MODELING MALE AND FEMALE WORK IN A COMPUTABLE GENERAL EQUILIBRIUM MODEL APPLIED TO NEPAL

Ismaël FOFANA[@], John COCKBURN and Bernard DÉCALUWÉ

Centre Interuniversitaire sur le Risque, les Politiques Économiques et l'Emploi

Politiques Économiques et Pauvreté

Université Laval, Québec

ABSTRACT

This study has two purposes. First, it shows how to analyze gender issues in a standard computable general equilibrium model. Second, it analyses the effects of trade reform on male and female work in Nepal. Our contribution principally concerns the modeling of leisure activities on the one hand, and the links between different CGE models used in policy analysis on the other hand. While previous studies explicitly incorporating leisure activities require data, which is generally unavailable, we use a microeconomic model and alternative calibration procedures to avoid arbitrariness. The experiment conducted in this study shows that trade reform based upon import substitution strategy in Nepal, i.e. a complete elimination of tariffs on imported goods, benefits women more than men in term of income distribution. Women contribute more to household income as their wage increases relatively to men. It appears that the entrance of women into the labor market does not lead to a decrease in the time spent in domestic work, but rather in their leisure time. Furthermore, the study indicates that leisure time consumed by men, which is generally greater than for women, increases with trade reform. Disaggregating labor between male and female workers is relevant when the study has a gender purpose; otherwise, standard models are suitable to analyze the impacts of macroeconomic policy shocks on households. We also found that the welfare gain from tariffs removal is higher in work-leisure models than in a standard exogenous work model. Decomposing gender non-market work time into domestic work and leisure is important when we wish to emphasize the role of women in home produced goods, and to analyze the impact of macroeconomic policies on the well-being of men and women.

Keywords: Nepal, trade, gender, leisure, home production, and computable general equilibrium.

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[@] ifofana@ecn.ulaval.ca

I. INTRODUCTION

In this new era of globalization, developing countries must selectively and strategically seize the opportunities of the global economy and trade integration to enhance human development and combat poverty. Although the principal argument in favor of globalization has been the benefit brought to all nations, its partisans recognize that it creates winners and losers in all countries. The problem of distribution of gains from trade in the developing countries, where national income is already unequally distributed, is at the core of the current trade debate.

Compared to men, several studies showed that women are more vulnerable to chronic poverty, because of gender inequalities in the distribution of income, access to productive inputs such as credit, asset management, and the labor market.

Most studies recognize a significant increase in female labor market participation during the last decade, corresponding to the period of liberalization in the majority of the developing countries. Although, the expansion of female work and income could have perverse consequences on their leisure and their welfare, as well as on the welfare of children and other dependents, these aspects still remained under-explored in studies.

We develop a computable general equilibrium (CGE) for Nepalese economy to analyze the effects of trade on gender work (in the market and at home) and leisure. Indeed, men and women may be affected differently by the macroeconomic policies implemented, depending on the sectors in which they work. CGE models are powerful tools to capture, in a general equilibrium framework, all direct and indirect effects of macroeconomic shocks (wherever the shock occurs in the economy) on sectoral production and factor demands. Gender market work, leisure, and home production are modeled successively. This allows us to capture successively the major changes in male and female activities and income when we incorporate a work-leisure choice, then home production, in a standard CGE model. Therefore, considering the actual characteristics of the Nepalese economy, we bring some answers to the

question of how trade liberalization affects female market work, income inequality between males and females and the amount of time they devote to leisure and home activities.

We present in section I and II a brief review of literature and salient features of the Nepalese economy; section III and IV discuss quantitative aspects of gender issues in Nepal and model specification; in section V and VI we present the macroeconomic closure and data, and finally in section VII and VIII we discuss results and test the model sensitivity to key parameters.

II. REVIEW OF LITERATURE

During the last decade, gender poverty and inequality has become an important issue in developing countries. Many studies have focused on several gender issues including the impact of trade liberalization on gender inequalities.

Most studies note a significant increase in female labor market participation during the last decade, corresponding to the period of liberalization in the majority of the developing countries. The feminization of paid work has been pronounced in semi-industrialized economies, with exporting industries employing more females. Elson and Pearson (1981) show the increase in female participation in manufacturing sectors and export industries, as a flexible and underpaid labor force. Several other studies, Standing (1989); Wood (1991); Cagatay and Ozler (1995); Joekes (1995 and 1999); Ozler (2000 and 2001); confirm the relationship between the expansion of exported-oriented industries and female employment. Typical female labor-intensive exported-oriented industries are textiles, garments, electronics, leather and agricultural processing industries. These studies show that the feminization of work in export sectors is stronger in the industrial sector and semi-industrialized economies, than in agricultural sectors and economies.

In agricultural economies, studies reveal that the increase in traditional agricultural exports could benefit men more than women (Gladwin 1991; Fontana et al 1998). In the majority of African countries, female work constitutes the base of foundation food production, which is

crucial to household food security. They are often owners of small plots of land. In these economies, economic reforms tend to favor large landowners to the detriment of small holders, as agricultural exports are more conducive to large landholdings. When market opportunities emerge, it appears that men benefit more than women, because of the difficulties for women to access loans, assets, new technologies, knowledge, etc. The impact of these changes is more severe for women who are household heads and/or poor (Fontana et al. 1998). In a situation where household income increases with the increase in female work in exported-oriented manufactures, female welfare may not necessarily be improved. The increase in household income may be accompanied by decreasing food production to the detriment of household. This case is particularly apparent when men control household income and use it for their own needs rather than for family needs. Although study results are still ambiguous, several others reasons suggest that trade liberalization in agricultural economies could also have perverse effects on the welfare of women.

In semi-industrialized countries, where female work in export-oriented sectors has increased, analysts conclude that liberalization is beneficial to women and reduces the gap between men and women in labor market participation and income distribution. However, in these countries some reservations have been expressed for several reasons, mostly, concerning the conditions under which female work grows.

However, even if pro-female in employment and income distribution, trade liberalization creates winners and losers among women. The distribution of gains from trade will be closely related to factor endowments, particularly labor skills, sectoral factor intensities and mobility. Although, the expansion of female market work is seen as enhancing their negotiating power within the household, it constitutes for them a burden if there is not a similar reduction in their domestic work. Its perverse effects on female leisure and domestic work leave some skeptical of its benefits for women and household dependents.

Time use surveys conducted by the International Center for Research on Women in many less developed countries show that women participate both in home and market production, and the time they devote to the latter is greater the poorer is the household. Women tend to

work longer hours and have less leisure time than men. When home production is added to market production, they found that women's and children's contribution to the household (in term of time spent at work) is greater than men's. When women enter the labor market, it is their leisure time rather than their home production hours that is reduced. The demand for household income makes women's market work a necessity, and it is their leisure that responds and adapts to the market.

Therefore, failure to account for gender leisure and home production time seriously biases the analysis of the impacts of macroeconomic policies on welfare of men and women in less developed countries.

While most computable general equilibrium (CGE) models do not incorporate a labor-leisure choice, a number of studies have included endogenous labor supply in their model[1]. The majority of these studies focus on issues other than gender. They show the importance of household allocation of time between work and leisure for welfare results in tariff analysis. Mayer (1991) derives the effect of a change in tariffs on labor supply and notes that it is important to endogenize unearned income. Further, Mayer states that introduction of tariffs raises the supply of labor, if the export good is capital intensive, and a substitute for leisure. He shows that this result may not hold if the export good is labor intensive. Roussland and Tokarick, (1995) show that welfare gains on tariff removal is higher in work-leisure models than traditional exogenous work models[2].

Few CGE models have incorporated home produced goods to analyze household labor supply decisions. Generally, these models assume that home produced goods are close substitutes to market goods. Recently Fontana and Wood (2000), and Fontana (2001 and 2002) built CGE models for Bangladesh and Zambia to analyze the effects of macroeconomic policies on female work in the market and at home. They explicitly incorporate leisure and home produced goods as sectors that behave in the same way as market sectors. In general,

[1] Kemp and Jones (1962), Mayer (1991); De Melo and Tarr (1971); Ballard and al. (1984); Whalley and Piggott (1996); Bovenberg, Graafland and Mooij (1998).
[2] Roussland and Tokarick (1995) incorporate leisure as a substitute for certain goods and services, and a complement for others.

they found that trade liberalization expands female work and income, and could have perverse consequences on female leisure and household dependents.

The difficulty in the preceding CGE framework studies on gender issues is that rarely available data on leisure time is required for model calibration. We use an alternative modeling procedure to avoid these data requirements.

III. NEPALESE ECONOMY

The macroeconomic performance of the Nepalese economy shows moderate growth. The saving ratio remains stagnant and there is a surge in investments in the early 90s. The overall consumer price inflation rate is around 8 percent during the 90s excluding 92 and 93.[3]

TABLE 1: MACROECONOMIC INDICATORS (IN PERCENT)

Period\Year	Growth Rate of GDP			Saving/ GDP	Investment/GDP	Consumer Prices
	Agriculture	Industry	Services			
Average 1981-90	1.4	9.0	7.2	12	19.1	9.8
Average 1991-97	2.3	8.0	7.2	13.5	22.5	11.1
1993/94	7.6	9.0	7.7	16.5	22.4	8.9
1994/95	-0.3	3.9	6.0	15.2	25.1	7.6
1995/96	4.4	5.9	7.9	10.3	27.2	8.1
196/97	4.1	3.2	5.0	12.5	25.3	7.8
1997/98	2.0	4.6	5.0	13.1	24.8	7.5
1998/99	3.5	4.0	4.5	13.0	20.5	8.0

Source: Asian Development Bank, Asian Development Outlook, various Issues and International Monetary Fund.

III.1 Trade features

Nepal's exports have been increasing during the last two decades. There have also been major compositional changes. The share of agricultural exports has declined from 70 percent of export earnings in the early 80s to nil by the mid 90s. In contrast, manufactured exports, particularly textile manufactures, have increased and, by the mid 90s, represent almost all of Nepal's export earnings[4]. Food exports have since rebounded somewhat. The destination of Nepalese exports is mainly Europe and America.

[3] The Nepalese currency was devaluated by 20 percent in 1992.

[4] The major export goods are hand knotted woollen carpets, readymade garments and recently pashminas, and manufactured goods: light engineering products, handicrafts, silver jewellery, paper products. The major export product, carpets, faced a severe blow during 1994 and 1995 because of the allegation of use of child labour in the industry. It took two to three years to take requisite measures and clarify

Also, Nepalese imports have increased rapidly. Food and beverage, Textiles and, chemical and mechanical products are the main imports over the last decade. There has been a large increase in the share of manufactured goods.

Before liberalization reform, the highest level of protection was accorded to metal and metal products and export oriented industries, paper and paper products. The moderately protected industries were textiles, chemicals, and building materials. Wood and wood based industries were least protected. Similarly, food and beverage industries were also least protected. After the reforms[5], there has been a substantial decrease in the level of protection. Average nominal protection has declined from 88 percent in the mid 80s to around 40 percent at present. The nominal tariff rates for the majority of commodities are around 30 percent, and there is still a cascading structure of tariffs. As a result, the average effective rate of protection is much higher.

In 1991/92, the average import-weighted tariff on total imports was 28.6 percent. The average import-weighted tariff on imports from India was 7.1 percent. By 1994/95, the average import-weighted tariff rate was 13 percent for total imports, 17 percent for third country imports and 9 percent for imports from India. The share of India in total imports was 40 percent. However, the share of tariff revenue on imports from India was only 27 percent. By 1996/97, the share of India in Nepal's imports was 23.4 percent. The import-weighted average tariff rate were 8.6 percent, 5.2 percent and 6 percent for import from India, third countries and total imports, respectively.

TABLE 2: EXPORT BY MAIN CATEGORIES (IN PERCENT)

Categories	1980	1990	1995	2000
Total Value (million dollars)	93.7	179.9	286.3	971
All food items	21.4	13.2	1.1	10.4
Agricultural Raw materials	48.0	3.0	0.1	4.4
Fuels	0	0	0	0
Ores & metals	0.1	0.3	-	-
Manufactured Goods	30.5	83.5	98.9	85.2

Source: United Nation Commission of Trade and Asian Development, Handbook of Trade and Development Statistics, 1995.

allegations. The industry witnessed large shocks and recovered by 1996. Despite the situation, exports in 1996/97 were at an all-time high during the 1990s.

[5] For more details on Nepalese tariff and tax reform see Sapkota (2001)

TABLE 3: IMPORTS BY MAIN CATEGORIES (IN PERCENT)

Categories	1980	1990	1995	1996	2000
Total Value (million dollars)	226.3	574.7	601.7	1350	1713
All food items	4.3	14.8	15.1	15.0	12.5
Agriculture Raw materials	0.6	7.0	5.0	5.0	7.0
Fuels	17.7	8.7	19.5	20.0	9.7
Ores and metals	1.2	2.0	4.9	5.0	4.4
Manufactured Goods	73.1	67.4	47.4	47.0	66.4
Of which:					
Chemical products	7.3	18.0	11.5	-	
Other manufactures	33.7	30.4	16.8	-	
Machinery & transport	32.2	19.1	19.1	-	
Unallocated	3.1	-	8.1	-	

Source: United Nation Commission of Trade and Asian Development, Handbook of Trade and Development Statistics, 1995.

III.2 Tax reform

In the last decade, the top income tax rate was reduced from 45 percent to 33 percent and tax brackets were also reduced from 8 to 4. Dozens of domestic industrial products were removed from the excise net in order to simplify the tax system. The sales tax rates were also reduced from 5 (ranging from 5 to 40 percent) to 2 (10 and 20 percent). Later, the sales tax was further reduced to a single rate of 15 percent. Finally, a VAT of ten percent with an exemption limit for annual turnover of less than 2.0 million rupees has been levied since mid-July 1997[6].

TABLE 4: IMPORT TARIFFS BY MAIN CATEGORY OF GOODS, 1999/2000 (IN PERCENT)

Main Category of Goods [1]	Import Tariff [2]
Live animals	5.00
Grains, vegetable extracts, sugars	15.60
Beverage, tobacco, mineral fuels, pharmaceuticals	11.70
Fertilizers, cosmetics, soaps, chemicals, plastics	15.30
Raw hides, skins, wood, paper, silk	10.90
Wool, cotton, man-made fibers, carpets	13.20
Clothing. Footwear, ceramics, glassware, stoneware	21.10
Iron, steel copper, nickel, aluminum, lead, zinc, tin	12.90
Tools, machinery, vehicles, aircrafts	11.90
Clocks, musical instruments, arms, furniture, art	20.60
Average customs duty	13.14

Source: International Monetary Fund. 1/ Harmonized System Classification; 2/ Average of customs duties for all item in each chapter.

[6] Sapkota P. (2001)

III.3 Composition of government revenues

Nepal's government largely depends on trade taxes for revenue. Custom revenue contributes as much as 17 percent, second only to the domestic taxes on production and consumption of goods (20 percent). Total tax revenue contributes about 50 percent of government finance. The rest is financed from other revenues (12.1 percent), foreign grants (7.7 percent), foreign loans (21.1 percent) and domestic loans (8.3 percent).

TABLE 5: NEPAL'S COMPOSITION OF GOVERNMENT REVENUES (IN PERCENT)

Type of Revenue	**90/91**	**91/92**	**92/93**	**93/94**	**94/95**	**95/96**	**96/97**	**97/98**	**98/99**
Customs	12.8	14.0	14.4	15.9	18.3	16.5	17.0	16.1	16.9
Taxes on Consumption & production	15.9	20.5	20.7	22.0	23.0	21.8	22.0	21.3	20.8
Domestic excise	5.1	5.9	5.3	4.8	4.3	4.4	4.7	5.5	5.2
Sales taxes[1]	8.5	16.0	12.5	14.2	15.7	14.5	14.6	13.5	14.2
Land Revenue & Registration	2.3	2.6	2.7	2.5	2.4	2.4	2.1	1.9	1.8
Taxes on Property, Profit & Income	3.5	4.0	4.7	6.1	7.6	8.1	8.8	9.8	11.5
Total Tax revenue	**34.5**	**41.1**	**42.4**	**46.6**	**51.3**	**48.8**	**50.0**	**49.1**	**50.9**
Other Revenue	10.8	15.1	12.7	12.8	12.9	14.5	13.2	13.2	12.1
Total Revenue	**45.3**	**56.2**	**55.1**	**59.4**	**64.2**	**63.3**	**63.1**	**62.4**	**63.0**
Foreign Grants	9.1	6.8	13.8	7.3	7.5	10.9	12.2	10.2	7.7
Foreign Loans	26.4	28.3	25.2	27.8	23.6	21.3	18.5	20.9	21.0
Domestic Loans	19.2	8.6	5.9	5.5	4.6	4.5	6.1	6.4	8.3
Total	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
Government Finance[2]	23704	24052	27483	32958	38311	44397	48893	52788	56464

Source: His Majesty Government of Nepal, Economic Survey, various Issues. [1]Domestic and import. [2] Nepalese rupees in million

IV. GENDER IN THE NEPALESE ECONOMY

Agriculture is the main sector of employment in Nepal with 76% of workers (85% of female workers and 67% of male workers) in 1998/99. In urban areas, men are mostly active in the service sectors (particularly in wholesale, retail and trade activity), while women are more active in agriculture activity. In rural areas, agriculture is the primary activity of both men and women. The manufacturing sector employs 3.9% of female workers and 7.7% of male workers, and more urban than rural workers. Women represent one third of all workers in this sector. Agriculture and private household work are female labor-intensive activities.

The female labor share has been increasing in all sectors, particularly in industry, due to the growth of textile and garment production (Table 7). Before the nineties, more than 90% of

male and female workers were employed in agriculture. These shares have subsequently fallen to 67% and 85% by 1998, as employment in industry and, particularly services grow (Table8).

TABLE 6: EMPLOYED PERSONS BY SEX, LOCALITY, AND INDUSTRY

	Nepal*			Urban*			Rural*			Female/
	All	Male	Female	All	Male	Female	All	Male	Female	Male
TOTAL	100	100	100	100	100	100	100	100	100	0.998
ALL AGRICULTURE	76.1	67.0	85.2	40.4	28.2	57.1	80.2	72.2	87.9	1.269
Agriculture, hunting & forestry	76.0	66.8	85.2	40.3	28.0	57.1	80.1	72.0	87.9	1.273
Fishing	0.1	0.2	0.0	0.1	0.2	0.0	0.1	0.2	0.0	0.091
ALL INDUSTRY	5.9	7.9	4.0	13.3	14.6	11.5	5.1	6.9	3.2	0.503
Mining & quarrying	0.1	0.1	0.0	0.2	0.2	0.2	0.1	0.1	0.0	0.167
Manufacturing	5.8	7.7	3.9	13.1	14.5	11.2	5.0	6.8	3.2	0.508
ALL SERVICES	18.0	25.1	10.8	46.3	57.1	31.5	14.7	20.8	8.8	0.429
Electricity, gas & water supply	0.3	0.5	0.0	1.0	1.6	0.2	0.2	0.4	0.0	0.080
Construction	3.6	6.2	1.1	4.4	6.6	1.5	3.5	6.1	1.1	0.178
Wholesale, retail & trade	4.3	6.0	2.6	15.1	18.4	10.5	3.1	4.3	1.9	0.442
Hotels & Restaurants	1.2	1.3	1.1	4.5	4.5	4.6	0.8	0.9	0.7	0.810
Transport, storage & communication	1.4	2.7	0.1	4.4	7.1	0.7	1.1	2.2	0.1	0.046
Financial intermediation	0.2	0.4	0.0	1.1	1.6	0.5	0.1	0.2	0.0	0.118
Real estate, renting & business	0.3	0.5	0.1	1.8	2.7	0.5	0.2	0.3	0.1	0.231
Public administration & defense	0.7	1.4	0.1	3.2	4.8	1.0	0.5	0.9	0.0	0.094
Education	1.7	2.7	0.8	4.0	4.3	3.7	1.5	2.4	0.5	0.294
Health & social work	0.3	0.5	0.1	1.1	1.4	0.7	0.3	0.4	0.1	0.269
Other community, social activities	0.6	1.1	0.1	1.6	2.3	0.7	0.5	0.9	0.1	0.118
Private household workers	3.1	1.7	4.4	3.7	1.4	6.8	3.0	1.7	4.2	2.613
Extra territorial organizations	0.1	0.1	0.0	0.2	0.4	0.0	0.1	0.1	0.0	0.167

Source: Nepal Labor Force Survey 98/99. * In percent.

TABLE 7: EVOLUTION OF SECTORAL FEMALE LABOR SHARE (IN PERCENT)

	1950	1960	1970	1980	1990	1998
Agriculture	38.9	39.0	39.1	39.5	40.3	55.9
All Industry	25.4	21.1	18.5	5.1	13.6	33.5
Manufacturing				6.1	18.8	33.7
Services	7.3	11.4	11.7	12.6	11.7	30.0

Source: Labor Statistics Database, 98-02, International Labor Organization Geneva, and Nepal Labor Force Survey 98/99

The average total monthly earnings of paid employees in 1998/99 were slightly more than 2100 rupees. Men in paid employment had much higher monthly earnings (at around 2400 rupees) than women (around 1400 rupees). Within particular occupation groups the contrast between male and female earnings is sometimes quite marked. While average monthly earnings for males and females appear roughly comparable for jobs such as

technicians and clerks, women in paid employment appear to be at a disadvantage relative to men in agriculture, crafts and related trades, and in elementary occupations (Table 9).

TABLE 8: EVOLUTION OF MALE AND FEMALE SECTORAL WORK REPARTITION (IN PERCENT)

	Sector	1950	1960	1970	1980	1990	1998
BOTH SEXES	Agriculture	95.1	94.9	94.3	93.7	93.5	76.1
	All Industry	2.6	2.1	1.3	0.5	0.3	5.8
	Manufacture				0.45	0.18	5.91
	Services	2.3	3.0	4.4	5.8	6.2	18.0
	Total	100	100	100	100	100	100
MEN	Agriculture	93.5	93.1	92.1	91.1	90.7	67.0
	All Industry	3.1	2.6	1.7	0.8	0.4	7.9
	Manufacture				0.7	0.3	7.7
	Services	3.4	4.3	6.2	8.1	9.0	25.1
	Total	100	100	100	100	100	100
WOMEN	Agriculture	97.8	97.9	98.0	98.0	98.0	85.3
	All Industry	1.7	1.2	0.6	0.1	0.1	4.0
	Manufacture				0.08	0.08	3.94
	Services	0.4	0.9	1.4	1.9	1.9	10.8
	Total	100	100	100	100	100	100

Source: Labor Statistics Database, 1998-2002, International Labor Organization in Geneva, and Nepal Labor Force Survey 98/99

TABLE 9: AVERAGE MONTHLY EARNINGS[7] BY ALL PAID EMPLOYEES (RUPEES)

	All	**Male**	**Female**
All	2143	2389	1368
Legislators, senior officials	8037	8068	7525
Professionals	5079	5141	4631
Technicians	2971	3057	2678
Clerks	2832	2836	2805
Services workers	2507	2506	2525
Agriculture workers	2109	2756	957
Craft & related trades	2773	2973	1393
Plant & machine operators	2981	2995	2037
Elementary occupations	1491	1692	1054
Armed forces	3306	3258	4250

Source: Nepal Labor Force Survey 98/99

V. THE MODELS

The core of our computable general equilibrium (CGE) model is adapted from *Sapkota (2001)*. The model has eleven sectors of production: five agricultural sectors, five non-agricultural sectors, and one public sector. Six sectors export part of their production. All

[7] Cash and in kind

sectors produce import-competing goods. There are four types of factors: male and female labor, which are perfectly mobile in the whole economy, agricultural capital and non-agricultural capital, which are mobile within the agricultural sectors and the non-agricultural sectors, respectively. Households are classified in seven representative categories: mountain landless[8] (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï[9] landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB).

In this section, we successively present the different stages of modeling male and female paid work, leisure and domestic work. We start with a standard model (**model0**), presenting one aggregate labor[10]. Most CGE standard models make the hypothesis that i) male and female labor are perfect substitutes in market production, and ii) household labor supply is exogenous, and iii) there is perfect substitution between male and female labor in household labor supply. In the models presented below, we successively relax these hypotheses, and analyze their effects on macroeconomic variables and gender features in the context of trade policy reform in Nepal.

1- In the first step, we disaggregate *male and female labor and allow them to be imperfect substitutes in sectoral production*. Household supplies of Male and female labor are both exogenous, maintained at their base year levels : **model1**

2- In the second step, contrary to model1, *male and female labor supply are endogenously determined by the household*. In this context, male and female non-market labor time (leisure and domestic work) are assumed to be imperfect substitutes in the household utility function. However, leisure and domestic work time, which are not distinguished for each household member (men and women), are implicitly assumed to be perfect substitutes (**model2**).

[8] We follow the households classification of Sapkota (2001) according to the land holding size; landless households = less than 0.5 ha, small landholders = between 0.5 ha and 2 ha, and large landholders = more than 2 ha.
[9] Terai has the most fertile agriculture land in Nepal.
[10] The equations and results of the standard model are presented in appendixes 11 and 5, respectively.

3- In the third step, we *incorporate domestic work in model2*. At this stage, male and female imperfectly substitute their time devoted to leisure and to domestic work (**model3**).

V.1 DISAGGREGATING SECTORAL LABOR BY SEX - model1

The labor market is segmented into male and female work to highlight the wage inequality observed in the Nepalese economy. Each market satisfies the neoclassical hypothesis of perfect competition: perfect homogeneity of labor force[11], perfect sectoral and geographical mobility, etc.

- *On the factor demand side* (or production of goods), the unique labor factor is disaggregated into male and female labor, which are imperfect substitutes in sectoral production, with identical or different elasticities of substitution[12] in each sector. Sectoral value added is modeled by a two-level constant elasticity of substitution (CES) function. On the first level, male labor (LMmal) and female labor (LMfem) are aggregated into composite labor (LM).

$$LM_i = A_i \left[\alpha_i LMfem_i^{-\rho_i} + (1-\alpha_i) LMmal_i^{-\rho_i} \right]^{-1/\rho_i} \qquad [0.1]$$

where ρ is a substitution parameter.

Relative demand for male and female labor depends on a share parameter (α), the relative wage rate and the sectoral elasticity of substitution (σ).

$$\frac{LMfem_i}{LMmal_i} = \left[\left(\frac{w_{mal}}{w_{fem}} \right) \left(\frac{\alpha_i}{1-\alpha_i} \right) \right]^{\sigma_i} \qquad [0.2]$$

As in the core model, aggregate labor and capital constitute the sector's value added, and production is a fixed combination of value added and intermediate consumption.

[11] This assumption is made to simplify the model; different skill levels can be introduced in a more complex model (see Fontana 2001).
[12] Previous studies (Fontana et Wood, 1999; Fontana, 2001) use the same elasticity of substitution for all sectors. However, substitution between male and female work may be greater in some sectors than others. Unfortunately, the lack of available data on these parameters justifies the use of uniform elasticities in these studies.

Each market is cleared when total labor supply (TLM) is equal to the sum of sectoral labor demands.

$$\text{TLMmal} = \sum_{i} \text{LMmal}_{i} \qquad [0.3]$$

$$\text{TLMfem} = \sum_{i} \text{LMfem}_{i} \qquad [0.4]$$

Unlike the core model, sectoral average wage rates differ according to their respective mixes of male and female labor.

$$w_{i} = \frac{\text{wfem} \cdot \text{LMfem}_{i} + \text{wmal} \cdot \text{LMmal}_{i}}{\text{LMfem}_{i} + \text{LMmal}_{i}} \qquad [0.5]$$

- *On the supply side*, instead of the unique wage income observed in the standard model, we distinguish two sources of household wage income representing the remuneration of labor that the household's male and female members have supplied in the market. Household labor supply of male and female labor is still considered to be exogenous. The sum of all household supply constitutes total supply of labor in each labor market.

$$\text{TLMmal} = \sum_{H} \text{LMmal}_{H} \qquad [0.6]$$

$$\text{TLMfem} = \sum_{H} \text{LMfem}_{H} \qquad [0.7]$$

The new equations of the model are [0.1], [0.2] and [0.5]. Equations [0.6] and [0.7], [0.3] and [0.4], replace [4.52] and [4.53], respectively, in the standard model. The additional base year data needed are:

- Male and female labor remuneration in all sectors;
- Male and female wage income in all households;
- Sectoral elasticities of substitution between male and female labor.

Model calibration and results are presented in appendices L and F, respectively.

V.2 GENDER LEISURE AND ENDOGENOUS LABOR SUPPLY: model2

Following the approach of Ashenfelter and Heckman (1974), we consider that each household member (men and women) considers leisure time and domestic work time to be perfect substitutes. The household acts as if it possesses and maximizes a unique utility function which is continuous and twice differentiable.

Unitary household utility is modeled by an extended Stone-Geary utility function defined over market goods and unpaid time.

$$U_h = \left(L_h^{mal} - \overline{L}_h^{mal}\right)^{\beta_h^{mal}} \left(L_h^{fem} - \overline{L}_h^{fem}\right)^{\beta_h^{fem}} \prod_i \left(C_h^i - \overline{C}_h^i\right)^{\beta_h^i} \quad [2.1]$$

with, $\beta_h^{mal} + \beta_h^{fem} + \sum_i \beta_h^i = 1$

L and $\overline{L}$ represent, respectively, the total and minimal subsistence levels of unpaid time consumed by household's members. In this section we use the term «leisure» for time that is not devoted to market work. C and $\overline{C}$ are, respectively, the total and minimal subsistence levels of consumption of market goods; the β are the marginal budget shares that determine the allocation of household h supernumerary income between market goods and gender leisure.

Leisure is a normal good, male and female leisure are imperfect substitutes, on one hand, and with respect to other market goods, on the other hand. The household faces the following constraints:

- Budget constraint:

$$\sum_i P_i C_{i,h} = R_h + w_{mal} LM_{mal,h} + w_{fem} LM_{fem,h} = Y_h \quad [2.2]$$

Y is the real income, w are the wage rates, LM are market work time, R is non-labor income and P are the market good prices.

- Time constraint:

$$T_{mal,h} = LM_{mal,h} + L_{mal,h} \quad [2.3]$$

$$T_{fem,h} = LM_{fem,h} + L_{fem,h} \quad [2.4]$$

T_{mal} and T_{fem} are the total time endowments of men and women in household h.

Full income is obtained from equations [2.2], [2.3] and [2.4],

$$\sum_i P_i C_{i,h} + w_{mal} L_{mal,h} + w_{fem} L_{fem,h} = R_h + w_{mal} T_{mal,h} + w_{fem} T_{fem,h} = FY_h \quad [2.5]$$

$$= Y_h + w_{mal} L_{mal,h} + w_{fem} L_{fem,h} = FY_h \quad [2.6]$$

Demand and supply functions are obtained from maximizing utility [2.1] under the constraints [2.5][13].

$$C_{i,h} = \overline{C}_{i,h} + \frac{\beta_h^i \left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{P_i \left(1 - \beta_h^{mal} - \beta_h^{fem} \right)} \quad [2.7]$$

$$LMmal_h = MAXHOURS_{mal,h} - \frac{\beta_h^{mal} \left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{W_{mal} \left(1 - \beta_h^{mal} - \beta_h^{fem} \right)} \quad [2.8]$$

$$LMfem_h = MAXHOURS_{fem,h} - \frac{\beta_h^{fem} \left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{W_{fem} \left(1 - \beta_h^{mal} - \beta_h^{fem} \right)} \quad [2.9]$$

Where $MAXHOURS_{mal,h} = Tmal_h - \overline{L}mal_h$, and $MAXHOURS_{fem,h} = Tfem_h - \overline{L}fem_h$

Welfare is measured by equivalent variations (EV),

$$EV_h = \left(\frac{1}{1 - \beta_{mal,h} - \beta_{fem,h}} \right) \left[\left(Y_h^1 - \sum_i P_i^1 \overline{C}_{i.h} \right) \left(\frac{w_m^0}{w_m^1} \right)^{\beta_i} \left(\frac{w_f^0}{w_f^1} \right)^{\beta_i} \prod_i \left(\frac{P_i^0}{P_i^1} \right)^{\beta_i} - \left(Y_h^0 - \sum_i P_i^0 \overline{C}_{i.h} \right) \right] \quad [2.10]$$

[13] The complete derivation procedure is noted in appendix 11.

Equations [2.7] and [2.10] replace [4.25] and [4.59], respectively, in the standard model. There are two additional equations, [2.8] and [2.9], representing the endogenous supply of male and female labor functions. The additional data required to calibrate parameters are male and female maximum time devoted to work and leisure (MAXHOURS). In sections V and IX we discuss this parameter in more detail. The calibration procedure is presented in appendix.

V.3 INTRODUCTION OF DOMESTIC WORK (HOME PRODUCTION): model3

Productive activities are not limited to market activities. Households devote a large proportion of their time to produce "home" goods, which can neither be purchased nor sold on the market and which, therefore, are consumed entirely by the household themselves. While advances in economic theory have stressed that important productive activities occur within the household, less attention has been devoted to distinguishing domestic work activities from leisure activities. The International Center for Research on Women (1980) states that it is not likely that home production and leisure activities will be affected in the same way by changes in technology, wage rates or socioeconomic variables and it is therefore important for empirical analysis to separate these two activities.

We present a simple version of the Graham and Green (1984)[14] model. In contrast with previous studies, we consider that home produced goods are imperfect substitutes for market goods[15]. Households maximize a utility function defined over market goods (Ci), home goods (CZ_k), and the leisure time of its members ($LEmal_h$ and $LEfem_h$):

$$U_h = U\left(C_{i,h}, CZ_{k,h}, LEmal_h, LEfem_h\right) \qquad [3.1]$$

Subscript k represents various home goods.

To simplify the model, we suppose that:

- Market and home goods are imperfect substitutes in the household utility function;

[14] Gronau (1977) and Solberg and Wong (1992)

[15] Gronau (1977) and Solberg and Wong (1992) assume that home goods are perfect substitutes for market goods. However, in other versions of Gronau's model these goods are imperfect substitutes.

- Home goods are produced using only labor (male and female) and do not require intermediate inputs or capital[16].

- Time spent in various activities (leisure, home production, and market activities) is perfectly separable, i.e. the same hour cannot be used, simultaneously, in two different activities[17];

- In equilibrium and for each gender, the marginal utility of time is equal across different activities (leisure, home production, and market work in different sectors)[18].

Under these assumptions, on the consumption side, households maximize a direct unitary utility function in [3.1] under the following constraints:

- Technology used in home good production,

$$Z_h = A_h \left[\alpha_h LZmal_h^{-\rho_h} + (1-\alpha_h) LZfem_h^{-\rho_h} \right]^{-1/\rho_h} \quad [3.2]$$

Z_h is a CES function, $LZmal$ and $LZfem$ represent, male and female labor used in home production

- Budget constraint,

$$\sum_i P_{i,h} C_{i,h} = R_h + w_{mal} LMmal_h + w_{fem} LMfem_h = Y_h \quad [3.3]$$

- Time constraint,

$$Tmal_h = LMmal_h + LZmal_h + LEmal_h \quad [3.4]$$

$$Tfem_h = LMfem_h + LZfem_h + LEfem_h \quad [3.5]$$

[16] See *Gronau (1977)* and, *Solberg and Wong (1992)*. Other studies, *Gronau (1973) and, Graham and Green (1984),* incorporate market intermediate inputs in home production activities. Practically, it is difficult to follow this approach, because national surveys do not distinguish intermediate and final consumption of market goods. This hypothesis should not substantively influence our results, as substitution and complementarity between factors and intermediate consumption are captured in the household direct utility function.

[17] None separability is often observed, particularly in developing countries where individuals (specially women) combine home production activities (e.g. child care) with leisure activities (e.g. community meetings) or market (e.g. traditional agriculture and milling). For more details on the model, see *Graham and Green (1984)*. *Wales and Woodland (1977)* examine the degree of separability between domestic work and leisure.

[18] For differential productivities see *Graham et Green (1984)*

In the following section, we assume that the household produces a single composite good. The household's budget constraint is expressed in terms of full income (FY) by rearranging equations [3.3], [3.4] and [3.5] :

$$\sum_i P_{i,h} C_{i,h} + P_h^z CZ_h + w_{mal} LEmal_h + w_{fem} LEfem_h = FY_h \quad [3.6]$$

With $P_h^z Z_h = w_{mal} LZmal_h + w_{fem} LZfem_h$

$$Z_h = CZ_h$$

$$FY_h = R_h + w_{mal} Tmal_h + w_{fem} Tfem_h \quad [3.7]$$

$$= Y_h + w_{mal} LEmal_h + w_{fem} LEfem_h + P_h^z CZ_h \quad [3.8]$$

P^z and Z represent the price and volume of home goods, respectively.

Explicitly, the household maximizes an extended Stone and Geary utility function, under the constraint [3.6]

$$U_h = \left(LEmal_h - \overline{LE}_h \right)^{\beta_h^{mal}} \left(LEfem_h - \overline{LE} fem_h \right)^{\beta_h^{fem}} \left(CZ_h - \overline{CZ}_h \right)^{\beta_h^z} \prod_i \left(C_h^i - \overline{C}_h^i \right)^{\beta_h^i} \quad [3.9]$$

With, $\beta_h^{mal} + \beta_h^{fem} + \beta_h^z + \sum_i \beta_h^i = 1$

The resulting demand and supply functions are[19]:

$$C_{i,h} = \overline{C}_{i,h} + \frac{\beta_h^i \left[Y_h - \sum_i P_i \overline{C}_{i,h} \right]}{P_i (1 - \beta_h^{mal} - \beta_h^{fem} - \beta_h^z)} \quad [3.10]$$

$$CZ_h = \overline{CZ}_h + \frac{\beta_h^z \left[Y_h - \sum_i P_i \overline{C}_{i,h} \right]}{P_h^z (1 - \beta_h^{mal} - \beta_h^{fem} - \beta_h^z)} \quad [3.11]$$

$$LMmal_h = MAXHOURS_{mal,h} - LZmal_h - \frac{\beta_h^{mal} \left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{W_{mal} (1 - \beta_h^{mal} - \beta_h^{fem} - \beta_h^z)} \quad [3.12]$$

[19] See appendix 12 for the details.

$$LMfem_h = MAXHOURS_{fem,h} - LZfem_h - \frac{\beta_h^{fem}\left(Y_h - \sum_i P_i \overline{C}_{i,h}\right)}{W_{fem}(1-\beta_h^{mal}-\beta_h^{fem}-\beta_h^{z})} \quad [3.13]$$

Welfare changes are measured in equivalent variations

$$EV_h = \left(\frac{1}{1-\beta_{mal,h}-\beta_{fem,h}-\beta_{z,h}}\right)\left[\left(Y_h^1 - \sum_i P_i^1 \overline{C}_{i,h}\right)\left(\frac{w_m^0}{w_m^1}\right)^{\beta_1}\left(\frac{w_f^0}{w_f^1}\right)^{\beta_1}\left(\frac{P_z^0}{P_z^1}\right)^{\beta_z}\prod_i\left(\frac{P_i^0}{P_i^1}\right)^{\beta_i} - \left(Y_h^0 - \sum_i P_i^0 \overline{C}_{i,h}\right)\right] \quad [3.14]$$

The home good production function, equation [3.2], is a single level CES involving male and female labor. By assumption, it requires neither intermediate goods nor capital.

The relative demand for male and female labor in home production depends on the share parameter in home production function (α), relative wage rates, and their elasticity of substitution (σ).

$$\frac{LZfem_h}{LZmal_h} = \left[\left(\frac{1-\alpha_h}{\alpha_h}\right)\left(\frac{w_{mal}}{w_{fem}}\right)\right]^{\sigma_h} \quad [3.15]$$

The value of home produced goods is equal to the value of the labor devoted to its production where non-market labor is valued at its opportunity cost as measured by the market wage rates.

$$P_h^z Z_h = w_{mal} LZmal_h + w_{fem} LZfem_h \quad [3.16]$$

The household entirely consumes the goods it produces at home, as there is no market for these goods.

$$Z_h = CZ_h \quad [3.17]$$

The set of equations [3.10], [3.12], [3.13], and [3.14] replace [2.7], [2.8], [2.9] and [2.10] in the previous model, respectively. There are 5 new sets of equations [3.11], [3.2], [3.15], [3.16] and [3.17].

The additional base year data needed for parameter calibration are:

- Time devoted by men and women to home production activities;
- The elasticity of substitution between male and female labor in home production.
- The minimum consumption level of home produced goods.

Calibration procedures are presented in appendix.

VI. MACROECONOMIC CLOSURE

The main closure rules are introduced in order to be consistent with the welfare measure: the equivalent variation (EV), which is based on household consumption.

Whereas, the current account balance is assumed fixed to avoid situation in which capital inflows finance domestic policies (free-lunch situation). Hence, higher imports of some goods will require higher exports and/or lower imports of other goods in order to keep the current account balanced.

Government expenditures in goods and services are assumed constant in real terms, as public spending impacts on households well-being has not been clearly analyzed in CGE models.

Positive EV associated with decreasing investment is hardly considered as an improvement from the original situation. Therefore, we fix the real investment at its benchmark value.

Since nominal investment is equal to total savings, and in order to make sure that our welfare measures capture the total effect, we let the average propensity to save of households adjust. Foreign and public saving are fixed in real term, so that the adjustments in household saving are generated only by changes in firm saving and in relative price of investment goods, and so tend to be small. Consequently, ceteris paribus, a decrease of other agents' savings must be compensated with an increase in households' savings in order to maintain real investment fixed. This would result in a decline in household consumption and thus have a negative impact on welfare.

VII- DATA ANALYSIS

We present in this section the procedure followed in collecting and estimating additional data required to calibrate parameters.

VII.1- Male and female market work

This data is collected from the Nepal Labor Force Survey (NLFS, 1998/99). We assume that no major changes have been observed in the sectoral distribution of male and female labor between 1995/96 (year of the Nepal Standard Living Survey - NLSS) and 1998/99. Sectoral wage bills are approximated by the value of each gender's labor time evaluated at their average wage rates for the whole economy.

VII.2 – Male and female wage income in the household

We collect the income contribution of men and women in the various representative households from the NLSS 1995/96. We use the average wage rates by region (Mountain, Terai and Urban), by sex (men and women) and by age category (adult and teenager) to estimate the value of unpaid work in self-employment activities and to distribute the income from these activities between the factors of production (male and female labor and capital).

VII.3 – Time devoted by men and women to home production

These data are available in the NLFS, but not in the NLSS. Consequently, we estimate simple regression model for time devoted by men and women to home production based on individual characteristics in both surveys (age, sex, area, region, paid hour worked, education, household size, etc.). Then, we use the model to predict corresponding values for the NLSS households.

VII.4 - Maximum time available for men and women (MAXHOURS)

Individual time is used for four different activities: personal needs, paid work, household work and free time[20]. In our models, personal needs corresponds to the minimum leisure ($\overline{LE}$) of household members (men and women), paid work corresponds to market work LM, household work to domestic work LZ, and free time to surplus leisure ($LE - \overline{LE}$).

Following previous studies (*Fontana and Wood, 2000; Fontana, 2001 and 2002*), total time endowment (T) is 24 hours per days for an individual, i.e. 8760 hours in a 365 days-year. Minimum leisure or personal needs is fixed at 10 hours per day. With the demographical composition of each household in the NLSS, we estimate the maximum time available for work and surplus leisure ($MAXHOURS=T-\overline{LE}$) for men and women.

In the literature, the monetary value of unpaid time is usually computed using different wage rates in accordance with two major concepts: the opportunity cost method, and the replacement cost method. We use the first approach to valuate male and female unpaid work. Concretely, maximum time available for leisure and work (*MAXHOURS)* and time used in home production are valued at the average wage rates of men and women in the household. For households in which men and/or women do not earn wage income, this time is valued using average wage rates for the whole economy.

In sensitivity tests (section IX) we analyze the response of the model to lower values of MAXHOURS, and propose an alternative method to calibrate MAXHOURS.

VII.5 - The minimal consumption of home goods

Generally, data are not available for the minimum consumption of home goods. We arbitrary fix this value at 30% of total home goods consumed in the household, and test the sensitivity of the model to this parameter.

[20] The quadripartite approach noted in the report of expert group meeting on trial international classification for time-use activities (U.N. Secretariat 1997).

VII.6 – To stress the rigidity of gender substitution, we fix the **Elasticity of substitution between male and female labor in market production** at 0.5 for all sectors[21].

VII.7 - Elasticity of substitution between male and female labor in home production

We use a lower elasticity of substitution between male and female labor (0.3) compared to that used in market production. Later, we discuss the effects of using higher elasticities of substitution.

After collecting and estimating data, we adjust household income and expenditures, and reconcile these new data with the Nepalese 1995-96 social accounting matrix (SAM).

VIII- TRADE POLICY EXPERIMENTS AND RESULTS

We conducted a single experiment in each model (model0 to model3) to focus on the major changes occurring when we pass from one model to another. We experiment a trade reform strategy based upon import substitution, which consists in a complete elimination of import tariffs and an introduction of a sales tax as a compensatory mechanism to rebalance the government's budget after the decrease in its customs receipts. Our discussion is limited to some key aspects of the results.

VIII.1 The standard model with no gender disaggregation of labor

We start our analysis with the standard model, in which male and female labor are not distinguished in any aspect of the model. Removal of import tariffs induces consumers to substitute cheaper imported goods for domestically produced goods, so that the demand for domestic goods falls, particularly in previously protected and import-intensive sectors. As the trade deficit (foreign savings) is held constant, increased imports leads to a real exchange rate depreciation, to the benefit of export-oriented sectors.

Effects on resources

[21] Fontana et Woods (2000)

In Nepal, the agricultural sector is less protected and less import-intensive than industry. Its average tariff was 10.8 percent of imports value[22] (15.1 percent for industry) in year 2000 (Table 4). Agriculture imports and exports represented 20 percent and 19 percent of the total values, respectively, in year 2000 (Tables 2 and 3). Consequently, the elimination of tariffs has less impact on the agriculture sector, as evidenced by the smaller reduction in its nominal producer prices in this simulation. While the nominal returns to all factors of production decrease, the returns to land fall less (-4.76 percent)[23] than the returns to non-agriculture capital (-5.29 percent). The reduction in the nominal wage rate is between these two extremes (-5.19 percent), as labor is used in and mobile throughout the whole economy. Indeed, labor is reallocated from contracting sectors (Government, Construction, and Gas-Electricity-Water) to expanding sectors (Manufacturing, Mining-Quarrying, Agriculture Cash Crops, and other services).

Effects on household's income and welfare

Nominal incomes fall for all household categories as a result of the trade liberalization induced fall in prices. However, this fall in income is most important for households that receive a large share of their income from capital or receive a small share of land, particularly the urban and landless households. While nominal incomes fall, households also benefit from lower consumer prices, such that real income often increases. As agricultural prices fall least, households that consume relatively more agricultural goods – poor rural households – benefit least, whereas households that consume non-agricultural goods (particularly "other services") – urban households – benefit most.

The net effect of these nominal income and consumer price changes is a very small increase in aggregate welfare (0.04% of total income), which reflects the relatively non-distorted nature of Nepal's tariff structure. Urban households (which benefit most from the fall in consumer prices, as well as Rural Rich – i.e. large landholders - which have the smallest nominal income loss) benefit most.

[22] The import tariff of paddy and cash crop remains relatively high (15.6 percent).

Table 10: Change* in income, price and welfare (Model 0).

	HMO	HMS	HML	TEO	TES	TEL	URB	All
Change in nominal income	-5.12	-5.12	-4.88	-5.08	-5.04	-4.94	-5.14	-5.00
Change in Supernumerary	-4.46	-4.59	-4.37	-4.46	-4.78	-4.30	-3.83	
Change in consumer price index	-4.26	-4.30	-4.30	-4.28	-4.28	-4.29	-4.92	
Equivalent variation (EV)	-28.14	-3.58	-38.06	-22.83	-8.57	-2.89	232.33	
EV percent of initial nominal income	-0.10	-0.16	-0.04	-0.09	-0.34	0.00	0.34	0.04

Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB). * In percent variation of the base-year value.

Table 11: Income shares and change in factor returns (Model 0).

	Income share (in percent)							Change* in	Income change*						
	HMO	HMS	HML	TEO	TES	TEL	URB	Return	HMO	HMS	HML	TEO	TES	TEL	URB
Wage rate	90.98	86.76	40.42	91.20	82.42	47.24	19.95	-5.19	-4.72	-4.5	-2.1	-4.73	-4.28	-2.45	-1.04
Capital	1.09	5.21	14.48	1.78	4.43	9.34	61.97	-5.29	-0.06	-0.28	-0.77	-0.09	-0.23	-0.49	-3.28
Land	0.02	2.39	35.33	0.02	1.82	37.40	12.18	-4.76	0	-0.11	-1.68	0	-0.09	-1.78	-0.58
Other income	7.91	5.65	9.76	7.00	11.33	6.02	5.90	-	0.94	1.13	1.54	1.6	1.18	1.43	1.11
Total	100	100	100	100	100	100	100	-	-5.12	-5.12	-4.88	-5.08	-5.04	-4.94	-5.14

Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB). * In percent variation of the base-year value.

VIII.2 Model with disaggregated male and female labor

The standard model (model0) can be seen as a variation of the gender model (model1) in which there is an infinite elasticity of substitution between male and female labor in production. We focus on the principal changes when the elasticity is finite[24]. While aggregate results change little, there are important changes in male and female nominal wage rates and labor allocation.

Agriculture is the most female labor-intensive sector. As agricultural producer prices fall less than non-agriculture prices, the nominal wage rate of women falls less than the male wage rate: -4.90 and -5.38, respectively[25]. This, in turn, penalizes the agricultural sector and leads to less favorable production effects for the agricultural sector as compared to the previous model.

[23] Change values are in percent variation of the base-year value.
[24] We set the elasticity of substitution equal to 0.5.
[25] When we experiment with larger substitution elasticities, this gap in wage effects declines.

In all households, female income contributions increase as a result of trade liberalization. However the greater rigidity introduced by imperfect substitution between male and female labor results in a slightly less positive total welfare effect of trade liberalization.

Compare to the standard model, a finite elasticity of substitution between male and female labor is less beneficial for agricultural sectors in term of outcome. Agriculture sectors is intensive in female work, its labor cost is relatively higher than non-agriculture sectors as female wage rate relative to male increase and the low substitution possibility between male and female work. Consequently, agriculture prices decrease less, and households are worse-off in welfare gains. The experiment shows that the complete elimination of tariffs on import-goods in Nepal is pro-female in terms of income distribution.

In experiments, we found that higher elasticities of substitution between male and female labor reduces the differences in the wage effects, and results in model 1 are similar to those in model 0.

Table 12: Change* in income, price and welfare (Model 1)

	HMO	HMS	HML	TEO	TES	TEL	URB	All
Change in nominal income	-5.10	-5.12	-4.88	-5.06	-5.07	-4.94	-5.16	-5.00
Change in Supernumerary	-4.43	-4.58	-4.36	-4.43	-4.8	-4.29	-3.82	
Change in consumer price index	-4.23	-4.27	-4.27	-4.25	-4.26	-4.27	-4.92	
Equivalent variation (EV)	-26.8	-3.75	-41.11	-22.4	-9.32	-5.09	231.82	
EV percent of initial nominal income	-0.10	-0.16	-0.04	-0.08	-0.37	-0.01	0.34	0.04

Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB). * In percent variation of the base-year value.

Table 13: Change in factors returns and income shares (Model 1)

	Income share (%)							Change* in	Income change*						
	HMO	HMS	HML	TEO	TES	TEL	URB	Return	HMO	HMS	HML	TEO	TES	TEL	URB
Male wage	51.37	53.06	24.50	52.41	55.43	29.55	15.59	-5.38	-0.30	-0.27	-0.53	-0.33	-0.33	-0.46	-0.23
Female wage	39.62	33.69	15.92	38.79	27.00	17.68	4.36	-4.90	0.21	0.24	-0.02	0.18	0.18	0.05	0.28
Capital	1.09	5.21	14.48	1.78	4.43	9.34	61.97	-5.31	-0.06	-0.28	-0.77	-0.09	-0.24	-0.50	-3.29
Land	0.02	2.39	35.33	0.02	1.82	37.40	12.18	-4.74	0.00	-0.11	-1.68	0.00	-0.09	-1.77	-0.58
Other income	7.91	5.65	9.76	7.00	11.33	6.02	5.90	-	0.92	1.14	1.54	1.58	1.21	1.42	1.14
Total	100	100	100	100	100	100	100	-	-5.1	-5.12	-4.88	-5.06	-5.07	-4.94	-5.16

Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB). * In percent variation of the base-year value.

VIII.3 Model with endogenous male and female leisure and labor supply

Because male leisure[26], female leisure, and composite goods are net substitutes, we observe an increase in female labor supply as their nominal wage increases, and a decline in their leisure and domestic work time in rural households, and contrary in urban households. In general, men and women reduce the time devoted to market work, -0.23 and -0.04 percent, respectively, as households substitute composite market goods for male and female leisure (and work at home), due to their decreasing real wage.

Table 14: Male and Female Labor Supply (Model 2)

	HMO	HMS	HML	TEO	TES	TEL	URB	ALL
Change* in male market work	0.14	0.16	0.17	0.07	0.32	0.07	-2.64	-0.23
Change in female market work	0.31	0.55	0.56	0.24	0.65	0.42	-7.35	-0.04
Change in male leisure	0.00	0.00	0.00	0.00	-0.01	0.00	0.05	0.00
Change in female leisure	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	0.04	0.00

Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB). * In percent variation of the base-year value.

The decrease of male and female labor supply induces a greater contraction of labor-intensive sectors, particularly, agriculture sectors. The imports of goods increase and replace the domestically produced output to the benefit of the export-oriented sectors (Manufacturing and Mining-Quarrying). These sectors increase their output as they export more.

The returns to factors converge compared to the previous version (model1). The return to agriculture capital decreases (from –4.74 to -5.11); the return to non-agriculture capital increases (from –5.31 to -5.27). Sectoral average wage rates converge as females wage rate decreases more (from -4.90 to -5.10) and males wage rate decreases less (from -5.38 to -5.11) in response to the increase in female labor supply.

[26] In this model the term « leisure » is used for non-market work time or unpaid time, i.e. leisure and work at home.

Table 15: Change in factors returns and income shares (Model 2)

	Income share (%)							Change* in	Income change*						
	HMO	HMS	HML	TEO	TES	TEL	URB	Return	HMO	HMS	HML	TEO	TES	TEL	URB
Male wage	51.37	53.06	24.50	52.41	55.43	29.55	15.59	-5.11	-0.13	-0.16	-0.10	-0.17	-0.16	-0.10	-1.87
Female wage	39.62	33.69	15.92	38.79	27.00	17.68	4.36	-5.10	0.05	0.23	0.29	0.01	0.17	0.25	-6.62
Capital	1.09	5.21	14.48	1.78	4.43	9.34	61.97	-5.27	-0.06	-0.27	-0.76	-0.09	-0.23	-0.49	-3.27
Land	0.02	2.39	35.33	0.02	1.82	37.40	12.18	-5.12	0.00	-0.12	-1.81	0.00	-0.09	-1.92	-0.62
Other income	7.91	5.65	9.76	7.00	11.33	6.02	5.90	-	0.63	0.76	1.48	1.36	0.73	1.40	1.85
Total	100	100	100	100	100	100	100	-	-4.86	-4.80	-4.85	-4.88	-4.65	-4.95	-5.85

Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB). * In percent variation of the base-year value.

In general, removal of tariffs on imported goods does not expand female market work. Women in rural areas expand their paid work, while women in urban areas reduced theirs relatively to men. Only in households that benefit most from trade liberalization (urban and mountain large landholders) do men devote less time to market work; in other households they became more active. In urban areas, women devote more time to leisure and work at home than men and contribute less to household real income, while the variation of their income is greater than men's in other households. In the work-leisure model, the households are neither better off nor worse off when tariffs are eliminated in Nepal.

Table 16: Change* in income, price and welfare (Model 2)

	HMO	HMS	HML	TEO	TES	TEL	URB	ALL
Change in nominal income	-4.86	-4.8	-4.85	-4.88	-4.65	-4.95	-5.85	-5.11
Change in Supernumerary	-5.11	-5.11	-5.11	-5.11	-5.11	-5.11	-5.06	
Change in consumer price index	-4.37	-4.41	-4.42	-4.39	-4.4	-4.41	-5.01	
Equivalent variation (EV)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
EV percent of initial nominal income	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB). * In percent variation of the base-year value.

Compared to the model with exogenous labor supply, a work-leisure choice induces a reduction in male and female market work, and a contraction in the global output of sectors, particularly in labor-intensive sectors. The effect of trade liberalization on female market work is ambiguous, rural women expand their market work, while urban women reduce theirs. Rural households are better off and urban household worse off compared to the previous model.

VIII.4 Model with home production

Compared to the previous model, when we explicitly model home produced-goods, we found no significant changes in the aggregate results. However, it does provide relevant details on gender time allocation between various activities (market work, home work and leisure). The rigidity of gender roles within the household activities reflected by a low male participation rate in domestic work and a low elasticity of substitution between male and female domestic work, add new constraints to the model. Compared to the previous model, women participate less in market work, and men reduce their market work less. Female wage rates decrease less, and male wage rates decrease more compared to the previous model.

Table 17: Male and Female Labor Supply (Model 3)

	HMO	HMS	HML	TEO	TES	TEL	URB	ALL
Change* in Male market work	0.14	0.17	0.18	0.07	0.33	0.08	-2.69	-0.23
Change in Female market work	0.30	0.53	0.54	0.24	0.63	0.41	-7.17	-0.04
Change in Male Leisure	0.00	0.00	0.00	0.00	-0.01	0.00	0.05	0.00
Change in Female Leisure	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.04	0.00
Male domestic work/Total domestic work	0.29	0.23	0.26	0.28	0.34	0.25	0.29	0.27
Elasticity of substitution in domestic work	0.30	0.30	0.30	0.30	0.30	0.30	0.30	
Change in Male domestic work	0.00	0.00	0.00	0.00	-0.01	0.00	0.03	0.00
Change in Female domestic work	0.00	-0.01	0.00	0.00	-0.01	0.00	0.03	0.00
Change in Household home production	0.00	-0.01	0.00	0.00	-0.01	0.00	0.03	0.00
Change in Household home goods price	-5.11	-5.11	-5.11	-5.11	-5.11	-5.11	-5.11	

Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB). * In percent variation of the base-year value.

Our experiment shows that tariffs elimination has no significant effects on home production activities. In general, we found that women reduce their leisure time in favor of increased market work, while men increase their leisure and reduce their market work.

Table 18: Change in factors returns and income shares (Model 3)

	Income share (%)							Change* in	Income change*						
	HMO	HMS	HML	TEO	TES	TEL	URB	Return	HMO	HMS	HML	TEO	TES	TEL	URB
Male wage	51.37	53.06	24.50	52.41	55.43	29.55	15.59	-5.11	-0.12	-0.15	-0.09	-0.17	-0.15	-0.09	-1.92
Female wage	39.62	33.69	15.92	38.79	27.00	17.68	4.36	-5.10	0.04	0.21	0.27	0.00	0.15	0.24	-6.43
Capital	1.09	5.21	14.48	1.78	4.43	9.34	61.97	-5.27	-0.06	-0.27	-0.76	-0.09	-0.23	-0.49	-3.27
Land	0.02	2.39	35.33	0.02	1.82	37.40	12.18	-5.12	0.00	-0.12	-1.81	0.00	-0.09	-1.92	-0.62
Other income	7.91	5.65	9.76	7.00	11.33	6.02	5.90	-	0.63	0.76	1.48	1.36	0.73	1.40	1.85
Total	100	100	100	100	100	100	100	-	-4.86	-4.80	-4.85	-4.88	-4.65	-4.95	-5.85

Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB). * In percent variation of the base-year value.

Table 19: Change* in income, price and welfare (Model 3)

	HMO	HMS	HML	TEO	TES	TEL	URB	All
Change in nominal income	-4.86	-4.8	-4.85	-4.88	-4.65	-4.95	-5.85	-5.11
Change in Supernumerary	-5.11	-5.11	-5.11	-5.11	-5.11	-5.11	-5.06	
Change in consumer price index	-4.37	-4.41	-4.42	-4.39	-4.4	-4.41	-5.01	
Equivalent variation (EV)	0.00	0.00	0.00	0.00	0.00	0.00	0.01	
EV percent of initial nominal income	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB). * In percent variation of the base-year value.

When incorporating home production, we add more rigidity in male and female mobility between home and market activities. Labor-intensive sectors contract less, as labor is no longer so mobile toward home production activities. Therefore, all households benefit less in welfare terms. Women's contribution to household real income increases, as their wages go up.

When we relax the rigidity of male and female participation in home production by introducing higher elasticity of substitution, results in model3 are similar to those in model2.

IX. SENSITIVITY TEST

As argued by *De Melo and Tarr (1992),* the total time available either for work and surplus leisure is some scalar of the total endowed time of the household worker (*MAXHOURS*=T-$\overline{L} = \mu T$). *Ballard and al. (1985)* have chosen the approach arbitrary setting μ =0.8. *Fontana and Woods (2000)* have used the demographic composition of the household to assess T, and assumed an arbitrary value of ten hours per day an individual for the minimum leisure $\overline{L}$. Time used for surplus leisure is residual after taking off the time devoted to all kind of work (market and home). Leisure and domestic work are both valued at their opportunity cost, which is the wage forgone in market work. *Ballard and al. (1985)* note that the problem is that their results depend heavily on the assumed value of the scalar multiple, a parameter about which little is known. The approach of *De Melo and Tarr (1992)* eliminates this element of arbitrariness by calibrating the *MAXHOURS* using the elasticity of labor supply with respect to income or real wage. The two methods can be seen as inverse. *De Melo and Tarr (1992)* calibrate the marginal share parameters of leisure in a first step, then the maximum time

available for work and surplus leisure in a second step. *Ballard and al. (1985)* estimate the maximum time and calibrate these marginal share parameters. The difficulty of *De Melo and Tarr* approach is the elasticity of labor supply with respect to income or real wage are not available in many developing countries, particularly disaggregated for men and women[27].

i)- Since these two approaches generally lead to different values of the maximum time available for men and women, the first test highlights the sensitivity of our models to these parameters. We test the effects of an increasing value of male and female minimum leisure time. Its value estimated from household demographical composition, with an initial hypothesis of 10 hours in a 24 hours-day endowed by an individual, is set at 14 hours. Thus, male and female have less time to devote to work and leisure.

Contrary to Ballard and al. statement, we found that the variation of maximum time available for leisure and work does not (significantly) affect the simulation results in our model's specification. The marginal share of male and female surplus leisure remains relatively constant[28].

Table 20: Comparing the maximum time available for male and female - Ballard and al. method

	HMO	HMS	HML	TEO	TES	TEL	URB
10 hours-day for an Individual Minimum Leisure Time							
Male	62.13	4.89	131.50	57.49	7.14	105.11	62.97
Female	51.97	5.53	124.67	48.56	4.51	102.17	52.64
14 hours-day for an Individual Minimum Leisure Time							
Male	46.59	3.67	98.62	43.12	5.36	78.83	47.23
Female	38.98	4.15	93.50	36.42	3.38	76.62	39.48

In 10000 unit. Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB).

ii)- The other alternative is to calibrate *MAXHOURS*. Following *De Melo & Tarr (1992)*, we use different elasticities of labor supply relative to household income for men and women, and for households.

[27] Tarr (1989) has discussed the elasticity of labor supply with respect to income and real wage for U.S.
[28] Results are noted in appendix 9.

We found that the maximum time available for leisure and work (MAXHOURS) is sensitive to elasticities of labor supply we chose[29]*. Values of MAXHOURS decrease substantively for the chosen elasticity of labor supply with respect to income, but the simulation results do not change significantly.*

Table 21: comparing the maximum time available for male and female - Ballard & al. vs De Melo & Tarr methods

	HMO	HMS	HML	TEO	TES	TEL	URB
10 hours-day for an Individual Minimum Leisure Time (Ballard and al. method)							
Male	62.13	4.89	131.50	57.49	7.14	105.11	62.97
Female	51.97	5.53	124.67	48.56	4.51	102.17	52.64
14 hours-day for an Individual Minimum Leisure Time							
Male	46.59	3.67	98.62	43.12	5.36	78.83	47.23
Female	38.98	4.15	93.50	36.42	3.38	76.62	39.48
Calibration of Maximum Time Available for Leisure and Work (De Melo and Tarr method)							
Elasticity of male labor supply	-0.05	-0.05	-0.10	-0.05	-0.05	-0.10	-0.20
Elasticity of female labor supply	-0.15	-0.15	-0.20	-0.15	-0.15	-0.20	-0.25
Male	6.80	0.57	13.40	6.57	0.74	11.57	7.14
Female	14.27	1.48	31.45	13.86	1.22	26.59	12.45

In 10000 unit. Mountain landless (HMO), mountain small landholders (HMS), mountain large landholders (HML), Teraï landless (TEO), Teraï small landholders (TES), Teraï large landholders (TEL) and urban (URB).

ii)- We also test different values for the minimum subsistence of home produced goods, since it is arbitrary in our model.

When we lowered this value from 30% to 20% of the total value of home produced goods, we found no significant changes.

[29] Calibration procedures and results are presented in appendixes 14 and 10, respectively.

X. CONCLUSION

The experiment conducted in our models shows that the complete elimination of tariffs on imported goods in Nepal benefits women more than men in term of income distribution. Generally, female and male market work expands in rural households and contracts in urban households. Indeed, households in urban areas benefit more from decreasing prices as non-agriculture goods prices decrease more than agriculture goods. Their high income and saving levels permit them to easily adjust the loss of income by reducing their saving. While households in rural areas relatively maintain their initial consumption level by supplying more labor force for wages because of their limited income, and consequently saving, and their least benefit from falling prices. Women contribute more to household income, as their nominal wage rate increases relatively to men. It appears that this increase in female market work is not met with a decrease in the time spent in home production activities. Instead, their leisure time declines as they enter the labor market. Furthermore, the study indicates that leisure time consumed by men, generally greater than that consumed by women, increases with trade reform.

Disaggregating labor between men and women is more relevant for studies with a gender focus; otherwise, the standard model is found to be suitable to analyze macroeconomic policy shocks on households.

We also found that welfare gain on tariff removal is higher in work-leisure models than in the standard exogenous labor supply model.

Distinction between male and female non-market labor time between domestic and leisure is important when we wish to emphasize the role of women in home produced goods, and to analyze the impact of macroeconomic policies on the welfare of men and women.

Finally, The exercise shows that gender issues can be analyze in CGE models with less arbitrariness in gender data and with consistency in the results.

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APPENDIX A: PATTERN OF TRADE FLOWS

US $ Million

Year	Export (f.o.b)	% Change	Import	% Change	Trade
1989/90	216	-	452	-	-236
1990/91	257	19.0	500	10.6	-243
1991/92	352	37.0	477	-4.6	-125
1992/93	367	4.3	527	10.5	-160
1993/94	351	-4.4	615	16.7	-264
1994/95	324	-7.7	752	22.3	-428
1995/96	602	85.8	1350	79.5	-749
1996/97	1160	92.7	1750	29.6	-589
1997/98	856	-26.2	1551	-11.4	-695
1998/99	763	-10.9	1390	-10.4	-627
1999/2000	971	27.3	1713	23.2	-742

Source: International Monetary Fund, Direction of Trade Statistics Yearbook, 2001.

APPENDIX B: TRADE AND FISCAL INDICATORS AS A PERCENT OF GDP

Year	Trade Deficit			C\A Deficit	Fiscal Deficit	Govt. Revenue	Government Expenditure	
	India	Third Country	Total				Regular	Development
1980/81	-4.7	-6.4	-11.1	-1.1	-6.4	8.8	5.2	10.0
1981/82	-4.2	-7.0	-11.2	-1.3	-8.9	8.6	5.5	12.0
1982/83	-4.9	-10.4	-15.3	-5.0	-12.7	8.4	6.3	14.8
1983/84	-4.8	-7.4	-12.2	-3.4	-10.4	8.6	6.0	13.1
1984/85	-4.9	-5.8	-10.7	-4.2	-10.3	8.8	6.8	12.4
1985/86	-4.9	-6.3	-11.2	-4.6	-9.9	8.7	6.9	11.7
1986/87	-4.6	-7.8	-12.4	-4.8	-9.3	9.8	7.0	12.1
1987/88	-3.9	-8.8	-12.7	-6.3	-9.5	10.0	6.6	12.9
1988/89	-3.6	-9.9	-13.5	-7.4	-12.4	9.1	7.1	14.4
1989/90	-3.9	-8.8	-12.7	-7.7	-10.9	9.3	7.1	13.0
1990/91	-4.8	-8.4	-13.2	-8.2	-11.3	9.2	6.8	13.8
1991/92	-6.6	-5.6	-12.2	-7.0	-9.1	9.3	7.0	11.4
1992/93	-6.4	-6.4	-12.8	-6.0	-9.9	9.2	7.3	11.7
1993/94	-7.3	-8.9	-16.2	-4.0	-7.6	10.2	6.7	11.1
1994/95	-7.5	-13.5	-21.0	-5.4	-7.0	11.7	9.2	9.4
1995/96	-8.3	-13.6	-21.9	-8.7	-7.9	11.6	9.1	10.4
1996/97	-7.0	-18.3	-25.3	-5.9	-7.3	10.8	8.6	9.5
1997/98	-6.2	-14.3	-20.5	-5.1	-7.7	11.0	9.0	9.6
1998/99	-5.8	-9.5	-15.3	0.01	- 6.6	11.0	9.2	8.4

Source: Economic Survey, 1999-2000; Nepal Rastra Bank, Quarterly Economic Bulletins, 1996 and 2000.

APPENDIX C: COMPOSITION OF EXPORTS AND IMPORTS, 1999/2000 BY COMMODITIES

Sectors	Sub-sectors	Import US$ Million	Export US$ Million	Value Share Import	Value Share Export
Agriculture					
	Cereal Crops	12.6	2.6	0.8	0.4
	Cash Crops	42.2	14.5	2.7	2.0
	Tobacco	2.5	0.6	0.2	0.1
	Vegetable	4.2	3.6	0.3	0.5
	Horticulture	20.5	3.5	1.3	0.5
	Flower	0.1	0.0	0.0	0.0
	Livestock	23.0	2.6	1.5	0.4
	Fishery	0.2	0.0	0.0	0.0
	Forest	2.2	4.1	0.1	0.6
Mining & Quarrying	Mining & Quarrying	3.7	0.8	0.2	0.1
Manufacturing					
Food and Beverage	Food	189.8	69.6	12.3	9.6
	Beverage	3.6	5.6	0.2	0.8
Leather	Leather & Leather Products	2.4	7.3	0.2	1.0
Textiles	Textile	229.2	219.6	14.9	30.4
	Wearing Apparel	25.5	254.6	1.6	35.3
Chemical	Chemical & Chemical Products	228.4	74.9	14.8	10.4
	Rubber & Plastic	33.0	31.4	2.1	4.3
	Paper & Paper Products	16.8	4.5	1.1	0.6
	Non Metallic Products	42.6	1.2	2.8	0.2
Mechanical	Fabricated Metal	52.1	20.0	3.4	2.8
	Basic Metal	226.8	11.6	14.7	1.6
	Machinery & Equipment	96.9	3.5	6.3	0.5
	Printing & Publishing	10.7	2.1	0.7	0.3
Electrical\Electronics	Electrical Machinery & Apparatus	36.8	2.7	2.4	0.4
	Communication Equipment	50.9	0.0	3.3	0.0
	Medical, Precision & Optical Equipment, Watches & Clocks	25.1	0.1	1.6	0.0
Transport	Motor Vehicle, Trailer & S- Trailer	89.7	0.0	5.8	0.0
	Other Transport & Equipment	1.4	0.0	0.1	0.0
Energy	Petroleum Products	140.7	0.2	9.1	0.0
	Gas	8.6	0.0	0.6	0.0
	Electricity	0.0	0.0	0.0	0.0
Forest	Wood & Wood Products	3.1	5.6	0.2	0.8
Educ. Materials	Educational Material	1.5	0.7	0.1	0.1
Others	Furniture n.e.c.	1.0	0.0	0.1	0.0
	Other n.e.c.	1.4	0.2	0.1	0.0
Grand Total	Grand Total	1543.2	722.0	100	100

Source: Processed from Customs Primary Data in Harmonized Classification /Nepal.

APPENDIX D: Model0 - The standard model

1. Equations

- Production

$$XS_i = \frac{VA_i}{v_i} \quad [4.1]$$

$$VA_{nagr} = A^{kl}_{nagr}\left[\alpha^{kl}_{nagr} LM^{-\rho^{kl}_{ngr}}_{nagr} + (1-\alpha^{kl}_{nagr}) KD^{-\rho^{kl}_{ngr}}_{nagr}\right]^{-1/\rho^{kl}_{ngr}} \quad [4.2]$$

$$VA_{agr} = A^{ll}_{agr}\left[\alpha^{ll}_{agr} LM^{-\rho^{ll}_{agr}}_{agr} + (1-\alpha^{ll}_{agr}) KD^{-\rho^{ll}_{agr}}_{agr}\right]^{-1/\rho^{ll}_{agr}} \quad [4.3]$$

$$VA_{adm} = LM_{adm} \quad [4.4]$$

$$CI_i = io_i XS_i \quad [4.5]$$

$$DNCI_i = nio_i XS_i \quad [4.6]$$

$$DI_{i,j} = aij_{i,j} CI_j \quad [4.7]$$

$$\frac{KD_{agr}}{LM_{agr}} = \left[\left(\frac{1-\alpha^{ll}_{agr}}{\alpha^{ll}_{agr}}\right)\left(\frac{w}{rl_{agr}}\right)\right] \quad [4.8]$$

$$\frac{KD_{nagr}}{LM_{nagr}} = \left[\left(\frac{1-\alpha^{kl}_{nagr}}{\alpha^{kl}_{nagr}}\right)\left(\frac{w}{r_{nagr}}\right)\right] \quad [4.9]$$

$$w \cdot LM_{adm} = P_{adm} XS_{adm} - \sum_i DI_{i,adm} PCF_i - PNCI \cdot DNCI_{adm} \quad [4.10]$$

- Income and saving

$$YH_h = w \cdot LM_h + \lambda^r_h \sum_{nagr} r_{nagr} KD_{nagr} + \lambda^{rl}_h \sum_{agr} rl_{agr} KD_{agr} + HDIV_h + Pindex \cdot TG_h + e \cdot TRH_h + INH_h \quad [4.11]$$

$$YDH_h = YH_h - DTH_h - OUTH_h \quad [4.12]$$

$$YF = \lambda^{rf} \sum_{nagr} r_{nagr} KD_{nagr} + \lambda^{lf} \sum_{agr} rl_{agr} KD_{agr} + Pindex \cdot TGF + e \cdot TRF \quad [4.13]$$

$$YG \cdot Pindex = \sum_i TI_i + \sum_h DTH_h + \sum_{expt} TIE_{expt} + \sum_i TIM_i + \sum_i tc_i PC_i Q_i + TNCI + DTF + TRG + \quad [4.14]$$

$$SH_h = \eta_h \cdot \varphi_h \cdot YDH_h \quad [4.15]$$

$$SF = YF - DIV - \sum_h DIVH_h - DTF \quad [4.16]$$

$$SG = pindex\left(YG - TGF - \sum_h TG_h\right) - \sum_i G_i - e \cdot TGR \quad [4.17]$$

- Tax

$$TI_i = tx_i \cdot P_i \cdot XS_i \quad [4.18]$$

$$TMI_i = tm_i \left(e \cdot PWM_i \cdot M_i \right) \quad [4.19]$$

$$TE_{expt} = te_{expt} \left(PWE_{expt} EX_{expt} \right) \quad [4.20]$$

$$TNCI = tn \left(e \cdot PWNCI \cdot NCI \right) \quad [4.21]$$

$$DTH_h = tyh_h \cdot YH_h \quad [4.22]$$

$$DTF = tyf \cdot YF \quad [4.23]$$

- Demand

$$CTH_h = YDH_h \cdot SH_h \quad [4.24]$$

$$C_{h,i} \cdot PCF_i = \overline{C}_{h,i} \cdot PCF_i + \lambda_{h,i} \left(CTH_h - \sum_j \overline{C}_{h,j} \cdot PCF_j \right) \quad [4.25]$$

$$CG_i \cdot PCF_i = G_i \quad [4.26]$$

$$CT_i = CG_i + \sum_h C_{h,i} \quad [4.27]$$

$$INV_i \cdot PCF_i = \mu_i \cdot IT \quad [4.28]$$

$$ITVOL \cdot PINV = IT \quad [4.29]$$

$$DIT_i = \sum_j DI_{i,j} \quad [4.30]$$

$$NCI = \sum_i DNCI_i \quad [4.31]$$

- Prices

$$PV_i \cdot VA_i = P_i \cdot XS_i - \sum_j DI_{j,i} PCF_j - PNCI \cdot DNCI_i \quad [4.32]$$

$$r_{nagr} \cdot KD_{nagr} = PV_{nagr} \cdot VA_{nagr} - w \cdot LM_{nagr} \quad [4.33]$$

$$rl_{agr} \cdot KD_{agr} = PV_{agr} \cdot VA_{agr} - w \cdot LM_{agr} \quad [4.34]$$

$$PL_i = P_i \cdot (1 + tx_i) \quad [4.35]$$

$$PM_i = e \cdot PWM_i \cdot (1 + tm_i) \quad [4.36]$$

$$PNCI = e \cdot PWNCI \cdot (1 + tn) \quad [4.37]$$

$$PE_{expt} = e \cdot PWE_{expt} \Big/ \left(1 + te_{expt} \right) \quad [4.38]$$

$$PC_i \cdot Q_i = PD_i \cdot D_i + PM_i \cdot M_i \quad [4.39]$$

$$PCF_i = PC_i \left(1 + tc \right) \quad [4.40]$$

$$PL_{expt} \cdot XS_{expt} = PD_{expt} \cdot D_{expt} + PE_{expt} EX_{expt} \quad [4.41]$$

$$PL_{nexpt} \cdot XS_{nexpt} = PD_{nexpt} \cdot D_{nexpt} \quad [4.42]$$

$$PINV = \prod_i \left(PCF_i / \mu_i \right)^{\mu_i} \quad [4.43]$$

$$Pindex = \sum_i \gamma_i \cdot P_i \quad [4.44]$$

- International trade

$$XS_{expt} = B^e_{expt} \left[\beta^e_{expt} EX^{\kappa^e_{expt}}_{expt} + (1-\beta^e_{expt}) D^{\kappa^e_{expt}}_{expt} \right]^{1/\kappa^e_{expt}} \quad [4.45]$$

$$\frac{EX_{expt}}{D_{expt}} = \left[\left(\frac{1-\beta^e_{expt}}{\beta^e_{expt}} \right) \left(\frac{PE_{expt}}{PL_{expt}} \right) \right]^{\varepsilon^e_{expt}} \quad [4.46]$$

$$XS_{nexpt} = D_{nexpt} \quad [4.47]$$

$$Q_i = A^m_i \left[\beta^m_i M_i^{-\kappa^m_i} + (1-\beta^m_i) D_i^{-\kappa^m_i} \right]^{-1/\kappa^m_i} \quad [4.48]$$

$$\frac{M_i}{D_i} = \left[\left(\frac{1-\beta^m_i}{\beta^m_i} \right) \left(\frac{PM_i}{PD_i} \right) \right]^{\varepsilon^m_i} \quad [4.49]$$

$$CAB = \sum_i PWM_i \cdot M_i + PWNCI \cdot NCI + TGR/e + DIV - \sum_{expt} PWE_{expt} EX_{expt} - \sum_h TRH_h - TRF - TRG \quad [4.50]$$

- Equilibrium

$$Q_i = CT_i + DIT_i + INV_i \quad [4.51]$$

$$TLM = \sum_h LM_h \quad [4.52]$$

$$TLM = \sum_i LM_i \quad [4.53]$$

$$KS^{NAGR} = \sum_{nagr} KD_{nagr} \quad [4.54]$$

$$r_{nagr} = rf \quad [4.55]$$

$$KS^{AGR} = \sum_{agr} KD_{agr} \quad [4.56]$$

$$rl_{agr} = rlf \quad [4.57]$$

$$IT = \sum_h SH_h + SF + SG + CAB \cdot e + SHHOLD \quad [4.58]$$

- Welfare

$$EV_h = \prod_i \left(\frac{PCFO_i}{PCF_i} \right)^{\lambda_{h,i}} \left[\left(CTH_h - \sum_j \overline{C}_{h,j} PCF_j \right) - \left(CTHO_h - \sum_j \overline{C}_{h,j} PCFO_j \right) \right] \quad [4.59]$$

2. parameters definition

- *Parameters in CES between labor and capital*

A	Scale parameter
α	Share parameter
σ	Substitution elasticity
ρ	Substitution parameter

- *Parameters in production functions*

io_i	Coefficient (Leontief total intermediate consumption)
v_i	Coefficient (Leontief value added)
aij_{ij}	Input-output coefficient
nio_i	Coefficient (Leontief non-competitive intermediate consumption)

- *Parameters in Income and Savings*

$\lambda_{h,i}$	Marginal share of good I in LES consumption function
λ_i^g	Share of good I in public consumption
$\varepsilon_{h,i}$	Income elasticity of good I
$\overline{C}_{h,i}$	Minimum consumption of good I (LES consumption function)
$Frisch_h$	Frisch parameter (LES consumption function)
φ_h	Propensity to save for household H
μ_i	Share of the value of good I in total investment
λ_h^l	Share of land income received by household H
λ^{lf}	Share of land income received by firms
λ_h^r	Share of capital income received by household H
λ^{rf}	Share of capital income received by firms

- *Taxation rate*

te_{EXPT}	Tax on exports on good TR
tm_I	Import duties on good TR
tn	Non competitive import duties on good I

tx_I	Tax rate on good TR
tyh_H	Direct income tax rate for household H
tyf	Direct income tax rate for firms

- *Parameters in import/export function*

B	Scale parameter
β	Share parameter
ε	Substitution elasticity
κ	Substitution parameter

- *Other parameters*

γ	Share of sector I in total value added
γ^k	Share of sector I in total investment

3. Variables

- *Prices*

w	Wage rate
r_{NAGR}	Rate of return to capital in sector I
rl_{AGR}	Rate of return to agricultural land
rf	Uniform return to capital
rlf	Uniform return to land
P_I	Producer price of good I
PD_I	Domestic price of good I including tax
PV_I	Value added price for sector I
PL_I	Domestic price of good I excluding tax
PC_I	Price of composite good I
PCF_I	Price of composite good I
PM_I	Domestic price of imported good I
PNCI	Domestic price of non competitive imported good I
PE_{EXPT}	Domestic price of exported good I
PWM_I	World price of import I (foreign currency)
PWNCI	World price of non competitive import (foreign currency)
PWE_{EXPT}	World price of export I (foreign currency)
PINDEX	Producer price index
PINV	Price index of investment
e	Exchange rate
η	Saving parameter

- *Production*

XS_I Production of sector I

VA_I Value added in sector I (volume)

CI_I Total intermediate consumption of sector I

$DI_{I,j}$ Intermediate consumption of good I in sector J

$DNCI_I$ Non competitive imported good

- *Factors*

KD_{NAGR} Sector I demand for capital

KS^{NAGR} Total capital supply

KD_{AGR} Agricultural land demand

KS^{AGR} Agricultural land supply

LM_I Sector I demand for labour

- *Demand*$_H$

$C_{H,I}$ Household H consumption of good I (volume)

CT_I Total consumption of good I (volume)

CTH_h Household H total consumption (value)

INV_I Investment in good I (volume)

IT Total investment (value)

ITVOL Total investment (volume)

DIT_I Intermediate demand for good I

NCI Intermediate demand for non competitive good I

G_I Total public consumption (value)

CG_I Total public consumption (volume)

D_I Demand for domestic good I

Q_I Demand for composite good I

TLM Total market labour supply

- *International trade*

M_I Imports of good I

EX_{EXPT} Exports of good I

CAB Current account balance

- *Income and savings*

YH_H Household H income

YDH_H Household H disposable income

YF Firms income

YG Government income

SH_H Household H savings

SF Firms savings

SG Government savings

$HDIV_H$ Dividends paid to household

DIV	Dividends paid to foreigner
TG_H	Public transfers to households
TGF	Public transfers to firms
TGR	Public transfers to rest of the world
TRH_H	Transfer from rest of the world to households
TRF	Transfer from rest of the world to firms
TRG	Transfer from rest of the world to government
TI_i	Receipts from indirect tax
TIM_i	Receipts from import duties
TNCI	Receipts from non competitive goods import duties
TIE_{expt}	Receipts from tax on exports
DTH_H	Receipts from direct taxation on household H income
DTF	Receipts from direct taxation on firms income
INH_H	Received transfers from other households
$OUTH_H$	Sent transfers to other households
SHHOLD	Other household total saving
tc	Uniform consumption tax

- *Others*

EV_H	Equivalent variation for household H

4. Sets

I (J)	All sectors
NAGR	Non agriculture sectors
AGR	Agriculture sectors
EXPT	Export sectors
NEXPT	Non export sectors
H	Households

APPENDIX E: Calibration of model1 - Disaggregating labor between male and female

The elasticity parameter (ρ)

$\rho_i = \frac{1-\sigma_i}{\sigma_i}$; where σ = elasticity of substitution between male and female labor.

The share parameter of female labor relative to male labor is derived from equation [0.2]

$$\alpha_i = \frac{\left(\frac{LMfem_i}{LMmal_i}\right)^{1/\sigma_i}\left(\frac{w_{fem}}{w_{mal}}\right)}{1+\left(\frac{LMfem_i}{LMmal_i}\right)^{1/\sigma_i}\left(\frac{w_{fem}}{w_{mal}}\right)} \quad [5.1]$$

The scale parameter is calibrated from equation [0.1]

$$A_i = \frac{LM_i}{\left[\alpha_i\, LMfem_i^{-\rho_i} + (1-\alpha_i)LMmal_i^{-\rho_i}\right]^{-1/\rho_i}} \quad [5.2]$$

APPENDIX F: Model2 - Modeling gender leisure and endogenous labor supply

1-Model

Following Ashenfelter and Heckman (1974), the Stone and Geary function modified to incorporate leisure is given by:

$$U_h = \left(L_h^{mal} - \overline{L}_h^{mal}\right)^{\beta_h^{mal}} \left(L_h^{fem} - \overline{L}_h^{fem}\right)^{\beta_h^{fem}} \prod_i \left(C_h^i - \overline{C}_h^i\right)^{\beta_h^i} \quad [6.1]$$

$\overline{L}_h^{mal}$ and $\overline{L}_h^{fem}$ = minimum subsistence volumes of male and female non-market work (leisure and work at home) required by household *h*;

L^{mal} and L^{fem} = total of male and female unpaid time in household *h*;

$\overline{C}_i$ and C_i = minimum subsistence and total quantities of commodity I;

β = marginal budget share that determine the allocation of supernumerary income.

The household is subject to the following constraints:

- **Budget**:

$$\sum_i P_i C_{i,h} = R_h + w_{mal} LM_{mal,h} + w_{fem} LM_{fem,h} = Y_h \quad [6.2]$$

With Y= household *h* real income; LMmal and LMfem = male and female market work; Wmal and Wfem = male and female wage rate; R = non-labor income.

- **Time**:

$$T_{mal,h} = LM_{mal,h} + L_{mal,h} \quad [6.3]$$

$$T_{fem,h} = LM_{fem,h} + L_{fem,h} \quad [6.4]$$

Tmal and Tfem are the total time endowment for men and women

Household's full income (FY) is given by [6.2], [6.3] and [6.4] :

$$\sum_i P_i C_{i,h} + w_{mal} L_{mal,h} + w_{fem} L_{fem,h} = R_h + w_{mal} T_{mal,h} + w_{fem} T_{fem,h} = FY_h \quad [6.5]$$

$$= Y_h + w_{mal} L_{mal,h} + w_{fem} L_{fem,h} = FY_h \quad [6.6]$$

Finally, the household maximize [6.1], subject to [6.5]; its demand functions are given by:

$$C_{i,h} = \overline{C}_{i,h} + \frac{\beta_{i,h}\left[FY_h - \sum_i P_i \overline{C}_{i,h} - w_{mal}\overline{L}_{mal,h} - w_{fem}\overline{L}_{fem,h} \right]}{P_i} \quad [6.7]$$

$$L_{mal,h} = \overline{L}_{mal,h} + \frac{\beta_{mal,h}\left[FY_h - \sum_i P_i \overline{C}_{i,h} - w_{mal}\overline{L}_{mal,h} - w_{fem}\overline{L}_{fem,h} \right]}{w_{mal}} \quad [6.8]$$

$$L_{fem,h} = \overline{L}_{fem,h} + \frac{\beta_{fem,h}\left[FY_h - \sum_i P_i \overline{C}_{i,h} - w_{mal}\overline{L}_{mal,h} - w_{fem}\overline{L}_{fem,h} \right]}{w_{fem}} \quad [6.9]$$

Substituting equations [6.6] into equation [6.7], [6.8] and [6.9], and rearranging terms results in household's demand function for market commodities and its labor supply functions

$$C_{i,h} = \overline{C}_{i,h} + \frac{\beta_{i,h}\left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{P_i\left(1 - \beta_{mal,h} - \beta_{fem,h}\right)} \quad [6.10]$$

$$LM_{mal,h} = T_{mal,h} - \left(\overline{L}_{mal,h} + \frac{\beta_{mal,h}\left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{W_{mal}\left(1 - \beta_{mal,h} - \beta_{fem,h}\right)} \right) \quad [6.11]$$

$$LM_{fem,h} = T_{fem,h} - \left(\overline{L}_{fem,h} + \frac{\beta_{fem,h}\left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{W_{fem}\left(1 - \beta_{mal,h} - \beta_{fem,h}\right)} \right) \quad [6.12]$$

Following De Melo and Tarr (1971), we can rewrite households labor supply function as:

$$LM_{mal,h} = MAXHOURS_{mal,h} - \left(\frac{\beta_{mal,h}\left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{W_{mal}\left(1 - \beta_{mal,h} - \beta_{fem,h}\right)} \right) \quad [6.13]$$

$$LM_{fem,h} = MAXHOURS_{fem,h} - \left(\frac{\beta_{fem,h} \left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{W_{fem} \left(1 - \beta_{mal,h} - \beta_{fem,h} \right)} \right) \quad [6.14]$$

Where: $MAXHOURS_{mal,h} = T_{mal,h} - \overline{L}_{mal,h}$; and $MAXHOURS_{fem,h} = T_{fem,h} - \overline{L}_{fem,h}$

2- Calibration

To evaluate these equations, the parameters β_{mal}, β_{fem}, β_i and $\overline{C}_{i,h}$ need to be calibrated using data from the social accounting matrix (SAM), the maximum time available for male and female (Tmal and Tfem), the minimum subsistence required for male and female non-market work time ($\overline{L}^{mal}$ and $\overline{L}^{fem}$), the Frisch parameter and the income elasticity of market commodities demand.

1)- β_{fem} and β_{fem} are calibrated from equations [6.13] and [6.14]:

$$\beta_{mal,h} = \frac{w_{mal}(MAXHOURS_{mal,h} - LM_{mal,h})}{w_{mal}(MAXHOURS_{mal,h} - LM_{mal,h}) + w_{fem}(MAXHOURS_{fem,h} - LM_{fem,h}) - \frac{YH_h}{frisch_h}} \quad [6.15]$$

$$\beta_{mal,h} = \frac{w_{mal}(MAXHOURS_{mal,h} - LM_{mal,h})}{w_{mal}(MAXHOURS_{mal,h} - LM_{mal,h}) + w_{fem}(MAXHOURS_{fem,h} - LM_{fem,h}) - \frac{YH_h}{frisch_h}} \quad [6.16]$$

Where Tmal, Tfem, $\overline{L}^{fem}$, $\overline{L}^{mal}$, LMmal, LMfem and Frisch parameter are obtained from the SAM and other studies; Wfem and Wfem are normalized to one.

2- β_i are calibrated from the commodities demand equation [6.10]; the elasticity of demand for commodities i with respect to income, whose value is also obtained from previous studies, are given by:

$$\varepsilon_{i,h} = \frac{\beta_{i,h} Y_h}{(1 - \beta_{mal,h} - \beta_{fem,h}) P_i C_{i,h}} \quad [6.17]$$

$$\beta_{i,h} = \frac{(1 - \beta_{mal,h} - \beta_{fem,h}) \varepsilon_{i,h} P_i C_{i,h}}{Y_h} \quad [6.18]$$

Y and C are obtained from the SAM, and the price (P) are normalized to one.

3- calibration of the minimum consumption of market commodities ($\overline{C}_{i,h}$)[30]:

[30] The elasticity of demand for market commodities i with respect to prices can be also used to calibrate the minimum consumption of market commodities.

$$\overline{C}_{i,h} = C_{i,h} + \frac{\beta_{i,h}}{P_i(1-\beta_{mal,h}-\beta_{fem,h})}\left[\frac{Y_h}{Frisch_h}\right] \quad [6.19]$$

APPENDIX G: Model3 - Modeling gender leisure, work in the market and at home, and home production

1- Model

Following Graham and Green (1984), we incorporate gender leisure ($LEmal_h$ et $LEfem_h$) and household home production (CZ_k) in a Stone and Geary utility function:

$$U_h = \left(LEmal_h - \overline{LE}_h\right)^{\beta_h^{mal}} \left(LEfem_h - \overline{LE}fem_h\right)^{\beta_h^{fem}} \left(CZ_h - \overline{CZ}_h\right)^{\beta_h^z} \prod_i \left(C_h^i - \overline{C}_h^i\right)^{\beta_h^i} \quad [7.1]$$

The household produces a single commodities, aggregation of domestic goods its members produce at home. It faces the following constraints:

- Home production technology:

$$Z_h = f(LZmal_h, LZfem_h) \quad [7.2]$$

$LZmal$ et $LZfem$ are male and female time used to produce home commodities

- budget:

$$\sum_i P_{i,h}C_{i,h} = R_h + w_{mal}LMmal_h + w_{fem}LMfem_h = Y_h \quad [7.3]$$

- Time:

$$Tmal_h = LMmal_h + LZmal_h + LEmal_h \quad [7.4]$$

$$Tfem_h = LMfem_h + LZfem_h + LEfem_h \quad [7.5]$$

Variables and parameters keep their previous definition. The household's full income is obtained from [7.3], [7.4] and [7.5]

$$\sum_i P_{i,h}C_{i,h} + P_h^z CZ_h + LEmal_h + w_{fem}LEfem_h = FY_h \quad [7.6]$$

with

$$FY_h = R_h + w_{mal}LMmal_h + w_{fem}LMfem_h + w_{mal}LEmal_h + w_{fem}LEfem_h + P_h^z Z_h \quad [7.7]$$

$$= Y_h + w_{mal}LEmal_h + w_{fem}LEfem_h + P_h^z Z_h \quad [7.8]$$

Demand functions obtained from the utility [7.1] maximization, subject to constraint [7.7] are:

$$C_{i,h} = \overline{C}_{i,h} + \frac{\beta_h^i\left[FY_h - \sum_i P_i\,\overline{C}_{i,h} - P_h^z\overline{CZ}_h - w_{mal}\overline{LE}mal_h - w_{fem}\overline{LE}fem_h\right]}{P_i} \quad [7.9]$$

$$CZ_h = \overline{CZ}_h + \frac{\beta_h^z \left[FY_h - \sum_i P_i \overline{C}_{i,h} - P_h^z \overline{CZ}_h - w_{mal} \overline{LE}mal_h - w_{fem} \overline{LE}fem_h \right]}{P_h^z} \quad [7.10]$$

$$LEmal_h = \overline{LE}mal_h + \frac{\beta_h^{mal} \left[FY_h - \sum_i P_i \overline{C}_{i,h} - P_h^z \overline{CZ}_h - w_{mal} \overline{LE}mal_h - w_{fem} \overline{LE}fem_h \right]}{W_{mal}} \quad [7.11]$$

$$LEfem_h = \overline{LE}fem_h + \frac{\beta_h^{fem} \left[FY_h - \sum_i P_i \overline{C}_{i,h} - P_h^z \overline{CZ}_h - w_{mal} \overline{LE}mal_h - w_{fem} \overline{LE}fem_h \right]}{W_{fem}} \quad [7.12]$$

Similarly to the previous model, substituting equations [7.7] and [7.8], into [7.9], [7.10], [7.11] and [7.12], after rearranging, gives:

$$C_{i,h} = \overline{C}_{i,h} + \frac{\beta_h^i \left[Y_h - \sum_i P_i \overline{C}_{i,h} \right]}{P_i (1 - \beta_h^{mal} - \beta_h^{fem} - \beta_h^z)} \quad [7.13]$$

$$CZ_h = \overline{CZ}_h + \frac{\beta_h^z \left[Y_h - \sum_i P_i \overline{C}_{i,h} \right]}{P_h^z (1 - \beta_h^{mal} - \beta_h^{fem} - \beta_h^z)} \quad [7.14]$$

$$LMmal_h = Tmal_h - LZmal_h - \left[\overline{LEmal}_h + \frac{\beta_h^{mal} \left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{W_{mal} (1 - \beta_h^{mal} - \beta_h^{fem} - \beta_h^z)} \right] \quad [7.15]$$

$$LMfem_h = Tfem_h - LZfem_h - \left[\overline{LEfem}_h + \frac{\beta_h^{fem} \left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{W_{fem} (1 - \beta_h^{mal} - \beta_h^{fem} - \beta_h^z)} \right] \quad [7.16]$$

Following De Melo and Tarr (1971) method, we can write:

$MAXHRSmal_h = Tmal_h - \overline{LE}mal_h$; $MAXHRSfem_h = Tfem_h - \overline{LE}fem_h$; and:

$$LMmal_h = MAXHOURSmal_h - LZmal_h - \frac{\beta_h^{mal} \left(Y_h - \sum_i P_i \overline{C}_{i,h} \right)}{W_{mal} (1 - \beta_h^{mal} - \beta_h^{fem} - \beta_h^z)} \quad [7.17]$$

$$LMfem_h = MAXHOURSfem_h - LZfem_h - \frac{\beta_h^{fem}\left(Y_h - \sum_i P_i \overline{C}_{i,h}\right)}{W_{fem}(1-\beta_h^{mal}-\beta_h^{fem}-\beta_h^{z})} \quad [7.18]$$

2- Calibration

1- calibration of $\beta_{mal,h}$, $\beta_{fem,h}$ and $\beta_{z,h}$,

Equations [7.17] and [7.18] can be formulated as:

$$LMmal_h = MAXHRSmal_h - LZmal_h - \frac{\beta_h^{mal}\left[\psi_h P_h^z Z_h + Y_h - \sum_i P_i \overline{C}_{i,h}\right]}{W_{mal}(1-\beta_h^{mal}-\beta_h^{fem})} \quad [7.19]$$

$$LMfem_h = MAXHRSfem_h - LZfem_h - \frac{\beta_h^{fem}\left[\psi_h P_h^z Z_h + Y_h - \sum_i P_i \overline{C}_{i,h}\right]}{W_{fem}(1-\beta_h^{mal}-\beta_h^{fem})} \quad [7.20]$$

Parameter ψ_h represents the share of the surplus of home commodity consumption in the total available. When minimum subsistence requirement for home commodity consumption is fix to 0.3, this parameter take the value 0.7.

$$\psi_h = 1 - \frac{\overline{CZ}_h}{CZ_h}$$

Fixing ψ_h, we use the previous calibration procedure;

$$\beta_h^{mal} = \frac{W_{mal}\lambda_{mal}}{W_{mal}\lambda_{mal} + W_{fem}\lambda_{fem} + \left(\psi_h P_h^z CZ_h\right) - \frac{Y_h}{frisch_h}} \quad [7.21]$$

$$\beta_h^{fem} = \frac{W_{fem}\lambda_{fem}}{W_{mal}\lambda_{mal} + W_{fem}\lambda_{fem} + \left(\psi_h P_h^z CZ_h\right) - \frac{Y_h}{frisch_h}} \quad [7.22]$$

$$\beta_h^{z} = \frac{\psi_h P_h^z CZ_h}{W_{mal}\lambda_{mal} + W_{fem}\lambda_{fem} + \left(\psi_h P_h^z CZ_h\right) - \frac{Y_h}{frisch_h}} \quad [7.23]$$

Where,

$$\lambda_{mal} = MAXHRSmal_h - LZmal_h - LMmal_h$$
$$\lambda_{fem} = MAXHRSfem_h - LZfem_h - LMfem_h$$

2- calibration of β_i

When $\beta_{mal,h}$, $\beta_{fem,h}$ and $\beta_{z,h}$ are estimated, we can easily calibrate β_i using the similar procedure as in the previous model.

$$\varepsilon_{i,h} = \frac{\beta_{i,h} Y_h}{(1-\beta_h^{mal}-\beta_h^{fem}-\beta_h^{z}) P_i C_{i,h}} \quad [7.24]$$

$$\beta_{i,h} = \frac{(1-\beta_h^{mal}-\beta_h^{fem}-\beta_h^{z})\varepsilon_{i,h} P_i C_{i,h}}{Y_h} \quad [7.25]$$

3- Minimum consumption $\overline{C}_{i,h}$

$$\overline{C}_{i,h} = C_{i,h} - \frac{\beta_{i,h}\left[\frac{Y_h}{Frisch_h}\right]}{P_i(1-\beta_h^{mal}-\beta_h^{mal}-\beta_h^{z})} \quad [7.26]$$

4- the parameter in home production function are calibrated as in model1:

The elasticity parameter (ρ)

$$\rho_h = \frac{1-\sigma_h}{\sigma_h} \quad [7.27]$$

σ = Elasticity of substitution in male and female labor.

The share parameter of female labor relative to male labor in home production activity.

$$\alpha_h = \frac{\left(\frac{LMfem_h}{LMmal_h}\right)^{1/\sigma_h}\left(\frac{w_{fem}}{w_{mal}}\right)}{1+\left(\frac{LMfem_h}{LMmal_h}\right)^{1/\sigma_h}\left(\frac{w_{fem}}{w_{mal}}\right)} \quad [7.28]$$

The scale parameter

$$A_h = \frac{LM_h}{\left[\alpha_h LMfem_h^{-\rho_h} + (1-\alpha_h) LMmal_h^{-\rho_h}\right]^{-1/\rho_h}} \quad [7.29]$$

APPENDIX H: Calibrating gender maximum time available for work and leisure

The extend method of De Melo and Tarr to calibrate β_{fem} , β_{fem} , and MAXHOURS

- Step 1: Generally, data are not available on the maximum time available for work and leisure. We use De Melo and Tarr approach to derived this maximum time from the formula of elasticity of labor supply respect to income applied to equation [7.17] and [7.18]:

$$\varepsilon_{fem,h} = \frac{\beta_{fem,h} YH_h}{(1-\beta_{mal,h}-\beta_{fem,h}) W_{fem} LM_{fem,h}}$$

$$\varepsilon_{mal,h} = \frac{\beta_{mal,h} YH_h}{(1-\beta_{mal,h}-\beta_{fem,h}) W_{mal} LM_{mal,h}}$$

Where ε_{fem} and ε_{mal} are available from other studies.

$$\beta_{mal,h} = \frac{\varepsilon_{mal,h} w_{mal} LM_{mal,h}}{\varepsilon_{fem,h} w_{fem} LM_{fem,h} + \varepsilon_{mal,h} w_{mal} LM_{mal,h} - Y_h}$$

$$\beta_{fem,h} = \frac{\varepsilon_{fem,h} w_{fem} LM_{fem,h}}{\varepsilon_{fem,h} w_{fem} LM_{fem,h} + \varepsilon_{mal,h} w_{mal} LM_{mal,h} - Y_h}$$

- Step 2: From equation [7.14] we derived the marginal share of supernumerary expenditure on home produced goods:

$$\beta_h^z = \frac{\psi_h P_h^z CZ_h \left(1-\beta_{mal,h}-\beta_{fem,h}\right)}{\psi_h P_h^z CZ_h - \frac{Y_h}{frisch_h}}$$

- Step 3: Maximum number of hours available for work (MAXHOUR), which equal to total time endowment T (24 hours in our case) less minimum requirement for leisure and work at home, is calibrated by rearranging [7.17] and [7.18]:

$$MAXHOUR_{mal,h} = LM_{mal,h} + LZ_{mal,h} + \left(\frac{\beta_{mal,h}}{W_{mal}\left(1-\beta_{mal,h}-\beta_{fem,h}-\beta_h^z\right)}\right)\left(-\frac{Y_h}{Frisch_h}\right)$$

$$MAXHOUR_{fem,h} = LM_{fem,h} + LZ_{fem,h} + \left(\frac{\beta_{fem,h}}{W_{fem}\left(1-\beta_{mal,h}-\beta_{fem,h}-\beta_h^z\right)}\right)\left(-\frac{Y_h}{Frisch_h}\right)$$

- Step 4: Other parameters (β_i *and* $\overline{C}_{i,h}$) are calibrated with the manner used in the previous section.