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Modeling the Effects of Trade on Women, at Work and at Home

MARZIA FONTANA and ADRIAN WOOD *
University of Sussex, Brighton, UK

Summary. — Foreign trade affects women's wages and jobs, their household work, and their leisure. This paper develops a model which covers not only all the sectors of the market economy, but also social reproduction and leisure activities, for women and men separately. The model, which in other respects is a standard CGE (computable general equilibrium) model, is applied to a simplified set of data for Bangladesh. Its use is illustrated by simulating the gendered effects of changes in trade policies and capital flows. © 2000 Elsevier Science Ltd. All rights reserved.

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1. INTRODUCTION

Greater exposure to the world economy has uneven effects on women and men in developing countries, which are imperfectly understood, making it hard to design appropriate policies. Earlier research has documented the contribution of export growth to the expansion of female employment in manufacturing in many countries, and the adverse effect of growing cash crops for export on women's production of food in some African countries (Joekes & Weston, 1994). A full assessment of the impact of trade on women's earnings, job opportunities and well-being must, however, take account of (a) linkages and feedbacks among different sectors and (b) interactions between the market economy and the household economy.

For example, trade liberalization that creates more jobs in female-intensive exporting sectors also destroys jobs in sectors producing import substitutes. The lost jobs may or may not be female, but even if they are male, women members of the households of the men concerned may be adversely affected, either by reduction of consumption or by being forced to take paid work in addition to domestic commitments, including child-rearing. Growth of employment of women in exporting sectors may also occur largely through mobility from other sectors, with little or no increase in their net cash earnings. Moreover, even if increased employment involves a rise in women's labor force participation, this may be at the expense of the time they can devote to caring for their families, or of their leisure, their sleep and their health.

As these examples show, a better understanding of the impact of trade on women cannot be achieved just by further research on particular sectors or firms, or even particular households. It requires a comprehensive framework, both to track how the effects in specific sectors percolate through the rest of the market economy, and to analyze how these effects in the market economy influence, and are influenced by, behavior in the unpaid household economy where women are the main workers. Our objective in this paper is to provide such a framework by constructing a gendered CGE (computable general equilibrium) model.

The many CGE models that have been constructed since about 1970 have almost entirely neglected the gender dimension. [1] An earlier special issue of *World Development* (Cagatay, Elson & Grown, 1995) showed how gender can be added to macroeconomic models, but did not cover multisectoral microeconomic modeling. Yet CGE models could be

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useful for gender analysis in various ways. They allow for linkages among actors and sectors, and trace indirect effects under clear behavioral assumptions, generating hypotheses and identifying relationships for testing in other sorts of empirical work. Above all, they permit controlled experiments in which the effects of a specific policy measure or shock can be isolated from other influences. Moreover, CGE models are multipurpose tools: thus, although our immediate aim is to analyze the effects of trade in developing countries, the type of model we construct could be used to investigate many other gender-related issues.

This paper is organized as follows. Section 2 outlines our general approach. Section 3 explains how, in line with this approach, we organized our data on a particular developing country, Bangladesh. Section 4 provides a fuller description of the structure of our model. Section 5 reports the results of a series of experiments with the model. Section 6 concludes and outlines our agenda for further work.

2. PRINCIPLES

Our strategy is to start from a standard CGE model, but to extend its accounting framework by (a) treating men and women as separate factors of production, and (b) treating domestic work and leisure activities as sectors, in addition to the usual market-economy sectors. The first of these modifications is obviously necessary, but the second merits some discussion.

The many unpaid services provided within households, as emphasized by feminist economists (e.g., Elson, 1995), are not only vital for social well-being and human development but also supplied mainly by women—and occupy much of women's time. To make these services (which we call the "reproduction" sector) visible is thus important in itself as an ingredient of a gendered model. In addition, it allows consideration of more constraints and interactions than with the standard model, particularly interactions between behavior inside and outside the household which are crucial to understanding issues such as the response of female labor force participation to reform of economic policies.

An accurate assessment of the gendered impact of economic policy changes also requires explicit consideration of time spent on rest and recreation (which we call the "leisure" sector). This is because there are sharp differences in the extent of leisure time between women and men (with women generally spending more of their waking hours on work of all kinds), and because changes in the market can alter the amount of time spent on leisure, thus affecting welfare in ways that are overlooked in standard economic models. For example, an increase in female earnings from greater participation in the market economy might on balance reduce social welfare if it also resulted in a substantial decline in leisure time for women.

In our model, these two new sectors are assumed to behave qualitatively like market sectors. [2] Each of them has a production function, which converts inputs of labor (mainly female in reproduction and male in leisure) into an output—reproduction services and leisure activities respectively. Demand for this output, relative to other goods, depends on household preferences, and is a decreasing function of its relative price. This price, like those of other goods, depends on the cost of production, and more specifically on the opportunity cost of the wages that people forgo by spending time on reproduction or leisure rather than working in the market economy. Given the price of this output, the demand for it determines how much is produced, which in turn determines how much labor is employed in the sector.

In other words, the behavior of the reproduction and leisure sectors in our model resembles that in the standard neoclassical household model—often represented in the familiar diagram with indifference curves, reflecting preferences (in this case between reproduction or leisure and all other goods), and a budget line, reflecting income and relative prices (in this case the opportunity cost of reproduction and leisure relative to all other goods). There is more to our model than to the diagram—which is a partial equilibrium device, and does not make explicit the household production function or the gender division of labor in the provision of reproduction services—but the outcome is determined in essentially the same way.

We are well aware of the limitations of the neoclassical model of the household, particularly from a gender perspective: it permits no differences among the preferences of household members (which must be taken to be either all the same or imposed behind the scenes by a dominant member), and it assumes rational

utility-maximizing behavior. Game-theoretic bargaining models—in which household members have distinct preferences and personal economic constraints—have thus shed valuable additional light on gender relations (e.g., Haddad, Hoddinott & Alderman, 1997). For our purposes, however, the neoclassical household model has the great advantages of being simple, well-known, and instantly compatible with the principles of a standard CGE model. Moreover, despite its deficiencies, the neoclassical model captures an important part of the truth: its message that households, on average, respond to economic incentives in a predictable and privately rational way is consistent with much empirical evidence, for example on fertility (Birdsall, 1988).

While assuming the reproduction and leisure sectors in our model to behave in qualitatively the same way as market sectors, we can and do allow for important quantitative differences in setting the values of the parameters in each sector. For example, the demand for (and so the supply of) reproduction services is less responsive to changes in their price than in the case of most market goods, because many of these services are necessities, but this can be captured by setting a lower price elasticity of demand in the reproduction sector. Similarly, we can capture the greater rigidity of the gender division of labor in reproduction than in market sectors by setting a lower elasticity of substitution between female and male labor. It may ultimately be possible to go deeper, as explained in our final section, by making the values of these and other parameters the endogenous outcome of differences between female and male preferences, resources and bargaining power, but appropriately chosen exogenous values can convey much of the reality of how a gendered economy operates.

3. DATA

The first step toward making a model of a particular country is to construct a social accounting matrix (SAM), containing information about its economic and social structure. Our SAM, in Table 1, is a simplified description of Bangladesh in 1985, with only three factors of production (female labor, male labor, and capital) and five sectors. We shall refer to agriculture, manufacturing and services as the market sectors (although agriculture includes production for own-consumption) and to reproduction and leisure as the nonmarket sectors. Unlike many SAMs, ours does not distinguish among household types (rural and urban, rich and poor, for example), and contains only minimal information about the government and the balance of payments. This suppression of social and institutional detail means that our SAM consists of an input–output table with some supplementary rows on the labor market.

The SAM is simplified because the main aim of this paper is not to undertake a detailed study of Bangladesh (which we plan to do later, using a more elaborate SAM), but to explain and illustrate the principles of a gendered model which could be applied to any country. Thus our SAM, though it omits much customary detail, has three somewhat unusual features. [3] One is that it distinguishes between female and male labor, both in the labor market and in the distribution of value added in each sector. A second is that it includes the reproduction and leisure sectors, rather than being confined to the market economy. The third—a consequence of the second—is that labor use is measured in terms of hours rather than persons, since most people are involved in both market and nonmarket activities. The next few paragraphs discuss the principles and the data used in creating these features.

Our reproduction sector covers services produced and consumed within households. These are activities which the standard System of National Accounts (SNA) defines as "economic" but not "productive" (UN, 1993). Any activity which could be delegated to someone else is "economic," for example, making a shirt or preparing a meal. The SNA defines as productive (and includes in GDP) not only the economic activities which produce goods and services for sale, but also those which produce material goods for own-consumption within households—food, clothing and other articles. Services provided within households for own-consumption, however, are defined as nonproductive, and it is these which we label reproduction: cooking and cleaning; repairing the house, furniture and clothes; care of children, the sick and the elderly; and personal, social and community support services. [4]

Following this SNA convention has advantages in terms of availability and comparability of data, but also some disadvantages. The division of household activities between "productive" material goods and "nonproductive" services is arbitrary—since most of these

Table 1. *Bangladesh SAM, 1985 (US $ million)*

	Agri-culture	Manu-facturing	Services	Repro-duction	Leisure	Total	H'hold cons'n	Gov't cons'n	Invest-ment	Exports	Imports	Tariffs	Net final demand	Total demand
Intermediate flows							*Final demand*							
Agriculture	1759	733	38	0	0	2530	7583	58	0	318	449	0	7510	10039
Manufacturing	616	1540	1524	0	0	3680	1447	173	1016	549	1915	450	820	4500
Services	537	607	791	0	0	1935	6040	920	1016	217	322	0	7870	9805
Reproduction	0	0	0	0	0	0	4224	0	0	0	0	0	4224	4224
Leisure	0	0	0	0	0	0	4011	0	0	0	0	0	4011	4011
Total	2911	2880	2353	0	0	8145	23305	1150	2031	1084	2686	450	24435	32580
Value added														
Indirect taxes	0	237	503	0	0	740								
Wages:	4279	567	3335	4224	4011	16416								
Female	1064	49	271	2768	369	4521								
Male	3215	518	3064	1457	3641	11896								
Profits	2849	816	3613	0	0	7278								
							GDP							
Total	7128	1620	7452	4224	4011	24435	16200							
Gross output	10039	4500	9805	4224	4011	32580								
Employment (*million hours per year, over-10 population*)														
Female	43148	1726	6903	103555	13808	169141								
Male	62598	7154	30405	21462	53655	175273								
Wage rates (*US cents per hour*)														
Female	2.47	2.83	3.93	2.67	2.67	2.67								
Male	5.14	7.25	10.08	6.79	6.79	6.79								

services, like the goods, have substitutes in the market economy (restaurants, laundries and childcare, for example)—and it gets in the way of an integrated treatment of the economic behavior of households. In developed countries, this division hardly matters, because few material goods are made in households, but in low-income developing countries it is significant because of the extent of subsistence agriculture. [5]

Our leisure sector contains activities which the SNA defines as "noneconomic" (for example, one cannot send someone else to watch a film on one's behalf), but is only a subset of these activities. We distinguish leisure from "personal care," which we define as the minimum time needed for sleeping, eating, personal hygiene, and medical treatment. Amounts of time spent on these activities in excess of the minima—for example, spending most of the day in bed or at a feast—are categorized as leisure, in addition to activities such as watching TV, listening to music, engaging in hobbies or sports, parties, ceremonies and religious observance. All these leisure activities are included in our SAM, while personal care is excluded. Clearly, the division between leisure and personal care is a bit arbitrary, as is that between leisure and market activities, but some such distinctions seem necessary.

The sources of data for the market sectors are straightforward. [6] For the reproduction and leisure sectors, the key building block is an estimate of the average allocation of women's and men's time, in hours per week, among the five sectors, which is shown in Table 2. The estimate, which covers all 168 (7×24) hours of the week, is based partly on standard labor force data (which record the number of people working in each of the market sectors) and partly on time-use data, coupled with the assumption that 10 hours per day are needed for minimal personal care. [7] Since the underlying data are neither complete nor reliable, and since they are here averaged across rural and urban areas, the numbers in the table should be treated with caution. Of the hours not absorbed by minimal personal care, men spend 57% in market activities, compared to 30% for women; and 31% in leisure, compared to only 8% for women. The proportions are reversed for reproduction, which occupies only 12% of men's available hours, compared to 61% for women. The main market activity for both genders is agriculture, but particularly for women: employment in manufacturing and services occupies only 5% of their time, as compared to 21% of men's time.

Table 2. *Estimated average time-use in Bangladesh, 1985 (hours per week)*[a]

	Women	Men
Agriculture	25	35
Manufacturing	1	4
Services	4	17
All market sectors	30	56
Reproduction	60	12
Leisure	8	30
Personal care	70	70
Total	168	168

[a] *Source*: see text.

To complete the SAM, we also need estimates of the hourly wage rates of women and men in each of the market sectors (shown at the bottom of Table 1). [8] These, in conjunction with the time-use estimates, allow the wage bill in each market sector to be divided between females and males. They also provide a basis for valuing the labor time spent on reproduction and leisure, of which we assume the opportunity cost, for women and men separately, to be their average market wage. This valuation of labor time is also our valuation of the output of the leisure and reproduction sectors, since, following SNA conventions, these sectors use neither capital (housing is in the market services sector, and expenditure on consumer durables is classed as consumption, not investment) nor intermediate inputs (purchases of goods used in providing household services and in leisure activities are treated as final consumption). As shown in Table 3, the output of the reproduction sector is 26% of conventional GDP, which is similar in size to other estimates for developing countries (Goldschmidt-Clermont, 1987), and the output of leisure is also about a quarter of conventional GDP. [9]

The limitations of our way of valuing labor in reproduction and leisure should be noted. Although we believe the opportunity cost principle to be the correct one in this context, the true opportunity cost of time for both women and men varies greatly among households, depending on their qualifications and circumstances, whereas we have used a crude average for all households. The limitations of the SNA conventions (as well as their merits as a way of maximizing the use of readily available data) must also be re-emphasized. An

Table 3. *Sectoral structure of Bangladesh, 1985*[a]

	Net output (% of GDP)	Female labor (% of total hours)	Exports as share of gross output (%)	Imports as share of domestic use (%)
Agriculture	44.0	40.8	3.2	4.4
Manufacturing	10.0	19.4	12.2	37.4
Services	46.0	18.5	2.2	3.3
All market sectors	100.0	34.1	4.5	11.9
Reproduction	26.1	82.8	–	–
Leisure	24.8	20.5	–	–
Total	150.8	49.1	3.3	9.1

[a] *Source*: Table 1.

integrated model of the household would include its capital assets, including the house itself, and would treat most purchases of consumption goods as intermediate inputs into the production of final household services (raw food being turned into meals, for example), or as investment (consumer durables). Moreover, the household itself can be viewed as a supplier of intermediate inputs to the market economy—particularly the care and maintenance of the market labor force, as emphasized by Folbre (1994).

Table 3 also provides a summary of the sectoral structure of our SAM, in terms both of the gender division of labor and of the economy's openness to trade. Reproduction and leisure are both nontradable: employment in reproduction is mainly (83%) female, and in leisure is mainly (80%) male. Agriculture is the most female-intensive of the market sectors (women's hours are 41% of the total), and does not trade much: the share of imports in domestic use is 4%, while exports are 3% of output. Manufacturing is the most open sector (exports are 12% of output and imports are 37% of domestic use) and is less female-intensive than agriculture (female working hours are 19% of the total). In services, which are slightly less female-intensive than manufacturing, trade is also small: exports are 2% of output, and imports are 3% of domestic use.

4. MODEL

A CGE model is a system of equations which brings a SAM to life by simulating the working of a market economy. The prices and quantities of all the goods and factors are determined simultaneously in every market (hence *G* for "general") by the need to equate supply with demand (hence *E* for "equilibrium"—the *C* for "computable" just means that the equations can be solved using a computer with appropriate software). [10] Most of the equations in the model are microeconomic—specifying exactly how the quantities supplied and demanded in each market respond to price changes—but there are also a few macroeconomic equations to make everything add up correctly (so that, for example, saving equals investment). The equations used in CGE models are now fairly standard: we simply adapted those of another well-known model (applied to Cameroon in Devarajan, Lewis & Robinson, 1995, chapter 3). [11]

The parameters and exogenous variables in the equations must be given values such that the initial or "base" solution of the model replicates the data in the SAM: finding an appropriate set of values is referred to as "calibrating" the model. Some parameter values must be set independently of the data in the SAM, on the basis of econometric evidence or the values used in other models or guesswork—elasticities of substitution in production or consumption, for example. The values of the other parameters can then be calculated from the data in the SAM—for example, the efficiency parameter of the production function in each sector must make the quantity of output consistent with the quantities of factor inputs. The values of exogenous variables, for example economy-wide labor supplies, can be taken directly from the SAM.

The next few paragraphs outline our model—the general form of its equations, and how we calibrated it to our gendered Bangladesh SAM (the full model is available on request). What is described here is our "central" specification: experiments with alternative specifications of the model are reported in the next section.

The production functions in our five sectors, which are important on the supply side of goods markets and on the demand side of

factor markets, are two-level CES (constant elasticity of substitution) functions. At the lower level, female labor and male labor are aggregated into composite labor. [12] The ratio of female to male labor depends on the share parameter of this aggregation function, which differs across sectors, and varies with changes in the wage rate of women relative to men, which induce substitution between them. To reflect the rigidity of gender roles, particularly within the household, we limit female/male substitution by setting elasticities much lower than is usual in CGE models: −0.5 in the market sectors and −0.25 in reproduction and leisure. Composite labor is the "output" of the reproduction and leisure sectors, which in our SAM use neither capital nor intermediate inputs. In the market sectors, however, the production function has an upper level, with a substitution elasticity of unity, which combines composite labor and capital to produce net output (which is then combined in fixed proportions with intermediate inputs to make gross output).

The relative quantities of female and male labor and capital demanded vary inversely with relative factor prices (due to substitution), while the absolute quantities demanded in each sector depend mainly on the level of demand for the sector's output. The supply of capital in each sector is fixed (so profit rates may vary across sectors), but labor is mobile, so that the supply to each sector responds freely to demand, within limits set by the fixed total supplies of female and male labor. [13] Economy-wide average factor prices are set to clear factor markets—that is, to employ all factors fully—and so vary with the economy-wide demand for each factor, relative to its fixed supply. The average wage of women and men, relative to the average profit rate, thus depends on the sum of all the sectoral demands for composite labor, relative to those for capital. The wage of women, relative to men, likewise depends on the sum of all the sectoral demands for female labor, relative to male labor.

All wages and profits accrue to households, who pay part in taxes, save part, and spend the rest. [14] Households initially divide their expenditure among the five sectors in the proportions shown in the SAM, but the consumption function lets the mixture vary with relative prices (the "prices" of reproduction and leisure are the opportunity cost of the labor used in them, which is based on the average wage in the market sectors). The price elasticities of demand for manufactures, services and leisure are set at −1.0, but for agricultural goods (food) is set lower, at −0.4, by introducing a subsistence minimum level of consumption. [15] In the absence of any better information, we also set the price elasticity of demand for reproduction at −0.4. In reality, how much households alter the amount of time spent on reproduction activities in response to changes in market wages varies with their composition and circumstances—less adjustment being possible, for instance, in families with more children or elderly dependents—but with only one type of household in our model, we have to use an average.

In addition to household demands for the three market goods, there are demands from government and for investment and intermediate use. [16] The balancing of supply and demand in these three sectors also involves foreign trade flows. Buyers in each sector divide their expenditure between imports and domestically produced goods in shares which are initially based on those in the SAM, but vary in response to changes in the ratio of domestic prices to import prices—the import share rising, for example, if the domestic price rises (import prices being determined by fixed world prices plus tariffs). Likewise, producers in each sector divide their output between the home and the export markets in shares which vary with the ratio of domestic prices to export prices (world prices net of export taxes and subsidies). [17] The balance between total exports and total imports must match a fixed inflow of foreign capital: this is achieved by letting the exchange rate float (for example, a depreciation reduces the import share and raises the export share in each sector).

5. EXPERIMENTS

The purpose of constructing a model is to be able to simulate alternative states of the world—to carry out controlled experiments to assess the effects of changes in policies or behavior or economic circumstances. Once the investment of constructing a model has been made, an unlimited number of experiments of many kinds can easily be undertaken. In this section, however, we focus on only four possible trade-related shocks and policy changes, paying particular attention to their gender-related effects. We first report the results of all four experiments using the central

specification of the model described in the previous section. We then investigate how sensitive the results are to this specification by re-running one of these experiments with alternative gender-related versions of the model—using different elasticities and with different coverage of reproduction and leisure activities. In each case, we concentrate on what happens to:

—the allocation of labor, particularly female labor, between leisure, reproduction and employment in the market economy (and among its different sectors);

—the average female wage rate in the economy, both absolute and relative to male wages (the wage changes reported in the tables are in real terms, because the general price level is held constant in the simulations); [18] and

—the female wage bill in manufacturing and services, as an indicator of women's cash income from employment, which affects their bargaining power within the household and hence their well-being (and that of their children). [19]

The tables in this section thus contain only a few of the numbers which are generated by each simulation, and the discussion likewise is limited for brevity to a few features of the results, but the full results are available on request.

(a) *Trade-related experiments*

Table 4 summarizes the results of the four trade-related experiments using the central specification of the model.

(*T1*) *Rise in the world price of food imports*. Reform of agricultural policies in OECD countries is likely to lead to less dumping on world markets and a rise in the world price of food, which will adversely affect food-importing countries such as Bangladesh—although in our SAM, only 4% of domestic use of agricultural products is supplied by imports. The effects will not be gender-neutral, because in most developing countries agriculture, and particularly production of food, uses a lot of female labor—in our Bangladesh SAM, agriculture is the most female-intensive of the three market sectors.

Experiment *T*1 thus increases (by an arbitrary 50%) the world price of agricultural imports in the model. This halves the volume of agricultural imports, as consumers switch to domestic sources of supply, which are now

Table 4. *Results of trade-related experiments (absolute and percentage changes from base case levels)*

	Base case	(*T*1) Rise in world price of food imports		(*T*2) Rise in foreign capital inflow		(*T*3) Export incentives in manufacturing		(*T*4) Female-intensive manufactured exports	
		Absolute	%	Absolute	%	Absolute	%	Absolute	%
Female time-use (million hours)									
Leisure	13808	−247	−1.8	274	2.0	−613	−4.4	−885	−6.4
Reproduction	103556	−706	−0.7	591	0.6	−663	−0.6	−3722	−3.6
Market, of which	51777	953	1.8	−866	−1.7	1276	2.5	4606	8.9
Agriculture	43147	1152	2.7	−764	−1.8	−113	−0.3	−1943	−4.5
Manufacturing	1726	−95	−5.5	−185	−10.7	1381	80.0	6722	389.3
Services	6903	−104	−1.5	83	1.2	9	0.1	−172	−2.5
Male time-use (million hours)									
Leisure	53655	−906	−1.7	1130	2.1	−2941	−5.5	−2458	−4.6
Reproduction	21462	−124	−0.6	148	0.7	−369	−1.7	−368	−1.7
Market, of which	100156	1030	1.0	−1278	−1.3	3310	3.3	2826	2.8
Agriculture	62597	1804	2.9	−964	−1.5	−1515	−2.4	−464	−0.7
Manufacturing	7154	−379	−5.3	−752	−10.5	5444	76.1	2882	40.3
Services	30405	−395	−1.3	438	1.4	−619	−2.0	409	1.3
Wages (constant 1985 cents per hour)									
Female	2.7	0.0	0.2	0.0	0.9	−0.2	−6.7	0.1	3.0
Male	6.8	0.0	−0.5	0.0	0.6	−0.2	−2.3	6.5	−4.6
Female cash wage bill (\$ *million*)	320	−6	−1.8	1	0.3	15	4.7	197	61.6

relatively cheaper, and hence raises agricultural output (by about 2%). It also makes agricultural products in general more expensive (by about 1%), causing consumers to switch expenditure toward other goods and services. The increased demand for manufactures and services is met by a rise in imports and a fall in exports in these two sectors, whose output falls. The flow of labor into agricultural production also reduces the output of both reproduction services (by about 1%) and leisure (by about 2%).

The sectoral pattern of employment changes, shown in Table 4, resembles that of the changes in output, and is similar for females and males, with a rise of about 3% in agriculture and offsetting falls in other market and nonmarket sectors. The largest drop in absolute terms for women is in reproduction and for men is in leisure, so that for both women and men, there is a shift of labor into market activities. But the rise in market employment is proportionally larger for women (2%) than for men (1%), because agriculture is the most female-intensive market sector, and for the same reason the economy-wide wage rate of women rises (by about 1%) relative to that of men (which falls absolutely). In other words, the increase in the price of imported food boosts the relative demand for female labor by stimulating import-substituting production in a sector which employs a lot of women. The cash income of women declines, however, because of the drop in their employment in manufacturing and services, as does their leisure time, so that the net effect on their well-being is ambiguous.

(*T2*) *Rise in foreign capital inflow*. More outward-oriented policies often encourage larger inflows of foreign investment. This experiment simulates a rise in capital inflows, equal to about 50% of total exports in the base case (or about 3% of GDP). The associated rise in the trade deficit requires a drop in exports and/or an increase in imports, which is achieved in all three market sectors by appreciation of the exchange rate. These changes in exports and imports cause output to fall by 5% in manufacturing, the most open sector, and by 1% in agriculture. In services (the least open market sector), the rise in domestic demand caused by the higher capital inflow outweighs the rise in the sectoral trade deficit, so that output increases slightly, as it does also in the two entirely nontraded sectors—reproduction (by about 1%) and leisure (by about 2%).

Employment in manufacturing declines by about 11% for both women and men, and there are also absolutely large (though proportionally small) declines in employment in agriculture—for women, four times as large as the decline in manufacturing. As a result, labor shifts from market activities into reproduction and leisure, with the increase in each nonmarket activity being proportionally similar for women and men, but with the absolute increases being largest for women in reproduction and for men in leisure. Wage rates rise slightly for both women and men (because there is less demand for capital, which is used only in market sectors), but more for women than for men (because the contracting market sectors are on average more male-intensive than the expanding nonmarket sectors). The cash income of women increases slightly, because the drop in employment in manufacturing is partly offset by a rise in employment in services. The effect on the well-being of women is unambiguously positive, though small, since both their wages and their leisure time increase. [20]

(*T3*) *Export incentives in manufacturing*. Between 1985—the year to which our SAM refers—and 1998, Bangladesh's exports quadrupled in dollar terms, with manufactured exports accounting for most of the increase (ILO, 1999). This surge was triggered by entrepreneurs from East Asia taking advantage of the initial absence in Bangladesh of Multi-Fibre Arrangement quotas on exports of clothing, having hit the quota ceilings in their home countries (Page, 1994, pp. 259–268). To simulate the increased export-orientation of Bangladesh's manufacturing sector in a simple way, we introduce a 100% manufactured export subsidy, which causes the volume of manufactured exports to triple and the total volume of exports to double. [21] Because the trade deficit is held constant, there is a similar-sized rise in the volume of imports, which increase in all three market sectors as a result of an appreciation of the exchange rate (which also reduces exports in agriculture and services). Output rises by 26% in manufacturing, and falls in all other sectors—by about 1% in agriculture, services and reproduction, and by about 5% in leisure.

As can be seen in Table 4, employment in manufacturing increases by about 80% for both women and men, but the absolute increase is four times larger for men than for women, reflecting their much larger initial share of

manufacturing employment. The wage rates of both women and men fall (because expansion of manufacturing raises the demand for capital), but the fall is greater for women, whose relative wage drops by 4%, because the male-intensity of manufacturing means that expansion of this sector reduces the economy-wide relative demand for female labor. This change in relative wages raises the relative cost and hence the relative price of leisure (an even more male-intensive sector), which is why output and employment fall more in leisure than in the other three sectors.

(*T4*) *Female-intensive manufactured exports.* The previous experiment is unrealistic in one key respect, namely that in Bangladesh, as in other developing countries (e.g., Joekes & Weston, 1994; Wood, 1991), greater export-orientation of manufacturing involved changes in output mix which made the sector less male-intensive. Specifically, the expansion of exports was concentrated on clothing, a manufacturing subsector whose labor force is predominantly female. To simulate this, we extend the previous experiment by modifying the labor aggregation function in manufacturing in such a way as to make the sector more female-intensive, aiming at a female employment share of 40–50%, as in other Asian export-oriented countries (Wood, 1991, Table 1). [22]

In this modified experiment, the impact of increased export-orientation on trade flows is much the same as in the previous experiment, and so too are the effects on sectoral output—a large rise in manufacturing and small drops in all the other sectors (except services, whose output rises slightly). But the impact on the labor market—particularly its gender bias—is very different, as can be seen in Table 4. Employment in manufacturing increases for both women and men, but the increase is much larger for women, in both proportional and absolute terms. The corresponding falls in employment for women are largest, absolutely, in reproduction (which offsets more than half of the rise in manufacturing employment) and in agriculture (over a quarter), although the biggest proportional drop—about 6%—is in women's leisure time. There is thus a substantial (9%) rise in women's participation in market activities. Most of the increase in male manufacturing employment is offset by a reduction in leisure, and so men's participation in market activities also rises, though only by 3%.

The increase in the female-intensity of manufacturing clearly raises the economy-wide demand for female labor, which increases the wage rate of women both absolutely and relative to that of men (by about 8%). This change in the relative wage facilitates the movement of women into the market, by raising the opportunity cost of their time and thus increasing the relative price of reproduction, shifting demand toward other goods and services. A further result of the rise in the relative wage of females is that all sectors other than manufacturing become more male-intensive—especially the two other market sectors (where the elasticities of substitution between male and female labor are assumed to be higher than in reproduction and leisure), which explains why in the service sector employment rises for men but falls for women.

The combined effect of the small rise in the female wage and the large rise in female employment in manufacturing is a big (62%) increase in women's cash income. The downside of this change for women, though, is the 6% reduction in their leisure time, meaning that their well-being is not necessarily improved by the expansion of female-intensive manufactured exports. The number of hours devoted to reproduction by women and men combined also falls, albeit by only 3%, which could adversely affect children and other dependents.

(b) *Alternative gender-related elasticities*

There is uncertainty and disagreement about the responsiveness of gendered aspects of the division of labor to changes in economic incentives—for example, how much the amount of time women spend on household activities would fall as a result of a given improvement in their market wage or employment opportunities, or how much the mixture of female and male labor in market sectors might be altered by changes in the relative wages of men and women. In our central model specification, as explained in Section 4, we chose intermediate values for the relevant elasticities—lower than is normal in CGE models, but high enough to permit some responsiveness to price changes. In this section, we test the sensitivity of our results to alternative assumptions about gender-related elasticities. Each test involves re-calibrating the model with different elasticity values, and then re-running the fourth of the trade-related experiments discussed in the previous section (female-intensive manufactured

exports). The results are set out in Table 5, which also reproduces for comparison the results using our central specification.

(*E1*) *Lower price elasticity of demand for reproduction*. How much households adjust the amount of time spent on reproduction activities in response to changes in external economic circumstances depends on the price elasticity of demand for reproduction, which in our central specification we set at −0.4, a fairly low value (equal to that for food). In experiment *E*1, we reduce this elasticity to virtually zero—thus assuming almost no responsiveness of the consumption or output of reproduction services to changes in their relative price (or opportunity cost). [23]

As can be seen by comparing the *T*4 and *E*1 columns in Table 5, the effect of lowering this elasticity is to reduce greatly the outflow of labor from reproduction to meet the increased demand for labor in manufacturing, and indeed to make male labor flow into reproduction (as a result of the reduction in its female-intensity induced by the rise in the relative wage of women). This reduces somewhat the expansion of manufacturing employment, but most of the shortfall due to smaller outflows from reproduction has to be met by larger outflows from other sectors. The biggest difference for women is in agriculture—the absolute drop in employment is nearly twice as large in *E*1 as in *T*4—and for men is in leisure time.

This constriction of the supply of—mainly female—labor from reproduction means that the increase in demand in manufacturing generates a much larger rise in the wage of women, absolutely and relative to men (a rise of 15% in *E*1, as compared with 8% in *T*4). The rise in women's cash income, however, is only slightly larger—though still large—because their employment rises less in manufacturing and falls more in services. There is also a larger decline in women's leisure time (9%, rather than 6%), so that the net effect on women's well-being becomes somewhat more ambiguous.

(*E2*) *E1 plus lower female/male substitution elasticities*. In the central specification of the model, we assume that changes in relative wages would cause substitution between male and female workers in each sector, though less so in reproduction and leisure (with elasticities of −0.25) than in market sectors (with elastic-

Table 5. *Results of experiment T4 (female-intensive manufactured exports) with different elasticity values (absolute and percentage changes from base case levels)*

	Base case	(*T*4) Central model specification		(*E*1) Lower price elasticity of demand for reproduction		(*E*2) E1 plus lower female/male substitution elasticities		(*E*3) Higher demand and substitution elasticities	
		Absolute	%	Absolute	%	Absolute	%	Absolute	%
Female time-use (*million hours*)									
Leisure	13808	−885	−6.4	−1251	−9.1	−1225	−8.9	−604	−4.4
Reproduction	103556	−3722	−3.6	−1263	−1.2	−1125	−1.1	−4558	−4.4
Market, of which	51777	4606	8.9	2513	4.9	2350	4.5	5161	10.0
Agriculture	43147	−1943	−4.5	−3415	−7.9	−3577	−8.3	−1266	−2.9
Manufacturing	1726	6722	389.3	6372	369.1	6305	365.2	6458	374.1
Services	6903	−172	−2.5	−444	−6.4	−378	−5.5	−31	−0.5
Male time-use (*million hours*)									
Leisure	53655	−2458	−4.6	−3026	−5.6	−3081	−5.7	−1792	−3.3
Reproduction	21462	−368	−1.7	535	2.5	495	2.3	−723	−3.4
Market, of which	100156	2826	2.8	2491	2.5	2586	2.6	2515	2.5
Agriculture	62597	−464	−0.7	−540	−0.9	−489	−0.8	−1181	−1.9
Manufacturing	7154	2882	40.3	2810	39.3	2387	33.4	3508	49.0
Services	30405	409	1.3	221	0.7	688	2.3	188	0.6
Wages (*constant 1985 cents per hour*)									
Female	2.7	0.1	3.0	0.2	8.9	0.4	15.8	−0.1	−2.6
Male	6.8	6.9	−4.6	−0.4	−6.0	−0.5	−7.4	−0.2	−3.6
Female cash wage bill (*$ million*)									
	320	197	61.6	205	63.9	238	74.5	167	52.2

ities of −0.5), and with substitutability even in market sectors being less than is usually assumed in CGE models (which typically set elasticities at about unity). In this experiment, we reduce these elasticities further to −0.35 in the market sectors and −0.15 in reproduction and leisure. [24] We also maintain experiment *E*1's assumption of a near-zero price elasticity of demand for reproduction, bringing the model closer to a vision of the world in which the gender division of labor is completely rigid.

The main effect of lower substitution elasticities—comparing columns *E*1 and *E*2 in Table 5—is a larger rise in the relative wage rate of women (up by 23%, compared with 15% in *E*1 and 8% in *T*4). This is because part of the increased demand for female workers in manufacturing still needs to be met by substituting male for female labor in other sectors, but, with the lower elasticities, a larger rise in the relative wage of women is needed to induce this substitution. The larger rise in the female wage rate, with nearly as big a rise in the employment of women in manufacturing (and a smaller fall in their employment in services), makes the increase in women's cash income bigger (75% in *E*2, compared with 64% in *E*1). The drop in women's leisure time is slightly less than in *E*1. Somewhat paradoxically, therefore, the greater rigidity of gender roles implied by lower substitution elasticities causes women to benefit more from expansion of manufactured exports.

(*E3*) *Higher demand and substitution elasticities*. In this experiment, we change the elasticities in the opposite direction from the two previous experiments, moving toward a more flexible vision of the world than in the central specification of our model. Specifically, we set the values of all demand and substitution elasticities at (minus) unity. [25] This means more responsiveness of demand to price changes both in reproduction and in agriculture (where price elasticities were −0.4 in the central specification). It also means more substitutability between female and male labor in response to relative wage changes, particularly in reproduction and leisure (from −0.25 to −1.0), but also in the market sectors (from −0.5 to −1.0).

The clearest result of these higher elasticities—the most obvious difference between columns *T*4 and *E*3 in Table 5—is that the wage rate of women, relative to men, rises by much less (1%, rather than 8%). The basic reason for this is greater flexibility in the supply of female labor to meet the increased demand in manufacturing caused by the expansion of exports. The higher elasticity of demand permits a larger outflow of female labor from reproduction (which allows the outflows from leisure, agriculture and services to be smaller). In addition, the supply of female labor to manufacturing is enhanced by easier substitution of men for women in other sectors. Moreover, in manufacturing itself, substitution of men for women lowers the rise in female employment and increases the rise in male employment.

Mainly because the female wage rate rises less (in fact, it falls absolutely), but also because female employment in manufacturing rises less, there is a smaller increase—but still a large increase—in women's cash income (52% in *E*3, compared with 62% in *T*4). The decline in women's leisure time is also smaller. Thus in a more flexible world, women gain less in some respects from expansion of manufactured exports but more in other respects. The smaller decline in their leisure time is achieved mainly by a larger decline in the time they devote to reproduction, which might make children and other dependents worse off.

(c) *Alternative coverage of leisure and reproduction*

The principal innovation of our gendered CGE model is to include reproduction and leisure as sectors, and thus to integrate the analysis of women's time in the household with their work in (and all other aspects of) the market economy. In this section, we investigate how much difference this innovation makes to the results, by re-running experiment *T*4 with three alternative versions of the model, one defining leisure more broadly, a second excluding leisure altogether, and a third excluding both leisure and reproduction (leaving only the market sectors, as in a standard CGE model). Clearly, excluding these sectors in itself omits important information about women's activities and well-being, but the experiments reveal, in addition, how this affects the standard market variables which remain in the model. The results are set out in Table 6, which again reproduces for comparison the results using our central model specification.

(*S1*) *Extension of leisure to include personal care*. In constructing our SAM, as explained in Section 3, we assigned 10 hours per day for men and women to minimal personal care (most obviously, sleep), and defined leisure narrowly as the difference between the remaining 14 hours of each day and time spent on repro-

duction and market work. Since leisure so defined is not a basic necessity, we also made its price elasticity of demand fairly large (−1.0). The alternative approach in this experiment is to extend the definition of leisure to include minimal personal care (thus accounting in the model for all 24 hours of the day), but to recognize that much of this broader definition of leisure is a necessity by lowering the demand elasticity. More specifically, we set the minimum consumption of leisure at 10 hours per day per person (making the elasticity −0.4). Unlike our central specification, the 10-hours minimum is not fixed separately for women and men, but aggregated, so that male and female personal care become substitutable. The more broadly defined leisure sector is also much less male-intensive.

As can be seen by comparing columns *T*4 and *S*1 in Table 6, these two approaches to modeling leisure yield broadly similar results—the changes caused by expansion of female-intensive manufactured exports are of the same sign in all rows and are mainly of about the same size. A notable difference, however, is that the alternative approach causes the drop in women's leisure time to be three times greater in absolute terms than with the central specification. [26] As a consequence, the outflows of female labor from all the other nonmanufacturing sectors, including reproduction, are smaller, and the increase in female employment in manufacturing is larger. The greater flexibility of the female labor supply reduces the rise in the wage rate of women relative to men (from 8% in *T*4 to 4% in *S*1), but the rise in women's cash income is almost the same as with the central model specification, because their employment in manufacturing and services rises more.

(*S2*) *Exclusion of the leisure sector*. An entirely different approach would be to omit the leisure sector altogether from the model. Comparison of columns *T*4 and *S*2 in Table 6 shows how this would affect the outcome in other respects. Again, the difference is not radical, especially as regards the allocation of women's labor among the other sectors—since their leisure time is small even in the central specification. The change has more impact on

Table 6. *Results of experiment T4 (female-intensive manufactured exports) with different sectoral coverage (absolute and percentage changes from base case levels)*

	Base case	(*T*4) Central model specification		(*S*1) Extension of leisure to include personal care		(*S*2) Exclusion of leisure sector		(*S*3) Exclusion of leisure and reproduction	
		Absolute	%	Absolute	%	Absolute	%	Absolute	%
Female time-use (*million hours*)									
Leisure	13808	−885	−6.4	−2625[a]	−1.9	–	–	–	–
Reproduction	103556	−3722	−3.6	−2802	−2.7	−4144	−4.0	–	–
Market, of which	51777	4606	8.9	5427	10.5	4144	8.0	0	0.0
Agriculture	43147	−1943	−4.5	−1307	−3.0	−2129	−4.9	−4997	−11.6
Manufacturing	1726	6722	389.3	6818	395.0	6573	380.7	5850	338.8
Services	6903	−172	−2.5	−85	−1.2	−300	−4.4	−853	−12.3
Male time-use (*million hours*)									
Leisure	53655	−2458	−4.6	−1847[a]	−1.0	–	–	–	–
Reproduction	21462	−368	−1.7	−385	−1.8	−581	−2.7	–	–
Market, of which	100156	2826	2.8	2233	2.2	581	0.6	0	0.0
Agriculture	62597	−464	−0.7	−754	−1.2	−1474	−2.4	−1450	−2.3
Manufacturing	7154	2882	40.3	2796	39.1	2588	36.2	2412	33.7
Services	30405	409	1.3	192	0.6	−534	−1.8	−962	−3.2
Wages (*constant 1985 cents per hour*)									
Female	2.7	0.1	3.0	0.0	0.9	0.0	1.5	0.4	15.9
Male	6.8	6.7	−4.6	−0.2	−2.8	−0.3	−3.8	−0.4	−5.6
Female cash wage bill (*$ million*)									
	320	197	61.6	193	60.3	180	56.3	200	62.6

[a] These changes are from much higher base case levels of leisure (134,623 million hours per year for women and 178,850 million hours per year for men).

men because, without the possibility of reducing their leisure time to meet the increased demand for their labor in manufacturing, there has to be more of an outflow from other sectors, especially agriculture and services. This reduced flexibility of the male labor supply also causes the wage rate of women to rise less, relative to that of men (by 5% in *S*2, as compared with 8% in *T*4), and hence their cash income to rise less. [27]

(*S3*) *Exclusion of leisure and reproduction*. The most drastic change in model specification would be to omit both the leisure and the reproduction sectors, and to assume that the supplies of male and female labor to the market economy are exogenous—fixed at the initial levels of employment (as in this experiment) or changing over time in some given way. [28] The main drawback of this, the standard, approach is losing sight of much of women's work and thus getting a seriously incomplete picture of the impact of changes in policies and economic circumstances on the well-being of women and dependents, particularly children. But, exclusion of the leisure and reproduction sectors from the model can also yield wrong results about the impact of such changes on the market economy, particularly in terms of the magnitudes involved.

This can be seen by comparison of columns *T*4 and *S*3 in Table 6. Without the leisure and reproduction sectors, the supply of labor to the market economy is less flexible. This is especially so for female labor, because the excluded sectors contain far more women than men. As a result, increased export-orientation of manufacturing causes less of a rise in manufacturing employment (and in manufactured exports and output), while employment and output in other market sectors fall more. This restriction of the supply particularly of female labor also causes the wage rate of women, relative to that of men, to rise much more (by 22% in *S*3, compared with 8% in *T*4), although it hardly alters the increase in women's cash income, because their employment in manufacturing and services rises less.

6. CONCLUSIONS

The object of this paper was to see what could be learned about the effects of trade on women in developing countries by extending the accounting framework of an otherwise standard CGE model to distinguish female from male labor and to treat social reproduction (or household work) and leisure as sectors. These two extra sectors are assumed to behave qualitatively like market sectors—with inputs and outputs responding to demand and supply—but to differ quantitatively from market sectors, in particular with reproduction employing mainly women and being less responsive to price changes. We fitted the model to simplified data from Bangladesh, and simulated the effects of changes in trade policies and foreign capital flows. We also tested the sensitivity of the results to alterations in the specification of the model.

Opinions of the merit of modeling exercises tend to vary widely, depending on the point of view of the reader, but we believe that our gendered CGE model is illuminating in itself and deserves further development—including application to issues other than trade. Our changes have added little to the complexity of the standard model (although some people may think that such models are already too complex), and our experiments have provided insights into gendered economic outcomes which could not have emerged in a partial equilibrium framework. In particular, the experiments make clear that, to understand or predict the effects of changes in policies or other economic circumstances on women, it is important to take into account the interactions both among different sectors of the market economy and between the market economy and the nonmarket sphere (both reproduction and leisure).

With the wisdom of hindsight, the results of all the experiments seem logical, but some of them differ from what we had expected—which adds to their usefulness. Thus, for instance, a rise in the world price of food raises the relative wage of women, but reduces their cash income and their leisure time; while a larger foreign capital inflow gives women a higher wage, more cash and more leisure; and expansion of manufactured exports raises both their wage and their cash income, but reduces their leisure. Moreover, even where the direction of the effects could have been predicted from theoretical principles, it would have been impossible to predict their magnitude without a model. Our experiments with alternative specifications show that these magnitudes vary, depending on the assumptions made about the values of key parameters, but not so widely as to make the analysis uninformative.

The results of our experiments are, of course, not "the truth," but the outcome of complicated

calculations based on a particular set of data and on many assumptions, about both behavior and parameter values. There is thus room for disagreement about their accuracy, and also for improvement of the work described in this paper. In particular, we plan (a) to elaborate the SAM to provide a more detailed description of reality; and (b) to elaborate the specification of the model to make its behavior better capture gendered features of the economy.

The Bangladesh SAM used in this paper was deliberately simplified, to focus attention on the principles of the model. To develop further the analysis of Bangladesh we need to subdivide female and male labor, and households, by level of education. Each household type would be a separate reproduction sector, so that the division of time between household and market could vary as between more and less educated women. We could also distinguish among households according to demographic composition (with and without children, for instance) and rural or urban location. We intend to increase the number of market sectors—most CGE models have between 10 and 20, as compared with the three in the current model—and to introduce land, which will require ownership rights to be assigned to men and women. In addition to a more detailed model of Bangladesh, we will construct a similarly detailed model of a country in sub-Saharan Africa. South Asia and Africa are both under-educated regions, but with very different land/labor ratios (and hence different comparative advantage), so that the effects of trade on women may well differ substantially between the two regions.

There are many ways in which the specification of the model might be elaborated to provide a fuller description of gendered behavior. Our approach will be to make the values of some of its now-exogenous parameters into endogenous outcomes of the forces on which bargaining models of the household concentrate—differences between women and men in preferences, resources, and power. The parameters we intend to treat in this way are those which govern (i) the allocation of consumption between market goods, reproduction and leisure, and among different market goods, and (ii) the gender division of labor, both in reproduction and leisure and in market sectors. To endogenize them, we will make the bargaining power of women depend on other variables in the model, especially income and job opportunities. This deeper treatment of gendered behavior may not greatly alter the size of the effects of changes in policies and circumstances, but it could permit a better evaluation of their impact on women's well-being—whether women are better off with more cash income and less leisure, for instance, depends on whether they have chosen this outcome or been forced into it.

NOTES

1. The only exceptions we have found are the model of Evans (1972), which distinguishes between male and female labor in all sectors in Australia, and the Mozambique model in this issue of *World Development*, which distinguishes between male and female labor in agriculture (Arndt & Tarp, 2000).

2. The idea of treating the household as a production sector in a "broader" model of the economy was inspired by Darity (1995), although our particular way of doing this differs in several respects from his.

3. Other SAMs have included similar features (e.g., Kazemier, Keuning & van de Ven, 1998, distinguish people by gender and cover all 24 hours of the day), but models have not been based on them.

4. In compiling our SAM, we also included water and fuel collection in the reproduction sector, although in the SNA it is classified as a productive activity. This is because in practice it is probably not recorded in the national accounts, and because it occupies a lot of women's time. The work of paid domestic servants is not in the reproduction sector, but in the market services sector.

5. If sufficient data were available, this problem could be solved by creating a special sector of the "productive" economy which contained all material goods produced within households—for example, splitting agriculture between subsistence and marketed production (as in Arndt & Tarp, 2000). Such a sector could be treated for some purposes as part of the household economy and for other purposes as part of the market economy.

6. Basic national accounts and government budget data for Bangladesh are from World Bank (1995). The input–output coefficients and wage and profit shares in each sector were taken for simplicity from the data on

Turkey in Dervis, de Melo and Robinson (1982, Table 2.1). More details on the assembly of these data are available on request.

7. The labor force data are from Bangladesh Bureau of Statistics (1989): they appear to underestimate female participation in agriculture—colleagues tell us that women are heavily involved in some aspects of production—for which we attempted to correct. The time-use data are from UNDP (1995, Table 4). The 10-hour figure relates to minimum requirements, not to actual use of time, and is simply an assumption.

8. This was calculated from the total wage bills and our estimates of female and male employment in each sector, together with information that female wages are 48% of male wages in agriculture and 39% in the other market sectors (World Bank, 1990).

9. The estimated outputs of reproduction and leisure appear in the SAM both in the production accounts and in final demand (as part of household consumption).

10. The software we use is GAMS (general algebraic modeling system). It is technically feasible in a CGE model to fix some prices (including factor prices), so that the markets concerned do not clear, but in our model only intersectoral relative wages are fixed.

11. The main difference is that we replace the Cobb–Douglas production and consumption technology of the Cameroon model with two-level CES production functions and an LES consumption function. Our equations are also similar in most respects to those of the Mozambique CGE model in this issue of *World Development* (Arndt & Tarp, 2000). A good introduction to this family of models is Dervis, de Melo & Robinson (1982, Sections 5.3–5.5 and Chapter 7). The equations in the appendix to Chapter 7 are similar to those of our model, except that we (a) include export supply functions (pp. 228–230), (b) use a linear expenditure system (pp. 482–485); and (c) make savings adjust to equal a given level of investment (pp. 165–166).

12. This is not simple addition: the two categories of labor are weighted by their relative marginal products, as reflected in their wage rates. The lower wage of women than men is thus implicitly assumed, in calibrating the model, to be the result of women being less productive than men, which causes the economy-wide demand for their labor to be lower than for that of men.

13. It is technically possible in a CGE model, but less common, to allow capital also to be mobile across sectors. Although labor is mobile, wage rates are not equalized across sectors. Relative sectoral wage rates are fixed in the pattern observed in the SAM, which is assumed to reflect variation in the skill composition of the labor force or in working conditions.

14. The income of households includes the notional wages earned in reproduction and leisure, in much the same way as it includes the value of nonmarketed agricultural output. This "income" from reproduction and leisure activities must evidently be "spent" entirely on these activities, and cannot be taxed, saved or spent on other goods, but in the present model, with only one type of household, it is simplest and reasonably accurate to combine it with all other income. The saving rate of households is endogenous: it adjusts to make total savings equal to the exogenously given level of investment. We chose this closure to prevent, in our trade experiments, changes in government revenue from tariffs and export subsidies (which alter government savings) from altering aggregate investment.

15. The consumption function is a linear expenditure system (LES), in which the demand for each good consists of a subsistence minimum (which may be zero) plus a fixed share of the residual income after meeting all the minima. The larger the minimum for any good, the lower its price elasticity of demand: we chose the minimum for agriculture to make its price elasticity -0.4 (Lluch, Powell & Williams, 1977, Tables 2.2 and 3.13), and similarly for reproduction.

16. Government consumption in each sector is fixed in real terms, as is the demand for investment goods (since total investment is exogenous). Demand for intermediate use depends on the levels of output in all sectors and fixed input–output coefficients.

17. These import (Armington) functions and export (CET) functions partially insulate domestic prices from world prices, unlike more standard trade models in which the domestic prices of traded goods are strictly determined by world prices. In our model, the elasticity of substitution in both these functions is set at -2 in all sectors. In world export markets the country is assumed to face downward-sloping demand curves, but in our model their elasticities are set very high, except in agriculture (-4).

18. Like other CGE models, ours determines prices only relative to one another, with the general price level (the GDP deflator) as numeraire. The wage units are cents per year, because the SAM is denominated in US dollars, and more specifically are "base-year" 1985 cents (since the exchange rate alters in most experiments).

19. Income from agriculture is not included as it is often not in cash and rarely under women's control.

20. In all the experiments, including this one, aggregate investment is held constant, as explained in note 14. Thus in this experiment, the increased inflow of foreign capital raises consumption rather than investment. If it were assumed to raise investment (with a fixed household saving propensity), the outcome would be rather different. The rise in demand for investment goods would lessen the fall in manufacturing output and amplify the rise in services output (construction being in the services sector). As a result, since both manufacturing and services are male-intensive sectors, the wage rate of women would fall (by 0.1%, and by 0.6% relative to that of males), rather than rising, as in Table 4. The cash income of females would increase more, because their employment in manufacturing and services would rise rather than fall, but the rise in female leisure time would be correspondingly smaller.

21. A more realistic (but almost equivalent) way of simulating the cause of the export expansion, which involved a change more of behavior than of incentives, would have been to alter the share parameter of the (CET) function which allocates manufacturing output between exports and the domestic market. The rise in export volume in the model is smaller than that which actually occurred in Bangladesh, but the difference probably arises from increased use of imported intermediate inputs in export production, which caused the gross value of exports to rise faster than value added in exporting, and which we cannot simulate satisfactorily (because our model has only a single manufacturing sector).

22. Specifically, we increase the female share parameter in the labor aggregation function from 0.02 to 0.23, and correspondingly reduce the male share parameter. We also adjust (upward) the efficiency parameter of the labor aggregation function by an amount such that the base-case inputs of male and female labor at base-case wage rates would still produce the base-case quantity of aggregate labor.

23. Specifically, we set the minimum consumption of reproduction in our LES demand system equal to actual consumption in the base year data.

24. Even these reduced elasticities are higher than some people may regard as realistic, but reducing them further makes the model difficult to solve for technical reasons.

25. In other words, a "Cobb–Douglas" world. Because CES production technology breaks down with an elasticity of substitution of -1.0, we use a value of -0.95 in the labor aggregation and production functions.

26. The fall appears proportionally smaller in $S1$ than in $T4$ because the base-case level of leisure is higher as a result of broadening its definition to include minimal personal care. But the proportionate drop in women's *above-minimum* leisure, like the absolute fall, is three times greater in $S1$ than in $T4$. This happens because, as a result of the much-increased ratio of females to males in the more broadly-defined leisure sector: (a) the relative price of leisure is not reduced so much by the rise in the relative wage rate of women, and thus the demand for it is lower, so that the total outflow of labor (male plus female) from the sector is larger; and (b) the outflow is less concentrated on males—indeed more females than males flow out because the change in the relative wage causes men to be substituted for women.

27. Both broadening the leisure sector (as in $S1$) and excluding it (as in $S2$) reduce the rise in the relative wage rate of women, because both changes in sectoral coverage increase the ratio of women to men in nonmarket sectors (and in all nonmanufacturing sectors taken together) and hence increase the flexibility of the supply of female labor relative to male labor.

28. An intermediate approach would be to introduce wage-responsive labor supply functions, without explicitly modeling nonmarket activities.

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