	-	-	-0.866	-0.852
Change in CPI industries	-	-	-	-	-1.086	-	-	-	-	-	-1.050	-1.070
Change in CPI services	-	-	-	-	-0.607	-	-	-	-	-	-0.621	-0.614

Note: (1) Net disposable income is disposable income net of savings
(2) CPI is the consumer price index
(3) Welfare is in terms of equivalent variation as a percent of income

A11-sim3: Complete removal of tariff with indirect compensatory tax

Sectors	Sectoral shares					Volume Changes				Price Changes	
	VAi/VA	Mi/M	Exi/EX	Mi/Qi	EXi/Xsi	dMi	dDi	dEXi	dXSi=dVAi	dPDi	dPi
S1	0.59	1.55	0.47	1.22	-12.14	1.69	7.02	1.75	-12.08	-12.02	-4.28
S2	1.95	2.98	1.01	1.52	-5.90	1.84	7.54	1.92	-12.91	-12.83	-4.44
S3	0.62	0.89	1.07	1.52	0.00	1.79	7.51	1.87	-12.91	-12.83	-4.44
AGRICULTURE	**3.16**	**5.43**	**0.84**	**1.42**	**-6.06**	**1.78**	**7.39**	**1.86**	**-12.63**	**-12.56**	**-4.39**
S4	10.48	0.00	49.63	0.00	-4.24	3.44	0.00	3.44	-4.82	-4.82	-3.01
S5	8.88	1.33	34.99	7.42	-6.40	0.45	2.62	0.61	-5.01	-4.85	-3.10
S6	2.10	4.44	4.93	9.79	-8.48	0.45	6.29	0.99	-9.63	-9.19	-3.83
S7	1.47	2.83	5.38	9.80	0.00	0.23	6.18	0.78	-9.64	-9.19	-3.83
S8	1.36	14.74	2.31	20.24	-3.05	-0.10	10.57	1.89	-7.81	-7.05	-3.70
S9	0.79	8.29	2.38	20.24	0.00	-0.17	10.54	1.83	-7.81	-7.05	-3.70
S10	2.28	4.99	7.17	14.34	10.63	-2.27	3.40	-1.49	-7.26	-6.62	-3.64
S11	8.87	1.33	25.73	4.91	-3.98	0.19	1.00	0.23	-2.59	-2.54	-1.79
S12	1.35	1.80	5.77	7.47	30.84	-2.76	1.80	-2.43	-6.14	-5.78	-3.57
S13	1.06	0.04	13.41	0.51	-8.01	3.40	3.45	3.40	-4.86	-4.86	-3.18
S14	1.41	0.04	14.56	0.52	0.00	2.15	2.82	2.15	-4.87	-4.86	-3.18
S15	13.43	6.06	16.56	8.15	11.06	-4.28	-0.31	-3.97	-6.74	-6.04	-3.66
S16	0.84	9.15	4.98	36.09	50.95	-3.06	1.76	-1.38	-6.46	-4.65	-2.97
S17	10.96	3.44	14.22	4.91	4.05	-2.55	13.00	-1.89	-4.93	-4.79	-3.23
S18	0.94	1.53	3.13	4.93	35.66	-3.07	0.26	-2.91	-5.50	-5.24	-3.38
S19	12.51	4.06	11.48	4.01	12.84	-1.87	3.01	-1.68	-5.77	-5.63	-3.50
S20	4.53	1.67	10.21	3.99	0.00	-0.80	3.57	-0.63	-5.75	-5.63	-3.50
S21	0.00	3.74	0.00	18.74	-100.00	-6.63	2.08	-5.11	-6.95	-5.82	-3.52
S22	0.00	0.00	0.00	0.00	0.00	-0.11	0.00	-0.11	-6.56	-6.56	-3.69
S23	6.02	0.00	0.00	0.00	0.00	-3.75	0.00	-3.75	-4.21	-4.21	-2.77
INDUSTRY	**89.26**	**69.48**	**10.15**	**8.01**	**4.16**	**-1.52**	**5.57**	**-0.99**	**-6.29**	**-5.98**	**-3.44**
S24	5.42	21.79	1.76	6.65	-11.72	-0.38	2.42	-0.20	-5.47	-5.28	-3.08
S25	0.58	0.42	0.91	0.66	-10.93	-0.96	1.81	-0.95	-4.82	-4.80	-2.99
S26	0.00	0.00	0.00	0.00	0.00	-1.24	0.00	-1.24	-3.99	-3.99	-2.81
S27	0.00	0.00	0.00	0.00	0.00	-0.46	0.00	-0.46	-7.20	-7.20	-3.66
S28	1.58	2.88	1.33	2.37	-18.79	-4.61	1.08	-4.48	-7.20	-7.07	-3.76
SERVICES	**7.58**	**25.10**	**1.36**	**4.34**	**-13.24**	**-1.44**	**2.26**	**-1.28**	**-5.80**	**-5.65**	**-3.24**
Total	**100.00**	**100.00**	**5.52**	**5.47**	**2.26**	**-0.79**	**4.81**	**-0.50**	**-7.48**	**-7.22**	**-3.57**

Source: Initial tariff rates, tm are computed from SAM for India, Pradhan, Sahoo and Saluja (1999).

A12-sim3: Complete removal of tariff with indirect compensatory tax

Sectors						Shares			Price Changes		
	dPVAi	dVAi	Ki/Li	LDi/Li	Ki/Ldi	WLi/WL	rKi/rK	nLDi/nLD	dW	dr	dn
S1	-14.72	1.75	0.30	0.83	0.36	9.36	3.48	31.38	-4.66	-2.92	-8.55
S2	-14.71	1.92	0.30	0.82	0.36	15.84	5.85	52.84	-4.66	-2.92	-8.55
S3	-14.71	1.87	0.30	0.82	0.36	4.73	1.75	15.78	-4.66	-2.92	-8.55
AGRICULTURE	**-14.71**	**1.86**	**0.30**	**0.82**	**0.36**	**29.93**	**11.08**	**100.00**	**-4.66**	**-2.92**	**-8.55**
S4	-4.78	3.44	2.43			0.59	1.77		-4.66	-2.92	
S5	-4.81	0.61	2.38			0.72	2.12		-4.66	-2.92	
S6	-5.28	0.99	1.55			0.73	1.41		-4.66	-2.92	
S7	-5.28	0.78	1.55			0.47	0.90		-4.66	-2.92	
S8	-6.27	1.89	0.69			2.36	2.04		-4.66	-2.92	
S9	-6.27	1.83	0.69			1.33	1.15		-4.66	-2.92	
S10	-5.86	-1.49	0.97			1.15	1.39		-4.66	-2.92	
S11	-4.41	0.23	3.61			0.11	0.49		-4.66	-2.92	
S12	-4.25	-2.43	4.42			0.22	1.20		-4.66	-2.92	
S13	-4.57	3.40	3.04			0.09	0.34		-4.66	-2.92	
S14	-4.57	2.15	3.04			0.11	0.41		-4.66	-2.92	
S15	-4.60	-3.97	2.94			0.98	3.57		-4.66	-2.92	
S16	-5.46	-1.38	1.34			0.57	0.94		-4.66	-2.92	
S17	-5.03	-1.89	1.93			0.90	2.16		-4.66	-2.92	
S18	-5.95	-2.91	0.90			0.99	1.11		-4.66	-2.92	
S19	-6.16	-1.68	0.76			4.01	3.80		-4.66	-2.92	
S20	-6.16	-0.63	0.76			1.65	1.57		-4.66	-2.92	
S21	-5.59	-5.11	1.20			0.95	1.43		-4.66	-2.92	
S22	-7.48	-0.11	0.20			9.60	2.41		-4.66	-2.92	
S23	-4.90	-3.75	2.17			1.48	3.99		-4.66	-2.92	
INDUSTRY	**-5.88**	**-0.99**	**0.95**			**29.00**	**34.19**		**-4.66**	**-2.92**	
S24	-5.38	-0.20	1.43			18.15	32.30		-4.66	-2.92	
S25	-4.86	-0.95	2.27			3.52	9.94		-4.66	-2.92	
S26	-3.52	-1.24	25.36			0.22	6.86		-4.66	-2.92	
S27	-7.22	-0.46	0.28			5.25	1.83		-4.66	-2.92	
S28	-7.42	-4.48	0.22			13.94	3.80		-4.66	-2.92	
SERVICES	**-5.75**	**-1.28**	**1.07**			**41.07**	**54.73**		**-4.66**	**-2.92**	
Total	**-8.49**	**-0.50**	**0.80**	**0.25**	**3.26**	**100.00**	**100.00**	**100.00**	**-4.66**	**-2.92**	**-8.55**

Note: Aggregation of volumes of value added (VA) is done by Laspeyres method.

A13-sim3: Complete removal of tariff with indirect compensatory tax

Household groups	Rate	Income share (100%)											All
		Rural					Urban						
		Ragslf	Raglab	Rnag	Roth	Total	Uag	Unagslf	Usalary	Unaglab	Uoth	All	
Non-land capital	-9.96	25.08	1.50	36.47	11.64	21.33	42.34	67.57	19.20	39.11	66.42	40.84	30.00
Land capital	-9.87	36.82	0.70	14.60	4.95	20.40	12.85	0.00	0.00	0.00	0.00	0.33	11.48
Composite capital	-9.87	61.90	2.20	51.07	16.59	41.73	55.18	67.57	19.20	39.11	66.42	41.17	41.48
Labour	-9.80	26.25	88.05	39.50	73.46	47.62	31.02	19.96	74.08	52.34	11.41	48.62	48.07
Remittance		0.25	1.08	0.64	2.76	0.91	5.28	4.32	2.34	0.87	13.18	3.90	2.24
Other income		11.61	8.67	8.79	7.20	9.74	8.52	8.14	4.38	7.68	8.99	6.31	8.21
Total		100	100	100	100	100	100	100	100	100	100	100	100
Direct Tax rate		0.009	0.000	0.04	0.06	0.02	0.04	0.05	0.05	0.00	0.05	0.05	0.03
Saving		0.312	0.065	0.323	0.237	0.000	0.276	0.401	0.303	0.198	0.353	0.000	0.000

Household groups		Income change (%)											
		Rural					Urban						
		Ragslf	Raglab	Rnag	Roth	All	Uag	Unagslf	Usalary	Unaglab	Uoth	All	Total
Non-land capital		-0.11	-0.28	-0.16	-0.44	-0.21	-0.65	-0.51	-0.39	-0.19	-1.46	-0.52	-0.35
Land capital		-0.01	-0.18	-0.05	-0.34	-0.10	-0.55	0	0	0	0	-0.41	-0.24
Composite capital		-0.05	-0.25	-0.13	-0.41	-0.16	-0.63	-0.51	-0.39	-0.19	-1.46	-0.52	-0.32
Labour		0.07	-0.10	0.03	-0.26	-0.02	-0.47	-0.33	-0.21	-0.01	-1.28	-0.33	-0.16
Remittance		-	-	-	-	-	-	-	-	-	-	-	-
Other income		-0.12	-0.29	-0.17	-0.45	-0.24	-0.66	-0.52	-0.40	-0.20	-1.47	-0.70	-0.47
Total		-9.86	-9.71	-9.82	-9.56	-9.78	-9.38	-9.50	-9.61	-9.79	-8.63	-9.50	-9.65
Direct Tax rate		-9.88	0.00	-9.88	-9.82	-9.85	-9.89	-9.93	-9.83	0.00	-9.94	-9.87	-9.87
Saving		-10.91	-10.75	-10.86	-10.60	-10.84	-10.41	-10.53	-10.64	-10.83	-9.64	-10.51	-10.67
Disposable Income		-9.86	-9.71	-9.82	-9.55	-9.78	-9.36	-9.48	-9.60	-9.79	-8.58	-9.48	-9.65
Net Income (CTH)		-9.39	-9.64	-9.32	-9.23	-9.40	-8.96	-8.78	-9.14	-9.53	-8.00	-8.97	-9.22

A14-sim3: Complete removal of tariff with indirect compensatory tax

Sectors	Share M/Q	Change in sales tax	dPM	dPD	dPC	Consumption shares								
						RAGSLF	RAGLAB	RNAG	ROTH	UAG	UNAGSLF	USALAY	UNAGLAB	UOTH
S1	0.47	-10.55	0.62	-12.08	-11.47	15.73	25.77	17.66	21.07	13.44	7.65	11.71	12.27	7.90
S2	1.01	-11.31	-6.09	-12.91	-12.31	20.13	17.31	18.93	17.15	23.96	21.47	10.30	25.17	8.77
S3	1.07	-11.36	-11.02	-12.91	-12.36	6.02	5.17	5.65	5.12	7.16	6.41	3.08	7.52	2.62
AGRICULTURE	**0.84**	**-11.28**	**-6.59**	**-12.63**	**-12.05**	**41.87**	**48.26**	**42.24**	**43.35**	**44.56**	**35.53**	**25.08**	**44.95**	**19.29**
S4	49.63	-1.21	0.59	-4.82	-1.84									
S5	34.99	-4.60	-0.19	-5.01	-2.95	0.01	0.01	0.02	0.00	0.02	0.03	0.04	0.03	0.03
S6	4.93	-9.22	-1.31	-9.63	-8.66	5.11	5.78	6.58	5.53	6.36	5.80	5.46	6.69	7.88
S7	5.38	-9.44	-8.92	-9.64	-9.08	3.29	3.70	4.21	3.54	4.08	3.72	3.50	4.29	5.05
S8	2.31	-7.94	-6.37	-7.81	-7.24	4.70	6.14	5.09	7.49	4.32	4.41	7.08	4.73	3.74
S9	2.38	-8.00	-7.33	-7.81	-7.27	2.65	3.46	2.86	4.21	2.43	2.48	3.98	2.66	2.10
S10	7.17	-9.42	-10.77	-7.26	-7.06	1.16	0.71	1.00	0.79	0.81	1.06	1.09	0.75	1.06
S11	25.73	-2.42	0.00	-2.59	-1.37	0.75	1.14	0.97	1.61	1.05	1.38	2.24	1.51	1.40
S12	5.77	-9.03	-10.43	-6.14	-5.92	0.55	0.28	0.56	0.38	0.29	0.39	0.53	0.28	0.44
S13	13.41		0.10	-4.86	-3.65									
S14	14.56		-3.50	-4.87	-4.10									
S15	16.56	-11.66	-11.72	-6.74	-7.46	2.10	0.98	1.93	1.33	1.02	1.65	1.86	1.08	1.90
S16	4.98	-9.65	-19.75	-6.46	-6.93									
S17	14.22	-7.69	-8.88	-4.93	-5.18									
S18	3.13	-8.60	-13.25	-5.50	-5.26	0.03	0.66	0.28	0.85	0.70	0.96	1.50	1.03	0.98
S19	11.48	-7.55	-10.70	-5.77	-5.95	22.70	16.12	19.72	14.37	18.33	24.00	24.04	17.21	23.49
S20	10.21	-6.51	-5.53	-5.75	-5.25	1.70	1.19	1.47	1.05	1.36	1.78	1.76	1.26	1.74
S21	0.00	-13.84	-18.83	-6.95	-11.12	2.37	3.03	3.13	5.64	4.68	5.72	8.20	4.73	15.30
S22	0.00	-6.66		-6.56	-5.98									
S23	0.00	-7.81		-4.21	-3.65	5.63	4.99	4.83	5.01	5.46	5.27	5.65	4.66	9.39
INDUSTRY	**10.15**	**-7.13**	**-4.82**	**-6.29**	**-5.92**	**24.46**	**25.25**	**27.48**	**28.50**	**23.66**	**25.42**	**31.41**	**25.51**	**28.39**
S24	1.76	-5.83	0.00	-5.47	-4.79	22.70	16.12	19.72	14.37	18.33	24.00	24.04	17.21	23.49
S25	0.91		0.00	-4.82	-4.19	1.70	1.19	1.47	1.05	1.36	1.78	1.76	1.26	1.74
S26	0.00	-5.18		-3.99	-3.40	2.37	3.03	3.13	5.64	4.68	5.71	8.20	4.73	15.30
S27	0.00			-7.20	-6.62	1.27	1.16	1.13	2.09	1.95	2.29	3.87	1.68	2.40
S28	1.33	-11.48	0.00	-7.20	-6.55	5.63	4.99	4.83	5.01	5.46	5.27	5.65	4.66	9.39
SERVICES	**1.36**	**-8.16**	**0.00**	**-5.80**	**-5.15**	**33.67**	**26.49**	**30.27**	**28.16**	**31.78**	**39.05**	**43.51**	**29.53**	**52.32**
Total	**5.52**	**-7.92**	**3.97**	**-7.48**	**-6.90**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
	Change in household consumer price index					**-8.47**	**-8.80**	**-8.49**	**-8.47**	**-8.63**	**-7.98**	**-7.21**	**-8.66**	**-6.83**

A15-sim3: Complete removal of tariff with indirect compensatory tax

	Rural					Urban						All
	Ragslf	Raglab	Rnag	Roth	Total	Uag	Unagslf	Usalary	Unaglab	Uoth	URBAN	
Change in disposable income	-9.86	-9.71	-9.82	-9.55	-9.78	-9.36	-9.48	-9.60	-9.79	-8.58	-9.48	-9.65
Change in net disposable income	-9.39	-9.64	-9.32	-9.23	-9.40	-8.96	-8.78	-9.14	-9.53	-8.00	-8.97	-9.22
Change in CPI	-9.23	-9.01	-9.17	-9.04	-9.14	-9.05	-9.09	-9.08	-8.98	-9.16	-9.08	-9.11
Change in welfare	-0.11	-0.64	-0.1	-0.15	-0.20	0.08	0.21	-0.03	-0.47	0.81	0.10	-0.07
Change in poverty head-count	0.35	0.39	0.39	0.31	0.36	0.38	0.31	0.00	0.39	0.00	0.14	
Change in CPI agriculture	-	-	-	-	-8.85	-	-	-	-	-	-8.87	-8.86
Change in CPI industries	-	-	-	-	-9.89	-	-	-	-	-	-9.59	-9.76
Change in CPI services	-	-	-	-	-8.85	-	-	-	-	-	-8.88	-8.87

Note: (1) Net disposable income is disposable income net of savings
(2) CPI is the consumer price index
(3) Welfare is in terms of equivalent variation as a percent of income

Trade Liberalization and Poverty in Nepal: An Applied General Equilibrium Analysis*

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Abstract

Nepal aggressively liberalized its foreign trade during the 1990s. This paper attempts to estimate the impact of trade liberalization on household welfare and poverty in Nepal through the construction of a regional CGE model. The model disaggregates factors of production – capital, land, and labor – by region (urban, *Terai* and hills/mountains) in order to establish direct links between sector of activity, factor remuneration, and household income. In particular, certain activities are more intensive in factors from a given region (e.g. the manufacturing sector is more intensive in urban factors of production and the agriculture sector is more intensive in *Terai* factor of production). Regional factor remuneration in turn maps into regional household income. We find that trade liberalization reduces the nominal returns to urban factors of production in comparison with rural factors of production, resulting in a reduction in the relative income of urban households. Rural and urban households consume roughly the same share of industrial goods,

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but rural households consume relatively more agricultural goods and fewer services. As the fall in consumer prices in the latter two sectors are similar, there is little rural-urban difference in the variation in consumer price indices. Consumer prices generally fall in roughly the same proportion as nominal incomes such that there are negligible welfare changes. However, poverty falls substantially, with the greatest impact in rural *Terai*, followed by the rural hills and the mountain region, and least in urban areas.

Keywords: Computable general equilibrium modeling, international trade, poverty, Nepal. JEL: D33, D58, E27, F13, F14, I32, O15, O53

Introduction

The present paper attempts to isolate the impact of trade liberalization on household welfare and poverty in Nepal since the mid-1990s. Trade liberalization occurred in the context of many other important policy changes. Nepal implemented stabilization policies in the latter part of the 1980s (1986-89) and structural reforms in the early 1990s (1992-95). Stabilization involved an increase in public savings through expenditure cuts and tax increases, as well as a 15 percent devaluation. Since 2000, the Government improved tax policy and administration and strengthened Nepal's banking system. Furthermore, the tax base was broadened, revenue administration improved, the foreign exchange system unified, and the role of the private sector expanded through privatization and easing of business licensing.

The 1992 trade policy reform encouraged export-led growth through trade liberalization and a more important role for the private sector. In addition to tariff cuts, duty drawbacks and bonded warehouses were introduced, while import and industrial licensing were eased. Nepal became a member of the WTO in 2004, creating both opportunities and challenges.

With more liberal economic policies, per capita growth rates accelerated significantly, along with private investment and trade, in the early 1990s (Table 1). However, Nepal's economic growth rate

Table 1: Composition and growth of GDP

Sector/Year	SHARE				GROWTH RATES			
	1984-85	1995-96	2000-01	2005-06	1985-95	1996-2006	2001-06	1985-06
Agriculture and Forestry	48.4	38.1	36.2	33.4	2.5	2.6	1.4	2.6
Fishing	0.6	0.5	0.4	0.5	2.5	4.6	5.0	3.3
Mining and Quarrying	0.3	0.5	0.4	0.5	10.4	5.0	5.1	7.3
Manufacturing	5.8	9.4	9.0	7.7	10.4	1.5	0.1	6.0
Electricity Gas and Water	0.4	1.5	1.8	2.1	14.4	9.2	5.8	12.8
Construction	5.1	6.5	6.0	6.6	7.7	4.0	4.2	5.6
Wholesale and Retail Trade	15.0	17.2	16.4	14.5	6.1	1.6	1.1	4.1
Hotels and Restaurants	1.8	2.1	2.0	1.5	6.1	0.1	-1.0	3.6
Transport and Communication	5.3	5.8	7.4	10.4	6.2	9.0	9.4	8.0
Financial Intermediation	2.3	2.5	2.7	3.3	5.7	5.8	6.9	5.8
Real Estate and Business Services	7.1	7.7	8.3	8.3	5.7	4.3	3.4	5.3
Public Administration and Defense	1.1	1.1	1.2	1.8	6.0	9.0	8.1	7.3
Education	3.5	3.7	4.1	5.6	6.0	8.6	8.9	7.0
Health and Social Work	0.9	0.9	1.0	1.3	6.0	7.6	8.2	6.6
Other Community and Social Services	2.6	2.7	3.0	2.8	6.0	3.5	2.2	5.1
Gross Domestic Product	**100**	**100**	**100**	**100**	**5.0**	**3.7**	**3.1**	**4.5**

Source: CBS (2007) and Sapkota (2007).

began to decline after reaching a summit in 1996/97. The manufacturing and tourism sectors were particularly hard hit by the deteriorating security situation, political uncertainty, weak law enforcement, and the rising cost of fuel.

The major objective of the Tenth Plan of Nepal (2002-07) was poverty reduction. Although growth during the Tenth Plan was only 3.6 percent — much less than the targeted growth of 6.2 percent — poverty fell from 42 percent in 1995/96 to 31 percent in 2003/4. The decline in poverty was partly from the increase in remittances and partly from a dramatic decline in fertility. Poverty reduction remains the major agenda of the Interim Plan (2007/08-09/10). Nepal is also utilizing PRSP and PRGF facilities of the IMF in this regard.

Trade Regime

Nepal's major exports during the 1960s were agricultural and forest products, replaced by tourism in the 1970s. In the 1980s and 1990s, textiles and, in particular, carpets and readymade garments dominated (Table 2). With the end of the Multi-Fibre Agreement (MFA), Nepal's textile exporters began struggling. In response, there have been efforts to increase trade with China and to make Nepal a transit country between India and China.

The structure of Nepalese imports has remained relatively stable over the years. However, it is important to note that Nepal used to be a food exporter before the 1980s; currently, food imports account for 10 percent of the country's imports. About 15 percent of imports is composed of fuel while the rest are essentially manufacturing goods.

Nepal's last 50 years of trade history is largely influenced by the consequences of trade treaties with India. A stringent value added condition applied from the 1960s through to the mid-1990s was instrumental in diversifying Nepal's trade. The 1996 Indo-Nepal trade treaty created quasi-free trade between the two countries. However, a revised trade treaty with India in March 2002 introduced several new restrictions: (i) more stringent rules of origin (minimum 30 percent domestic value added); (ii) Tariff-rate Quotas (TRQs) on Nepal's exports of vegetable ghee, acrylic yarn, copper, and zinc oxide[1]; and (iii) clear specification of safeguard clauses against damages to Indian producers from an eventual "export surge" from Nepal through the application of countervailing duties applied so as to make the price of Nepalese products comparable with their Indian counterparts.

Table 2: The structure of Nepalese merchandise imports and exports

	Amount		Share (%)		Growth (%)
Imports Value ($, '000)	**1990**	**2000**	**1990**	**2000**	**1990-2000**
All goods	610,674	1,557,926	100.0	100.0	9.8
Food and Feeds	80,079	162,254	13.1	10.4	7.3
Agricultural Raw Material	40,401	55,029	6.6	3.5	3.1
Ores and Metals	43,076	68,164	7.1	4.4	4.7
Fuels	50,402	236,161	8.3	15.2	16.7
All Manufactures	386,970	709,756	63.4	45.6	6.3
Chemicals	102,688	165,877	16.8	10.6	4.9
Textiles and Clothing	48,691	146,002	8.0	9.4	11.6
Other Manufactures	58,035	61,292	9.5	3.9	0.5
Machinery and Transport Equipment	109,984	267,901	18.0	17.2	9.3
Export Value ($ '000)	**1990**	**2000**	**1990**	**2000**	**1990-2000**
All goods	180,366	708,775	100.0	100.0	14.7
Food and Feeds	23,341	68,937	12.9	9.7	11.4
Agricultural Raw Materials	5,423	3,223	3.0	0.5	-5.1
Ores and Metals	494	1,766	0.3	0.2	13.6
All Manufactures	150,177	473,061	83.3	66.7	12.2
Chemicals	849	60,540	0.5	8.5	53.2
Textiles and Clothing	132,043	391,614	73.2	55.3	11.5
Other Manufactures	11,096	6,842	6.2	1.0	-4.7
Machinery and Transport Equipment	7	3,362	0	0.5	84.2

Source: United Nations Com Trade Statistics.

[1] If Nepal's exports of these products exceed the quotas- which are lower than recent export levels - they are subject to MFN treatment. According to the amended clause of the renewed Trade Treaty, India has provided Nepal a fixed annual quota for the export of these products at 100,000 tons for vegetable ghee; 10,000 tons for acrylic yarn; 10,000 tons for copper; and 2,500 tons for zinc oxide.

In its trade with other partners, the prevailing applied customs tariff rates ranged from 5 to 130 percent (with intermediate tariffs of 10, 15, 25, 40 and 80 percent). The unweighted average customs duty for imports was approximately 11 percent since 1996/97. In addition, Nepal applied significant other duties and charges on imports, ranging from 2.5 to 14.5 percent. In 2004, Nepal became a member of the WTO. At this time, the average bound tariff rate in Nepal was 51 percent for agricultural products which was scheduled to go down to 42 percent by 2007. However, applied tariff rates on agricultural products are much lower, at generally 10 percent or less. Similarly, the average bound tariff rate for industrial products was 39 percent at the date of accession to WTO, a level that was to be lowered to 24 percent three years later. Nepal also made a commitment to WTO to eliminate other significant duties and charges over a period ranging from 2 to 10 years (WTO, 2003). An escalating structure of protection gives much higher rates of effective protection to the downstream industries.

One important trade-related fiscal issue for Nepal is its high dependence on tariffs and other duties and charges (ODCs) for government revenue (Table 3). In 2003/4, customs revenue contributed 17 percent of government revenue, followed by sales (16 percent), property (11 percent), and excise (7 percent) taxes. In addition to this, other revenue sources contribute another 14 percent. Thus, domestic revenue sources contribute two-thirds of government revenue, while the remaining third is financed from foreign grants (12.7 percent), foreign loans (12.3 percent), and domestic loans (8.1 percent).

Sauve (2005) estimated that Nepal's market access commitments could lead to a revenue loss of about US$55 million assuming that applied rates before accession would continue to be applied and that other duties and charges would be completely eliminated. This is equivalent to about one quarter of Nepal's total customs revenues (US$ 200 million). The biggest losses would result from the elimination of duties and charges on imports of rice (an estimated loss of US$ 5.5

Table 3: Nepal's composition of government revenues (In percent)

Type of Revenue	1985/86	1995/96	1999/00	2000/01	2001/02	2002/03	2003/04
Customs	12.6	15.7	16.9	16.0	16.0	17.9	17.1
Taxes on Consumption and production	18.0	20.8	20.9	20.9	20.8	23.0	22.6
Domestic excise	0.6	4.2	4.9	4.9	5.1	6.0	6.8
Sales taxes (Domestic and import)	10.1	13.8	15.4	15.9	15.7	16.9	15.8
Land Revenue and Registration	2.5	2.3	1.6	0.8	1.5	1.8	2.1
Taxes on Property, Profit and Income	4.3	7.7	12.4	12.3	12.1	10.9	11.2
Total Tax revenue	37.4	46.5	51.7	50.0	50.3	53.6	53.0
Other Revenue	10.1	13.8	11.8	10.3	11.8	15.2	14.0
Total Revenue	47.4	60.4	63.5	60.2	62.1	68.8	67.0
Foreign Grants	12.0	10.4	8.9	8.7	8.6	10.5	12.7
Gross Foreign Borrowing	25.5	20.3	18.4	15.5	9.9	5.7	12.3
Gross Domestic Borrowing	14.3	4.3	8.6	9.0	10.2	11.2	8.1
Cash balance (-increase)	0.8	4.6	0.6	6.6	9.3	3.8	0.0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Total Government Finance (NRs. Mln.)	9797.1	46557.6	64089.5	77778.0	78183.1	79499.5	90557.2

*Domestic and import. Source: HMGN, Economic Survey, Various Issues

million) and from the lowering of the tariffs on motor vehicles from the currently applied 130 percent to the bound rate of 40 percent (a decrease of about US$ 15 million). The estimated value of the resulting overall trade creation was US$ 89 million, mainly in the sectors where customs revenue losses would be highest (Sauve, 2005).

In terms of domestic taxation, various reforms were adopted in the 1990s. The top income tax rate was reduced from 45 percent to 33 percent, the number of tax brackets was reduced from 8 to 4, and value added taxes (VAT) replaced sales taxes in 1998. The VAT is levied both on imports and domestic goods at the same rate of 10 percent. An export service tax is levied on the gross value of Nepalese exports, other than those subject to export duties. The rate was initially 2 percent in 1993, but it has been reduced in several stages to its current rate of 0.5 percent since 1996. A small and decreasing number of products are also subject to export duties[2]. There is a blanket exemption from income tax for all income earned through exports, which is quite an unusual exemption. Nepal's excise taxes are applied only on domestic manufacturers of selected goods, primarily cigarettes and alcoholic beverages. Much more significant in this regard has been a refund of Indian excise taxes to the Government of Nepal in respect of exports from India to Nepal (Harvard University, 1997).

Poverty and Inequality

The official poverty line in Nepal since 1977 has been defined as a food budget sufficient to satisfy nutritional requirements ranging from 2124 to 2256 calories per day, including an additional 35 to 40 percent of this amount in order to meet other non-food basic necessities. Although, at 31 percent, the incidence of poverty in 2003/4 was identical to the rate in 1977, it was considerably lower than the summits attained in the mid-1990s of over 40 percent. Estimates vary considerably by source and methodology[3] yet, no matter how one defines poverty, its incidence is high in Nepal, even when compared to other South Asian countries. For international comparability, we evaluate poverty rates based on the "$1-a-day" poverty line. The Nepalese population living below "$1-a-day" was 33.5 percent in 1995-96 and decreased to 24.1 percent in 2003-04. With the "$2-a-day" poverty line, the poverty incidence estimate was 77.6 percent in 1995-96 and 65.8 percent for 2003-04.

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[2] These include a number of quarry products, several agricultural products (split and whole pulses, oil cakes, and rice bran) and forest products such as wood, sawn timber, and veneer sheets for plywood.

[3] Some examples: 40 percent (World Bank/UNDP, 1990), 49 percent (NPC, 1992), 64 percent in the Hills and Mountain region and 34 percent in the Terai region in 1992 (Chhetri 1996). Using the 1995-96 Nepal Living Standards Survey (NLSS), 42 percent were classified as poor using a nutrition-based poverty line, 37 percent using the international dollar-a-day measure of poverty, and 76 percent using two dollars per day.

Table 4.1: "Dollar a Day" poverty rates in Nepal

International Poverty Line	1995-96	2003-4	Change (Percentage Point)
$1-a-day	33.5	24.1	-9.4
$2-a-day	**77.6**	**65.8**	**-11.6**

Source: CBS (2005)

The spatial dimension of poverty in Nepal is very significant. First, poverty is predominantly rural as portrayed in Table 4.2 below. Only 3.3 percent of people living in the urban Kathmandu Valley were poor in 2003/4, in contrast to 34.6 percent of those living in rural areas. Among rural areas, the fertile *Terai* region has lower poverty rates than the Hills and Mountain regions. The latter suffer from poor transport infrastructure, resulting in inadequate development of markets and commerce, as well as poor government services.

Table 4.2: Poverty incidences by region, 1995–1996 and 2003-04 (in percent)

Region	Poverty Incidence		Poverty Gap		Poverty Severity	
	1995-96	2003-04	1995-96	2003-04	1995-96	2003-4
Nepal	41.8	30.9	11.8	7.6	4.7	2.7
Urban	21.6	9.6	6.5	2.2	2.7	0.7
Urban Katmandu	4	3.3	0.4	0.7	0.1	0.2
Other Urban	34	13.0	10.9	5.0	4.4	2.0
Rural	43.3	34.6	12.1	8.5	4.8	3.1
Terai	42	27.6	9.9	7.8	3.4	3.0
Hills	41	34.5	13.6	11.3	6.1	4.8
Mountain	56	32.6	18.5	12.5	8.2	5.2

Note: Estimates based on LSMS Survey 1995-96 and 2003-04; Source: Prenushi, G (1999) and CBS (2005).

Research on poverty among farm households found that the more access households had to non-farm income, the smaller was the likelihood of them being poor (Sharma and Chhetry, 1996). Table 4.3 shows that land ownership also reduces the probability of being poor in rural areas, especially in more recent years (CBS, 2005).

Table 4.3: Poverty measurement by land ownership (rural areas only)

	Poverty Rate Head Count			Distributionof the Poor			Distributionof the population		
	1995-96	2003-04	% Change	1995-96	2003-04	% Change	1995-96	2003-04	% Change
Less than 0.2 ha. of land	47.7	39.3	*-18*	22.9	25.2	*10*	20.8	22.2	*7*
0.2 – 1 ha. of land	45.0	38.1	*-15*	43.7	51.2	*17*	42.0	46.5	*11*
1 – 2 ha. of land	38.8	27.3	*-30*	18.7	16.0	*-15*	20.9	20.3	*-3*
More than 2 ha. of land	38.9	23.8	*-39*	14.6	7.6	*-48*	16.3	11.0	*-32*
Total	41.8	30.8	*-26*	100	100	-	100	100	-

Source: CBS (2005)
Note: Estimated from NLSS I and NLSS II;

Inequality has increased since the mid-1990s. The per capita consumption Gini coefficient increased from 0.342 to 0.414 between 1995/96 and 2003/4 (Table 5). This increase affected rural areas (from 0.308 to 0.349) more than urban areas (from 0.427 to 0.436). Between 1995/96 and 2003/04, the share of the bottom half of the population remained at one-fifth of total income, whereas the top quintile earned over half of total income.

Table 5: Inequality measures in per capita consumption in Nepal, 1995/96 and 2003/04

REGION	Gini Coefficient		Atkinson Measure (1995/96)		
	1995/96	2003/04	e=0.5	e=1.0	e=2.0
Nepal	0.342	0.414	0.10	0.18	0.3
Urban	0.427	0.436	0.15	0.28	0.47
Urban Katmandu	0.37		0.11	0.20	0.34
Other Urban	0.43		0.15	0.26	0.44
Rural	0.308	0.349	0.08	0.15	0.26
Terai	0.29		0.07	0.13	0.22
Hills	0.39		0.12	0.22	0.37
Mountain	0.35		0.10	0.18	0.31

Source: Prenushi, G (1999).

The Nepal 1995/96 social accounting matrix (SAM) provides information on the sources of household income by region (Table 6). Households in the *Terai* and Hills/Mountains regions have similar income patterns, except that *Terai* households have much higher land rents, whereas Hill/mountains households rely more on other (non-factor) income. Urban households stand out by their higher shares of skilled labor, capital and other income and their smaller shares of unskilled wages and land rents (Nepal SAM, 1995/96).

Table 6: Sources of Factor Income of Regional Households, 1995/96 (in percent)

Regional Households	Unskilled Labor	Skilled Labor	Capital	Land	Others	Total
Urban	14.8	23.0	23.8	8.2	30.2	100.0
Terai	23.2	8.5	15.6	40.9	11.9	100.0
Hills/Mountains	22.1	8.3	14.6	29.3	25.7	100.0
Nepal (Total)	**21.4**	**10.6**	**16.4**	**30.6**	**21.0**	**100.0**

Source: Social Accounting Matrices for Nepal, 1995-96.

Major Policy Issues

The main impediments to Nepal's integration into the world economy are labor market rigidities, high costs of transportation, high transaction costs, restrictions on foreign investment, and poor access to credit in the formal sectors. In agriculture, adverse factors include uncertainty about weather conditions, macro economic instability, uncertainty about land market regulations, a weak market infrastructure, high transaction costs, and the high cost of national and international transportation. These problems foster dependence on subsistence agriculture that, in turn, hurts agricultural growth.

Salient Features of Nepalese CGE Model

We use a standard CGE model with a disaggregation of factors, households, and commodities into three regions: Urban, *Terai*, Hills/ Mountains. The basic model structure is drawn from Decaluwe et al

(1999a) and Thorbecke (1999). The regional treatment of the model is similar to Coady and Harris (2001). A detailed discussion of the model structure is provided in Sapkota (2001). The core CGE model is comprised of 15 production sectors, 15 corresponding commodity sectors, and 4 primary factors in each of the three regions, as well as three household categories. We have taken 1995-96 as the benchmark year for the SAM because Nepal Living Standard Measurement Survey (NLSS) pertains to the year 1995-96.

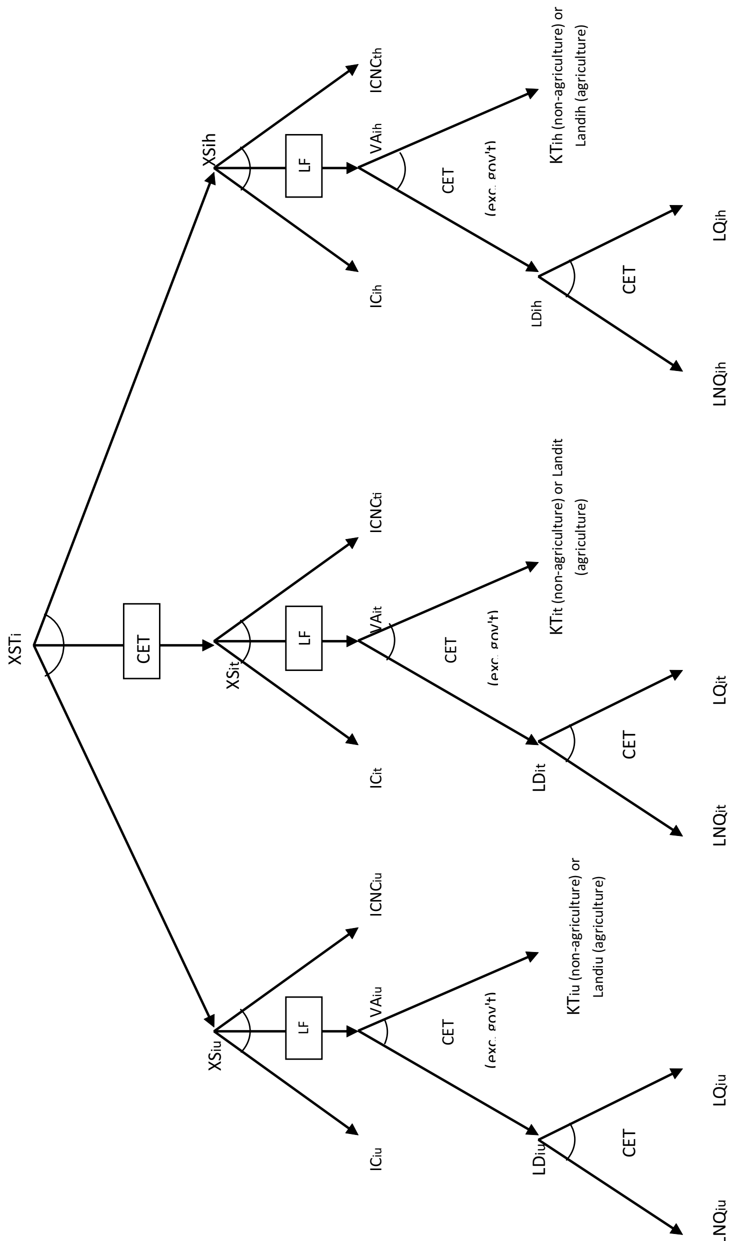
Production

The multi-level cascading specification of the production process is shown graphically in Figure 1. National sectoral production is a CET aggregation of production in the Urban (u), *Terai* (t) and Hills/ Mountains (h) regions. Each region has fifteen sectors of production: five agricultural sectors, nine non-agricultural sectors, and government. Regional sectoral output (XS) is a Leontief function of value-added (VA), domestic intermediate inputs (IC), and imported intermediate inputs (ICNC). In agriculture, value-added (VA) is a CES of composite labor (LD) and land (Land), whereas non-agricultural VA is a CES of composite labor and capital (KT). Government VA is generated solely by composite labor. In all sectors, composite labor is a CES of skilled (LDQ) and unskilled (LDNQ) labor. This hierarchical multi-level specification allows substitution among primary factors and between regional outputs.

Foreign Trade

The model does not distinguish between purely exportable and importable sectors. Imports are divided into competitive and non-competitive categories. Competitive imports are modeled according to the Armington assumptions (CES function) of imperfect substitution with respect to domestic goods. The competitive import demand function is derived from the cost minimization of the CES and depends on the relative prices of imports and domestic goods, as well as the Armington elasticity. Non-competitive imports are modeled with the

Figure 1:Multi-level, regional and nested production structure



Leontief fixed coefficient technology. The CET function is used to capture producer substitution between export and domestic markets. Export supply is thus determined by the relative price of exports to domestic prices and the elasticity of transformation adopted. The standard small-country assumption is invoked with regard to the world market prices.

Macro Closure

The model is static, with fixed real investments so as to avoid accounting for dynamic welfare/poverty effects. Total domestic savings adjust to finance investment through the household marginal propensity to save (mps). Total demand equals total supply in all commodities and zero profits are made in all industries. Regional demand for unskilled labor, skilled labor, capital, and land is equal to the regional supply of these factors, through adjustments in region-specific factor prices. All factors are fully mobile between sectors within a given region, but immobile between regions. Government transfers to households and government spending are fixed in real terms. Various counterfactual simulations are carried out under government revenue neutrality through the introduction of a compensatory domestic tax (production, consumption, value added or income tax). The model closes with fixed foreign savings (CAB) and a fixed exchange rate acting as the numeraire. The domestic price index (PINDEX) is endogenous.

Poverty Analysis

Income variations for each representative household are drawn from the CGE simulation results. We then use a household survey for poverty analysis, assuming that the income of each household in a given category increases by the same amount as the corresponding representative household in the CGE model. The poverty line is endogenized using consumer price variations from the model.

Calibration of Parameters and Elasticity Values

We follow standard calibration procedures (Mansur and Whalley, 1984) based on a base year data set (the SAM). The base year data set must be micro-consistent and satisfy all equilibrium conditions and properties of the model. Most of the model parameters, such as input-output coefficients (IO), shares in the returns to labor and capital by household type, and parameters of the Cobb-Douglas functions, are calibrated directly from the benchmark data. The calibration of the share and other parameters in the CES and CET functions requires estimates of the elasticities of substitution and transformation either from an econometric analysis and/or from a literature search. Other coefficients are implicit in the benchmark data, given the functional forms used in the model equation and other parameters. Thus calibrated, the model reproduces the initial year in the absence of any shock.

Simulation results

Our base simulation consists in the complete elimination of import tariffs in all sectors. To maintain government revenue neutrality, an endogenously-determined uniform sales tax is introduced. At the end of this section, we compare the results obtained with compensatory taxes on production, value-added, and income taxes. The impact of trade reform is evaluated first in terms of the effects on resource allocation, factor returns, household income, consumer prices and welfare, and then in terms of the poverty impacts.

Production

Table 7 presents the sectoral supply and demand effects. Initial tariffs are low so that import prices fall by less than 10 percent. The compensatory sales tax, which is applied to both imported and domestic goods as a requirement to compensate lost tariff revenue, is only 1.6 percent. Imports increase in response to the fall in import prices, but the increase is limited (less than three percent in all sectors)

Table 7: Effects of trade liberalization on sectoral production (in percent)

Sectors	Change in	Sectoral Shares					Volume Change				Price Changes			Regional Output		
	Import price	Imports	Exports	Value added	IPR	EIR	Import	Domestic	Export	Output	Domestic	Producer	Value added	Urban	Terai	HM
Agriculture	**-7.6**	**15.1**	**8.6**	**57.9**	**5.5**	**1.2**	**1.7**	**-0.2**	**1.9**	**-0.1**	**-3.8**	**-3.8**	**-4.1**	**-0.2**	**-0.1**	**-0.1**
Paddy	-9.1	7.8		12.4	11.1		2.5	-0.4		-0.4	-3.7	-3.7	-4.3	-0.4	-0.4	-0.4
Other food crops	-9.1	0.1		9.7	0.3		2.8	-0.1		-0.1	-3.8	-3.8	-4.2	0.0	-0.1	-0.2
Cash crops	-9.1	0.7	5.7	18.1	0.8	2.5	2.8	-0.1	1.9	0.0	-3.8	-3.7	-4.3	0.0	0.0	0.0
Livestock and fisheries	-5.5	6.5	2.2	10.2	14.5	2.2	0.7	-0.2	1.9	-0.1	-4.0	-3.9	-4.2	-0.2	0.0	0.0
Forestry	-9.1	0.0	0.7	7.6	0.0	0.9	2.8	0.0	2.0	0.0	-3.9	-3.9	-4.3	-0.2	0.4	0.4
Industry	**-7.9**	**84.9**	**62.3**	**6.7**	**54.4**	**28.0**	**1.5**	**0.3**	**3.3**	**1.1**	**-5.7**	**-4.2**	**-3.8**	**1.0**	**1.1**	**1.3**
Mining & quarrying	-2.8	1.1	0.3	0.5	33.7	5.2	0.7	1.3	3.4	1.4	-4.0	-3.8	-3.8	1.3	1.5	1.8
Manufacturing	-8.0	83.8	62.0	6.3	54.8	28.7	1.5	0.3	3.3	1.1	-5.8	-4.2	-3.8	1.0	1.1	1.2
Services			**29.1**	**35.4**		**4.6**		**-0.5**	**12.1**	**0.1**	**-4.5**	**-4.3**	**-3.8**	**-0.1**	**-0.1**	**-0.1**
Construction				8.3				-0.7		-0.7	-4.6	-4.6	-3.8	-1.0	-0.7	-0.4
Gas electricity & water				1.0				0.1		0.1	-3.2	-3.2	-3.8	0.7	0.4	-0.2
Hotel & restaurant			29.1	1.3		74.4		0.7	12.1	9.1	-19.3	-5.3	-3.8	8.5	9.0	9.3
Transport & communication				5.5				-0.5		-0.5	-4.1	-4.1	-3.8	-0.6	-0.5	-0.4
Wholesale & retail trade				6.2				-1.4		-1.4	-3.2	-3.2	-3.8	-1.0	-1.3	-1.6
Finance & real estate			6.5				-0.2		-0.2	-3.9	-3.9	-3.8	-0.3	-0.1	-0.1	
Government			0.7				0.2		0.2	-4.7	-4.7	-4.0	0.0	0.1	0.3	
Other services				5.9				0.2		0.2	-4.8	-4.8	-4.0	0.0	0.1	0.4
All	**-7.9**	**100.0**	**100.0**	**100.0**	**15.4**	**15.0**	**1.5**	**-0.2**	**5.8**	**0.1**	**-4.3**	**-4.0**	**-4.0**	**0.0**	**0.0**	**0.0**

* Average variation for volumes; Laspeyres index variation for prices. Legend: IPR: Import penetration rate, EIR: Export Intensity Ratio; HM: Hills and Mountains region.

as they are imperfect substitutes for domestic goods[4]. Roughly speaking, import increases are proportional to the tariff reductions (and fall in import prices), with the largest increases in the initially most-protected agricultural sectors.

In response to increased import competition, there is a general reduction in the prices and volumes of domestic sales by local producers. Price reductions are reinforced by cost savings on importable inputs, which are largest in the manufacturing sector where the import penetration rate (IPR) is highest, as well as in the hotel/restaurant sector[5]. Note that all prices are expressed relative to the fixed exchange rate.

Producers of exportable goods respond to declining domestic demand by diverting a portion of their sales to the export market[6]. The manufacturing sector is the main player here with an export intensity ratio (EIR = exports/production) of 28.7 percent and comprise 62 percent of total Nepalese exports, along with the much smaller hotel/restaurant and mining industries. It is these three export-oriented sectors that have the largest increases in production in this trade liberalization scenario, whereas the agricultural sectors generally contract.

High manufacturing exports also explain why the gap in the variations of producer prices (averaged over exports and domestic sales) between industry and agriculture (4.2 vs. 3.8 percent) is smaller than for their domestic sales prices (-5.7 vs. -3.8 percent). It is particularly striking that the industrial and service sectors benefit much more from input cost savings than agriculture following the reduction

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[4] The Armington elasticity of substitution between imported and local goods is set at 0.5.

[5] Domestic demand for hotel/restaurant services is mainly an intermediate input in the transport/communication and other services sectors. Given the contraction in the transport/communication sector and highly inelastic (fixed coefficient) intermediate input demand, this generates a huge domestic price reduction.

[6] The CET elasticity of transformation between exports and local sales is also set at 0.5.

in import and domestic prices. This can be seen by the fact that value-added prices fall more in the agricultural sector, especially in urban areas. Thus, expansionary export growth and input cost effects offset the contractionary import competition effect for export-oriented sectors, in particular the manufacturing sector.

In summary, trade liberalization engenders a clear sectoral reallocation of resources from non-traded services toward the export-oriented manufacturing, mining and hotel/restaurant sectors, with all other sectors relatively unaffected. There are also some regional variations in output effects due to regional factor price changes, which we will see later.

Factor markets

Let us now see how these production effects influence factor markets (Table 8). The general decline in factor remuneration rates relative to the exchange rate (numeraire) should be considered in the framework of the trade liberalization-induced fall in consumer and producer prices. We focus here on how these remuneration rates change relative to one another.

We note little difference in the changes in the nationwide average remuneration rates for the four factors in our model (bottom line of Table 8): -4.03 (unskilled labor), -3.94 (skilled labor), -3.77 (capital), -4.20 (land). To understand these results, we first note that, due to the inter-regional immobility of factors, these markets are segmented and determine region-specific factor remuneration rates. These rates are driven by value-added prices, which, in all regions, fall more in agriculture than in industry or services. As a result, changes in factor remuneration rates reflect the share of each factor's income coming from the agricultural sector. Nationwide, returns to land (100 percent agricultural) fall most, followed by unskilled labor (68.7 percent), skilled labor (36.4 percent), and capital (0 percent). Similar results are observed in the *Terai* and Hills/Mountain regions. However, in urban areas, skilled and unskilled wages fall in roughly the same proportion as returns to capital, as all three factors are primarily

Table 8: Changes in factor remuneration rates by sectors (in percent)

SECTOR	CHANGED VALUE ADDED PRICE				SECTORAL SHARES IN FACTOR REMUNERATION																GRAND
					UNSKILLED LABOR				SKILLED LABOR				CAPITAL				LAND				
	Urban	Terai	HM	Total	Urban	Terai	HM	Total	Urban	Terai	HM	Total	Urban	Terai	HM	Total	Urban	Terai	HM	Total	TOTAL
Agriculture	**-4.5**	**-4.1**	**-4.1**	**-4.1**	**22.9**	**68.3**	**79.4**	**68.7**	**8.0**	**41.4**	**59.0**	**36.4**					**100**	**100**	**100**	**100**	**57.9**
Paddy	-4.5	-4.1	-4.1	-4.3	6.1	21.5	8.7	13.9	2.1	13.1	6.5	7.1					27.4	30.4	11.2	22.1	12.4
Other food crops	-4.4	-4.1	-4.1	-4.2	5.0	12.7	22.9	16.7	1.7	7.7	17.0	9.0					11.9	9.5	15.6	12.2	9.7
Cash crops	-4.6	-4.2	-4.1	-4.3	3.4	15.3	24.3	18.3	1.2	9.3	18.1	9.7					20.7	29.0	42.0	34.0	18.1
Livestock and fisheries	-4.5	-4.1	-4.1	-4.2	5.9	10.6	18.0	13.6	2.0	6.4	13.4	7.4					22.2	12.6	19.6	16.1	10.2
Forestry	-4.6	-4.2	-4.1	-4.3	2.5	8.1	5.6	6.3	0.9	4.9	4.1	3.3					17.8	18.4	11.6	15.5	7.6
Industry	**-3.9**	**-3.8**	**-3.8**	**-3.8**	**7.7**	**3.2**	**1.6**	**2.9**	**9.3**	**6.7**	**3.1**	**6.3**	**18.7**	**21.9**	**17.2**	**19.7**					**6.7**
Mining & quarrying	-3.9	-3.8	-3.8	-3.8	0.3	0.1	0.6	0.4	0.2	0.2	0.4	0.3	0.1	0.3	3.8	1.3					0.5
Manufacturing	-3.9	-3.8	-3.8	-3.8	7.5	3.1	1.0	2.6	9.1	6.6	2.7	6.0	18.6	21.5	13.4	18.4					6.3
Services	**-3.9**	**-3.8**	**-3.9**	**-3.8**	**69.4**	**28.6**	**19.0**	**28.4**	**82.8**	**51.9**	**38.0**	**57.3**	**81.3**	**78.1**	**82.8**	**80.3**					**35.4**
Construction	-3.9	-3.8	-3.8	-3.8	8.8	4.6	3.1	4.3	15.4	14.0	11.4	13.5	14.6	21.3	26.5	21.0					8.3
Gas electricity & water	-3.9	-3.8	-3.8	-3.8	1.5	0.2	0.1	0.3	5.5	1.2	0.4	2.4	5.2	1.9	1.0	2.5					1.0
Hotel & restaurant	-3.9	-3.8	-3.8	-3.8	3.3	0.9	0.4	0.9	2.1	1.0	0.6	1.2	4.4	3.3	2.8	3.4					1.3
Transport & communication	-3.9	-3.8	-3.8	-3.8	8.5	4.4	3.0	4.2	8.2	7.5	6.1	7.2	9.4	13.6	17.0	13.4					5.5
Wholesale & retail trade	-3.9	-3.7	-3.8	-3.8	3.7	0.8	0.3	0.9	4.4	1.7	0.8	2.3	32.1	19.5	14.7	21.5					6.2
Finance & real estate	-3.9	-3.8	-3.8	-3.8	17.4	7.2	4.3	6.9	4.3	3.2	2.3	3.2	14.3	16.7	18.5	16.6					6.5
Other services	-3.9	-4.0	-4.0	-4.0	23.7	9.6	7.2	10.0	37.3	20.5	14.4	24.0	1.3	1.9	2.4	1.9					5.9
Government services	-3.9	-4.0	-4.0	-4.0	2.5	0.9	0.7	1.0	5.6	3.0	2.1	3.5	0.0	0.0	0.0	0.0					0.7
Total	**-4.0**	**-4.0**	**-4.0**	**-4.0**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**
Change in remuneration rate					-3.91	-4.05	-4.05	**-4.03**	-3.89	-3.97	-3.95	**-3.94**	-3.85	-3.77	-3.72	**-3.77**	-4.78	-4.13	-4.20	**-4.20**	

* Laspeyres index variation for prices and remuneration rates

employed in the service sector. In contrast, returns to land fall even more than in the other two regions, given the greater reduction in urban agricultural value-added prices observed above.

Household income

How do these changes in the rates of factor remuneration affect household income? Income effects are weighted averages of factor remuneration rates where the weights are given by the shares of income the household draws from each factor. In Table 9 we decompose the average income changes for households in each region into changes in income from each factor, expressed as a share of total base-year income. The latter are equal to the factor's share in the household income multiplied by the change in the factor's remuneration rate (drawn from Table 8).

In general, income falls relative to the exchange rate numeraire as a result of the fall in factor prices. There is little difference in the income effects, as all types of households show substantial diversification of their income sources. Urban households are little affected by the strong decline in the urban rates of return to land given its small share in their incomes. Furthermore, they derive a large share of income from non-factor sources – principally foreign, government, and inter-household transfers as well as dividends – which decline less than factor returns. While rural households derive more income from land and less from non-factor sources, their income fall is similar to urban households, as the fall in the returns to land and non-factor income are both smaller than in urban areas. Within rural areas, *Terai* households are slightly more negatively affected given their greater reliance on land income and their more limited recourse to non-factor income, which both fall more than in the hills and mountains region.

The fall in the prices of investment goods translates into a reduction in investment-driven domestic household savings that primarily affects urban households, who have the highest initial

Table 9: Changes of household income by regional households (in percent)

	Change in Rate				Initial Income Share				Change in Income (share of total base year income)			
	Urban	Terai	HM	All	Urban	Terai	HM	All	Urban	Terai	HM	All
Unskilled labor	-3.91	-4.05	-4.05	**-4.03**	14.8	23.2	22.1	21.4	-0.6	-0.9	-0.9	-0.9
Skilled labor	-3.89	-3.97	-3.95	**-3.94**	23.0	8.5	8.3	10.6	-0.9	-0.3	-0.3	-0.4
Capital	-3.85	-3.77	-3.72	**-3.77**	23.8	15.5	14.6	16.4	-0.9	-0.6	-0.6	-0.6
Land	-4.78	-4.13	-4.20	**-4.20**	8.2	40.9	29.3	30.6	-0.4	-1.7	-1.2	-1.3
Other	-3.47	-2.88	-3.18	**-3.18**	30.2	11.9	25.7	21.0	-1.0	-0.3	-0.8	-0.7
Total					100.0	100.0	100.0	100.0	-3.8	-3.9	-3.8	-3.8
Direct Tax									-0.2	-0.1	-0.1	-0.1
Out transfers									-0.6	-0.8	-0.4	-0.6
Saving									-1.5	-1.0	-0.8	-1.0
Consumption									**-1.6**	**-2.0**	**-2.5**	**-2.2**

savings rates. This results in a smaller reduction in their consumption, expressed as a share of total base year income. On the other hand, households in the hills and mountains region have the largest consumption loss as they benefit less from the fall in domestic savings and from the indexation of out transfers.

Consumer prices

At the same time as households see a reduction in their income and consumption, they see a counteracting reduction in consumer prices. Sectoral consumer prices reflect changes in import prices (and thus initial tariff rates), changes in the prices of local sales by domestic producers, and the share of imports in local consumption. The largest reduction is observed in the export-oriented hotel and restaurant sector, although this represents a negligible share of household consumption in Nepal. The more important impact is the fall in the consumer prices of manufacturing goods, which is driven by the important reduction in their import prices coupled with the high import penetration ratios.

From this, it is easy to understand that consumer prices fall principally in manufacturing followed by agriculture and services.

Table 10: Changes in consumer prices (in percent)

Sectors	Import Penetration	Change in Sales Tax	Change in Prices			Consumption Share			
			Import	Domestic	Consumer	Terai	H/M	Urban	All
Agriculture	**5.5**	**1.6**	**-7.6**	**-3.8**	**-2.5**	**79.2**	**79.0**	**65.3**	**77.3**
Paddy	11.1	1.6	-9.1	-3.7	-2.8	22.8	14.9	14.2	22.8
Other food crops	0.3	1.6	-9.1	-3.8	-2.2	9.6	14.8	5.9	14.7
Cash crops	0.8	1.6	-9.1	-3.8	-2.3	17.2	23.6	24.2	26.5
Livestock and fisheries	14.5	1.6	-5.5	-4.0	-2.6	2.8	4.1	4.5	4.6
Forestry	0.0	1.6	-9.1	-3.9	-2.3	3.8	7.2	16.6	8.7
Industry	**54.4**	**1.6**	**-7.9**	**-5.7**	**-5.5**	**13.2**	**15.1**	**19.5**	**15.1**
Mining & quarrying	33.7	1.6	-2.8	-4.0	-2.0	0.0	0.0	0.0	0.0
Manufacturing	54.8	1.6	-8.0	-5.8	-5.6	9.3	12.4	19.5	15.1
Services		**1.6**		**-4.5**	**-2.9**	**7.4**	**5.7**	**15.1**	**7.7**
Construction		1.6		-4.6	-3.0	0.0	0.0	0.0	0.0
Gas electricity & water		1.6		-3.2	-1.6	0.0	0.0	0.5	0.1
Hotel & restaurant		1.6		-19.3	-17.9	0.1	0.1	0.2	0.1
Transport & communication		1.6		-4.1	-2.5	0.8	0.9	2.9	1.3
Wholesale & retail trade		1.6		-3.2	-1.6	0.0	0.0	0.0	0.0
Finance & real estate		1.6		-3.9	-2.4	0.3	0.1	0.2	0.3
Government services		1.6		-4.7	-3.1	0.0	0.0	0.0	0.0
Other services		1.6		-4.8	-3.2	4.0	3.6	11.3	5.9
All	**15.4**	**1.6**	**-7.9**	**-4.3**	**-3.3**	**100.0**	**100.0**	**100.0**	**100.0**
			Change in household consumer price			**-3.0**	**-2.9**	**-3.2**	**-3.0**

Note: Household consumer prices were calculated by multiplying the changes in consumer prices by the share of sectoral commodities in household consumption. Legend: H/M=Hills and Mountains

The sectoral consumer prices fall more in the industry followed by agriculture and services sector. The links between the sectoral prices and the prices households face in their budget constraints are provided in Table 10. Household-specific consumer price indices are computed as averages of sectoral consumer prices weighted by the shares of each item in the household's consumption basket. The overall household consumer price declines by 3 percent, although urban households benefit slightly more due to their greater dependency on manufactured goods.

Welfare

We are now in a position to draw the results above together in order to analyze the impact of trade liberalization on income, consumption, prices, and welfare (Table 11). As we saw earlier, incomes fall in a similar proportion in all regions, although *Terai* households experience a slightly larger loss in income given the greater fall in factor returns and non-factor income there. Consumption falls less than income given declining household savings rates, an effect that impacts urban households – who have the highest initial savings rate – most, and hills/mountains households least[7].

Table 11: Changes in income, consumption, prices and welfare

	URBAN	TERAI	HILLS/MOUNTAINS	TOTAL
Income	-3.83	-3.91	-3.80	-3.85
Consumption	-1.59	-2.02	-2.50	-2.17
Consumer price index	-3.17	-2.97	-2.95	-2.99
Welfare*	0.58	0.01	-0.15	0.03

*Measured by equivalent variation (relative to income)

[7] Note that the variations in consumption are expressed as a share of initial consumption, whereas in table 9, they are presented as a share of total income for decomposition purposes.

This pro-urban effect is reinforced by the evolution of consumer prices, which fall most for urban households and least for hills/mountains households. As a result, welfare (measured by equivalent variations) increases for urban households and falls for hills/mountains households, while remaining practically unchanged for *Terai* households.

Poverty and inequality

In this section we present the counterfactual experiments of the effects of trade liberalization on household poverty. The Foster, Greer and Thorbecke (FGT) P_a class of additively decomposable poverty measures allows us to determine the proportion of poor in the population (the headcount ratio) and the depth (poverty gap) and severity of poverty. Assuming that the income distribution is stable and by endogenizing the poverty line with respect to changes in consumer prices, it is possible to produce counterfactual results on poverty.

In Figures 2 to 4, we present the variations in the headcount ratios, poverty gaps and poverty severity index for a wide range of poverty lines (from zero to twice the median consumption). The national poverty line of NRs. 4,404 per capita consumption for the year 1995-96 was used to derive the FGT curves.[8] The headcount ratio shows that poverty decreases, particularly for households with incomes somewhat above the national poverty line. In contrast, the reduction in the percentage of population with very low income (i.e. less than half of the national poverty line) is very small. The poverty gap and poverty severity curves show that poverty falls progressively more as the poverty line is increased, once again emphasizing the fact that trade liberalization appears to benefit the poorest less than richer households.

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[8] We have used NLSS consumption vectors with 3345 observations after removing 22 outliers.

Figure 2. Variation in headcount ratio curves

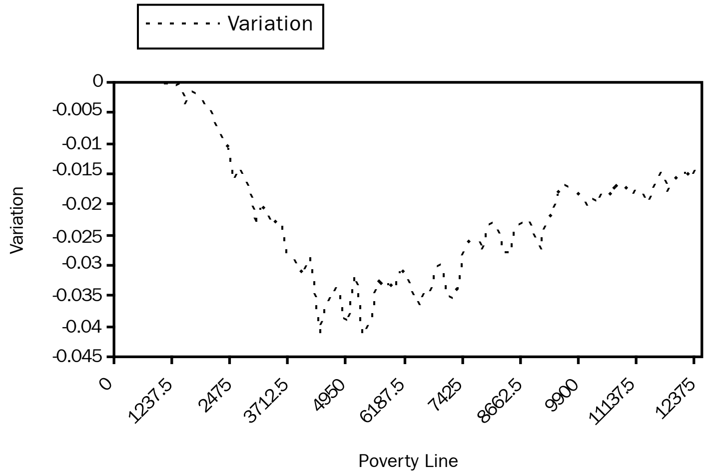


Figure 3. Variation in poverty gap curves

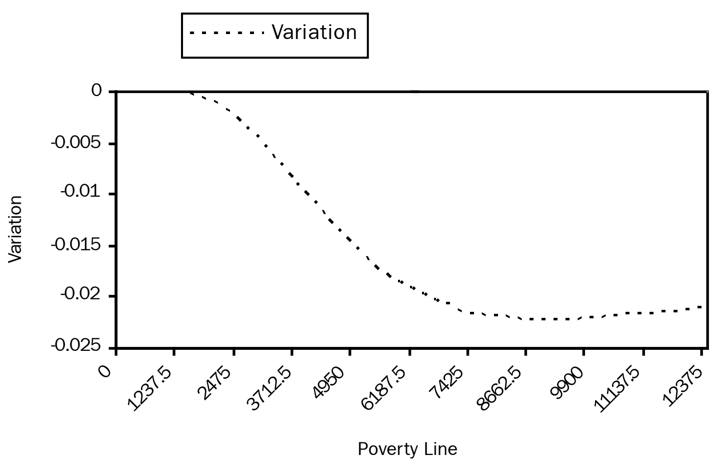


Figure 4. Variation in poverty severity curves

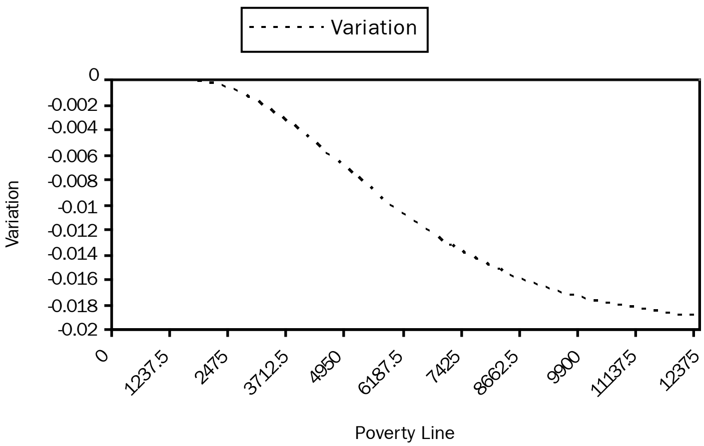


Table 12 displays the normalized poverty indicators using the national poverty line. The effects of poverty reductions are consistently higher for the *Terai* area followed by hills and mountain areas, and least in urban areas for all the poverty indicators, including headcount, poverty gap, and poverty severity measures. This result suggests that the positive welfare effects for urban households are primarily focused on the non-poor.

To obtain a perspective on the distributive effects of trade liberalization, we look at changes in quantile curves (Figure 5) and Lorenz curves (Figure 6). Quantile curves show the inverse of the cumulative density functions (CDF). This analysis generates quite striking results. Individuals in all quintiles experience a loss in nominal

Table 12: Normalized FGT Poverty Indicators

REGION	Head Count Ratio (a=0)			Poverty Gap (a=1)			Poverty Severity (a=2)		
	Before	After	Change	Before	After	Change	Before	After	Change
Urban	12.19	11.84	-0.35	3.21	2.73	-0.49	1.14	0.93	-0.21
Terai	39.54	35.31	-4.23	9.69	8.18	-1.51	3.39	2.77	-0.62
Hills & Mountain	31.38	27.73	-3.65	9.40	8.29	-1.11	3.94	3.39	-0.55
Total	33.49	29.83	-3.66	9.08	7.84	-1.24	3.50	2.95	-0.55

consumption as a result of trade liberalization, with the exception of those in the highest percentiles. Indeed, we truncated the quantiles at 0.95 as the increase among the highest percentile went off the scale. The variation in Lorenz curve shows that inequality decreases up to the 95th percentile and reverses thereafter.

Figure 5: Variation in quantile curves

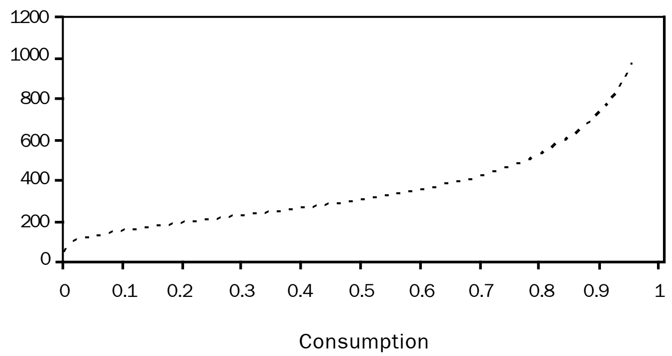
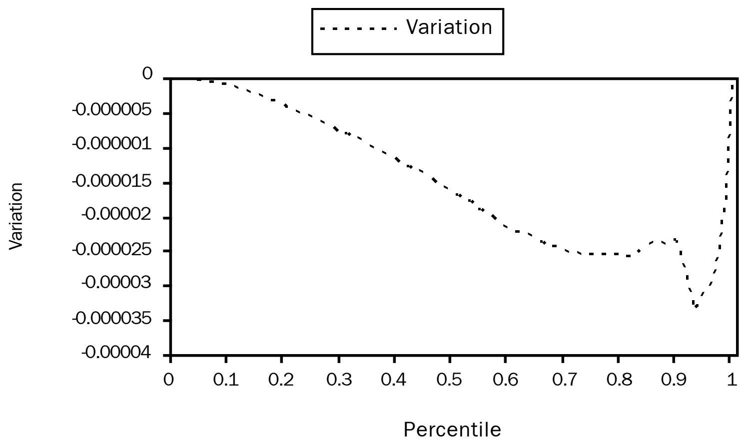


Figure 6: Variation in Lorenz curves



Alternative Fiscal Mechanisms

Table 13 shows the simulation results for the complete elimination of tariffs with alternative compensatory mechanisms to keep government revenue constant. We present the impacts of using compensatory sales, production, value-added, and income taxes for the counterfactual experiment of trade liberalization. The 1.6 percent increase in compensatory sales tax increases consumer prices. Similarly, production-compensatory taxes increase producer prices, value-added compensatory taxes increase prices per unit of value added, and compensatory direct household income taxes increase household income taxes. Sales and direct income taxes are considered less distortionary than production taxes. In terms of compensation to be paid, sales tax with 1.6 percent is less distortionary than production tax (1.8 percent), income tax (2.7 percent) and value added tax (3.0 percent).

CONCLUSION

From the foregoing analysis, it emerges that trade liberalization engenders a clear sectoral reallocation of resources from non-traded services toward the export-oriented manufacturing, mining and hotel/restaurant sectors, with all other sectors relatively unaffected. There are also some regional variations in output effects, due to regional factor price changes.

We note little difference in the changes in the nationwide average remuneration rates for the factors of production. Due to the inter-regional immobility of factors of production in the model, regional markets are segmented and determine region-specific factor remuneration rates (driven by value-added prices), which, in all regions, fall more in agriculture than in industry or services. Nationwide, returns to land fall most, followed by unskilled labor, skilled labor and capital. Similar results are observed in the *Terai* and Hills/Mountains regions. However, in urban areas, skilled and unskilled wages fall in roughly the same proportion as returns to capital, as all three factors are primarily employed in the service

Table 13: Impacts of alternative fiscal mechanisms (in %)

Variables	Income Tax	Sales Tax	Value Added Tax	Production Tax
IMPORT VOLUME				
Agriculture	1.85	1.72	1.87	1.51
Industry	1.46	1.46	1.45	1.36
All	1.52	1.50	1.51	1.38
EXPORT VOLUME				
Agriculture	1.22	1.90	1.21	2.36
Industry	3.78	3.35	3.76	3.28
Services	11.63	12.12	11.59	10.37
All	5.84	5.77	5.82	5.26
DOMESTIC PRODUCTION VOLUME				
Agriculture	-0.35	-0.14	-0.35	-0.04
Industry	1.41	1.15	1.40	1.07
Services	0.04	0.11	0.04	0.08
All	0.06	0.15	0.06	0.17
CONSUMER GOODS PRICES				
Agriculture	-3.20	-2.48	-3.20	-4.67
Industry	-7.17	-5.50	-7.17	-7.04
Services	-4.15	-2.92	-4.13	-4.81
All	-4.47	-3.35	-4.47	-5.28
PRODUCER PRICES				
Agriculture	-2.88	-3.77	-2.88	-4.42
Industry	-4.48	-4.21	-4.48	-4.24
Services	-3.95	-4.27	-3.94	-4.58
All	-3.55	-4.04	-3.55	-4.46
HOUSEHOLD CONSUMPTION VOLUME				
Urban Households	2.12	-1.59	1.73	0.77
Terai Households	-0.38	-2.02	-0.20	0.08
Hill/Mountain Households	-0.68	-2.50	-0.71	-0.08
HOUSEHOLD CONSUMER PRICE INDEX				
Urban	-4.09	-3.17	-4.09	-5.19
Terai	-3.89	-2.97	-3.90	-5.03
Hills And Mountain	-3.84	-2.95	-3.84	-5.02
EV as a Percent of BASE INCOME				
Nepal (All Households)	-0.12	0.03	-0.13	0.08
Urban Households	1.45	0.58	1.18	0.53
Terai Households	-0.26	0.01	-0.13	0.05
Hill/Mountain Households	-0.54	-0.15	-0.57	-0.06
COMPENSATION	2.7	1.6	3.0	18

sector. In contrast, returns to land fall even more than in the other two regions, given the greater reduction in urban agricultural value-added prices. As a result, changes in factor remuneration rates reflect the share of each factor's income coming from the agricultural sector.

In general, income falls— relative to the exchange rate numeraire — as a result of the fall in factor prices. While rural households derive more income from land and less from non-factor sources, their income fall is similar to urban households, as the fall in the returns to land and non-factor income are both smaller than in urban areas. This pro-urban effect is reinforced by the evolution of consumer prices, which fall most for urban households and least for hills/mountains households.

There is little difference in the income effects, as all types of households show substantial diversification of their income sources. Urban households are little affected by the strong decline in the urban rates of return to land given its small share in their incomes. Furthermore, they derive a large share of income from non-factor sources – principally foreign, government, and inter-household transfers as well as dividends – which decline less than factor returns. While rural households derive more income from land and less from non-factor sources, their income fall is similar to urban households, as the fall in the returns to land and non-factor income is smaller for both instances than in urban areas. Within rural areas, *Terai* households are slightly more negatively affected given their greater reliance on land income and their more limited recourse to non-factor income, which both fall more than in the hills and mountains region.

The fall in the prices of investment goods translates into a reduction in investment-driven domestic household savings that primarily affects urban households, who have the highest initial savings rates. This results in a smaller reduction in their consumption, expressed as a share of total base year income. On the other hand, households in the hills and mountains region have the largest consumption loss as they benefit less from the fall in domestic savings and from the indexation of out transfers.

At the same time as households see a reduction in their income and consumption, they see a counteracting reduction in consumer prices. The largest reduction in consumer prices is observed in the export-oriented hotel and restaurant sector, although this represents a negligible share of household consumption in Nepal. The more important impact is the fall in the consumer prices of manufacturing goods, which is driven by the important reduction in their import prices coupled with the high import penetration ratios.

Consumer prices fall principally in manufacturing followed by agriculture and services. The sectoral consumer prices fall more in the industry, followed by agriculture and services sector. The overall household consumer price declines by 3 percent, although urban households benefit slightly more due to their greater dependency on manufactured goods.

Welfare (measured by equivalent variations) increases for urban households and falls for hills/mountains households, while remaining practically unchanged for *Terai* households.

In our policy simulation of a free trade scenario keeping the government revenue neutral, the fiscal implication of various tax instruments to replace the lost tariff revenue amounts to compensation of 1.6 percent of base income with sales tax, 1.8 percent with production tax, 2.7 percent with income tax, and 3.0 percent with value-added tax.

The headcount ratio shows that poverty decreases, particularly for households with incomes somewhat above the national poverty line. In contrast, the reduction in the percentage of population with very low income (i.e. less than half of the national poverty line) is very small. The poverty gap and poverty severity curves show that poverty falls progressively more as the poverty line is increased, once again underlining the fact that trade liberalization appears to benefit the poorest less than the richer households. The effects of poverty reductions are consistently higher for *Terai* followed by hills and mountains and least in urban areas for all the poverty indicators including headcount, poverty gap, and poverty severity measures. This result suggests that the positive welfare effects for urban households are primarily focused among the non-poor.

Quantile and Lozenz curves provide further perspective on distribution analysis. The quantile curve shows that individuals in all quintiles experience a loss in nominal consumption as a result of trade liberalization, with the exception of the highest percentiles. The variation in the Lorenz curve shows that inequality decreases up to the 95th percentile and reverses thereafter.

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Appendix: Regional poverty and inequality effects

Figure 1a: Urban FGT Curve (a=0)

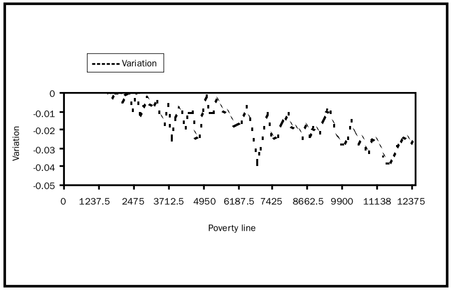


Figure 2a: Urban FGT Curve (a=1)

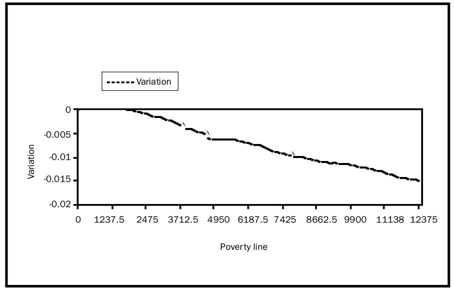


Figure 3a: Urban FGT Curve (a=2)

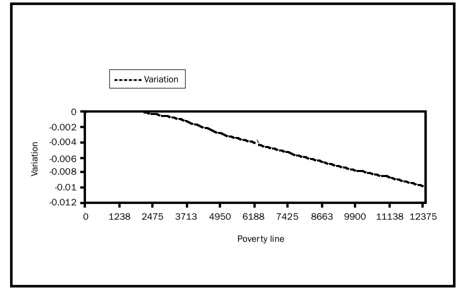


Figure 1b: Terai FGT Curve (a=0)

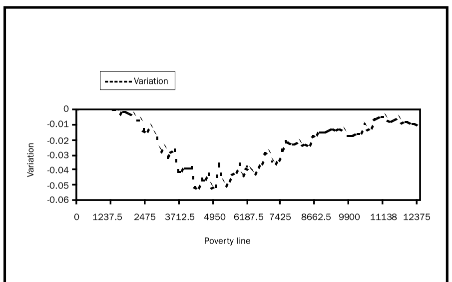


Figure 2b: Terai FGT Curve (a=1)

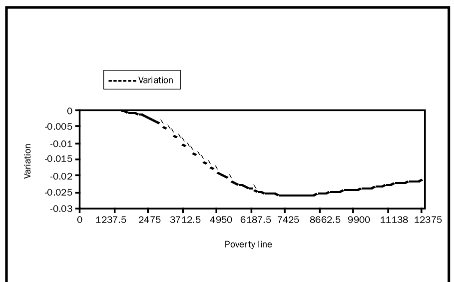


Figure 3b: Urban FGT Curve (a=2)

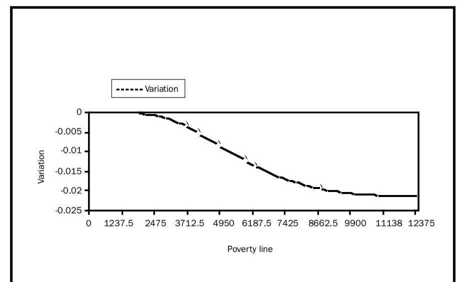


Figure 1c: Hill & Mountains FGT Curve (a=0)

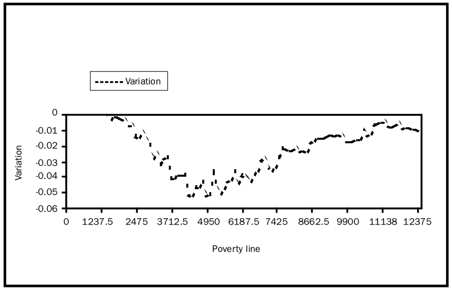


Figure 2c: Hill & Mountains FGT Curve (a=1)

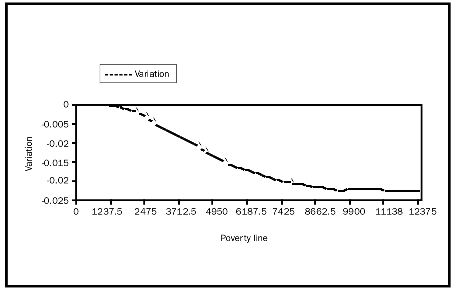


Figure 3c: Hill & Mountains FGT Curve (a=2)

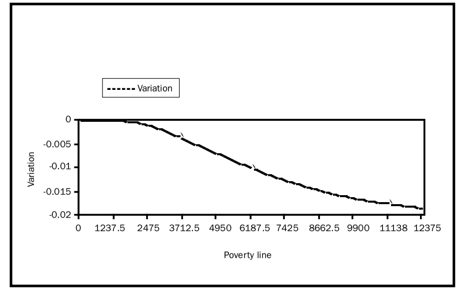


Figure 4a: Urban Kernel Density Functions

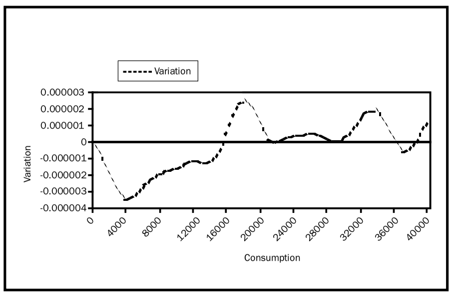


Figure 5a: Urban Quantile Curves

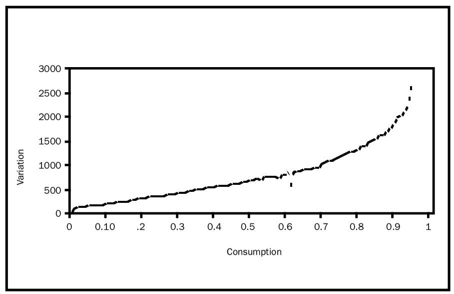


Figure 6a: Urban Lorenz Curve

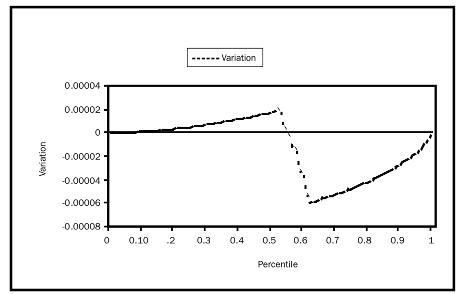


Figure 4b: Urban Kernel Density Functions

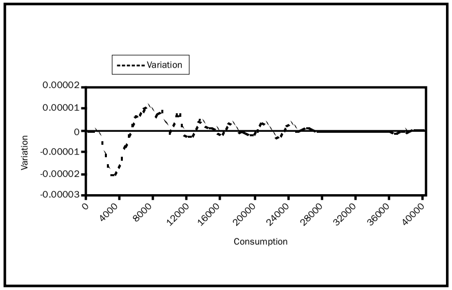


Figure 5b: Terai Quantile Curves

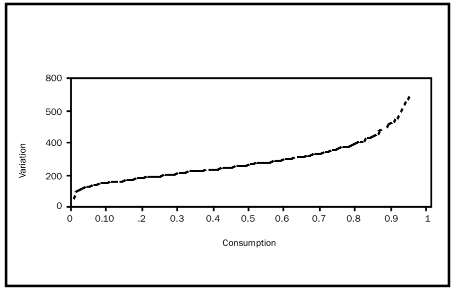


Figure 6b: Terai Lorenz Curve

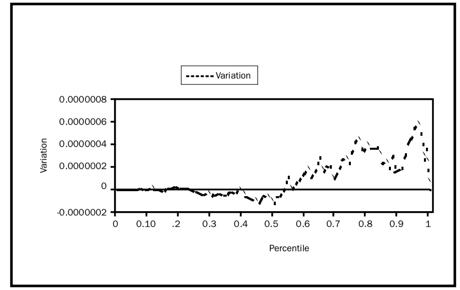


Figure 4c: Hills & Mountain Density Function

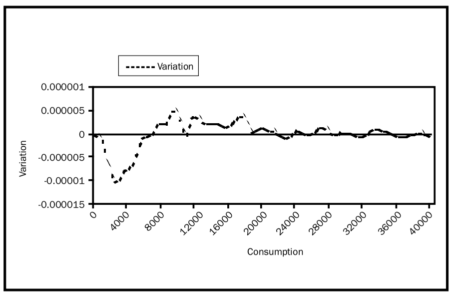


Figure 5c: Hills & Mountains Quantile Curves

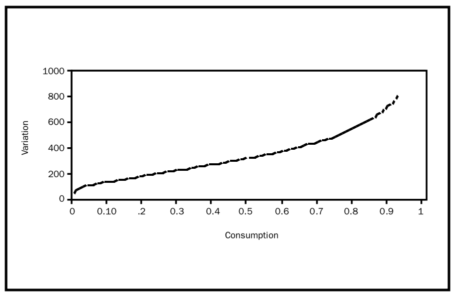
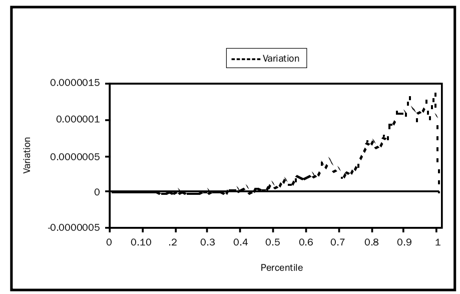


Figure 6c: Hills & Mountains Lorenz Curve



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Tariff Reduction, Fiscal Adjustment and Poverty in Pakistan: A CGE-Based Analysis[1]

Rizwana Siddiqui[2]
A. R. Kemal
Rehana Siddiqui
M. Ali Kemal

Abstract

After more than four decades of protective trade policy, Pakistan undertook substantial trade liberalization beginning in the 1990s. We assess the short- and long-run impacts of trade liberalization (full and partial) on household incomes, welfare, and poverty under various fiscal scenarios. A computable general equilibrium (CGE) model of the Pakistan economy for the year 1990 is used with 10 household categories (identified by employment status in urban areas and by land holdings in rural areas), 12 production activities, and two factors of production. Our general conclusion is that trade reform improves the average welfare of urban households but reduces the welfare of rural households. In both regions, the rich generally benefit, whereas the poor lose out. The fall in urban poverty dominates the increase in rural poverty such that overall poverty is reduced.

Introduction

From independence until the 1980s, Pakistan adopted a regulated trade regime. Over the last couple of decades however, the country

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[1] We are very thankful to Véronique Robichaud, Bernard Decaluwé and John Cockburn (Université Laval, Canada) for their helpful comments. We are also thankful to Randy Spence and the International Development Research Centre (IDRC, Canada) for providing financial support.

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has been gradually liberalized. The impact of trade restrictions on prices as well as on manufacturing industries in Pakistan is well documented[3]. During the 1980s and throughout the 1990s, Pakistan implemented various stabilization and Structural Adjustment Programs (SAP) with a view to improving the level of efficiency and consequently increasing growth and employment. In the initial stages, quota restrictions were removed and protection was provided through tariffs. Later, the Government of Pakistan (GOP) focused on the rationalization of its tariff structure.

Tariff revenue had always been the major source of government revenue until trade liberalization was initiated in the 1980s. To compensate for the loss in government revenue, GOP made changes in its tax structure. A general sales tax was imposed on domestic production as well as on imports. Such policy changes affect different socio-economic groups directly and indirectly through changes in prices and real income, and hence welfare and poverty. This paper simulates the effects of trade liberalization on welfare and poverty in the presence of alternative fiscal compensatory policies. Analysis of welfare and poverty consequences of policy changes is very important for a country like Pakistan where one-third of the population still lives below the poverty line (Siddiqui and Iqbal, 2001).

It is often argued that if poor countries concentrate on the production of labor-intensive goods, in accordance with their factor endowments, then income growth and employment creation will tend to reduce poverty. In this context, by reducing anti-export bias, trade liberalization encourages labor-intensive export-oriented industries, employment, productivity, and growth, while reducing poverty (McCulloch et al., 2001). However, loss of tariff revenue is generally compensated by an increase in sales or income taxes. As a result, domestic prices rise or disposable income declines. In this scenario, welfare and poverty consequences remain inconclusive without a

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[3] For examples see Pal (1964), Alamgir (1968), Lewis and Guisinger (1968), Kemal et al (1981), Naqvi and Kemal (1991), Guisinger and Scully (1991), Kemal et al (1994).

comprehensive framework of analysis. The main question that this study addresses is '*How does revenue-neutral trade liberalization affect poverty and welfare among different socio-economic groups in Pakistan's rural and urban areas?*

The computable general equilibrium (CGE) framework is widely utilized for this kind of policy analysis in both developed and developing countries[4]. Using a CGE model of Pakistan, this study explores the impact of policy changes on resource allocation, household income and consumption by different socio-economic groups, as well as the resulting changes in poverty and welfare.

The rest of this paper is organized as follows. The next section presents an overview of trade policies in Pakistan over the liberalization period from 1985 to 2000. The main characteristics of the 1989-90 social accounting matrix (SAM) for Pakistan are discussed in the third section. The particularities of the CGE model used are explained in the fourth section. The fifth section presents simulation results, and major conclusions are presented in the final section of the study.

Overview of Economy

a. Trade Restrictions

Beginning in 1947, high tariffs and non-tariff barriers were imposed on imports to protect domestic industry, particularly newly established industries. By 1981, Pakistan's import regime had reached its most restrictive stage; 41 percent of domestic industrial value-added was protected through import bans, and another 22 percent by various forms of import restrictions (Kemal *et al*, 1994). However, in the 1990s the economy was gradually exposed to the global market through open and liberal trade policy, with the objective of making local industry efficient and competitive in the new, liberalized world economic environment.

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[4] For details, see Decaluwé et al (1999), Shoven and Whalley (1992), Srinivasan and Whalley (1986), Thorbecke and Berrian (1992), Thorbecke (1991), Takashi (1972), etc.

In the initial stages, quantitative restrictions were removed and replaced with tariffs. Later, a negative list was introduced[5]. A large number of items were removed from the negative list during the 1983-99 period. As shown in Table 1, the items on the negative list were reduced from 315 in 1983 to 128 in 1999 for the industrial sectors, and from 19 items to only 6 in agriculture[6]. Items on the list were restricted due to religious or health reasons, except for textiles, where imports were restricted for balance-of-payment reasons[7]. The value ceiling was also gradually eliminated by the year 1993.

Table 1: Indicators of protection

Sectors	Implicit Effective Rate of Protection		Negative list**	
	1990	2002	1983	1999
Wheat	-21.1	-2.5	0	0
Major Crops	1.4	-0.5	0	0
Minor Crops*	43.2	40.5	10	0
Non-Crops	28.3	0.9	9	6
Agriculture	**20.9**	**16.9**	**19**	**6**
Mining	0.0	0.0	5	0
Food	105.2	247.2	45	32
Textiles	45.7	31.3	38	59
Petroleum	2.6	36.7	1	0
Machinery*	302.9	100.8	60	7
OtherManufacturing	53.6	104.2	166	30
Industry	**46.6**	**29.3**	**315**	**128**
Other traded * **	**-16.1**	**-0.8**	**-**	**-**
Total	**42.5**	**27.4**	**334**	**134**

Source: Authors calculations based on Input Output table of 1989-90 (Pakistan, 1996) and SAM-2002 (Dorosh et al, 2004).
*These two categories are little different from the categories used in the SAM for this paper. Minor crop includes only horticulture, and machinery includes motor vehicle only.
** Indicating number of commodities that cannot be imported.
***Mainly services

[5] All goods except those on the negative list were allowed for imports.
[6] These six items include pigs and related items, opium, etc.
[7] Since 1999, even these have been removed from the negative list.

Import duties were also reduced, as were the number of duty rates. Consequently, the protection structure changed between 1991 and 2000. As can be seen in table 1, the implicit effective rate of protection (IERP) for industry went down from 42.5 percent in 1990 to 27.4 percent in 2002[8]. The table shows that IERPs have declined for the majority of sectors with the notable exception of food products, which is expected to increase poverty and reduce welfare.

b. Trade structure

Table 2 presents the evolution of the structure of Pakistan's trade. The share of agriculture exports remained small over the 1985-2000 period. Textiles represent most of the country's exports (65.3%), followed by-to a much lesser degree-food (mainly rice) and "other manufacturing" (mostly leather, carpets, and sports items). Such a high degree of export concentration has led to severe instability in exports earnings. Despite a fall in food and other manufacturing exports[9,10], the share of industrial exports increased from 73.6 percent in 1984-85 to 83.5 percent in 1999-2000. This increase was mainly driven by an increase in the share of textile exports, which went from 44.8 to 65.3 percent over the same period. The rise in the share of manufactured goods exports in total exports could be considered as a sign of successful implementation of trade liberalization efforts.

Pakistani imports are also overwhelmingly industrial in nature. The shares of agricultural and industrial imports increased between 1985 and 2000, whereas the share of service sector imports declined. The reduction in protection of the industrial sector resulted in a

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[8] The IEPR takes into account actual differentials between the domestic and the world market prices of inputs and outputs in order to correctly measure the protection enjoyed by an economic activity.

[9] Many factors were responsible for this decline, which include severe competition from China and India and recession in industrialized economies.

[10] Exports of carpets/rugs were about one-tenth of total exports in 1980 and declined to 2.3% in 1994-95.

Table 2: Structure of international trade

Sectors	Import shares				Export shares			
	1985	1990	1995	2000	1985	1990	1995	2000
Wheat	2.6	5.0	3.5	2.6	0.3	0.0	0.0	0.0
Major Crops	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1
Minor Crops	1.7	1.7	1.1	3.8	0.8	1.4	0.8	1.4
Non-Crops	0.5	0.5	0.8	0.3	1.5	1.7	0.9	1.4
Agriculture	**4.7**	**7.2**	**5.4**	**6.8**	**2.5**	**3.2**	**1.6**	**2.8**
Mining	16.2	9.0	7.6	10.0	0.5	1.0	0.6	0.8
Food	11.7	9.7	11.6	7.5	10.3	6.9	8.5	8.2
Textiles	3.0	2.6	4.4	3.1	44.8	62.2	60.3	65.3
Petroleum	6.9	9.2	9.7	18.3	1.0	0.2	0.4	0.3
Machinery	22.2	23.0	25.5	18.3	1.1	0.3	0.2	0.3
Other Manufacturing	19.4	25.3	24.4	30.5	15.9	10.4	9.0	8.7
Industry	**79.4**	**78.7**	**83.2**	**87.7**	**73.6**	**80.9**	**78.9**	**83.5**
Other Traded	15.9	14.1	11.5	5.6	23.9	15.9	19.4	13.8
Total	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**
Total value*	**3459.8**	**5160.1**	**11507.4**	**16828.1**	**1617.3**	**3769.3**	**9900.5**	**15314.1**
CAB*	**1842.6**	**1390.9**	**1606.9**	**1514.0**				

*Source: Pakistan (various issues) and State Bank of Pakistan. * Value in constant dollars at 1995 prices.*

large inflow of industrial imports. Pakistan is dependent on imports to meet its oil requirements, with an import share that registered a large increase (from 6.9 to 18.3 percent) during this period. The share of other manufacture imports also increased, from 19.4 to 30.5 percent, over the 1985-2000 period. The import share of machinery initially increased from 22 to 25 percent, but then declined to 18 percent because of a slowdown in industrial activity and a fall in the investment rate from 20.1 percent in 1992-93 to 15.6 percent in 1999-2000 (Pakistan, 2001).

c. Compensatory Measures

In 1989-90, the GOP introduced a general sales tax (GST) on both imports and domestic products. In the following years, the government broadened the GST basis and adopted a uniform rate structure of 15 percent, although on a few products the GST is as high as 20 percent. Although the removal of exemptions has widened the tax base, a large number of commodities and services are still exempted from the sales tax thus reducing the average sales tax on imports to 5.6 percent and on domestic production to 5 percent.

There have been other fiscal reforms such as a reduction in tax exemptions on dividend income in 1990-91 and, more recently, dividend income of insurance companies has been made taxable (Pakistan, 2001). Income tax rates have also been rationalized and new rates of 25, 30 and 35 percent have been introduced for higher personal incomes (Pakistan, 2001). Income tax rates on wages have been reduced by 5 to 80 percent depending on the income group. As a result, the share of tariff revenue in total government income declined over the 1985-2000 period and conversely, the shares of sales tax and direct taxes have both increased (see Figure 1 and Table 3).

Since 1981, the restructuring of taxes, tariffs, sales taxes, and income taxes has changed the structure of protection. Table 4 presents the structure of protection in 1990, which is the base year for our CGE analysis.

Figure 1. Customs duties and sales tax as percentage of government revenue

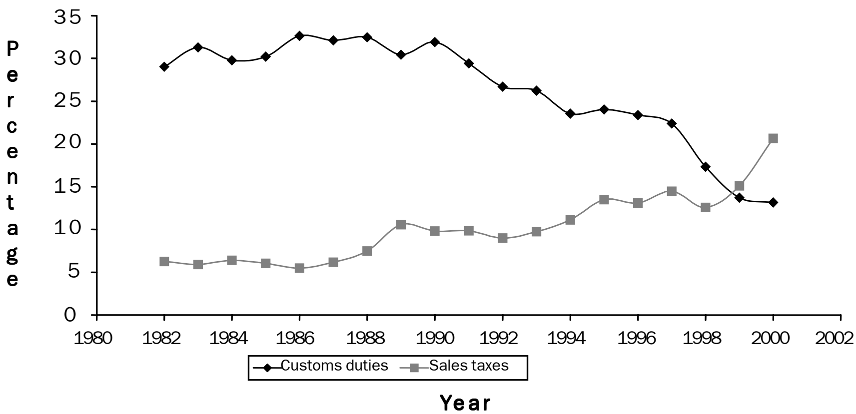

Table 3: Structure of government budget

	1984-85	1989-90	1994-95	1999-00
Tariffs	29.2	30.6	24.1	11.9
Direct taxes	12.2	9.5	19.6	21.0
Sales taxes	35.1	32.0	36.3	42.7
Other revenue	23.5	27.9	20.1	24.4
Total	100%	100%	100%	100%
Total Revenue	2594.7	4930.6	10253.8	14721.5
Total Expenditure	3786.9	6599.9	13598.9	20392.5
Public Deficit	-1192.2	-1669.3	-3345.2	-5671.0

Notes: Values in constant dollars at 1995; Source: Pakistan (various issues-b)

Table 4: Average tax rates for 1989-90

Sectors	Effective rate of protection	Effective tariffs	SalesTax
Wheat	1.5	0.0	1.0
Major Crops	1.2	18.2	0.8
Minor Crops	1.8	18.9	0.7
Non-Crops	0.3	27.7	0.0
Agriculture	1.0	6.9	0.4
Mining	28.4	2.8	29.6
Food	88.3	26.3	12.3
Textiles	11.6	26.3	1.1
Petroleum	182.9	12.1	3.2
Machinery	60.7	28.6	2.2
Other Manufacturing	38.8	31.0	3.9
Industry	54.0	25.5	6.4
Other Traded	4.1	0.0	2.7
Other Non-Traded	-	-	0.4
Services	4.1	0.0	1.6
Total	21.5	22.2	3.2

We observe that effective rates of protection were highest for petroleum and the industrial sector in general and lowest for the agriculture sector. Effective tariffs were highest for the 'other manufacturing' sector, which is mostly export-oriented. On average, effective protection and effective tariffs were the same, although the gap between the agricultural and industrial sectors is much bigger in terms of effective rates of protection. Average sales tax rates were also higher for industrial products and lower for agricultural products, although this gap was much smaller than for effective tariffs and rates of protection.

Structure of Pakistan SAM

The benchmark data for the year 1989-90 was prepared using the aggregate social accounting matrix (SAM) from Siddiqui and Iqbal (1999), and the supply and use tables (Pakistan, 1996). Household aggregation by employment status in urban areas and by landholdings in rural areas was obtained using data from the household integrated economic survey (HIES; Pakistan, 1993).

a. Production and Factor Markets

The production sector is aggregated into 12 sectors from an 82-sector input-output matrix. The agriculture sector includes wheat (main staple food)[11], major crops, minor crops, and non-crop sectors. Mining is aggregated into one sector and manufacturing sectors are aggregated into five sectors: food processing, textiles, petroleum, machinery, and other miscellaneous manufactured goods. The service sectors are grouped into other traded and non-traded services. The model includes two primary factors of production: labor and capital.

The structure of production for the year 1989-90 is presented in Table 5. The share of agriculture in total output is 21.3 percent, of which 12.1 percent are from crop sectors (wheat, major crops, and minor crops) and 9.2 percent are from the non-crop sectors (livestock, forestry and fisheries). This constitutes an important raw material source for the manufacturing sector[12]. Within the agricultural sector, the wheat and major crop sectors are relatively labor intensive, in contrast with minor crop and non-crop sectors that are capital intensive.

The industrial sector constitutes 39.5 percent of total output, although its share in GDP is only 19.5 percent, owing to its low value added share. Among industrial sectors, exportable sectors such as textiles and other manufacturing are the main contributors to GDP. Import-competing sectors like mining, petroleum, and machinery, represent a small share of GDP: 2.7, 0.1 and 2.0 percent, respectively. The textile, machinery and "other manufacturing" industries are the most labor intensive, whereas the petroleum and food processing industries are the most capital intensive. The services sector accounts for 39.2 percent of output and produces more than half of national GDP. Whereas tradable services are very capital intensive, non-tradable services are the most labor-intensive activity in Pakistan.

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[11] Rural households use it after grinding, while most urban households use flour.

[12] The agricultural sector provides raw materials for major exports, in particular cotton, rice, fisheries and leather.

Table 5: Production and factor markets (1989-90)

Sectors	Output (values)	Output(%)	Value added rate (VA/XS)	Value added (GDP, %)	Capital/VA (%)	Labor/VA (%-)	Returns to capital (%)	Returns to Labor (%)
Wheat	1,348.0	2.7	51.5	3.1	58.1	41.9	2.5	4.7
Major Crops	1,847.9	3.7	61.4	5.1	60.4	39.6	4.3	7.2
Minor Crops	2,878.1	5.7	66.0	8.5	81.4	18.7	9.6	5.7
Non-Crops	4,618.8	9.2	57.6	11.9	90.0	10.0	14.9	4.3
Agriculture	**10,692.9**	**21.3**	**59.7**	**28.7**	**78.7**	**21.3**	**31.3**	**21.8**
Mining	1,085.1	2.2	55.4	2.7	69.3	30.7	2.6	3.0
Food	5,685.0	11.3	14.0	3.6	77.4	22.6	3.9	2.9
Textiles	4,905.4	9.8	22.3	4.9	64.9	35.1	4.4	6.2
Petroleum	1,051.1	2.1	2.6	0.1	82.1	17.9	0.1	0.1
Machinery	1,790.6	3.6	25.2	2.0	65.9	34.1	1.9	2.5
Other Manufacturing	5,322.6	10.6	25.6	6.1	67.5	32.5	5.7	7.1
Industry	**19,839.9**	**39.5**	**21.9**	**19.5**	**68.8**	**31.2**	**18.6**	**21.7**
Other Traded	10,490.9	20.9	61.3	28.9	82.4	17.6	33.1	18.1
Other Non-Traded	9,211.2	18.3	55.5	23.0	53.3	46.7	17.0	38.3
Services	**19,702.1**	**39.2**	**58.6**	**51.9**	**69.5**	**30.5**	**50.1**	**56.5**
Total	**50,234.9**	**100%**	**44.32**	**100%**	**72.01%**	**27.99%**	**100%**	**100%**

Notes: Values in constant 1995 dollars.

Labor gets a larger share of its income from the service and industrial sectors than does capital, whereas capital (including land) gets a relatively higher share of its income from agriculture. Thus, capital income will be more affected by changes in output and prices in the agricultural sectors, whereas labor income will be relatively more affected by changes in the industrial and service sectors. Further analysis shows that, within the agriculture sector, labor gets the largest share of its income from the major crop sector. Among industrial sectors, both labor and capital receive the largest share of their income from the exportable textile and other manufacturing industries. The service sector provides the majority of factor income, both labor and capital. Tradable services are the major source of capital income, whereas non-tradable services contribute most to labor income. To the extent that these two service sub-sectors are affected differently by trade liberalization, this could have important consequences for the relative returns to labor and capital.

b. Income Distribution, Poverty and Inequality

The primary objective of this paper is to evaluate the impact of revenue-neutral trade liberalization on poverty in Pakistan. Urban households are aggregated by employment status of the head of household: employer, self-employed, employees, agriculture, and others. On the other hand, rural households are aggregated by landholdings (LH): no land (NL), 0 < LH £ 0.5 acres, 0.5 < LH £ 12.5 acres, 12.5 < LH £ 25 acres and greater than 25 acres, respectively. This classification of households allows the model to identify the impacts of alternative trade policies on different socioeconomic groups through changes in the demand for and returns to their factor endowments, and changes in consumer prices.

Table 6 provides information on socioeconomic characteristics of households in the base year[13]. In 1990, 30.1 percent of Pakistan's

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[13] We are thankful to Mr. Masood Ishfaq, System Analyst in the Computer Section of PIDE, for helping us in preparing HIES data.

Table 6: Income sources by household category, 1989-90*(%)

Household Categories	Population	Average income per capita per year (value in dollar)	Wage income (1)	Capital income (2)	Public transfers (3)	Firms transfers (4)	Foreign transfers (5)
Urban							
Employer	4.7	734.1	1.1	16.3	3.8	6.0	17.9
Self-Employed	27.0	376.6	3.9	49.2	4.1	9.3	53.5
Employee	47.6	248.3	80.3	6.1	27.3	27.2	22.0
Agriculture	5.2	332.5	2.4	9.1	2.2	1.2	0.3
Miscellaneous	15.5	422.0	12.3	19.2	62.6	56.4	6.3
Total	100%		100%	100%	100%	100%	100%
Total urban (value)	32.5 (30.1%)	337.0	3728.2	5040.2	77.5	1030.6	1091.0
Rural							
No Land	73.2	123.2	90.3	63.0	72.4	91.6	75.7
0-0.5	1.7	119.9	1.0	1.8	0.4	1.6	3.8
0.51-12.5	19.1	114.4	7.3	23.1	26.4	2.8	6.2
12.51-25	3.7	161.6	1.2	6.6	0.4	1.5	7.1
25 & above	2.3	221.2	0.3	5.6	0.4	2.4	7.2
Total	100%		100%	100%	100%	100%	100%
Total Rural (value)	75.5 (69.9%)	125.1	2503.8	6008.7	197.2	415.3	320.7
Firms				4985.6			
Pakistan (total)	108.4(100%)	185.5	6232.0	16034.5	274.7	1445.9	1411.7

Authors calculations based on the 1990 SAM-* Values are in constant dollars at 1995 prices.

108.4 million inhabitants were living in urban areas and 69.9 percent in rural areas. Within the urban groups, the richest households (employers) represent 4.7 percent of the urban population whereas the poorest groups (self-employed and employees) represent 74.6 percent. A similar pattern is observed in rural areas. Only 6 percent of the population is in the two richest household categories, with landholdings larger than 12.5 acres, while the poorest group of households - i.e. those with no land - represents 73.2 percent of the rural population. Average per capita income is almost three times higher, and distributed much more unequally, in urban areas, with the highest per capita income for the employer group (USD734.1) and lowest for the employees group (USD248.3). In rural areas, the highest per capita income is for the large landholders, USD 221.2, whereas the first three groups receive average per capita income of less than USD 130.

Household income comes from five sources: wages, returns to capital, and transfers from government, firms (dividends), and the rest of the world (remittances). Table 6 shows that income is very unequally distributed. The highest wage shares in urban areas are for the employee group of households, which represent 47.6 percent of urban population and yet receive only 6.1 percent of capital income. In contrast, employers, who represent 4.7 percent of urban population, receive 16.3 percent of capital income. The "miscellaneous" group receives 62.6 percent of total government transfers in urban areas, followed by the employees group (27.3 percent). The same pattern is observed for firm transfers. However, it is the self-employed group that receives the lion's share of foreign transfers.

In rural areas most income accrues from capital as this includes land, which is a crucial factor in the rural economy. Households with no land in rural areas, representing 73.2 percent of rural population, receive 90.3 percent of total rural wage income and 63.0 percent of returns to capital. Rich households with 25 acres or more of land represent only 2.3 percent of the rural population, yet receive 5.6 percent of returns to capital. Households with no land and households with between only 0.5 and 12.5 acres of land together receive 99 percent of government transfers to rural areas. The largest share of firm and foreign transfers accrue to households with no land.

c. Household Expenditure

Table 7 reveals the detailed pattern of expenditure by household group. It shows that Pakistan's private consumption was USD 18.7 billion in 1989-90. On average, households spend 32.5 percent of their consumption budget on agricultural products, 27 percent on industrial goods, and 25.5 percent on services.

Although industrial goods constitute the principal expenditure for all household groups, rural households consume a larger share of agricultural goods and a smaller share of services, in comparison to urban households. Employer households spend most on "other manufacturing", which is primarily composed of durables goods. Food and non-crop agricultural goods generally represent a higher share of expenditure among poorer household categories. In rural areas, consumption of textiles, petroleum, machinery and, especially, other manufacturing appears to increase with income.

d. Poverty and Inequality

During the pre-adjustment period, poverty was less widespread than in the post adjustment period (see Table 8). The head count ratio increased from 29.4 percent in 1990-91 to 33.7 percent in 1999-2000. The poverty gap, which represented roughly 21 percent of the poverty line in 1986-87, increased to 28 percent in 1993-94. The poverty severity index increased substantially over the same period, rising from 1.8 to 4.1. Similar patterns are observed in both urban and rural areas. Income inequality (measured by Gini coefficient) also increased from 0.35 to 0.41.

Table 7: Household consumption patterns (%, 1989-90)

Sector	Urban Households by Employment Status					Rural Households by Landholdings						
	Employer	Self-employed	Employee	Agriculture	Miscellaneous	No-Land	0-0.5 Acres	0.51-12.5 Acres	12.51-25 Acres	25 Acres and above	Total	Total Value
Wheat	0.7	1.2	0.7	1.7	1.0	5.4	4.6	4.7	6.7	4.6	3.1	586.8
Major Crops	0.0	0.3	0.2	0.5	0.2	0.8	1.6	1.5	1.0	0.4	0.6	108.5
Minor Crops	6.6	9.5	8.9	8.5	8.3	10.2	9.7	10.9	9.4	9.3	9.5	1,778.7
Non-Crops	13.5	18.7	16.4	21.5	15.9	22.0	21.4	20.2	19.5	18.0	19.2	3,597.3
Agriculture	20.8	29.7	26.1	32.2	25.4	38.4	37.4	37.2	36.6	32.2	32.5	6,071.4
Mining	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	14.8
Food	19.7	29.3	27.4	26.9	23.3	30.6	30.4	28.4	22.7	24.9	28.2	5,266.8
Textiles	3.1	4.9	4.2	4.7	4.6	4.8	4.4	6.5	5.8	7.0	4.8	895.2
Petroleum	3.3	0.9	1.7	1.2	3.3	0.5	0.3	0.3	0.5	2.7	1.2	220.2
Machinery	0.6	1.1	1.2	0.9	1.5	1.0	0.8	0.9	1.0	1.7	1.1	199.1
Other Manufacturing	20.5	6.9	6.8	4.3	6.1	5.2	6.1	6.7	15.1	10.1	6.8	1,269.8
Industry	47.2	43.2	41.3	37.9	38.8	42.2	42.0	42.8	45.2	46.4	42.0	7,865.8
Other Traded	12.4	11.8	14.0	9.0	17.2	6.9	5.7	6.4	5.8	4.8	10.1	1,886.4
Other Non-Traded	19.5	15.3	18.6	20.8	18.7	12.6	14.9	13.6	12.5	16.5	15.4	2,884.7
Services	32.0	27.1	32.6	29.8	35.8	19.5	20.6	20.0	18.3	21.4	25.5	4,771.1
Total	100	100	100	100	100	100	100	100	100	100	100	18,708.3

Note: Total values in constant dollars at 1995 prices

Table 8: Poverty and inequality for Pakistan, urban and rural areas (Basic needs approach)

(Based on income distribution)

Measure (%)	Area	Pre-adjustment			Post Adjustment		
		1984-85	1986-87	1987-88	1990-91	1993-94	1999-00
Head Count	Pakistan	24.6	28.6	29.2	29.4	35.7	33.5
	Urban	-	28.8	28.9	31.3	29.9	-
	Rural	-	28.1	30.1	29.1	37.3	-
Income Gap	Pakistan	-	20.6	21.1	26.3	27.9	-
	Urban	-	21.2	21.7	25.5	24.1	-
	Rural	-	20.2	20.1	26.1	27.5	-
Severity index	Pakistan	-	1.8	1.9	3.1	4.1	-
	Urban	-	1.9	2.0	3.2	2.8	-
	Rural	-	1.7	1.9	3.0	4.2	-
Gini Coefficient	Pakistan	0.37	0.35	0.35	0.41	0.41	

Source: Amjad and Kemal (1993), MCHD (1999), Pakistan (2001) and Social Policy Development Center (SPDC).

Model Characteristics

The computable general equilibrium model (CGEM) was built in a neo-classical framework and presents six blocks of equations; production, income and saving, demand for commodities, prices, foreign trade, and market equilibrium. The CGEM is static and focuses explicitly on income generation, income distribution and consumption patterns in order to analyse poverty and welfare outcome of policy changes. Foster-Greer-Thorbecke (FGT) Pa measures are used to measure the proportion of poor in the population (head count), as well as depth and severity of poverty. Equivalent variation (EV) captures the welfare impact in the model.

a. Elasticities

Numerical values of behavioral relationships and policy parameters as well as shift and share parameters in demand and supply equations for production, imports, and exports are generated from the SAM using calibration techniques. Elasticities for these functions are taken from various sources. Some elasticities of substitution for industrial sectors are taken from Kemal (1981) and from Malik *et al* (1989). Export demand elasticities are taken from Afzal (2000). We estimated household-specific income elasticities for each commodity by using micro data on household income and expenditure. Some elasticities for specific commodities are taken from Naqvi *et al.* (1995).

b. Closure

The Walras law holds as all markets are in equilibrium. The current account balance is exogenous to the model. We assume price-taking behavior for exports as well as for imports in the international market[14], i.e. world export prices, except for major crops and non-crops, and world import prices are exogenous to the model. The nominal exchange rate acts as the numeraire relative to which all other prices are expressed. The real exchange rate is implicit in the model and is calculated in the following way:

$$er = e * (P^w/P_d)$$

where er, e, P^W and P_d respectively represent the real exchange rate, the nominal exchange rate, world prices, and domestic prices.

To analyze the aggregate welfare gain or loss to the country, we fixed real investment and government consumption to show that an increase of household consumption is not at the expense of domestic investment or government consumption. The price indices for government consumption and investment adjust in response to a policy shock. Tariff cuts significantly reduce government revenue. For the revenue neutral analysis, direct or indirect tax rates are used as adjustment variables to keep government revenue constant. As firms' savings are fixed, the household savings rates for all households adjust uniformly to ensure balance between investment and saving.

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[14] Small open economy assumption.

The total supply of primary factors of production (labor and capital) is fixed and their rates of return adjust to maintain market equilibrium.

c. Poverty Analysis

The present study investigates the impact of trade liberalization on poverty. Using household data at the micro level, we estimated the food poverty line based on 2550 calories per adult equivalent per day. Non-food requirements are defined by taking the average expenditure on other items for households included in a range of two percentage points above and below the food poverty line. The monetary value of the basic needs poverty line is defined as follows:

$$\sum C_{hi} P_c^i = \textit{monetary value of basic need}$$

where C_{hi} is the quantity of goods required to satisfy the basic needs for good i for household h and P_c^i is the consumer price of the good i. Since prices are endogenously determined by the model, changes in prices will modify the monetary value of the poverty line (for details see Decaluwé *et al.*, 1999). Using the variation in the consumer price index (CPI) and income for every household group after a policy shock, a new poverty line and post-simulation income vector are generated at the household level (Siddiqui and Kemal, 2006).

Poverty estimates for the base year are presented in table 14. We observe that 30 percent of the population is below the poverty line in both the urban miscellaneous ("Other") and employer household groups, which can be classified as rich households. The incidence of poverty amongst self-employed and employee and agriculture households is much higher at 40.0 percent. In rural areas, 40 percent of the population lives below the poverty line in all household groups except large land holders [own more than 25 acres of land]. In this group, only 10 percent of the population is below the poverty line.

Simulation Results with Alternative Trade Policy Shocks

In this section we assess the impact of trade liberalization and different compensatory measures on poverty and welfare in the short and long runs, where capital is either sector-specific (short run) or mobile (long run) across the sectors. Four simulation experiments with alternative compensatory measures are conducted:

1. Full Trade Liberalization with Sales Tax Adjustment (Short Run)
2. Full Trade Liberalization with Income Tax Adjustment (Short Run)
3. Partial Trade Liberalization (real life scenario) with Sales tax adjustment (Short Run)
4. Third simulation is rerun for long run analysis by dropping the assumption of sector specificity of capital.

Simulation 1: Full Trade Liberalization with Sales Tax Adjustment (Short Run)

The elimination of import tariffs across the board reduces the price of imports, as shown in Table 12. The higher the initial tariff, the bigger the drop in import prices. Consequently, overall demand for imports increases relative to demand for domestically produced goods for most commodities (Table 9). Sector wise, as initial tariffs were inexistent or rather low for wheat, mining and services, and because of current account balance rigidity, a relatively small decrease in imports is observed for these three commodities. Furthermore, as wheat represents a large share of agricultural imports, reduction in its imports counterbalance the increased imports for other crops.

Industrial imports increase by 8.7 percent. Within industry(with the exception of mining) imports increase from 6.5 to 23.7 percent depending on elasticity of substitution, base year values and initial

Table 9: Effect of tariff reduction on sectoral production

Sectors		Elasticities		Sectoral share					Change in Volume											
									Simulation 1				Simulation 2				Simulation 3			
	tm%	CES	CET	Vi	Mi	Exi	Mi/Qi	EXi XSi	Mi	Di	EXi	XSi	Mi	Di	EXi	XSi	Mi	Di	EXi	XSi
Agriculture				**28.7**	**6.3**	**3.0**	**3.4**	**1.1**	**-0.3**	**-0.3**	**3.9**	**-0.3**	**1.3**	**-0.5**	**2.2**	**-0.5**	**1.2**	**-0.1**	**1.0**	**-0.1**
Wheat	0.0	1.0	1.1	3.1	4.3	0.0	15.9	0.0	-7.1	0.0	8.3	0.0	-5.9	-0.2	6.4	-0.2	-1.6	0.1	1.9	0.1
Major Crops	18.2	1.5	1.5	5.1	0.0	0.0	0.0	0.0	18.3	2.0	5.5	2.0	23.0	2.6	4.2	2.6	23.4	0.3	1.2	0.3
Minor Crops	18.9	1.1	0.8	8.5	1.5	1.2	3.0	1.7	11.0	-0.8	5.1	-0.7	13.2	-1.2	2.8	-1.1	2.3	-0.1	1.3	-0.1
Non-Crops	27.2	1.2	1.0	11.9	0.5	1.8	0.7	1.5	22.6	-1.1	3.0	-1.0	24.8	-1.4	1.9	-1.4	20.0	-0.2	0.7	-0.2
Industry				**19.5**	**85.4**	**79.6**	**24.3**	**16.3**	**8.7**	**-1.6**	**11.3**	**0.6**	**9.1**	**-1.0**	**12.6**	**1.2**	**1.7**	**0.0**	**2.2**	**0.3**
Mining	0.0	1.2	0.8	2.7	7.8	0.8	36.3	3.5	-5.5	-0.4	5.5	-0.2	-3.8	-0.8	3.5	-0.7	2.9	1.0	0.8	1.0
Food	26.3	1.2	1.0	3.6	8.8	7.0	9.7	5.3	18.6	-2.2	5.4	-1.8	18.7	-1.8	6.0	-1.4	2.6	-0.4	1.2	-0.3
Textiles	26.3	1.3	1.0	4.9	1.7	52.1	3.4	41.1	23.7	3.8	14.5	8.3	24.0	4.8	16.4	9.7	7.2	0.6	2.9	1.5
Petroleum	12.1	1.3	1.5	0.1	6.0	0.1	25.6	0.4	6.5	-2.8	3.9	-2.8	5.5	-2.1	6.6	-2.0	-13.0	4.7	3.7	4.7
Machinery	28.6	1.0	1.0	2.0	37.5	0.4	55.9	0.8	7.6	-4.3	10.1	-4.1	8.0	-3.7	11.0	-3.6	4.3	-2.3	2.7	-2.2
Other Manufacturing	31.0	0.8	0.8	6.1	23.6	19.3	24.0	14.4	10.9	-3.2	5.0	-1.9	11.3	-2.8	5.4	-1.6	0.3	-0.4	0.9	-0.2
Services				**51.9**	**8.3**	**6.5**	**2.5**	**6.5**	**-7.7**	**-0.4**	**7.5**	**-0.2**	**-6.7**	**-0.5**	**6.1**	**-0.2**	**-2.1**	**-0.1**	**1.8**	**0.0**
Traded Sector	0.0	0.8	0.9	28.9	8.3	17.4	4.9	6.5	-7.7	-0.8	7.5	-0.2	-6.7	-0.9	6.1	-0.4	-2.1	-0.3	1.8	-0.2
Non-Traded Sector	-	-	-	23.0	-	-	-	-	0.0	-0.1	0.0	-0.1	-	-	-	-0.1	0.0	0.1	0.0	0.1
Total*	**0.2**			**100.0**	**100.0**	**100.0**	**11.6**	**100.0**	**6.8**	**-0.8**	**10.4**	**0.1**	**7.3**	**-0.7**	**11.2**	**0.3**	**1.4**	**-0.1**	**2.1**	**0.1**

tariff rates, and import penetration rates. Therefore, although the import price falls a lot for sectors like machinery and other manufacturing, the low elasticity prevents the imports from growing proportionally.

Given that current account balance is fixed, a rise in imports leads to a real exchange rate depreciation to generate an equivalent increase in exports. Overall, impact on sectoral output will depend on what impact is dominant: the decrease of local production following the switch to cheaper imports or the increase of exports led by the real exchange rate depreciation. Because the textile sector is the most oriented towards exports, it is not surprising that this sector benefits the most from the export expansion and sees its overall production rise by 8.3 percent Similar analysis can be done for the major crops sector although part of the production push is led by increased demand from textiles, which uses major crops goods in its production processes. For all other sectors, the import effect dominates the export push and thus, total output decreases. On the overall, total production for Pakistan slightly increases (0.1%).

Finally, sectors with very low/zero tariffs in the base year and small import penetration ratios, like wheat and other traded sectors, witness a decline in their imports and output as consumers shift to relatively cheaper goods from the industry or agriculture sectors. Decreased imports can also be explained by the current account constraint, as discussed above. The overall impact shown in table 9 is that demand for domestically produced goods drops, resulting in decreased domestic prices. As discussed previously, production drops in all sectors except for the major crops and textiles sectors, resulting in a movement of labor toward these two sectors, which are relatively more labor intensive and away from all other sectors (Table 10).

Table 10. Effects on factor demand and remuneration

Sectors returns	K/L ratio	Simulation 1				Simulation 2				Simulation 3			
		Value added	Labor	Wage	Capital returns	Value added	Labor	Wage	Capital returns	Value added	Labor	Wage	Capital returns
Agriculture	**0.6**	**-0.3**	**-0.4**	**-6.4**	**-7.2**	**-0.5**	**-0.7**	**-2.2**	**-3.6**	**-0.1**	**-0.1**	**-1.7**	**-1.9**
Wheat	0.4	0.0	0.0	-6.4	-6.4	-0.2	-0.3	-2.2	-2.6	0.1	0.1	-1.7	-1.6
Major Crops	0.4	2.0	2.9	-6.4	-3.4	2.6	3.7	-2.2	1.8	0.3	0.4	-1.7	-1.3
Minor Crops	0.7	-0.7	-1.1	-6.4	-7.5	-1.1	-1.8	-2.2	-4.2	-0.1	-0.1	-1.7	-1.8
Non-Crops	0.8	-1.0	-1.8	-6.4	-8.2	-1.4	-2.5	-2.2	-4.9	-0.2	-0.4	-1.7	-2.1
Industry	**2.2**	**0.7**	**2.6**	**-6.4**	**-9.5**	**1.2**	**4.3**	**-2.2**	**-4.4**	**0.2**	**0.7**	**-1.7**	**-1.8**
Mining	2.3	-0.2	-0.5	-6.4	-6.9	-0.7	-2.1	-2.2	-4.5	1.0	3.1	-1.7	1.7
Food	3.4	-1.8	-7.6	-6.4	-15.2	-1.4	-5.9	-2.2	-9.4	-0.3	-1.4	-1.7	-3.4
Textiles	1.8	8.3	24.4	-6.4	2.7	9.7	28.5	-2.2	8.7	1.5	4.4	-1.7	0.1
Petroleum	4.6	-2.8	-14.1	-6.4	-24.6	-2.0	-10.6	-2.2	-16.7	4.7	30.6	-1.7	43.9
Machinery	1.9	-4.1	-11.6	-6.4	-18.4	-3.6	-10.1	-2.2	-13.1	-2.2	-6.4	-1.7	-8.7
Other mfg.	2.1	-1.9	-5.8	-6.4	-13.1	-1.6	-4.7	-2.2	-8.0	-0.2	-0.6	-1.7	-2.5
Services	**2.3**	**-0.2**	**-0.5**	**-6.4**	**-7.6**	**-0.3**	**-0.8**	**-2.2**	**-4.3**	**-0.1**	**-0.2**	**-1.7**	**-2.5**
Other Traded	4.7	-0.2	-1.4	-6.4	-8.2	-0.4	-2.2	-2.2	-5.3	-0.2	-0.9	-1.7	-2.9
Other Non-traded	1.1	-0.1	-0.1	-6.4	-6.5	-0.1	-0.2	-2.2	-2.4	0.1	0.2	-1.7	-1.5
Total*	**1.5**	**0.0**	**0.0**	**-6.4**	**-8.0**	**0.0**	**0.0**	**-2.2**	**-4.2**	**0.0**	**0.0**	**-1.7**	**-2.2**

The results shown in table 10 are consistent with the expectation that returns to mobile factors (labor) are less affected than the returns to sector-specific capital. Average returns to capital decline more than average wage rates (-8.0 percent and -6.4 percent, respectively). However, the variations in sectoral returns to capital differ according to the change in its output price, capital to labor ratio and elasticity of substitution between these two factors of production. Table 10 shows that returns to capital fell most in import competing sectors, i.e., petroleum and machinery.

The decline in factor remuneration translates into a decline in factor income for all households. As each household receives a fixed share of total labor income, all households will see income from labor fall by 6.4 percent. The same story can be told for capital income, which falls by 8.0 percent for all households. However, given that endowments in capital and labor vary across household categories, and given that they may rely on other stable sources of income (public transfers, dividend and remittances) the overall impact on income will vary accordingly (Table 13).

Among urban households, the agriculture and other households suffer a relatively larger decrease in their income at 7.7 and 7.3 percent, respectively. In rural areas, relatively richer households, i.e. with greater than one half acre of land, see their income fall the most. These results indicate that income distribution deteriorates in urban areas and improves in rural areas. Overall, and contrary to our expectations, trade liberalization is slightly pro-urban in terms of income effects. The main reason is that urban households rely more on labor income than their rural counterparts whose revenues are more dependant on return to capital (land) and that urban households benefit more from the export push.

As income tax rates did not vary, table 12 shows total income taxes and disposable income decline in the exact same proportions. In terms of consumption budget, this decline in income is partially offset by a reduction in savings among the relatively rich households, whose savings rate adjusts to keep the balance between

Table 12. Effects on prices (percentage-changes)

Sectors	Simulation 1				Simulation 2				Simulation 3			
	Pm	PDi	Pi	PC	Pm	PDi	Pi	PC	Pm	PDi	Pi	PC
Agriculture	**-6.4**	**-6.7**	**-6.6**	**-4.2**	**-6.4**	**-4.8**	**-4.8**	**-4.9**	**-2.6**	**-1.6**	**-1.6**	**-1.1**
Wheat	0.0	-7.0	-7.0	-3.4	0.0	-5.7	-5.7	-4.8	0.0	-1.6	-1.6	-0.8
Major Crops	-15.4	-6.6	-6.6	-4.1	-15.4	-4.5	-4.5	-4.5	-14.4	-1.6	-1.6	-1.0
Minor Crops	-15.9	-6.9	-6.8	-4.8	-15.9	-4.8	-4.7	-5.2	-3.8	-1.7	-1.7	-1.2
Non-Crops	-21.7	-6.4	-6.3	-4.0	-21.7	-4.7	-4.7	-4.9	-15.6	-1.6	-1.6	-1.1
Industry	**-20.1**	**-8.6**	**-7.2**	**-9.6**	**-20.1**	**-8.7**	**-7.3**	**-12.1**	**-5.0**	**-1.8**	**-1.5**	**-2.1**
Mining	-2.7	-6.9	-6.6	-2.8	-2.7	-5.2	-5.0	-4.3	-1.4	0.2	0.2	0.2
Food	-20.8	-7.0	-6.7	-6.4	-20.8	-7.3	-6.9	-9.0	-4.0	-1.6	-1.5	-1.3
Textiles	-20.8	-9.3	-5.4	-7.4	-20.8	-9.9	-5.7	-10.3	-6.9	-2.2	-1.3	-1.8
Petroleum	-10.8	-4.3	-4.3	-3.7	-10.8	-5.5	-5.5	-7.0	16.1	0.7	0.7	5.3
Machinery	-22.2	-12.8	-12.7	-16.6	-22.2	-13.0	-12.9	-18.8	-10.7	-4.8	-4.8	-7.9
Other mfg	-23.7	-9.6	-8.2	-11.6	-23.7	-9.6	-8.2	-13.9	-2.4	-1.6	-1.3	-1.2
Services	**0.0**	**-7.9**	**-7.6**	**-5.2**	**0.0**	**-6.5**	**-6.3**	**-6.4**	**0.0**	**-2.0**	**-1.9**	**-1.4**
Other Traded	0.0	-8.6	-8.0	-5.7	0.0	-7.3	-6.8	-6.9	0.0	-2.2	-2.1	-1.5
Other Non-Traded	0.0	-7.2	-7.2	-4.7	0.0	0.0	-5.7	-5.7	0.0	-1.7	-1.7	-1.1
Total	**-18.0**	**-7.9**	**-7.2**	**-6.9**	**-18.0**	**-6.9**	**-6.3**	**-8.5**	**-4.6**	**-1.8**	**-1.7**	**-1.6**

savings and investment. Resultantly, consumption budget declines less for richer households than for poorer households, whose savings were negative in the base period and remained fixed after the shock.

In order to assess the impact on welfare and poverty, we must now determine how the policies have affected prices. We have seen that the reduction in tariffs had a negative impact on prices. However, in order to maintain the government's budget in equilibrium, a compensatory sales tax was put in place, which has the opposite impact on prices. The net effect is a reduction in all consumer prices as can be seen in table 12. The importance of the price fall is mostly linked to the share of imports in total consumption. Hence, as imports of mining, petroleum, machinery and other manufacturing sectors account for relatively large shares in total consumption (table 9), it is thus not surprising to see the consumer prices of machinery and other manufacturing products decline by 16.6 percent and 11.6 percent, respectively.

Given that the size of the impact differs from one good to another, the consumption pattern will determine how each household is affected differently. The decline in consumer prices of machinery and other manufacturing products benefits more those households that spend a relatively larger percentage of their incomes on those goods. In both urban and rural areas, richer households, i.e. employers, miscellaneous household groups, and large land holders, purchase more of these goods.

Therefore, although the consumer price index (CPI) declines for all households, in both rural and urban areas it drops more for the richer households than for their poorer counterparts (Table 13).

Welfare effects, as measured by equivalent variations, depend on the combination of both the income and consumer effects mentioned above. Overall, welfare effects are positive for rich households and negative for poor households in both rural and urban areas (Table 13). In urban areas, welfare improves by 5.6 percent and 4.0 percent for the employer and self-employed households, respectively. In rural areas, the welfare of large landholders improves by 0.3 percent and 0.7 percent, respectively. Conversely, the welfare of agriculture household groups decreases in urban areas by 1.0 percent. A comparison of welfare between rural and urban areas shows that welfare improves by 1.5 percent for urban households, while it decreases by 0.7 percent for rural households. Overall, the country is better off than in the base year by 0.4 percent.

FGT Indices of poverty are presented in table 14. The results show that trade liberalization reduces poverty by all measures in all urban households except agriculture household groups, for which the poverty gap and the severity of poverty increase. In aggregate, poverty falls in urban areas by all measures. On the other hand, in rural areas, poverty increases among the relatively poorer households and decreases for richer households. In aggregate, the headcount index increases by 1.7 percent in rural households. However, the positive impact on urban poverty dominates and poverty decreases by all measures in Pakistan as a whole.

Simulation 2: Full Trade Liberalization with Income Tax Adjustment (Short Run)

In this simulation, tariffs are eliminated and the reduction in government revenue is compensated by an increase in direct taxes, i.e. income taxes. As previously, a decrease in tariffs results in a decline in import prices thus stimulating demand for imported goods, which is detrimental to domestically produced goods. These changes are similar to the ones observed for the previous simulation, although inflow of imports increases slightly more in the present case across almost all sectors. This import competition leads to a reduction in

Table 13. Change in income, prices and equivalent variation

Change in income by Source	Rural Households by Land Holdings					Urban Households by Employment Status							
	No Land	0.01 - 0.5 acres	0.51 - 12.5	12.51 - 25	25 and Above	Rural	Employer	Self Employed	Employee	Agriculture	Other	Urban	Pakistan
Simulation 1													
Household Income	-6.6	-6.8	-7.5	-7.3	-7.4	-6.8	-6.5	-6.5	-6.2	-7.7	-7.3	-6.6	-6.7
Disposable Income	-6.6	-6.8	-7.5	-7.3	-7.4	-6.8	-6.5	-6.5	-6.2	-7.7	-7.3	-6.6	-6.7
Savings	0.0	0.0	0.0	-14.9	-14.9	-11.0	-14.1	-14.1	0.0	-15.2	-14.9	-17.3	-20.8
Net Income	-6.3	-6.3	-7.4	-6.0	-5.4	-6.4	-1.4	-2.1	-5.7	-6.5	-5.3	-4.5	-5.5
Consumption	-6.3	-6.3	-7.4	-6.0	-5.4	-6.4	-1.4	-2.1	-5.7	-6.5	-5.3	-4.5	-5.5
Consumer Price Index	-5.7	-5.7	-5.8	-6.2	-6.1	-5.7	-6.6	-5.9	-5.9	-5.6	-5.8	-5.9	-5.8
Equivalent Variation	-0.6	-0.7	-1.7	0.3	0.7	-0.7	5.6	4.0	0.3	-1.0	0.6	1.5	0.4
Change in CPI agriculture	-	-	-	-	-	-4.1	-	-	-	-	-	-4.2	-4.2
Change in CPI industry	-	-	-	-	-	-7.5	-	-	-	-	-	-7.6	-7.5
Change in CPI services	-	-	-	-	-	-5.0	-	-	-	-	-	-5.1	-5.1
Simulation 2													
Household Income	-2.8	-3.2	-3.8	-3.7	-3.9	-3.1	-3.4	-3.4	-2.4	-3.9	-3.7	-3.1	-3.1
Disposable Income	-8.9	-9.3	-9.8	-9.7	-9.9	-9.1	-9.4	-9.4	-8.5	-9.9	-9.7	-9.2	-9.2
Direct Tax (value)	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
Savings	0.0	0.0	0.0	-22.9	-23.1	-17.0	-22.7	-22.7	0.0	-23.1	-22.9	-27.4	-33.0
Consumption	-8.5	-8.7	-9.7	-7.4	-6.4	-8.6	-0.6	-1.8	-7.8	-7.9	-6.1	-5.6	-7.1
Consumer Price Index	-7.3	-7.3	-7.4	-7.9	-7.8	-7.4	-8.3	-7.6	-7.5	-7.2	-7.5	-7.6	-7.5
Equivalent Variation	-1.2	-1.5	-2.5	0.6	1.5	-1.3	8.5	6.2	-0.2	-0.8	1.5	2.2	0.4
Change in CPI agriculture	-	-	-	-	-	-5.0	-	-	-	-	-	-5.0	-5.0
Change in CPI industry	-	-	-	-	-	-10.1	-	-	-	-	-	-10.2	-10.0
Change in CPI services	-	-	-	-	-	-6.1	-	-	-	-	-	-6.2	-6.2

Simulation 3 Household Income	-1.8	-1.9	-2.1	-2.0	-2.0	-1.9	-1.8	-1.8	-1.7	-2.1	-2.0	-1.8	-1.8
Disposable Income	-1.8	-1.9	-2.1	-2.0	-2.0	-1.9	-1.8	-1.8	-1.7	-2.1	-2.0	-1.8	-1.8
Savings	0	0	0	-6.9	-6.9	-5.1	-6.7	-6.7	0	-7	-6.9	-8.2	-9.8
Consumption	-1.7	-1.7	-2.0	-1.0	-0.6	-1.7	1.8	1.3	-1.5	-1.3	-0.5	-0.4	-1.1
Consumer Price Index	-1.3	-1.2	-1.3	-1.3	-1.2	-1.3	-1.1	-1.3	-1.2	-1.2	-1.2	-1.2	-1.2
Equivalent Variation	-0.5	-0.5	-0.8	0.2	0.5	-1.0	2.9	2.6	-0.3	-0.1	0.6	5.8	4.8
Change in CPI agriculture	-	-	-	-	-	-1.1	-	-	-	-	-	-1.1	-1.1
Change in CPI industry	-	-	-	-	-	-1.4	-	-	-	-	-	-1.2	-1.3
Change in CPI services	-	-	-	-	-	-1.3	-	-	-	-	-	-1.3	-1.3

Table 14. Effects of tariff reduction on poverty

	Base Year			Simulation 1			Simulation 2			Simulation 3			Simulation 4		
	P0	P1	P2	P0	P1	P2	P0	P1	P2	P0	P1	P2	P0	P1	P2
Urban	**0.4**	**0.1**	**0.0**	**-3.4**	**-4.6**	**-5.7**	**-4.5**	**-6.3**	**-7.6**	**-1.8**	**-2.4**	**-2.9**	**-1.5**	**-2.4**	**-2.9**
Employer	0.3	0.1	0.0	-10.2	-14.2	-17.7	-10.2	-21.8	-26.6	-10.2	-9.3	-11.6	-10.2	-9.7	-12.0
Self-Employed	0.4	0.1	0.0	-9.2	-12.3	-15.4	-14.9	-18.5	-23.0	-5.9	-7.9	-9.9	-5.9	-8.3	-10.4
Employee	0.4	0.1	0.0	-0.3	-0.9	-1.0	0.9	0.7	0.8	1.1	0.9	1.1	1.7	1.3	1.6
Agriculture	0.4	0.1	0.0	0.0	2.9	3.3	0.0	1.5	1.7	0.0	0.5	0.5	0.0	-0.4	-0.5
Other	0.3	0.1	0.0	-2.3	-2.6	-3.5	-2.8	-6.2	-8.3	-2.3	-2.7	-3.7	-2.3	-3.0	-4.2
Rural	**0.4**	**0.1**	**0.0**	**1.7**	**2.8**	**3.2**	**3.5**	**5.0**	**5.8**	**0.9**	**1.5**	**1.8**	**0.9**	**1.7**	**2.1**
No-Land	0.4	0.1	0.0	1.1	2.1	2.5	2.5	4.2	5.1	0.5	1.4	1.7	1.0	1.7	2.1
>0-0.05 Acres	0.4	0.1	0.0	0.0	3.5	4.4	3.0	7.8	9.8	0.0	2.2	2.7	0.0	2.3	2.9
0.051-12.5 Acres	0.4	0.1	0.0	-0.3	-0.9	-1.0	0.9	0.7	0.8	1.1	0.9	1.1	1.7	1.3	1.6
12.51-25 Acres	0.4	0.1	0.0	0.0	2.9	3.3	0.0	1.5	1.7	0.0	0.5	0.5	0.0	-0.4	-0.5
>25 Acres	0.1	0.1	0.0	-10.5	-2.0	-2.3	-10.5	-6.0	-7.3	-10.5	-4.0	-4.9	-10.5	-4.7	-5.7
Pakistan	**0.4**	**0.1**	**0.0**	**-0.5**	**-0.6**	**-0.9**	**0.1**	**-0.1**	**-0.4**	**-0.2**	**-0.2**	**-0.3**	**-0.1**	**-0.1**	**-0.2**

Note : Po= Headcount index, P1= Poverty gap, P2 = Severity of Poverty (squared poverty gap) domestic sales, a reorientation of domestic production toward export markets and an overall slight increase in production that also mirrors the first simulation.

As in the first simulation, there is a decline in the wage rate and returns to capital (Table 10). However, these declines, of 2.2 and 4.2 percent respectively, are less than in the previous exercise, as total production increases more (0.3 vs. 0.1 percent). The income tax rate increases by 6 percent for all households to compensate lost tariff revenue. As a result, and despite a lesser fall in nominal income, disposable income declines more than it did in the previous scenario. However, the impact on the consumption budget is partly compensated for richer households by a decrease in savings.

In this simulation, as there is no increase in the sales tax, consumer prices decline more than in the previous exercise. As before, consumer prices decline more in the industry and services sectors than in agriculture (Table 12). This mostly benefits the urban households as they spend a larger share of their income on industrial goods and services. Among urban and rural households, the consumer price reductions benefit richer groups as they spend a larger share of their income on industrial goods.

The net effect of changes in income and prices will determine the ultimate impact on welfare. Overall, welfare in Pakistan increases slightly (0.4 percent), as in the first simulation. However, this increase is even more unequally distributed. Urban household welfare increases by 2.2 percent (vs. 1.5 percent in the first simulation), while rural household welfare decreases by 1.3 percent (vs. 0.7 percent). Within urban areas, the employer and self-employed groups are better off with welfare increases of 8.5 and 6.2 percent, respectively (Table 13). To a lesser extent, welfare also improves for other urban households (1.5). In rural areas, welfare improves for large landholders (owners of 12.5 acres and more) by 0.6 and 1.5 percent, respectively. All other poorer household groups face a decline in welfare. From this analysis we can conclude that an income tax worsens the distributional effects of trade liberalization, although part of the positive impact on richer households is brought about by the decline in savings.

In this simulation, the number of people below the poverty line increases by 0.9 percent in the employee household group, a major tax paying group, and decreases or remains constant for all other types of households in urban areas. The other two indicators of poverty, gap and severity indices, rise in the case of employees and agriculture households, and decline in the case of all other households. Overall, the positive impacts for certain households exceed that of others and therefore we observe a decline in poverty for urban households as a whole. However, in rural areas, there is a significant rise in poverty by all measures and for all households but one. The only household to gain in rural areas is the largest land holders. In this case, the negative impact of poverty dominates and poverty rises by all measures in the rural area as a whole.

Overall results show that the percentage of the population below the poverty line increases in Pakistan. However, the other two measures of poverty - the poverty gap and severity indices – decline. This indicates that, while there are more poor in numbers, the depth and severity of their poverty has fallen [Table 14]. A comparison of the results of simulation 1 and 2 indicate that poverty declines more in urban areas and rises more in rural areas in this exercise.

Simulation 3: Partial Trade Liberalization with Sales Tax Adjustment (Short Run: Realistic Scenario)

Over the 1990-98 period, tariffs in Pakistan were reduced for all imports except for petroleum. Table 15 shows that the maximum tariff reductions occur in the major crops and non-crops sectors (93 percent and 72 percent), followed by mining and machinery (50 percent and 48 percent, respectively). However, tariffs increased for imports of petroleum by almost 150 percent. Therefore, import prices decline, leading to increased imports of all goods other than petroleum. In this particular case, the increase in the import price of petroleum stimulates the demand for domestic petroleum as consumers shift from imported petroleum to domestic petroleum. Sectors with high import substitution elasticity and/or large penetration ratios show larger declines in import prices and large increases in imports (Table 9). On the other hand, sectors with very low/zero tariffs, like wheat and other traded sectors, have shown a significant decline in their imports.

Tariff reduction changes the price of imports as well as the prices of domestically produced goods. In addition to an increased domestic output for the major crops and textiles sectors observed in previous scenarios, petroleum production also increases. Mobile factors consequently move towards these three sectors and return to capital rises in textiles and petroleum. On average, return to capital and wages declines relatively less in this exercise than they did in scenario 1 (Table 10). Consequently, income falls less for all households (Table 11).

Likewise, as tariff reductions are lower than in the previous experiment, consumer price indexes fall by a smaller percentage for all households (Table 13). Here again, the price decrease is more important for richer household groups in urban and rural areas. Overall, the income effect dominates the consumer prices effect in rural areas where welfare decreases by 1.0 percent for rural households, and the opposite happens in urban areas where welfare increases by 5.8 percent. As a whole, the country witnesses a slight improvement in its welfare (4.8 percent).

In this exercise of partial trade liberalization with sales tax adjustment, poverty impacts mimic the ones for scenario 1 but to a smaller degree except for the employee group where poverty increases. Therefore, on the overall, poverty falls less in this scenario than it did in the first one. In rural areas, as discussed previously, the richest households benefit the most from trade liberalization as they consume more industrial products and as their savings fell. For all other rural households, poverty rises by all measures. Overall, poverty rises in rural areas. Overall results show that an impact on poverty in urban areas dominates, and that poverty declines by all measures in Pakistan as a whole, as it did in scenario 1.

Simulation 4: Partial Trade Liberalization with Sales Tax Adjustment (Long Run)

In this experiment, we assume that capital is mobile across the sectors. Tariffs are reduced as in the previous exercise. The results are presented in tables 15 and 16.

A comparison of long run impacts of policy shocks with the results of respective shocks in the short run shows that an inflow of imports (where it increases) is larger in the long run and the decline is smaller (where it declines). Due to a larger inflow of imports, demand for domestically produced goods fell more than in the short run. Hence, production in all sectors fell by a larger percentage in the long run. Similarly, production in major crops, textiles and petroleum rises by a larger percentage compared to the short run increase (Table 15). In aggregate, exports increase more in the long run.

The results indicate that intensity of the adverse impacts decreases in the long run. In this exercise, reallocation of labor and capital leads to a smaller decline in wage rates and returns to capital than in the short run. Consequently negative impacts on nominal income are less than in the short run for all households.

A comparison of welfare gains and losses unveils the differences in the short and the long run impacts. In the long run, welfare loss/gain is larger in rural/urban areas. However, in both rural and urban areas relatively rich households gain while poor households lose. All three poverty ‘Pa’ measures presented in Table 14 show that poverty declines by all measures in urban areas despite a rise in poverty among employees and agriculture households in the long run. This contrasts with rural poverty, which rises by all measures among relatively poorer household groups and declines among richer households. Overall results indicate that trade liberalization reduces poverty by all measures in Pakistan in the short run as well as in the long run.

Table 15: Effect of Tariff reduction on macro variables in long run

	Base			Tariff Reduction	Simulation Results											
	Ki/Li	WLi/wL	riKi/rK		M	D	Ex	XS	PD	P	VA	w	R	Sales tax	PM	Pc
Agriculture	0.6	44.3	18.6		1.4	0.0	0.8	0.0	-1.4	-1.4	0.0	-1.5	-1.6	0.6	-2.6	-0.8
Wheat	0.4	5.6	1.5	0	-1.5	0.0	1.5	0.0	-1.4	-1.4	0.0	-1.5	-1.6	0.6	0.0	-0.6
Major Crops	0.4	9.1	2.5	93.3	23.9	0.5	1.2	0.5	-1.5	-1.5	0.5	-1.5	-1.6	0.6	-14.4	-0.9
Minor Crops	0.7	12.9	5.7	24.0	2.6	-0.1	1.1	-0.1	-1.4	-1.4	-0.1	-1.5	-1.6	0.6	-3.8	-0.9
Non-Crops	0.8	16.7	8.8	72.0	20.5	-0.2	0.6	-0.2	-1.3	-1.2	-0.2	-1.5	-1.6	0.6	-15.6	-0.8
Industry	2.2	15.5	22.1		1.9	0.0	2.8	0.4	-1.6	-1.4	0.3	-1.5	-1.6	0.6	-5.0	-2.0
Mining	2.3	2.1	3.1	50.0	1.9	2.0	3.2	2.0	-1.4	-1.4	2.0	-1.5	-1.6	0.6	-1.4	-0.8
Food Consumer	3.4	2.1	4.6	19.0	3.1	-0.5	0.5	-0.5	-1.0	-1.0	-0.5	-1.5	-1.6	0.6	-4.0	-0.8
Textiles	1.8	4.4	5.2	33.0	7.2	1.1	3.9	2.3	-2.6	-1.5	2.3	-1.5	-1.6	0.6	-6.9	-2.2
Petroleum	4.6	0.1	0.2	(149.0)*	-14.1	5.4	6.6	5.4	-0.8	-0.8	5.4	-1.5	-1.6	0.6	16.1	4.2
Machinery	1.9	1.8	2.2	48.0	4.8	-3.4	-0.1	-3.4	-3.3	-3.3	-3.4	-1.5	-1.6	0.6	-10.7	-7.4
Other Mfg.	2.1	5.1	6.8	100	0.4	-0.5	0.6	-0.3	-1.3	-1.1	-0.3	-1.5	-1.6	0.6	-2.4	-1.0
Services	2.3	40.2	59.4	0	-1.5	-0.1	0.9	-0.1	-1.5	-1.5	-0.1	-1.5	-1.6	0.6	0.0	-0.9
Other trade sector	4.7	12.9	39.2	0	-1.5	-0.4	0.9	-0.3	-1.5	-1.4	-0.3	-1.5	-1.6	0.6	0.0	-0.8
Non-trade sector	1.1	27.3	20.1		0.0	0.1	0.0	0.1	-1.6	-1.6	0.1	-1.5	-1.6	0.6	0.0	-1.0
ALL	1.5	100.0	100.0		1.5	-0.1	2.4	0.1	-1.5	-1.4	0.0	-1.5	-1.6	0.6	-4.6	-1.4

*Figure in the bracket show increase

Table 16 Change in Households income by source

Change in Households Receipts From	Rural Households by Land Holdings						Urban Households by Employment Status						
	No Land	0.01 - 0.5 acres	0.51 - 12.5	12.51 - 25	25 and Above	All Rural	Employer	Self Employed	Employee	Agriculture	Other	All Urban	Pakistan
Labor	-0.03	-0.07	0.06	0.01	0.00	-0.01	-0.19	-0.19	-0.08	0.08	0.03	-0.10	-0.06
Capital	-0.14	-0.17	-0.05	-0.10	-0.11	-0.12	-0.30	-0.30	-0.19	-0.03	-0.08	-0.21	-0.17
Remittances	1.54	1.50	1.63	1.58	1.57	1.56	1.38	1.37	1.48	1.65	1.59	1.47	1.51
Other Income	-0.07	-0.15	0.14	-0.07	-0.09	-0.04	-0.29	-0.29	-0.17	0.00	-0.07	-0.19	-0.13
Direct Tax rate	-1.5	-1.5	-1.6	-1.6	-1.5	-1.5	-1.4	-1.4	-1.5	-1.6	-1.6	-1.5	-1.5
Disposable Income	-1.52	-1.48	-1.60	-1.55	-1.54	-1.53	-1.36	-1.35	-1.46	-1.62	-1.57	-1.45	-1.49
Savings	0.0	0.0	0.0	-6.9	-6.9	5.1	-6.7	-6.7	0.0	-7.0	-6.9	-8.2	-9.8
Consumption	-1.45	-1.38	-1.59	-0.58	-0.14	-1.39	2.23	1.72	-1.33	-0.82	-0.12	-0.12	-0.77
Consumer Price Index	-0.95	-0.95	-0.99	-0.99	-0.94	-0.96	-0.82	-0.95	-0.92	-0.93	-0.86	-0.91	-0.94
Welfare	-0.50	-0.44	-0.60	0.41	0.81	-0.44	3.07	2.70	-0.41	0.11	0.76	0.80	0.17

Conclusion

Like many developing countries facing persistent budget deficits and balance of payments crises, Pakistan opted for a structural adjustment program in the 1980s. The analysis of these policies is very important as one-third of Pakistanis still live below the poverty line. Using a calibrated general equilibrium model of the Pakistan economy, with ten types of households identified by employment status in urban areas and land holdings in rural areas, as well as twelve production activities with two factors of production, this paper assesses the short- and long-term impacts of partial and full trade liberalization - with sales and income tax adjustments as alternative compensatory measures -on poverty and welfare of households in Pakistan's urban and rural areas. It uses benchmark data from a Social Accounting Matrix for the year 1989-90.

The results of the simulation exercises show that trade liberalization leads to a decrease in import prices that generates a decline in consumer prices and household income. The impact of trade liberalization policies and compensatory measures on consumption and prices translate into impacts on the welfare of households. Trade reforms improve average welfare of urban households but deteriorate the welfare of rural households. Within urban and rural areas, the rich benefit and the poor lose. The same pattern can be found using poverty estimates. Poverty decreases in urban areas and increases in rural areas by all measures with full liberalization. However, a positive impact of poverty decline dominates and poverty decreases by all measures in Pakistan in the short run as well as in the long run. We conclude that trade liberalization is pro-rich in both urban and rural areas. However, trade liberalization with direct tax (income tax) adjustment increases poverty using the head count ratio but reduces the gap and severity, which is expected as income tax has a direct effect on poverty and income distribution. From the results, we recommend that the government adopt such compensatory measures which would neutralize the negative impact of liberalization on the poor such as taxing commodities which have a smaller share in the basket of goods that the poor consume or by direct transfers to the poorer households.

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The Impact of Trade Reform in the 1990s on Welfare and Poverty in the Philippines

Caesar B. Cororaton

Abstract

This paper analyzes the impact of trade reform on welfare and poverty in the Philippines in the 1990s using a CGE model. The results indicate that while welfare rises and poverty falls for all household groups except the poorest (those with rural unskilled private employees as household head), urban households gain more than rural households. Policy experiments involving full tariff reduction and uniform five percent tariff rate indicate generally the same pattern of effects, except that the magnitude of change is relatively larger in the former while all household groups, including the poorest, experience a reduction in poverty in the latter. Since poverty remains high and the disparity between rural and urban poverty is still wide, other poverty-reducing measures have to be designed and implemented to target those households that do not benefit much from this type of market reform.

Keywords: computable general equilibrium, international trade, poverty, Philippines

Introduction

The Philippine government has pursued major structural economic reforms in the last one and a half decades. One of the areas in which reforms were most vigorously pursued was foreign trade through tariff

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reductions, the simplification of tariff structure, and "tariffication" of quantitative restrictions. While some of these reforms were pursued unilaterally, others were done under various multilateral agreements such as the World Trade Organization (WTO), as well as regional agreements such as the Association of Southeast Asian Nations (ASEAN) and the ASEAN Free Trade Area (AFTA).

Trade reforms have far-ranging, complex and deep impacts on all aspects of an economy, yet little is known about the impact on the poor. Do the poor share in the gains from freer trade? What alternative or accompanying policies may be used in order to ensure a more equitable distribution of the gains from freer trade? What are the transmission mechanisms through which these reforms may affect the poor? These are challenging policy issues that occupy the ongoing debate on trade reforms in the country. We employ a 12-sector computable general equilibrium (CGE) model calibrated to Philippine data to analyze the impact of trade reform on resource allocation, factor demand and prices, consumer prices, household income, welfare and, ultimately, poverty.

There have been numerous attempts to adapt CGE models to the analysis of income distribution and poverty issues. Usually, one must impose strong assumptions concerning the distribution of income among household in each category. A popular approach is to assume a lognormal distribution of income within each category where the variance is estimated with the base year data (De Janvry, Sadoulet, and Fargeix, 1991). In this approach, the CGE model is used to estimate the change in the average income for each household category, while the variance of this income is assumed fixed. Decaluwé et al (2000) argue that a beta distribution is preferable to other distributions because it can be skewed left or right and thus may better represent the types of intra-category income distributions commonly observed. In the present paper, we do not impose a fixed functional form. We take the actual distribution of household income from the 1994 Family Income and Expenditure Survey (FIES) consisting of 24,797 households. We group households by region (urban and rural), as well as by education and occupation of the household head. These household groupings are consistent with the household categories s in the CGE model. Averages of the variations in household income and consumer prices are derived for each household category from the CGE model and then applied to all corresponding households in the FIES in order to compute poverty indices.

A number of Philippine CGE models[1] are reviewed in Cororaton (1994). The focus of analysis in most of these models is on production efficiency and resource allocation issues. Impacts at the household level have not been emphasized or have been completely ignored. The present paper addresses this gap in the literature.

Philippine Growth Performance

The last 35 years saw wide swings in the Philippines' economic growth. Growth was highest during the period 1973-82 under the military regime of the Marcos administration, averaging 5.5 percent per year (Table 1). This was not sustained, however, as dissatisfaction among Filipinos with military rule mounted, which eventually led to a political uprising in the following period, 1983-85. This in turn triggered political crisis that resulted in a severe economic crisis. The economy contracted by an average of 4.1 percent per year during this period. Political as well as economic difficulties created the critical pressure to force the Marcos administration out of power in the early 1986, and gave way to the new Aquino government. In the following period, 1986-90, the economy bounced back with growth averaging 4.5 percent per annum under the new administration. Towards the end of the Aquino administration, a political tug-of-war led to a series of military coup attempts. Although the attempts failed, they created political uncertainties and instability. This, together with a series of natural calamities and a severe energy crisis, brought the economy to

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[1] Bautista, R. (1988), Bautista, C. (1987), Clarete and Warr (1992), Clarete (1984, 1991), Cororaton (1990), Habito (1984, 1989), and Gaspay (1993) to name some.

a halt in the 1991-93 period with a contraction of 0.1 percent per year. The Ramos administration revived the economy with growth averaging 4.9 percent per year from 1994 to 1997. However, the Asian financial crisis, the El Nino effects on agriculture production in 1998, and the political scandals that wreaked havoc on the subsequent Estrada administration took a heavy toll on the economy, with growth sliding to 3.5 percent per year in the period 1998-2000.

Table 1: The Philippine Economy (in percent)

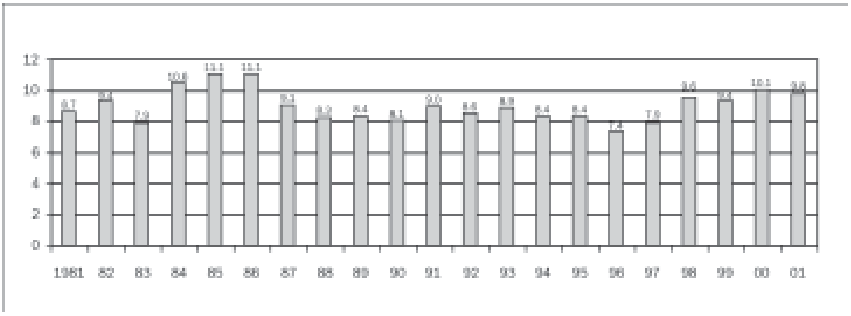
	GDP Growth	Exports/GDP	Imports/GDP
1967-72	4.8	13.6	17.4
1973-82	5.5	16.0	22.8
1983-85	-4.1	15.4	20.4
1986-90	4.5	17.4	23.0
1991-93	-0.1	19.5	30.2
1994-97	4.9	24.5	39.3
1998-2000	3.5	45.8	43.2

Source: *National Income Accounts, Philippine Statistical Yearbook, Selected Philippine Economic Indicators*

The effects on the unemployment rate of unstable economic growth are presented in Figure 1. The deep recession in the mid-1980s resulted in high unemployment of 11.1 percent by 1985 and 1986. The situation slightly improved under the Aquino and Ramos administrations, with a record low of 7.4 percent unemployment in 1996. However, the combined effects of the Asian financial crisis in 1997, the drought in 1998 and the scandals in the Estrada administration brought the unemployment rate back to double digits by 2000.

This boom and bust growth cycle is attributable to an unstable political system and weak economic fundamentals. To address the various weaknesses in the economy, major policy reforms were implemented during the Aquino government. Structural reforms like trade liberalization, foreign exchange liberalization, investment reforms, banking reforms, privatization, among others, were pursued.

Figure 1: Unemployment rates (in percent)



Source: *Philippine Statistical Yearbook*

The implementation of the reforms intensified in the 1990s. However, pressure from various groups and sectors opposed to these reforms are starting to emerge and are gaining momentum, which has resulted in some postponements and, in a few cases, some policy reversals. Whether these reforms resulted in favorable changes in the economy remains to be carefully investigated, but noticeable changes in some trends are starting to show up, especially in the foreign trade sector. The export-to-GDP ratio increased from 13.6 percent, in the 1967-72 period, to 45.8 percent in 1998-2000 (Table 1). The import-to-GDP ratio likewise increased from 17.4 percent to 43.2 percent over the same period.

Underlying this impressive trade sector performance is the phenomenal growth of the semi-conductor industry, which largely caters to the export market. Its share in total exports increased from 24 percent in 1990 to 59.5 percent in 2000 (Table 2). However, this sector is highly import-dependent, with extremely small value added.[2] Thus the rise in exports goes hand-in-hand with the increase in imports. Garments used to be a major export item before the 1990s, however their share dropped significantly in the 1990s. A similar declining trend is observed in agriculture-based exports over the same period.

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[2] Semi-conductor firms are often located in export processing zones. The linkage with the rest of the economy is generally thin as production in these firms normally involves assembly operations only.

Table 2: Merchandise Exports (million US dollars)

	Value			Shares (percent))		
	1990	1995	2000	1990	1995	2000
Coconut Products	503	989	595	6.1	5.7	1.6
Sugar and Products	133	74	57	1.6	0.4	0.2
Fruits and Vegetables	326	458	528	4.0	2.6	1.4
Other Agro-based Products	431	575	486	5.3	3.3	1.3
Forest Products	94	38	44	1.1	0.2	0.1
Agriculture-based	**1,487**	**2,134**	**1,710**	**18.2**	**12.2**	**4.6**
Mineral Products	723	893	650	8.8	5.1	1.7
Petroleum Products	155	171	436	1.9	1.0	1.2
Manufactures	5,707	13,868	33,989	69.7	79.5	91.2
Electrical and Electrical Equipment	1,964	7,413	22,178	24.0	42.5	59.5
Garments	1,776	2,570	2,563	21.7	14.7	6.9
Textile Yarns/Fabrics	93	208	249	1.1	1.2	0.7
Others	1,874	3,677	8,999	22.9	21.1	24.1
Others Exports	114	381	502	1.4	2.2	1.3
Industry-based	**6,699**	**15,313**	**35,577**	**81.8**	**87.8**	**95.4**
Total Merchandise Exports	8,186	17,447	37,287	100.0	100.0	100.0
Current Account Balance	(2,695)	(3,297)	9,349			

***Source**: Balance of Payments Accounts, Selected Philippine Economic Indicators, Bangko Sentral ng Pilipinas.*

In terms of imports, Table 3 shows a significant rise in the share of capital goods, from 25.6 percent in 1990 to 40 percent in 2000. The rest of the imports do not show any recognizable trend over the same period.

Table 3: Merchandise Imports (million US dollars)

	Value			Shares (percent))		
	1990	1995	2000	1990	1995	2000
Capital Goods	3122	8029	12161	25.6	30.4	40.0
Raw Materials and Intermediate Goods	5808	12174	12062	47.6	46.1	39.7
Unprocessed Raw Materials	862	1562	1338	7.1	5.9	4.4
Semi-Processed Raw Materials	4946	10612	10724	40.5	40.2	35.3
Chemicals	1367	2406	2618	11.2	9.1	8.6
Textile Yarn/Fabric	547	872	804	4.5	3.3	2.6
Iron and Steel	572	1312	856	4.7	5.0	2.8
Materials for Electrical Equipment	1106	3772	4208	9.1	14.3	13.9
Others	1354	2250	2238	11.1	8.5	7.4
Mineral Fuels and Lubricants	1842	2461	3877	15.1	9.3	12.8
Consumer Goods	1061	2784	2523	8.7	10.5	8.3
Others	373	943	-244	3.1	3.6	-0.8
Total Imports	12206	26391	30379	100.0	100.0	100.0

***Source**: Selected Philippine Economic Indicators, Bangko Sentral ng Pilipinas*

Signs of structural weaknesses prevail in the local economy despite reforms. The shares of industry and, in particular, the manufacturing sector have stagnated or fallen in the last 35 years (Table 4). Industry's share picked up from 31.7 percent in 1967-72 to 37.4 percent in 1983-85, but it has since declined to reach 30.9 percent in 1998-2000. A similar pattern is observed for the manufacturing sector over the same period. Agriculture's share has fallen continuously and strongly, with a corresponding increase noted in the share of services.

Table 4: Production Structure (value added shares in percent)

	Agriculture	Industry			Services	Total
		Manufacturing	Non-Manufacturing	Total		
1967-72	29.3	24.7	7.0	31.7	39.0	**100**
1973-82	27.9	25.6	11.1	36.8	35.3	**100**
1983-85	23.9	24.7	12.7	37.4	38.7	**100**
1986-90	23.1	25.0	9.7	34.7	42.2	**100**
1991-93	21.5	24.4	8.8	33.2	45.4	**100**
1994-97	20.7	22.8	9.4	32.2	47.0	**100**
1998-2000	17.2	21.9	9.0	30.9	52.0	**100**

***Sources**: National Income Accounts, Philippine Statistical Yearbook*

The share of industry and manufacturing in total employment also stagnated over the same period, with a strong movement noted from agriculture to service employment (Table 5).

Table 5: Employment Structure (shares in percent)

	Agriculture	Industry			Services	Total
		Manufacturing	Non-Manufacturing	Total		
1967-72	55.1			15.5	29.4	**100**
1973-82	52.5			14.7	32.7	**100**
1983-85	50.0	9.9	4.6	14.6	35.5	**100**
1986-90	46.9	10.0	5.0	15.0	38.0	**100**
1991-93	45.3	10.4	5.4	15.9	38.9	**100**
1994-97	43.0	10.1	6.1	16.2	40.7	**100**
1998-2000	38.4	9.8	6.5	16.3	45.3	**100**

Sources: *Philippine Statistical Yearbook*

The contrast between the strong foreign trade expansion on one hand, and industrial output and employment stagnation on the other, implies the absence of trickle down effects. Considering the fact that these policy reforms have been pursued for quite a while, the lack of trickle down effects suggests a high degree of duality between the local and foreign sectors.

Trade Reforms

During the 1980s, the trade reform program has three major components: the Tariff Reform Program (TRP); the Import Liberalization Program (ILP); and the complimentary realignment of the indirect taxes. In the TRP, there was a narrowing of the tariff rate structure from a range of 0-100 percent to 10-50 percent. At the same time, the ILP focused on removing non-tariff trade barriers. During the period 1983-1985, sales taxes on imports and locally produced goods were equalized. Also, the mark-up applied to the value of imports (for sales tax valuation) was reduced and eventually eliminated.

However, because of the balance of payments, economic and political crises during the mid-1980s, the import liberalization program was suspended. In fact, some of the items that had been deregulated earlier were re-regulated during this period. When the Aquino government took over in 1986, the trade reform program of the early 1980s was resumed, which resulted in the reduction of the number of regulated items from 1,802 in 1985 to 609 in 1988. Furthermore, export taxes on all products except logs were abolished.

In 1991, the government launched a second phase of this trade reform program, called TRP-II, in which tariff rates were realigned over a five-year period. The realignment involved the narrowing of the tariff rates through a series of reductions in the number of commodity lines with high tariffs, and an increase in the commodity lines with low tariffs. In particular, the program sought to bring tariffs within the 10–30 range by 1995. Despite the programmed narrowing of tariff rates, about 10 percent of the total number of commodity lines were still subjected to tariffs of 0-5 percent or 50 percent by the end of the program in 1995.

"Tariffication" of quantitative restrictions (QRs) began in 1992. QRs on 153 commodities were converted into tariff equivalents. In a number of cases, tariff rates were raised over 100 percent and were actually higher than their tariff equivalents, especially during the initial years of the conversion. However, a built-in program to phase down the "tariffied" rates over a five-year period was also put into effect. Tariff rates on 48 other commodities were further re-aligned. Deregulation continued on an additional 286 commodities under the tariffication program such that, by the end of 1992, only 164 commodities were covered under the QRs. However, in 1993, QRs were re-imposed on 93 items. This re-regulation came largely as the result of the Magna Carta for Small Farmers in 1991.

Beginning in 1994, major reforms were implemented under the TRP-III. Tariff rates on capital equipment and machinery were reduced in January 2004. This was followed in September 2004 by tariff reductions on textiles, garments, and chemical inputs. In July 1995, tariff rates were reduced on 4,142 harmonized lines in the manufacturing sector. Finally, a decision in January 1996 reduced tariffs on "non-sensitive" components of the agricultural sector. These reforms led to a reduction in both the number of tariff tiers and the maximum tariff rates. In particular, the program aimed to establish a four-tier tariff schedule, namely: 3 percent for raw materials and capital equipment that are not available locally; 10 percent for raw materials and capital equipment that are available from local sources; 20 percent for intermediate goods; and 30 percent for finished goods.

Another major component of the tariff reform program is the implementation of a uniform tariff rate. Policy discussions on the issue, however, are still ongoing. At what level shall the tariff rate be made uniform eventually across sectors is still an unsettled issue at present.

Table 6 shows the weighted average nominal tariff rates in 1990, 1995, and 2000 across various industries. The overall tariff rate declined from 26.4 percent in 1990 to 17.0 percent in 1995, to 8 percent in 2000. Although both agriculture and industry saw reductions in their tariff rates over the period, the drop in industry was more significant.

Tariffs are a major source of government revenue (Table 7). In 1990, the share of revenue derived from import duties and taxes was 26.4 percent. This increased to 27.7 percent in 1995. However, because of the tariff reduction program, it dropped to 19.3 percent in 2000. At the same time income and profit taxes increased from 27.3 to 38.6 percent of government revenue. Indeed, tariff reform has substantial government budget implications that pose a major policy challenge, especially in a situation of a growing government budget deficit.

Table 6: Weighted Nominal Tariff (percent)*

Sectors	1990	1995	2000
Palay and Corn	40.9	40.9	43.2
Fruits and Vegetables	40.9	39.6	11.8
Coconut & Sugar	20.2	36.7	11.0
Livestock & Poultry	2.8	1.9	0.9
Fishing	29.9	25.1	8.0
Other Agriculture	13.2	10.9	11.3
Forestry	18.2	11.0	3.1
Total Agriculture	**22.8**	**21.8**	**12.2**
Mining	11.1	22.2	2.6
Rice & Corn Milling	40.0	40.0	44.3
Milled Sugar	49.8	49.6	62.9
Meat Manufacturing	43.8	29.6	18.0
Fish Manufacturing	47.7	29.7	14.9
Beverage & Tobacco	49.2	45.9	11.4
Other Food Manufacturing	35.5	31.2	13.3
Textile manufacturing	41.6	18.6	10.3
Garments & Leather	49.0	29.0	18.2
Wood Manufacturing	45.5	25.6	13.5
Paper & Paper Products	33.2	18.5	7.9
Chemical Manufacturing	23.3	12.4	6.1
Petroleum Refining	10.9	13.4	3.1
Non-metal Manufacturing	19.3	10.3	6.0
Metal Manufacturing	25.8	16.6	7.7
Electrical Equipment Manufacturing	27.2	9.6	4.3
Transport & Other Machinery	24.5	16.0	9.7
Other Manufacturing	34.8	18.7	6.9
Total Industry	**26.4**	**17.0**	**8.0**
Grand Total	**26.4**	**17.0**	**8.0**

Source: *Basic data came from Manasan and Querubin (1997). * Weighted by 1990 imports.*

Table 7: National Government Balances
(percent, unless otherwise specified)

Sectors	1990	1995	2000
Tax Revenue	83.9	85.7	89.1
Taxes on Net Income and Profits	27.3	30.7	38.6
Excise and Sales Taxes	27.2	23.4	28.1
Import Duties and Other Import Taxes	26.4	27.7	19.3
Other Taxes	3.0	3.9	3.1
Non-Tax Revenue	14.8	14.0	10.6
Grants	1.3	0.3	0.3
Total	100.0	100.0	100.0
Total Revenue (billion pesos)	180.9	362.2	507.1
Total Expenditure (billion pesos)	218.1	350.1	641.8
(Deficit)/Surplus (billion pesos)	(37.2)	12.1	(134.7)
Total Revenue (percent of GNP)	16.9	18.4	14.5
Total Expenditure (percent of GNP)	20.4	17.9	18.4
(Deficit)/Surplus (percent of GNP)	-3.5	0.6	-3.9

Source: *1990 SAM, Selected Philippine Economic Indicators*

Table 7 shows the growing public deficit following the post-1995 reduction in tariff rates.[3] While the expenditure ratio remained close to 18 percent of GNP, revenue fell substantially. Given this, the viability of the continued implementation of the tariff reduction program will largely depend on how the government can improve tax revenue generation from other sources like income tax and other excise and indirect taxes.

Poverty and Income Distribution

The overall poverty situation in the country from 1985 to 2000 is presented in Table 8. The headcount ratio dropped from 49.2 percent in 1985 to 36.9 percent in 1997. It then increased to 39.5 percent in 2000, mainly as a result of El Nino and the Asian financial crisis as

[3] Recent figures indicate that the budget deficit-to-GNP ratio is fast approaching 6 percent in 2002.

discussed earlier. A similar pattern is observed with the other indices. While all indices generally move in the same direction for the National Capital Region (NCR), urban, and rural areas, a disturbing pattern seems to emerge: the drop in poverty is greatest in the NCR, where poverty is already lowest, and least in rural areas, where poverty is widespread. Indeed, 71 percent of the poor are in rural areas, 26 percent in urban areas, and only three percent are in the NCR.

Table 8: Poverty and Income Distribution

Index	1985	1988	1991	1994	1997 /a/	2000 /a/
Philippines						
Headcount	49.2	45.4	45.2	40.6	33.0	34.0
Gap	17.0	15.1	15.4	13.5	10.3	10.6
Severity	7.9	6.7	7.0	6.1	4.4	4.5
National Capital Region (NCR)						
Headcount	27.1	25.1	16.6	10.4	6.5	7.6
Gap	7.0	6.7	3.8	2.0	1.2	1.6
Severity	2.7	2.6	1.3	0.6	0.4	0.5
Urban						
Headcount	43.9	39.4	42.7	34.7	18.4	18.6
Gap	15.1	12.8	14.9	11.4	5.1	5.0
Severity	7.0	5.6	6.9	5.2	2.0	2.0
Rural						
Headcount	56.4	52.3	55.0	53.1	46.3	48.8
Gap	20.1	17.8	19.0	18.2	15.1	15.9
Severity	9.4	8.0	8.7	8.3	6.6	6.9
Poverty Distribution						
NCR	7.7	7.6	5.1	3.5	2.7	3.1
Urban	22.0	21.0	34.1	30.7	25.7	26.0
Rural	70.2	71.4	60.7	65.7	71.6	70.9
Total	100.0	100.0	100.0	100.0	100.0	100.0
Income Distribution						
Gini Coefficient	0.452	0.457	0.480	0.464	0.507	0.505
Top 20 percent /b/	0.6	0.3	0.9	0.5	2.0	2.3
Middle 40 percent /b/	39.5	37.7	22.6	36.9	37.9	38.0
Bottom 20 percent /b/	60.0	61.9	76.5	62.5	60.1	59.7

Source: *1985, 1988, 1991, 1994, 1997& 2000 Family Income and Expenditure Surveys*

/a/ Using revised estimates of poverty line; /b/ percent of overall population

Indicators of income distribution do not show an encouraging picture either. The Gini coefficient increased from 0.452 in 1985 to 0.507 in 1997 and 0.505 in 2000. In 2000, the top 2.3 percent of the population receives 20 percent of overall income, while the bottom 60 percent of the population also receives 20 percent of total income.

Structure of the Economy in the 1994 SAM

We briefly discuss the structure of the economy in terms of the 1994 social accounting matrix (SAM). As the CGE model is calibrated to this SAM, it is important to have this structure in mind when interpreting the results of the various policy experiments presented further on.

Table 9 indicates that the agricultural sector contributed 20 percent of national value added (GDP) in 1994, whereas the industrial and service sectors had 31.6 and 48.5 percent shares. The agricultural sector was dominated by crops, which contributed 10.3 percent of national value added. In the industrial sector, the non-food manufacturing industry dominated.

While the agricultural sector had the smallest share in the overall value added, it had the highest value added ratio (71.4 percent), more than double that of the industrial sector (34.5 percent) and higher than that of the service sector (63.3 percent). These ratios vary among the branches of each of the major sectors. In particular, the largest agricultural branch, crops, had the second highest value added ratio (77.7 percent), which is more than 2.5 times that of the largest industrial branch, non-food manufacturing (29.7).

The foreign trade sector is becoming a dominant sector in the Philippines. In 1994, exports represented 16.5 percent of total output and imports represented 17.4 percent of domestic consumption. Here, too, there are large differences between and within sectors. The agricultural sector had very low trade ratios, whereas the industrial sector and, in particular, its dominant non-food manufacturing branch, had quite high trade ratios. As a result, nearly half of all exports and more than three-quarters of all imports are concentrated in the non-food manufacturing sector. This is largely due to the semi-conductor

Table 9: Sectoral characteristics and parameters (percent)

SECTORS	TRADE						PRODUCTION			
	Elasticities		Exports		Imports		VA ratios (VA/X)	VA shares (VA/total VA)	X shares (X/total X)	Ratio
	Armington	CET	Share	Intensity[b]	Share	Intensity[b]				
Crops	2.0	1.3	3.1	7.5	0.7	1.7	77.7	10.3	6.8	1.0
Livestock	1.4	0.4	0.0	0.1	0.6	2.6	58.1	4.5	4.0	1.0
Fishing	1.1	1.5	3.4	20.8	0.0	0.2	71.7	3.7	2.7	1.8
Other agriculture	0.9	0.4	0.0	0.0	0.1	2.6	82.3	1.4	0.9	1.0
Agriculture			**6.5**	**7.5**	**1.5**	**1.8**	**71.4**	**20.0**	**14.3**	
Mining	1.1	1.5	2.5	43.1	6.5	66.3	55.0	1.0	0.9	1.1
Food manufacturing	1.1	1.2	8.6	9.7	5.4	6.3	30.8	8.8	14.7	1.7
Non-food manufacturing	1.0	1.0	48.2	34.7	76.1	45.3	29.7	13.4	23.0	1.2
Construction	1.0	1.0	0.3	0.8	0.9	2.6	52.8	5.5	5.3	1.3
Utilities	1.0	1.0	0.2	1.2	0.0	0.0	53.0	2.8	2.7	3.0
Industry			**59.7**	**21.2**	**88.8**	**28.3**	**34.5**	**31.6**	**46.7**	
Wholesale/retail trade	1.0	1.0	14.3	20.9	0.0	0.0	64.1	14.2	11.3	1.9
Other services	1.0	1.0	19.5	14.6	9.7	7.8	61.4	26.6	22.1	1.6
Government services								7.7	5.7	
Services			**33.8**	**14.3**	**9.7**	**5.4**	**63.3**	**48.5**	**39.1**	
Total			**100.0**	**16.5**	**100.0**	**17.4**	**51.0**	**100.0**	**100.0**	

Source: *1994 Social Accounting Matrix. a: exports/output; b: imports/consumption; CET-constant elasticity of transformation; VA-value added; Xoutput; K-capital; L-labor*

Table 10: Sources of Household Income, percent

	Household	Labor				Capital	div	trgov	yfor	Total
		L1	L2	L3	L4					
URBAN	**(h1)** Unskilled private employee	–	17.4	–	42.0	26.6	–	12.3	1.7	100
	(h2) Skilled private employee	4.6	–	75.9	–	6.0	12.3	1.1	0.2	100
	(h3) Government employee	0.9	–	91.5	–	7.3	–	0.3	0.1	100
	(h4) Unskilled self employed/unemployed	–	8.6	–	5.6	69.5	3.2	5.6	7.4	100
	(h5) Skilled self employed/unemployed	0.9	–	45.4	–	24.8	25.4	0.3	3.1	100
RURAL	**(h6)** Employer	0.2	0.8	23.4	–	66.7	2.3	0.7	5.9	100
	(h7) Unskilled private employee	–	29.8	–	14.2	31.3	–	23.2	1.6	100
	(h8) Skilled private employee	20.0	–	67.4	–	6.9	1.3	4.1	0.2	100
	(h9) Government employee	4.7	–	88.8	–	5.1	0.0	1.3	0.0	100
	(h10) Unskilled self employed/unemployed	–	19.5	–	17.1	46.2	–	13.0	4.2	100
	(h11) Skilled self employed/unemployed	–	5.6	50.7	–	36.0	–	3.9	3.8	100
	(h12) Employer	1.8	9.0	11.6	5.7	58.9	–	7.0	5.9	100

Source: *1994 Social Accounting Matrix. L1 = Skilled agriculture labor; L2 = Unskilled agriculture labor; L3 = Skilled non-agriculture labor; L4 = Unskilled non-agriculture labor; div = dividends; trgov = government transfers; yfor = foreign income*

Table 11: Consumption Share of Households, percent Households

	Urban						Rural					
	h1	h2	h3	h4	h5	h6	h7	h8	h9	h10	h11	h12
Crops	4.7	3.4	3.1	4.1	3.3	2.6	5.9	4.8	4.1	5.6	4.7	5.0
Livestock	4.0	2.9	2.6	3.5	2.8	2.2	5.0	4.0	3.5	4.8	3.9	4.2
Fishing	3.9	2.9	2.6	3.4	2.7	2.2	4.9	4.0	3.4	4.7	3.9	4.2
Other agriculture	-	-	-	-	-	-	-	-	-	-	-	-
Mining	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.2	0.1	0.2
Food manufacturing	35.4	24.3	22.1	29.4	22.8	18.8	46.3	37.0	31.2	42.5	35.1	37.9
Non-food manufacturing	13.7	16.2	16.1	14.8	16.5	16.7	11.1	13.3	14.0	11.8	13.7	13.1
Construction	0.3	0.4	0.3	0.2	0.3	0.4	0.1	0.1	0.2	0.1	0.2	0.2
Utilities	1.0	1.3	1.6	1.2	1.3	1.6	0.8	1.2	1.5	1.0	1.3	1.1
Wholesale and retail trade	12.0	17.1	14.2	13.4	17.6	17.6	5.6	7.3	6.6	6.1	7.5	7.4
Other services	24.9	31.4	37.3	29.8	32.5	37.8	20.1	28.1	35.4	23.3	29.6	26.8
Total	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**

Source: *1994 Social Accounting Matrix **6.***

industry, which exports most of its output, yet is heavily dependent on imported inputs.

There are 12 household groups in the 1994 SAM, categorized by location (urban and rural), as well as by the skills and occupation of the household head. Table 10 shows the sources of income of households, which are broken down into income from labor, capital, dividends, government and foreign transfers. The sources of income vary greatly among household groups.

The largest item in the expenditure of households is food manufacturing, followed by other services (Table 11). Like income sources, consumption patterns vary substantially between household groups. In particular, both rural households and households headed by unskilled workers tend to consume relatively more manufactured foods and agricultural goods, and relatively less non-food manufactures and services than their counterparts.

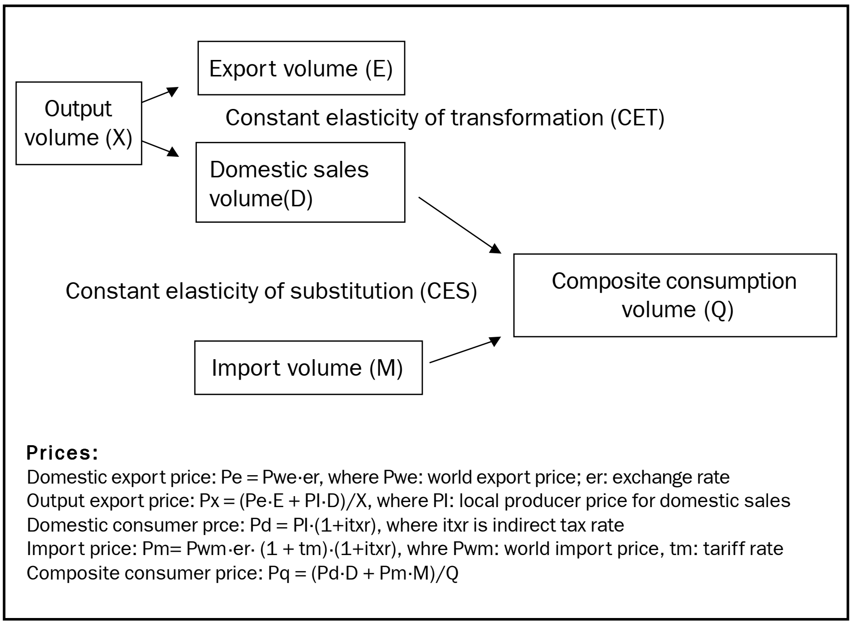
The CGE Model

We use a static CGE model with 12 production sectors, 12 household groups, four labor categories and capital.

Figure 2 outlines the foreign trade behavior in the model. Producers have the option, depending upon relative prices, of selling their output on the export or domestic markets, which is modeled by a constant elasticity of transformation (CET) function. If the domestic export price increases relative to the local producer price for domestic sales, export shares will increase. Consumers, on the other hand, decide between buying domestically produced or imported goods according to a constant elasticity of substitution (CES) or Armington function, which can be interpreted as representing product differentiation with imperfect substitution between imports and domestically produced goods. If the domestic import price declines relative to the domestic consumer price for locally-produced goods, the demand for imports will increase and the demand for local goods will decline. The direct effect of a tariff reduction is a reduction in the domestic import price, which in turn reduces the composite consumer price for the good in question.

Value added is a Cobb-Douglas (CD) function of capital and composite labor, which is itself a CD function of the different labor categories. Sectoral capital is fixed. Sectoral intermediate input is determined using Leontief fixed coefficients.

Figure 2: Foreign Trade Behavior in the CGE model



Total investment is equal to total savings, where total savings is the sum of foreign, private (households and firms) and government savings. The current account balance (foreign savings) is fixed. The nominal exchange rate is the numeraire. The foreign trade sector is effectively cleared by changes in the real exchange rate, through changes in domestic prices. Total nominal investment is equal to total real investment multiplied by its price index. Total real investment is held fixed in order to abstract from inter-temporal welfare/poverty effects. The price of total real investment is endogenous.

Nominal government consumption is equal to exogenous real government consumption multiplied by its (endogenous) price. Fixing real government spending neutralizes any possible welfare/poverty effects of variations in government spending.

All policy simulation experiments conducted in the paper are government balance–neutral. This is done by fixing government savings. An endogenously determined uniform compensatory indirect tax (ntaxr) is introduced to offset government revenue losses incurred by tariff reductions. The compensatory indirect tax applies to the domestic prices of both local products and imports. The increase in the domestic price of local goods is given by $pd_i = pl_i$ ´ $(1 + itxr_i)$ ´ $(1 + ntaxr)$, while the increase in domestic import prices is defined by $pm_i = pwm_i$ ´ er ´ $(1 + tm_i)$ ´ $(1 + itxr_i)$ ´ $(1 + ntaxr)$. The compensatory indirect tax is price non-distortionary in the sense that it does not affect sectoral relative prices pd_i / pd_j and pm_i / pm_j.

Definition of Experiments

There are three policy experiments conducted in the paper: (i) Actual

Table 12: Average Tax Rates (1994 Calibrated SAM values)

	Tariff Rates (percent)			1994 Indirect
	1994	2000	Variation	Tax Rates (percent)
Crops	14.9	8.1	45.6	1.9
Livestock	0.6	0.3	50.0	1.8
Fishing	31.9	7.5	76.5	2.9
Other Agriculture	0.3	0.2	33.3	2.2
AGRICULTURE	**8.1**			**2.1**
Mining	40.9	4.5	89.0	1.2
Food Manufacturing	33.6	15.0	55.4	3.7
Non-food Manufacturing	19.5	7.0	64.1	1.6
Construction				1.6
Electricity, Gas and Water				2.2
INDUSTRY	**22.1**			**2.4**
Wholesale trade & retail				5.5
Other Services				3.7
Government services				
SERVICES				**4.3**
TOTAL	**21.4**			**3.0**

***Source**: Estimated by the author based on the 1994 Social Accounting Matrix.*

tariff reductions; (ii) Full tariff reduction; and (iii) Uniform tariff rate. Initial sectoral tariff and indirect tax rates, as calibrated from the 1994 SAM, are presented in Table 12. The experiment with actual tariff reductions involves reducing tariff rates by the actual change in the sectoral weighted tariff rates between 1994 and 2000. The full tariff reduction experiment involves setting all sectoral tariff rates to zero. The uniform tariff rate experiment involves setting all sectoral tariff rates equal to five percent.

Simulation Results

We first present the results for the actual tariff reductions before comparing with the full tariff reduction and uniform tariff rate scenarios.

Actual Tariff Reductions Simulation

The impact of the actual reduction in tariff rates on government accounts are presented in Table 13. Tariff revenue falls by almost two-thirds. Direct tax revenue declines marginally because of the decrease in private (firm and household) income. In order to maintain government balance, which we hold constant, an endogenously determined uniform 2.1 percent compensatory indirect tax is introduced, which nearly doubles indirect tax revenue. Overall government expenditure also drops marginally as real spending is held constant and prices fall.

The macro impact of the actual reduction in tariff rates is presented in Table 14 (column 1). The average tariff rate drops by 66.5 percent,

Table 13: Government Accounts – Actual Tariff Reduction Scenario, % change from base

	Change
Total revenue	**-0.5**
Tariff revenue	-6.6
Direct tax revenue	-0.2
Indirect tax revenue	6.3
Compensatory indirect tax rate (percent)	2.1
Government Balance	**0.00**

which triggers a whole chain of effects. On average, import price declines by 8.5 percent. The average price of the imperfectly substitutable domestically-sold local output declines somewhat less, at 3.1 percent. This triggers a fall in the relative price of imports, which leads consumers in the Philippines to substitute in their favor. Real imports increase by 4.7 percent while domestically-sold output declines by -0.6 percent. However, the 4.6 percent decline in the real exchange rate increases export competitiveness, as local producers substitute away from the local market where prices are falling. As a result, real exports increase by 4.3 percent. There are only marginal increases in domestic consumption and output, as a result of the reallocation of resources. These are accompanied by reductions in consumer and producer prices as the import price reductions ripple through the economy. Thus tariff reform significantly increases the overall share of the foreign trade sector.

Sectoral effects are presented in Table 15. Import prices (pm) fall most where the tariff rates were initially high, such as in mining,

Table 14: Macro Effects (percent change from base)

Variables	Actual	Full tariff	Uniform
Overall average nominal tariff rate	-66.5	-100.0	-77.1
Prices			
Imports	-8.5	-12.9	-9.9
Exports	0.0	0.0	0.0
Domestically-sold local output*	-3.1	-5.3	-3.9
Household CPI**	-1.1	-2.5	-1.8
Domestic Output	-2.5	-4.2	-3.1
Real values			
Imports	4.7	7.7	5.7
Exports	4.3	6.9	5.2
Domestically-sold local output	-0.6	-1.1	-0.8
Domestic Consumption	0.4	0.6	0.5
Domestic Output	0.2	0.3	0.2
Real exchange rate* **	4.6	7.5	5.6

* = net of indirect taxes; ** = weighted by consumption; *** = world export price/domestic output price;

fishing, and food manufacturing. The reduction in sectoral import prices triggers a chain of reductions in output prices (px), composite consumer good prices (pq), consumer prices of locally-produced goods (pd) and local producer prices (pl).

Sectoral imports increase roughly in proportion to the drop in import prices in sectors with significant tariff reductions, whereas they fall in the other sectors as a result of the real exchange rate appreciation. Overall, imports increase more in industry than agriculture, and they actually fall in services. The depreciation of the real exchange rate also increases sectoral exports. The average increase in agricultural exports is 2.4 percent, while industrial exports increase by 6.1 percent. This reflects the greater substitution toward exports in industry as stronger tariff reductions bring prices on the local market down more.

Let us focus on the effects in the non-food manufacturing sector, as this is the largest industrial sector and represents three-quarters of all imports and nearly half of exports (Table 9). Given the high import penetration, the fall in import prices in this sector leads to a substantial drop (6.4 percent) in producer prices for local sales (pl). Producers react by reorienting their sales to the export market (increase of 7.2 percent). Despite the fall in local producer prices, this sector benefits enormously from cost savings on its imported (and importable) inputs such that its value added price actually increases. As a result, its output and even its domestic sales increase. On the demand side, falling domestic prices for both imports and, to a lesser degree, locally-produced goods motor a 6.5 percent reduction in the composite consumer price index and a 2.5 percent increase in domestic consumption of non-food manufactures, mainly in the form of increased imports.

The expansion of the non-food manufacturing sector leads to a 1.1 percent increase in total industrial output, despite a contraction in the initially heavily protected mining sector. As a result, resources move from the contracting agricultural and service sectors to industry.

As a result of the general reduction in domestic prices, all nominal factor prices also decline. Factor prices changes are the

Table 15: Sectoral Results (percent change from base)

	Change in Volume					Change in Prices						
Sectors	**m**	**d**	**q**	**e**	**x**	**pm**	**pd**	**pq**	**pl**	**px**	**pv**	**r**
	ACTUAL TARIFF REDUCTION SCENARIO											
Crops	6.6	-0.9	-0.8	2.1	-0.7	-3.9	-0.2	-0.3	-2.3	-2.2	-2.1	-2.8
Livestock	-3.9	-1.4	-1.5	-0.6	-1.4	1.8	0.0	0.0	-2.1	-2.1	-2.9	-4.3
Fishing	21.4	-0.7	-0.6	2.7	0.0	-16.7	-0.1	-0.1	-2.2	-1.7	-1.4	-1.4
Other agriculture	-1.3	0.0	0.0		0.0	2.1	0.5	0.6	-1.6	-1.6	-1.5	-1.4
Agriculture	**1.5**	**-1.0**	**-0.9**	**2.4**	**-0.7**	**-1.1**	**-0.1**	**-0.1**	**-2.2**	**-2.0**	**-2.1**	**-2.7**
Mining	8.9	-11.8	3.0	3.5	-5.0	-24.2	-8.2	-20.3	-10.1	-5.6	-7.1	-11.7
Food manufacturing	13.9	-1.3	-0.1	0.8	-1.1	-12.1	0.4	-0.8	-1.8	-1.6	-3.3	-4.4
Non-food manufacturing	4.8	0.3	2.5	7.2	2.7	-8.5	-4.4	-6.5	-6.4	-4.1	1.8	4.6
Construction	-5.3	-1.4	-1.5	2.7	-1.3	2.1	-1.9	-1.8	-4.0	-3.9	-3.1	-4.4
Utilities		0.2	0.2	3.0	0.2		-0.7	-0.7	-2.8	-2.7	-0.8	-0.6
Industry	**5.7**	**-0.7**	**1.7**	**6.1**	**1.1**	**-9.9**	**-2.3**	**-5.1**	**-4.3**	**-3.2**	**-0.5**	**0.2**
Wholesale and retail trade		-0.7	-0.7	1.4	-0.3		0.0	0.0	-2.1	-1.6	-2.1	-2.3
Other services	-2.4	-0.3	-0.4	1.9	0.1	2.1	0.0	0.2	-2.1	-1.8	-1.4	-1.4
Government services										-1.6	-1.5	
Services	**-2.4**	**-0.5**	**-0.2**	**1.7**	**-0.2**	**2.1**	**-0.3**	**-0.2**	**-2.4**	**-2.0**	**-1.7**	**-1.9**
Overall	**4.7**	**-0.6**	**0.4**	**4.3**	**0.2**	**-8.5**	**-1.0**	**-2.4**	**-3.1**	**-2.5**	**-1.5**	**-1.5**
	FULL TARIFF REDUCTION SCENARIO											
Agriculture	5.5	-1.6	-1.4	4.7	-1.1	-3.4	-0.9	-0.9	-4.1	-3.8	-4.0	-4.8
Industry	9.2	-1.3	2.5	9.2	1.5	-15.0	-3.8	-8.0	-6.9	-5.1	-1.8	-0.8
Services	-4.4	-0.8	-0.3	3.3	-0.2	3.4	-1.1	-0.9	-4.4	-3.7	-3.3	-3.5
Overall	**7.7**	**-1.1**	**0.6**	**6.9**	**0.3**	**-12.9**	**-2.1**	**-4.2**	**-5.3**	**-4.2**	**-3.1**	**-3.1**
	UNIFORM TARIFF SCENARIO											
Agriculture	2.6	-1.2	-1.1	3.3	-0.8	-1.8	-0.6	-0.6	-3.0	-2.8	-2.9	-3.5
Industry	6.9	-0.9	2.0	7.0	1.2	-11.5	-2.8	-6.1	-5.2	-3.9	-1.2	-0.4
Services	-3.2	-0.6	-0.2	2.3	-0.2	2.5	-0.7	-0.6	-3.2	-2.7	-2.4	-2.5
Overall	**5.7**	**-0.8**	**0.5**	**5.2**	**0.2**	**-9.9**	**-1.5**	**-3.1**	**-3.9**	**-3.1**	**-2.2**	**-2.2**

m = imports; d = domestic demand; q = composite commodity; e = exports; x = output; va = value added; pm = import price in local currency; pd = consumer price for locally-produced output (including indirect tax); pl = producer price for locally-sold output (excluding indirect tax); pq = composite consumer price; px = composite producer price; pv = value added price; r = returns to capital reflection of changes in sectoral value added prices. This is particularly apparent when we consider the sectoral nominal returns to capital in Table 15. Among labor categories, the greatest reduction in nominal wages concern agricultural labor (Table 16, "Actual" columns). Unskilled non-agricultural labor, which is employed intensively in the expanding non-food manufacturing sector, has the smallest wage reduction.

Table 16: Change in Factor Prices (percent from base)

	Change in nominal factor prices		
	Actual	Full	Uniform
Average wage	**-1.5**	**-3.0**	**-2.2**
Agriculture labor, skilled (L1)	-2.9	-5.1	-3.8
Agriculture labor, unskilled (L2)	-2.9	-5.1	-3.8
Non-agriculture labor, skilled (L3)	-1.3	-2.8	-2.0
Non-agriculture labor, unskilled (L4)	-0.5	-1.7	-1.1
Average return to capital	**-1.5**	**-3.1**	**-2.2**

Table 17 presents the impacts on household income, welfare and poverty[1]. We focus for the moment on the results from the actual tariff reduction (first set of columns). To understand these results it is important to refer to household income sources (Table 10) and factor price changes (Table 16). We first note that the fall in nominal wage rates and returns to capital translates into a 1.3 to 1.8 percent reduction in nominal incomes. However, we saw earlier (Table 15) that consumer prices fell even more (2.4 percent on average), such that real incomes and welfare increase on average.

Nominal income falls most among rural households, given their greater reliance on agricultural wages. As a result, they also have smaller welfare gains. Employers, who draw a large share of their income from the returns to non-food manufacturing capital, fare particularly well as do government employees, who derive most of their income from skilled non-agricultural labor. Households headed

Table 17: Welfare and Poverty

	Actual Tariff Reduction					Full Tariff Reduction					Uniform Tariff				
			Poverty Indices*					Poverty Indices*					Poverty Indices*		
Households	**Nominal Income***	**Welfare****	**P1**	**P2**	**P3**	**Income***	**Welfare****	**P1**	**P2**	**P3**	**Income***	**Welfare****	**P1**	**P2**	**P3**
(h1) Unskilled private employee	-1.3	0.6	-0.9	-1.2	-1.4	-2.8	0.8	-1.4	-1.6	-1.8	-2.0	0.7	-1.2	-1.4	-1.7
(h2) Skilled private employee	-1.4	0.7	-1.7	-1.9	-2.1	-2.9	1	-2	-2.5	-2.8	-2.1	0.8	-1.7	-2.1	-2.4
(h3) Government employee	-1.4	0.7	0	-1.7	-2	-2.8	0.9	0	-2.3	-2.6	-2.0	0.7	0	-1.9	-2.2
(h4) Unskilled self/un-employed	-1.5	0.5	-0.5	-0.7	-0.9	-2.9	0.7	-0.8	-1.1	-1.3	-2.1	0.6	-0.7	-0.9	-1.2
(h5) Skilled self/un-employed	-1.4	0.7	-1	-1.5	-1.6	-2.9	1	-1.6	-2.1	-2.2	-2.0	0.8	-1	-1.7	-1.8
(h6) Employer	-1.4	1	-0.8	-1.9	-2.2	-2.8	1.5	-1.4	-2.6	-3	-2.0	1.1	-0.8	-2.1	-2.4
Urban		**0.7**	**-0.8**	**-1.1**	**-1.3**		**0.9**	**-1.1**	**-1.5**	**-1.7**		**0.8**	**-0.9**	**-1.3**	**-1.5**
(h7) Unskilled private employee	-1.8	0.1	0	0	0	-3.4	0.1	0	0	0	-2.5	0.2	-0.3	-0.2	-0.3
(h8) Skilled private employee	-1.7	0.3	-1	-0.4	-0.5	-3.3	0.4	-1	-0.5	-0.6	-2.3	0.4	-1	-0.6	-0.7
(h9) Government employee	-1.4	0.8	-1.4	-1.7	-2	-2.9	1.2	-1.4	-2.4	-2.8	-2.1	1	-1.4	-2	-2.4
(h10) Unskilled self/un-employed	-1.5	0.1	-0.1	-0.1	-0.1	-3.1	0.2	-0.1	-0.2	-0.3	-2.2	0.3	-0.2	-0.4	-0.5
(h11) Skilled self/un-employed	-1.4	0.5	-0.6	-0.9	-1.1	-2.9	0.7	-0.6	-1.3	-1.7	-2.1	0.6	-0.6	-1.2	-1.5
(h12) Employer	-1.5	0.6	-0.7	-1.3	-1.4	-3.0	0.9	-1.1	-1.9	-2.1	-2.1	0.8	-1.1	-1.6	-1.9
Rural		**0.3**	**-0.2**	**-0.2**	**-0.3**		**0.4**	**-0.2**	**-0.3**	**-0.4**		**0.4**	**-0.3**	**-0.5**	**-0.6**
Overall		**0.5**	**-0.4**	**-0.5**	**-0.6**		**0.8**	**-0.5**	**-0.7**	**-0.8**		**0.7**	**-0.5**	**-0.7**	**-0.9**

*Percent change from base; **Equivalent variation/disposable income (percent); P1: Headcount index; P2: Poverty Gap; P3: Squared Poverty Gap (Severity of poverty).

by unskilled workers have slightly smaller welfare gains than their skilled counterparts given their dependency on the returns to capital employed outside the non-food manufacturing sector. This result comes despite the greater reduction in non-agricultural wages for unskilled workers as compared to their skilled counterparts.

Our simulation of the actual reduction in tariff rates also indicates an overall reduction in poverty incidence of 0.4 percent. As in the case of our welfare indicators, the reduction in the headcount ratio is greater in urban areas. There is a reduction in the poverty incidence in all household groups except in the poorest household (h7). In terms of the depth and the severity of poverty, the results indicate that poverty worsens in this particular group, while all other households see improvement in their poverty situation.

Full Tariff Reduction and Uniform Tariff Rate Simulations

We now compare the results of the other two scenarios (full tariff reduction and uniform tariff). In Table 14, a uniform tariff results in a greater (77.1 percent) reduction in the overall nominal tariff compared to the actual tariff reduction (66.5 percent). Of course, full tariff reduction leads to an even greater 100-percent reduction. Consequently, the impacts on key macro variables are larger across the board, especially in the case of full tariff reduction.

Sectoral (Table 15, bottom sections) are also qualitatively similar but of greater magnitude, especially with full tariff reduction. The similarity of the results can be linked to the fact that the actual tariff reductions affected all sectors strongly (Table 12). As a result, the direct impact on import prices has the same structure – with a much stronger reduction in industrial import prices and an actual small increase in the import price of services – in all three scenarios. As a result, factor impacts are also similar in structure but larger in magnitude (Table 16). Finally, we turn our attention to our main concern, the poverty impacts of these various trade liberalization scenarios. Here again, the welfare gains and poverty reductions are larger with the uniform tariff and, a fortiori, the full reduction scenarios

(Table 17). Note that even the rural unskilled private employees enjoy a reduction in poverty in the uniform tariff scenario.

Conclusion

The paper analyzes the welfare and the poverty effects of trade reforms using a CGE model calibrated to the 1994 SAM. The policy experiments indicate that the actual 1994-2000 tariff reductions increased the size of foreign trade sector through higher exports and imports. Trade reforms also resulted in lower prices, which contribute to welfare gains of less than one percent of income and reductions in poverty.

While welfare rises and poverty falls for all household groups except the poorest (those with rural unskilled private employees as household head), urban households gain more than rural households. This result can be traced to the strong expansion of the non-food manufacturing sector, which benefits from a real exchange rate driven export expansion and cost savings on imported and importable inputs.

The same pattern of effects is observed when we compare with a full tariff reduction experiment or the imposition of a uniform five percent tariff rate, although the magnitude of impacts are larger, especially in the full tariff reduction scenario. In the case of the uniform tariff rate, all household groups, including the poorest, experience a reduction in poverty.

All told, the trade reform program has been beneficial to the Philippines in terms of reducing consumer prices, increasing foreign trade and reducing overall poverty. However, since poverty remains high and the disparity between rural and urban poverty is still wide, other poverty-reducing measures have to be designed and implemented to target those households that do not benefit much from this type of market reform. This is particularly true for the poorest household group (households headed by unskilled rural workers), which, according to the simulation results, is benefiting very little from the reform process.

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Trade Policies, Regional Integration, Poverty and Income Distribution in Senegal

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Abstract

Since January 2002, within the framework of the sub-regional economic integration process of the West African Economic and Monetary Union (WAEMU), Senegal has adopted a Common External Tariff (CET) and harmonization of the tax system. These measures have considerably reduced the protection of its economy (50% reduction in customs duties) and consolidated its domestic tax system. This paper assesses, using a computable general equilibrium model, the impact on the well-being of both rural and urban households of trade liberalization scenarios in Senegal.

Results show that Government has given more priority to fiscal consolidation than to the potential negative effects of a higher VAT on income distribution and the well-being of households. This arbitration is in line with the spirit of local stabilization and adjustment policies, which have always been characterized by primacy of fiscal rehabilitation over improvements in the competitiveness of the economy.

Keywords: Computable general equilibrium model, poverty analysis, trade policy, income distribution, regional integration.

Introduction[1]

Since gaining political independence in 1960 and up to the mid-1980s, Senegal consolidated its import substitution protection mechanisms. However, the structural adjustment policy initiated in 1985 compelled the national authorities to gradually expose the country's economy to international competition. All programs that ensued have invariably included measures aimed at reducing tariff and non-tariff barriers.

Yet trade restrictions have always constituted an important source of income for the State (over 40 percent of government income in the early 1990s, in fact). The quest for economic efficiency through a reallocation of factors between sectors following trade liberalization was quickly confronted by the need to absorb an important budget deficit, as well as by the opposition of the interest groups that benefited from the existing protection. This dilemma was aggravated by the overvaluation of the CFA Franc at the time that the initial trade liberalization measures were implemented. A reduction of tariffs and the removal of non-tariff barriers, accompanied by exchange rate appreciation (by nearly 40 percent in the 1980s and in 1990), inevitably led to a considerable loss of competitiveness for local producers on the domestic markets. The first tariff reduction policies adopted in 1987 under the New Industrial Policy (NIP) were consequently quickly abandoned.

It was not until the devaluation of the CFA Franc in January 1994 that Senegal actively embarked on trade liberalization, which was henceforth carried out under the supervision of the West African Economic and Monetary Union (WAEMU). Members of the WAEMU - which was created on the eve of the decision to devaluate the CFA Franc – agreed to introduce a Common External Tariff (CET) and to harmonize their tax systems. These two major reforms came into force in January 2002. Tariffs were set at a maximum of 20 percent. For

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Senegal, one of only two countries of the Union with tariffs above the maximum rate, the CET was an important tariff reduction tool. At the same time, the value added tax (VAT) was harmonized at a rate of 18 percent, which corresponded to a 30 percent increase from the previous rate of 14.3 percent.

Trade liberalization and the increase in the VAT rate have important consequences for resource allocation, factor remuneration, and consumption patterns. Yet this has not been given enough attention by the authorities of the WAEMU and Senegal, who are instead preoccupied by the budgetary repercussions of fiscal reform. This study assesses the impact of these two reforms on resource allocation, income distribution, and the welfare of rural and urban households in Senegal.

Computable general equilibrium (CGE) modeling is particularly useful in analyzing the effects of a policy that profoundly modifies the relative price system of an economy. There are few CGE studies concerning Senegal. The only ones we are aware of were carried out by Mesplé-Somps (2001), Decaluwé, Dissou and Patry (2001), Dansokho (2000) and Dissou (1998). The first author examines the effects of different sources of financing for increases in public investment. Dansokho focuses on the impacts of external shocks and structural adjustment programs (SAPs), while Decaluwé, Dissou and Patry study the consequences of both the introduction of the CET and full trade liberalization among WAEMU States. However, these studies were conducted long before the substantial trade and tax reform of September 2001. Also, the liberalization of trade between Senegal and the rest of the Union (as examined by these authors) had a limited effect since tariffs within WAEMU before 2002 were already negligible (2.7 percent of all imports). Regarding duty collections, WAEMU's share was markedly lower with a rate of 0.7 percent (Chesty, Benon, Simard, 1999).

A CGE model of the Senegalese economy (SenMCEG) is used to assess the impacts of the 2001 trade and tax reforms. This paper describes the Senegalese economy on the basis of accounting data, highlights the specificities of the model, presents and analyzes the results of the simulations and, finally, draws key conclusions.

The structure of the Senegalese economy

Senegal is among the poorest countries in Sub-Saharan Africa, with a per capita gross national product (GNP) of 510 US dollars. It is also ranked 153rd among 174 countries in terms of its human development index (HDI), according to the United Nations Development Programme (UNDP, 2000). Poverty is widespread, as revealed by the 1994 Senegalese Household Survey (ESAM-I). This survey made it possible to identify 44,600 households (or 58 percent of the total) living below the poverty line (based on 2,400 calories per adult per day), which was estimated at 204 US dollars (Diagne et Daffé, 2002). According to extrapolations from the unified survey questionnaire on development indicators (Quid; ESAM-II, 2001), the incidence of poverty dropped to 54 percent in 2001.

The economy is described using the 1996 social accounting matrix (SAM) developed by CREA. This 24-account SAM is the aggregated version of the 83 account SAM developed by Dansokho and Diouf (1999). Macroeconomic and sector-based data produced by the Direction of Forecasting and Statistics (DPS), of the Ministry of Economy and Finance, are obtained from the input/output matrix (TES), the product-level resource-utilization equilibrium matrix (TRE), and the State's flow of funds tables (TOFE), all for the year 1996. Information on households is drawn from the 1995 ESAM survey, as well as from the accounts of the National Pension Fund (FNR) and the "Institut de Prévoyance et des Retraites du Sénégal" (IPRES).

The SAM structure distinguishes the following five sectors of production: agriculture, food processing, other industrial activities, tradable services, and non-tradable services. Production factors include labor, capital, and land. Besides the State and the rest of the world, the institutions include three household groups by location: in the country's capital city (Dakar), in other urban centers, and in rural areas.

Production Activities

The analysis of GDP reveals the predominance of the tertiary sector in the Senegalese economy, which accounts for 31.5 percent of total production and nearly half (47 percent) of total value added (Table 1). Next in importance is industry (26 percent of value added, including 9 percent in food processing). In comparison, the contribution of the primary sector is low (19.4 percent of value added), including 10 percent in agriculture, yet it employs more than 54 percent of the workforce. Given this modest contribution of agriculture, income disparities remain very acute. The high value-added rates observed in the tertiary (65.44 percent) and agricultural (52 percent) sectors reflect their low consumption of intermediate goods. The value-added rate of industry, which consumes a considerable proportion of intermediate inputs, is lower (28 percent).

Table 1: Sectoral contributions to value-added

	Production		Value Added		Value Added Rate
	Value (millions of CFA Francs)	Share (percent)	Value (millions of CFA Francs)	Share (percent)	Value added/ Production (percent)
Primary	824,659	16.49	426,020	19.41	51.66
Food processing	965,886	19.32	200,189	9.12	20.73
Other industries	1,320,495	26.41	366,814	16.72	27.78
Tradable Services	1,577,303	31.54	1,032,261	47.04	65.44
Non-tradable services	311,910	6.24	169,076	7.71	54.21
Total	5,000,253	100	2,194,360	100	43.88

Source: Computations based on Senegal's SAM data (1996).

Another important characteristic of the Senegalese economy is the highly dual nature of its production activities. The modern sector co-exists with a large informal sector composed of small-scale family businesses. With a GDP contribution of 54 percent in 1996 and consumption of 47 percent of intermediate inputs, the informal sector plays an important role in economic activities and welfare (DPS, 1999).

Informal activities account for 95.5 percent of the total production of the primary sector, and 27 percent and 55 percent, respectively, of production in the secondary and tertiary sectors. The growth of the informal sector was accompanied by stability in the GDP share of tradable goods and services. The share of tradables in GDP, which stood at 35.2 percent for the 1985-1993 period, dropped to 34.8 percent in 1994-2000 (Diagne and Daffé (eds), 2002).

External trade

The Senegalese economy is highly dependent on external trade. Imports of goods and services accounted for 40.8 percent of GDP in 1996, compared to 32.3 percent for exports (Table 2), which explains the structural deficit of the country's current account. The industrial sector is the main exporter of goods and services (69.1 percent of exports). Food processing alone provides 29.8 percent of foreign exchange earnings, followed by chemical and petroleum industries (not shown), which contribute nearly 23 percent of total exports (DPS, 1999). The contribution of the agricultural sector to exports is modest (6.4 percent).

Table 2: International trade

Sectors	Import shares (percent)	Export shares (percent)
Agriculture	15.8	6.4
Food industries	9.5	29.8
Other industries	55.7	39.3
Services	19.0	24.6
All	100.0	100.0
GDP share (percent)	40.8	32.3

Source: Computations based on Senegal's SAM (1996).

In 1996, 65.2 percent of imports were of industrial products, of which 17.5 percent were processed food. Consumer goods and petroleum products accounted for 42 percent of imports (DPS, 1999).

Production factors

Table 3a reveals a larger share of labor payments in total value added (62 percent), compared to capital returns (34.2 percent) and returns to land (3.9 percent). The highly informal agriculture, food processing, and service sectors are more labor-intensive, with shares of labor remuneration in value-added of 58, 59 and 64 percent, respectively. Capital returns in these three sectors represent 22, 41 and 36 percent of value-added, respectively. In contrast, "other industries" are more capital-intensive.

Table 3a: Contribution of production factors to value added

Sectors	Primary factor remuneration (millions of CFA Francs)				Contribution of production factors to value added (percent)			
	Labor	Capital	Land	Total	Labor	Capital	Land	Total
Agriculture	247,401	93,841	84,778	426,020	58.1	22.0	19.9	100
Food processing	118,932	81,257		200,189	59.4	40.6	0	100
Other industries	167,821	198,993		366,814	45.8	54.3	0	100
Tradable services	656,564	375,697		1,032,261	63.6	36.4	0	100
Non-tradable services	169,076			169,076	100.0	0	0	100
All	1,359,794	749,788	84,778	2,194,360	62.0	34.2	3.9	100

Source: Computations based on Senegal's Input/output matrix (1996).

Households

Households are grouped into three categories depending on whether they live in Dakar, in other urban centers (OUC) or in rural areas. There are large differences in the living standards of these different groups. Rural households have an annual average per capita income that is seven times lower than households in Dakar. These rural households represent 58 percent of the total population, of which 80 percent are considered to be poor (Table 4). This compares to poverty rates of 19 percent in Dakar and 39 percent in other urban centers. In terms of inequality, the poorest 40 percent of the population earns 17 percent of total income, while the richest 10 percent earn up to 44 percent. The Gini coefficient, which measures the level of inequality in income distribution, was 0.48 percent in 1995. Inequalities are greater in urban areas than in rural areas.

Table 4: Poverty and inequality indices

	Dakar	Other urban centers	Rural	All
Population ratio (percent)	23.5	19	57.5	100
Annual per capita income (CFA Francs)	799, 000	440, 000	116,500	338, 500
Poverty incidence (percent)	19.2	38.6	80	58
Total income share (percent)	42.01	27.04	30.95	100
Poverty depth (percent)	4.3	10	32.5	22
Poverty severity (percent)	1.4	3.7	16.5	11
Gini coefficient	0.47	0.38	0.32	0.48

Source: Computations based on ESAM I survey (1995).

Sources of income

Households derive their income from returns to labor, capital and land, as well as transfers from firms (dividends), government, and the rest of the world. Factor remuneration constitutes the primary source of income for households, representing 85 to 90 percent of total income for all household groups (Table 5a).

Table 5a: Household incomes by source (percent)

	Factors	Transfers received	Total
Dakar	84.64	15.36	100
Other urban centers	86.63	13.37	100
Rural	88.16	11.84	100
All	86.42	13.58	100

Source: Computations based on Senegal's SAM (1996).

The contribution of labor to household income is 63.5 percent, with much higher rates in Dakar and other urban centers (Table 5b). Capital income ranks second, with a contribution of 19 percent. The importance of capital income varies inversely with the standard of living of the region. Returns to land represent only 4 percent of total income and exclusively concern rural households, for which they constitute 17.6 percent of total income. Transfers, primarily from firms and the rest of the world, are also a non-negligible source of household income (13.5 percent), although they are somewhat greater for rural households (18.5 percent).

Table 5b: Household incomes by source (percent)

				Transfers from:			
	Labor	Capital	Land	Firms	State	Rest of the world	Total
Dakar	76.5	11.6	0.00	7.8	0.8	3.2	100
Other urban centers	69.5	17.9	0.00	6.9	0.9	4.8	100
Rural	27.9	36.1	17.6	7.1	1.3	10.1	100
All	63.5	18.9	4.0	7.4	0.9	5.2	100

Source: Computations based on Senegal's SAM (1996).

Intra-household transfers benefit the poorest households least (Table 5c). All household groups receive the majority of their intra-household transfers from rural households, especially in the case of households in other urban centers and rural areas. The smallest share of intra-household transfers comes from Dakar.

Table 5c: Distribution of intra-household transfers by source (percent)

	Transfers from:			
to:	Dakar	Other urban centers	Rural	Total
Dakar	25.5	35.6	38.8	100
Other urban centers	20.7	25.3	54.0	100
Rural	13.2	33.1	53.7	100

Source: Computations based on Senegal's SAM data (1996).

Income use

Household groups are also differentiated by the way they use their income (Table 6). On the whole, household income is distributed between final consumption (91.4 percent), direct taxes (3.1 percent), and savings (5.5 percent). For rural households, final consumption exceeds income by 20 percent, indicating negative savings. In contrast, the consumption ratios are 79 percent and 85.6 percent of disposable income, respectively, for households in Dakar and in other urban centers. Thus, the relatively low overall rate of household savings (5.5 percent) is to a large extent attributable to dissavings of rural households (21.7 percent of income net of transfers and -14.1 percent of total income). In Dakar, the savings rate is about 17 percent of net income and 15 percent of total income. These rates are 11 and 8.1 percent for households in other urban centers. Finally, we note that urban households pay relatively more direct taxes.

Table 6: Consumption of household income (percent)

	Dakar	Other urban centers	Rural	Total
Consumption	79.2	85.6	120.0	91.4
- **Agricultural products**	16.3	22.0	28.7	21.0
- **Food processing**	16.8	19.8	31.2	21.3
- **Other industrial products**	15.1	17.8	28.1	19.2
- **Services**	31.0	25.0	32.1	29.8
Income tax	3.5	4.1	1.5	3.1
Savings	17.3	11.3	-21.7	5.5
Total	100	100	100	100

Source: Computations based on Senegal's SAM (1996).

Consumption structure is characterized by an important share of industrial products (41 percent of total consumption) and services (30 percent), and a modest share of agricultural products (21 percent), although this differs from one stratum to another. While industrial products make up 35 percent of the overall consumption of urban households, this ratio reaches 60 percent among rural households. The share of consumption of agricultural products is naturally more important among the latter (29 percent) than among those who live in Dakar (16 percent) and in other urban centers (22 percent).

The State

As is the case in most WAEMU countries, Senegal is under-taxed. The total tax burden is equal to only 16 percent of GDP in 1996. Informal activities contributed only marginally to the tax base. Sales taxes, which have the largest base, accounted for 34.4 percent of overall revenue in 1996. Income and property taxes accounted for 21.6 percent of the State's income, mainly composed of salary taxes, which contributed almost twice the amount of corporate taxes.

Table 7: State incomes, expenditures and savings (1996)

Items	Share (percent)
(as a percent of total revenue)	
Non-tax revenue	6.3
Tax revenue	93.7
Taxes on goods and services	34.4
Income and property taxes	21.6
Including: - Taxes on wages	12.0
- Corporate taxes	6.7
Taxes on imports	37.7
Total	100
(as a percent of GDP)	
Total revenue	20.9
Total expenditures	21.0
Total normal expenditures	12.7
Public deficit	2.2

Source: DPS (1996).

Up until 1998, revenue derived from external trade was the State's main source of income. In 1996, it accounted for 38 percent of total revenue.

The model

Characteristics of the model

The computable general equilibrium (CGE) model used in our analysis (SenMCEG) was adapted from the EXTER+ neoclassical model of Decaluwé, Cockburn, and Robichaud (2002). SenMCEG differs from EXTER+ in several ways. First, SenMCEG has three production factors (labor, capital, and land), whereas EXTER-PLUS has only two (labor and capital). In the model, land is combined with a composite labor-capital factor. in a CES agricultural production function. The composite labor-capital factor is also a CES function. Second, the model explicitly takes into account intra-household transfers in addition to the transfers between households and other agents (firms, State, and the rest of the world). Finally, as rural household savings were negative in 1996, the initial level is maintained and adjustment is only made through the savings of the other categories of households. This helps to restrict borrowing, which might paradoxically increase, and thus bolster consumption, if income increases (Ponzi effect).

Parametrization

The elasticities used in the production, household consumption, import, and export demand functions are close to those found in studies conducted in Senegal (Dissou, 1998), Niger, and the Gambia (Dorosh, Essama-Nsaah and Samba-Mamadou 1996). Minimal consumption values are calculated based on estimated Frisch parameters. All other parameters are calibrated to reproduce the base year values from the SAM.

Simulations

Justification

The first series of simulations analyzes the consequences of the complete elimination of tariffs on all imports with a fixed current account balance. Two variants are analyzed. First, it is assumed that lost tariff revenue is compensated by the introduction of a uniform sales tax (Sim1a), which replaces the existing sales taxes. Second, it is a uniform direct tax on household incomes, which replaces the previous income tax, that generates compensatory revenue (Sim1b).

The second simulation (sim2) assumes a 50 percent reduction of all import tariffs. It is assumed that partial trade liberalization is compensated by the application of a uniform 18 percent VAT. Sim2 assesses the effects of the dismantling of customs duties that occurred in Senegal between 1998 and 2001, during which average tariff rates likely dropped by over 50 percent. Indeed, the maximum import tariff rate dropped from 65 percent to 20 percent from 1998 to 2001, while the minimum rate dropped from 15 percent to 5 percent, and even to 0 percent for basic social goods included in a restrictive list.

It has not been possible to obtain the data necessary to compute the average rates of customs duties for agricultural and industrial products before 1998 and in 2001, in order to determine the registered decrease. This explains the 50 percent uniform reduction assumed for the rates, somewhat underestimating the magnitude of the dismantling of tariffs. In a situation characterized by a 5 percent average annual real GDP growth and an output improvement of customs administration, it has been possible to dismantle customs duties without any modification of the internal taxation system which took place in September 2001. Sim2 corresponds to the policy adopted by the Government in the second semester of 2001 when it applied the Common External Tariff (CET) and introduced an 18 percent nominal uniform VAT. For this simulation to be done, a prior link between the nominal or official rate and the effective VAT rate computed on the basis of the SAM must first be established.

The uniform rate that replaced the VAT revenue in 1998 was estimated on the basis of the implementation of a microeconomic approach that developed an aggregate of the VAT base using all individual statements of available income at the Direction Générale des Impôts et Domaines, in 1997, and at Customs, in 1998 (Chesty, Benon and Simard, 1999). By extrapolation, the 1998 internal tax base is deducted from that of 1997. The internal VAT statements are broken down between the normal 20 percent rate and the reduced 10 percent rate. It is then assumed that the breakdown of these two rates is similar to that of the gross VAT.

A reduced rate internal VAT base and a normal rate VAT base are thus determined and added to the corresponding VAT bases collected by customs services. The overall VAT base obtained makes it possible to compute the neutral VAT rate which is the ratio maintaining the revenue at its initial levels. This percentage, known as a uniform rate, is the weighted average of the normal and reduced rates, the weights being the respective shares of the two rates in the overall base. The computations reveal that the uniform nominal rate required to maintain 1998 total revenue is similar to that of both the normal and reduced rates at 14.3 percent. It is assumed that this rate has remained constant between 1996 and 2001. The corresponding real uniform rate computed on the basis of the SAM is 3 percent and thus represents one fifth of the nominal uniform rate. If unchanged, this ratio makes it possible to compute the corresponding nominal uniform VAT at the real uniform rate determined by the model.

The implementation of the indirect tax reform also implies a reclassification of goods and services between the categories subjected to a uniform tax rate and the tax exempt category. Most goods and services previously taxed at a reduced rate (basic consumption goods, inputs, cereals, calor gas, kerosene, etc.) are now subjected to a uniform tax. Consequently, a rise in the prices of basic commodities consumed primarily by the poor is expected.

Simulation results

Simulation 1: Unilateral free trade scenario

In this scenario, it is assumed that the State decides to abandon the collection of customs duties on all imported goods and services. The two possible adjustment methods which allow it to compensate the subsequent drop in its revenue are examined: the uniform tax on goods and services (Sim1a), and the uniform direct tax on household incomes (Sim1b). In the first scenario, the abolition of customs tariffs is compensated by a new 3 percent uniform indirect tax which replaces the indirect tax that existed prior to trade liberalization. In the second scenario, the abolition of customs duties is compensated by a direct tax on household incomes, which amounts to 2.5 percent for all households and replaces the original taxation rates. A comparison is then made between the effects of these two scenarios.

The drop in the prices of imports (Table A1) as a result of the lifting of customs duties is greater in Sim1a (-15.74 percent) than in Sim1b (-13.64 percent). Imports increase respectively by 6.94 percent and 6.33 percent (Table A2). The food industries sector, which was relatively more protected before the liberalization, increases the most in the two simulations: 33.93 percent in Sim1a and 33.61 percent in Sim1b.

The share of imports in domestic consumption (19.74 percent) and the relative weakness of Armington elasticities of substitution between imports and domestic production (between 0.5 and 1.8), explain the smaller drop in local demand for domestic products in both experiments, -1.94 percent in Sim1a and -2.18 percent in Sim1b (Table A2). The prices granted to producers drop in Sim1a (-3.37 percent) and Sim1b (-3.62 percent), leading to a change in supply of domestic products into a supply of exported goods. Likewise, given the constraint related to the fixed balance of payments, the increase in imports must be compensated by an increase in exports.

Sales abroad increase by 9.34 percent in Sim1a and 8.52 percent in Sim1b. The "other industries" sector reveals the greatest increase with 14.19 percent and 11.41 percent, respectively. The increase in exports of the other industries and tradable services leads to an increase in their production. The drop registered in the agricultural sectors and the food industries is not compensated by an increase in the production of the other industries and tradable services. The overall production decreases by 0.17 percent in Sim1a and 0.49 percent in Sim1b.

The effects of the reallocation of resources by sector on the remuneration of production factors (Table A3) will now be analyzed. A drop in producer prices results in a drop of -3.77 percent in added value in Sim1a, and of -5.53 percent in Sim1b (Table A1). This results in a drop in the minimal wage rate in Sim1a (-3.87 percent) and in Sim1b (-5.55 percent) (Table A3). Due to its immobility, its output varies from one sector to another. In Sim1a, capital remuneration decreases by 7.68 percent in agriculture, 8.12 percent in food industries, and 2.87 percent in the tradable services sector. In contrast, it increases by 0.70 percent for the other industries, a sector which has witnessed a growth in exports. In Sim1b, it drops by 8.32 percent in agriculture, 10.56 percent in food industries, 3.18 percent in the other industries sector, and 4.22 percent in tradable services (Table A3).

The modification in factor remuneration leads to a change in the remuneration of nominal income. The latter contracts in Sim1a (-3.69 percent) as well as in Sim1b (-5.35 percent). Households are affected in a relatively similar way, although those most affected by the reduction in incomes are found in rural areas, with incomes reduced by 3.84 percent in Sim1a and 5.37 percent in Sim1b. Income reduction is also important for households in Dakar (-5.37 percent) in Sim 1b (Table A4).

As far as the effects of liberalization on household consumption are concerned, the changes in consumption result from the modifications in import prices, domestic prices, and the importance of imports in local consumption. They also reflect the introduction of a uniform tax on products (Sim1a) and a uniform taxation rate imposed on household incomes (Sim1b).

The reduction of import prices and the importance of imports in consumption lead to a drop in producer prices. Therefore, it is not surprising that the consumer prices (Table A.1) register a drop in both simulations (-3.38 percent in Sim1a and -2.38 percent in Sim1b). By combining the price-income effects and the price-consumption effects in equivalent variation (Table A5), the results show that liberalization in both scenarios improves household aggregated welfare. The welfare variation is 0.27 percent in Sim1a and 0.24 percent in Sim1b. However, liberalization affects the three household groups differently. In Sim1a, the welfare of rural households improves (+1.68 percent) whereas the welfare of the households in Dakar (-0.07 percent) and those that live in urban centers (-0.19 percent) deteriorates. In Sim1b, only the households in Dakar witness a drop in their welfare (0.34 percent). On the contrary, the welfare of the households of other urban and rural centers improves by 0.40 percent and 1.40 percent. The improvement of the welfare of rural households can be explained by the more pronounced drop of their price index. Rural households spend the majority of their income on goods from the « other industries » sector, which have registered the highest drop in the consumer price.

Simulation 2: Scenario of a partial liberalization of external trade

A simulation is done on the effects of a 50 percent reduction in customs duties. In order to compensate for the resulting revenue losses, an 18 percent uniform nominal VAT is introduced by the State (Sim2). Emphasis is placed on supply and demand by sector, factor remuneration, household welfare, as well as public funds.

Both domestic and imported products are affected by these measures. The real entry duties were 14 percent for agricultural products, 27 percent for food industry products, and 20 percent for the other industrial products. The 50 percent reduction on the rate of import customs duties brought the real rate down to 7 percent for agricultural products, 14 percent for food industry products, and 10 percent for the other industrial products. The impact of the reduction of customs duties on import prices is far greater than the impact of the introduction of the uniform tax on sales on prices of the imported goods market. Import prices decrease by 4.84 percent (Table A1), whereas production prices fluctuate differently, where a reduction rate of 1.57 percent occurs. However, the impact on these different categories of products depends on their initial level of protection and taxation. Import prices in the agriculture and food sectors, as well as in the other industries, decrease by 1.61 percent, 9.39 percent and 7.03 percent. Meanwhile, trade liberalization induces a 3.45 percent increase in the cost of import services.

The reduction in import prices is a result of the trade restriction measures which most of the sectors are subjected to. The harmonization of taxes on the sale of products is explained by much higher taxation of agriculture and services, because the previous real rates in these sectors were almost insignificant (0.06 percent and 0.01 percent). The industrial sector, relatively more protected prior to the introduction of this policy, reacts more (an average of 3 percent) to the reduction of entry duties. The prices of foreign industrial products, notably non-food products, are subjected to a much greater reduction than are agricultural products. On the whole, the trade liberalization measure is a source of an increase in the volume of imports (Table A2); in this case, an increase of 3.40 percent. As expected, industrial products (food industry products in particular) registered the highest increases in their imported volumes.

With a continuously stable current account balance, the increase in imports can only be financed by an increase in exports. The assumed price elasticities of both demand and supply result in an increase of 4.57 percent in the volume of sales abroad. The non-food industries sector, which represents close to 39 percent of the overall volume of imports, registered the highest increase in sales abroad. The increase in sales abroad is combined with a slight reduction in internal market opening (-0.85 percent). The reorientation of domestic supply towards export supply is explained by the depreciation of the real exchange rate, making sales abroad more profitable (Table A2).

However, the transformation of domestic sales into export sales is relatively important in the non-food industries sector. This situation is best explained by the superiority of the trade elasticities of transformation of industrial products (2.5) over that of industrial food products (1.80). Yet, it is observed that increases in sales abroad are accompanied by a reduction of the production.

In the agriculture and food industries sectors, a decrease of 2.6 percent and 1.79 percent is observed. Conversely, a supply increase of 2.04 percent and 0.46 percent is observed in the other industries, and tradable services (Table A2) that compensates the reduction at both the agriculture and food industry level. Consequently, production is generally stable on the whole. This result stems from the variation of the effective level of protection measured by the variation in the added value price. Therefore, the rate of protection in the agricultural sector decreases by 2.75 percent, while the price of the added value decreases by 2.58 percent for the food industries sector and 0.20 percent for the other industries sector. In scenario Sim2, where the real VAT rate is 4.7 percent, the decrease in the price of the added value of services is 1.62 percent.

The impact of external trade liberalization and VAT reform measures on production leads to a modification of the remuneration of production factors. The remuneration of labor is reduced by 1.77 percent, as the labor made available for agricultural and food industries activities is not yet entirely absorbed by the other industries and services. Capital remuneration evolves differently from one sector to another. This factor, which is steady among sectors, registers a reduction of its output and agricultural and food industries (-4.10 percent and -3.4 percent). Conversely, this output increases by 1.15 percent for the other industries and decreases by 1.30 percent for services. The drop in the agricultural production decreases the output from land by 4.10 percent.

The changes in the prices of the primary production factors explain those observed in household incomes. The nominal revenue of all the households decreases by 1.67 percent. This reduction is more pronounced in rural households than in households in urban areas (Table A4).

The level of welfare in the households, measured by equivalent variation, is determined by the incomes they receive, the consumer prices, and the contents of their consumer basket. With a nominal VAT harmonization rate of 18 percent, the welfare of all the households increases by 0.22 percent (Table A5). However, household groups are not evenly affected. Households in other urban areas witness a slight utility decrease (-0.02 percent). Their consumption accounts for more than 24 percent devoted to agricultural products which have witnessed the highest increase in consumer prices. The welfare of households in Dakar and other rural areas improves by 0.15 percent and 0.69 percent respectively.

When examining the effects of these measures on public funds, it is noted that in spite of the harmonization of 18 percent of the domestic sales tax, the State's income decreased by 1.62 percent. Furthermore, the State's consumption decreased by 1.66 percent while investment decreased by 4.66 percent in real value.

Impacts on poverty

Changes in welfare measured in terms of equivalent variation do not take into account the heterogeneity of households within a group, due to differences in their incomes and consumption structures. Poor households living in rural areas devote 56 percent of their consumption to food products whereas those living in urban centers devote an important share of their budgets to services (34 percent on average), besides the 43 percent share devoted to agricultural products (Table 8).

The analysis of the impact of total and partial liberalization policies on household poverty considered as a whole and grouped in strata builds on two hypotheses. Firstly, the variation of average consumption is stable between households within the same stratum. Secondly, the average consumption of each stratum is applied to the consumption vector of this group of households. An estimation of household consumption vectors for each of the simulations has thus been made, using the base year data. The estimation of the value of the national poverty line corresponding to each simulation has been made on the basis of variations of the national consumer price index.

Table 8: Consumption structure of the poor by strata (share percent)

Strata	Agriculture	Food industries	Other industries	Services	Total
Dakar	43	8	17	32	1.00
Other urban centers	43	7	15	36	1.00
Rural areas	56	10	16	18	1.00
All	54	10	16	20	1.00

Source: Computations based on ESAM I data (1995).

The poverty indices of each simulation and their variation as compared to the base year have been computed on the basis of the new vectors of consumption and the new value of the poverty line. The indices used are those revealed by Foster, Greer, and Thorbecke (1984) (FGT), symbolized by Pa, and known to be both decomposable and additive. They enable several poverty dimensions to be taken into account, depending on the level of aversion to poor people (measured by the value attributed to a). These include poverty incidence (P0), poverty depth (P1) and poverty severity (P2).

Table 9 presents the results of the estimations of these indices for the three household groups in the three simulations. Computations are made on the basis of the household per equivalent adult consumption, with a nominal poverty line of 143,080 CFA Francs at the base year. This nominal poverty line was computed by the DPS, derived from the 1995 ESAM I data. An analysis of the results reveals several trends:

- The average income of households decreases in all the simulations;
- The trade liberalization policy results in a reduction of poverty in all simulated liberalization scenarios;
- The total liberalization policy (Sim 1a and Sim 1b) is more conducive to poverty reduction than to a partial dismantling of tariffs;

Table 9 : Poverty indices variation

	Poverty line (in CFA Francs)	Initial level	Sim1a		Sim1b		Sim2	
			Level	Variation (percent)	Level	Variation (percent)	Level	Variation (percent)
Location		143 080	138 248	*-3.377*	139673	-2,38102	140747	-1,63038
All	P0	0.691	0.686	*-0.718*	0.685	*-0.874*	0.688	*-0.540*
	P1	0.284	0.278	*-2.117*	0.279	*-1.747*	0.280	*-1.123*
	P2	0.147	0.143	*-2.921*	0.144	*-2.387*	0.145	*-1.474*
Dakar	P0	0.288	0.281	*-2.457*	0.288	*0.000*	0.281	*-2.457*
	P1	0.065	0.063	*-2.866*	0.065	*-0.213*	0.063	*-3.035*
	P2	0.021	0.020	*-3.493*	0.021	*-0.260*	0.020	*-3.698*
Other urban centers	P0	0.510	0.507	*-0.550*	0.491	*-3.702*	0.507	*-0.550*
	P1	0.140	0.139	*-0.894*	0.136	*-2.833*	0.139	*-1.160*
	P2	0.053	0.052	*-1.115*	0.051	*-3.539*	0.052	*-1.446*
Rural areas	P0	0.884	0.879	*-0.551*	0.880	*-0.491*	0.881	*-0.323*
	P1	0.401	0.392	*-2.201*	0.394	*-1.721*	0.397	*-1.013*
	P2	0.218	0.212	*-3.031*	0.213	*-2.376*	0.215	*-1.402*

Source: Computations made on the basis of simulation results.

- In all the simulations, urban dwellers benefit the most, as poverty rates decrease more in this group than in the rural area dwellers group;
- The magnitude of the impact of unilateral free trade policy on poverty differs according to the mode of compensation of revenue losses. When applying the uniform tax on household incomes (Sim1b), the poverty incidence at the national level decreases by 0.87 percent. On the other hand, when the uniform tax on sales (sim1a) is applied, the number of poor people decreases by 0.72 percent;
- Household categories are affected differently. Poverty variation rates depend on the initial levels of both direct and indirect taxes paid, as well as on the structures of household incomes and consumption. Under Sim1a, the incidence of poverty decreases by 2.6 percent in Dakar and by 0.55 percent in other urban centers and rural areas. In the case of trade liberalization with a uniform tax on income as a mode of compensation (Sim1b), the effect on poverty depends on the initial levels of the rate of taxation of the various household groups. Tax rates on real income were 2.57 percent for Dakar, 2.77 percent for other urban centers and 1.47 percent for rural areas. With the harmonization of the income tax, its real rate henceforth stands at 2.49 percent, which is more beneficial to other urban centers that were relatively subjected to more taxes. The incidence of poverty thus decreases more in other urban centers (-3.70 percent). This decrease equals 0.49 percent in rural areas, whereas in Dakar, no variation of the poverty incidence has been registered;
- If the VAT is harmonized at an 18 percent rate (Sim 2), the partial liberalization of external trade leads to a reduction of the poverty incidence at the national level and in the various household groups. But the magnitude of this reduction varies from one group of households to another. Households in the

capital city are the ones that benefit most from this shock, as the poverty incidence decreases by 2.46 percent. In other urban centers and in rural areas, it decreases by 0.5 percent and 0.32 percent, respectively.

Overall, poverty depth and severity measurements decrease while gaps between household groups remain.

Conclusion

Within the framework of the sub-regional economic integration under the West African Economic and Monetary Union (WAEMU), Senegal's economy became less protected while its internal taxation system was strengthened. A simulation model capturing the general equilibrium effects of these reforms has been used. The first two experiments imply the potential introduction of a unilateral free trade mechanism. The State's foregone earnings are compensated by either a uniform tax on sales or a uniform direct tax rate. The third simulation deals with partial liberalization. It transforms the tax reform implemented in Senegal between 1998 and 2001, which led to a more than 50 percent reduction of import taxes and a modification of the internal taxation system. The compensation of foregone earnings is effected through the introduction of an 18 percent uniform value-added tax.

Simulations have revealed that an integral and partial liberalization of external trade results in the reallocation of resources to the benefit of « other industries » and « tradable services » sectors, and to the detriment of agriculture and food industries.

The impact on households is analyzed in terms of welfare measurements and poverty. The results will depend on the relative impact of the liberalization on sectors and households depending on export and import shares, and on the tariff rates of the sectors of the economy and the structure of the consumer baskets of the various household categories. The more involved that households are in strongly extroverted sectors, the greater will be the impact on income. This impact will be equally important for sectors that had previously been highly protected and produced substitutes for imported goods. The price effect on the household consumption budget will depend on the relative weight of imported goods in the consumer basket.

The results reveal that regardless of the selected mode of compensation, the welfare of all the households is improved. However, if grouped in three categories based on geographical location, rural households have welfare gains in all three scenarios, unlike households based in Dakar and other urban centers. Therefore, when considering the entire population in each household group, the combination of both income-price and consumption-price effects in equivalent variations reveals a more pronounced improvement of the welfare of the rural population. However, an analysis of the situation of poor households before and after the various experimented scenarios reveals that urban households benefit more from the liberalization policy. Poverty has decreased more in urban than in rural areas.

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Table A1: Effects on prices (percent)

	External trade Elasticities		Share by sector (percent)					PRICE VARIATIONS														
	CES	*CET*	*VAi/VA*	*Mi/M*	*EXi/EX*	*Mi/Qi*	*EXi/Xs*	*PV*			*Pi*			*PMi*			*PDi*			*PDi*		
								Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2
Agriculture	0.60	2.20	19.41	14.64	0.68	14.83	0.59	-5.50	-6.73	-2.76	-2.82	-3.60	-1.17	-11.99	-11.93	-1,61	-2.90	-3.63	3.41	0.51	-0.86	1.37
Food industries	1.80	1.80	9.12	10.66	31.62	12.37	23.74	-5.63	-7.63	-2.58	-3.24	-3.05	-1.38	-23.76	-21.28	-9,39	-7.30	-4.04	-0.44	-5.54	-3.00	-3.04
Other industries	0.50	2.50	16.72	55.67	41.65	34.77	22.87	-1.43	-4.27	-0.20	-3.95	-3.57	-2.04	-19.09	-16.32	-7,03	-8.33	-4.70	-1.46	-8.07	-5.33	-4.77
Tradable services	0.70	2.80	47.04	19.03	26.05	11.79	11.98	-3.51	-5.07	-1.60	-3.24	-3.94	-1.50	-1.19	0.00	3,45	-4.85	-4.51	1.69	0.53	0.22	0.71
Non-tradable services	-	-	7.71	-	-	-	-	-3.87	-5.55	-1.77	-3.48	-3.95	-1.66	-	-	-	-	-	-			
Total for Industries								-2.91	-5.46	-1.04	-3.65	-3.35	-1.76	-19.88	-17.16	-7,42	-7.90	-4.42	-1.03	-7.21	-4.53	-4.18
Total for Services								-3.56	-5.14	-1.62	-3.27	-3.94	-1.52	-1.19	0.00	3,45	-4.85	-4.51	1.69	0.53	0.22	0.71
Total	-	-	100.00	100.00	100.00	19.74	15.47	-3.77	-5.53	-1.69	-3.37	-3.62	-1.57	-15.74	-13.64	-4,84	-5.82	-4.29	0.82	-3.38	-2.38	-1.63

NB: The price index used here is the Laspeyes price index.

Source: Computations based on simulation results.

Table A2: Effects on volumes (percent)

SECTORS	*VAi*			*XSi*			*Mi*			*Di*			*Exi*		
	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2
Agriculture	-3.45	-2.56	-2.06	-3.45	-2.56	-2.06	2.38	2.80	0.89	-3.49	-2.61	-2.08	2.82	5.64	0.50
Food industries	-3.93	-4.72	-1.79	-3.93	-4.72	-1.79	33.93	33.61	15.42	-5.80	-6.46	-2.57	1.93	0.75	0.71
Other industries	3.26	1.72	2.04	3.26	1.72	2.04	6.36	5.41	3.38	-0.07	-1.23	0.42	14.20	11.41	7.44
Tradable services	0.99	1.34	0.46	0.99	1.34	0.46	-2.95	-3.52	-1.33	-0.36	-0.35	-0.13	10.73	13.42	4.79
Non-tradable services	0.00	0.00	0.00	0.00	0.00	0.00	-	-	-	-	-	-	-	-	-
Total for Industries	0.72	-0.55	0.69	0.72	-1.00	0.42	10.79	9.94	5.31	-2.48	-3.42	-0.84	8.90	6.81	4.53
Total for Services	0.85	1.15	0.40	0.83	1.12	0.39	-2.95	-3.52	-1.33	-0.36	-0.35	-0.13	10.73	13.42	4.79
Total	-0.02	-0.01	-0.01	-0.17	-0.49	0.00	6.94	6.34	3.40	-1.94	-2.18	-0.85	9.34	8.52	4.57

Source: Computations made on the basis of simulation results.

Table A3: Effects on factor remuneration by sector

	Share (percent)									FACTOR PRICE VARIATIONS								
	Ki/Li			*Wli/WL*			*rKi/Rk*			*w*			*r*			*r l*		
	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2
Agriculture	0.38	0.38	0.38	18.19	18.19	18.19	12.52	12.52	12.52	-3.87	-5.55	-1.77	-7.68	-8.32	-4.10	-7.68	-8.32	-4.10
Food industries	0.68	0.68	0.68	8.75	8.75	8.75	10.84	10.84	10.84	-3.87	-5.55	-1.77	-8.12	-10.56	-3.74	0.00	0.00	0.00
Other industries	1.19	1.19	1.19	12.34	12.34	12.34	26.54	26.54	26.54	-3.87	-5.55	-1.77	0.70	-3.18	1.15	0.00	0.00	0.00
Tradable services	0.57	0.57	0.57	48.28	48.28	48.28	50.11	50.11	50.11	-3.87	-5.55	-1.77	-2.87	-4.22	-1.30	0.00	0.00	0.00
Non-tradable services	-	-	-	12.43	12.43	12.43	-	-	-	-3.87	-5.55	-1.77	-	-	-	-	-	-
Total for Industries										-3.87	-5.55	-1.77	-1.86	-5.32	-0.27	0.00	0.00	0.00
Total for Services										-3.87	-5.55	-1.77	-2.87	-4.22	-1.30	0.00	0.00	0.00
Total	0.63	0.63	0.63	100.00	100.00	100.00	100.00	100.00	100.00	-3.87	-5.55	-1.77	-3.09	-5.15	-1.26	-7.68	-8.32	-4.10

Source: Computations made on the basis of simulation results.

Table A4: Effects on household net incomes and savings

Strata	Nominal incomes			Direct taxes			Net incomes		
	Sim1a	Sim1b	Sim2	Sim1a	Sim1b[1]	Sim2	Sim1a	Sim1b	Sim2
Dakar	-3.68	-5.37	-1.66	-3.68	-100.00	-1.66	-3.67	-2. 5	-1.66
Other urban centers	-3.59	-5.28	-1.61	-3.59	-100.00	-1.61	-3.52	-1.41	-1.58
Rural	-3.84	-5.37	-1.79	-3.84	-100.00	-1.79	-3.92	-2.31	-1.89
Urban	-3.65	-5.34	-1.64	-3.64	-100.00	-1.64	-3.62	-2.20	-1.63
All	-3.69	-5.35	-1.67	-3.67	-100.00	-1.66	-3.66	-2.21	-1.67

Source: Computations made on the basis of simulation results.

[1] Original rates were cancelled in this simulation and replaced by a uniform 2.49 percent rate.

Table A5: Effects on household welfare

Strata	Nominal incomes			Consumption prices			Equivalent variation		
	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2	Sim1a	Sim1b	Sim2
Dakar	-3.68	-5.37	-1.66	-2.40	-1.74	-0.99	-0.07	-0.34	0.15
Other urban centers	-3.59	-5.28	-1.61	-2.70	-1.98	-1.15	-0.19	0.40	-0.02
Rural	-3.84	-5.37	-1.79	-3.07	-2.17	-1.39	1.68	1.40	0.69
Urban	-3.65	-5.34	-1.64	-2.51	-1.83	-1.05	-0.11	-0.07	0.09
All	-3.69	-5.35	-1.67	-3.38	-2.38	-1.63	0.27	0.24	0.22

Source: Computations made on the basis of simulation results.

The Impact of Trade Liberalization on Household Welfare in Vietnam

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Abstract

This paper evaluates the efficiency and distributional effects of trade liberalization in the context of fiscal reform in Vietnam. The analysis is performed using a computable general equilibrium (CGE) model of the Vietnamese economy calibrated to late-1990s production and household data. It is a standard small open price taking economy model with CES nested demand and CES production functions.

Results show that the efficiency gains (in terms of aggregate welfare measure) from the combined tax and tariff reform are modest, but significant redistribution occurs among rich and poor household groups and between urban and rural populations. Careful analyses show that the sharpness of the redistribution falls as the country moves from only trade liberalization to combined tax and tariff reforms. Finally, additional simulations have been performed to make clearer the transmission mechanisms linking tariff policy to income distribution and household welfare. A key finding is that trade liberalization is pro-rich due essentially to the higher share of imported goods consumed by the rich.

Keywords: CGE model, counterfactual simulations, distributional effects, efficiency, household welfare, tariff, tax reform, trade liberalization, VAT, Vietnam.

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Introduction

Trade liberalization is an important issue in Vietnam as it works to comply with the requirements for joining the ASEAN Free Trade Agreement (AFTA) and the World Trade Organization (WTO). The objective of this paper is to evaluate the impacts of trade liberalization in Vietnam on economic efficiency (at macro level) as well as on the welfare of households ranked by expenditure groups.

The structure of model used is fairly standard along the lines of Dervis, et al (1985), Devarajan and Lewis (1980), Shoven and Whalley (1992), Harrison, Rutherford and Tarr (1993) and Ghosh, Hutton and Whalley (1999). However, some degree of novelty lies in the use of fixed factors and the application of the Armington (1969) structure both in production and consumption within the small economy assumptions. We use Vietnamese data for 1996 to calibrate the model and to perform a series of counterfactual experiments to analyze the impacts of tariff reductions and VAT reform at the macro and micro levels.

The model is used in counterfactual mode by replacing the existing (1996) Vietnamese tariff structure by a yield preserving VAT. Four VAT rates in the ration of 0:1:2:4 are endogenously determined. Trade balance conditions hold in both the base and new equilibria.

We have run several additional counterfactual scenarios to highlight the channels of impacts of trade liberalization policy on income distribution and household welfare. The particular channels are via renumeration of specific factors, consumer prices, and household expenditure patterns.

We begin with an overview of trade policy, poverty and inequality in Vietnam, before we proceed to a detailed description of the model. The remainder of paper is devoted to the presentation of counterfactual simulations, discussion of results and concluding remarks.

Trade Policies

Tax reform in Vietnam is ongoing with a value added tax (VAT) introduced in 1999. The key issue is tariff reform, which is necessary as a part of the country's commitments prior to its integration into AFTA and Asia-Pacific Economic Cooperation (APEC) agreement. Tariff liberalization is also an indispensable requirement for joining the WTO in the future.[1]

To comply with these requirements the Vietnamese government announced a tariff schedule in early 1998. Vietnam committed to maximize the list of goods with a tariff rate of 5 percent in 2003 and expand the list of goods with 0 percent tariff in 2006. Table 1 provides estimates of current effective rates of protection of Vietnam.

Table 1: Effective rates of protection (ERP), 1996

Model Sector		ERP	Model Sector		ERP
1. Paddy	D1	3.7	10. Chemicals and printing	D10	2.3
	E1	0.8		E10	0.4
2. Other agriculture	D2	9.8	11. Textiles and garments	D11	18.0
	E2	2.4		E11	9.5
3. Forestry.	D3	0.7	12. Electricity, gas and water	D12	18.2
	E3	0.0		E12	3.1
4. Aquatic goods	D4	4.5	13. Construction	D13	0.0
	E4	1.1	14. Hotel and restauration	D14	0.0
5. Mining	D5	3.6		E14	0.0
	E5	0.4	15. Transport and	D15	0.0
6. Alcoholic beverages	D6	7.6	communication	E15	0.0
	E6	1.6	16. Financial services	D16	0.0
7. Food Manufacturing	D7	7.6		E16	0.0
	E7	1.0	17. Non-financial private	D17	0.0
8. Ceramics and paper	D8	7.3	and public services	E17	0.0
	E8	0.9			
9. Construction material	D9	13.4			
	E9	0.2			

[1] One significant step recently made in this direction, after a prolonged discussion, is the US-Vietnam Trade Agreement signed on July 13, 2000, in Washington, DC.

Currently, tax revenues are around 20 percent of GDP and constitute more than 90 percent.

Table 2: Government revenue 1997-1998

Total revenue from all taxes and fees	100 percent
– Corporate profit	10.1
– Labor use tax	20.5
– Capital use tax	5.4
– Commodity input tax	25.2
– Export tax	5.4
– Import tax	14.3
– Sales tax	17.4
– Household income tax	1.70

Sources: *General Department of Taxes, 2000, I/O Table 1996, the SNA 1997 and authors' estimates.*

Vietnam expects that the tariffs on ASEAN imports will be removed by 2006 and those on APEC imports by 2020. Following WTO regulations, tariffs should be the last protective barriers removed by states. This implies that tariff reductions should be accompanied by the removal of non-tariff barriers (NTBs), such as import quotas, fixation of the basic import price to determine the tariff, application of higher domestic taxes on imported goods, fees on imported products, and subsidies in the form of tax reduction or tax exemptions for domestically produced goods. We do not include NTBs to avoid undue compexity and instead focus on our analysis on the impacts of tariff policy.[2]

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[2] More details on this subject, including the problem of quantitative estimation of tariff equivalence of NTBs can be found in Huy et al. (2000A, 2000B). Recently, Ghosh and Whalley (2001) also arrived at interesting results on the effects of export quotas and price controls for the rice market in Vienam.

Poverty and Inequality

Results from the 1997-98 Vietnam Living Standard Survey (VLSS) indicate that although living standards have generally improved in the last five years, the gap remains very significant between urban and rural population (see Table 3).

Table 3: Sources of Household Income 1996

Household group	Population share (percent)	Annual per capita income (000 VND)	Share in total income by source (percent)			
			Wage income	Capital income	Government transfers	Foreign transfers
H1U	0.8	926	6.0	3.0	4.8	3.0
H1R	19.2	804	3.8	1.5	3.1	2.0
H2U	1.4	1550	7.5	5.9	6.5	6.0
H2R	18.6	1487	5.5	2.1	4.8	2.0
H3U	2.5	2235	8.3	7.5	7.2	7.0
H3R	17.5	2173	7.1	4.7	6.5	5.0
H4U	5.2	3360	11.2	7.7	9.3	8.0
H4R	14.9	3257	8.4	10.0	8.3	10.0
H5U	12.6	9617	26.7	29.7	32.8	30.0
H5R	7.4	6625	15.6	27.9	16.8	27.0
Total	**100.0**		**100.0**	**100.0**	**100.0**	**100.0**

Sources: Vietnam I/O Table 1996 (GSO, 1999); VLSS 1997-1998, GSO (2000); General Department of Taxes. *Notes*: H1: poorest quintile, H5: richest quintile, U = urban, R = rural.

According to the survey, the annual income per capita of the top quintile is 7,905 thousands VND (roughly $US 680), or 10.5 times higher than that of the bottom quantile. If the top and bottom deciles are compared, this gap is doubled. We also note that the gaps vary according to the source of household income. Consumption patterns are also very different between the poor and rich household groups (Table 4).

Table 4: Household consumption patterns 1996

Model Sector		H1U	H1R	H2U	H2R	H3U	H3R	H4U	H4R	H5U	H5R
Paddy	D1	0.03	0.05	0.03	0.04	0.02	0.03	0.03	0.02	0.02	0.02
Other agriculture	D2	0.05	0.07	0.06	0.06	0.06	0.05	0.07	0.07	0.06	0.07
Forestry.	D3	0.05	0.08	0.06	0.08	0.07	0.07	0.13	0.13	0.09	0.11
Aquatic goods	D4	0.04	0.04	0.04	0.04	0.04	0.04	0.13	0.12	0.16	0.14
Agriculture		**0.17**	**0.24**	**0.19**	**0.22**	**0.19**	**0.19**	**0.36**	**0.34**	**0.33**	**0.34**
Mining	D5	0.04	0.04	0.04	0.04	0.04	0.03	0.04	0.06	0.04	0.05
Alcoholic beverages	D6	0.08	0.08	0.09	0.08	0.09	0.08	0.17	0.12	0.19	0.18
Food Manufacturing	D7	0.13	0.13	0.19	0.15	0.17	0.14	0.08	0.08	0.09	0.07
Ceramics and paper	D8	0.04	0.05	0.06	0.06	0.07	0.08	0.01	0.01	0.02	0.02
Construction material	D9	0.00	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01
Chemicals and printing	D10	0.03	0.04	0.05	0.05	0.04	0.05	0.13	0.14	0.15	0.14
Textiles and garments	D11	0.03	0.05	0.04	0.05	0.04	0.04	0.01	0.02	0.01	0.01
Electricity, gas and water	D12	0.01	0.00	0.02	0.00	0.02	0.01	0.06	0.05	0.05	0.04
Construction	D13	0.21	0.19	0.09	0.14	0.08	0.16	0.06	0.07	0.05	0.06
Industry		**0.57**	**0.59**	**0.58**	**0.58**	**0.55**	**0.61**	**0.57**	**0.56**	**0.61**	**0.58**
Hotel and restoration	D14	0.06	0.04	0.07	0.06	0.08	0.07	0.03	0.03	0.02	0.02
Transport and communication	D15	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
Financial services	D16	0.01	0.00	0.02	0.00	0.01	0.01	0.03	0.04	0.02	0.03
Non-financial private and public services	D17	0.17	0.13	0.15	0.14	0.15	0.13	0.02	0.01	0.02	0.02
Services		**0.24**	**0.18**	**0.24**	**0.20**	**0.25**	**0.22**	**0.09**	**0.09**	**0.07**	**0.08**
	Total	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**	**1.00**

Source: Computed from the Social Accounting Matrix (SAM) prepared by the authors.

Description of the Model

The model structure and specifications

The CGE model provided in this paper is a small, price-taking open economy model. Before entering into the details of different blocks of the model, its general features are described through a circular flow relation in Figure 1.

There are 4 blocks that form the economy; Household (10 household groups), Production (33 goods and services sectors, among which 17 are for domestic sale and 16 for export), Government and the rest of the World (ROW). The benchmark data set used in model calibration is for the base year 1996). A detailed social accounting matrix (SAM) prepared using the latest I/O Table (1996) and the 1997-98 VLSS serve as the main data sources.

Production

The model incorporates 33 production sectors (17 for domestics and 16 for export aggregated from 97 sectors identified in the Vietnam I/O Table 1996. Production market characteristics used in model calibration are reported in Table 5. There is only one non-trade sector (Sector G13: Construction). All other sectors are traded and decomposed into production for domestic sale (D_i) and production for export (E_i).

The choice of sectoral aggregation aims to capture the key characteristics of the Vietnamese economy. Lack of data limits further disaggregation. Each sector of the model produces goods using both primary factors (including capital, labor, foreign capital and sector-specific factors) and intermediate (domestically produced or imported) inputs.

The production functions used are of the double nested constant elasticity of substitution (CES) from (FIgure 2). At the bottom level, primary factors are aggregated by CES function into composite factor inputs. Similarly, all intermediate goods including imported goods are nested into composite intermediate goods input by a CES function.

Figure 1: An overview of transactions

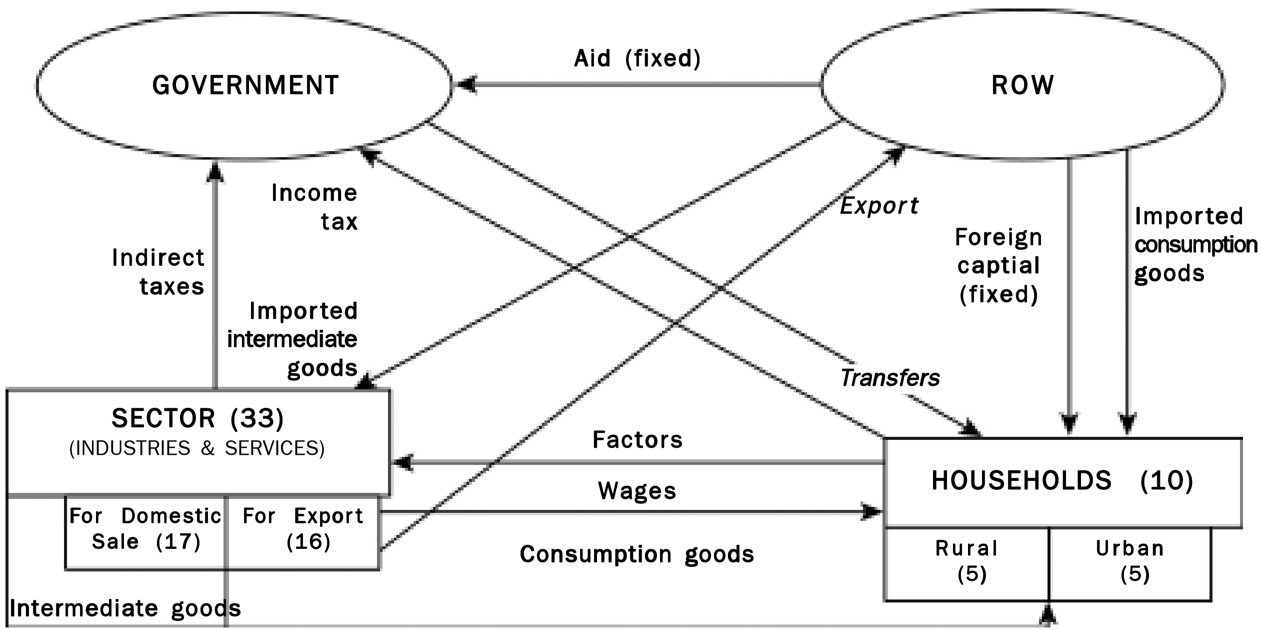


Table 5: Production and factor markets 1996

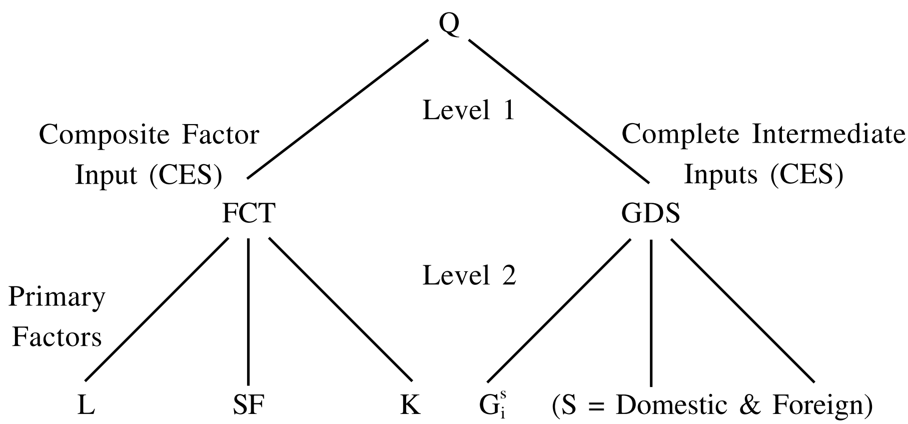
Model Sector		Value Added		Capital VA	Labor VA	Output	
		Rate (VA/SX)	Share	Share	Share	Share	Value (Bill VND)
Paddy	D1	59.3	11.1	1.3	14.1	8.3	48959
	E1	59.3	0.2	0.0	0.2	0.1	834
Other agriculture	D2	71.4	4.8	1.2	6.6	3.0	17728
	E2	71.2	3.8	1.0	5.3	2.4	14070
Forestry.	D3	59.2	6.3	1.8	7.8	4.7	28042
	E3	58.9	0.3	0.1	0.4	0.3	1513
Aquatic goods	D4	61.1	3.5	1.3	4.4	2.5	15031
	E4	60.6	0.7	0.3	0.9	0.5	2998
Mining	D5	51.9	2.1	5.1	0.7	1.8	10712
	E5	54.5	4.3	9.5	1.3	3.4	20439
Alcoholic beverages	D6	31.9	3.3	4.0	2.3	4.6	27411
	E6	25.9	1.0	1.6	1.0	1.8	10416
Food Manufacturing	D7	10.7	1.7	1.9	1.6	6.8	40338
	E7	10.2	0.5	0.6	0.5	2.1	12462
Ceramics and paper	D8	17.6	2.5	3.0	2.3	6.2	37013
	E8	19.0	0.7	0.8	0.6	1.6	9386
Construction material	D9	26.8	1.7	3.5	0.8	2.8	16602
	E9	26.6	0.1	0.2	0.0	0.1	741
Chemical snd printing	D10	21.4	2.3	2.8	1.8	4.7	27699
	E10	20.0	0.3	0.4	0.3	0.7	3848
Textiles and garments	D11	23.8	1.0	1.1	1.0	1.8	10758
	E11	23.5	1.8	2.1	1.9	3.4	20349
Electricity, gas and water	D12	43.7	2.4	2.2	2.6	2.4	14483
	E12	47.6	0.0	0.0	0.0	0.0	30
Construction	D13	31.2	6.4	8.3	6.3	9.1	53710
Hotel and restauration	D14	69.7	16.5	31.0	11.9	10.5	62507
	E14	69.1	1.5	3.0	1.2	1.0	5768
Transport and communication	D15	54.7	4.3	5.5	2.8	3.5	20477
	E15	54.5	0.4	0.5	0.3	0.3	1789
Financial services	D16	70.2	0.9	1.4	0.9	0.6	3298
	E16	70.7	0.8	1.3	0.8	0.5	3034
Non-financial private and public services	D17	65.1	12.1	3.2	16.4	8.2	48838
	E17	64.6	0.6	0.2	0.9	0.4	2575

Sources: GSO; General Department of Taxes and author's estimates.

Notes: D: Production for domestic sale; E: Production for export

Intermediate goods and factor inputs are then aggregated at the upper level of the production function to obtain final output. Factor and intermediate good demands are determined from the first order conditions of cost minimization (see Shoven and Whalley, 1992). Note that for both the supply and demand sides of the model, we adopt the small country assumption.

Figure 2: Nesting structure of production functions



The parameters of the model are calibrated. There are no elasticity estimates available for the Vietnamese economy. Thus, the production side elasticity values used are based on Chia, Wahba and Whalley (1992), which they adopted in their work on the Cote d'lvoire Model. These values are shown in Table 8. On the production side, the elasticities of substitution between composite inputs (factor input and good input) are naturally lower than the elasticities of substitution between inputs. We assume that the bottom level elasticities are 1.5 times greater than the upper level elasticities.

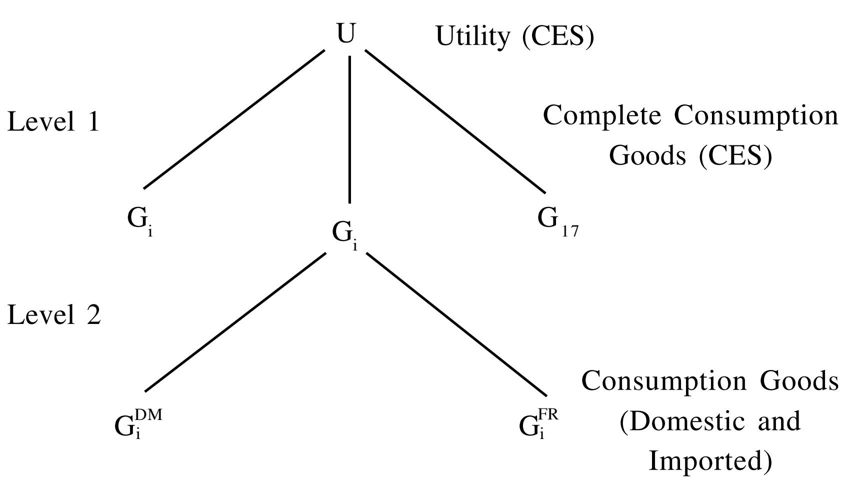
Households

In the model, 10 household groups are identified according to their classification by level of expenditure in the VLSS. The survey data indicates five households quintiles. These quintile groups are decomposed into urban and rural households using information from the GSO survey data.

Households receive income in the form of wages and returns from other factors they hold as well as transfers from the government. The model remains static and considers neither savings nor investment. Thus, household disposable income is entirely spent on consumption.

Each household has a double nested CES utility function to be maximized subject to the household budget constraint (Figure 3). At the lower level, Armington differentiation between domestically produced and imported consumption goods is used. At the upper level, composites of domestic and imports are aggregated to determine the level of utility. In the model, final demands of composts goods by source (imported or domestic) for each household group are derived from the first order conditions of utility maximization.

Figure 3: Nesting structure of utility functions



Elasticity values used for the upper level of the nests are based on our assumptions and in line with central tendency estimates available in Shoven and Whalley (1992), Piggot and Whalley (1985), Marques (1990) and Orcutt (1950). The convention is again followed that the lower level elasticities are 1.5 times that of the upper level ones (Perroni and Whalley, 1996). Upper level elasticities are presented in Table 6. Several sensitivity tests were undertaken on the elasticity parameters used in the central case model specification and showed that the results were robust.

Table 6: Consumption side elasticity of substitution

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Urban	0.94	0.94	1.26	1.56	1.56
Rural	0.75	0.75	1.01	1.25	1.25

Sources: Authors assumption based on Shoven and Whalley (1992), Piggot and Whalley (1985), Marques (1990) and Orcutt (1950).

Equilibrium conditions

Equilibrium is attained by endogenously determining prices of factors and domestic goods and assuming full market clearing and zeo profit conditions for each of 33 sectors.

Simulation Results

Base case

In the base case, we simulate trade reforms to comply with the AFTA and WTO requirements that no tariff be higher than 5 percent. The simulation exercise is performed by reducing all tariffs that are higher than 5 percent, to 5 percent and keeping other tariffs unchanged.

We also replace existing sales taxes by four yield-preserving VAT rates in the ratio (0:1:2:4) applicable to commodities classified into four groups, where the rates are endogenously determined by the equal yield condition. The four groups are, in increasing order of VAT rates, basic agricultural activities (0), other agriculture and mining

(1), manufacturing and services (2) and hotel, restauration, tourism, wine and other luxuries (4). This captures the fact that Vietnam introduced a VAT system in 1999 with rates of 0. 5, 10 and 20 percent applicable to the four groups of commodities identified.

The combined effects of the VAT (sales tax reform) and tariff reductions are evaluated using money metric measures of utility, namely Hicksian Equivalent Variations (EVs) and Compensating Variations (CVs). The results indicate a modest welfare gain of 0.28 percent of national income from the combined tariff and sales tax reform for the economy as a whole (Table 7).

However, these are accompanied by a sharp redistribution effect both between the rural and urban population and between the poor and the rich. The rich groups (H4 and H5) benefit in both the rural and urban populations. Moreover, the richest groups (H5) have the largest gain at 0.43 percent of income. For the second richest groups (H4) also gain, but by half as much as the richest groups (0.2 versus 0.4 percent). The second poorest groups (H2) lose out in both urban and rural areas: 0.02 percent and 0.08 percent of income, respectively.

The changes in consumer prices (Table 8) due to the tariff and tax reforms affect the consumption behavior of households and, consequently, their utility and welfare. As an example, consider the two poorest urban household groups H1U and H2U (Table 7), which primarily consume domestically produced goods. They have the same elasticities of substitution in consumption. Reviewing tables 4 and 7, we see that 34 percent of total consumption by the poorest group (H1U) is og goods for which prices have fallen[3] while 54 percent is of goods for which prices increased by more than one percent[4]. For the second poorest urban household group (H2U), the figures are 22 and 53 percent, respectively. Thus the poorest urban household group

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[3] Mining (D5) alcoholic beverages (D6), construction (D13) and transport and communication (D15).

[4] In percentage terms, price increases are generally not as important as price reductions: the greates increase is less than 5% for Finance, banking and insurance (D16), and Public services (D17).

Table 7: Welfare impacts from sale tax and tariff reform in Vietnam (1997)

Household Groups by Consumption Expenditure	Base Case	ASB	AS1	AS2	AS3	AS4	AS5	AS6-1	AS6-2
H1U (poorest)	0.19	-0.25	0.30	0.30	0.16	0.13	-0.02	0.21	0.10
H1R (poorest)	0.21	-0.11	0.31	0.31	0.17	0.23	0.05	0.21	0.11
H2U	-0.02	-0.47	-0.04	0.00	-0.06	-0.12	-0.14	0.04	-0.04
H2R	-0.08	-0.53	0.02	0.02	-0.12	-0.15	-0.39	-0.06	-0.15
H3U	0.20	0.03	0.16	0.11	0.17	0.23	0.38	0.22	0.06
H3R	-0.01	-0.32	0.06	0.10	-0.06	-0.03	-0.07	0.01	-0.08
H4U	0.34	0.59	0.19	0.21	0.31	0.88	1.19	0.32	0.19
H4R	0.21	0.41	0.24	0.17	0.19	0.46	0.65	0.21	0.00
H5U (richest)	0.43	0.82	0.43	0.44	0.44	0.94	1.31	0.40	0.27
H5R (richest)	0.43	0.83	0.42	0.42	0.41	0.86	1.22	0.39	0.23
Aggregate Welfare Measure									
Sum of EV over household as percent of base income	0.28	0.39	0.28	0.28	0.26	0.57	0.77	0.27	0.14
Sum of CV over household as percent of base income	0.28	0.39	0.28	0.28	0.26	0.58	0.79	0.27	0.14
VAT Rate by commodity groups									
Basic agricultural activities	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Other agriculture and mining	2.40	3.51	2.40	2.40	2.45	3.17	3.57	2.42	2.49
Manufacturing and services	4.90	7.02	4.90	4.90	4.90	6.34	7.13	4.84	4.97
Hotel, restaurant, tourism, wine, etc…	9.80	14.05	9.80	9.80	9.80	12.67	14.26	9.68	9.94

Base Case: All tariffs above 5 percent set to 5 percent, tariffs below 5 percent remain unchanged and endogenous yield preserving VAT.
Additional simulations (AS) (Note: Simulations AS1 – AS5 are with hypothetical benchmark)

ASB (base case): Elimination of all **tariffs and yield preserving endogenous VAT applicable to four groups of commodities in the ratio (0:1:2:4).**
AS1: Average import ratios in consumption applied to all households.
AS2: AS1 plus average sector-specific to total factor endowments applied to all households.
AS3: The same consumption structure by sector for all household groups.
AS4: The ratio in endowment between labor & capital is the same for all households.
AS5: Doubling initial tariffs in benchmark.
AS6-1: Capital of domestic sectors is immobile; AS6-2: Capital of all sectors is immobile.

benefits more from price reductions and suffers less from price increases, which explains the result (Table 7-Base case) that they have a positive EV (0.19 percent), whereas the next poorest household group has a negative EV (-0.02 percent).

Similarly, the model can also explain the differences in welfare effects from trade and tax reforms between the two poorest rural household groups namely: H1R (+0.21 percent) and H2R (-0.08 percent). In the middle income group (H3), urban households gain by +0.20 percent while their rural counterparts lose marginally by -0.01 percent.

Table 8 also shows changes in prices of domestically produced and imported goods as well as in total demand of commodities. After tariff removal, even if the consumer prices of imported goods fall, the prices of domestically produced substitutes can rise because of higher sales taxes. This is true in the case of other agriculture (D2), Construction material (D9), Textiles and garments (D11) and Electricity, gas and water (D12)[5].

There is another group of commodities for which the tariffs remain unchanged, but the consumer prices (both of imported and of domestically produced goods) increase, again due to the combined tariff and VAT reform. This group includes chemicals, printing and other industrial products (D10), financial services (D16) and public services (D17).

In response to the increasing relative price of domestic versus imported goods, consumers, notably rich households who consume a larger share of imported goods, shift their demand toward imports. In industries where tariffs are reduced, import volumes increase. However, imports also increase in sectors for which tariffs do not change, but where the VAT rate falls and consequently demand increases. Note, for example, that in the mining sector (D5), which has a constant tariff rate of 3.6 percent, the consumer price of imported products falls by 9.8 percent and imports increased by 6.7 percent.

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[5] Note that sales taxes double, even triple for D11.

Table 8: Effect of trade liberalization on sectoral production (percent)

Industry		Initial tariff	Elasticities e_f	e_i	Sectoral shares VA_i/VA	M_i/M	EX_i/EX	M_i/Q_i	Volume changes (percent) VA_i	M_i	D_i	EX_i	XS_i	Price changes (percent) P_i	PD_i	PM_i
Paddy	D1	3.7	0.30	0.40	10.6	0.1		1.3	-3.4	0.1	0.7		-3.4	0.60	0.60	
	E1	0.8	0.30	0.40	0.2	0.4	0.7		-1.3	-3.5		1.3	-1.3			
Other agriculture	D2	9.8	0.30	0.40	4.9	1.6		18.4	-1.0	7.1	0.1		-0.9	0.60	2.06	-2.94
	E2	2.4	0.30	0.40	3.9	3.3	12.2		-0.9	2.1		0.9	-0.9			
Forestry	D3	0.7	0.30	0.40	6.5	0.3		2.8	0.0	0.7	-0.1		0.1	0.43	1.26	0.83
	E3	0.0	0.30	0.40	0.4	0.3	1.3		-0.3	0.8		0.3	-0.3			
Aquatic goods	D4	4.5	0.30	0.40	3.6	0.0		0.1	0.7	1.1	1.1		0.8	0.09	0.31	0.22
	E4	1.1	0.30	0.40	0.7	0.7	2.6		-0.1	0.5		0.0	0.0			
AGRICULTURE					30.7	6.8	16.8									
Mining	D5	3.6	0.45	0.60	2.0	1.0		5.7	10.7	6.7	14.1		11.1	0.70	-9.17	-9.80
	E5	0.4	0.45	0.60	3.0	4.0	13.8		-8.5	1.7		8.4	-8.4			
Alcoholic beverages	D6	7.6	0.68	0.90	2.9	2.0		9.6	0.6	4.7	1.8		1.1	0.05	-0.01	-2.44
	E6	1.6	0.68	0.90	1.2	1.5	9.1		-0.5	-0.1		0.1	-0.1			
Food Manufacturing	D7	7.6	0.60	0.80	2.1	1.1		3.7	-4.3	0.9	-4.2		-4.1	0.53	4.83	1.78
	E7	1.0	0.60	0.80	0.7	0.7	10.5		-2.8	-0.8		3.8	-3.8			
Ceramics and paper	D8	7.3	0.53	0.70	2.9	27.3		27.3	-1.5	3.2	-1.5		-1.1	-0.50	2.78	1.13
	E8	0.9	0.45	0.60	0.9	7.1	10.1		25.4	2.6		26.6	26.6			
Construction material	D9	13.4	0.30	0.40	1.8	1.4		6.5	1.5	6.0	-0.7		1.8	-0.18	2.14	-5.24
	E9	0.2	0.30	0.40	0.1	0.5	0.6		1.8	2.2		2.2	2.2			
Chemicals and printing	D10	2.3	0.60	0.80	2.3	14.6		25.3	0.8	1.8	-0.4		1.2	-0.12	1.51	1.62
	E10	0.4	0.60	0.80	0.4	3.2	3.6		8.4	2.2		9.0	9.0			
Textiles and garments	D11	18.0	0.30	0.40	1.2	2.6		7.4	2.3	31.6	1.1		2.7	-2.13	0.84	-8.29
	E11	9.5	0.30	0.40	3.3	5.8	26.2		45.7	29.5		48.2	48.2			
Electricity, gas and water	D12	18.2	0.30	0.40	2.5	7.7		58.0	1.9	12.3	9.1		2.3	-0.90	0.14	-10.2
	E12	3.1	0.60	0.80	0.0	0.0	0.0		1.5	3.0		2.4	2.4			
Construction	D13	0.00	0.30	0.40	7.1	0.0		0.0	2.5		2.8		2.8	-0.48	-0.98	
INDUSTRY					34.5	80.5	74.0									
Hotel and restauration	D14	0.00	0.60	0.80	15.7	2.1		13.6	0.1	-0.1	-1.7		0.5	0.80	2.58	1.76
	E14	0.00	0.60	0.80	1.4	2.4	4.6		-4.8	2.2		4.7	-4.7			
Transport and communication	D15	0.00	0.30	0.40	3.5	3.0		34.9	3.5	3.9	5.3		3.9	-0.23	-2.59	-2.36
	E15	0.00	0.30	0.40	0.3	1.2	1.4		1.3	3.4		1.5	1.5			
Financial services	D16	0.00	0.60	0.80	0.9	1.0		12.0	-3.8	-1.2	-4.3		-3.7	0.996	4.94	3.90
	E16	0.00	0.60	0.80	0.6	1.3	2.0		-24.9	-0.8		24.9	-24.9			
Non-financial private and	D17	0.00	0.30	0.40	12.1	1.7		5.8	-1.3	-0.6	-1.0		-1.0	0.24	1.96	1.71
public services	E17	0.00	0.30	0.40	0.4	0.2	1.3		-43.1	-1.1		44.9	-44.8			
SERVICES					34.8	12.7	9.2									
					100.0	100.0	100.0									

D_i: domestic sales; E_i: exports; e_f (e_i): elasticities of substitution between factors (inputs); VA: value added; M: import volumes; D: total domestic demand volumes; EX_i: export volumes; Q_i: total consumption; XS_i: output volumes; P_i: producer price; PD_i: consumer price for domestic goods; PM_i: consumer price for imported goods

Details on the sector-wise impacts on output volumes, as well as domestic and import prices, are reported in Table 8. The expanding sectors serving the domestic market are mining (D5; 11.1 percent output growth), transport and communication (D15; 3.9 percent), construction, and textiles and garments (D11; 2.7 percent). On the contrary, other agriculture (D2), ceramics and paper (D8), and non-financial public and private services (D17) contract marginally (-1 percent), while output of paddy (D1), food manufacturing (D6) and financial services (D17) fall by roughly 4 percent. This result is quite consistent with the impacts that the Vietnamese economy is currently experiencing.

Much more dramatic impacts of trade liberaization are noted for export sectors such as textile and garment (E11) and ceramics and paper (E8), where output increases by 48.2 and 26.6 percent, respectively, as a result of exchange rate depreciation.

Simulation with removal of all tariffs

The base case counterfactual experiment presented in the previous section is taken from the Government's policy agenda in the framework of commitments of Vietnam for joining AFTA. In other countries, trade liberalization can signify a complete removal of all tariffs. To facilitate a comparative analysis, the authors have also run such a hypothetical scenario.

The results given in Table 7 (column ASB) show that the whole economy benefits more from a complete removal of tariffs: Welfare increases by 0.39 percent of national income, as compared to 0.28 percent in the base case. However, the redistribution effect becomes sharper: all the poor household groups (H1, H2) lose, whereas all the rich household groups (H4 and H5) gain. The richest group H5 has the largest gain: 0.83 percent, almost double that of the base case.

The main channels of transmission remain the same as in the base case. When all tariffs are removed, the VAT is increased (see four last rows in Tables 7) to compensate lost tariff revenue. In turn, the raising of VAT negatively affects the poorest households (H1, H2 and H3R) who primarily consume domestic goods and thus do not benefit much from the fall in import prices. On the contrary, complete tariff removal considerably benefits the rich households, who consume much more imports than domestic goods.

Decomposition of impacts

The analysis presented in the previous section leads to preliminary conclusions that the impacts of combined tariff and VAT reform on household welfare are via the remuneration of fixed factors (particularly immobile capital) and consumer prices. In other words, the welfare of each household groups depends primarily on differences in its endowment of specific factors and its consumption patterns. To verify the importance of each of these channels, we prepare five alternative hypothetical benchmarks where, as in the base cae, all tariffs above five percent are reduced to five percent. In all but the last case, differences between households in one dimension are eliminated in order to then examine how the simulation results are affected:

1. Equal import consumption ratios by sector (AS1)
2. AS1 plus equal ratios of sector-specific to total factor endowments (AS2)
3. AS2 plus equal sectoral consumption ratios (AS3)
4. Equal capital-labor endowment ratios (AS4)
5. Initial tariffs doubled (AS5)

Equal import consumption ratios: In this simulation we apply the average sectoral import ratios in final consumption to all households. In the real benchmark, poor households consume a much smaller share of imported goods than rich households. We can see in Table 7 (column AS1) that the welfare impacts on poor households are considerably improved. The poorest groups (H1U and H1R) now have a welfare gain equivalent to about 0.3 percent of their income instead of 0.2 percent in the base case. The situation of the next poorest household groups (H2 and H3) also improves considerabl with the rural households in question going from a reduction in welfare to an improvement. The welfare gains of the two richest urban and rich household groups decline, as their initial import consumption ratios decline by about 0.4 percent of their income. Overall, the equalization of import ratios almost entirely eliminates the differences in welfare impacts between household groups.

Equal sector-specific to total factor endowments: Inthe real benchmark, most of the immobile capital belongs to the urban and rich households, while the rural and poor households own only small portions of immobile labor. In this simulation, in addition to imposing equal import consumption ratios, the benchmark is adjusted so that all household groups have the same average sector-specific to total factor endowments. The results of the hypothethical simulation (column AS2) show that the EVS remain almost the same as in the hypothetical simulation AS1[6]. Thus, we conclude that, for the welfare impacts of combined tariff and VAT reform, *the ratio in consumption between imported and domestic goods, and not the endowment of specific immobile factors, plays an essential role*. Note also that, in terms of household income (Table 9) there are no significant differences between the base case and both of the hypothetical simulations S1 and AS2, indicating that it is the consumer price channel that predominates.

Equal sectoral consumption ratios: In this third simulation, in addition to the previous two adjustments, the same (average) sectoral consumption shares are applied to all households (column AS3). In the real benchmark, for example, the share of non-financial services (G17) in total consumption is much higher for the poorer household groups (Table 10). We observe in Tables 7 and 9 that the welfare and income of all households groups, except the richest urban group H5U,

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[6] We also performed another alternative scenario in which the share of specific factors is equalized, but the sectoral import consumption ratios are as in the real benchmark. In this case the household EVs are almost the same as in the base case information.

increase less than in the benchmark simulation. In terms of redistribution effects among the households, there is no improvement in comparison with the real benchmark simulation. Thus, combined with the first additional simulation, it can be ascertained that for these effects the ratio in consumption by household between imported and domestic goods in more important than their consumption structure by sector.

Table 9: Sale tax and tariff reform in Vietnam (1997): Welfare and income impacts

Household Groups by Consumption Expenditure	Percentage change in household income					
	Real benchmark	AS1	AS2	AS3	AS4	AS5
H1U (poorest)	1.06	1.07	1.07	0.99	2.02	2.44
H1R (poorest)	1.05	1.06	1.06	0.97	2.02	2.41
H2U	1.15	1.16	1.19	1.08	2.06	2.59
H2R	1.02	1.03	1.03	0.95	1.99	2.37
H3U	1.26	1.27	1.22	1.20	2.21	2.83
H3R	1.11	1.11	1.15	1.02	2.03	2.51
H4U	1.14	1.14	1.16	1.07	2.20	2.63
H4R	1.39	1.40	1.32	1.34	2.48	3.11
H5U (richest)	1.26	1.26	1.27	1.24	2.34	2.88
H5R (riches)	1.47	1.47	1.47	1.41	2.61	3.27
Percentage change in National income	1.02	1.03	1.03	0.99	1.83	2.22

Equal labor-capital endowment: In this simulation (AS4), the ratio of labor and capital endowments is assumed to be the same for all households. The structure of welfare does not change: those who lost (or gained) in the real benchmark case, here lose (gain, respectively), too (Table 7, column AS4), as the consumption structure of households remains the same as in the real benchmark case. The welfare of richer groups (H4 and H5) increases by double, while that the poorer groups does not change so much. Thus it can be said that the hypothesis of an equal ratio in endowment between labor an dcapital for all household groups considerably reinforces the sharpness of redistribution effects. This implies that in the real benchmark, the income effect slightly offsets the consumption effect.

Table 10: Change in consumption pattern under trade liberalization

Sectors		Share	Change in prices			Consumption shares									
		M/Q	PD	PC	PM	H1	H2	H3	H4	H5	H6	H7	H8	H9	H10
1. Paddy	D1	1.3	0.6	0.6		3	4	3	4	2	3	1	2	1	1
2. Other agriculture	D2	18.4	0.6	2.1	-2.9	5	7	6	6	6	5	6	5	5	4
3. Forestry.	D3	2.8	0.4	1.3	0.8	5	7	6	8	7	7	5	7	5	6
4. Aquatic goods	D4	0.1	0.1	0.3	0.2	4	4	4	4	4	4	3	3	2	2
Agriculture						17	22	19	22	19	19	15	17	13	13
5. Mining	D5	5.7	0.7	-9.2	-9.8	4	4	4	4	4	3	3	3	2	2
6. Alcoholic beverages	D6	9.6	0.1	0.0	-2.4	9	9	10	9	10	8	7	8	7	7
7. Food Manufacturing	D7	3.7	0.5	4.8	1.8	13	13	18	14	16	13	12	12	8	11
8. Ceramics and paper	D8	27.3	-0.5	2.8	1.1	4	5	6	6	7	8	13	12	16	14
9. Construction material	D9	6.5	-0.2	2.1	-5.2	0	1	0	1	0	0	1	1	1	1
10. Chemicals and printing	D10	25.3	-0.1	1.5	1.6	3	4	5	5	4	5	3	6	1	1
11. Textiles and garments	D11	7.4	-2.1	0.8	-8.3	3	4	4	5	4	4	3	4	2	3
12. Electricity, gas and water	D12	58.0	-0.9	0.1	-10.2	1	0	2	0	3	1	2	1	3	2
13. Construction	D13	0.0	**-0.5**	**-1.0**		21	19	9	14	8	16	17	12	19	18
Industry						55	59	58	58	56	58	62	59	62	63
14. Hotel and restauration	D14	13.6	0.8	2.6	1.8	6	4	7	6	8	8	8	8	9	7
15. Transport and communication	D15	34.9	**-0.2**	**-2.6**	**-2.4**	0	1	0	0	1	1	1	1	2	2
16. Financial services	D16	12.0	**1.0**	**4.9**	**3.9**	1	0	2	0	1	1	1	1	1	1
17. Non-financial services	D17	5.8	0.2	2.0	1.7	17	13	15	14	15	13	13	14	15	14
Services						24	18	24	20	25	23	23	24	27	24

PD_i: Producer price, PC_i: Consumer price for domestic goods; PM_i: Consumer price for imported goods; M_i/Q_i: Share of import in local consumption

Doubling of all initial tariffs: With the same idea as simulation ASB of analyzing the effects of stronger tariff reduction, we first double the initial tariffs (to obtain a hypothetical benchmark) and then repeat our earlier simulation, i.e. reduce to five percent all tariffs that are higher (column AS5 of TAble 7). Results of this simulation indicate that welfare gains are much bigger overall. Only the richer household categories, who consume relatively more imported goods, benefit, whereas the poor households see their welfare decrease with respect to the base case as they are hit by an even larger increase in VAT rates. In general (except the poorest group which is now totally disadvantaged) those who gained before, now gain three times, more, and those who lost before, now lose seven times over.

Base case simulations with immobile capital

Capital (except for capital specific factors) has been treated until now as mobile across sectors. It is also interesting to consider the case where sector capital is fixed (at least in the short run). The additional base case simulations (AS6-1 and AS6-2 below give some results in this direction. Thus, in simulation AS6-1 (base case) we assumed that all domestic sectors have capital fixed at their benchmark levels (Table 7). In simulation AS6-2, this immobility of capital facctor is assumed for all sectors (domestic and export).

It can be seen from Table 7 that, in comparison with the base case simulation, the welfare effect (both at the national and the household levels) is insignificant (AS6-1). This is because the domestic sectors do not participate in exports, therefore these sectors (and, consequently, household revenue and consumption) are not much affected by the immobility of capital.

As shown in the last column of Table 7, the effect becomes very strong if capital is fixed in all domestic and export sectors (AS6-2). Both household and national welfares decrease at least by half. The problem in simulation AS6-2 is that capital cannot move from the contracting sectors to the expanding ones. Therefore, in the former some stagnation of capital is observed while in the latter there is some capital shortage.

To conclude, the mobility of capital across sectors is a very important determinant of the gains from tariff and tax reforms, as well as of household income and welfare effects. It has strong impacts on exports and imports. In the base case where capital can move from contracting sectors to expanding ones (especially export sectors), there is a rise of 1.02 percent in national income, whereas this figure is only 0.7 percent in the case of capital immobility. The overall household income and welfare gains are also twices as high with capital mobility.

Comparison of alternative tariff and tax reforms

We now decompose the combined effects of VAT and tariff reforms in the orginal benchmark. Table 11 reports the results of tariff reductions with equal yield revenue and various combinations of tariff and tax reforms. Contrasting columns 3 and 4, we note that almost of the overall welfare gains are generated by trade liberalization, rather than the introductions of the 4-VAT system. However, the poorest household group benefits substantially from the tax reform, given the less progressive nature of the original sales tax. Indeed, the tax reform somewhat offsets the regressive impacts of trade liberalization. When we then contrast the effects of a single VAT in the last column, we observe that the economy as a whole marginally gains 0.02 points by going for a single VAT vis-à-vis a 4-VAT system. Interestingly, the 4-VAT system appears to favor rural households over ubran households, particularly among the poorest.

Distribution of sector-specific factors

The sensitivity of the results with respect to the distribution of *specific factors* among sectors is also verified by running different model simulations (not reported here). The shares used in the central case model specification are based on the characteristics of export sectors and on the authors' estimates resulting from various discussions with experts[7]. Although the magnitude of welfare effects

Table 11: Decomposition of the welfare (EV) impacts from sales tax (4 VAT) and tariff reform in Vietnam (1997)

Household Groups by Consumption Expenditure	Combined effect of sales tax (4 VAT) and tariff reform	Tariff reform with proportional increase in sales taxes	Only sales tax reform (4VAT introduced)	Combined effect of sales tax (single VAT) and tariff reform	Only Sales tax reform (1 VAT introduced)
H1U (poorest)	0.19	-0.22	0.27	-0.02	0.08
H1R (poorest)	0.21	-0.14	0.22	-0.17	-0.10
H2U	-0.02	0.02	-0.05	0.13	0.04
H2R	-0.08	-0.17	0.02	-0.22	-0.11
H3U	0.20	0.20	-0.01	0.41	0.13
H3R	-0.01	-0.03	-0.01	-0.04	-0.06
H4U	0.34	0.36	-0.01	0.31	-0.04
H4R	0.21	0.36	-0.11	0.32	-0.02
H5U (richest)	0.43	0.41	0.01	0.47	0.05
H5R (richest)	0.43	0.50	-0.04	0.46	0.01
Sum over households as percent of base income					
EV	0.28	0.27	0.0024	0.30	0.02
CV	0.28	0.27	0.0023	0.30	0.02
Single VAT				4.80	3.48
Basic agricultural activities	0.00	–	0.00		
Other agriculture and mining	2.40	–	1.78		
Manufacturing and Services	4.90	–	2.56		
Hotel, restaurant, Tourism, wine, etc…	9.80	–	7.12		

Note: VAT rates applied to four commodity groups in the ratio (0:1:2:4) as proposed by the government.

vary somewhat with the different distribution of specific factors among sectors, the main conclusions remain the same presented above.

Marginal excess burden of raising revenue from taxes

Table 12 presents the estimates of *the marginal social cost* associated with the use of alternative tax financing vehicles available in Vietnam that could potentially be used to raise additional government revenue. In this exercise, we marginally increase government reveneu by proportionally raising tax rates in all sectors. The marginal social cost of increasing revenue for each tax instrument is measured in money metric welfare terms calculated in terms of the Hicksian equivalent variation summed across households per extra Dong of revenue raised.

Results indicates significant social cost associated with raising additional funds through tariffs (0.08 Dong per Dong) or commodity input taxes (0.03 Dong per Dong). The social cost of raising additional funds through a corporate tax is negligible (6.4E-5 Dong per Dong), which reflects the uniformity of corporate taxes in the base case equilibrium. The marginal excess burden of raising revenue from sales and factor use taxes is also low: 0.004 Dong per Dong revenue generated in the case of sales tax and 0.001 Dong per Dong in the case of factor use tax.

The results from model analyses thus suggest small gains from trade liberalization for Vietnam as a whole, but with sharp redistributive effects against the poor. The impact of the introduction of the 4-VAT system on the overall efficiency of the Vietnamese economy is small compared to the tariff reform, which indicates the minor role of changes in sales taxes. Data show small variability in the sales tax rates (in the range of 0 to 20 percent)[8]. In general, the rural population suffers more than the urban population, although the poorer

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[7] Useful comments were received from seminar participants at the institute of Information Technology in August 2000 on an earlier version of the paper.

[8] Chan, Ghosh and Whalley (1999) estimated a larger impact from VAT reforms because their benchmarks tax and tariff data show higher degree of variability in the range of 4 to 65% and 0 to 34% respectively.

households lose out in both rural and urban areas. The sharp distributive impact of the trade reform is due to differences in the expenditure patterns and ownership of fixed factors between the rural and urban and between the rich and the poor. The regressivity of trade liberalization would be even stronger if the initial tariff levels were higher. Results are somewhat sensitive to elasticity parameters but in a way that is consistent with literature and that do not substantively after our results.

Table 12: The social cost (marginal excess burden) of alternative, financing vehicles for extra government revenue in Vietnam

	Marginal Excess Burden (Welfare cost (sum of EVs) of extra revenue raised) of various tax instruments in perent
Sales tax	0.39
Tariff	8.19
Commodity input tax	2.66
Factor tax	0.08
Corporate tax	0.006

Concluding Remarks

This paper evaluates the impact of trade liberalization using a small open/price taking economy model for Vietnam. The study focuses on welfare impacts on aggregate as well as on different household groups identified in the model. We also analyze the impacts of liberalization on output, export and import by sectors on producer, consumer and import prices.

The model results provide insights into a series of trade-related issues not often discussed until now in the economic literature on Vietnam, such as the growth opportunities for some sectors and the risks for others, as well as the increasing gap between urban and rural areas, and between the rich and the poor. The results also give- and this is thanks to advantages of CGE modeling techniques - quantitative evaluations of overall and distributional impacts of current and alternative trade liberalization policies. The results show that there is a modest but significant (close to 0.3 percent in terms of national income) efficiency gain to the Vietnamese economy from trade liberalization. This however, is accompanied by redistribution against the rural and poor households in general. The richest groups gain, while the middle-income groups generally lose. The poorest households also benefits, but by half as much as the richest households.

This reflects sharp differences in the impacts of the tariff reforms among different household groups and also between rural and urban households. Urban and rural households, even in the same income group, are affected differently. In every group (except the poorest) urban people benefit more from tariff reduction than rural people. In particular, in themiddle-income group, urban households gain, while rural ones lose. These differences in the impacts between rural and urabn populations and between the rich and the poor are explained in terms of the differences in the expenditure patterns across households and differences in their factor endowments where the former plays the dominant role.

On the expenditure side, rich and urban households benefit from trade liberalization as they buy proportioinally more imported goods than poor and rural households. Two likely explanations for the differences in the expenditure patterns between the rural and urban households could be differnces in purchasing power and the lack of availability of imported goods in the rural areas. Furthermore, imported goods cost more in rural areas due to the transaction costs involved. Transaction costs are high due to high transportation costs as well as imperfections in the rural market. Thus it is quite obvious that the benefits of trade liberalization to people located at different places are not uniform, particularly in Vietnam.

Our sensitivity analysis confirms these findings. The welfare effects would be considerably stronger if initial tariffs were even higher. These effects also vary according to the allocation of specific factors between sectors and among households, athough the main conclusions remain unchanged.

Computations are also made regarding the marginal excess burden of alternative financing vehicles for extra government revenue, which the government might need in the future. The results show that corporate and factor use taxes are the lowest burden source for additional government revenue, as these are relatively non-distoring compared to other vehicles such as tariffs, input taxes and sales taxes.

The clear policy conclusion that follows from this modeling exercise is that unless tariff liberalization is accompanied by appropriate redistributive measures, the poverty gap in Vietnam is going to increase.

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Trade Liberalization and Poverty: Lessons from Asia and Africa

John Cockburn[1], Bernard Decaluwé and Véronique Robichaud[2]

Abstract

We bring together the lessons drawn from the computable general equilibrium (CGE) analysis of the impacts of trade liberalization on poverty in seven Asian and African countries: Bangladesh, Benin, India, Nepal, Pakistan, the Philippines and Senegal. We compare and contrast the results in these countries, explaining where there are similarities and why there are differences. Particular attention is paid to identifying how the specific characteristics of each country – initial tariff structure, trade patterns, relative factor endowments, production patterns, income sources and consumption patterns of the poor, etc. – modify the results. Conclusions are then drawn with respect to the key factors in managing trade liberalization and designing appropriate accompanying measures. Results show that trade liberalization has small, but positive, impacts on welfare and poverty. Overall, industrial sectors benefit - relative to agriculture - from trade liberalization, as do urban households relative to their rural counterparts.

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Introduction

In recent years, the impacts of macroeconomic shocks, such as fiscal reform and trade liberalization, on income distribution and poverty have become the subject of intense debate. Which tax regime is most equitable? Do the poor share in the gains from freer trade? What alternative or accompanying policies could be used to ensure a more equitable distribution? What are the mechanisms linking macro policies to micro, and particularly poverty, impacts?

The standard story begins with the observation that initial tariff rates are generally much higher for industrial imports, so that trade liberalization leads to an expansion in the agricultural sector, which benefits unskilled workers and rural households relatively more than capital owners and urban households. The results of our study challenge the standard story in important ways. Most importantly, trade liberalization is found to generally favor urban households and to actually lead to an increase in rural poverty in four of the seven countries analyzed. The explanations for these results reveal a number of unexpected channels of impact through which trade liberalization influences these economies and, ultimately, poverty.

The analysis of macroeconomic shocks and poverty are generally based on very different techniques and sources of data. Income distribution and poverty issues are generally analyzed on the basis of household data in recognition of the heterogeneity of these agents and the importance of capturing their full distribution. On the other hand, given its economywide nature and the strong general equilibrium effects they imply, macroeconomic shocks are ideally examined in the context of a computable general equilibrium (CGE) model based on national accounting data. The use of a CGE model is also justified by the complexity of the impacts of trade liberalization on households, as they involve changes in wage rates, returns to land, capital returns, consumption prices and compensatory direct and indirect taxes. Finally, CGE simulation analysis has the advantage over ex post econometric analysis of generating a counterfactual in the absence of trade liberalization and also of allowing ex ante predictions.

In this study we meld these two currents. Average household income variations following trade liberalization are estimated at the household category level in CGE models of seven Asian and African countries: Bangladesh, Benin, India, Nepal, Pakistan, Philippines and Senegal. These variations are then applied to individual households within each category using base-year income data from household surveys. These results are then contrasted with initial income values through the estimation of standard Foster-Greer-Thorbecke (FGT) poverty indicators.

Underlying individual country studies were all conducted by local researchers in the context of the Poverty and Economic Policy (PEP) research network[3]. The differences between these countries provide us with a natural laboratory to better understand how trade liberalization impacts the poor. The economy-wide modeling framework we have adopted allows us to identify and compare the principal channels of influence. Every effort has been made to ensure the comparability of the modeling frameworks in each country to ensure that all observed differences reflect actual differences rather than differences of approach.

Brief literature review

There have been numerous attempts to use CGE models in the analysis of income distribution and poverty issues[4]. The simplest approach is to increase the number of categories of households. In this context, it is possible to examine how different types of households (rural vs. urban, landholders vs. sharecroppers, region A vs. region B, etc.) are affected by a given shock. However, nothing

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[3] www.pep-net.org.

[4] A detailed review of the CGE literature on the welfare, poverty and distributional effects of trade liberalization is provided in chapter 2.

can be said about the relative impacts on households within any given category as the model only generates information on the representative (or "average") household. There is increasing evidence that households within a given category may be affected quite differently according to their factor endowments, location, demographics, education, consumption patterns, etc. Of course, this problem of intra-category variation decreases with the degree of disaggregation of household categories. Yet even in the most disaggregate versions – Piggott and Whalley (1985) have over 100 household categories – substantial intra-category heterogeneity in the impacts of a given shock is likely to subsist.

A popular alternative is to assume a lognormal distribution of income within each category where the variance is estimated using base year data (see De Janvry, Sadoulet and Fargeix, 1991). In this approach, the CGE model is used to estimate the change in the average income for each household category, while the variance of this income is assumed to be fixed. Decaluwé et al. (1999) argue that a beta distribution is preferable as, unlike the lognormal, it can be skewed left or right and thus better represent the different types of intra-category income distributions commonly observed. In this paper, we do not impose any specific functional form on the distribution function. Instead, we apply the income variation obtained for each household category in the CGE model simulation to the income of each individual household belonging to this category. This provides us with a vector of household incomes before and after the trade liberalization simulation on which we can perform standard poverty analysis.

A final alternative, currently pursued by the members of this research network, is to model each household individually in a microsimulation model. This microsimulation model can be either linked to a CGE model (Savard, 2003) or fully integrated into a CGE model (Cockburn, 2001; Cogneau and Robilliard, 2001).

In the following sections, we track the effects of trade liberalization through the economies studied in order to explain the welfare and poverty results. In particular, we trace the channels of impact on sectoral production and trade, factor prices, household income and consumer prices before revisiting our welfare and poverty analysis in the light of the preceding results. Throughout, we draw a series of lessons, many of which contrast with the standard trade liberalization-poverty story outlined in the introduction.

Simulation Results

The standard expectations for the impacts of trade liberalization on poverty go as follows. First, as initial tariffs are generally higher for industrial goods, we expect that the agricultural sector will be the main beneficiary of trade liberalization. This, in turn, raises the relative returns to factors used intensively in the agricultural sector: unskilled labor and land. Rural and poor households, which derive a relatively large share of their income from these two factors, should therefore be the "winners" from trade liberalization in income terms. On the other hand, consumer prices are expected to fall more for industrial goods, which is to the advantage of rich and urban households. The net effects on poverty will depend on the relative strength of the income and consumer price effects, although it is generally assumed that the income effect will dominate and the poor will thus benefit. The results of our simulations in these seven quite different developing countries challenge these expectations in a number of important ways.

Welfare and Poverty Impacts

LESSON ONE: Trade liberalization increases welfare and reduces poverty marginally

Our results do indicate that trade liberalization has positive, although generally small, aggregate welfare and poverty effects in most countries studied (Table 1). Note that welfare indicators concern

Table 1: Impact on Income, Welfare and Poverty (in %)

	Income	CTH	CPI	EV	P_0	P_1	P_2	Initial poverty level		
								P_0	P_1	P_2
Bangladesh	**-3.1**	**-2.7**	**-2.8**	**0.1**	**0.13**	**0.53**	**0.71**	**0.418**	**0.099**	**0.034**
Rural	-3.2	-2.9	-2.8	-0.1	0.10	0.53	0.71	0.461	0.109	0.038
Urban	-3.1	-2.5	-2.9	0.4	0.46	0.53	0.67	0.204	0.047	0.016
Benin	**-4.2**	**-3.1**	**-3.2**	**-0.3**	**-1.02**	**-1.00**	**-1.23**	**0.354**	**0.110**	**0.050**
Rural	-5.5	-5.2	-2.4	-3.0	2.38	3.12	3.76	0.389	0.109	0.043
Urban	-3.1	-1.1	-4.1	2.0	-4.92	-4.84	-4.86	0.320	0.110	0.056
India	**-9.7**	**-9.2**	**-9.1**	**-0.1**	**-0.10**	**-0.13**	**-0.16**	**0.383**	**0.133**	**0.064**
Rural	-9.8	-9.4	-9.1	-0.2	0.00	0.27	0.32	0.404	0.134	0.062
Urban	-9.5	-9.0	-9.1	0.1	-0.14	-0.27	-0.31	0.376	0.133	0.065
Nepal	**-3.8**	**-2.2**	**-3.0**	**0.0**	**0.23**	**0.12**	**0.17**	**0.429**	**0.124**	**0.049**
Rural	-3.8	-2.3	-3.0	-0.1	0.31	0.19	0.26	0.445	0.130	0.052
Urban	-3.8	-1.6	-3.2	0.6	-2.18	-2.30	-2.87	0.205	0.054	0.020
Pakistan	**-6.7**	**-5.5**	**-5.8**	**0.4**	**-0.50**	**-0.55**	**-0.89**	**0.383**	**0.086**	**0.028**
Rural	-6.8	-6.4	-5.7	-0.7	1.70	2.78	3.19	0.372	0.081	0.026
Urban	-6.6	-4.5	-5.9	1.5	-3.42	-4.64	-5.74	0.397	0.094	0.031
Philippines	**-3.0**	**-1.8**	**-2.5**	**0.8**	**-0.5**	**-0.7**	**-0.8**	**0.485**	**0,171**	**0.079**
Rural	-3.1	-2.1	-2.5	0.4	-0.2	-0.3	-0.4	0.632	0.228	0.107
Urban	-2.9	-1.7	-2.5	0.9	-1.10	-1.5	-1.7	0.337	0.112	0.051
Senegal	**-3.7**	**-2.6**	**-3.4**	**0.3**	**-0.71**	**-2.11**	**-2.92**	**0.691**	**0.284**	**0.147**
Rural	-3.8	-1.6	-3.4	1.7	-0.55	-2.20	-3.03	0.884	0.401	0.218
Urban	-3.7	-3.2	-2.5	-0.1	-1.50	-1.88	2.07	0.390	0.100	0.036

CTH: Consumption, CPI: Consumer price index; EV: Equivalent variations; $P\text{-}_0$: Headcount ratio; P_1: Poverty gap; P_2: Poverty severity all households, whereas poverty indicators compare the income of the poorest households with a minimum income required to satisfy their basic necessities. Overall welfare effects, as measured by equivalent variations (EV), are generally small but positive, with the exception of Benin (-0.3%) and India (-0.1%). At the same time, poverty is found to fall in all countries but Bangladesh and Nepal, regardless of the poverty indicator chosen. Headcount ratios (P_0) fall substantially in Benin (1.02%) and moderately in all other countries, except for Bangladesh (+0.13%) and Nepal (+0.23%). Similar, if sometimes stronger, reductions are noted in the poverty gap (P_1) and poverty severity (P_2), the latter decreasing by 2.92% in Senegal. The rest of this paper will be devoted to explaining this and the following lesson.

LESSON TWO: Trade liberalization is pro-urban and may increase rural poverty

Trade liberalization affects rural and urban households quite differently. In every country apart from Senegal, welfare increases and poverty decreases most for urban households. This contrasts with the standard story, which suggests that rural households are the "winners" from tariff reductions. Indeed, welfare actually decreases and poverty increases in the rural areas of five (Bangladesh, Benin, India, Nepal and Pakistan) of the seven countries studied. Note that welfare and poverty results with more disaggregate household categories are presented in the country chapters.

To better understand these results, we now trace the impacts of trade liberalization through its effects on resource allocation, factor remuneration and the price structure.

Trade and output effects

LESSON THREE: Industrial output increases relative to agricultural output as a result of a stronger export response and greater input cost savings.

The pro-industrial nature of trade liberalization can be explained by three major factors: a muted impact of import price reductions on domestic demand for local products, given their imperfect substitutability and low initial import penetration rates; a stronger positive industrial export response; and, finally, greater input cost savings in the industrial sector. These factors are outlined in more detail below.

The initial impact of trade liberalization is felt on imports. The elimination of tariffs directly reduces import prices (Table 2). In all countries, import prices decline more in the industrial sector as a result of higher initial tariff rates. Consequently, the import response (1 to 10 percent increase) is higher among industrial imports in all countries studied except Nepal. As this response also depends on the degree to which imports and domestic goods are considered to be substitutes, which varies across countries, the increases in import volumes are not necessarily proportional to the fall in import prices. The smallest import increase is observed in Nepal, where initial tariff rates were lowest. In the case of India, the strong industrial import response is also due to the elimination of quantitative restrictions, whereas these restrictions had already been removed by the mid-1990s in the other countries.

In the agricultural and industrial sectors, domestic demand for locally-produced goods ("Dom. sales") declines in the face of lower-priced imports. However, as imports represent on average less than 20% of domestic consumption in all countries and are considered to be imperfect substitutes for local goods, the resulting fall in the price and volume of domestic sales of local goods is quite limited. Although these price impacts are strongest in the industrial sector, the differences

Table 2: Impact on Production, Trade and Prices (in %)

	Sectoral shares*			Ratios*		Volume changes					Price changes				
	Value added	Imports	Exports	Imports/ Cons'n	Exports/ Output	Imports	Dom. sales	Exports	Output	Value added	Imports	Dom. sales	Exports	Output	Value added
Bangladesh				**9.1**	**5.0**	**10.0**	**-0.1**	**15.3**	**0.6**	**0.0**	**-13.3**	**-4.0**	**-8.2**	**-3.8**	**-3.3**
Agriculture	22.3	5.2	8.1	2.4	1.9	8.9	-0.7	6.7	-0.5	-0.6	-8.1	-3.3	-2.1	-3.2	-3.1
Industry	22.1	94.8	91.9	24.4	14.0	10.0	-0.4	16.0	1.9	1.2	-13.6	-4.7	-8.8	-4.0	-2.9
Services	55.5	0.0	0.0	0.0	0.0	-	0.2	-	0.2	-0.3	-	-3.9	-	-3.9	-3.5
Benin				**19.6**	**17.0**	**3.6**	**-1.4**	**5.0**	**-0.2**	**0.0**	**-14.9**	**-5.4**	**0.0**	**-4.4**	**-3.9**
Agriculture	36.3	3.0	6.0	2.7	3.9	3.3	-1.1	2.6	-1.0	-1.0	-9.6	-4.8	0.0	-4.6	-5.1
Industry	13.5	91.5	37.7	39.7	18.4	4.1	-3.0	2.6	-2.0	-2.2	-15.8	-5.4	0.0	-4.4	-7.1
Services	50.3	5.6	56.3	4.2	24.7	-4.6	0.1	6.9	1.8	1.8	0.0	-5.8	0.0	-4.3	-3.0
India				**5.5**	**6.1**	**8.1**	**-0.7**	**10.3**	**-0.1**	**0.0**	**-14.6**	**-10.1**	**-3.2**	**-9.8**	**-10.0**
Agriculture	30.2	3.4	5.3	0.9	1.4	3.6	-0.1	7.3	0.0	0.0	-11.0	-9.6	-2.3	-9.5	-9.9
Industry	19.8	87.6	69.0	12.8	9.7	9.9	-1.3	11.6	0.1	0.2	-15.8	-10.8	-3.6	-10.1	-10.1
Services	50.0	8.9	25.7	1.2	4.7	-8.0	-0.4	7.2	-0.2	-0.1	0.0	-9.9	-2.3	-9.6	-10.0
Nepal				**15.4**	**15.0**	**1.5**	**-0.2**	**5.8**	**0.1**	**0.0**	**-7.9**	**-4.3**	**0.0**	**-4.0**	**-4.0**
Agriculture	57.9	15.1	8.6	5.5	1.2	1.7	0.2	1.9	-0.1	0.0	-7.6	-3.8	0.0	-3.8	-4.1
Industry	6.7	84.9	62.3	54.4	28.0	1.5	0.3	3.3	1.1	0.9	-7.9	-5.7	0.0	-4.2	-3.8
Services	35.4	0.0	29.1	0.0	4.6	0.0	-0.5	12.1	0.1	-0.1	0.0	-4.8	0.0	-4.3	-3.8
Pakistan				**11.6**	**9.7**	**6.8**	**-0.8**	**10.4**	**0.1**	**0.0**	**-18.0**	**-7.9**	**0.0**	**-7.2**	**-7.3**
Agriculture	28.7	6.3	3.0	3.4	1.1	-0.3	-0.3	3.9	-0.3	-0.3	-6.4	-6.7	-1.5	-6.6	-6.7
Industry	19.5	85.4	79.6	24.3	16.3	8.7	-1.6	11.3	0.6	0.7	-20.1	-8.6	0.0	-7.2	-8.6
Services	51.9	8.3	17.4	2.5	6.5	-7.7	-0.4	7.5	-0.2	-0.2	0.0	-7.9	0.0	-7.6	-7.2
Philippines				**17.4**	**16.7**	**7.7**	**-1.1**	**6.9**	**0.3**	**0.0**	**-12.9**	**-2.1**	**0.0**	**-4.2**	**-3.1**
Agriculture	20.0	1.5	6.5	1.8	7.5	5.5	-1.6	4.7	-1.1	-1.0	-3.4	-0.9	0.0	-3.8	-4.0
Industry	31.6	88.8	59.7	28.3	21.2	9.2	-1.3	9.2	1.5	1.3	-15.0	-3.8	0.0	-5.1	-1.8
Services	48.5	9.7	33.8	5.4	14.3	-4.7	-0.8	3.3	-0.2	-0.2	3.4	-1.1	0.0	-3.7	-3.3
Senegal				**19.7**	**15.5**	**6.9**	**-1.9**	**9.3**	**-0.3**	**0.0**	**-13.6**	**-5.8**	**0.0**	**-3.4**	**-3.8**
Agriculture	19.4	15.8	6.4	14.8	0.6	2.4	-3.5	2.8	-3.5	-3.5	-11.9	-2.9	0.0	-2.8	-5.5
Industry	25.8	65.2	69.1	26.9	23.2	10.8	-2.5	8.9	-0.7	0.7	-17.2	-7.9	0.0	-3.6	-2.9
Services	54.7	19.0	24.6	11.8	10.0	-3.0	-0.4	10.7	0.9	0.9	0.0	-4.9	0.0	-3.3	-3.6

** Initial shares and ratios*

with respect to agriculture are generally small. A particularly strong price reduction is observed in India, where quantitative import restrictions are simultaneously removed.

With a fixed current account balance, the increase in imports following trade liberalization leads to a real exchange rate depreciation. This, in turn, stimulates exports. The strength of this export response depends on the fall in prices for domestic sales, the capacity of local producers to substitute between local and export markets, the price elasticity of world demand for these exports[5] and initial export intensities. As domestic prices fall most and initial export intensities are highest in the industrial sector, it is this sector that generally has the strongest export response.

Indeed, this response is strong enough to counteract the reduction in domestic sales such that total industrial output actually rises relative to total agricultural output in all but Benin and Senegal. Even there, the difference in output response is much smaller than the difference in domestic sales. This pro-industrial "export-push" effect of trade liberalization is not often noted in studies of trade liberalization. However, the combined effect of fixed or falling export prices and falling prices for domestic sales is a fall in output prices that hits the industrial sector slightly harder than the agricultural sector, except in Benin.

Given higher initial tariff rates and import penetration rates in the industrial sector, consumer prices systematically decline much more than in the agricultural sector[6]. As the industrial sector consumes a higher share of industrial inputs in most countries, it benefits most from the resulting input cost savings of trade liberalization. While industrial output prices fall relative to agricultural output prices in all countries except Benin, value added prices actually increase in the industrial sector relative to the agricultural sector in four (Bangladesh,

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[5] In all countries but Bangladesh, India and Pakistan, world demand for the country's exports are assumed to be infinitely elastic.

[6] We will discuss this result further in section 7 below.

Nepal, Philippines and Senegal) of these seven countries. This counteracting input cost effect of trade liberalization on the relative value added prices of industry and agriculture is another novel finding of this study.

We now turn our attention to the impacts on the service sector. Initial tariffs on the limited or inexistent imports of services are all zero. Consequently, where there are any imports of services, their price remains constant and import values actually decrease as consumers switch to cheaper agricultural and industrial goods. Domestic sales decline nonetheless in most countries, albeit much less than in agriculture or industry, as import penetration ratios are small and real depreciation leads producers to increase their exports. However, the net impact on the output and value added of services is generally small. Output and value added prices fall roughly in proportion with the agricultural and industrial sector.

In conclusion, in most countries we observe a similar pattern concerning the trade and output effects of trade liberalization. Higher initial tariffs on industrial imports translate into greater reductions in their import prices. However, due to their imperfect substitutability with respect to domestic goods and generally low import penetration ratios, the resulting reductions in domestic output prices and volumes are much smaller. Furthermore, due to its high export intensity, it is the industrial sector that benefits most from the resulting export expansion, such that industrial output, with the exception of Benin, rises relative to agricultural output. This pro-industrial impact is further reinforced by industry's more substantial input cost savings. Finally, the service sector is characterized by generally small output effects as it has no initial tariffs.

Factor Price Effects

In this section, we see how the general fall in value added prices affects factor prices, which are the prime determinants of household income and, ultimately, poverty effects.

LESSON FOUR: Relative wages increase, returns to capital fall

We assume perfect sectoral mobility of labor, but no intersectoral mobility of capital[7]. Consequently, variations in capital prices differ from sector to sector, whereas variations in wage rates are uniform. The two exceptions here are Bangladesh and Benin, given that these models distinguish numerous labor categories: male and female low, medium and high-skilled workers in Bangladesh, and informal, modern and civil servants in Benin. Thus, wage rate variations are weighted averages of the variations in the corresponding wage rates of these labor categories, where the weights differ between sectors.

Generally speaking, we expect that the cost of mobile factors to be less affected than those of fixed factors. The more rigid the market for a factor is, the greater will be the price response and vice-versa. Therefore, it is not surprising to record a smaller fall in wage rate than in capital prices. Although overall returns to capital fall relatively more than wages in most countries, sectoral impacts mimic changes in value added prices. Hence, sectors in which value added prices fall more will also show a greater decline in the returns to capital. The factor share in value added will determine the degree to which the impact on value added price is transmitted to return to capital. Finally, the overall impact will depend on the sectoral share in overall factor payments.

In the models of India, Nepal and Senegal, land is distinguished. In the case of India and Nepal, constant relative agricultural prices explain that the returns to land are stable relative to the other factors of production. In Senegal, returns to land fall relative to all other factors, reflecting the stronger fall in agricultural value added relative prices in this country. In conclusion, with the exception of Nepal and Senegal (relative gain for capital), trade liberalization leads to an increase in the relative price of labor.

[7] We examine the long-term effects with capital mobility further on.

Table 3: Impact on Factor Prices (in %)

	Change in		Sectoral shares in factor payments*				Factor shares in value added*				Change in price of:			
	VA price	VA	Labor		Capital	Land	Labor		Capital	Land	Labor		Capital	Land
			Unskilled	Skilled			Unskilled	Skilled			Unskilled	Skilled		
Bangladesh	**-3.3**	**0.0**	**100.0**	**100.0**	**100.0**	-	**25.2**	**21.2**	**53.7**	-	**-3.1**	**-3.2**	**-3.4**	-
Agriculture	-3.1	-0.6	30.0	10.9	23.2	-	33.9	10.4	55.8	-	-2.9	-2.9	-3.3	-
Industry	-2.9	1.2	12.9	13.6	29.8	-	14.7	13.0	72.3	-	-2.6	-3.0	-2.8	-
Services	-3.5	-0.3	57.1	75.4	47.0	-	25.8	28.8	45.4	-	-3.3	-3.3	-3.7	-
Benin	**-3.9**	**0.0**	**100.0**	**100.0**	-	**63.1**	**36.9**	-	**-2.7**	**-5.3**	-			
Agriculture	-5.1	-1.0	47.6	41.5	-	57.8	42.2	-	-3.8	-6.9	-			
Industry	-7.1	-2.2	10.0	18.3	-	49.9	50.1	-	-2.5	-10.0	-			
Services	-3.0	1.8	42.3	40.3	-	70.4	29.6	-	-3.2	-1.6	-			
India	**-10.0**	**0.0**	**100.0**	**100.0**	**100.0**	**48.8**	**39.2**	**12.0**	**-9.8**	**-10.0**	**-9.9**			
Agriculture	-9.9	0.0	30.9	7.9	100.0	50.0	10.2	39.8	-9.8	-9.9	-9.9			
Industry	-10.1	0.2	17.6	28.6	0.0	43.4	56.6	0.0	-9.8	-10.4	-			
Services	-10.0	-0.1	51.5	63.5	0.0	50.2	49.8	0.0	-9.8	-9.8	-			
			Unskilled	Skilled			Unskilled	Skilled			Unskilled	Skilled		
Nepal	**-4.0**	**0.0**	**100.0**	**100.0**	**100.0**	**100.0**	**24.8**	**12.3**	**64.0**	**62.9**	**-4.0**	**-3.9**	**-3.8**	**-4.2**
Agriculture	-4.1	0.0	68.7	36.4	-	100.0	29.4	7.7	-	62.9	-4.0	-3.9	-	-4.2
Industry	-3.8	0.9	2.9	6.3	19.7	0.0	10.8	11.5	77.6	-	-4.0	-3.9	-3.8	-
Services	-3.8	-0.1	28.4	57.3	80.3	0.0	19.9	19.9	60.2	-	-4.0	-3.9	-3.8	-
Pakistan	**-7.3**	**0.0**	**100.0**	**100.0**	-	**39.3**	**60.7**	-	**-6.4**	**-8.0**	-			
Agriculture	-6.7	-0.3	44.3	18.6	-	60.7	39.3	-	-6.4	-7.2	-			
Industry	-8.6	0.7	15.5	22.1	-	31.2	68.8	-	-6.4	-9.5	-			
Services	-7.2	-0.2	40.2	59.4	-	30.5	69.5	-	-6.4	-7.6	-			
Philippines	**-3.1**	**0.0**	**100.0**	**100.0**	-	**44.9**	**55.1**	-	**-3.0**	**-3.1**	-			
Agriculture	-4.0	-1.0	21.2	19.0	-	47.7	52.3	-	-3.0	-4.8	-			
Industry	-1.8	1.3	21.6	24.6	-	41.7	58.3	-	-3.0	-0.7	-			
Services	-3.3	-0.2	57.2	56.5	-	45.2	54.8	-	-3.0	-3.5				
Senegal	**-3.8**	**0.0**	**100.0**	**100.0**	**.100,0**	**62.0**	**34.2**	**3.9**	**-3.9**	**-3.1**	**-7.7**			
Agriculture	-5.5	-3.5	18.2	12.5	100.0	58.1	22.0	19.9	-3.9	-7.7	-7.7			
Industry	-2.9	0.7	21.1	37.4	0.0	50.6	49.4	-	-3.9	-1.7	-			
Services	-3.6	0.9	60.7	50.1	0.0	68.7	31.3	-	-3.9	-2.9	-			

* Initial shares

Household Income Effects

LESSON FIVE: Nominal income tends to fall most in rural areas

In the preceding section, we saw that nominal returns to all factors fall as a result of trade liberalization. Consequently, it is not surprising that nominal household income also falls in all countries (Table 4). These incomes fall the most for countries where the reductions in nominal factor returns are the strongest: India (9.7%) and Pakistan (6.7%). Conversely, nominal incomes in the Philippines (3.0%) and in Bangladesh (-3.1%) – where factor incomes fall least – and Senegal (3.7%) – where fixed "other income" (inter-household transfers) is a major part of household income – are least affected by trade liberalization.

In all but Nepal, rural households experience a larger nominal income reduction than urban households. Thus, we conclude that trade liberalization tends to be pro-urban or anti-rural. Different explanations underlie this result, depending on the country analyzed. In Bangladesh, Benin, the Philippines and Pakistan, urban households are less affected due to their greater reliance on relatively stable other (non-factor) income such as government transfers and domestic or foreign remittances. In the cases of India and Senegal, rural income losses can be traced primarily to the reduction in returns to land in these countries. Finally, in the case of Nepal, the nominal income of urban households fall as much as their rural counterparts, as skilled wages, returns to capital and "other income" decline more for urban households than for rural households, but unskilled wages and return to land fall less.

Once again, the use of full-scale realistic models has led us to a surprising conclusion concerning the important positive impact of non-factor income for households and the substantial negative impact of land income for rural households. These two effects outweigh the

Table 4: Impact on Income (in %)

	Change in rate			Share in Total income			Contribution to change in income		
	Rural	Urban	All	Rural	Urban	All	Rural	Urban	All
Bangladesh									
Unskilled wage	-3.1	-3.1	-3.1	36.5	12.0	24.2	-1.1	-0.4	-0.7
Skilled wage	-3.2	-3.2	-3.2	18.4	22.3	20.4	-0.6	-0.7	-0.7
Capital	-3.4	-3.4	-3.4	43.7	59.6	51.7	-1.5	-2.0	-1.7
Other income	0.0	0.0	0.0	1.5	6.0	3.8	0.0	0.0	0.0
TOTAL	–	–	–	100.0	100.0	100.0	-3.2	-3.1	-3.1
Benin									
Wage	-2.7	-2.7	-2.7	79.0	47.4	61.5	-2.1	-1.3	-1.6
Capital	-5.3	-5.3	-5.3	19.8	36.6	29.1	-1.1	-2.0	-1.5
Other income	-1.9	0.0	-0.1	1.2	16.0	9.4	-2.3	0.1	-1.0
TOTAL	–	–	–	100.0	100.0	100.0	-5.5	-3.1	-4.2
India									
Wage	-9.8	-9.8	-9.8	47.6	48.6	48.1	-4.7	-4.8	-4.7
Capital	-10.0	-10.0	-10.0	21.3	40.8	30.0	-2.1	-4.1	-3.0
Land	-9.9	-9.9	-9.9	20.4	0.3	11.5	-2.0	0.0	-1.1
Other income	0.0	0.0	0.0	10.6	10.2	10.5	-1.0	-0.6	-0.8
TOTAL	–	–	–	100.0	100.0	100.0	-9.8	-9.5	-9.7
Nepal									
Unskilled wage	-4.1	-3.9	-4.0	22.6	14.8	21.4	-0.9	-0.6	-0.9
Skilled wage	-4.0	-3.9	-3.9	8.4	23.0	10.6	-0.3	-0.9	-0.4
Capital	-3.8	-3.9	-3.8	15.1	23.8	16.4	-0.6	-0.9	-0.6
Land	-4.2	-4.8	-4.2	34.7	8.2	30.6	-1.5	-0.4	-1.3
Other income	-3.0	-3.5	-3.2	19.3	30.2	21.0	-0.6	-1.0	-0.7
TOTAL	–	–	–	100.0	100.0	100.0	-3.8	-3.8	-3.8
Pakistan									
Wage	-6.4	-6.4	-6.4	53.1	34.0	42.8	-3.4	-2.2	-2.7
Capital	-7.9	-7.9	-7.9	37.0	46.0	41.8	-2.9	-3.7	-3.3
Other income	-0.1	0.0	0.0	9.9	20.1	15.3	-0.5	-0.8	-0.7
TOTAL	–	–	–	100.0	100.0	100.0	-6.8	-6.6	-6.7
Philippines									
Wage	-3.0	-3.0	-3.0	48.4	53.2	51.6	-1.5	-1.6	-1.6
Capital	-3.1	-3.1	-3.1	37.2	31.0	33.0	-1.1	-1.0	-1.0
Other income	0.0	0.0	0.0	14.4	15.8	15.4	-0.5	-0.3	-0.4
TOTAL	–	–	–	100.0	100.0	100.0	-3.1	-2.9	-3.0
Senegal									
Wage	-3.9	-3.9	-3.9	22.4	55.4	48.4	-0.9	-2.1	-1.9
Capital	-3.1	-3.1	-3.1	29.0	10.5	14.4	-0.9	-0.3	-0.5
Land	-7.7	-7.7	-7.7	14.1	0.0	3.0	-1.1	0.0	-0.2
Other income	0.0	0.0	0.0	34.5	34.1	34.2	-1.0	-1.2	-1.2
TOTAL	–	–	–	100.0	100.0	100.0	-3.8	-3.7	-3.7

more traditional labor and capital income share effects.

Consumer price effects

LESSON SIX: Nominal consumer prices fall more in industry than agriculture of services

The analysis in the preceding section suggests that trade liberalization is pro-urban in terms of its impacts on nominal income. However, by reducing import prices and local competing goods, trade liberalization may also substantially reduce consumer prices. These impacts may also differ between households according to their consumption patterns. It is the net impact of these income and consumer price effects that ultimately determine the welfare and poverty impacts of trade liberalization.

Observing Table 5, we note that consumer prices fall on average by 3.3% (Nepal) to 9.7% (India) as a result of trade liberalization. In all countries, consumer prices for industrial goods fall substantially more – 4.7% to 10.8% – than for the agricultural and service sectors, reflecting high initial tariff rates and/or high import penetration ratios in the industrial sector.

LESSON SEVEN: Cost of living effects vary

In all countries but Senegal, rural households devote a larger share of their total consumption to agricultural goods than their urban counterparts, whereas urban households consume relatively more services. It should be stressed that "industrial goods" are defined very broadly here to include very simple food processing such as milled rice (23% of household consumption in Bangladesh). Consequently, in most countries, rural households benefit less than urban households from the fall in the relative consumer prices of industrial goods, resulting in a smaller reduction in their consumer price indices. In India, Nepal

Table 5: Impact on Consumer Price (in%)

	Import share of cons'n	Compensatory sales tax	Change in prices			Share in totalconsumption			Change in CPI		
			Imports	Dom.sales	Consumer	Rural	Urban	ALL	Rural	Urban	ALL
Bangladesh	**9.1**	**1.3**	**-13.3**	**-4.0**	**-3.7**	**100.0**	**100.0**	**100.0**	**-2.8**	**-2.9**	**-2.8**
Agriculture	2.4	1.3	-8.1	-3.3	-2.1	16.8	14.1	15.5			
Industry	24.4	1.3	-13.6	-4.7	-5.8	55.1	36.2	46.2			
Services	0.0	1.3	-	-3.9	-2.6	28.1	49.7	38.3			
Benin	**19.6**	**3.8**	**-14.9**	**-5.4**	**-4.3**	**100.0**	**100.0**	**100.0**	**-2.4**	**-4.1**	**-3.2**
Agriculture	2.7	3.8	-9.6	-4.8	-1.4	34.7	31.2	32.9			
Industry	39.7	3.8	-15.8	-5.4	-7.0	51.8	39.8	45.6			
Services	4.2	3.8	0.0	-5.8	-2.6	13.5	29.1	21.5			
India	**5.5**	**0.9**	**-14.6**	**-10.1**	**-9.7**	**100.0**	**100.0**	**100.0**	**-9.1**	**-9.1**	**-9.1**
Agriculture	0.9	0.9	-11.0	-9.6	-8.9	42.6	29.2	37.1			
Industry	12.8	0.9	-15.8	-10.8	-10.9	26.2	27.2	26.6			
Services	1.2	0.9	0.0	-9.9	-9.0	31.2	43.5	36.3			
Nepal	**15.4**	**1.6**	**-7.9**	**-4.3**	**-3.3**	**100.0**	**100.0**	**100.0**	**-3.0**	**-3.2**	**-3.0**
Agriculture	5.5	1.6	-7.6	-3.8	-2.5	79.3	65.3	77.3			
Industry	54.4	1.6	-7.9	-5.7	-5.5	14.3	19.5	15.1			
Services	0.0	1.6	0.0	-4.8	-2.9	6.4	15.1	7.7			
Pakistan	**11.6**	**2.7**	**-18.0**	**-7.9**	**-6.9**	**100.0**	**100.0**	**100.0**	**-5.6**	**-5.8**	**-5.7**
Agriculture	3.4	2.7	-6.4	-6.7	-4.2	39.7	28.0	34.0			
Industry	24.3	2.7	-20.1	-8.6	-9.6	39.9	39.1	39.5			
Services	2.5	2.7	0.0	-7.9	-5.2	20.4	32.9	26.5			
Philippines	**17.4**	**3.4**	**-12.9**	**-2.1**	**-4.3**	**100.0**	**100.0**	**100.0**	**-2.5**	**-2.5**	**-2.5**
Agriculture	1.8	3.4	-3.4	-0.9	-0.9	14.6	9.8	11.4			
Industry	28.3	3.4	-15.0	-3.8	-8.2	52.1	40.6	44.4			
Services	5.4	3.4	3.4	-1.1	-0.9	33.3	49.6	44.1			
Senegal	**19.7**	**3.1**	**-13.6**	**-5.8**	**-3.4**	**100.0**	**100.0**	**100.0**	**-3.4**	**-2.9**	**-3.1**
Agriculture	14.8	3.1	-11.9	-2.9	0.5	17.1	20.3	19.2			
Industry	26.9	3.1	-17.2	-7.9	-7.2	54.3	43.3	47.1			
Services	11.8	3.1	0.0	-4.9	0.5	28.6	36.4	33.7			

and Pakistan, rural and urban households consume roughly the same share of industrial goods. Although rural households consume relatively more agricultural goods and fewer services, consumer prices in these two sectors vary in roughly the same proportion, and thus there is little urban-rural difference in the variation in consumer price indices. Thus, we can say that trade liberalization, is pro-urban in terms of income, and in terms of consumption as well.

Welfare and poverty effects revisited

Having now followed the channels of impact of trade liberalization through these different economies, we are in a position to return to the original poverty and welfare results to better understand the underlying mechanisms. As mentioned earlier, there are two main channels of impact linking trade liberalization to household welfare and poverty: Income effects and consumer price effects. To examine these effects, we reproduce the income and consumer price changes discussed in the preceding two sections in the first two columns of Table 1. We also reproduce total consumption of households since the closure chosen in the models implies that household savings should vary to equilibrate the investment-saving condition.

It becomes quite clear that the generally positive welfare effects of trade liberalization can be explained by the fact that the reduction in consumer prices is greater than the fall in total consumption, which accounts for variation in income and savings. We also note that the welfare effects of trade liberalization favor rural households over their urban counterparts only in Senegal. This result comes despite greater nominal income reductions among rural households and can be attributed to the greater fall in total consumption for urban households. In this model, rural savings are maintained fixed. Consequently, compensation for lower governmental saving must be entirely covered by urban households. In all other countries, the higher decline in income is mirrored by a greater decline in total consumption. Except in the Philippines and Senegal, urban households therefore gain from trade liberalization whereas rural households experience a slight reduction in welfare. Urban welfare gains can be traced primarily to their greater reliance on stable "other income" sources and their proportionately smaller consumption of agricultural goods, for which prices fall least.

Poverty reductions are greatest in Benin, although overall welfare declines slightly. Gains in welfare thus principally reach the poorest households while losses are concentrated among rich households. In India, Nepal and Pakistan, poverty reductions are very small. This is quite understandable in India, where welfare slightly decreases, and in Nepal, where welfare gains are inexistent. It suggests, in Pakistan, that the welfare gains from trade liberalization accrue primarily to richer households.

Conclusions

As we are economists, it may not be surprising that the main conclusion of this study of the impacts of trade liberalization on poverty is that there is no general relationship between trade liberalization and poverty; "it depends". As this detailed analysis based on disaggregated large-scale CGE models shows, trade liberalization is more complicated than policy makers may want to admit, with numerous complex and opposing impacts on these economies that channel through the output, factor and product markets to influence household income and consumer prices. The main contribution of this paper is to point out some general trends and to explain carefully on what factors the poverty impacts of trade liberalization "depends".

Nonetheless, it does appear that trade liberalization generally increases welfare and reduces poverty marginally, although some categories of households, and certainly some specific households, clearly lose out. An almost clear conclusion emerges concerning the rural-urban bias in the welfare and poverty impacts: urban households gain in terms of welfare and poverty, while rural households lose from trade liberalization.

When we now examine the channels of impacts, some interesting results emerge. Initial tariffs tend to be higher for industrial imports.

As a result, trade liberalization generally reduces import, domestic and output prices of industrial goods with respect to their agricultural and service counterparts. The cases of Pakistan and India are interesting in this regard, as it shows how trade liberalization and ensuing export expansion may lead to a greater fall in export prices where a country faces world demand that is not perfectly elastic (i.e. which demand price reductions as export increase). However, greater export intensities in the industrial sector imply that this sector benefits more from the ensuing export expansion such that industrial output actually increases more than output in the other two sectors in all but Benin.

Another remarkable result of our analysis is the importance of the input cost effects of trade liberalization. As each sector consumes a large share of inputs from within the sector itself, it is the industrial sector - where price reductions are greatest - that gains most in terms of cost reductions from trade. Indeed, these cost savings are so strong that, in most countries, value added prices actually fall less in the industrial sector than in the agriculture sector. However, it is the service sector, which is essentially cut off from international trade, which often experiences the smallest reductions in value added price following the removal of tariffs. As value added prices determine factor remunerations, these results have important welfare and poverty implications.

As labor's principal source of income is the service sector, wage rates tend to fall less than the returns to capital and land. Conversely, the returns to land, where this factor is explicitly taken into account, fall relative to the other factors given its tight links to the agricultural sector where value added prices decline most. Capital is assumed to be sector-specific, so that the returns to capital in the service sector falls less than in the other two sectors.

Surprisingly, it is not the differences in the returns to the two principal factors of production – labor and capital – that drives the household income results. Instead, we find that it is the greater reliance of urban households on relatively stable non-factor income and the greater reliance of rural households on the strongly falling returns to land that explain a general pro-urban bias in the household income effects of trade liberalization.

The impacts of tariff removal on consumer prices also hold a few surprises. Although the effects are about the same for both types of households in most countries, it is rural households that consume relatively more agricultural goods, such that they benefit less from the reduction in the prices of industrial goods than urban households. Finally, we find that positive welfare and poverty effects are driven by consumer price reductions that outweigh the reductions in total consumption, nominal income taking into account variation in savings. However, we note that income effects may dominate consumer effects when we look at the rural-urban bias in specific countries.

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Increased trade – whether it is the result of unilateral liberalization or bilateral, regional and global trade agreements – is increasingly accepted as key to economic growth and, eventually, prosperity. Yet, simultaneously, grave concerns are expressed with respect to the immediate impacts, particularly among the poor. The poor are seen as vulnerable to losing their livelihoods in the face of increased imports, while at the same time lacking the human and physical assets necessary to take advantage of emerging export opportunities. It is thus urgent that we understand in depth just how trade liberalization channels through developing country economies, changing the demand and prices for local goods, which in turn determines the relative returns to the different categories of labour and capital that generate the incomes of rich and poor alike.

In the 1990s, the International Development Research Centre undertook a daring and ambitious project to assist researchers residing in developing countries to examine themselves the poverty impacts of the various macro and adjustment policies undertaken at that time. Among these, trade liberalization figured prominently. This book gathers together the results of studies by teams of researchers in eight African and Asian countries who jointly examined the poverty impacts of the trade policies adopted throughout the 1990s in their respective countries. By adopting a common methodology and working in close consultation, with the support of a team of international experts, it became possible to carefully compare and contrast the findings in this wide range of countries to discover important similarities and differences, and several surprising results, concerning this important issue that can guide future trade reforms.

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Country papers presented in this book are drawn from studies conducted in the Micro Impacts of Macro and Adjustment Policies (MIMAP) program of the International Development Research Centre (IDRC). General chapters were begun under the MIMAP program and completed in the context of the Poverty and Economic Policy (PEP) Research Network, which is financed by the Government of Canada through the International Development Research Centre (IDRC) and the Canadian International Development Agency (CIDA), and by the Australian Agency for International Development (AusAID).

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