

Multi-sectoral Analysis of Foreign investment and Trade liberalization in India: A CGE modeling approach

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Abstract

India's growth story has attracted worldwide attention, particularly because this growth has been fuelled by the wide ranging economic reforms introduced since early 1990s. A distinctive feature of Indian liberalization was the gradual and calibrated manner in which the reforms were introduced in the various sectors of agriculture, manufacturing and services. This paper is a modest attempt to capture the role played by trade liberalization and foreign direct investment (FDI) policies in growth and development of different sectors in India. We applied computable general equilibrium (CGE) modelling as our relevant methodology following Das and Chakraborti (DOI 10.1007/s40622-013-0003-3), 2013. The paper constructs a social accounting matrix (SAM) and attempts to analyze the impacts of reduced import tariff and increased FDI on export-import volumes of different sectors and on exchange rate, GDP, rural and urban income levels and government income under perfect competition market structure. The study reveals that reduction in import tariff increases imports leading to a depreciation of home currency and boosting exports. On the other hand, increase in FDI appreciates exchange rate, making import cheaper and so import increases in all sectors. Export becomes less profitable leading to a reduction of sectoral export.

Keywords: SAM, Trade liberalization, Foreign investment

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1. Introduction

The trade liberalization in India refers to the ongoing economic liberalization of the country's policies initiated in 1991. The goal of liberalization was to make the economy more market oriented and expand the role of private and foreign investment. The reforms include a reduction in import tariffs, deregulation of markets, reduction of taxes, and greater foreign investment. Liberalization has been credited by its proponents for the high economic growth recorded by the country in the last two decades while its opponents have blamed it for increased poverty, inequality and economic degradation. In fact, in recent years, the Reserve Bank of India Governor, Raghuram Rajan took a bold step by raising the limit of foreign stake holding in banking sector. Within a fortnight, exchange rate problem was under control owing to greater supply of foreign exchange. After depreciating to a record low of almost 69 in the beginning of September 2013, the Indian Rupee rose in value to 63.5 on 15th September, 2013 as a result of greater flow of foreign direct investment into the country.

This paper tries to analyze (a) the impact of trade liberalization and particularly the impact of variation in import tariff and (b) impact of variation of foreign direct investment in the country on:

- (i) volume of import and export
- (ii) GDP
- (iii) exchange rate
- (iv) rural and urban income levels
- (v) income of the government.

The paper considers the five major sectors of agriculture, manufacturing, services, trade and infrastructure for an open economy and perfect competition using a CGE model.

Most of the economic literature considers that trade liberalization leads to an increase in welfare derived from an improved allocation of domestic resources. Import restrictions of any kind create an anti-export bias by raising the price of importable goods relative to exportable goods. The removal of this bias through trade liberalization will encourage a shift of resources from the production of import substitutes to the production of export-oriented goods. This, in turn, will generate growth in the short medium term as the country adjusts to a new allocation of resources more in keeping with its comparative advantage (McCulloch, Winters and Cirera, 2001). On the contrary, it is expected to create adjustment costs, encompassing wide variety of potentially

disadvantageous short-term outcomes. These outcomes may include a reduction in employment and output, the loss of industry- and firm-specific human capital, and macro-economic instability arising from balance-of-payments difficulties or reductions in government revenue (Matuszand Tarr, 1999). The size of the adjustment costs depends on the speed with which resources make the transition from one sector to another.

Indian reforms in the 1990s were manifold, encompassing macroeconomic and external trade aspects. The macroeconomic (stabilization) programme placed emphasis on addressing the fiscal and current account imbalances. The unilateral liberalization coincided with multilateral trade negotiations undertaken as part of the Uruguay Round trade negotiations. The main bilateral and regional trade agreements include SAPTA, BIMSTEC and IOR-ARC. The export–import policy, in effect from 1992-1997 (Foreign Trade Regulation Act 1992) significantly reduced trade restrictions. Import tariffs were reduced gradually by compressing the top tariff rates, while rationalizing the tariff structure by reducing the number of tariff bands. The highest tariff stood at 355%, simple average 113% weighted average 87%. This was further reduced to 71% in 1993/94 and to 41% in 1995/96. The different import license systems continued to function, but were reformed to make them less restrictive (Open General Licenses, Value Based Advance Licensing drop). Special Economic Zones (SEZs) were introduced through the Export/Import Policy of 2000 to provide an internationally competitive and “hassle free” environment for export-oriented firms.

Also, the government of India with the help of World Bank and IMF introduced the macro-economic stabilization and structural adjustment program. As a result of these reforms India opened its door to FDI inflows and adopted a more liberal foreign policy in order to restore the confidence of foreign investors. Further, under the new foreign investment policy Government of India constituted FIPB (Foreign Investment Promotion Board) whose main function was to invite and facilitates foreign investment. Starting from a baseline of less than USD 1 billion in 1990, a recent UNCTAD survey projected India as the second most important FDI destination (after China) for transnational corporations during 2010-2012. As per the data, the sectors which attracted higher inflows were services, telecommunication, infrastructure and computer software and hardware. Mauritius, Singapore, USA and UK are among leading sources of FDI in India. FDI has an important impact on country’s trade balance, increasing labour standards and skills, transfer of technology and the general business climate.

Selection of Computable General Equilibrium (CGE) model: A CGE model is a general equilibrium model which uses the power of today's computers to calculate numerically the effects of a particular change that is introduced to the model (e.g. a change in trade policy). It preserves the optimizing assumptions and links between markets that are the hallmarks of the standard general equilibrium model. The main reason why a CGE trade model has been chosen is that it arrives at a numerically precise answer while ensuring that the results are theoretically consistent. However, the results of CGE simulations are only as good as the specification of the models and the data that are fed into them.

2. Review of Literatures

Literature review has been done on two main topics: Social Accounting Matrix and CGE modeling both in Indian context and abroad.

a) Social Accounting Matrix (SAM)

There have been a lot of studies around construction of SAM in India and abroad. Some of the relevant ones in India have been presented as below:

Table 1: Relevant literature on SAM in India

No.	Name of researchers/ year	Salient Features of SAM
1	Sarkar, H. and Subbarao, (1981).	Base year: 1979-80. Sectors (3 in all): agriculture, industry and services. Agents: non-agricultural wage income class, non-agricultural non-wage income class, agricultural income class, and government.
2	Sarkar, H. and M. Panda, (1986).	Base year: 1983-84. Sectors (6 in all): agriculture (2), industry (2), infrastructure and services. Agents: non-agricultural wage income class, non-agricultural non-wage income class, agricultural income class, and government.
3	Bhide, S. and S, Pohit. (1993).	Base year: 1985-86. Sectors (6 in all): agriculture (2), livestock & forestry, industry (2), infrastructure and services. Agents: government, non-agricultural wage income earners, non-agricultural profit income earners, and agricultural income earners
4	Pradhan, B. and A. Sahoo, (1996).	Base year: 1989-90. Sectors (8 in all): agriculture (2), mining and quarrying, industry

No.	Name of researchers/ year	Salient Features of SAM
		(2), construction, electricity combined with water and gas distribution, and services (3). Agents: government, agricultural self-employed, agricultural labour, and nonagricultural self-employed and other labour.
5	Pradhan, B. Sahoo, A. and M.R. Saluja, (1999).	Base year: 1994-95. Sectors (60 in all): agriculture (4), livestock products (2), forestry sector, mining (4), manufacturing (27), machinery and equipment (6), construction, electricity, transport (2), gas and water supply, other services (11). Agents: government, self employed in agriculture (rural & urban), self employment in non-agriculture (rural & urban), agricultural wage earners (rural & urban), other households (rural & urban), private corporate, and public non-departmental enterprises.
6	Pradhan, B. K. M.R. Saluja and S. K. Sing (2006).	Base year: 1997-98. Sectors (57 in all): agriculture (4), livestock products (2), forestry, mining, manufacturing (27), machinery and equipment (6), construction, electricity, transport (2), gas and water supply, other services (11). Agents: government, self employed in agriculture (rural & urban), self employment in non-agriculture (rural & urban), agricultural wage earners (rural & urban), other households (rural & urban), private corporate, and public non-departmental enterprises.
7	Sinha, A. Siddiqui. K.A, and Munjal. P (2007).	Base year: 1999-2000. Sectors (13 in all): agriculture (informal), formal manufacturing (9), construction (informal), other services (formal & informal), and government service. Agents: casual labour (rural & urban), regular wage earner (rural & urban), own account worker (rural & urban), employer (rural & urban), and government.
8	M.R.Saluja and Yadav.B (2006).	Base year: 2003-04. Sectors (73 in all): agriculture (12), livestock products (4), forestry, mining (4), manufacturing (28), machinery and equipment (7), construction, energy, gas distribution, water supply, transport (2), other services (10). Agents: 5 rural households' expenditure classes, 5 urban households expenditure classes, private corporation, public

No.	Name of researchers/ year	Salient Features of SAM
		enterprises and government.
9	Ojha V.P. and S, Pohit et al. (2009).	<p>Base year: 2003-04.</p> <p>Sectors (36 in all): Agriculture & allied (7), Mining & Quarrying (4), Manufacturing industries (12), Transport (5), Other service (2), Electricity (3), Water supply, Biomass and construction.</p> <p>Agents: 5 rural household income classes, 4 urban household income classes, private corporation, public enterprises and government.</p>

b) Computable General Equilibrium Models

The first CGE model was developed by L. Johansen (1960) which was a simple model and could be solved easily using elementary algebra. This was followed by Scarf who converted theoretical general equilibrium framework to a useful tool for policy analysis. Hansen and Scarf (1973) formalized new techniques for computation of equilibrium prices in a nonlinear set up. Development of different software made CGE popular to the academicians as well as to the policy makers in the beginning of 80's.

Full blown global trade model started with Michigan model of world production and trade by Deardorf and Stern, 1986 which is developed to examine employment effects of Tokyo round. There are several other global trade models including Mckibbin and Sach (1991), G-cubed (Mckibbin and Wilcoxon, 1992) and SALTER (Jomimi et al. 1994) and the multiregional global trade model by Harrison, Rutherford and Tarr, 1996. At present, the most acclaimed and widely popular global trade model is GTAP (Global Trade Analysis Project) model by Hertel, et al 1997.

Table 2: Relevant literature on CGE model

Name of author	Objectives of the study	Results and Conclusion
Dervis, Melo and S.Robinson (1982)	Construction of General equilibrium models for development policy.	<ul style="list-style-type: none"> • Systematic formulation of computable general equilibrium models and their application to the policy problems of individual countries. • They made applications to problems ranging from the response to rising energy prices to long-term structural change and income distribution. • As a result of extensive testing of alternative methods, like Input-Output modelling and CGE models they are able to show the advantages and limitations of more complex general equilibrium formulations in comparison to simpler forms of inter industry analysis.
Dixon, Parmenter, Powell and Wilcoxon(1992)	To discuss the Notes and Problems on Applied General Equilibrium.	<ul style="list-style-type: none"> • The book is written as a text for an applied general equilibrium course, as well as a useful reference for students interested in using computational general equilibrium models as a research tool. • Different chapters of the book described Input-Output Data and Input-Output Models, the Johansen Approach the Construction of a Model for Practical Policy Analysis and an Introduction to Inter temporal Modeling.
Johansen, L.(1960)	Multi sectoral study of economic growth.	<ul style="list-style-type: none"> • It is the first CGE model. The model is general as it contained 20 cost –minimizing industries and a utility –maximizing household sector. • For the optimizing actor s, price played an important role in determining consumption and production decisions. The model employed market equilibrium assumption in the determination of prices. • The model is computable. It produced a numerical, multi sectoral description of growth in Norway using Norwegian input-output data.
Pyatt and Round(1985)	Development of Social Accounting Matrix as the basis for planning.	<ul style="list-style-type: none"> • This literature has shown how a SAM can be used to provide a bridge between macro and micro analysis of the poverty impacts of policy via socio-economic household groups. • As a data and economic accounting framework, which integrates the macroeconomic accounts with key micro datasets, especially household and labour force surveys, many of its virtues are self-evident. • As a single-entry accounting system in which the transactions between agents are traced through explicitly, the SAM has additional appeal as a basis for simple macro-meso level analysis and multiplier

		modeling.
Lofgren A. et al(2002)	Development of a Standard Computable General Equilibrium (CGE) Model in GAMS.	<ul style="list-style-type: none"> • Described underlying economic assumptions of the CGE models. • Narrated the basic schematic structure of Social Accounting Matrix (SAM). • Described basic Mathematical structure of the CGE model in GAMS. • Described Calibration of the model parameters using GAMS.
Robinson, S.(1989)	Development of Multi-sectoral Models.	<ul style="list-style-type: none"> • Surveyed different multisectoral models, like a) Input-output models, SAM based models and CGE models. • In the last few years, there has been lot of work to advance the theoretical underpinnings of CGE models, especially in the areas of trade and macro, and also to improve the statistical base for parameter estimation.
Shoven and Whalley(1984)		<ul style="list-style-type: none"> • Computer permits the quantitative analysis of large-dimensional models. Qualitative analysis of an issue in a general equilibrium frame-work can often only identify potentially offsetting effects, and this new quantification offers a way to determine the size of the net effect. • In the tax models, a general theme seems to be that efficiency costs (deadweight losses) of taxes may be more severe than had previously been supposed. This is especially the case with marginal dead-weight losses from taxes. • In the trade models, the role of terms-of-trade effects and the difference between national and global interests is an important theme.
Shoven and Whalley(1992)	Development of the structure of Applied General Equilibrium.	<ul style="list-style-type: none"> • Discussed the techniques of general equilibrium. Theoretical structure of Arrow-Debrew general equilibrium has been explored. • Discussed the methodology for applying general equilibrium. They primarily applied it in the context of US tax policy reforms. • Discussed domestic policy implications like trade policy, tax policy and price control.
Taylor, L.(1990)	Demonstration of Structuralist CGE Models in Socially relevant Policy analysis.	<ul style="list-style-type: none"> • The models described in this book are easy to set up and manipulate on microcomputers • Author has discussed structuralist CGE models and that is followed by contributions that take up their application in specific countries. This collection of work reviews the results of using CGE models since the early 1970s, with an emphasis on models that

		<p>encompass broad structural factors such as distribution of income and wealth, land tenancy relationships, foreign trade, production, markets, and control of the means of production that are fundamental to the behavior of developing economies.</p> <ul style="list-style-type: none"> • Different chapters explain the macro constraints on India's economic growth and describe policy shocks, describe the application of a structuralist model to Nicaragua, to Mexican food consumption policies, and to the food market in Colombia.
T. Hertel(1998)	Global Trade Analysis using GTAP models.	<ul style="list-style-type: none"> • Described the basic structure of GTAP framework. • GTAP database, model parameters and GEMPACK as the relevant software have been discussed elaborately. • Application of GTAP in agricultural analysis, Multi Fibre agreement analysis and Environmental analysis.

Table 3: Relevant literature on application of CGE model in policy analysis in India

MODEL	USES/APPLICATION	DATABASE USED
Sarkar H. and M. Panda (1990)	Short run forecasting and policy analysis through structural macroeconomic model	SAM of India for 1983-84
Panda M. and H. Sarkar (1990)	Resource mobilization through administered price in India	SAM of India for 1983-84
Narayana et al.(1991)	Policy analysis for agricultural growth and redistribution	SAM of India for 1983 – 84
Panda M.(1992)	A note on the database for poverty analysis through CGE model	-----
Panda M. and J. Quizon (2001)	Growth and Distribution under Trade liberalization in India	SAM of India for 1990-91
Parikh K.S. et al.(1997)	Agricultural trade liberalization, growth , welfare and large country effects	SAM of India for 1990-91
Sinha A.et al.(Sept,2003)	Impact of Globalization on Indian Women Workers	SAM of India for 1999
Panda M. and A. GaneshKumar (2009)	Impact of trade liberalization on Poverty and Food security in India	SAM of India for the year 2003-04
Ojha V. P. and	Human capital formation and Economic	SAM of india-1994-95

MODEL	USES/APPLICATION	DATABASE USED
B.K.Pradhan	growth in India	
Ojha V. P. and B.K.Pradhan(2009)	Macroeconomic and sectoral impacts of HIV and AIDS in India.	SAM of India 2002-03
Ojha V.P. et al. (May 2011)	Economy-Wide Impacts of Biodiesel Production and Use in India.	SAM of India of 2006-07

Gaps in the Existing Literature:

1. There exists considerable number of works on CGE modeling applied in developmental aspects like trade liberalization, poverty, inequality, food security issue etc. However, none of the literature reviewed have studied the impact of variation of FDI and import tariff reduction separately.
2. Our research work tries to study the multisectoral impact of policy change resulting in import tariff reduction and FDI increase.

3. Construction of Social Accounting Matrix

A social accounting matrix (SAM) is a representation of the macro accounts of a socio-economic system, which captures the transactions and transfers between all economic agents in the system. It defines a comprehensive framework that can depict full circular flow of income from production activities to factor service providers such as households. Each row of a SAM represents total receipts of any account, and column represents expenditure of that account. Therefore, the row total is supposed to be equal to the corresponding column total. An entry in the i th row and j th column represents receipts of i th account from the j th account. CGE models are traditionally based on SAM.

		Activities	Commodities	Factors	Households	PVT Corp.	Pub.Ent	Govt.	Ind. taxes	Capital A/C	ROW	Total
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	
1	Activities		Gross output									Output
2	Commodities	Purchase of raw Material			Household consumption			Govt. consumption		Gross Fixed Capital Formation	Exports	Aggregate demand
3	Factors	Value added									Net factor income	Factor Income
4	Household			Endowment Of HH				Govt. transfer,			Net current transfer	Total Household income
5	PVT corp.			Operating Profits				Interest on debt				Income of Private Corporate
6	Pub. Ent.			Operating Surplus								Income of Public departmental
7	Govt.			Income from entrepr.	Income tax by households	Corporate taxes			Total indirect taxes		Net capital transfer	Total govt. earnings
8	Ind. tax	Taxes on Intermediate			Taxes on purchases			Taxes on purchases		Taxes on investment	Tax on exports	Total Indirect taxes
9	Capital A/C			Depreciation	Household savings	Corporate savings	Public sector Savings	Govt. savings			Foreign savings	Gross savings of economy
10	ROW		Imports									Foreign exchange payments
	Total	Total cost of Production	Aggregate Supply	Total factor endowments	Total use of HH income	PVT CORP income	Income of PSU	Aggregate govt. exp.	Total ind. tax	Aggregate investment	Foreign Ex. Recept.	

Figure 1: Schematic structure of SAM

Table 4: SAM of India 2007-08

Sector	Primary sector	Secondary Sector	Services	Trade	Infrastructure	Labour	Capital +Land	Rural	Urban	Pvt. Corp.	Pub. Enter.	Govt.	Ind. Taxes	Capital a/c (domestic)	ROW (Capital)	ROW (Current)	Row Total
Primary sector	2388	2397	1019	29	406	0	0	4388	2077	0	0	100	0	-6	2	280	13080
Secondary Sector	724	17165	7251	532	7151	0	0	3988	3145	0	0	538	0	8636	224	4634	53988
Services	585	4241	8558	492	882	0	0	4137	6893	0	0	4304	0	9241	929	3897	44159
Trade	633	3066	253	83	507	0	0	962	1728	0	0	74	0	413	11	771	8500
Infrastructure	445	3053	365	507	2966	0	0	1638	1596	0	0	585	0	9142	287	1339	21923
Labour	4720	2237	13056	2561	5866	0	0	0	0	0	0	0	0	0	0	-25	28415
Capital+ Land	3749	6192	8709	4590	2437	0	0	0	0	0	0	0	0	0	0	-180	25497
Rural	0	0	0	0	0	9989	8033	0	0	0	0	2189	0	0	0	378	20589
Urban	0	0	0	0	0	12560	5125	0	0	0	0	1502	0	0	0	1297	20484
Pvt. Corp.	0	0	0	0	0	0	2928	0	0	0	0	1921	0	0	0	0	4849
Pub. Enter.	0	0	0	0	0	0	1142	0	0	0	0	0	0	0	0	0	1142
Govt.	0	0	0	0	0	0	987	820	982	1921	0	0	4050	0	0	0	8760
Ind. Taxes	-326	1176	1099	14	918	0	0	247	263	0	0	114	0	735	0	728	4968
Capital a/c (domestic)	0	0	0	0	0	0	4846	6045	5396	2928	1142	-1982	0	0	0	644	19019
ROW (Capital)	0	490	536	114	399	0	0	0	0	0	0	0	0	0	0	0	1539
ROW (Current)	198	10140	2052	35	526	0	0	0	0	0	0	0	0	0	0	0	12951
Column Total	13116	50157	42898	8956	22057	22549	23061	22225	22080	4849	1142	9345	4050	28161	1453	13763	

Our CGE model is based on the schematic structure of SAM and for calibration of the model, we constructed the SAM for India for the year 2007-08 following Pradhan, Saluja and Sharma (2013)²⁸.

4. Structure of Indian CGE Model

Structure of the Benchmark CGE model under perfect competition

Our benchmark CGE model is based on perfect competition and constant returns to scale assumption both in commodity market and factor market. The model is based on the following assumptions.

Sectors and Agents

Following SAM for India for the year 2007-08 produced by Pradhan, Saluja and Sharma (2013), we grouped all sectors of the economy into five aggregated sectors, namely, (a) *Primary sector* consists of all agricultural products, minerals, primary products such as iron ores, crude petroleum and agro process activities. (b) *Secondary sector* is comprised mainly of all manufacturing activities such as cotton and textile, plastic, rubber and leather products, cement, different chemical products, etc.(c) *Service sectors* such as education, health care services, public administration, bank and insurance, postal services etc. (d)*Trade* includes all trading activities etc. and (e) *Infrastructure* includes construction, electricity, water supply, railways, land transport including pipelines, water transport, air transport, supporting and auxiliary transport services and communication. We considered four types of agents in the economy, namely, (a) household, (b) firm, (c) government and (d) Rest of World (ROW). There are two types of households, namely, (a) Rural and (b) Urban. All other countries and regions are clubbed together into ROW.

Production and Factor Inputs

We have considered two basic factors of production, namely, labour and capital that take part in the production process within which substitution is possible through Cobb–Dauglus production technology. Each production unit requires intermediate inputs following fixed-coefficient-type Lontief technology.

²⁸ In Indian context I/O table is published by the Central Statistical Office in every five years gap. Pradhan, Saluja and Sharma (2013) constructed SAM for India using the I/O matrix for the year 2007-08.

Prices

Product prices are determined from the equality of price and average cost. The average cost is comprised of basic factor cost, cost of intermediate inputs that includes cost of energy inputs. Increasing returns to scale is assumed through the presence of fixed cost in the production units.⁴

Household Income and Expenditure

Households are rendering factor services in terms of labour and capital while in return they are receiving factor payments in the form of wages and rentals. We have considered two types of household, rural and urban. A household spends its income for consumption purposes. We have assumed the linear expenditure-system-type demand function for a household.

Government Income and Expenditure

Sources of income of the government are (a) direct, indirect and corporate taxes; (b) import tariff; and (c) income from entrepreneurial activity. In the expenditure front we assumed government's expenditure in any sector is exogenously determined, that is, determined in the government's budget and adjusted to benchmark SAM. The difference between government's income and expenditure is government's savings.

Investment and Savings

We considered Neo-classical-type closure rule where investment is guided by saving. Total saving is comprised of (a) household saving, (b) government saving, (c) corporate saving and (d) foreign savings. Total saving is converted to total investment.

Armington Function and Trade

International trade in our model is guided by Armington function. Total availability of composite commodity in the domestic economy is composed of domestically produced variety of the good demanded by the domestic people and foreign variety of the same good. Both types of the varieties are combined together following a constant elasticity of substitution type preference function.

Production of Output and Transformation

Total supply of each domestic good produced using labour, capital and intermediate input is used up by export of that good and to meet up the domestic demand of domestic variety. Both export and domestic demands of the produced good are combined together following the constant elasticity of substitution (CES)-type transformation function. \

Factor Prices and Equilibrium

We consider two basic factors of production, namely, labour and capital. Total supply of the basic factors is fixed in value terms, and factor prices are flexible. Physical quantity of labour or capital may change in different simulation experiments following demand and supply equilibrium mechanism in the factor market. Demand for a factor is originated from the production of goods and services.

Equilibrium in Commodity Market

In the commodity market, total supply of the composite commodity is constituted by domestic variety as well as imported foreign variety corresponds to each good. Demand for the composite commodity is generated from household consumption, government consumption expenditure, total investment demand and demand for intermediate input. Composite commodity price is determined from the demand and supply of composite commodity. \

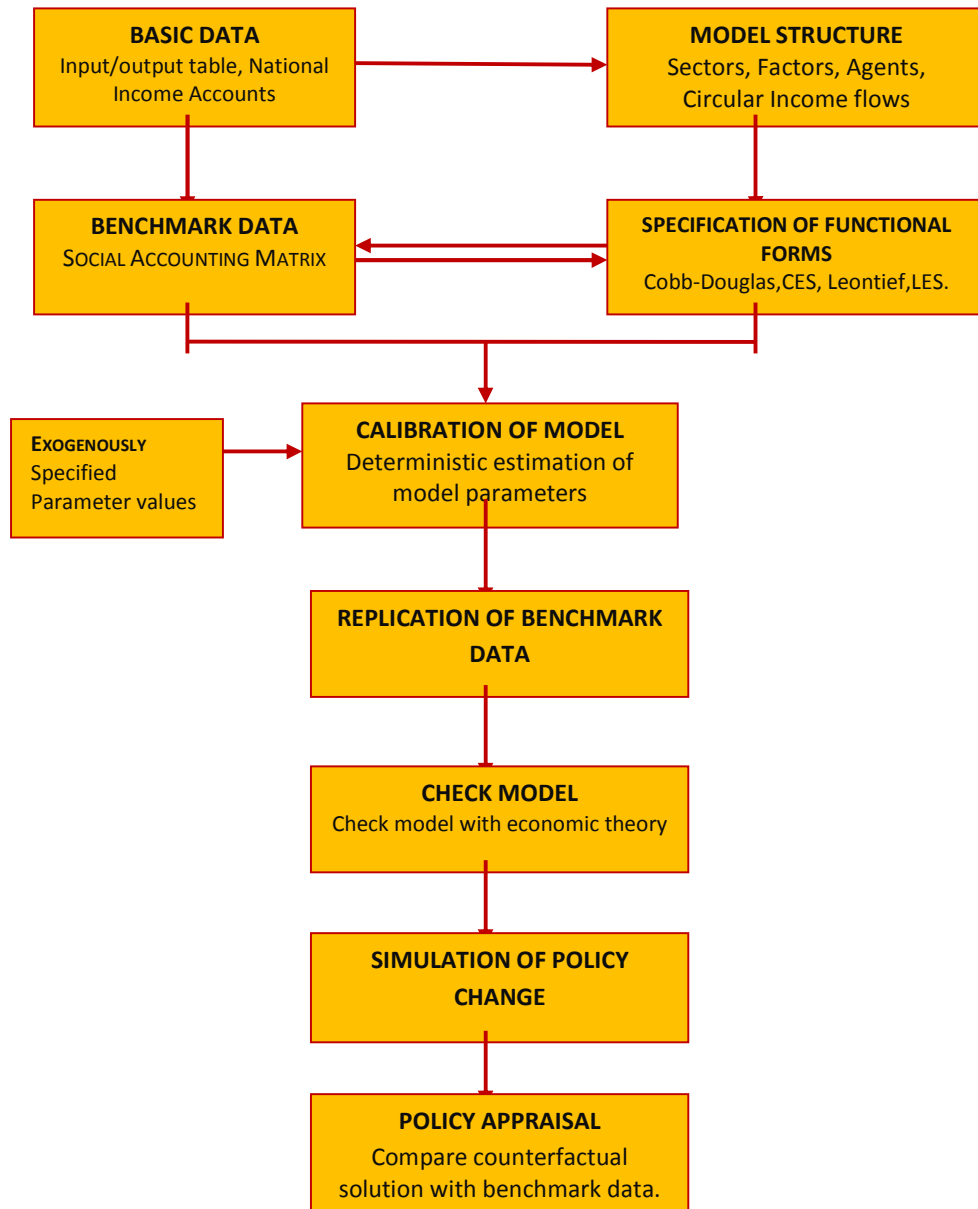
GDP and Welfare

Under perfect competition GDP has been computed adding all sectoral outputs. Social welfare has been of Cobb–Douglas type and depends on private household consumption, that is, elasticity of substitution between any two sectors' product is constant and takes the value unity

5. Calibration and Benchmark Equilibrium (Estimation of Model Parameters)

The parameters and different elasticity values involved in the mathematical equation of the CGE model are very much important to study the impact of trade liberalization. The parameter values are computed using a method known as Calibration, which enables our CGE model to generate base year equilibrium values or short run solution. Method of Calibration relies on the assumption that the economy is in Equilibrium. This is established by invoking a benchmark dataset to represent equilibrium for the economy in such a manner that the model is actually solved from the dataset for its parameter values (Shoven and Whalley, 1992: 103). In our analysis benchmark dataset is represented by our constructed SAM. Equilibrium exists because the SAM is a square matrix whose row and column sum for a given account are equal (Pyatt and Round, 1979: 854) .The Calibration process is outlined in the following figure.

Figure 2: Flow chart of Calibration



In the first stage we have to choose functional form for our model which is based on our model assumptions discussed in the previous section. Model equations are supplied with the data in the second stage so that all parameter and variable values are adjusted with corresponding SAM

values²⁹. Few parameters such as elasticity values and few behavioral parameter values are obtained elsewhere.³⁰

Since the SAM is estimated in value terms, units must be chosen for goods such that separate price and quantity observations are obtained (Shoven and Whally, 1992:105). Following Harberger (1962) we used “unit convention” by which units for goods are chosen so that they have a price of unity in the base year. Benchmark solution is thus expected to represent the state of the economy in real terms. In benchmark equilibrium each quantity value generated in the model after feeding with the data reproduces corresponding value in the SAM. After this stage, any change in exogenous variables or parameter would generate a new dataset from a new static equilibrium condition. We may compare the new situation with reference scenario to get the impact of policy change.

For our calibration of the model we used SAM³¹ of India for the year 2007-08 that we have constructed in our previous section. Tariff rates are supplied exogenously. For all the non-agricultural sectors average tariff rates are assumed as 14% while for the agricultural and primary sector in general average tariff rate is 40%³².

6. Policy Simulation Experiments

We performed four different simulation experiments to find the impacts of trade liberalization and foreign direct investment on volume of import and export, GDP, exchange rate, rural and urban income levels and income of the government. Simulation experiments have been explained as below.

Experiment 1: Trade liberalization by reduction in import tariff under perfect competition

Trade liberalization through the reduction of import duty under perfect competition leads to the following immediate impacts:

(i) Reduction in domestic import price due to which import increases in all sectors. This leads to depreciation of home currency due to higher foreign currency demand.

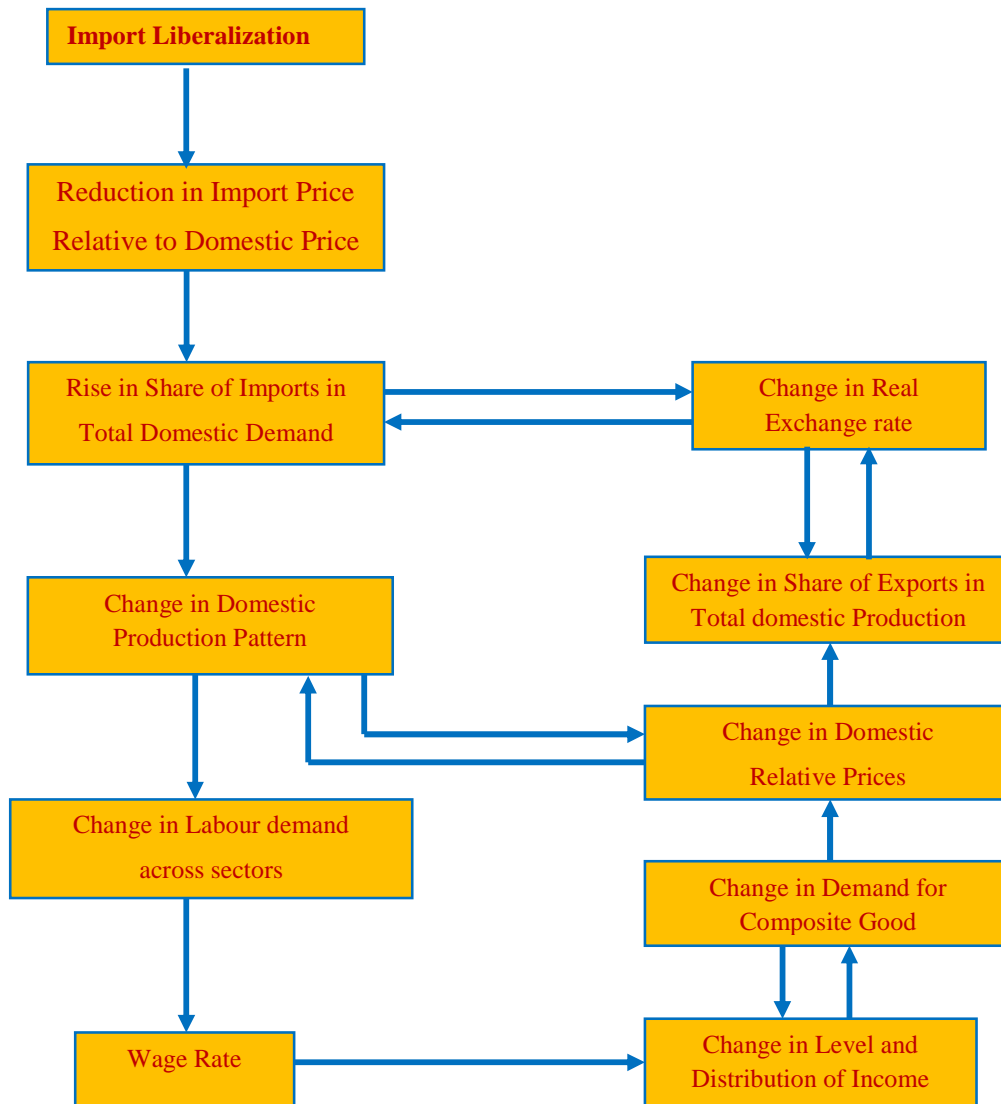
²⁹ Model equations are manipulated in such a manner that parameters are expressed as a function of data. During solve of the model, parameter values are generated.

³⁰ These estimates are known as econometric estimates. Values can be obtained from other studies also.

³¹ For calibration of this model our benchmark SAM is used.

³² See Panda et al 2005. In our SAM total indirect tax is inclusive of tariff revenue. To get the impact of tariff change on government income we separated total indirect tax as domestic indirect tax and tariff revenue. Indirect tax rate is computed on domestic indirect tax only.

Fig-3: Major Interactions due to import liberalization



ii) Increase in export volume across sectors since exporters can now earn more home currency for same volume of exports.

(iii) Government's income reduces with lower tariff revenue earnings and consequently transfer of the government to different types of household also declines. There is also a decrease in rural and urban household incomes.

(iv) Negligible impact on GDP. The impact of trade liberalization is most significant on the trading sector and least on the manufacturing sector.

Experiment 2: Greater inflow of foreign capital

Greater foreign capital inflow appreciates exchange rate making import cheaper and so import increases in all sectors. Export becomes less profitable leading to a reduction of sectoral export.

There is increase in both rural and urban household incomes which leads to increased domestic demand of goods. There is an increase in overall GDP as well.

Table 2: Impact of trade liberalization on various sectors, parameters and agents

	Agriculture	Manufacturing	Services	Trade	Infrastructure	Rural household	Urban household	Exchange rate	GDP	Government income
100% reduction in overall import tariff										
Volume of export	Increase by 1.5%	Increase by 0.2%	Increase by 0.2%	Increase by 0.7%	Increase by 0.4%	-	-	-	-	-
Volume of import	Increase by 17.7%	Increase by 0.01%	Increase by 1.7%	Increase by 102%	Increase by 6.1%	-	-	-	-	-
Income	-	-	-	-	-	Negligible decrease	Negligible decrease	-	-	Negligible decrease
Exchange rate	-	-	-	-	-	-	-	Reduce by 3.4%	-	-
GDP	-	-	-	-	-	-	-	-	Negligible increase	-
50% reduction in overall import tariff										
Volume of export	Increase by 0.7%	Increase by 0.1%	Increase by 0.1%	Increase by 0.3%	Increase by 0.2%	-	-	-	-	-
Volume of import	Increase by 7.6%	Increase by 0.01%	Increase by 0.7%	Increase by 44%	Increase by 2.7%	-	-	-	-	-
Income	-	-	-	-	-	Negligible decrease	Negligible decrease	-	-	Negligible decrease
Exchange rate	-	-	-	-	-	-	-	Reduce by 1.5%	-	-
GDP	-	-	-	-	-	-	-	-	Negligible increase	-

Note: Figures rounded off to first place of decimal

Table 3: Impact of increased inflow of foreign capital on various sectors, parameters and agents

	Agriculture	Manufacturing	Services	Trade	Infrastructure	Rural household	Urban household	Exchange rate	GDP	Government income
100% increase in FDI										
Volume of export	Reduce by 8.2%	Reduce by 0.5%	Reduce by 0.6%	Reduce by 3%	Reduce by 1.7%	-	-	-	-	-
Volume of import	Increase by 15.7%	Increase by 0.1%	Increase by 1.6%	Increase by 94%	Increase by 6%	-	-	-	-	-
Income	-	-	-	-	-	Negligible Increase	Negligible Increase	-	-	Increase by 0.03%
Exchange	-	-	-	-	-	-	-	Increase by	-	-

rate									17.9%		
GDP	-	-	-	-	-	-	-	-		Negligible Increase	-
100% increase in FDI in service sector including retail											
Volume of export	Reduce by 0.7%	Reduce by 0.1%	Reduce by 0.1%	Reduce by 1%	Reduce by 0.4%	-	-	-	-	-	-
Volume of import	Increase by 0.4%	Increase by 0.1%	Increase by 0.3%	Increase by 17%	Increase by 1%	-	-	-	-	-	-
Income	-	-	-	-	-	Negligible change	Negligible change	-	-	-	Negligible change
Exchange rate	-	-	-	-	-	-	-	Increase by 4%	-	-	-
GDP	-	-	-	-	-	-	-			Negligible change	-

Note: Figures rounded off to first place of decimal

7. Summary and Conclusion

This paper is devoted to examine India's trade liberalization impacts over macroeconomic factors like GDP, private investment, export-import, sectoral output, household income-consumption etc. Considering India's Social Accounting Matrix for the year 2007-08, we have worked out Computable General Equilibrium based simulation exercises related to trade liberalization and foreign capital movement that India undertook in the last few decades. Our study reveals that import liberalization expands trade, increases GDP, social welfare, private consumption, gross investment and reduces composite commodity prices. Greater foreign capital inflow appreciates exchange rate, increases import and reduces export. GDP, gross investment, welfare and gross private consumption expand. Greater foreign capital inflow appreciates exchange rate and dampens export. However, appreciation of exchange rate helps to reduce import price and thus there is greater demand for importable.

Our simulation study also corresponds to current Indian economic scenario as we find there is a gradual reduction of import duty along with greater ease in foreign capital inflow and technological improvement in the neo liberalized regime. This led to a continuous growth of GDP, external sector transaction in goods and services, inflow and outflow of foreign capital and per capita household consumption in the last two decades.

From the policy maker's perspective, allowance of higher foreign investment could be one policy option to manage the problem of exchange rate depreciation while the country like India has to import substantial amount of energy fuels causing excess demand for foreign currency. Since the other source of foreign exchange earnings by raising export³³ cannot be instrumented in a short period of time, increase of foreign stake holding in domestic firms can be right policy option for the domestic central bank in managing exchange rate problem³⁴.

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³³ For the country like China, foreign exchange earnings from export sector provide the chief source of foreign exchange.

³⁴ In managing exchange rate problem in recent years Reserve Bank of India Governor, Raghuram Rajan has taken a bold step by raising the limit of foreign stake holding in banking sector. Within a fortnight, exchange rate problem was under control owing to greater supply of foreign exchange. After depreciating to a record low of almost 69 in the beginning of September 2013, the Indian Rupee rose in value to 63.5 on 15th September, 2013 as a result of such policies.

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APPENDICES:

APPENDIX-1: MATHEMATICAL STRUCTURE OF THE BENCHMARK CGE MODEL:

Production Block:

$$Y_j = b_j \cdot \left[\prod_h F_{h,j}^{\beta_{j,h}} \right] \quad (1)$$

$$X_{i,j} = ax_{i,j} \cdot Z_j \quad (2)$$

$$Y_j = ay_j \cdot Z_j \quad (3)$$

$$F_{h,j} = \beta_{h,j} \cdot py_j \cdot Y_j / pf_h \quad (4)$$

$$pz_j = ay_j \cdot py_j + \sum_i ax_{i,j} \cdot pq_i + \frac{FC_j}{Z_j} \quad (5)$$

Government behavior:

$$GINC = Td + Tdc + TInd + NCAT + ENT + TARR - Ts \quad (6)$$

$$Td = \sum_b \tau aud_b \cdot \left[\sum_h pf_h \cdot FF_h \cdot r_{h,b} + GT_b + NCUT_b \right] \quad (7)$$

$$Tdc = tcorp \cdot (OPR + IND) \quad (8)$$

$$OPR = sop \cdot \left[\sum_h pf_h \cdot FF_h + NF_1 + NF_2 \right] \quad (9)$$

$$TInd = \sum_b \tau au z_j \cdot pz_j \cdot Z_j \quad (10)$$

$$TARR = \sum_i \tau aum_i \cdot pm_i \cdot M_i \quad (11)$$

$$Ts = \tau aus \cdot \sum_i pe_i \cdot E_i \quad (12)$$

$$Xg_i = mu \times GDP / pq_i \quad (13)$$

$$GT_b = gt_b \cdot GINC \quad (14)$$

$$GEXP = \sum_i Xg_i + \sum_b GT_b + Ts \quad (15)$$

$$S_G = GINC - GEXP \quad (16)$$

Investment behaviors:

$$Xv_i = lamda_i \cdot \left[Dep + \sum_b Sp_b + Sg + Sc + Sf \cdot \epsilon \right] / pq_i \quad (17)$$

Savings:

$$HHIN_b = \sum_h \left[\sum_h FF_h \cdot pf_h + NF_1 + NF_2 \right] \cdot r_{h,b} + NCUT_b + GT_b \quad (18)$$

$$HHIN_b = \left[\sum_h FF_h \cdot pf_h + NF_1 + NF_2 \right] \cdot r_b + NCUT_b + GT_b \quad (18.a)$$

Where $r_b = \sum_h r_{h,b}$

$$Sp_b = ssp_b \cdot HHIN_b \quad (19)$$

$$Sc = ssc \cdot (OPR + IND) \quad (20)$$

Household consumption:

$$Xp_{i,b} = \alpha_{i,b} \cdot [HHIN_b - Td_b - Sp_b] / pq_i \quad (21)$$

International trade:

$$pm_i = \epsilon \cdot pWm_i \cdot (1 + \tau_{m_i}) \quad (22)$$

$$pe_i = \epsilon \cdot pWe_i \cdot (1 + \tau_{e_i}) \quad (23)$$

$$\sum_i pWe_i \cdot E_i + Sf + \sum_b NCUT_b + NF_1 + NF_2 + NCAT + Ts = \sum_i pWm_i \cdot M_i \quad (24)$$

Armington function:

$$Q_i = \gamma_i \left[\delta_{m_i} \cdot M_i^{\epsilon_{m_i}} + \delta_{d_i} \cdot D_i^{\epsilon_{d_i}} \right]^{\frac{1}{\epsilon_i}} \quad (25)$$

$$\frac{M_i}{Q_i} = \left[\gamma_i^{\epsilon_{m_i}} \cdot \delta_{m_i} \cdot \frac{pq_i}{pm_i} \right]^{\frac{1}{1-\epsilon_{m_i}}} \quad (26)$$

$$\frac{D_i}{Q_i} = \left[\gamma_i^{\epsilon_{d_i}} \cdot \delta_{d_i} \cdot \frac{pq_i}{pd_i} \right]^{\frac{1}{1-\epsilon_{d_i}}} \quad (27)$$

Transformation function:

$$Z_i = \theta_i \cdot \left[\chi_{e_i} \cdot E_i^{\phi_i} + \chi_{d_i} \cdot D_i^{\phi_i} \right]^{\frac{1}{\phi_i}} \quad (28)$$

$$\frac{E_i}{Z_i} = \left[\theta_i^{\phi_i} \cdot \chi_{e_i} \cdot (1 + \tau_{ind}) \cdot \frac{pz_i}{pe_i} \right]^{\frac{1}{1-\phi_i}} \quad (29)$$

$$\frac{D_i}{Z_i} = \left[\theta_i^{\phi_i} \cdot \chi_{d_i} \cdot (1 + \tau_{ind}) \cdot \frac{pz_i}{pd_i} \right]^{\frac{1}{1-\phi_i}} \quad (30)$$

Market clearing condition:

$$Q_i = \sum_b Xp_{i,b} + Xg_i + Xv_i + \sum_j X_{i,j} \quad (31)$$

$$FF_h = \sum_j F_{h,j} \quad (32)$$

Fictitious Objective function:

$$UU = \sum_b \prod_i Xp_{i,b}^{\alpha_{i,b}} \quad (33)$$

APPENDIX-1.A: LIST OF ENDOGENOUS VARIABLES:

Y_j = Combined input used in j^{th} activity.

$F_{h,j}$ = Demand for basic input h in j^{th} activity.

Z_j = Output of j^{th} activity

py_j = Price of combined input in j^{th} activity.

pf_h = Price of basic input h.

pq_i = Price of the i^{th} commodity.

$GINC$ = Total Government income.

Td = Household income tax.

Tdc = Corporate tax.

$TInd$ = Indirect tax

pf_h = Factor price of the h^{th} factor.

FF_h = Factor demand of the h^{th} factor

GT_b = Government transfer to the b^{th} household.

gt_b = Government income share transferred to b^{th} household.

$Xp_{i,b}$ = b^{th} household consumption of the i^{th} good.

Xg_i = Government consumption of the i^{th} good.

$X_{i,j}$ = i^{th} sector's output goes to j^{th} sector as intermediate input.

Xv_i = i^{th} commodity used as investment good.

pq_i = Price of the i^{th} commodity.

pe_i = Price of export.

Sg = Government savings.

Sp_b = Private savings of the b^{th} household.

Sg = Government savings.

Sc = Corporate savings.

$epsilon$ = Exchange rate.

$HHIN_b$ = Income of the b^{th} household.

pe_i = Export price of good i in domestic currency.

pm_i = Imports price of good i in domestic currency.

pd_i = Price of domestic good.

pz_i = Supply price of the i^{th} good.

pWe_i = World export price.

pWm_i = World import price.

E_i = Export of good i.

M_i = Import of good i.

ϵ = Exchange rate.

Q_i = Output composite good.

D_i = Output domestic good.

UU = Social welfare function.

APPENDIX-1.B: LIST OF EXOGENOUS VARIABLES:

b_j = Production function shift parameter.

$\beta^{j,h}$ = Share of hth input within combined input in jth activity.

$ax_{i,j}$ = Per unit requirement of ith commodity in jth activity as intermediate input.

ay_j = Per unit requirement of combined input in jth activity.

$r_{h,b}$ = hth factor income share of bth household.

ENT = Income of the government from entrepreneurial activity.

$taud_b$ = Share of total household income paid as income tax by bth household.

mu_i = Share of government expenditure on ith commodity.

$NCAT$ = Net transfer to government.

Sf = Foreign savings at world prices.

$lamda_i$ = Proportion of savings converted into investment.

Dep = Depreciation of capital.

FF_h = Total factor demand of the hth factor.

$gamma_i$ = Scale parameter in Armington function.

$deltad_i$ = Share coefficient of domestic good in Armington function.

$deltam_i$ = Share coefficient of import good in Armington function.

eta_i = Constant determining elasticity of substitution in Armington function.

$theta_i$ = Scale parameter transformation function.

xie_i = Share parameter of export in Transformation function.

xid_i = Share parameter of domestic good in transformation function.

phi_i = Constant determining elasticity of substitution in Transformation function.

$tind$ = Indirect tax rate.

$taum_i$ = Import tariff rate.

$taus$ = Export subsidy rate.

$NCUT_b$ = Net current transfer to bth household.

$tcorp$ = Share of corporate income to tax.

OPR = Operating profit.

IND = Interest on debt.

sop = Share of operating profit to total factor income.

NF_1 = Net labor income earned abroad.

NF_2 = Net capital income earned abroad.

T_{purhh} = b^{th} household purchase tax.

T_{purg} = Government purchase tax.

T_{ing} = Taxes on intermediate.

T_{inv} = Taxes on investment good.

T_s = Taxes on export.

$tpurhh_b$ = Share of household purchase paid as purchase tax by b^{th} household.

$tpurg$ = Share of government purchase paid as purchase tax.

t_{ing} = Share of intermediate good purchase to tax.

t_{inv} = Share of investment to tax.

t_{aus} = Share of export paid as tax.

FC_j = Fixed cost in the j^{th} sector.

APPENDIX 2: Simulation Experiment Results

ECONOMIC VARIABLES	BASE RUN VALUE	EXP-1	EXP-2	EXP-3	EXP-4
<u>Macro Indicators</u>	Rs. In billion	% change	% change	% change	% change
GDP	116,969	3.42E-05	1.11-E05	2.31E-04	2.56E-04
<u>External Account</u>					
Import (Primary sector)	198	17.68	7.58	15.65	0.35
Import (Secondary sector)	10,140	0.01	0.01	0.059	0.029
Import (Tertiary sector)	2,052	1.66	0.73	1.51	0.34
Import (Trade sector)	34	102.95	44.11	94.11	17.65
Import (Infrastructure sector)	525	6.09	2.67	5.91	0.95
Export (Primary sector)	280	1.42	0.72	-8.21	-0.72
Export (Secondary sector)	4,634	0.16	0.06	-0.48	-0.11
Export (Tertiary sector)	3,897	0.15	0.08	-0.62	-0.13
Export (Trade sector)	770	0.65	0.26	-2.99	-0.91
Export (Infrastructure sector)	1,339	0.38	0.15	-1.72	-0.37
Exchange rate	67	3.43	1.50	-17.91	-4.48
<u>Government Account</u>					
Govt. Income	7,470	-0.17	-0.081	0.028	0.027
<u>HH Income</u>					
Rural	20,730	-4.82E-03	-1.93E-03	1.74E-03	4.82E-04
Urban	19,517	-3.59E-03	-1.54E-03	1.28E-03	5.12E-04

Note:

- (i) EXP 1: 100% reduction in overall import tariff

- (ii) EXP 2: 50% reduction in overall import tariff
- (iii) EXP 3: 100% increase in FDI
- (iv) EXP 4: 100% increase in FDI in service sector including retail

APPENDIX 3: Calibrated values of the parameters

Parameter	Description	Primar	Secondary	Tertiary	Trade	Infra
β_i (Labour)	Share parameter in production function	0.531	0.245	0.574	0.334	0.684
β_i (Capital)	Share parameter in production function	0.469	0.755	0.426	0.666	0.316
b_j	Production function shift parameter	1.996	1.746	1.978	1.891	1.866
ay_i	Composite factor requirement	0.626	0.215	0.54	0.81	0.393
mu_i	Government consumption share	8.5E-04	0.005	0.03	6.3E-04	0.005
$taum_i$	Import tariff rate	0.2	0.05	0.2	0.2	0.2
$tind_i$	Indirect tax rate	-0.005	0.006	0.006	3.2E-04	0.009
$gamma_i$	Scale parameter in Armington function	1.266	2.064	1.585	1.121	1.419
$deltam_i$	Share parameter of imported good.	0.112	0.354	0.197	0.063	0.144
$deltad_i$	Share parameter of domestic good.	0.888	0.646	0.803	0.937	0.856
eta_i	Elasticity of substitution in Armington.	0.5	0.5	0.5	0.5	0.5
$theta_i$	Scale parameter in transformation func.	145.78	470.27	450.83	162.3	262.3
xie_i	Share parameter of export.	0.004	2.95E-04	3.43E-04	0.002	9.48E-
xid_i	Share param. Of domestic good(Trans)	5.78E-	1.03E-04	1.08E-04	5.04E-	2.39E-
phi_i	Substitution elasticity in transformation.	1.5	1.5	1.5	1.5	1.5
Parameter	Description	Rural		Urban		
$taud_b$	Direct tax rate.	0.041		0.051		
gt_b	Parameter for govt. transfer.	0.288		0.198		
ssp_b	Propensity to save for households.	0.299		0.281		