Adjustment and Household Welfare: A Multisectoral Analysis

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Abstract: A 10-sectors, 2-factors and 7-household groups Computable General Equilibrium (CGE) model with neoclassical closure is carried out to analyse the relative impact of various taxes and tariffs on the welfare of seven socioeconomic household groups. The policy simulations are based on the equal yield tax rates.

JEL Classification No. : JEL C68, H31,1-3

Key Words : CGE, Household Groups, Equivalent Variation, Equal Yield Tax

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1. Introduction

Many developing countries including India, in the face of the internal as wall as external imbalances, have undergone various kinds of structural adjustment policies. The international agencies and the government policy makers look at the macro implications of the policies. Generally, the macro variables like inflation, budget deficit, trade deficit, exchange rate are monitored by the policy makers. The impact on households is not monitored. However, their impacts at the household level are of great concern to any society.

India has an impressive record of growth since late 1980s. But it faces massive challenges of poverty, inequality and low quality of life. Quite a substantial amount of research has gone into the problems of economic reforms. But hardly, any attempt has been made to link the macro level policies to micro level impacts. A computable general equilibrium (CGE) model becomes suitable for such type of analysis. This type of multi-sector, multi-agent linkage model becomes an indispensable tool for development economists and policy makers. An attempt has been made in this paper to build a CGE model for India and then analyse the impact of tax and tariff policies on the income distribution and the household welfare.

The rest of the paper is divided into four sections. The Section 2 explains the model. Data requirements and parameter estimates are explained in the Section 3. The policy simulations are carried out in the Section 4, where impact of various taxes and tariffs on different socio-economic groups of households are analysed with the help of equal yield tax rates. The last section contains the conclusion. The equations for the model are provided in Appendix-III.

2. The Model

The model, which is based on the 1983 table updated to 1989-90 I-O table, contains ten production activities and two factors of production, viz. labour and capital. Household and Government are the two institutions. The household institution is classified into six rural categories and one urban category (Appendix-I). As the model has been static one, the investment acts as one of the final demands only. Exported and imported goods are differentiated from the domestically produced goods by a 'Constant Elasticity of

the two institutions. The household institution is classified into six rural categories and one urban category (Appendix-1). As the model has been static one, the investment acts as one of the final demands only. Exported and imported goods are differentiated from the domestically produced goods by a 'Constant Elasticity of Transformation ' (CET) and 'Constant Elasticity of Substitution' (CES) function respectively. Neo-classical macro closure is assumed in case of trade as well as investment-saving balance. Various policy simulations in regards to taxes and government expen -ditures have been attempted.

The main aim of our model has been to capture the impacts of various macro - economic policy changes at the macro level on the welfare of the households. The model follows closely the appl -ications of SAM-based CGE models,to the developing countries. It is neoclassical and Walrasian in spirit. Some of the key features of our model can be outlined below.

A. The model is static one where investment is not made to add to the capital formation. It only plays as one of the macro demand variables.
B. Physical capital and labour are fully utilised and mobile across sectors.
C. In the government's budget constraint, transfer to households is residual and government real expenditure is fixed. The government saving is determin in the investment-saving closure.
D. In the external closure, the exchange rate moves freely in the system, while the foreign saving is fixed exogenously.
E. The model does not distinguish between purely exportable and importable sectors.
F. Foreign and domestically produced goods are assumed to be imperfect substitutes in use.
G. Total investment is given in the economy. Total saving is investment driven, which allows the government saving to be residually determined.
H. Demands equal supplies in all commodities and zero profits are made in all industries.

2.1 Production Activities and the Factor Market

Each producing sector produces a single and distinct commodity. The output in a sector is a Leontief function of intermediate inputs and real value added in that sector. The value added is a CES function of the primary factors, i.e. labour input and capital stock. This nesting is taken care of in the following manner. Output is a function of labour and capital. But the cost of production also includes the cost of fixed intermediate use.

It is assumed that factors are mobile across sectors and the aggregate labour supply and capital stock fixed in the system. They are the simple aggregation of the factors owned by the households. These total factor supplies are allotted to different sectors according to the demands generated from them.

Each sector is assumed to be one firm, maximising profit using factors and intermediate products. The producers get revenue by selling their products. They make payments to the government as excise taxes, to factors as wages on labour and rentals on capital and other producers for the purchase of raw materials. Their receipt is equal to their payment. This is called the zero profit condition. Prices attached to the demand for intermediate inputs are the producer prices, not the composite prices, because as per the assumption our intermediate inputs are not imported.

The above described producer behaviour results in well- behaved supply functions for commodities, demand functions for intermediate consumption and revenue (on account of excise tax) for the government. Given the wage rate and rental, the factor incomes are also determined.

2.2 Private Income and Consumption Demand

There are seven private consumers in the system. The consumers derive their income by selling the factors they own. Their budget also includes the taxes they pay to and transfers they receive from the government. Their income includes transfer from abroad as well. The households are assumed to save a fixed fraction of their disposable income. The rest of it is spent on the consumption of goods. The consumption functions of the households are estimated by the most suitable Stone and Greary linear expenditure system (LES) which is widely used in India.

2.3 Exports and Imports

Imports and exports augment the total supply and demand respectively. Similarly, imports deplete the demand, while exports the supply in the domestic market. There are six tradable sectors in the model (Appendix 1).

The model follows the standard small country assumption, i.e. India can import as much as it wants, given the world price level. It is a price taker and cannot affect the world prices. For import, world prices are given and on the export side, a downward sloping world demand curve is assumed. Imports and exports are functions of world prices relative to the domestic prices and exchange rate. The importable goods are not the same as the domestic goods. The Armington assumption is used for this purpose. Exported goods are assumed to be different from goods for domestic consumption. To capture this, the domestic supply of output is a constant elasticity transformation (CET) function of the above two.

2.4 The Government Sector

We have very simplistic assumption for the government behaviour. The government does not take part in production. The government gets its revenue from the excise tax on production, sales tax on goods, import duties from imported goods and income tax from households. Government income also includes the capital income from the entrepreneurship, and current as well as factor income from abroad. Government always balances its budget. Government budget includes residual transfer payments to households, while its real current consumption expenditure is fixed exogenously. The government saving is endogenously determined in the saving-investment closure.

2.5 Model Closure and Equilibrium Conditions

The model presented is purely static one. The endogenous variables are simultaneously determined in the system. The Walras Law holds as all the economic agents, the households, the producers and the government balance their budgets. The gross domestic product is same whether calculated from income or product side.

The supplies of both domestic and imports are functions of product and factor prices. The demands, both domestic and exports are also functions of product and factor prices. The excess demand functions are equalised to zero. They are homogeneous of degree zero in prices. Factor Price of labour is chosen as numeraire and is normalised to unity.

The macroeconomic equilibrium conditions for the balance of payments and the saving-investment balance close the model. Total savings comprise of private savings, government savings and foreign savings. Total investment is given in the economy and the government saving is adjusted to balance the saving-investment closure.

The balance of payment constraint holds. The foreign savings in dollar term are the difference between the total imports and total imports valued at the world price with net transfer and factor payment from abroad. For the specification of macro closure, exchange rate is endogenously determined while the foreign saving in dollar term is fixed.

3. Calibration and The Benchmark Equilibrium Data Set

The Social Accounting Matrix (SAM) gives the benchmark equilibrium data set for the model. The SAM used for the present study is constructed by Pradhan and Sahoo (1996) using 1989-90 Input-Output table The SAM is reproduced in Appendix-II.

Calibration involves a deterministic approach to specifying parameter values to be used in an applied general equilibrium model (Shoven and Whalley, 1992). In calibration if we solve the model using the base year data inputs, the result will be the input data itself. This requires finding values of 'shift' and 'share' parameters for production functions, the CES aggregation function for imports and the CET function of exports. Given benchmark data for all the variables and with estimated elasticity parameters, the shift and share parameters are calibrated.

In the LES demand functions, the values of marginal budget shares and minimum consumption parameters have been estimated with the help of micro household data taken from MIMAP Household Survey (1995). conducted by the National Council of Applied Economic Research (NCAER), New Delhi. In the benchmark, the minimum consumption parameters are calibrated with the use of these budget shares and the 'supernumerary income ratio'[1] for each household.

[1] The supernumerary income ratio measures the amount of available spending power that consumers have above the minimum consumption level. For details see Taylor, 1990.

In the benchmark equilibrium, units are so chosen that all the prices including factor prices set to one except for the composite price. Given this, the associated quantities are known from the given SAM. The model has been solved with the Generalised Algebraic Modelling System (GAMS) software.

4. Policy Issues

For a model to be successful, it is essential to do some relevant simulation exercises that should address to the policy issues of the economy. In the wake of India's New Economic Policy, attempts have been made by the policy makers to change the structure of the existing tax and trade policies, viz. reducing the excise duties and also sales taxes by the state government in some cases, moving away from quantity control to tariff control and gradually reducing the tariff rates, better income tax structure, etc. However, despite the various policy changes in the liberlised regime, the total investment required for the economy is assumed to be determined by the policy maker. This, to some extent, emphasises the role of planning (policy making) in the Indian economy. Hence, in the model, the total investment of the economy is assumed to be fixed exogenously. Policy makers have always been concerned about the efficiency of a particular type of tax. Different tax policies could have different impact on the welfare and revenue of the government. In Indian tax system, there is no tax on factors of production. In the policy simulation attempt has been to introduce the factor tax on labour and capital vis-à-vis the domestic taxes.

The policy changes have no doubt impacted on the households by affecting their income and consumption levels, and hence, their welfare. Hence, in order to look into the above issues, following simulation exercises have been proposed in the model.

SIM1: 10 % reduction in import Tariff on the manufacturing industry other than capital goods and simultaneously varying the Excise duty on this industry.

SIM2: 10% reduction in excise tax on the manufacturing industry other than capital goods and simultaneously varying the sales tax on this industry.

SIM3: 10% reduction in import Tariff on the manufacturing industry other than capital goods and simultaneously varying the sale tax on this industry.

SIM4: 10% reduction in excise duty on the manufacturing industry other than capital goods and simultaneously varying the income tax rate.

SIM5: 30% reduction in excise duty on the manufacturing industry other than capital goods and simultaneously varying the factor tax on capital in this industry.

SIM6: 30% reduction in excise duty on the manufacturing industry other than capital goods and simultaneously varying the factor tax on labour in this industry.

In the model, for the simulation purpose, tax revenue is fixed equal to the new real benchmark value i.e. using the Laspaer's Price index method and one of the tax rates will now be allowed to vary. This would determine an equilibrium equal yield tax rate.

A reduction in tariff and varying excise tax keeping the base period revenue constant (SIM 1) has shown over all inequality in the economy has not been affected much, rather it has improved to some extent (from base period 0.1959 to 0.1958). The relative factors price of capital as against the labour declines. There has been an increase in welfare for whole economy as well as for each household group. Rural agricultural households, of which agricultural self-employed household group gets maximum welfare benefit and on the other hand, the minimum welfare gain is accrued to the other household group. The rise in welfare gain is because of the increase in real consumption of agricultural commodities, electricity, education and manufacturing industries other than capital goods. Production of all these commodities have gone up except for the manufacturing industries. However, the increase in the domestic availability of the manufacturing commodities could be because of the rise in its import. A rise in excise duty on the manufacturing commodities leads to relative price rise in producer price of this industry. The domestic prices (PD) and the composite prices (PC) play important role in determining the structure of the domestic demand for domestically produced goods and for tradable goods. The structure of domestic prices depends on the relative importance of demand and supply of domestically produced goods vis-à-vis the tradable goods. It is seen that import price of manufacturing commodities has significantly gone down, while these have gone up for capital goods and, mining and quarrying. This has led to increase in imports of the former and decline in the case of capital goods and mining and quarrying. On the other hand the relative increases in the domestic price vis-à-vis the

export price reduces the production of less profitable exportable sectors. However, it depends on the price competition faced by domestic traded goods depending on how substitutable they are, in both domestic and exportable markets. This has caused the decline in the export of manufacturing commodities significantly. Despite the lower composite price for this industry which is likely to increase the domestic demand, due to the a significant dampening impact of export demand the production of manufacturing commodities goes down.

The Excise duty and the sale tax are the two domestic taxes, one is levied on the production of and the other on the demand for the commodity. The simulation pertaining to reducing the excise duty while varying the sale tax (SIM 2) on the manufacturing commodities other than the capital goods has led to a slight increase in the inequality (from base 0.1959 to 0.1962). The over all welfare of the economy goes up, but it declines for the rural non-agricultural households. Urban households gain the most in the rise in welfare and among the rural households, the welfare rises more for salaried class. The rural non-agricultural labour incurs the most welfare loss. It is mostly the increase in the real consumption demand for the manufacturing commodities, which has helped rise in welfare of some households. The production of manufacturing industry has gone up, while that of agriculture and electricity declined. The decline in excise on production of manufacturing industry is seen to be having more say on the domestic price than the increase in the sales tax. The producer, the domestic and the composite prices of this sector relative to other sectors have declined.

A reduction in tariff and varying the domestic sale tax (SIM 3) on the manufacturing commodities has slightly deteriorated the inequality in the economy (from 0.1959 to 0.1962), while the over all welfare of the economy has gone up. All the household groups except the rural non-agricultural labour have shown increase in welfare. There has been a significant welfare gain for urban households, while a loss for the rural non-agricultural labour. Like the SIM 1, in this case also the production of manufacturing industry has declined while its demand for consumption across all the household groups has gone up. This is mainly because of the increase in the domestic availability due to rise in imports. The increase in the final domestic demand due to the decrease in the relative composite price of the manufacturing commodities is outweighed by the sharp decline in the export demand for this. This has a dampening impact on the production. The

decline in the relative factor price of capital has caused a shift in the factor demand from labour to capital.

A decrease in the excise duty on the manufacturing commodities while adjusting the income tax (SIM 4) has slightly worsened the income distribution (Ginni coefficient from 0.1959 to 0.1960). The income tax is levied only on the urban households. The over all welfare of the society has declined. It has declined significantly for the urban households and among rural households groups, for the non-agricultural wage earners. The maximum welfare gain accrues to the rural agricultural self-employed and the rural salaried class. The household demand has been mostly for the manufacturing commodities and the least for the electricity. For the former, the production has gone up, whereas for the latter, it has declined significantly. Due to the decline in the excise, all the relative prices of the manufacturing industry have gone down. This causes a rise in the domestic demand for the manufacturing commodities, while a decline in the import of these commodities.

In SIM 5 and 6, the tax on the factors of production has been introduced. A cutting down of the excise duty on the manufacturing commodities and varying the factor tax on the capital in the manufacturing industry (SIM 6) has resulted in slightly deterioration of income distribution (Ginni coefficient from 0.1959 to 0.1961). There has been a welfare gain in the economy, despite the welfare loss of three houehold groups, viz. rural agricultural self-employed, rural non-agricultural self-employed and rural other households. The urban households derive the maximum welfare while the rural agricultural self-employed incurs a significant decline in the welfare. Among the rural household groups, the agricultural labour household group benefits from this policy. There has been a significant decline in the factor price for the capital relative to the labour, which leads to the decline in the relative demand for the labour for all industries except for the manufacturing industry. It is interesting to note that the electricity sector has gained in this policy change. Its production has gone up significantly and also its demand from the household groups has also shown significant rise. Though the production of manufacturing industry has shown an increase, other sectors like capital goods and mining and quarrying have also increased their output more than the manufacturing industry. However, the agricultural production has declined. Except for the capital goods, there is a decline in the import demand. There has been a significant slump in the export demand for the manufacturing industry.

If the excise duty on the manufacturing industry is reduced varying the factor tax on the labour in this industry, the income distribution marginally improves (Ginni coefficient from 0.1959 to 0.1958). On the other hand, the welfare of the economy declines because of the reduction in the welfare for the urban households, rural agricultural labour, rural non-agricultural labour and rural salaried class. The urban households have maximum decline in the welfare. Among rural household groups, agricultural labour incurred maximum loss of welfare. Rural agricultural self-employed has gained maximum welfare in this scenario. The factor price of capital has shown a significant increase relative to the labour resulting in the decline in the relative demand for capital for almost all industries but for the manufacturing industry. Barring the production of agriculture, education and health, other sectors shown slide in the production. Among the relative prices of other industries, the agricultural prices have marked relatively slow rise. This has caused the rise in the relative demand for the agriculture and hence, resulting in the rise in the production. Unlike the SIM 6, in this case the imports of all the commodities rise except for the capital goods and the relative demand for the export of manufacturing industry is the highest.

5. Conclusion

In the Indian economy, the tax policies play a very significant role in guiding the price, demand and production in the economy. They affect the welfare of the economy directly as well as indirectly. These issues have been analysed using a computable general equilibrium (CGE) model, which have taken care of the relevant tax structure of the Indian economy. It is seen that the import tax reduction on the manufacturing industry vis-à-vis the domestic taxes gives rise to more household welfare. In the domestic tax policies, the excise tax reduction results in a gain in the welfare vis-à-vis the sale tax. A raise in the income tax vis-à-vis a reduction in the domestic tax, excise or sales tax, on the manufacturing industry sector yields the total welfare loss, mainly because only the urban households pay income tax. However, there has been a gain in welfare for all the rural household groups. While reducing the excise duty on the manufacturing industry, an increase in the factor tax on labour is preferable to an increase in the factor tax on capital in the same industry from the point of view of household welfare. In general, the study shows the existence of an inverse relationship between income distribution and welfare when the economy grows.

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APPENDIX-I

Factors of Production

1. Labour
2. Capital

Production Sectors

1. Foodgrains (tradable)
2. Other Agriculture (tradable)
3. Mining & Quarry (tradable)
4. Manufacturing Industries other than Capital goods (tradable)
5. Capital Goods (tradable)
6. Construction
7. Electricity, Gas & Water
8. Education
9. Health
10. Other Services (tradable)

Households

a.Rural Households

1. Agricultural Self-Employed
2. Agricultural Labour
3. Non-agricultural Labour
4. Non-Agricultural Self-Employed
5. Salaried Class
6. Other Households

b. Urban Households

Social Accounting Matrix for India, 1989-90 (Rs. Million)

	FACTORS		RURAL								
	Labour	Capital	Ag.Self Employ.	Agril Labour	Non Ag. Labour	Non Ag. Self	Salaried class	Other house	Urban house	GOVT.	IND.TAX
Labour Capital											
HOUSEHOLDS											
AG. SELF(R)	1301820	87350								8440	
AG LAB(R)	285320	370								1510	
NON AG.LAB(R)	11930	30								80	
NON AG. SELF(R)	233710	24840								1480	
SALARIED(R)	238770	10680								1540	
OTHERS(R)	28140	45830								67680	
URBAN	683945	1027605								216420	
GOVERNMENT	0	106270							118880	1660	481590
IND. TAXES			37717	15732	985	10580	4951	8874	41714	18990	
ACTIVITIES											
FOODGR			189275	101475	8834	50684	18310	32865	114007	766	
OTH AG			169075	55552	4836	42919	21684	37253	213915	657	
MINING & Q.			646	352	31	186	82	137	611	74	
OTHER IND.			259883	112115	7018	72814	37089	63618	227733	44649	
CAP.GOOD			7863	1695	106	1881	703	1877	16565	7634	
CONSTRUCN.			0	0	0	0	0	0	0	47632	
ELECTR			5336	2912	254	1536	674	1130	5052	13245	
EDUCATION			14403	2150	1822	8873	5102	1033	24716	85152	
HEALTH			15091	4168	4042	5321	6047	1249	18322	38886	
OTH SERV			209868	82224	1710	62507	20014	66728	344727	284346	
CAPITAL ACC			489573	0	0	2929	136534	0	754588	-	115330
ROW											940
TOTAL	2783635	1302975	1398730	378375	29638	260230	251190	214764	1880830	726451	481590

Social Accounting Matrix for India, 1989-90 (Rs. Million) (Contd.)

	Food Grain	*Other Ag.*	*Mining Quarry*	*Other Ind.*	*Capital Goods*	*Const-ruction*	*Elect-ricity*	*Educ-ation*	*Health*	*Other Serv.*	*Captial Account*	*Rest of World*	*TOTAL*
Labour	433679	623419	53188	298442	98211	219245	37223	83296	25720	911212	2783635		2783635
Capital	101581	111831	49902	309348	64759	16615	50007	34414	9780	554738	1302975		1302975
HOUSEHOLDS													
AG. SELF(Rural)											1120	1398730	1398730
AG LAB(Rural)											90975	200	378375
NON AG.LAB(Rural)	17588	10	29638										29638
NON AG. SELF(Rural)	200	260230											260230
SALARIED(Rural)	200	251190											251190
OTHERS(Rural)	64144	8970	214764										214764
URBAN	-47140	1880830											1880830
GOVERNMENT	18050	726450											726451
IND. TAXES	-56499	-10293	80797	40275	134451	67298	6482	6566	8946	-13121	74932	2213	481590
ACTIVITIES													
FOODGR	72088	31746	0	61477	0	0	17	1150	600	16826	13039	4375	717534
OTH AG	51319	204764	2	186314	886	18213	292	671	402	27909	41898	34796	1113357
MINING & Q.	450	300	1192	145889	897	30035	27711	0	0	6371	8576	10131	233671
OTHER IND.	47809	62281	9351	633692	111964	142375	8535	11437	37261	116537	164755	211690	2382606
CAP.GOOD	5084	4512	8593	13250	76630	21372	7686	145	123	46392	409930	20227	652268
CONSTRUCN.	19047	15059	2327	10462	4362	72	4151	1644	588	43896	459537	0	608777
ELECTR	9108	4201	7498	74115	6666	9736	53339	54	705	19582	0	0	215143
EDUCATION	0	0	0	0	0	0	0	0	0	203	0	0	143454
HEALTH	6	27	0	0	0	0	16	105	85	998	0	0	94363
OTH SERV	30127	59635	11523	324861	56743	83817	19682	3971	10153	229991	45712	68368	2016707
CAPITAL ACC												8970	1277264
ROW	3735	5875	9297	284479	96700	0	0	0	0	55173	-113820	342379	
TOTAL	**717534**	**1113357**	**233670**	**2382604**	**652269**	**608778**	**215141**	**143453**	**94363**	**2016707**	**1277266**	**342380**	

Production Function

For each sector, output is a CES production function of labour and capital.

$$Q(s) = A(s)*[\alpha(s)*L^d(s)^{(\sigma(s)-1)/\sigma(s)} + (1-\alpha(s))*K^d(s)^{(\sigma(s)-1)/\sigma(s)}]^{\sigma(s)/(\sigma(s)-1)}$$

s = 1,.....10 production sectors

$Q(s)$ = sectoral output

$A(s)$ = scale parameter

$\alpha(s)$ = share parameter

$\sigma(s)$ = elasticity of substitution

$L^d(s)$ = sectoral labour demand

$K^d(s)$ = sectoral demand for capital

Factor demands from the cost minimising behaviour:

$$L^d(s) = A(s)^{-1}*\{\alpha(s)+(1-\alpha(s))*[\alpha(s)P_L/(1-\alpha(s))P_K]^{(1-\sigma(s))}\}^{\sigma(s)/(1-\sigma(s))}$$

$$K^d(s) = A(s)^{-1}*\{\alpha(s)+(1-\alpha(s))*[\alpha(s)P_K/(1-\alpha(s))P_L]^{(1-\sigma(s))}\}^{\sigma(s)/(1-\sigma(s))}$$

where P_L = unit price of labour

P_K = unit price of capital

Zero Profit Condition for Output:

Value added and intermediate demands are fixed proportion of output.

$$Pq(s)*(1-prtax(s))*Q_S(s)= P_L*L^d + P_k*K^d +\sum_t IOINt,s)*Pq(t)*Q_S(s)$$

Pq(s) = Domestic producer's prices

prtax(s) = Net excise taxes

IOIN(t,s) = Input-Output coefficients

s,t = 1,....10 production sectors

Factor Market Equilibrium:

Ttoal factor endowment of household is equal to the total factor demand.

$$\sum_s L^d(s) = \sum_h L^S(h)$$

$$\sum_s K^d(s) = \sum_h K^S(h) + K_G \quad h=1,...7 \text{ households}$$

Where,

K_G = exogenously given government's capital endowments.

$K^S(h)$ = exogenously given capital endowment of household 'h'.

Disposable Income of Households

$$Y(h) = [P_L{*}L^S(h) + P_k{*}K^S(h)]{*}(1\text{-inctax}(h)) + TRNG(h) + TRNFRD(h){*}EXRAT$$

Where,

inctax(h) = Income tax rate paid by the household on their factor income

TRNG(h) = Government transfer payment going to each household

REV = Total government revenue

TRNFRD(h) = Net transfer in dollar from the rest of the world to household

EXRAT = Exchange rate

Private Consumption Demand:

The household consumption demand for the composite goods is derived by maximising the Stone-Geary utility function s.t. that

$$\sum_s Pc(s){*}\sum_s Cd(h,s) + SAV(h) = Y(h)$$

Hence, the LES consumption demand function for composite goods becomes,

$$Cd(h,s) = C_0(h,s) + (\beta(h,s)/P_c(s)){*}[TotCd(h) - \sum C_0(h,s){*}P_c(s)]$$

Where,

Cd(h,s) = Private demand for composite goods/

$C_0(h,s)$ = Minimum consumption of good 's' of household 'h'

$\beta(h,s)$ = Marginal budget share of household 'h' for good 's'

TotCd(h) = Total consumption expenditure of household 'h'

$P_c(s)$ = Prices of composite goods for final demand

Private Savings:

Private saving is constant proportion of nominal disposable income.

$$PS(h) = S_0(h)*Y(h)$$

where,

PS(h) = Private savings

$S_0(h)$ = Constant proportion of private saving of the private disposable income

Investment Demand:

Sectoral investment demand by origin is fixed proportion of total investment in the economy.

$$Id(s) = i(s)*TINV/Pc(s)$$

Where

i(s) = Sectoral investment share by origin

TINV = Total nominal investment in the economy.

Total Final Demand:

$$FD(s) = \sum_h Cd(h,s) - Gd(s) + Id(s)$$

Gd(s) = Sectoral Government consumption expenditure

Export Transformation:

Price of export is defined as

$$Px(s) = PWE(s)*EXRAT$$

And the exports face a constant elasticity demand function:

$$EXPT(s) = EXPT_0(s)*(PWE_0(s)/PWE(s))^{e(s)}$$

where $PWE_0(s)$ is exogenously given world export price and India's export price to the importing countries for commodity 's'. EXPT(s) is export of commodity 's' and e(s) is the export demand elasticity.

The CET function between domestically consumed and exported goods are given as

$$Q_d(s) = CET(s)*[\pi(s)*EXPT(s)^{\omega(s)}+(1-\pi(s))*FDD(s)^{\omega(s)})^{(1/\omega(s))}$$

$Q_q(s)$ is the demand for sectoral output. CET(s), ð(s) are technological constant and share parameters and ù(s) is elasticity of transformation. FDD(s)is the final domestic demand for domestically produce goods. Maximizing the revenue from a given output.

$$Pq(s)*Q_d(s) = Pd(s)*FDD(s)+Px(s)*EXPT(s)+Pq(s)*\sum_t IOIN(s,t)*Q(t)$$

subject to CET function gives the ratio of exports to domestic sales:

$$EXPT(s)/FDD(s) =(\pi(s))/(1-\pi(s)))^{(1/(1-\omega(s)))} *(Px(s)/Pd(s))^{(1/(1-\omega(s)))}$$

Where Pd(s) is price for domestic supply for domestically produced goods and IOIN(s,t) is the demand for intermediate inputs.

Import Aggregation:

Assuming that consumers try to minimise the cost of acquiring a given amount of the composite good, the desired ratio of imports to domestic commodity is derived from first-order conditions of CES aggregation and is a function of the relative prices of domestic good and imported substitute.

The CES aggregation function is given by

$$FD(s) = ARM(s)*[\sigma(s)*IMP(s)^{-\rho(s)}+(1-\sigma(s))*FDD(s)^{-\rho(s)})^{(-1/\rho(s))}$$

Minimizing the cost of obtaining the unit composite good,

$$FD(s)*P_c(s) = FDD(s)*Pd(s)*(1+saltax(s))+ IMP(s)*Pm(s)*(1+tm(s))$$

subject to the CES function gives:

$$IMP(s)/FDD(s) = (\sigma(s)/(1-\sigma(s)))^{(1/(1+\rho(s)))}$$

$$*(Pq(s)*(1+saltax(s))/Pm(s)*(1+tm(s)))^{(1/(1+\rho(s)))}$$

FD(s) and IMP(s) are total final composite goods, and imports. σ(s), ARM(s) and σ(s) are share parameter, scale parameter and elasticity of substitution respectively. $P_c(s)$, slstax(s) and tm(s) represent composite price, sales tax rate and import tariff respectively.

World price is converted to import price by:

$$Pm(s) = PWM(s)*EXRAT$$

Commodity Market Equilibrium:

$$Q_d(s) = Q_S(s)$$

Saving-Investment Equilibrium:

$$TS = TINV$$

Government Budget:

Tax Revenue:

$$TAXREV = \sum[P_L{}^*L^S(h) + P_K{}^*K^S(h)]^*inctax(h) + \acute{O}_s\, FD(s)^*Pc(s)^*saltax(s) + \sum_s Q_S(s)^*Pq(s)^*prtax(s) + \sum_s IMP(s)^*PWM(s)^*EXRAT^*tm(s)$$

Total Revenue:

$$REV = TAXREV + TRNFGRD^*EXRAT + P_K{}^*K_G$$

Where, TRNFGRD is the net transfer from the rest of the world to the Government in dollar.

$$REV = REV0^*\acute{O}_s\, Q_S(s)^*Pq(s)/\, Q0_S(s)^*Pq0(s)$$

REV0 is the benchmark revenue and Pq0(s) is the benchmark producer price of sector, 's'.

Fiscal Balance:

$$GS = REV - TRNGT - \sum_s Gd(s)^*Pc(s)$$

GS is the government saving and Gd(s) is the government consumption expenditure for commodity 's'. TRNGT is the total nominal government transfer payment to the households.

$$TRNG(h) = TRN0(h)^*TRNGT$$

A fixed TRNG(h) goes as the transfer payment of government to the household 'h'.

Trade Balance:

$$\sum_S(EXPT(s)^*PWE(s)) - \sum_S(IMP(s)^*PWM(s)) + FSD + \sum_h TRNFRD(h) + TRNFGRD = 0$$

where FSD is the foreign savings in dollar.

Total Savings:

$$TS = \sum_h PS(h) + GS + FSD^*EXRAT$$

Parameters and Exogenous Variables

1. $\sigma(s)$: elasticity of substitution
2. $\alpha(s)$: share parameters in the production
3. A(s) : scale parameters in the production
4. IOIN(t,s) : intermediate goods coeffients
5. $V_0(s)$: proportion of value added to the output
6. $C_0(s)$: private consumption share
7. $S_0(h)$: constant proportion of household saving of the household to disposable income
8. i(s) : sectoral investment share by origin
9. $\pi(s)$: share parameters in the import CES aggregation function
10. $\rho(s)$: elasticity of substitution between imported and domestically produced goods
11. ARM(s) : scale parameters of the import (CES) aggregation function
12. CET(s) : sclae parameters of the export transformation function
13. $\delta(s)$: share parameters in the export CET function
14. $\eta(s)$: export elasticity of transformation
15. e(s) : price elasticities of export demand
16. Gd(s) : sectoral government "composite consumption"
17. prtax(s) : net excise tax rates
18. saltax(s) : sales tax rates
19. inctax(h) : income tax rates
20. tm(s) : import tariff rates
21. shgd(s) : fixed share of real government expenditure going to household, 'h'
22. TRNFRD(h): net transfer from the rest of the world to household in dollar
23. $K^S(h)$: capital endowment with the households
24. K_G : capital endowment of the government

25. $PWE_0(s)$: world export price

26. PWM(s) : world import prices

27. $EXPT_0(s)$: constant term in the export demand function

28. TINV(s) : total investment in the economy

29. FSD : foreign savings in dollar

Endogenous Variables

1. Pc(s) : prices of composite goods for domestic demand

2. P_L : unit price of labour

3. P_K : unit price of capital

4. Pv(s) : value added prices

5. Pq(s) : producer's prices

6. Pm(s) : domestic prices of imported goods

7. PWE(s) : India's export price faced by the trading county

7. VA(s) : sectoral value added

8. $Q_S(s)$: sectoral output

10. $L^d(s)$: sectoral labour demand

11. $K^d(s)$: sectoral capital demand

12. Cd(h,s) : household sectoral consumption demand for composite goods

13. PS(h) : household savings

14. Id(s) : composite investment demand

15. $Q_d(s)$: total demand for output

16. Y(h) : disposable income of the household

17. TAXREV : tax revenue

18. REV : total government revenue

19. FDD(s) : final domestic demand for domestically produce goods

20. FD(s) : total final demand

21. XD(s) : total domestic demand for domestically produced goods

22. EXRAT : exchange rate

23. TGD : total nominal government current expenditure

24. Gd (s) : real government consumption demand for sector. 's'

24. TS : total savings in the economy

25. GS : government saving

26. TRNG (h) : government transfer payment to the household, 'h', to the revenue

27. TRNGT : total government transfer to the households

28. TRNG (h) : fixed proportion of govt. transfer to the household 'h'

Table 1: Change in Equivalent Variation, Ginni and Factor Price of Capital (Percentage Change)

	PERCENTAGE CHANGE IN EV							*TOTAL*	*GINNI*	*Factor Price*
	RURH1	*RURH2*	*RURH3*	*RURH4*	*RURH5*	*RURH6*	*URB*	*EV*	*COEF.*	*of Capital**
BASE	0	0	0	0	0	0	0	0	0.1959	0
SIM1	2.478	1.582	0.964	0.856	1.439	0.702	1.084	9.104	0.1958	-0.0283
SIM2	0.021	0.329	-1.484	-0.010	0.558	-0.394	1.199	0.218	0.1962	0.0133
SIM3	2.479	2.108	-1.550	0.823	2.347	0.030	3.074	9.311	0.1962	-0.0048
SIM4	0.912	0.612	-0.370	0.301	0.730	-0.053	-3.792	-1.659	0.1960	0.2402
SIM5	-3.870	2.010	0.552	-0.622	1.638	-0.426	3.205	2.487	0.1961	-0.7122
SIM6	4.137	-2.073	-0.534	0.678	-1.695	0.480	-3.399	-2.406	0.1958	0.7521

* Factor price of Labour (wage) is taken as numeraire.

Table 2: Change in Production under different Alternatives (percentage change)

	SIM 1	*SIM 2*	*SIM 3*	*SIM 4*	*SIM 5*	*SIM 6*
Foodgrain	0.05902	-0.02405	0.01660	0.00683	-0.02449	0.02631
Other Agriculture	0.08632	-0.05158	-0.00222	-0.03612	-0.15446	0.16449
Minig & quarrying	0.21436	-0.08824	0.06968	-0.07932	0.09002	-0.08164
Manufacturing Industries	-0.24798	0.12657	-0.03162	0.15977	0.02650	-0.06335
Capital Goods	-0.36144	0.04517	-0.28584	0.02935	0.12265	-0.16027
Construction	-0.11280	0.06786	0.00152	0.06802	0.03582	-0.05534
Electricity	0.34299	-0.22053	-0.02075	-0.18819	0.17326	-0.15604
Education	0.00493	-0.00972	-0.01207	-0.02043	-0.02623	0.02683
Health	-0.03895	0.01002	-0.02302	0.00847	-0.03248	0.02768
Other Services	0.06136	-0.01390	0.03755	-0.04661	0.03506	-0.03479

Table 3: Change in Prices under different Alternatives (percentage change)

Sectors	SIM 1			SIM 2			SIM 3			SIM 4			SIM 5			SIM 6		
	Producer Price (PQ)	Domestic Price (PD)	Composite Price (PC)	Producer Price (PQ)	Domestic Price (PD)	Composite Price (PC)	Producer Price (PQ)	Domestic Price (PD)	Composite Price (PC)	Producer Price (PQ)	Domestic Price (PD)	Composite Price (PC)	Producer Price (PQ)	Domestic Price (PD)	Composite Price (PC)	Producer Price (PQ)	Domestic Price (PD)	Composite Price (PC)
Foodgrain	0.03958	0.02118	0.03050	-0.02417	-0.00918	0.00828	-0.00106	0.00504	0.01591	-0.02476	-0.00687	-0.00734	-0.15609	-0.13987	-0.13974	0.16831	0.14938	0.14973
Other Agriculture	0.03719	-0.00095	0.01672	0.02265	-0.00236	-0.00075	-0.00092	-0.00669	0.01371	-0.02317	-0.00470	-0.00560	-0.13531	-0.16861	-0.16799	0.14620	0.17707	0.17736
Minig & quarrying	0.03965	-2.50524	1.00359	-0.02503	-0.58680	0.05828	-0.00223	-3.47408	1.10162	0.02628	-0.04120	-0.07057	-0.32788	-0.28002	-0.13537	0.19465	0.14641	0.19465
Manufacturing Industries	0.49366	-0.31893	-0.44539	-0.29341	-0.64418	-0.39897	-0.00201	-1.38533	-1.10527	-0.29453	-0.39135	-0.28912	-0.27477	-0.43948	-0.39298	0.40868	0.48039	0.40868
Capital Goods	0.16351	0.05668	0.39560	-0.09808	-0.09255	-0.03653	-0.00193	-0.09965	0.33381	-0.09916	-0.09645	-0.09032	-0.27754	-0.25960	-0.22309	0.29222	0.28496	0.26222
Construction	0.14482	0.15586	0.15586	-0.08653	-0.09297	-0.09297	-0.00123	-0.00116	-0.00116	-0.08721	-0.09361	-0.09361	-0.17547	-0.16426	-0.16426	0.19043	0.19043	0.19043
Electricity	0.04142	-1.09786	-1.09786	0.02621	0.67526	0.67526	-0.00242	-0.00500	-0.00500	-0.02757	0.67191	0.67191	-0.35550	-0.78498	-0.78498	0.71501	0.71501	0.71501
Education	0.03772	0.03773	0.03773	-0.02335	-0.02335	-0.02335	-0.00146	-0.00146	-0.00146	-0.02417	-0.02417	-0.02417	-0.21474	-0.21467	-0.21467	0.23088	0.23088	0.23088
Health	0.21836	0.22064	0.22064	-0.13035	-0.13169	-0.13169	-0.00169	-0.00169	-0.00169	-0.13129	-0.13264	-0.13264	-0.23968	-0.23944	-0.23944	0.27701	0.27001	0.27700
Other Services	0.03369	0.00181	0.06692	-0.02120	0.02568	0.03025	-0.00181	0.04412	0.11693	-0.02222	-0.00158	-0.00510	-0.26598	-0.27254	-0.26515	0.28484	0.28926	0.28484

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