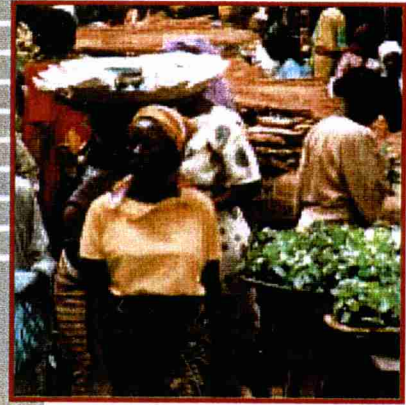


GENDER PLANNING NETWORK
Phase I



MIMAP

**Gender in a Macro Economic Framework:
A CGE Model Analysis**

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Gender in a Macro Economic Framework: A CGE Model Analysis

By

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ABSTRACT

This study attempts to examine the impact policy changes on the welfare of women in India. In this paper a standard CGE model is extended to incorporate factors of production distinguished by gender and informality. As a large section of women workers are involved in informal activities, we have differentiated factor of production by informality. The study distinguishes households deriving income from formal and the informal sector and studies the structure of such households. The flow of value added from different sectors to the various factors of production and the flow of factor income to different households on the basis of factor ownership differentiated by gender is incorporated in a Social Accounting Matrix (SAM). The SAM is used here as a base for building a Computable General Equilibrium (CGE) model.

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I. Introduction

The importance of gender aware macro-economic analysis has increased with many more developing countries including India embarking upon Structural Adjustment Programmes (SAP), 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 cost generally lead to informalisation (Portes et al., 1989). A number of studies have revealed that the informal sector has continued to grow faster 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 work force 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 percent of the female labour force including helpers or unpaid workers, are 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. 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 is also linked to work. This is so 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 would enable study of the impact of policy changes on women. With many developing countries adopting SAP during the 1990s, there was more 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 also 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 value of household work to estimate its value in national accounts (Beneria, 1995). It has been recognised that more accurate and conceptually sophisticated gender-sensitive statistics are useful to generate 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 since 1991. There have been major changes in industrial policies leading to reduction in the scope of industrial licensing. The procedural rules have been simplified. Entry and investment has been allowed in areas that were earlier reserved for the public sector. The major thrust of the liberalisation process have 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 very high import duties that were among the highest in the world. The tariff duty rates were above 200 percent 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 percent in 1994-95 to 45 percent in 1997-98, 40 percent in 1999-2000 and to 35 percent in 2000-2001. At present there a total of 4 custom duty rates, i.e. 35 percent, 25 percent, 15 percent and 5 percent. The reform measures undertaken so far have created a more open economy. Moreover, along with liberal import policies, export promotion schemes are given further boost through 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 analysing 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 liberalisation has affected growth favourably in India during the 90s (Srinivasan, 1998). However, 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.

The paper is organised 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 results from our simulation exercise in Section V. Section VI concludes the paper with a discussion of future directions and extensions.

II. 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 also have 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 MIMAP³ data analysed at NCAER.

³ Survey of 5000 households conducted by NCAER to collect data for research program on Micro Impacts on Macroeconomic Adjustment Policies (MIMAP).

II.1 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 Organisation (CSO), India are aggregated into 7 sectors for this exercise (see Appendix 1). 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.

Table II.1 : Percentage Share of Women Workers by 7 Sectors

No.	Sector	Female	Male
1	Agriculture	51.18	26.54
2	Manufacture	16.30	9.02
3	Capital goods	0.14	1.79
4	Construction	3.51	9.93
5	Infrastructure	2.15	11.04
6	Services	15.93	26.31
7	Public admn.	10.79	15.36
	Total	100.00	100.00

II.2 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 1-digit and a few at 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 one to one correspondence between value added and the workers. The NAS data give total 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 Organisation'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 "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 drawing of regular salary/wage or those who hire labor 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. 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 7 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.⁴ Hence, though in this exercise we do not distinguish

⁴ The 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

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.

To summarise, the NAS provides total number of workers in each of the 3-digit NIC sectors. without any break up between labourers, employers, own account workers. There is no further information about how many of the workers belong to unregistered and how many in registered part 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 at present allows us to break up workers by gender and informality adhering to the overall national accounting as given by NAS. We thus obtain 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.

II.3 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 7 industry sectors using the survey data. It is observed that women are mostly engaged as casual labourers rather than regular labourers. It is seen that *nearly 80 percent 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 percent of the total OAW. Overall, on an average 78 percent of the worker population (which includes both labour and capitalist) is male and only 22 percent are female workers.

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 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.

earning rate of the different types of labour.

The percentage of different types of factor owners by sector is presented in Table II.2. Table II.3 depicts 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 stated 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. Capital earnings are distinguished into formal and informal at present on the basis of information on capital ownership.

TABLE II.2: PERCENTAGE DISTRIBUTION FACTOR OWNERS BY INDUSTRY SECTORS

Sector	(percentage)							
	Agri- Culture	Manu- facture	Capital goods	Constr- uction	Infrastru- cture	Services	Public adm.	Total
Factor Of Production	1	2	3	4	5	6	7	8
Casual Labour: Female	11.79	6.02	0.15	9.18	0.42	3.49	4.41	6.73
Casual Labour: Male	19.27	18.80	14.34	68.24	6.41	28.98	24.16	25.15
Regular Labour: Female	0.10	1.51	1.57	0.08	3.87	3.71	13.04	3.32
Regular Labour: Male	0.54	11.85	27.41	2.34	55.26	15.95	58.39	19.16
Own account worker (IF)	59.27	45.98	20.03	18.97	8.56	22.74	0.00	32.12
Employer (F)	9.04	15.82	36.51	1.20	25.49	25.13	0.00	13.52
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

TABLE II.3: PERCENTAGE DISTRIBUTION FACTOR EARNINGS BY INDUSTRY SECTORS

Sector	Agri- Culture	Manu- facture	Capital goods	Constr- uction	Infrastru- cture	Services	Public adm.	Total
Factor Of Production	1	2	3	4	5	6	7	8
Casual Labour: Female	4.79	2.75	0.02	4.53	0.08	0.44	0.91	2.31
Casual Labour: Male	11.65	14.97	3.28	58.67	2.12	6.31	8.70	11.90
Regular Labour: Female	0.16	1.21	1.03	0.21	2.05	4.03	12.24	3.06
Regular Labour: Male	1.01	13.56	25.77	9.43	41.73	24.77	78.15	23.41
Own account worker (IF)	56.42	39.69	24.26	22.78	9.91	47.03	0.00	37.92
Employer (F)	25.97	27.82	45.63	4.39	44.11	17.43	0.00	21.40
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Sectorwise distribution of labour force shows that, as much as 12 percent of all workers in the agricultural sector are female casual workers. However, they get only about 5 percent (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 percent less earnings per unit of labour compared to their male counterparts. Of the total labour force in the construction sector, 9 percent are female casual labourers and they retain 4.5 percent of the value added of this sector. In manufacturing the female casual labour force constitute 6 percent of the total workers in the sector and earn about 3 percent of the sectoral value added.

III. 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.

states that In a developing country most households operate within an informal system and their number even increase 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.. It has been observed that informal households consume more of agricultural products (see Appendix II). Informal households face uncertainty of income flows and are also outside of security rights. It may be noted here that apart from categorising households as merely formal or informal it is meaningful to have other socio-economic characteristics to distinguish the households. It is possible that at 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 percent of households in India can be termed as informal and 39 percent 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 households are first distinguished as rural or urban. Next households are classified as formal and informal by classifying 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 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" code, such households are classified as informal. Finally, households are classified into different income levels, i.e., poor, middle and rich within each broad category. The households are then scrutinised to identify the different types of workers and factor owners distinguished by gender that make up the household. Further, the inclusion of non-labour force activities of household members is important as much of women's time is devoted to "reproductive"⁵ rather than market activities.

⁵ The term is now familiarised 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 III.1 : DISTRIBUTION OF FEMALE MEMBER ACTIVITY WITHIN FORMAL /INFORMAL HOUSEHOLDS (PERCENT)

FEMALE	RURAL FORMAL			URBAN FORMAL			RURAL: INFORMAL				URBAN INFORMAL			Total
	Poor	Middle	Rich	Poor	Middle	Rich	Poor	Middle	Rich	Non-Agr	Poor	Middle	Rich	
I Lab	1.56	3.16	3.95	4.84	0.54	1.57	7.61	1.23	0.52	3.07	8.73	0.29	0.04	5.23
F Lab	4.77	0.22	0.04	1.64	9.25	3.63	0.16	0.09	0.01	0.91	0.00	0.01	0.00	0.50
I Cap	4.31	7.11	6.11	0.17	1.09	2.57	4.79	3.63	3.74	6.19	1.28	0.21	1.25	4.59
F Cap	0.00	2.66	1.25	0.21	0.43	2.61	0.30	0.10	0.14	0.43	0.18	0.01	0.06	0.35
Unpaid Helper	2.16	2.21	0.34	3.13	1.14	0.57	11.83	10.98	9.84	6.81	3.10	2.19	1.37	8.22
Worker	12.79	15.35	11.68	9.99	12.44	10.95	24.70	16.02	14.25	17.41	13.30	2.70	2.72	18.88
Domestic workers	50.08	54.08	44.53	71.28	69.58	70.80	35.03	39.56	41.89	45.13	63.02	73.91	76.70	46.14
Other HH duties ⁶	37.13	30.57	43.79	18.73	17.97	18.25	40.28	44.42	43.86	37.46	23.69	23.38	20.58	34.98
Total Members by Activity ('Mil)	1.52	0.94	0.29	13.31	15.20	6.44	108.52	13.48	2.02	38.05	9.30	4.09	0.75	213.91
(Percent)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

TABLE III.2: DISTRIBUTION OF MALE MEMBER ACTIVITY WITHIN FORMAL /INFORMAL HOUSEHOLDS (PERCENT)

MALE	RURAL FORMAL			URBAN FORMAL			RURAL: INFORMAL				URBAN INFORMAL			Total
	Poor	Middle	Rich	Poor	Middle	Rich	Poor	Middle	Rich	Non-Agr	Poor	Middle	Rich	
I Lab	16.51	1.68	0.17	19.91	7.22	1.48	17.65	3.81	2.03	20.85	4.16	3.06	0.00	15.97
F Lab	44.56	57.89	51.20	41.43	23.88	46.23	1.21	2.36	2.21	2.80	2.13	0.73	0.21	4.67
I Cap	24.20	31.01	29.56	1.66	11.36	12.43	32.97	36.28	30.65	40.77	42.56	12.31	0.00	34.91
F Cap	6.83	5.35	14.03	8.79	19.99	34.75	3.63	2.88	3.76	4.40	7.81	5.82	6.21	5.55
Unpaid Helper	6.62	3.03	5.04	25.08	32.73	4.08	40.97	52.77	52.59	28.44	34.68	66.27	79.33	35.57
Worker	98.73	98.96	100.00	96.88	95.19	98.96	96.43	98.10	91.24	97.25	91.33	88.18	85.75	96.66

Domestic workers	0.44	0.44	0.00	2.14	3.50	0.73	1.85	0.80	6.46	1.65	6.03	7.52	7.65	1.89
Other III duties ^a	0.32	0.60	0.00	0.98	1.30	0.31	1.71	1.10	2.30	1.09	2.65	4.29	6.60	1.44
Total Members by Activity (Mil)	1.53	1.14	0.50	17.42	11.49	16.28	121.81	14.67	2.38	34.34	5.31	0.91	0.13	228.96
(Percent of 100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)	(100)

The above tables further show that 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. Further, 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.

IV. The CGE Model

We have discussed the data as a base for the modeling structure. We now characterise the economic system generating the data. One way of viewing a SAM is to consider each recorded transaction as the outcome of a (constrained) optimisation problem faced by one or more agents of the economy. Thus, for example, factor income flow from firm to household reflect 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 maximisation 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.

The CGE model developed is of the type discussed in Devarajan, et al (1996), which are widely used trade focussed models for developing countries. In this model we intend 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. In a limited sense the model 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 built 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 indefinitely⁶. The model is being written using the GAMS programming language.

IV.1.1 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 to the domestic market or exported. In the current version of the model all firms are price takers for all imports. The model consists of 7 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 model, however, 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

⁶ There is no labour supply growth assumed in the model at present.

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 (see Appendix III). 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 raise 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 is 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.

IV.1.2 Allocation mechanism in Goods Market

In this system each productive sector 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 good are imperfect substitutes so that the firm cannot switch their output costlessly

for imports and

$$pe_i = p_i^{wc} er(1 + tx_i)$$

for exports.

As stated earlier, domestic and traded goods are considered as imperfect substitutes so that consumers and producers make decisions over composite consumption (Q) and output (X). On the basis of the CES/CET aggregation functions the true price aggregates for these two composite are defined as:

$$pc_i = \frac{pd_i XD_i + pm_i M_i}{Q_i}$$

for consumption prices, and

$$pq_i = \frac{pd_i XD + pe_i E_i}{X_i}$$

as aggregate output price.

In this system the crucial domestic price pd is endogenously determined which is the (implicit) price of domestic output. Composite demand by households and aggregate firm-level production determine Q and X . The CES/CET functions define the optimal combination of tradable and domestic goods based on embodied preferences in these functions. Under small country assumption pe and pm are given exogenously. Therefore, relative price changes required to clear the market for domestic goods will define the equilibrium value of pd . All other prices in the model are for accounting conventions. 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 quantities of Q aggregated according to the input-output matrix aji which are priced at the aggregate price pc . It is then possible to derive the

implicit price of value added as the difference between the net price of aggregate output and the price of intermediate inputs

$$pva_i = pq_i(1 - pt_i) - \sum_j a_{ij} pc_j$$

Composite commodity Q 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 i decides to increase its capital stock Dk_i . The composition of capital goods in the sector would 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 are prices at pc_i and are combined according to a capital composition matrix b_{ji} . Therefore, the price of capital by destination is defined as

$$pk_i = \sum_j b_{ji} pc_j$$

Finally, we define two price indices for convenience which are useful. These are the consumer price index,

$$CPI = \sum_i wc_i pc_i$$

and the GDP deflator, $PGDP = GDPV A/RGDP$.

IV.2 Households

In the model the households form a distinctive feature. In this exercise thirteen different household types have been identified. Household types are first distinguished by regions to which they belong (denoted R for rural and U for urban). Further, the households are identified as formal and informal households (denoted F and I). Finally, households are classified into three or four (in the case of rural informal) per capita consumption levels (denoted 1, 2, and 3) where 3 denotes the highest income/wealth household and 1 the lowest. The baseline factor flow relationship, which provide a mapping from factor demands by firms to households (see Table W.1) are obtained from the base Social Accounting Matrix.

Table IV.1. Household Classification and Factor Flows

Distribution of Factor Incomes (percent)

Household Type ⁽¹⁾	Casual Labour Income		Regular Labour Income		Capital Income	
	Female	Male	Female	Male	Informal	Formal
RF1	0.2	1.3	3.4	5.2	1.0	1.0
RF2	0.1	0.3	4.1	3.0	1.0	1.0
RF3	0.0	0.0	2.1	1.3	0.0	1.0
UF1	4.0	8.3	14.7	21.5	0.0	4.0
UF2	11.0	14.5	4.1	2.9	1.0	9.0
UF3	4.0	8.7	27.9	28.1	0.0	7.0
RI1	51.6	30.9	8.7	13.0	54.0	37.0
RI2	2.8	2.5	2.0	3.5	12.0	6.0
RI3	0.2	0.3	0.4	0.7	2.0	2.0
RI4	25.9	32.7	13.9	12.5	18.0	12.0
UI1	0.2	0.3	18.0	8.0	6.0	7.0
UI2	0.1	0.2	0.6	0.3	3.0	7.0
UI3	0.0	0.0	0.1	0.0	2.0	6.0

Notes: [1] See above for explanation of household types.

[2] Capital income share equal for net profit and consumption of capital.

The exogenous allocation coefficients are defined from the base line 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 where the aggregate price of consumption good is defined as:

$$PC_i = \underline{PD}_i X D_i + P m_i M_i$$

Q_i

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 II). 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.

IV.3 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 propensity 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 ($r_i - \bar{r}$)

$$DK_i = \frac{D_i(1 + \theta(r_i - \bar{r}))[SAVING - pk_{pub}(DK_{pub} + DKG)]}{pk_i}$$

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 b_{ij}

$$ID_j = \sum_i b_{ij} DK_i$$

IV.4 Macroeconomic Balance and Dynamic Specification

Three conditions determine macroeconomic balance. The first is that the goods market clears.

$$Q_i = \sum_{hh} CD_{i, hh} + ND_i + GD_i + ID_i$$

The second is that the external balance constraint is satisfied.

$$\Delta NFA = \sum_i p_i^{we} E_i + aid + \sum_{hh} rmit_{hh} - \sum_i p_i^{wm} M_i - debtsery$$

and the third is that the labour market clears .

$$\sum_i L_{i,lc} = \bar{L}_{lc}$$

The above constraint taken together implies that by Walras Law the savings equals investment constraint is satisfied ex post. For each time this defines a solution which is defined 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 model is strictly recursive. Therefore, at the beginning of each period, agents inherit real stocks of physical capital. Firms and households update these stocks according to the dynamic equation

$$KP_{it} = KP_{it-1}(1 - \phi_i) + DK_{it}$$

so that the new capital stocks enter 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 III for complete model equations).

Welfare Function

As the model is square, the equal number of equations and endogenous variables results in a unique solution. Therefore, a separate maximand is not absolutely necessary to solve the model. However, the GAMS software requires a maximand to implement its solution algorithm. It is possible for any variable to be selected as the maximand (for example real aggregate output). In this exercise it is meaningful to define a specific welfare-based objective function.

The utility function of households is defined in terms of their level of consumption (of private and public goods) using a standard iso-elastic inter-temporal form

$$U_{hh} = \int_0^{\infty} \left[\frac{v(c_{hh})^{1-\varepsilon}}{1-\varepsilon} \right] e^{-\beta t} dt \quad (17)$$

where β is the discount rate and $v(c_{hh}) = u(c_{hh}) X_{pub}^{\alpha}$ which defines private welfare in terms of the real discounted value of private and public consumption where X_{pub} is the level of recurrent government output α is the weight of government output in private welfare). While undertaking the simulations as considered below we assume the limiting case of $\varepsilon=1$, which simplifies the welfare function to:

$$U = \beta \sum_{hh} hw_{hh} \log \prod_t CD_t^{\alpha c_t} X_{pub}^{\alpha g_{pub}} \quad (18)$$

with hw_{hh} as household weights based on the relative size of each household type (see Adam and Bayar, 1998).

V. Simulation Experiments

During the 90s 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 examine the distributional consequences of trade reforms. We have designed three simulations taking into consideration the cumulative changes in tariff rates as shown in Table V.1. 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 percent; in Simulation 2, import tariff of the capital goods sector reduced by 17 percent; and in Simulation 3 we hypothesise a 50 percent reduction in tariff rates of all tradable sectors.

**Table V.1: Percentage Change in Sectoral Custom Rates
for the Period 1991-1992 to 1998-1999**

Year	Manufacturing	Capital Goods
1991-92	-3.20	6.67
1992-93	-9.23	-17.19
1993-94	-13.21	-41.51
1994-95	-16.59	22.58
1995-96	-1.56	-13.16
1996-97	3.48	18.18
1997-98	-11.54	5.13
1998-99	1.88	2.44
Cumulative	-49.96	-16.86

Source: Economic Survey, various issues.

We present below in Table V.2, 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 90s. 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 V.2 : Application of Post Liberalization Cumulative Change in Tax Rates
CUSTOM DUTIES [as percent of the world price]**

	Custom Rates	New Custom Rates		
	Base 1994-95	Simulation 1	Simulation 2	Simulation 3
Agriculture	0.37%	0.37%	0.37%	0.19%
Manufacturing	30.19%	15.10%	30.19%	15.10%
Capital Goods	36.75%	36.75%	30.50%	18.38%
Construction	0.00%	0.00%	0.00%	0.00%
Infrastructure	0.00%	0.00%	0.00%	0.00%
Services	0.00%	0.00%	0.00%	0.00%
Pub. Administration	0.00%	0.00%	0.00%	0.00%

Reduction in tariff reduces the distortion between domestic and world price of tradeables but this is accompanied with 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.

Table V.3 : Input-Output Coefficient Matrix and Changes in Domestic Consumption Prices

									Change in domestic Consumption prices			
	Agr.	Mfg.	Cap.	Cons.	Infra	Ser.	Pub.	T.PRO D	Sim 1 (%)	Sim 2 (%)	Sim 3 (%)	
											P1	P6
	1	2	3	4	5	6	7	8	9	10	11	12
Agriculture	0.119	0.120	0.002	0.047	0.010	0.032	0.005	317061	-1.20	0.16	-0.94	-1.26
Manufacturing	0.049	0.316	0.247	0.318	0.133	0.047	0.041	376027	-5.88	-0.07	-6.07	-5.73
Capital Goods	0.005	0.014	0.173	0.004	0.045	0.007	0.011	40418	-56.78	-10.83	-80.54	-67.58
Construction	0.006	0.001	0.008	0.003	0.001	0.012	0.029	118773	18.32	3.45	25.71	15.90
Infrastructure	0.009	0.124	0.058	0.051	0.188	0.048	0.031	194503	-3.26	-0.27	-3.90	-3.20
Services	0.020	0.089	0.101	0.067	0.133	0.100	0.099	357745	-0.91	0.19	-0.58	-1.54
Pub. Admn	0.000	0.000	0.000	0.000	0.000	0.000	0.000	135967	0.00	0.00	0.00	0.00

As consumption of domestic manufactured goods decline due to higher imports, there is a corresponding decline in intermediate capital goods. The price of composite consumption for capital goods fall more sharply in simulation 1 compared to 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 price (pm/pd) of capital goods rise very sharply as seen from Table V.3. When import tariff rate of capital goods is reduced by 17 percent, the consumption price of capital goods decline 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 V.4) fall due to an across the board tariff reduction. As a result again consumption price of capital goods fall very sharply.

Table V.4: Impact of Trade Reforms on Prices and Relative Prices

	BASE	Sim 1	Sim 2	Sim 3	
				P1	P6
Relative Price					
Export Relative Price					
Agriculture	1.00	1.23	-0.16	0.95	1.29
Manufactures	1.00	4.42	0.09	4.70	4.22
Capital	1.00	11.73	2.46	19.62	24.12
Construction	1.00	4.67	0.10	4.99	7.85
Infrastructure	1.00	3.70	0.29	4.46	3.63
Services	1.00	0.93	-0.20	0.59	1.58
Import Relative Price					
Agriculture	1.00	1.23	-0.16	0.77	1.10
Manufactures	1.00	-7.69	0.09	-7.44	-7.86
Capital	1.00	11.73	-2.22	3.55	7.44
Construction	1.00	4.67	0.10	4.99	7.85
Infrastructure	1.00	3.70	0.29	4.46	3.63
Services	1.00	0.93	-0.20	0.59	1.58
CPI	1.00	-2.69	0.05	-2.64	-2.83

Note: P1=First simulation period; P6= Last simulation period.

Impact of Trade Liberalisation on Production and Trade

The impacts of the tariff reduction on sales, production and trade are presented in Table V.5 below. We see that in case of simulation 1 tariff on manufacturing is reduced by 50 percent implying a very large absolute reduction in tariff rate of this sector (see Table V.2). 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, tariff on capital goods are reduced by 17 percent. There is a reduction in 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 domestic output of capital goods experience a contraction. In case of simulation 3 we assume that tariff rates are reduced for all sectors uniformly. In case of manufacturing sector imports fall and domestic production is diverted towards export market with a fall in domestic sales. This is a "classical" tariff reduction situation. In case of capital goods, we see (Table V.5) imports of this sector declines and there is a substantial increase in exports of this sector. Tariff reduction occurs contiguously with the liberalisation in other sectors, so there is a decline in input cost for the capital goods sector as price of manufactured goods fall. At the same time exports of capital goods sector rise drastically. The domestic price of capital goods sector falls more sharply than the import price of capital goods. Therefore, the relative import price rises (Table V.5) 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.

Table V.5: Impact of Tariff Reduction on Output and Trade

	BASE	Sim 1	Sim 2	Sim 3	
				P1	P6
Imports					
Agriculture	3,803	-0.62	0.15	-0.20	-3.32
Manufactures	88,039	5.66	-0.05	5.51	3.15
Capital	16,990	-7.03	1.04	-3.60	-6.35
Construction	17,311	-1.81	-0.04	0.00	0.00
Infrastructure	-	0.00	0.00	-1.95	-4.17
Services	3,655	-1.12	0.11	-0.95	-3.72
Total	129,798	2.63	0.10	2.98	0.55
Exports					
Agriculture	3,802	1.23	-0.09	1.09	-1.58
Manufactures	60,231	2.79	0.09	3.06	0.06
Capital	3,454	9.80	1.18	13.18	16.22
Construction	-	0.00	0.00	0.00	0.00
Infrastructure	12,340	3.69	0.40	4.68	1.09
Services	21,778	0.26	-0.18	-0.07	-1.43
Total	101,605	2.54	0.10	2.86	0.35
Domestic Sales					
Agriculture	313,259	0.30	0.03	0.37	-2.52
Manufactures	315,796	-0.49	0.02	-0.43	-3.00
Capital	36,964	1.04	-0.65	-1.05	-1.17
Construction	118,773	-5.67	-0.55	-6.87	-7.72
Infrastructure	182,163	0.90	0.18	1.31	-1.58
Services	335,967	-0.43	-0.04	-0.51	-2.58
Total	1,438,889	-0.47	-0.04	-0.56	-2.68
Output					
Agriculture	317,061	0.31	0.03	0.38	-2.51
Manufactures	376,027	0.04	0.03	0.14	-2.50
Capital	40,418	1.83	-0.49	0.27	0.48
Construction	118,773	-5.67	-0.55	-6.87	-7.72
Infrastructure	194,503	1.08	0.19	1.53	-1.41
Services	357,745	-0.39	-0.05	-0.49	-2.51
Total	1,540,494	-0.27	-0.03	-0.33	-2.47

Impact on Factor Remuneration:

The factor intensity in the base level is presented in Table V.6. 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 V.7).

Table V.6: Worker Composition by Sectors

	Casual Female	Casual Male	Regular Female	Regular Male	Total Labour	
SECTOR	Percentage Share of Workers by Type (Base Level)				%	Million
AGRIC	37.20	60.80	0.30	1.70	100.00	421
MAN	15.78	49.22	3.96	31.04	100.00	168
CAP	0.35	32.98	3.61	63.06	100.00	25
CONST	11.49	85.48	0.09	2.94	100.00	278
INFRA	0.63	9.72	5.87	83.79	100.00	244
SERV	6.70	55.59	7.11	30.60	100.00	513
PUB	4.41	24.16	13.04	58.39	100.00	589
ALL	12.37	46.27	6.11	35.24	100.00	2239

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 V.7). 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 marginal product of labour. With 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 V.7: Impact of Trade Reforms on Wages and Consumption

	BASE	Sim 1	Sim 2	Sim 3	
				P1	P6
W. Real Wage rate					
Casual female	71.47	-1.57	0.15	-1.32	-4.81
Casual male	98.57	-2.72	0.01	-2.77	-6.72
Regular female	191.97	0.57	0.37	1.31	-1.84
Regular male	254.63	1.52	0.47	2.45	-0.89
HH Consumption					
RF1	5123.60	4.37	0.32	5.07	1.77
RF2	3372.60	3.83	0.27	4.41	1.35
RF3	1312.50	4.52	0.29	5.15	2.41
RM1	13586.10	3.88	0.44	4.86	1.20
RM2	11585.30	3.81	0.42	4.73	1.29
RM3	3565.20	3.56	0.49	4.65	1.33
FC1	85338.80	1.78	0.12	2.04	-1.21
FC2	13139.40	2.43	0.16	2.78	-0.24
FC3	5223.20	2.81	0.18	3.19	0.50
FC4	17993.70	2.05	0.16	2.39	-0.83
UI1	9852.00	2.15	0.14	2.44	-0.86
UI2	4667.60	1.87	0.13	2.15	-0.84
UI3	3238.80	2.20	0.15	2.51	-0.13
Welfare					
	16.26	0.11	0.01	0.13	-0.04

Household Income Structure and Welfare

The table on income sources of each type of household is presented in Table V.8. 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 are

not paid for at the point of consumption these do 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 V.7) 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 percent. As the fiscal distortion begins to materialise, however, this welfare effect diminishes so that by the end of the 5th year, welfare declines marginally from the baseline.

Table V.8: Structure of Factor Ownership by Households

	Lab- Cas: Female	Lab- Cas: Male	Lab- Reg: Female	Lab- Reg: Male	Informal Capitalist: Female	Informal Capitalist: Male	Formal Capitalist: Female	Formal Capitalist: Male	Total
RF1	0.24	4.91	6.01	70.21	1.13	10.78	0.00	6.72	100.00
RF2	0.28	6.10	10.58	60.04	2.34	12.37	2.41	5.89	100.00
RF3	0.00	0.00	12.52	58.06	0.00	0.00	1.45	27.98	100.00
UF1	0.63	7.34	6.38	71.15	0.00	0.00	0.26	14.24	100.00
UF2	0.23	1.53	11.20	59.64	0.51	4.00	0.63	22.26	100.00
UF3	0.00	0.00	7.34	56.53	0.00	0.00	1.04	35.09	100.00
RI1	4.18	17.70	0.65	7.95	5.75	44.39	1.33	18.06	100.00
RI2	0.94	4.61	1.21	16.59	5.03	54.74	0.52	16.35	100.00
RI3	0.00	0.00	1.41	17.14	4.89	47.19	0.90	28.49	100.00
RI4	2.19	13.15	2.34	16.19	6.92	41.13	1.77	16.31	100.00
UI1	1.85	23.12	2.00	6.79	2.00	37.94	1.02	25.28	100.00
UI2	1.19	8.10	1.74	6.16	2.55	33.20	0.36	46.71	100.00
UI3	0.00	0.00	0.00	0.00	37.13	0.00	3.32	59.55	100.00

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

Table V.9: Percentage Change in Real Earnings of Female and Male Workers

Household Type	Simulation 1		Simulation 2		Simulation 3			
	Female	Male	Female	Male	P1		P6	
					Female	Male	Female	Male
RF1	3.11	3.78	0.29	0.36	3.77	4.57	0.69	1.25
RF2	1.49	4.28	0.13	0.41	1.78	5.19	-1.57	1.94
RF3	1.21	4.32	0.10	0.41	1.43	5.24	-1.96	1.99
UF1	2.20	3.64	0.20	0.34	2.65	4.40	-0.59	1.06
UF2	3.31	3.87	0.31	0.36	4.01	4.68	0.96	1.37
UF3	3.05	4.27	0.29	0.41	3.69	5.18	0.60	1.93
RI1	1.26	0.63	0.10	0.03	1.51	0.68	-1.88	-3.11
RI2	1.50	2.65	0.13	0.24	1.80	3.18	-1.55	-0.31
RI3	1.22	3.19	0.10	0.29	1.45	3.84	-1.95	0.43
RI4	2.12	1.09	0.19	0.08	2.56	1.26	-0.69	-2.47
UI1	1.15	2.45	0.09	0.22	1.37	2.93	-2.04	-0.59
UI2	1.26	1.63	0.10	0.13	1.50	1.92	-1.89	-1.72
UI3	1.15	4.33	0.09	0.41	1.36	5.25	-2.04	2.00
Total	2.01	2.58	0.18	0.23	2.42	3.09	-0.85	-0.42

The impacts of the simulations on the female and male earnings within different types of households are reported in the Table V.9. In these simulations formal households gain more than informal households, because males form a higher shares 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 wages rate 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 V.7). We see that in all cases regular wage rates of male 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 household is very high as compared to other informal households and 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.

VI. Conclusions and Future Directions

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 realised that in a gender-oriented CGE model, the proportion of female workers should motivate the choice of production sectors. We have scrutinised a more disaggregated sector classification so that the sectors with higher female labour intensity can be identified. In Appendix IV we present a further break up of the 7 sectors used in the present model to a reclassification of 10 sectors. These 10 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 7 sectors used in this study, so that certain sector like manufacturing is 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 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 globalisation on informalisation with likely rise in sub-contracting, it has

also become important to have information on home based work, such as garment manufacturing and food processing. The CGE model should be modified to incorporate supply response to the informalisation of labour force. As demand for informal labour rises there could be an increase in wage rates. 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). Endogenising bargaining power of women in the model will enrich the understanding of female response to external forces during the process of globalisation.

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APPENDICES

APPENDIX I: AGGREGATION SCHEME FOR 7 INDUSTRY SECTORS

S. No.	Sectors	IOS9-90
1	Agriculture sector including forestry, fishing etc.	000 - 022
2	Manufacture of food products	035-036, 038
	Production of indigenous sugar, gur, etc.	033 - 034
	Manufacture of Beverages, Tobacco and Related products	037, 039, 040
	Manufacture of Textile products	041 - 049
	Manufacture of wood and wood products: Furniture and fixtures	050 - 051
	Manufacture of batteries, household electricals, etc	086-088, 090
	Other manufacturing industries incl.mfg of paper and paper products & printing, publishing & allied industries	052, 053, 083, 098
	Manufacture of watches and clocks	097
	Manufacture of leather and products of leather, fur & substitutes of leather	054-055
3	Capital goods and manufacture of office, computing and accounting machinery and parts	073-082, 084, 085, 087
	Manufacture of transport equipment and parts	091 - 096
4	Construction	099
5	Mining & quarrying	023 - 032, 058 - 059
	Manufacture of rubber, plastic, petroleum and coal products, processing of nuclear fuels	056-057
	Manufacture of basic chemicals and chemical products (except products of petroleum and coal)	061 - 068
	Manufacture of non-metallic mineral products	069 - 071
	Iron and Steel	072 -075
	Manufacture of miscellaneous metal products	076 -077
	Electricity, gas and water supply	101 - 102
6	Trade, hotels and restaurants	107, 108
	Communication services	109
	Real estate, banking and insurance	103-104
	Education, scientific and research services	110
	Health and medical services	113
	Other services including transport services and storage and warehousing	105 - 105, 114
7	Public administration and defence	115

Source: Input-Output Transactions Table 1989-90, Central Statistical Organisation, (1997), Government of India, New Delhi.

APPENDIX II : PROPORTION OF CONSUMPTION EXPENDITURE BY HOUSEHOLD TYPES FOR 7 SECTORS

	Agriculture	Manufacturing	Capital Goods	Construction	Infrastructure	Services	Public Admn.	Total
INSTITUTIONS	1	2	3	4	5	6	7	8
POOR: R F	5.433	54.216	0.000	0.000	8.518	31.833	0.000	100.000
MIDDLE: R F	4.988	50.223	0.000	0.000	3.617	41.172	0.000	100.000
RICH: R F	2.094	67.640	0.000	0.000	2.817	27.449	0.000	100.000
POOR: U F	0.886	23.729	0.000	0.000	51.733	23.652	0.000	100.000
MIDDLE: U F	0.931	24.653	0.000	0.000	45.480	28.935	0.000	100.000
RICH: U F	0.375	14.409	0.000	0.000	67.068	18.148	0.000	100.000
POOR: R I	44.479	26.019	0.000	0.000	4.825	24.677	0.000	100.000
MIDDLE: R I	25.575	32.543	0.000	0.000	2.272	39.610	0.000	100.000
RICH: R I	44.230	43.075	0.000	0.000	2.294	10.401	0.000	100.000
NON-AGR: R I	37.302	24.592	0.000	0.000	8.962	29.144	0.000	100.000
POOR: U I	24.419	34.976	0.000	0.000	5.550	35.055	0.000	100.000
MIDDLE: U I	35.310	18.761	0.000	0.000	2.646	43.284	0.000	100.000
RICH: U I	37.075	26.889	0.000	0.000	3.316	32.719	0.000	100.000
TOTAL	32.156	28.226	0.000	0.000	12.014	27.603	0.000	100.000

Appendix III : Model Equations

Prices

Import Prices:

$$pm_i = p_i^{wm} er(1 + tm_i)$$

Export Prices:

$$pe_i = p_i^{we} er(1 + tx_i)$$

Consumer Prices:

$$pc_i = \frac{pd_i XD_i + pm_i M_i}{Q_i}$$

Output Prices:

$$pq_i = \frac{pd_i XD_i + pe_i E_i}{X_i}$$

Value added Prices:

$$pva_i = pq_i(1 - pt_i) - \sum_j a_{ji} pc_j$$

Capital Prices:

$$pk_i = \sum_j b_{ji} pc_j$$

Consumer Price Index:

$$CPI = \sum_j wc_j pc_j$$

GDP deflator:

$$PGDP = \frac{GDPVA}{RGDP}$$

Output and Factors

Aggregate production function:

$$X_i = AD_i \prod_{lc} L_{i,lc}^{\alpha_{l,lc}} KP_i^{\alpha_k} KG^{\alpha_g}$$

Average wage determination:

$$wa_{lc} = \frac{X_i pva_i \alpha_{l,lc}}{\Psi_{i,lc} L_{i,lc}}$$

Labour market equilibrium:

$$\sum_i L_{i,lc} = \bar{L}_{lc}$$

CET output aggregation:

$$X_i = AT_i [\gamma_i E_i^\alpha + (1 - \gamma_i) XD_i^\alpha]^{1/\alpha}$$

Output share equation:

$$\frac{E_i}{XD_i} = \left[\left(\frac{1 - \gamma_i}{\gamma_i} \right) \left(\frac{pe}{pd} \right)_i \right]^{\left(\frac{1}{\alpha - 1} \right)}$$

Consumer good aggregation:

$$Q_i = AC_i [\delta_i M_i^{-\rho} + (1 - \delta_i) XD_i^{-\rho}]^{-1/\rho}$$

Consumption share equation:

$$\frac{M_i}{XD_i} = \left[\left(\frac{\delta_i}{1 - \delta_i} \right) \left(\frac{pd}{pm} \right)_i \right]^{\left(\frac{1}{1 + \rho} \right)}$$

Current Demand

Intermediate goods demand:

$$ND_i = \sum_j a_{ij} X_j$$

Consumption Demand:

$$CD_{i,hh} = \frac{cles_{i,hh} Y_{hh} (1 - s_{hh}) (1 - t_{hh})}{p_{ci} (1 + it_i)}$$

GDP (value added):

$$GDPVA = \sum_i pva_i X_i$$

Real GDP:

$$RGDP = \sum_i X_i - ND_i$$

Government

Government value added price:

$$pva_{pub} = \frac{\sum_{lc} wa_{lc} \Psi_{pub,lc} L_{pub,lc}}{X_{pub}}$$

Government current expenditure:

$$GX = (pva_{pub} + \sum_j a_{i,pub} pc_j) X_{pub}$$

Government revenue:

$$GR = TARIFF + DUTY + IND TAX + DIRTAX + PTAX$$

Import tariff revenue:

$$TARIFF = \sum_i tm_i M_i p_i^{wm} er$$

Export duty revenue:

$$DUTY = \frac{\sum_i te_i E_i p_e}{(1 + te_i)}$$

Domestic indirect tax revenue:

$$IND TAX = \sum_i it_i pc_i \sum_{lc} CD_{i,lc}$$

Direct tax revenue:

$$DIRTAX = \sum_{hh} t_{cn} Y_{hh}$$

Production tax:

$$PTAX = \sum_i pt_i pq_i X_i$$

Government current savings:

$$GOVSAV = GR - GX - er.debtstsv - \sum_{hh} CPI.trns$$

Income, Savings and Investment

Gross profit, net of interest costs:

$$RK_i = pva_i X_i - \sum_{lc} wa_{i,c} \Psi_{i,lc} L_{i,lc}$$

Sectoral profit rate:

$$r_i = \frac{(RK_i - DEPRC_i)}{KP_i}$$

Average profit rate:

$$\bar{r} = \frac{\sum_i (RK_i - DEPRC_i)}{\sum_i KP_i}$$

Gross household income generation

$$Y_{hh} = \Gamma_{hh}^l \sum_{lc} wa_{i,c} \Psi_{i,lc} L_{i,lc} + \Gamma_{hh}^f \lambda_i \sum_i RK_i + \Gamma_{hh}^{mf} (1 - \lambda_i) \sum_i RK_i + CPI.trns_{hh} + er.rmit_{hh}$$

Household saving:

$$HHSAV_{hh} = s_{hh} Y_{hh} (1 - t_{lc})$$

Firms investment function:

$$DK_i = \frac{\Pi_i (1 + \theta(r_i - \bar{r})) [SAVING - pk_{pub} (DK_{pub} + DKG)]}{pk_i}$$

Demand for investment goods:

$$ID_i = \sum_j b_{ij} DK_{ip} + b_{i,pub} (DKG + DK_{pub})$$

Capital stock dynamics:

$$KP_i = KP_{-1,i} (1 - \phi_i) + DK_i$$

Depreciation:

$$DEPRC_i = \phi_i p k_i KP$$

Total savings:

$$SAVING = \sum_{hh} HHSAV_{hh} + GOVSAV + aid.er$$

Equilibrium Conditions

Balance of payments:

$$\Delta NFA = \sum_i p_i^{*c} E_i - \sum_i p_i^{*m} M_i + aid + \sum_{hh} rmit_{hh} - debtsrv$$

Commodity balance:

$$Q_i = \sum_{hh} CD_{i,hh} + ND_i + ID_i$$

Objective Function

$$U = \sum_{hh} hw_{hh} \log \Pi_i CD_{i,hh}^{\frac{(cles, hh)}{(1-gles)}} X_{pub}^{\frac{(gles)}{(1+gles)}}$$

Variable List

Endogenous Variables

pm	Domestic price of imports.
pe	Domestic price of exports.
pd	Price of domestic good.
pc	Price of composite good.
pq	Price of composite output.
pva	Value added price.
pk	Destination price of capital.
CPI	Consumer price index.
PGDP	GDP deflator.
X	Domestic output.
XD	Sales of domestic output to domestic market.
Q	Total composite supply.
M	Total imports.
E _i	Total exports.

GDPVA	Total value added.
RGDP	Real GDP.
L	Labour demand.
Wa	Average wage by skill-type
ND	Intermediate demand.
CD	Consumption by household.
Y	Household income.
GX	Government recurrent expenditure
GR	Government recurrent revenue
GOVSAV	Government recurrent surplus
TARIFF	Tariff revenue
DUTY	Export duties
INDTAX	Indirect taxes
DURTAX	Direct taxes
PTAX	Production taxes
r	Real sectoral profit rate.
\bar{r}	Real average sectoral profit rate.
RK	Gross sectoral profit (net of interest costs).
HNSAV	Household saving.
DK	Investment demand by sector of destination.
IDI	Investment demand by sector of origin.
DEPRC	Depreciation by sector.
SAVING	Total savings.
INVEST	Total investment

Exogenous Variables

er	Nominal exchange rate.
p^{wm}	World price of imports.
p^{we}	World price of export.
tm	Import tariff rate.
tx	Export duty rate.
it	Indirect tax rate.
pt	Production tax rate.
t	Direct tax rate.
s	Savings propensity.
KP	Sectoral capital stock.
KG	Public capital stock
DKG	Government investment in public goods.
DKpub	Government investment in government capital.
Trns	Government transfers
debtstv	External debt service (US\$).
rmit	Remittances from overseas (US\$).
NFA	Net foreign assets (US\$).
aid	Foreign gross aid flows (US\$).
\bar{L}	Labour supply.

Technical, Behavioural and Policy Parameters

Calibration Parameters

a_j	input-output coefficients.
b_j	capital-composition coefficients.
w_c	weights for consumer price index.
AD_i	Production function shift parameter
$\Psi_{i,c}$	Wage distribution matrix
AT_i	Output CET aggregation function shift parameter
γ	Output CET share parameter
AC_i	Consumer good CES aggregation shift parameter
$\bar{\sigma}_i$	Consumer good CET share parameter
$\sigma_{i,hh}$	Consumption shares (by sector and household)
σ_g	Government share in GDP
δ	Depreciation rate
hw	Household welfare weights

"Exogenous" Parameters

α_l	Production function labour shares
α_k	Production function private capital shares
α_g	Production function public capital shares
σ_t	CES transformation parameter
σ_c	CES substitution parameter
Π_i	Investment share parameter
$\hat{\sigma}$	Investment responsiveness parameter.
λ	Formal profit share
Γ_{hh}^l	Labour income allocation parameter
Γ_{hh}^c	Formal Capital income allocation parameter
Γ_{hh}^{nc}	Informal Capital income allocation parameter

Appendix IV: Percentage Share of Women Workers by 10 sectors

No.	Sector	Female	Male
1	Agriculture	51.18	26.54
2	Beverages	5.53	0.40
3	Textiles	4.27	2.29
4	Other Manufacturing	6.49	6.33
5	Capital goods	0.14	1.79
6	Construction	3.51	9.93
7	Infrastructure	2.15	11.04
8	Combined Services	8.62	13.74
9	Other Services	7.31	12.57
10	Public admn.	10.79	15.36
	Total	100.00	100.00

Note: Aggregation from 115 sectors from Input-Output Transactions Table 1989-90.