Gender in a Macroeconomic Framework: A CGE Model Analysis

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Introduction

The importance of gender aware macro-economic analysis has increased with many developing countries, including India, embarking upon Structural Adjustment Programmes (SAPs), since women and men are differentially affected by such programmes. One reason for this is the nature of participation in work. Greater competition and a need to reduce production costs generally lead to informalization (Portes et al., 1989). A number of studies have revealed that the informal sector has continued to grow at a faster rate than the formal economy in many developing countries during periods of economic reform (see Meagher and Yunusa, 1996). Further, it is observed that most of the female workforce is involved in informal activities, and there are indications of an increase in the labour force participation of women in the informal sector (Cagatay, Elson and Grown, 1995). In India around 90 per cent

1This report forms part of the ISST-NCAER project titled, “Macroeconomic Analysis of Gender: An Attempt at CGE Modelling” funded by IDRC, Canada. We thankfully acknowledge Christopher Adam for his valuable contribution in developing the CGE model. We would also like to thank K.A. Siddiqui, Diane Elson, Swapna Mukhopadhyay, Renana Jhabvala, Faye Duchin and Ratna Sudarshan for their contribution. We are grateful to Randy Spence, Luc Savard, John Cockburn, Bernard Decaluwe, Veronique Robichand, M.M.Khan and Praveen Sachdeva for their support in this work. Finally we would like to thank Rakesh Mohan for his encouragement in undertaking this research. Of the female labour force, including helpers or unpaid workers, is involved in informal activities (Sinha, Sangeeta and Siddiqui, 2000). It is important to explore the different types of work carried out by women in the informal economy and the corresponding remuneration they earn. Distinguishing the database by gender would enable an assessment of the impact of alternative development strategies on both men and women and an evaluation of policies that might improve the economic situation of women in particular (Duchin and Sinha, 1998). Major macroeconomic changes also impact upon income distribution and the social sector (Stewart, 1995). The implications of SAP for poverty are also linked to work because much of the informal sector consists of work that is too poorly paid to meet basic human needs or remains excluded from the welfare or solidarity network (Hugon, 1990).

Incorporating gender in a macro framework will allow us to understand the impact of policy changes on women. With many developing countries adopting SAPs during the 1990s, there has been greater emphasis on the integration of gender as a category of analysis in economics. Gender issues have been considered not only at a micro, intra household level, but have also been integrated into macro analysis (Beneria, 1995; Bakker, 1994). Progress in methodology has been on two fronts. The first important area is the availability of statistical data to capture women’s labour force participation with greater accuracy than in the past. Another important area is
methods of imputation of the worth of household work to estimate its value in national accounts (Beneria, 1995). It has been recognized that more accurate and conceptually sophisticated gender-sensitive statistics are useful to generate a quantitative measurement of women’s work, and allow better analysis of social and economic conditions as well, more specifically in countries undergoing structural adjustment.

As in other developing countries, the Government of India also initiated a range of policy reforms designed to usher in a regime of greater competition with a more open and market-oriented economic structure in the early nineties. There have been major changes in industrial policies leading to a reduction in the scope of industrial licensing. The procedural rules have been simplified. Entry and investment has been allowed in areas that were reserved for the public sector. The major thrust of the liberalization process has been wide-ranging trade reforms, bringing about restructuring and a reduction in custom duties together with a gradual elimination of quantitative restrictions on trade. In the pre-reform regime India nurtured import duties that were among the highest in the world. The tariff duty rates were above 200 per cent for many items in the pre-reform period. Since 1991 these rates are being reduced and the maximum tariff rate was brought down from 65 per cent in 1994–95 to 45 per cent in 1997–98, 40 per cent in 1999–2000 and to 35 per cent in 2000–2001. At present there is a total of 4 custom duty rates, i.e. 35 per cent, 25 per cent, 15 per cent and 5 per cent. The reform measures undertaken so far have created a more open economy and, alongside liberal import policies, export promotion schemes have been given a further boost through the setting up of special export zones.

To understand the impact of major policy changes on women, it is essential to have a comprehensive macro framework. In this study we build a standard computable general equilibrium (CGE) model for a preliminary analysis of the impact of macro policy changes on women. Here, gender is analysed within the formal and informal sectors of the economy because a large section of women in India are involved in informal activities, as noted earlier. There is evidence that liberalization affected growth favourably in India during the 90s (Srinivasan, 1998). However, the impact of such policies on different socio-economic groups requires an assessment. The purpose of this exercise is relatively narrow. It is an attempt to study the impact of trade reforms on income distribution distinguished by informality and gender.

This essay is organized as follows. Section II describes the Social Accounting Matrix (SAM) database, which incorporates the flow of formal and informal labour, distinguished by gender. Section III describes the concept of households distinguished into different categories and examines the structure of these households in the light of activities differentiated by gender. In Section IV we briefly describe the model and then present the preliminary results from our simulation exercise in Section V. Section VI concludes the paper with a discussion of future directions and extensions.

**Building of the Base SAM**

The data base for a CGE model is a Social Accounting Matrix (SAM). The SAM combines information from different sources in a consistent framework to reflect the economic and social structure of an economy at a particular point in time. The SAM constructed in this work distinguishes factors of production by formal and informal
parts as well as by gender. We have mapped the flow of value added from sectors to the different types of factors of production and have also mapped the flow of factor earnings to different types of factor owners within households, thus determining the factor incomes of these households. The major steps in building the base SAM for the CGE model are explained in the following sub-sections. To complete the SAM we have used information from other sources as well, such as savings rates which are from MIMAP\textsuperscript{2} data analysed at the National Council of Applied Economic Research (NCAER).

### Sectoral classification

The 115 sectors as given in the input-output table of the Indian economy for the year 1989-90 published by the Central Statistical Organization (CSO) India, are aggregated into 7 sectors for this exercise (see Appendix I). The purpose of the aggregation is to keep the major broad sectors which are also important in terms of the share of the formal and informal value added disaggregated by gender. For example, agriculture is mainly an informal sector activity or the construction sector employs a large number of informal female workers. Gender wise percentage shares of workers by each of the 7 sectors are presented below (see Table II.1). The other concern in respect of these broad sectors is to help analyse policy changes, and at the same time project a more macro picture of the economy. This SAM assumes that each activity produces exactly one good, which is entirely supplied to its commodity market.

\textsuperscript{2}Survey of 5000 households conducted by NCAER to collect data for the research programme on Micro Impacts on Macroeconomic Adjustment Policies (MIMAP).

TABLE 1
Percentage Share of Women Workers by 7 Sectors

### Factors of production distinguished by gender

A distinction of the present exercise is to treat factors of production as separate for women and men and consequently determine factor earnings distinguished by gender. The Annual Survey of Industries (ASI) provides information on value added (both wages and returns to capital) generated by each sector at the 3-digit level of National Industrial Code (NIC) code for registered manufacturing. The National Account Statistics (NAS) provide information on value added generated from all production
sectors at the 1-digit and a few at the 2-digit NIC code for both registered and unregistered parts of these sectors. To attribute formal and informal value added distinguished by gender to formal and informal workers differentiated by gender respectively, we need to have a one to one correspondence between value added and the workers. The NAS data give us the total of workers in a sector, which needs to be broken up by different types of workers. The share of each type of labour, i.e., female and male within formal and informal types of labour, in a particular sector, is generated from the National Sample Survey Organization’s (NSSO) household survey on employment/unemployment based on certain assumptions regarding informal workers.

NIC identification of each household member is available through the NSSO survey data, and information regarding the member’s status is also recorded through this survey. Such information about the ‘working status’ of each household member above 5 years of age is taken into consideration to distinguish a worker as formal or informal. Members who have stable employment reflected through the drawing of a regular salary/wage or those who hire labour for their own household enterprises are classified as formal workers/capital owners. Members who are casual wage labourers and own account workers are informal. We make certain objective judgements to qualify these distinctions further for rural household entrepreneurs in the agricultural sector who are identified as informal even if they hire outside labour. The rest of the working class (own account workers and casual wage labourers) in agriculture are also identified as informal workers. Thus, the factors of production distinguished by gender and informal and formal categories are broken up into the following categories for each of the seven sectors (by aggregating NIC sectors) using NSSO data:

1. Female casual (informal) labour
2. Male casual (informal) labour
3. Female regular (formal) labour
4. Male regular (formal) labour
5. Own Account Workers (Informal Capital Owners)
6. Employers (Formal Capital Owners)

We assume that the value added generated in a sector gets distributed to female and male workers distinguished by informality in the proportion obtained from sample survey data according to average earning rates. Hence, though in this exercise we do not distinguish between formal and informal production sectors, the value added is distinguished by that generated by formal and informal workers differentiated by gender. The wage rates that have been used are not at the sectoral level but at the overall level. Out of the total value added the wage income is taken out to provide the total capital income. Further, capital earnings are distinguished into formal and informal earnings on the basis of information on own-account workers and employers.

In sum, the NAS provides the total number of workers in each of the three-digit NIC sectors, without any break up between labourers, employers and own account workers. There is no further information about how many of the workers belong to unregistered

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3The average earning rate is weighted by shares of different types of labour (i.e., female and male within formal and informal workers) and their wage rates so that it captures the differential earning rate of the different types of labour.

and how many to the registered parts of these sectors. We impose the formal/informal
proportions of the estimated female and male workers on the actual number of workers as given by National Accounts. This methodology allows us to break up workers by gender and informality adhering to the overall national accounting as given by NAS. We thus obtain a one to one correspondence between all types of workers and value added for each sector remaining within the overall information given by the NAS on value added and workers.

**Structure of labour and earnings by gender**

NSSO’s Employment\Unemployment Survey is used to get the information about the male-female factor ownership proportion as noted above. Moreover, factor owners distinguished by gender are distributed across the seven industry sectors using the survey data. We see that women are mostly engaged as casual labourers rather than as regular labourers and that nearly 80 per cent of the employers are male. The difference in percentage between men and women is smaller in the case of own account workers (OAW), though women still constitute less than 40 per cent of the total OAWs. Overall, on an average 78 per cent of the worker population (which includes both labour and capitalist) is male and only 22 per cent is female.

Factor owners are related to their factor earnings and since it is difficult to distinguish capital earnings by gender from the available data collected by the statistical office, we do not use the break up earnings of OAW and employers by gender. This implies that incomes originating from such activities are neutral to male/female distinction in this study.

The percentage of different types of factor owners by sector is presented in Table 2. Table 3 depicts the sectorwise distribution of factor earnings. Sectoral value added by gender is computed by using the wage rates for different types of labourers (NSSO report) differentiated by gender as noted earlier. Information on wage rates is at the overall level and is not sector specific. Casual labourers are considered to be informal workers and so casual labour earnings are the informal labour incomes. At present capital earnings are distinguished into formal and informal and by gender on the basis of information on capital ownership because of lack of data on capital earning rates.

**TABLE 2**

Percentage Distribution Factor Owners by Industry Sectors
The sectorwise distribution of the labour force shows that, as much as 12 per cent of all workers in the agricultural sector are female casual workers. However, they get only about 5 per cent (see Table II.3) of the total value added generated in the sector. Female casual labourers in agriculture contribute a substantial share in work participation, but obtain 33 per cent less earnings per unit of labour compared to their male counterparts. Of the total labour force in the construction sector, 9 per cent are female casual labourers and they retain 4.5 per cent of the value added of this sector. In manufacturing, the female casual labour force constitutes 6 per cent of the total workers in the sector and earns about 3 per cent of the sectoral value added.

**Activities of Households**

The activity of each member within a household is obtained from the NSSO’s 50th round survey (NSSO, 1993–94). We have used only labour force activities (i.e., the different factors of production such as casual female labour, casual male labour, etc.) for building the SAM as a base data set for the CGE model. However, it is important to understand the structure of a household and also the contribution household members make towards the well-being of a household through domestic and other unpaid duties. In a developing country, most households operate within an informal system and their number even increases with modernization (Duchin, 1998). The hypothesis we have is that households earning income through informal activities will have a different economic behaviour compared to households earning from formal activities.

The households are first distinguished as rural or urban. Next, they are classified as formal and informal by taking the NIC, NCO and the ‘Type’ codes of households as formal-informal. The ‘Type’ code formulated on the basis of composite household information, and the household NIC and NCO codes are provided by the NSSO. Households in the urban region are classified as formal with ‘Type’ codes as employers and regular wage earners. In rural regions, exceptions are households with NIC agriculture; even with formal ‘Type’ codes, such households are classified as...
informal. Finally, households are classified into different income levels, i.e., poor, middle and rich within each broad category (Appendix II). The households are then scrutinized to identify the different types of workers and factor owners distinguished by gender that make them up. Further, the inclusion of non-labour force activities of household members is important as much of women’s time is devoted to ‘reproductive’\(^4\) rather than market activities. However, all the information on household structure is not used in the SAM building exercise since only few among the worker types are involved in labour-force activities and we have still not incorporated other types of work in the SAM.

It has been observed that informal households consume more of agricultural products than formal ones. (see Appendix III). Informal households face uncertainties of income flow and are also outside the frame of security rights. It may be noted here that apart from categorizing households as merely formal or informal, it is meaningful to have other socio-economic characteristics to distinguish them. It is possible that at a certain high level of earnings the difference in behaviour of formal and informal households may be marginal. However, most of the households involved in informal activities are poor. It has been estimated that 86 per cent of households in India can be termed as informal and 39 per cent of the population residing in such households are below the poverty line. Furthermore, a large proportion of women are involved in the informal sector and as such belong to informal households (Sinha, Sangeeta and Siddiqui, 2000).

The above tables further show that the female work force is mostly informal and even in formal rural households females are engaged more as informal workers. Moreover, in all types of households, female workers contribute to household work much more than male workers do. In addition, the share of female unpaid workers is much higher than female paid workers in all households, whereas, the share of male paid workers is higher than the share of male unpaid workers in all household categories.

\(^4\)The term is now familiarized by feminist economists to describe the many unpaid services provided in households mainly by women for maintaining social well being and welfare of the household (see Elson, 1995 and Fontana and Wood, 2000).

**TABLE 4**
Distribution of Female Member Activity within Formal/Informal Households (per cent)
The CGE Model

We have discussed the data as a base for the modeling structure. We now characterize the economic system generating the data. One way of viewing a SAM is to consider each recorded transaction as the outcome of a (constrained) optimization problem faced by one or more agents of the economy. Thus, for example, factor income flow from firm to household reflects the firm’s labour demand given the demand for their output, the nature of technology, their capital stock and the price of labour. Similarly, a household’s consumption of items such as manufactured goods reflects the utility maximization given their income and prevailing prices.

We can think of a (general equilibrium) model as a systematic and internally consistent description of the behavioural relations, constants and market clearing conditions, which could have generated the SAM. Moreover, the specific form of the model will determine how the system reacts when perturbed. It is important to stress
that any SAM will be consistent with an infinite set of rival models. Unlike econometric analysis, the process of calibration allows all models to fit the baseline data equally well.

In this study we have developed a preliminary standard CGE model of the type discussed in Devarajan, et al. (1996), which is a widely used trade focussed models for developing countries. In this model the major contribution is to characterize the consequences of changes in trade policy for the distribution of income between the formal and informal factors (Sinha and Adam, 2000) distinguished by gender and across a variety of household types. The distribution of factor income flows, both formal and informal by gender, between household types is treated as parametric, obtained from the baseline data. In future versions of the model, we would attempt to endogenize this distribution mechanism.

This is a real economy model. Therefore, real consumer demand functions and producer supply functions are homogeneous of degree zero in the aggregate price level. Here at present we abstract from macroeconomic considerations, so that the government is not restricted to a balanced budget. Thus public sector deficits or surpluses can take place. The financing of these can be carried out through a tax or rebate on private sector saving leading to crowding-out or crowding-in of private investment through a neoclassical closure system. We have experimented with one version of the model which, in a limited sense, is recursively dynamic. The first period solution of the model defines a vector of public and private sector gross capital formation. Net capital formation is combined with exogenous depreciation evolving capital stock. This leads to capital stock build up ‘between periods’ such that the new capital stock investment is available at the beginning of the next period. We calibrate the model to a steady-state equilibrium in which net public and private investment in the baseline is zero (gross investment exactly matches depreciation) so that the capital stock is constant. This allows us to analyse the impact of trade reforms in a focused manner. Thus with no exogenous shock the model exactly replicates the baseline indefinitely. In this study we also use a static version of this preliminary CGE model, where capital stock is sector specific and is obtained from the base level data. The model is being written using the GAMS programming language.

The goods market

We adopt standard goods market specifications. Firms are assumed to be perfectly competitive and produce a homogeneous output which can either be sold in the domestic market or exported. In the current version of the model all firms are price takers for all imports. The model consists of seven productive sectors, each producing a single representative good or service as noted above.

Gross output is determined by fixed-coefficients Leontief production structure where intermediate inputs are combined with value added. Value added is determined according to Cobb-Douglas production functions for all sectors of the economy. In the present dynamic version of the model the capital stock evolves over time in order to equalize real sectoral rates of return. We assume ownership of a homogenous sector-specific capital. The distinction of the capital as formal and informal provides a link of capital income to household income. In the model capital prices are equalized but the sectoral decomposition of capital between formal and informal capital is defined
exogenously from the calibration data. The purpose of this specification is to define the flow of

capital income to households. In future versions of the model we aim to develop a structure in which there are two capital stocks, which are no longer perfect substitutes, and there exists an explicit market for the two types of capital.

The level of government capital formation also determines the level of private sector output in this model (key equations are presented in Appendix IV). We assume that the government produces two forms of capital: a ‘sector-specific’ capital good which is required only for the production of government services (such as government offices etc.) and a ‘public good’ capital (for example in infrastructure). The latter enters the production function of all private sector firms without competition, so that higher public spending raises private output in all sectors.

Labour markets

We assume that the supply of the four labour types, i.e., formal and informal labour distinguished by gender is fixed within the period. Since firms are profit maximizers and all the four types of labour, consisting of both female and male labour, are mobile, the average wages for each broad labour type are driven towards the value of their marginal product in each sector. However, the observed sectoral wage distribution is maintained and sector-specific wage rates are not equalized across sectors (for a given labour type). The sectoral wages are distributed around the mean wage for each skill type according to a fixed wage distribution matrix. The distribution matrix may be considered as wage rigidities, which might arise from variation in skill, or union power in certain sectors.

Allocation mechanism in goods market

In this system each productive sector’s goods are distinguished between tradable and a domestic variant. The economy is assumed to be a price taker for all tradable goods, under small country assumption. However, domestic goods and factor prices are fully flexible. Output can be consumed or applied to the formation of the capital stock, and is sold either to the domestic market or exported. On the production side, the model assumes that the domestic and export variant of the goods are imperfect substitutes so that the firm cannot switch their output costlessly between the domestic and foreign markets. Following the ‘1-2-3’ convention, imperfect substitutability is reflected in the following manner. Firms produce a total output which is allocated between the export and domestic markets according to a sector specific constant elasticity of transformation (CET) functions.

Consumption for each sectoral output is assumed to be regulated by the Armington assumption of imperfect substitution between domestic product and imports. The demanded composite consumption good is a constant elasticity of substitution (CES) aggregation of imports and domestically produced goods. Here consumers are assumed to have a choice for quality so that they distinguish between domestic and
imported variants of good. The composition of consumers’ demand between domestic and imported goods by household as final consumption and firms (for intermediate purchases) is therefore defined analogously to the firms’ production functions.

**Prices**

The CGE model has a number of prices that clear the different markets defined in the model. As the model is described in entirely real terms, it provides a solution for relative prices only. As it is a real model, we need to define a numeraire, which can be any of the prices. The numeraire should be chosen depending on the type of questions the model is designed to address. As we adopt small country assumption, firms and consumers are price takers in the world market. Domestic prices for tradables are linked to world prices wedged by the domestic tax system. The model is within the neoclassical framework and all endogenously determined prices clear their relevant markets. Domestic prices for imports and exports are defined by the price-taking assumptions. As stated earlier, domestic and traded goods are considered as imperfect substitutes so that consumers and producers make decisions over composite consumption and output. On the basis of the CES/CET aggregation functions the price aggregates i.e. consumption prices and the aggregate output prices are obtained. In this system the crucial domestic price is endogenously determined which is the (implicit) price of domestic output. Composite demand by households and aggregate firm-level production determine the total composite supply and domestic output. The CES/CET functions define the optimal combination of tradable and domestic goods based on embodied preferences in these functions. Under small country assumption, world prices are exogenous. Therefore, relative price changes required to clear the market for domestic goods will define the equilibrium value of the domestic price. All other prices in the model are for accounting conventions (see Appendix IV). As production involves both intermediate goods and value added it is necessary to partition the total output price into the relevant prices for the two components. Intermediate goods consist of the total composite good aggregated according to input requirement which are priced at the aggregate consumption prices. The implicit price of value added is then the difference between the net price of aggregate output and the price of intermediate inputs.

Composite commodity can be used for final or intermediate consumption as mentioned above or for capital formation. Capital formation in this system has two dimensions. The decision to invest is made on a destination basis: a firm in sector decides to increase its capital stock. The composition of capital goods in the sector will determine the price of one unit of this capital. One unit of capital stock in, say, manufacturing may require a certain amount of capital goods, a certain amount of services (for example building services) and a certain amount of consumer goods. All of these sectoral inputs at the consumption price are combined according to a capital composition matrix to determine the price of capital. Finally, we define two price indices for convenience, which are useful. These are the consumer price index, and the GDP deflator.
**Households**

In the model the households form a distinctive feature. In this exercise thirteen different household types have been identified. They are first distinguished by the regions to which they belong (rural and urban). Further, the households are identified as formal and informal. Finally, they are classified into three or four (in the case of rural informal) per capita consumption levels denoting the highest to lowest income/wealth household categories. The baseline factor flow relationship, which provides a mapping from factor demands by firms to households (see Table 6) are obtained from the base Social Accounting Matrix.

**TABLE 6**
Household Classification and Factor Flows Distribution of Factor Incomes (per cent)

Notes: [1] See Appendix II.

The exogenous allocation coefficients are defined from the baseline data, which are then used to map the factor income generated into gross household income. Gross household income is obtained by augmenting factor income by government income transfers and private remittances from abroad. Net of direct income taxes, as paid here only by formal sector households and savings, this income is allocated to consumption across the composite goods priced at consumption price.

The consumption function is a Cobb-Douglas for each household type, where a matrix describes household consumption shares across the different goods by household type (see Appendix III). At present we have this as a first approximation: it is possible to introduce an alternative consumption function specification such as a variant on the linear expenditure system.

**Savings and investment**
The model has a simple neo-classical savings driven investment closure. Foreign savings are exogenously given and the level of domestic savings determines total investment. Households are assumed to have a constant propensity to save out of their net of tax gross income, however, the propensities are different across household types. Government savings are exogenous. After determining the exogenous public sector investment requirements, the sectoral allocation of the residual investment is defined by a return sensitive function where firms’ demand for (their own sector-specific) capital is a function of the differential between the sectoral real rate of return and the economy-wide average. Investment by sector of demand is translated into a demand for investment goods, which are mainly machinery and construction services, determined by the capital composition matrix.

**Macroeconomic balance and dynamic specification**

Three conditions determine macroeconomic balance. The first is that the goods market clears. The second is that the external balance constraint is satisfied and the third is that the labour market clears. The above constraints taken together imply that by Walras Law the savings equals investment constraint is satisfied ex post. For each time this defines a solution in terms of market-clearing prices and quantities for goods and factors and a vector of savings and investment demand. These latter vectors determine the dynamics of the model.

The dynamic version of the preliminary model is strictly recursive as noted earlier. Therefore, at the beginning of each period, agents inherit real stocks of physical capital. Firms and households update these stocks so that the new capital stocks enter the firms’ production functions the following period. The other version is static where capital is fixed across sectors, and is used to study the impact of any exogenous change in a comparative static framework (see Appendix IV for key model equations).

In this study it is meaningful to define a specific welfare-based objective function as we attempt to study the impact of trade policy changes on the welfare of informal households. Further, we can infer welfare implications on women workers to a certain extent since the majority of them belong to informal households Therefore, we have a welfare-based objective function in the model, which provides some indication about household welfare measures (see Appendix IV). The utility function of households (see Adam and Bevan, 1998) is defined in terms of their level of consumption (of private and public goods) where private welfare is defined by real discounted value of private and public consumption.

**Simulation Experiments**

During the nineties there have been major changes in tariff rates in the process of economic reforms undertaken by the government. In Table V.1 we present the percentage change in custom rates for the manufacturing and the capital goods sector for the period 1991-92 through 1998-99. In this section we present the preliminary findings by examining the distributional consequences of trade reforms using the two versions of the model. We have designed three simulations taking into consideration the cumulative changes in tariff rates as shown in Table 7. We have used the static
version of the model for a comparative static analysis in simulation 1 and 2. In simulation 3 we use the dynamic version so as to capture the longer run fiscal consequences of trade reforms. In Simulation 1, import tariff of the manufacturing sector is reduced by 50 per cent; in Simulation 2, import tariff of the capital goods sector reduced by 17 per cent; and in Simulation 3 we hypothesize a 50 per cent reduction in tariff rates of all tradable sectors.

We present below in Table 8, the average tariff rates by sector in the base case and for the simulation scenarios. As noted the simulations have been designed by taking into consideration the actual changes in tariff rates that have taken place in the nineties. The lower tariff and the resultant lower import prices would change the relative demand for domestic goods to imports in each sector. These changes depend on the reduction of tariff rates and the elasticities of substitution. The values chosen for behavioural parameters follows common practice in similar CGE models applied to low income developing countries. Here we have assumed that price elasticity of substitution in consumption is less than unity. Given common Armington elasticities for all sectors, the import share and tariff rates will play the main role in variation in sectoral production levels and sectoral prices.

TABLE 7


TABLE 8
Application of Post Liberalization Cumulative Change in Tax Rates Custom Duties [as per cent of the world price]

Reduction in tariff reduces the distortion between domestic and world prices of tradables but this is accompanied by a loss in revenue, at least in a static sense. In this model the level of public investment is a determinant of private sector output. Therefore, in
the dynamic version of the model changes in fiscal situation influences private sector behaviour. The fiscal response as assumed in the present model leads to a decline in revenue. This is translated into a decline in government savings and hence government capital formation. Since government capital formation has a positive externality for private profitability this fiscal contraction leads to a general reduction in private sector profits which squeeze domestic profitability arising from the higher level of import penetration. In the dynamic version double pressure on private profitability leads to decline in total capital stock in the economy substantially in the long run.

As consumption of domestic manufactured goods declines due to higher imports, there is a corresponding decline in intermediate capital goods. The price of composite
consumption for capital goods falls more sharply in simulation 1 compared to the composite price of manufactured goods even though the import price of manufacturing falls more sharply. The capital goods sector uses a very high share of manufacturing intermediate goods. Therefore a fall in the price of manufacturing goods would reduce the price of capital goods because of the input-output structure. Moreover, exports rise very sharply in capital goods given the elasticities and export structure. As a result domestic import prices of capital goods rise very sharply as seen from Table 9. When the import tariff rate of capital goods is reduced by 17 per cent, the consumption price of capital goods declines most sharply. The input-output structure shows that the intermediate demand for capital goods is high for its own production. The intermediate demands from other sectors are not very high for the capital goods sector. In case of simulation 3, import prices of all tradable sectors (see Table 10) fall due to an across the board tariff reduction. As a result again the consumption price of capital goods falls very sharply.

**Impact of trade liberalization on production and trade**

The impact of the tariff reduction on sales, production and trade are presented in Table 11 below. We see that in case of simulation 1 tariff on manufacturing is reduced by 50 per cent implying a very large absolute reduction in tariff rate of this sector (see Table 8). As a result, imports of this sector increase and exports also experience a marginal rise. So even though there is decline in domestic sales, domestic production improves very slightly. In case of simulation 2, tariffs on capital goods are reduced by 17 per cent. There is a reduction in the import price of this sector and imports rise for capital goods. The fall in domestic prices leads to an increase in exports and decline in domestic sales. As a result the domestic output of capital goods experiences a contraction. In case of simulation 3 we assume that tariff rates are reduced for all sectors uniformly. In case of the manufacturing sector imports fall, and domestic production is diverted towards the export market with a fall in domestic sales. This is a ‘classical ’ tariff reduction situation. In case of capital goods, we see (Table 11) imports of this sector decline and there is a substantial increase in exports. Tariff reduction occurs contiguously with the liberalization in other sectors, so there is a decline in input cost for the capital goods sector as prices of manufactured goods fall. At the same time exports of...

**TABLE 11**
Impact of Tariff Reduction on Output and Trade
capital goods sector rise drastically. The domestic price of the capital goods sector falls more sharply than the import price of capital goods. Therefore, the relative import price rises (Table 11) and this leads to the fall in imports in this sector. Viewed in the aggregate, however, the economy’s demand for imports rises and this is matched by an increase in export production. The substitution effect is sufficiently strong to offset the small aggregate income effect from the removal of the trade distortion. Hence aggregate domestic output shrinks slightly in the short run. As noted above, the level of investment declines in the long and so overall output declines more sharply in the long run.

**Impact on factor remuneration**

The factor intensity in the base level is presented in Table 12. We see that the manufacturing sector is less intensive in both male and female regular labour. In case of simulation 1, there is contraction in sectors like manufacturing as well as in
construction which are less intensive in regular male labour and expansion in sectors that are more intensive in regular male labour. So the relative remuneration of regular male labour rise the highest in this simulation (see Table 13).

**TABLE 12**
Worker Composition by Sectors

The opposite is true for casual male labour. In case of simulation 2, there is relative contraction in capital goods and construction sector, but there is not much expansion in other sectors. As a result the average wage rate of male regular labour rises less sharply in this simulation (see Table 13). In case of simulation 3 the level of investment declines with lower government savings leading to lower private investment. Now each worker has less capital and is less productive leading to a decline in the marginal product of labour. With a built-in assumption of full-employment and competitive market, the result of the tariff change is a decline of real wage over time. This results in absolute decline in casual real wages (more so for male casual wage earners) and a moderate growth in wages for the regular workers in the long-run.

**TABLE 13**
Impact of Trade Reforms on Wages and Consumption
Table 14
Structure of Factor Ownership by Households

Note: Formal and Informal capitalist are not differentiated by gender in the base SAM as yet.

**Household income structure and welfare**

The table on income sources of each type of household is presented in Table 14. We see that the major share of income of formal households is from regular male labour. In case of informal households, the higher earning shares are from casual workers and
own account workers. So as regular male wages improve in all the simulations, the formal households benefit. Together with improvement in regular wages, the prices of manufactured items decline due to tariff reduction. Hence real consumption by formal households increases reflecting improvement in their welfare. This reflects the fact that with tariff reforms in non-agricultural sectors male workers benefit more than women workers who are less in formal households. We also present an overall welfare measure of all types of households. As public consumption is not paid for at the point of consumption this does not enter household consumption in the usual consumption based welfare measures. However, we need to add back the value of public goods into the welfare function. Otherwise we would find that reduction in public expenditure leads to an increase in welfare. So, we also assume that households benefit from the level of government production. Households’ utility is defined in terms of their level of consumption of both private and public goods. (See Section IV). We find that welfare gain (see Table 13) is higher in simulation 1 as compared to simulation 2. In case of simulation 3, trade reform has an initially positive effect raising social welfare marginally by 0.13 per cent. As the fiscal distortion begins to materialize, however, this welfare effect diminishes so than by the end of the 5th year, welfare declines marginally from the baseline.

The impacts of the simulations on the female and male earnings within different types of households are reported in Table 15. In these simulations formal households gain more than informal households, because males form a higher share of such households and their earnings rise more sharply (depending on the value added distribution of the affected sectors) compared to female earnings. In simulation 1, regular wage rates for male workers rise the highest. In simulation 2 average wage rate of male labour rises less sharply and again in simulation 3 both male and female regular wage rates increase with male rates more sharply than female rates (see Table 13). We see that in all cases regular wage rates of male

TABLE 15
Percentage Change in Real Earnings of Female and Male Workers

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation 1</td>
<td>+0.13%</td>
<td>+0.23%</td>
</tr>
<tr>
<td>Simulation 2</td>
<td>+0.05%</td>
<td>+0.08%</td>
</tr>
<tr>
<td>Simulation 3</td>
<td>+0.03%</td>
<td>+0.10%</td>
</tr>
</tbody>
</table>

Note: The earnings refer to wage earnings as capital earnings have no male–female variation.

workers rise more sharply for reasons noted above. In case of casual wage rates, female casual wage rates fare better than male casual wage rates. The earnings of
households change as a result of the wage rate changes. The above table reveals that the male earnings increase more than female earnings for nearly all types of households except for rural poor and non-agriculture informal households. We can explain this by studying the worker composition of these households and the change in wage rates due to these simulations. The percentage of casual male workers in rural informal poor and non-agriculture households is very high as compared to other informal households and the share of regular male labour is very small. The lower rise in the casual male wage rate than the female casual wage rate results in lesser benefit for males in rural poor and non-agriculture households. However, in all other types of households the earnings of male workers rise more in comparison to earnings of female workers as a result of the 3 simulations.

Conclusions and Future Directions

The results presented above help us to draw certain conclusions. It should, however, be recognized that the model is a preliminary model taking a first step towards a gender oriented CGE model. The preliminary findings show that tariff reduction leads to welfare gains (measured as rise in real consumption expenditure of households) in all households as prices fall. However the formal households gain relatively more, as the regular wage rates increase marginally, whereas in comparison casual wage rates suffer. This implies that men wage earners benefit more than women wage earners as they form a larger share of workers in formal households.

It is realized that in a gender-oriented CGE model, the proportion of female workers should motivate the choice of production sectors. We have scrutinized a more disaggregated sector classification so that the sectors with higher female labour intensity can be identified and used in future work. In Appendix V we present a further break up of the seven sectors used in the present model to a reclassification of ten sectors. These ten sectors are obtained by aggregating the production sectors as given in the 1989–90 input-output table. Further, these 10 sectors are disaggregated from the current seven sectors used in this study, so that certain sectors like manufacturing are broken up further to highlight the share of women workers in these sub-sectors of manufacturing.

So far our simulations are local approximations based on the assumption that factor/gender proportions do not alter (although there may be top level substitution of capital for labour). To actually take it further requires more research on economic structure. For example, we would need a theory (and hence a structural model) about the way in which formal and informal factor markets function and how gender discrimination works. We might want to model two separate labour markets for men and women that would require investigation about how these two markets work. The Indian Statistical Office has completed a pilot study on the Time Use Survey and it will be possible to use time use data to some extent from this source in the near future. In light of the impact of globalization on informalization with likely rise in subcontracting, it has also become important to have information on home based work, such as garment manufacturing and food processing. The CGE model could be modified to incorporate supply response to the informalization of labour force. As demand for informal labour rises there could be an increase in wage rates. The supply of labour would respond to the wage rates, however there will be supply side constraints,
which will be different for females and males. Further, incorporating ‘reproduction
services’ as a production sector would allow determination of demand for this service
as any other market good. However, it is important to be able to determine the
opportunity cost of such services. Also it will be useful to have different price
elasticity of demand in the reproduction sector (see Fontana and Wood, 2000).

More information on female and male members of a household will help in
obtaining the differential earning and expenditure preferences by gender. The
information on activities will determine the resources that women and men can
generate. How household income is allocated by gender is a matter of research. It is
important to establish any difference in household behaviour that originates due to the
female/male ratio in a household. The question is how can one theoretically measure
any such pattern of household behaviour. At one extreme is the ‘unitary’ household
where all household income (from whichever source) is pooled. In this case,
household consumption patterns are independent of the gender composition of
household labour supply (and hence income). At the other extreme is what could be
called the ‘partitioned’ household where there is no pooling of income. As a
consequence aggregate household consumption patterns would reflect the gender
composition of income and labour supply. The most probable situation is that there is
some bargaining that takes place in a household that determine the household’s
pattern of consumption. The bargaining power will depend, in part, on the gender
composition of income and labour supply, but will also reflect other determinants of
household bargaining (such as male and female reservation wages, assets brought by
different members into the household, and other, possibly unmeasurable, factors such
as cultural norms). Endogenizing the bargaining power of women in the model will
enrich the understanding of female response to external forces during the process of
globalization.

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Appendices

**Appendix I: Aggregation Scheme for Seven Industry Sectors**
Appendix II: List of Household Categories Identified
Appendix III: Proportion of Consumption Expenditure by Household Types for 7 Sectors

Appendix IV: Key Model Equations

Prices

Import Prices:
Export Prices:
Consumer Prices:

Output Prices:
Value added Prices:

Capital Prices:
Consumer Price Index:
GDP deflator:

Output and Factors
Aggregate production function:
Average wage determination:
Labour market equilibrium:
CET output aggregation:
Output share equation:

Consumer good aggregation:
Consumption share equation:

Current Demand
Intermediate goods demand:
Consumption Demand:
GDP (value added):
Real GDP:

Government
Government value added price:
Government current expenditure:
Government revenue:
Import tariff revenue:
Income, Savings and Investment

Gross profit, net of interest costs:
Sectoral profit rate:
Average profit rate:
Gross household income generation:
Household savings:
Firms investment function:
Demand for investment goods:
Depreciation:
Total savings:
Current Account Balance:
Commodity balance:

Objective Function
Variable List

Endogenous Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>pm</code></td>
<td>Domestic price of imports</td>
</tr>
<tr>
<td><code>pe</code></td>
<td>Domestic price of exports</td>
</tr>
<tr>
<td><code>pd</code></td>
<td>Price of domestic good</td>
</tr>
<tr>
<td><code>pc</code></td>
<td>Price of composite good</td>
</tr>
<tr>
<td><code>pq</code></td>
<td>Price of composite output</td>
</tr>
<tr>
<td><code>pva</code></td>
<td>Value added price</td>
</tr>
<tr>
<td><code>pk</code></td>
<td>Destination price of capital</td>
</tr>
<tr>
<td><code>CPI</code></td>
<td>Consumer price index</td>
</tr>
<tr>
<td><code>PGDP</code></td>
<td>GDP deflator</td>
</tr>
<tr>
<td><code>X</code></td>
<td>Domestic output</td>
</tr>
<tr>
<td><code>XD</code></td>
<td>Sales of domestic output to domestic market</td>
</tr>
<tr>
<td><code>Q</code></td>
<td>Total composite supply</td>
</tr>
<tr>
<td><code>M</code></td>
<td>Total imports</td>
</tr>
<tr>
<td><code>Ei</code></td>
<td>Total exports.</td>
</tr>
<tr>
<td><code>GDPVA</code></td>
<td>Total value added</td>
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<tr>
<td><code>RGDP</code></td>
<td>Real GDP</td>
</tr>
<tr>
<td><code>L</code></td>
<td>Labour demand</td>
</tr>
<tr>
<td><code>Wa</code></td>
<td>Average wage by skill-type</td>
</tr>
<tr>
<td><code>ND</code></td>
<td>Intermediate demand</td>
</tr>
<tr>
<td><code>CD</code></td>
<td>Consumption by household</td>
</tr>
<tr>
<td><code>Y</code></td>
<td>Household income</td>
</tr>
<tr>
<td><code>GX</code></td>
<td>Government recurrent expenditure</td>
</tr>
<tr>
<td><code>GR</code></td>
<td>Government recurrent revenue</td>
</tr>
<tr>
<td><code>GOVSAV</code></td>
<td>Government recurrent surplus</td>
</tr>
<tr>
<td><code>TARIFF</code></td>
<td>Tariff revenue</td>
</tr>
<tr>
<td><code>DUTY</code></td>
<td>Export duties</td>
</tr>
<tr>
<td><code>INDTAX</code></td>
<td>Indirect taxes</td>
</tr>
<tr>
<td><code>DURTA</code></td>
<td>Direct taxes</td>
</tr>
<tr>
<td><code>PTAX</code></td>
<td>Production taxes</td>
</tr>
<tr>
<td><code>r</code></td>
<td>Real sectoral profit rate</td>
</tr>
<tr>
<td><code>r</code></td>
<td>Real average sectoral profit rate</td>
</tr>
<tr>
<td><code>RK</code></td>
<td>Gross sectoral profit (net of interest costs)</td>
</tr>
<tr>
<td><code>HHSAV</code></td>
<td>Household saving</td>
</tr>
<tr>
<td><code>IDi</code></td>
<td>Investment demand by sector of origin</td>
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<tr>
<td><code>DEPRC</code></td>
<td>Depreciation by sector</td>
</tr>
<tr>
<td><code>SAVING</code></td>
<td>Total savings</td>
</tr>
<tr>
<td><code>FS</code></td>
<td>Foreign Savings</td>
</tr>
<tr>
<td><code>INVEST</code></td>
<td>Total investment</td>
</tr>
</tbody>
</table>

Exogenous Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>er</code></td>
<td>Nominal exchange rate</td>
</tr>
<tr>
<td><code>p^m</code></td>
<td>World price of imports</td>
</tr>
<tr>
<td><code>p^e</code></td>
<td>World price of export</td>
</tr>
<tr>
<td><code>tm</code></td>
<td>Import tariff rate</td>
</tr>
<tr>
<td><code>tx</code></td>
<td>Export duty rate</td>
</tr>
<tr>
<td><code>it</code></td>
<td>Indirect tax rate</td>
</tr>
<tr>
<td><code>pt</code></td>
<td>Production tax rate</td>
</tr>
<tr>
<td><code>t</code></td>
<td>Direct tax rate</td>
</tr>
<tr>
<td><code>s</code></td>
<td>Savings propensity</td>
</tr>
<tr>
<td><code>KP</code></td>
<td>Sectoral capital stock</td>
</tr>
</tbody>
</table>
KG: Public capital stock
DKG: Government investment in public goods
DKpub: Government investment in government capital
Trns: Government transfers
debtsrv: External debt service (US$)
rmit: Remittances from overseas (US$)
L: Labour supply
NETP: Net factor payment to factor service (US$)

Technical, Behavioural and Policy Parameters

Calibration Parameters

- $a_{ij}$: input-output coefficients
- $b_{ij}$: capital-composition coefficients
- $w_c$: weights for consumer price index
- $AD_i$: Production function shift parameter
- $\Psi_{ik}$: Wage distribution matrix
- $AT_i$: Output CET aggregation function shift parameter
- $\gamma_i$: Output CET share parameter
- $AC_i$: Consumer good CES aggregation shift parameter
- $\delta_i$: Consumer good CET share parameter
- $c_{les,i,hh}$: Consumption shares (by sector and household)
- $gles$: Government share in GDP
- $\phi_i$: Depreciation rate
- $hw$: Household welfare weights

‘Exogenous’ Parameters

- $\alpha_{li}$: Production function labour shares
- $\alpha_{ki}$: Production function private capital shares
- $\alpha_{gi}$: Production function public capital shares
- $\rho_t$: CES transformation parameter
- $\rho_c$: CES substitution parameter
- $\Pi_i$: Investment share parameter
- $\theta$: Investment responsiveness parameter
- $\lambda_i$: Formal profit share
- $\Gamma_{li}$: Labour income allocation parameter
- $\Gamma_{ci}$: Formal Capital income allocation parameter
- $\Gamma_{inf_i}$: Informal Capital income allocation parameter

Appendix V: Percentage Share of Women Workers by 10 Sectors
Note: Aggregation from 115 sectors from Input-Output Transactions Table 1989–90.

Source: International Development Research Centre of Canada 2003
Accessed on 01/08/2006