Impact of Efficiency gain under Competitive Pressure on Indian Households: A General Equilibrium Approach

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Abstract: The study makes an attempt to look into the question how competitive pressure would impact upon the income distribution and poverty of household groups through the change in productivity-efficiency in the economy using an input-output analysis in a general equilibrium framework. We consider three sources of growth: efficient utilization of available resources, technical progress and gain from terms of trade by re-orientation of trade. Welfare maximization under competitive spirit has resulted in efficiency gain, but at the cost of adverse income distribution. Rural household groups suffer more than the urban ones. It is noticed that change in income at the optimal allocation is the dominant factor in affecting household poverty. Urban households also enjoy significantly more reduction in poverty than the rural households. In fact, some of the rural households, involved in agricultural wage activity, suffer from increase in poverty. When capital is allowed to mobile across the sectors, there is higher gain in productivity and higher income disparity vis-à-vis the sector-specific capital. But, poverty effect is better, though marginally; in case capital is sector specific than mobile. The study shows that competitive pressure has positive effect on productivity-efficiency and poverty, but adverse effect on income distribution in Indian economy.

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1. Introduction

Economists and policy makers are always concerned about the economic growth, income distribution and poverty of a low-income economy like India. Various studies have highlighted that growth of the economy can affect the poor and income distribution some way or other. Having faced with the unprecedented economic crisis in the beginning of 1990s, Indian economic resorted to major reform program in July 1991. With a view to improving the efficiency, productivity and global competitiveness, both macro and microeconomic reforms were introduced in industrial, trade and financial policies (Bhagwati and Srinivasan, 1993). Indian economy seemed to be responsive to the reform measures undertaken during 1991-96 with considerable globalisation and liberalisation. The GDP growth was more than 6.5 percent per annum during this period. However, many reform commentators believe that a still lot remains on India's unfinished agenda (Bajpai and Sachs, 1997). A greater momentum of reform is necessary with more openness in trade, deregulation of industries, agricultural reforms in prices and trade, labour market reform (Fischer, 2002). It is expected that the renewal of momentum in ongoing reform process would inspire the economy into a competitive environment, where efficient reallocation of resources would result in gain in productivity level and activities of the economy would operate on the frontier. Once the economy operates on the frontier, the, the resultant competitive rewards to factors would force the households to re-adjustment of their consumption and income, which would indicate heterogeneous impact on the welfare distribution of households in the economy.

For last couple of decades, a lot of research has gone into the issue of growth- to- inequality causality in the tradition of Kaldor (1956) and Kuznets (1955), which discuss the hypotheses that growth could create or absorb inequality (Papanek and Kyn, 1986, Fields, 1991, Cogneau and Guenard, 2002). Economic growth is the main source of creating income and employment opportunity. With the economic growth, market for different goods in which different households are engaged, expands which results in extended employment opportunities and hence, change in income distribution. For India, major policy changes took place in the beginning of 1990's. Biggest challenge of India's economic reforms programme has been liberalisation of different sectors, e.g. trade and industry. In the pre-1990s, for long, Indian industries were characterized by inefficiency, high costs and uneconomical means of production with pervasive government control. To make Indian economy more competitive, policy makers are still struggling with the idea to keep the distortion and restriction on trade and industry to the minimum possible level. Though macro implications of the these reforms are important, their impacts at the household level are not analysed well, which are of great concern to any society. Given the heterogeneity of population and household groups, effects of competition on their income distribution and welfare are not expected to be uniform. Further, though India has an impressive record of growth since late 1980s, it still faces massive challenges of poverty and inequality. Many studies, viz. Kawani and Subbarao (1990), Jain and Tendulkar (1990), Datt and Ravallion (1992), and Ravallion and Datt (1996), have emphasised the dominating influence of growth on poverty in India. This paper makes an attempt to look into the question how competitive pressure with free trade would impact upon the income distribution and poverty of household groups through the change in productivity-efficiency in the economy using an input-output analysis in a general equilibrium framework.

Productivity of an economy depends on the maximum value added generated by proper utilization of given amount of factors of production, e.g. land, labour and capital. If the economy is competitive, all the economic agents maximize their objective function and the economy is supposed to function on the production possibility frontier with competitive prices. Hence, both first welfare theorem, i.e. commodity bundle generated by the equilibrium price vector is efficient, and the second welfare theorem, i.e. an efficient allocation is equilibrium, are fulfilled (ten Raa, 2002). As it is believed that Indian economy is not yet perfectly competitive, the resource allocation in the economy is not yet optimal and hence, below the production possibility frontier. The inefficiency is measured by the degree by which the net output vector could be extended until it reaches the production frontier (ten Raa, 1995). Despite many sceptical views on free trade versus growth (Rodriguez and Rodrik, 1999; Rodrik, 1999), there has been strong evidence that free trade is growth enhancing (Sachs and Warner, 1995; Edwards, 1992). Some of the heavyweights in trade and development economics have strongly reiterated in their theoretical expositions that in the absence of market failure and distortions, trade is welfare-improving growth (Bhagwati, 1994; Srinivasan and Bhagawati, 1999). Our basic model is drawn heavily from ten Raa and Mohnen (2002). The growth of total factor productivity (TFP) is captured by more efficient utilization of resources (Debreu, 1951) as well as by technological change (Solow, 1957). The incorporation of input-output (I-O) framework in this model allows for capturing intersectoral linkages and provides technological change of TFP. However, unlike Solow residual, which is based on observable value share due to the inherent assumption of competitive economy, the model used shadow prices of the output and input derived from frontier program in the general equilibrium framework. Consumer preferences are maximized given the constraint on technology and endowments of primary endowment (trade surplus is also considered to be endowment of the economy). The model is based on the fundamentals of the economies, where both the welfare theorems are satisfied. This above theory could explain that the economy without trade can make use of the available set, i.e. vectors of goods and services available for final use to operate on production possibility curve. But by using gainful trade to exchange goods and services produced at home for those produced abroad, the economy could add to its availability set under autarky (Srinivasan and Bhagwati, 1999). In their theoretical exposition they explained that under the neoclassical assumptions of complete market structure and minimal government intervention, a competitive equilibrium under free trade is Pareto Optimum, where an economy will be productively efficient (on its production possibility frontier) and also distributionally efficient (on utility possibility frontier).

In a small open economy framework using the above technique, ten Raa and Mohnen (2001) have shown the location of comparative advantages between Canada and Europe. Using I-O tables from 1962 to 1991, ten Raa and Mohnen (2002) tried to capture the shift of source of productivity growth from technical change to terms of trade effect. In all their studies, they endogenize internal prices, while keeping the international prices exogenous. In the similar line, with a new technological change measure, Shestalova (2002) has analyzed the TFP performance of three large trading economies, viz. US, Japan and Europe. Both internal as well as international prices are endogenized in her model. However, all the above models have not focused on the change in personal income under perfect competition. ten Raa and Pan (2002) have dealt with this issue for China. They divide China into 30 I-O sectors and 27 provinces. This study shows that competition leads to losers and winners, both in terms of factor claims and in terms of regions. Their input-output table divides factor of production of labour, i.e. factor income of labour into different categories according to skill. Both Shestalova(2002) and Raa and Paan (2002) have used differential optimum regional trade surpluses against the actual ones as an adjustment process to get final adjusted weights of individual preferences.

A significant difference of our model from similar above-mentioned models is that in our model, differential household propensity to consume plays an important role in readjustment of consumption-income at the optimum. This is because, if the household's propensity to consume at the optimum exceeds benchmark propensity to consume more than the other household, then the general equilibrium welfare maximization requires that former household should be assigned with higher consumption share than the later. The weights attached to the household preferences in our model are adjusted not using differential optimal trade surpluses, but keeping the ratio of optimum propensity to consume to the observed one same for all the household groups. Moreover, our income and consumption pattern will be evaluated for different household categories on the basis of an extended I-O table, i.e. social accounting matrix (SAM), based on household share of endowment of different factors. The nice thing about using SAM in our model is that it captures the sources of income for different household groups, i.e. ownership of factor endowments, and expenditure pattern of different household groups. The model deals with only one economy for one period. We consider small country assumption, where tradable sectors are price takers.

The rest of the paper is divided into five sections. The theoretical model is highlighted in the Section 2. Section 3 analyses the basic data set and Section4 briefly describes the endogenisation of poverty and measure inequality in our framework. Results and implications of the model are discussed in the Section 5, while Section 6 gives the conclusion to the paper.

2. The Methodology

The analysis has been conducted using the benchmark data set for 1994-95. The model includes 21 production sectors and 9 household groups defined on the basis of income classes. There are four rural and five urban household groups. Households have welfare function of the Leonteif type[1], that is, the vector of consumption demand describes the household preference. Considering an open economy, we endogenize the net exports, i.e. the trade deficit, in the model. The balance of payment controls the net exports. Capital, land, labour and trade deficit are considered to be endowment in the economy. In the model, each household group has consumption demand vector, $f_h d_h D$, where D can be interpreted as the expansion factor for the weighted sum of the private consumption demands of the nine household groups, f_h is the vector of consumption shares of commodities and d_h represents consumption weights attached to the household groups. Model maximizes total welfare of the economy by maximizing total final private consumption subject to commodity, factor and trade deficit constraints keeping the

[1] Concavity of individual utility functions should be assumed in order to preserve the concavity of the aggregate of these functions.

relative composition of the vector of private consumption demand each household group fixed. Rest of the final demand, which includes government consumption and investment, is fixed in the model[2]. The shadow prices reflect the commodity prices and factor prices of labour, capital and land. These optimum prices are applied to derive the income and expenditure of different household groups. In the general equilibrium setting, we want to keep the ratio computed new propensity to consume to the observed one same across all the household groups. The solution yields new set of consumption weight for each household. The allocations of activity and shadow prices that are finally obtained constitute the general equilibrium. Our model captures characteristics of Negishi format of welfare optimum (Negishi, 1960)[3].

It is obvious that given small country assumption and no trade distortion, if all sectors are assumed to be tradable, then competitive pressure seems to have no impact on the income distribution, though efficiency of the economy might change. In this case, even though the frontier of the economy moves, the prices of, both output and factor, remain same as benchmark (see Appendix II)[4]. In the extreme case of closed economy, as factors and productions are adjusted inside the economy, there is scope for prices and consumption-weights to change at the optimum. However, we take more realistic case for Indian economy with 19 tradable and 2 non-tradable sectors.

The frontier of the economy is the maximum expansion of its total final demand with relative composition of consumption for households fixed. This frontier can be reached by optimal allocations of factors of production across the sectors and by re-allocation of trade with the rest of the world (Fig. 1).

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[2] We assume fixed real investment implying that preference does not include future consumption. Government consumption also does not play any role in welfare maximization.

[3] In the Negishi format, the competitive equilibrium can be represented as a welfare program with the welfare weights adjusted to meet individual budgets. Here, the non-binding budget equation is kept out of the constraint set of the program.

[4] Even if all the sectors are allowed to be tradable, there could be price variations across the sectors and factors once international prices are endogenized in the model (Shestalova, 2002). Another important cursory remark can be made that we can expect domestic price variability if we assume that there is not perfect substitutability between demand for domestic goods and imported goods due to Armington assumption (Armington, 1969).

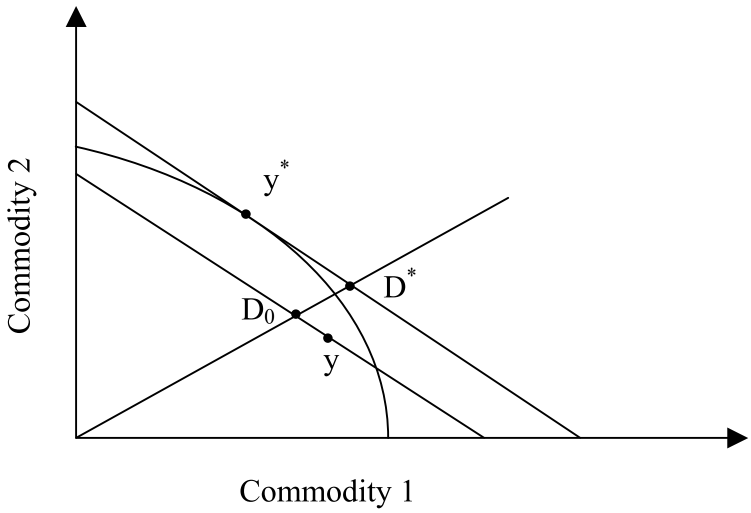

Figure 1

D_0 and Y are actual sub-optimal production and demand at international trade budget line. In an open economy with the assumption of Leontief welfare function, trade pushes the demand vector on its own direction to the optimum D^* (ten Raa and Mohnen, 2002). D expanded to D^* by an expansion factor c, i.e. $D^*=Dc$. The observed production, Y, reaches its optimal level on the frontier at Y^*. Reallocation of trade helps the domestic demand to reach its frontier at D*. Our basic primal of the domestic consumption demand maximization linear programming model is

$$
\begin{aligned}
&\underset{D,X,T}{Max}\, De^T \sum_h f_h d_h \\
&s.\,t. \quad \mathrm{X} \geq AX + + \sum_h^9 f_h d_h D + F + \begin{pmatrix} T_{19} \\ 0_2 \end{pmatrix} \\
&\qquad kX \leq \overline{K} \\
&\qquad nX \leq \overline{N} \\
&\qquad lX \leq \overline{L} \\
&\quad -\pi T_{19} \leq -\pi T_{19}^0 = B \\
&\qquad X \geq 0
\end{aligned}
$$

In the matrix for the primal problem can be written as:

$$
Max \begin{pmatrix} 0 & e^T \sum_h^9 f_h d_h D & 0 \end{pmatrix} \begin{pmatrix} X \\ D \\ T \end{pmatrix}
$$

$$\begin{pmatrix} A-I & \sum_h^9 f_h d_h & \begin{pmatrix} J_{19} \\ 0_2 \end{pmatrix} \\ k & 0 & 0 \\ n & 0 & 0 \\ l & 0 & 0 \\ 0 & 0 & -\pi \\ -I & 0 & 0 \end{pmatrix} \begin{pmatrix} X \\ D \\ T \end{pmatrix} \leq \begin{pmatrix} -F \\ K \\ N \\ L \\ B \\ 0 \end{pmatrix}$$

Exogenous variables:

f_h : column vector of h^{th} household's consumption share (23- dimensional)

d_h : a scalar of share of consumption demand of each h^{th} household in total consumption demand

e^T : a unit row vector

J_{19} : identity matrix for 19 tradable sectors

0_4 : zero matrix for 4 non-tradable sectors

A : a 21x21 - square matrix of intermediate flow coefficients

F : a 21-dimensional vector of fixed final demand comprising of government consumption demand, investment demand.

K : total endowment of capital stock

N : total land endowment

L : total labour endowment

k : row vector of technical coefficients of capital

n : row vector of technical coefficients of land

l : row vector of technical coefficients of labour

π : row vector of terms of trade in dollar term. Without loss of generality, we assume unit terms of trade for all tradable sectors.

Endogenous variables:

D : scalar of overall private consumption demand in the economy

X : a 21 dimensional column vector of economy's output

T^0_{19} : 19 dimensional vector of net exports,

The corresponding dual problem is:

$$\underset{P,r_1,r_2,w}{Min} \begin{pmatrix} r_1 & r_2 & w & P & \varepsilon \end{pmatrix} \begin{pmatrix} K \\ N \\ L \\ -F \\ B \end{pmatrix}$$

s.t.

$$\begin{pmatrix} P & r_1 & r_2 & w & \varepsilon & \partial \end{pmatrix} \begin{pmatrix} A-I & \sum_h^9 f_h d_h & \begin{pmatrix} J_{19} \\ 0_2 \end{pmatrix} \\ k & 0 & 0 \\ n & 0 & 0 \\ l & 0 & 0 \\ 0 & 0 & -\pi \\ -I & 0 & 0 \end{pmatrix} = \begin{pmatrix} 0 & e^T \sum_h^9 f_h d_h & 0 \end{pmatrix}$$

$$\begin{pmatrix} P \\ r_1 \\ r_2 \\ w \\ \varepsilon \\ \delta \end{pmatrix} \geq \begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

The objective of the primal problem is to expand the final private consumption demand *D* given the weights, d_h, at the observed share as the initial values. The first constraint indicates the commodity constraint, i.e. material balance while next three constraints are for capital, land and labour constraints respectively. It should be noticed that our three factors of production are mobile across the sectors. The fourth constraint explains that net exports valued at world prices should not exceed the existing trade deficit. Finally, the last one puts the nonnegative constraints on the activities. With corresponding dual problem, we get shadow prices associated with each constraint.

P, r_1, r_2, w and ε are shadow prices representing prices of output, capital, land, labour and purchasing power parity respectively and δ is the slack. The first dual constraint reflects that value added must be less than or equal to cost of production or equivalently, cost of production of the commodity should not exceed its price, i.e.

$P(A-I)+r_1k+r_2n+wl-\delta=0$

If the sectors are active, the non-negativity constraint is not binding, hence, associated slack variable is zero, and price of output is equal to its cost (ten Raa, 1995). Multiplying output on both sides, the equation becomes

$P(A-I)X+r_1K+r_2N+wL=0$

The second constraint of the dual, i.e. $P\sum_h^9 f_h d_h = e^T \sum_h^9 f_h d_h$ takes care of the price normalization. The coefficient in the objective function has been selected in such a way that only relative prices change, which is called normalization. The last constraint shows that if trade is free, prices of the tradable commodities will be same as their opportunity costs. It should be noted that in our case, the commodity constraint in the primal program has a non-zero bound, i.e. due to other fixed demands in the economy, *F*. Using the equilibrium values and shadow prices, we get equilibrium income level of each household group and it's consumption level. Equality between primal and dual condition gives rise to National Accounting balance:

$r_1K+r_2N+wL=D\sum f_h d_h+PF-\varepsilon B$

We can express this primal condition of our model in the following reduced (see Appendix II).

$$\underset{D,X}{Max}\, De^T \sum_h f_h d_h$$

$$s.\ t.\quad -\pi[X-AX-\sum_h^9 f_h d_h D-F]_{19} \le -\pi T_{19}^0$$

$$[X-AX-\sum_h^9 f_h d_h D-F]_4 \ge 0$$

$$\mathrm{k}X \le \overline{\mathrm{K}}$$

$$nX \le \overline{N}$$

$$lX \le \overline{L}$$

$$X \ge 0$$

The first constraint is for the 19 tradable sectors and its shadow price gives the terms trade between tradable domestic and foreign price, ε, which is no more unit. We can derive the domestic price by dividing foreign price, π by ε. The second constraint is for the two non-tradable sectors. The shadow prices of this constraint give the domestic prices of non-tradable sectors.

The next step of our methodology includes household consumption and income in a general equilibrium framework. This is done with the help of a social accounting matrix (SAM). A SAM captures the flows among different activities of the economy. A SAM provides a framework and consistent data for economy-wide models with detailed classification of accounts such as, industries, categories of working persons and institutional sub-sectors including various socio-economic household groups. It can be used to provide an analysis of inter-relationship between structural features of an economy and the distribution of income and expenditure of the household groups. The I-O matrix, however, does not show the interrelationships between value added and final expenditures. By extending an I-O table, to show an entire circular flow of income at macro level, one captures the essential features of a SAM. The rows in the SAM represent the receipts (income) of the different accounts, while the columns, their expenditure. The schematic picture below gives a bird's eye view about the SAM we have used for our analysis (Table 1).

Table1: A Simple Schematic SAM

	Production Account	Factors of Production	Households	Government	Capital Account	Rest of World	TOTAL
Production Account (21 sectors)	I-O		Household Consumption Df_hd_h	Government. Consumption	Investment Demand	Net Exports	Total Demand $De^T\sum f_hd_h$
Factors of Production [labour (L), Capital (K), land (N)]	Value added (VA) *kX, lX, nX*						Value added
Households (9 categories)		Factor income to households (h^h_l, h^h_k, h^h_n)					Total Household Income ($h^h_l + h^h_k + h^h_n$)
Government Account			Direct, Indirect taxes				Government Income
Capital Account			Household Savings	Government Savings		Foreign Savings	Total Savings
TOTAL	Value of Output	Value added	Total Household expenditure	Total Govt Outlay	Total Investment		

The second row and second column give the essence of I-O table. The crucial extension is the inclusion of household income and expenditure (row 4 and column 4). Different household groups owns different factor endowments and contribute to the production process as VA (column 2 x row2) and in return get factor income according to their ownership (column 3 x row4). Though household savings and taxes are also crucial in the general equilibrium framework, for simplicity, we do not consider them in our analysis.

The idea is to compute the propensity to consume at the competitive prices for each household group and in order to satisfy the general equilibrium condition, we set the ratio of new propensity to consume to the observed one evaluated at the competitive price same for all household groups. If the ratio of first household group exceeds the second one, then there is a higher consumption demand from this group relative to its income than the second one and hence, it shares more weight, d_h, in the economy. With the list of new weights, we impute new set of equilibrium values and competitive prices. Through the repetitive iteration process, we arrive at the optimum pattern of consumption and income for each household group.

Given the observed initial weight, we compute the new propensity to consume, $m^1{}_h$, through the linear program. Value of consumption for household through linear program:

$$C_h^1 = Pf_h d_h D$$

New income of the household:

$$Y_h^1 = r_1 h_K^h K + r_2 h_n^h N + w h_l^h L$$

Each household group's shares of capital, land and labour endowment are given by $h^h{}_K$, $h^h{}_n$, *and* $h^h{}_l$ respectively, where superscript h denotes the household category. The new propensity to consume for h^{th} household group is:

$$m_h^1 = \frac{C_h^1}{Y_h^1}$$

The observable propensity to consume at competitive prices is:

$$m_h^0(d) = \frac{Pf_h^o d_h^0 D^0}{Y_h^0}$$

In the equilibrium, the ratio of new propensity to consume to observed one should be same for each household group. If in our optimal computation, this ratio for a household group exceeds the other, the household weight attached to the consumption should get more shares at the expense of other in order to maintain the same ratio in the equilibrium.

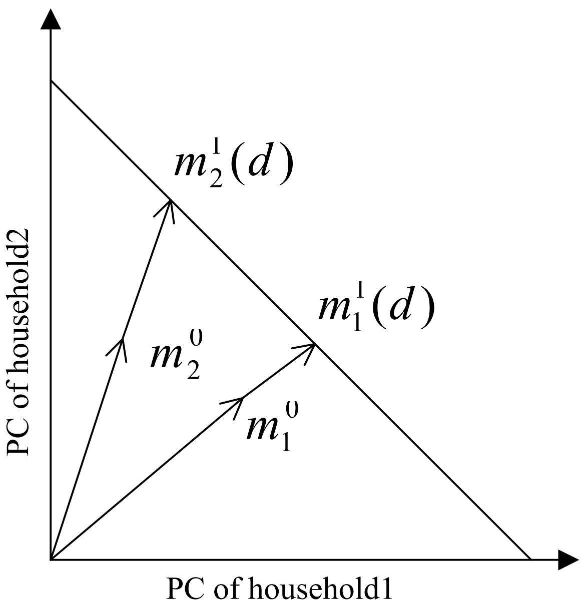

Figure 2

Propensity to consume at observed and optimum level for household1 and household2 are given as m_1^0, m_1^0 and $m_1^1(d)$, $m_2^1(d)$ respectively. The ratio of propensity to consume of household1 at optimum to its observed should equal to that of for household2 (Fig.2).

$$\frac{m_1^1(d)}{m_1^0} = \frac{m_2^1(d)}{m_2^0} = \ldots\ldots\ldots = \frac{m_9^1(d)}{m_9^0}$$

If $\frac{m_1^1(d)}{m_1^0} = \frac{m_2^1(d)}{m_2^0}$ then

$$\frac{e^T P_s f_1 d_1 D / Y_1^1}{m_1^0} = \frac{e^T P_s f_2 d_2 D / Y_2^1}{m_2^0} \text{ or, } \left(\frac{m_2^0}{Y_1^1} * e^T P_s f_1\right) d_1 = \left(\frac{m_1^0}{Y_2^1} * e^T P_s f_2\right) d_2 \cdots\cdots\cdots\cdots\cdots (1)$$

Similarly for other household groups,

$$\left(\frac{m_3^0}{Y_2^1} * e^T P_s f_2\right) d_2 = \left(\frac{m_2^0}{Y_3^1} * e^T P_s f_3\right) d_3 \cdots\cdots\cdots\cdots\cdots\cdots (2)$$

$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$

$$\left(\frac{m_9^0}{Y_8^1} * e^T P_s f_8\right) d_8 = \left(\frac{m_8^0}{Y_9^1} * e^T P_s f_9\right) d_9 \cdots\cdots\cdots\cdots\cdots\cdots (8)$$

$$\sum_{h=1}^{9} d_h = 1 \qquad \cdots\cdots\cdots\cdots\cdots\cdots (9)$$

There are nine variables, i.e. consumption weights, and nine equations to solve the system. The last equation (9) explains that the sum of share of consumption demand for household groups should be equal to one. We get new share for consumption of household groups, d_h. By plugging them into our primal maximization problem, we recalculate overall household consumption. By iteration, we obtain equilibrium final consumption of each household group and equilibrium output for the economy.

3. Benchmark Data

The Social Accounting Matrix (SAM) gives the benchmark equilibrium data set for the model. The SAM used for the present study is based on Pradhan, Sahoo and Saluja (1999). However, for this model, we have made some adjustment in the data (Appendix I). The intermediate flow in the SAM is based on the commodity x commodity (C x C) matrix. This is the case where number commodities are equal to the activity sectors and it is noticed that there is more scope for efficient improvement then otherwise (Mattey and Raa, 1994).

Economy is classified into 21 production sectors to take care of important economic activities. `Food-grains' has been separated from the rest of the agriculture sector for its vital role in poverty. 'Coal and lignite', and 'crude oil and natural gas' are the two components of primary energy. The primary energy requires higher investment in exploration and also due to high domestic demand a substantial amount of it is imported.

The sectors in the manufacturing are divided in such a way that capital goods are separated from consumer items like `food articles and beverages', `textiles', etc. in view of different capital structures. For the rapid development of the economy, the `cement and other non-metallic mineral products', which are basically inputs to the construction sector have assumed importance. Their growth will give a fillip to the crucial housing sector as well. `Fertilisers' as a sector has got a big role to play in influencing the agriculture. The `petroleum products' are kept separately as these are by-products of the one of the important energy sectors, `crude oil and natural gases'. They are also crucial energy sectors whose prices have so far been administered and the economy is very sensitive to their price changes.

`Construction' is highly labour intensive sector and also a part of this sector gives an idea about the physical infrastructure of the economy. `Electricity' is an important sector, having maximum inter-linkages in the economy. `Infrastructure services' and `financial services' have been kept as separate sectors as they have greater role to play particularly in the light of competitive scenario leading to greater liberalisation of these sectors. Last, but not the least, ‘other services’ is an unavoidable sector in the economy which includes, public services, repair services, services related to information technology (IT), etc. This sectors plays important role in influencing the welfare of the economy.

A general equilibrium model should be based on a sensible data set, which should reflect the structure of the economy. Households are classified according to their principal sources of income. There are four rural and five urban occupational household groups. Sources of income of households constitute one of the important aspects of our base SAM. The MIMAP-India Survey (NCAER, 2000), which is the basis for the income distribution in our SAM, reflects that about 56% of rural income comes from the agriculture while 97% of urban income from the non-agriculture. The rural agricultural households derive around 87% of their income from the agriculture. On the other hand, rest of the rural household groups get around 87%-89% of their income from the non-agricultural activities.

Table 2: Sources of Income for Household Groups

Household Categories	Agriculture	Non-agriculture	Total
Rural			
Self employed in agriculture	87.12	12.88	100
Self employed in non-agriculture	12.87	87.13	100
Agriculture wage earners	88.52	11.48	100
Non-agriculture wage earners	10.32	89.68	100
Other Households	12.53	87.47	100
Total Rural	55.66	44.34	100
Urban			
Agriculture households	74.91	25.09	100
Self employed in non-agriculture	0.95	99.05	100
Salaried earners	0.9	99.1	100
Non-agriculture wage earners	2.19	97.81	100
Other households	1.03	98.97	100
Total Urban	2.46	97.54	100
	32.14	67.86	100

Source: MIMAP-India Survey, NCAER, 2000.

Our SAM supplies another interesting related aspect of income distribution in Table 3. A significant dominance of wage income is observed by urban 'salaried class', where 12 per cent of this group population captures around 34 percent of wage income and next in the wage distribution stands the rural 'agriculture labour', which 22 percent of population shares around 17 percent of wage income. This shows the clear-cut wage disparity in the economy. Here it is worth-mentioning that salaried class are mostly employed in the service and secondary sectors, while agriculture labour households are engaged in the agriculture sector only. On the other hand, a large ownership of capital is observed in case of urban 'non-agriculture self-employed' household group, where 5.4 percent of this group has around 33 percent of capital income. Though the share of capital income is very high, around 20 percent, among the rural 'cultivator' household group, this income has to be apportioned among a big chunk of 24 percent of cultivator population. However, this group occupies a large share of agricultural land in the economy.

Table 3: Share income across household groups by sources

Household	Population (Shares)	Wage income (Shares)	Capital income (Shares)	Land rent (Shares)	Total (Shares)
Rural					
Cultivator	24.22	13.36	20.46	78.49	23.92
Agriculture labour	22.08	16.85	0.46	0.56	9.97
Artisans	13.85	10.01	14.81	15.5	12.12
Other households	14.76	14.8	3.76	4.18	10.21
Urban					
Agr. Households	1.24	0.74	1.62	1.28	1.06
Non-agr. Selfemployed	5.4	6.03	32.69	0	12.97
Salaried	12.19	34.34	14.26	0	24.04
Non-agr. Labour	2.81	2.96	3.54	0	2.74
Other households	3.44	0.9	8.4	0	2.96
Total	**100%**	**100%**	**100%**	**100%**	**100%**

Souce: NCAER (2000)
* SAM for India, Pradhan et al (1999)

The 1994-95 households demand structure shows that the pattern is much more uniform among rural households than that among the urban (Table 4). All the rural household groups spend above 40% of their consumption budget on primary sector, which is composed of mainly the agriculture sectors, compared to urban groups. Among the urban household groups, lowest expenditure on primary sectors is made by 'other households', salaried class' and non-agriculture self-employed', but higher spending on service sectors.

Table 4: Composition of Household Expenditure

	Rural				**Urban**				
	Cultivator	Agriculture Labour	Artisans	Other Households	Agriculture Households	Non-agriculture Self-employed	Salaried	Non-agriculture Labour	Other households
Primary	41.16	47.17	41.18	42.23	43.77	35.07	24.63	44.37	19.08
Secondary	26.10	25.71	28.08	29.07	23.76	24.86	31.36	25.32	27.46
Services	32.74	27.11	30.75	28.70	32.47	40.07	44.00	30.31	53.46
Total	100	100	100	100	100	100	100	100	100
Share in Total spending	0.12	0,06	0.06	0.05	0.01	0.06	0.11	0.02	0.02

It could be seen that rural household groups spend highest portion of their budget on primary sectors, i.e. on agriculture and, in fact, rural area's maximum livelihood comes from the agriculture. Among the rural household groups, the 'agriculture labour' class has highest consumption expenditure on the primary sector and also it has the highest earning from the agriculture sector, 89 percent (Table 2). In urban area, except for the 'agriculture households' and 'non-agriculture labour, whose share in total spending in the economy is very low, 0.01 and 0.02 respectively, expenditure on service sector constitutes highest in their consumption baskets while they earn their income maximum from non-agriculture sector. This rural and urban dichotomy may play an interesting role in influencing economic activities of the country. It is noted that the spending on secondary sector, comprising manufacturing sectors and 'electricity' in it, does not show much variability except for the case of urban 'salaried class' who allocates relatively more of its budget share than other household groups.

3.1. Data for the Model

The social accounting matrix for India by Prdhan et al. (1999) provides the base data for our model. The original SAM has 60 production sectors. For our purpose, we aggregated them to 21 sectors. As already discussed above, besides giving data on intermediate flows and value added of different factors the SAM provides information on the total household consumption, consumption share of household groups in the total demand and consumption vectors of commodities. It also gives us information on the endowment of different factors by various household groups. Major problem is encountered to set the benchmark price for labour, capital and land, hence, the factor-output ratios for the primal problem.

Given the diverse activities in the Indian economy, wages are expected to vary across different sectors. Annual Survey of Industry (ASI) (Government of India, 1994-95) gives information on number of employees engaged in different registered manufacturing industries and their total emoluments. We compute the average wage rate for each industry. However, because of the difficulty in procuring information on unregistered industries, we assume the same wage rates for all India industries. By applying these wage rates on SAM labour value added, we estimated number of employees, i.e. labour supply for manufacturing industries. However, ASI does not give information on agriculture sectors, mining and quarrying, construction and service sectors. Using the information on number of main and marginal workers engaged in these activities given by Census of India (1991), we compute the benchmark wage rate for these sectors. Total labour force is not fully employed in the model. Unemployment rate of 6 percent is applied to the labour constraint equation in the model[5].

[5] Unemployment rate is the ratio of unemployed to the total labour force based on daily status. The source is "National Sample Survey Organisation. Report no.409. Employment and Unemployment in India, 1993-94: NSS Fiftieth Round. July 1993-June 1994. New Delhi.1997"

Table 5: Factor prices and coefficients across the sectors

		Capital/ Output	Labour/ Output	Land/ Output	Average Wage	Rent of Capital	Rent of Land
S1	Food grains	0.065	48.814	0.276	0.065	1.000	1.000
S2	Other agriculture	0.075	57.464	0.302	0.065	1.000	1.000
S3	Crude oil, natural gas	0.594	27.013		0.089	1.000	
S4	Other Mining and quarrying	0.454	20.281		0.089	1.000	
S5	Food products, etc.	0.133	4.844		0.172	1.000	
S6	Textiles	0.117	6.292		0.262	1.000	
S7	Other traditional mnf.	0.162	5.808		0.289	1.000	
S8	Petroleum products	0.268	1.489		0.461	1.000	
S9	Finished petrochemicals	0.276	1.292		0.461	1.000	
S10	Fertiliser	0.230	2.028		0.365	1.000	
S11	Other chemicals	0.225	2.272		0.365	1.000	
S12	Non-metallic products	0.170	5.127		0.236	1.000	
S13	Basic metal industries	0.156	1.826		0.444	1.000	
S14	Metallic products	0.157	5.467		0.309	1.000	
S15	Capital goods	0.175	4.933		0.449	1.000	
S16	Other Manufacturing	0.269	6.976		0.342	1.000	
S17	Construction	0.075	4.574		0.810	1.000	
S18	Electricity	0.277	3.046		0.383	1.000	
S19	Infrastructure service	0.377	8.033		0.311	1.000	
S20	Financial service	0.531	7.483		0.311	1.000	
S21	Other services	0.243	16.525		0.289	1.000	

In our study, we assume uniform price of capital across sectors. The benchmark capital price is taken as unity, so that the value added of capital across the sectors is treated as supply of capital in the model. Our definition of land as factor of production is limited to agriculture sectors only. Though it's expected that land could be used as factor production in the some of the manufacturing sectors, agriculture sector takes the maximum share of the utilized land. Rent to the agriculture land is also assumed to be uniform for all the agriculture sectors with unit price in the benchmark. The benchmark coefficients for factors, i.e. factors to output ratio, are given in the Table 5. The model assumes no unutilised land in the production process. However, capacity utilization rates for different sectors have been taken from different sources (Table 6).

Table 6: Sector-wise Capacity utilization and sources of information

	Sectors	Capacity Utilization (%)	
S1	Food grains	81	Gupta, et. Al 2000 for irrigation
S2	Other agriculture	81	Gupta, et. Al 2000 for irrigation
S3	Crude oil, natural gas	88	Indiainfoline.com
S4	Other Mining and quarrying	85	Government Of India, 1996 (for Coal)
S5	Food products, etc.	49	Second All India Census, 1987-88
S6	Textiles	69	Second All India Census, 1987-88
S7	Other traditional mnf.	58	Hand of Industrial Policies and statistics
S8	Petroleum products	88	Indiainfoline.com
S9	Finished petrochemicals	78	Handbook of Industrial Policies and statistics
S10	Fertiliser	90	Trivedi et al.1998,
S11	Other chemicals	78	Directories-today.com
S12	Non-metallic products	71	Based on 7th Five-year Plan (for Cement industry)
S13	Basic metal industries	78	For Aluminium industries
S14	Metal products	55	
S15	Capital goods	83	Handbook of Industrial Policies and statistics
S16	Other Manufacturing	78	Handbook of Industrial Policies and statistics
S17	Construction	75	Infoline debate September 23, 2000 Indiainfoline.com
S18	Electricity	41	Economic Survey, 2000-2001, Ministry of Power
S19	Infrastructure service	75	Same as for construction sector
S20	Financial service	100	Personal guestimate
S21	Other services	52	Govt. of India, Second All India Census, 1987-88

4. Poverty Measure and the Income Distribution

This section of the study is based on Pradhan and Sahoo (2003). In order to measure poverty, within each social group, an estimation of income distribution within the respective group is required. The distribution will be used to evaluate the group poverty incidence. However, this assumes that, given the within-group variances, the intra-group distribution changes proportionally with the change in mean income. But, it could be assumed that any policy changes would not affect within group relative distributions in the short to medium term. For our study, within group distribution will be given by a two-parameter log-normal frequency distribution. The benchmark lognormal parameters will be estimated using the MIMAP survey data.

The following equation represents the lognormal distribution:

$$f\,(y)=1/(\sqrt{2\pi}\,\sigma(y-\tau))\,\exp -\tfrac{1}{2}\,\{[\log\,(y-\mu]/\sigma\}^{2}$$

where μ, and σ are mean income and standard deviation of log-normal distribution, respectively. For the purpose of our poverty analysis, we would use only head-count ratio as one of the three special cases of FGT poverty measure (Foster, Greer and Thorbecke, 1984). The FGT measure is especially suitable to estimate group-wise poverty. The FGT measure is defined by

$$P_\alpha = \frac{1}{n}\sum\left[\frac{Z - Y_i}{Z}\right]^\alpha,$$

where Z is the poverty line, n is the number of persons in a particular household group (i.e. occupational class), and Y_i is the income of the i^{th} household group. The α can be viewed as a measure of poverty aversion. The three special cases of FGT measure where α takes value 0, 1 and 2 are the most commonly used. When α=0, P_0 becomes the 'head-count ratio measure', when α=1, P_1 is the 'poverty-gap measure' and α=2, P_2 becomes distributionally sensitive measure'. The higher degree of 'poverty aversion', i.e. α=2, indicates that the poorest person should get relatively more weight in the poverty measure. In this paper, we have used only head count ratio of poverty measure for our analysis. However, it is not difficult to use the other measures. In the plain language the poverty head-count ratio of particular household group is the ratio of number households living below the poverty line to total population in the group.

When income distribution is given in the form of group data, the poverty measure requires a continuous distribution. We now intend to express the poverty measure in terms of lognormal distribution. The above-mentioned Pα measure would no longer be based on the discrete information. It is expressed in continuous distribution.

$$P_\alpha = \int_0^z \left[\frac{Z - Y}{Z}\right]^\alpha I(\mu,\sigma)\,dy,$$

where $I(\mu,\sigma)$ is the income distribution of the household group. The distribution varies from 0 to z. After transformation of the right hand side of the equation, the 'head-count ratio' becomes

$$P_0 = I_0(\mu,\sigma) = G\left\{\frac{log(z) - \mu}{\sigma}\right\}.$$

The right hand side of the expression is the standard normal distribution. Likewise one can compute the transformed expressions for P_1 and P_2.

Poverty line *Z* would be endogenised in our model through changes in the relative commodity prices. The change in mean income of household group will come from optimum solution of our model[6].

Poverty head-count ratio (P_0) in the benchmark for the household groups for the year 1994-95 is computed by applying base run values of relative prices, which are assumed to be unit, and income distribution taken from our SAM on the poverty lines[7]. We compare this with the head-count poverty ratio as provided by NCAER. 1999, which can be called as actual poverty head-count ratio. However, it is seen that the estimated benchmark poverty very closely replicates the actual (Table 7). This difference could be due to the several adjustments in the SAM.

Table 7: Poverty Head-count ratio P_0 in Benchmark and the Actual

	Poverty (1994-95)	
	Benchmark	Actual*
Rural	**0.3943**	**0.3979**
Cultivator	0.3679	0.2946
Agriculture labour	0.5497	0.5675
Artisan	0.3586	0.4404
Other households	0.2041	0.2451
Urban	**0.2837**	**0.2245**
Farmer	0.7396	0.6179
Non-ag. Self-employed	0.3860	0.2389
Salaried class	0.1424	0.1038
Casual Labour	0.6103	0.5910
Other household	0.2135	0.2912

*NCAER, 2000 (MIMAP-India Survey).

Log-normal distribution is used to estimate the income distribution within the household groups. The estimation is based on the MIMAP-India household survey data (Table 8).

[6] Our GE model provides the income for each group. If the log variances are known, then log means can be calculated from the following relationship $\mu = \ln(y) - (1/2)\ \sigma^2$, where y is the arithmetic mean income, σ^2 is log variance and μ is the log mean (Dervis, de Melo and Robinson, 1984).

[7] Poverty line is taken from NCAER (2000) for MIMAP-India study. Government of India (1993) estimated (nutritional) poverty line for Rural and Urban India for the year 1973-74 based on the pattern of consumption expenditures of households. Poverty lines for MIMAP-India are used by revising 1993-94 poverty lines by using consumer price index number for agriculture labour and industrial workers for rural and urban areas respectively.

Table 8: Parameters of log-normal distribution

	Log-mean	Standard deviation
Rural		
Cultivator	5.85	0.76
Agriculture labour	5.33	0.60
Artisan	5.55	0.79
Other household	5.93	0.72
Urban		
Farmer	5.41	1.05
Non-ag. Self-employed	6.36	0.89
Salaried Class	6.68	0.76
Casual Labour	5.54	0.82
Other Household	6.47	1.35

For our measure of inequality, we use standard Gini coefficient, which is often based on and derived from the Lorenz curve. We derive our Gini coefficients from Lorenze curve. Lorenze curve is a plot of cumulative fraction of population, starting from the lowest income, on the *x*-axis against cumulative fraction of population of the household groups on *y*-axis. If the resources were equally distributed, the Lorenze curve would be 45-degree line. The Gini is the area between the curve and 45-degree line as fraction of 0.5, which is the total area under 45-degree line (Fig.3).

5. Results and Implications

The main concern of this paper is to see the efficiency gain due to competitiveness in the economy resulted from possible economic reform process, which may result in the change in the income distribution and poverty among the household groups. If the hypothetical Indian economy under analysis is operating below the optimal level, then the expansion of domestic private final demand will reach the frontier by doing away with the slacks in the factor use and reallocation of resources. In the free trade environment, endogenizing the trade with net exports constraint will take care of the terms of trade effect, which in a way captures the gain in the technical efficiency.

Since 1991, the beginning of the era of full pace economic reform, there has been a great deal of debate in India about the possible impact of these policies on the poor. If one looks at the head count poverty ratio for rural and urban India since 1983, it is seen that rural poverty ratio has been always higher than that for urban (Table 9). The decline in the poverty ratio started in the late eighties itself. This is not, however, an unusual phenomenon, given the size of rural population. In the pre-reform period, until 1990, both the rural and the urban poverty have declined. It could be mentioned that there was some well-thought initiation of reform process, though not full heartedly, in the mid-eighties. And about 80 per cent of the total poor live in rural areas.

Table 9: Poverty Head-count Ratio

Year	Rural	Urban	Total
1973-74	56.4	49.0	54.9
1977-78	53.1	45.2	51.3
1983	45.7	40.8	44.5
1987-88	39.1	38.2	38.9
1993-94	37.3	32.4	36.0
1999-00	27.1	23.6	26.1
2007 *	21.1	15.1	19.3

Source: Government of India (2003)
*Poverty projection for 2007

The main objectives of the reforms in India have been to accelerate the growth of the economy by removing the distortions. If these policies are realized in hypothetical situation, the competitive pressure will not only deliver efficiency gain, but could have differential effects among household groups. It might, no doubt might, have impact on the household group by affecting their income and consumption levels, and hence, resultant income redistribution and poverty. The type of assumptions we make as regards to behaviour of the factors of production in the observed economy may greatly influence the results of the model. We have assumed labour and land are mobile across the sectors[8]. However, capital may or may not be mobile. In the evolving liberalized market, there is continuous adjustment among the industries. It is important for the market to reallocate the factor of production efficiently to productive uses in other sectors. Most of the capital is highly specialized due to its inherent technology, product-specific, etc. Effects of terms of trade in case of sectoral specificity capital will bring about sectoral specific technical efficiency for the capital-intensive exporting sectors. However, the fully competitive market will make the capital mobile across firms and sectors to be efficiently reallocated, though we have to make an assumption that it happens with minimal or no replacement and transaction costs. From Indian economy's point of capital is no longer strongly sector-specific like during import-substitution regime, yet it is too early to think that capital is fully mobile across all the sectors due to current reforms. Hence, it will be interesting to compare and analyse two different scenarios with fully capital mobility and sectoral specificity of capital.

- **Scenario 1**. Capital is mobile across the sectors. This implies the highest form of competitiveness, where capital can be re-allocated efficiently among the sectors.

[8] Please note that we have considered only agricultural land. We assume that land can be used in any types of agriculture purpose.

- **Scenario 2.** Capital is immobile and sector specific. In this case, we may lose the degree of efficiency due to constraint on capital re-allocation.

If the economy is operating under a competitive spirit with free trade and all the factors of productions are mobile, as in **Scen.1**, the expansion factor of the frontier at the optimal solution is 1.64 as compared to one in the benchmark. The total efficiency of the economy is 1/1.46 = 0.68, indicating that economy would achieve its potential 68 percent more than the observed performance. Despite the productivity growth, the inequality as represented by Gini coefficient has significantly increased to 0.3675 at the optimum from 0.2739 at the actual level. Poverty as measure of head-count ratio (P_0), as defined in the Section4 declines sharply urban households, while it has deteriorated for rural households (Table 11). This is because of the adverse income distribution of rural households against the urban households. Except for the rural artisans, income ratio of optimum to observed decline for all other rural household groups.

Our observed Indian economy has around 6 percent of unemployment rate in the labour force and sector specific unutilised capital. When the economy is allowed to be competitive to operate at the optimum, the mobile factors are reallocated themselves to the sectors where demand for demand for respective factor is more. Shadow prices of labour and capital are picked up by the two factor constrains. The factor mobility gives rise to one competitive factor price for each factor. In this scenario, we observe that demand for capital has been higher than that of labour. The removal of slack in the capital constraint results in more efficient use of unutilised capital. Land is seen to be non-binding at the optimum, yielding a zero shadow price. This hints at the fact that there is no scope to improve the efficiency of agricultural land use. Factor prices of capital and labour have increased at the optimum. The ratios of optimum factor prices to observed for capital and labour are 2.24 and 0.73 respectively (Table 10). Lagrange multipliers to the material balance and balance of constraints in the primal give the commodity prices and exchange rate respectively under competitive conditions, which are determined in the dual constraint. As we have already discussed in the model that cost and revenue of the sector must equate in the dual program. When the factors are binding, rise in the factor prices must either raise in the optimal commodity price or output. In our case, prices of tradable commodities are the same as the optimal exchange rate as the benchmark terms of trade is assumed to be one. It should also be noted that if there is an increase in price of non-tradable commodity, it must be driven by at the cost of price of commodities produced by the tradable sectors.

At this point it's important to mention that our kind of linear programming models give rise to specialisation in the production sectors. Theoretically, we have three factor constraints and two constraints for non-tradable sectors and hence, we expect five active sectors in the economy. However, land is found to be non-binding, resulting in four active sectors in Indian economy, viz. 'food grains' (S15), 'construction' (S17), 'electricity' (S18) and 'other services' (S21), of which construction and electricity are non-tradable sectors (Table 10). The 'other service sector', which includes information technology, (IT) shows a significant performance in the productivity at the optimum level with 7.72 times better than the actual. Free movement of factors, particularly capital, and free trade is expected to give boost to the service sector in the economy, which has already started realizing in India. The 'construction' comes next in the increase in the output followed by 'food grains'. Output declines for 'electricity' sector, while the price of this domestic non-tradable sector increases by factor 1.33. Productivity growth in other three active sectors results in decrease in their prices. Ever since the reform process started, globalizing of the agriculture sector has been a moot issue. In this perspective, our result that the 'food grains' as an important sub-sector of agriculture becoming active with increasing growth would support the globalizers. However, the most important question is which household group benefits from this.

As factor price of capital increases more than that of the labour, we expect that household groups owning more capital would gain in this allocation process. Table 4 shows that among rural household groups, the 'cultivator' households have highest capital as well as land ownership. Their consumption weight has declined due to zero land prices at the optimum. However, only 'artisan' household group gains in weight due to capital reward. The worst affected household group in the economy is the rural 'agricultural labour', which has very low share of capital and large labour endowment. On the other hand, among urban household groups, 'salaried class' has maximum contribution of labour, which contributes to its decline in consumption share and maximum gain incurs to the 'non-agricultural self-employed' household group. The wide income disparity between rural and urban household groups has given rise to increase in the Gini coefficient, the measure of inequality. Within rural household groups, income distribution is strongly biased towards the 'artisan' group and against the 'agricultural labour'.

Change in poverty ratio is reflected by the inter-play of change in price and income. Adverse income effect among most of the rural household groups dominantly explains the increase in rural poverty ratio. While only the 'artisan' household group shows a significant decline in poverty, the ' agricultural labour' suffers heavily from increase in poverty ratio. Poverty ratio increases by around 17 percent for rural 'agriculture labour' household group. With already high existing poverty ratio for this group, i.e. 0.55, the significant rise in poverty will certainly have disastrous effect on them. On the other hand, there is a sharp decline in the urban poverty. However, decline in poverty ratio is the least for the highly labour-endowed salaried class, because of its lower increase in income.

In the **Scen.2**, we consider capital is sector-specific and it is difficult to reallocate them among sectors. We take the same rate of capacity utilization as Scen.1. The basic differences of this scenario from the earlier one are that in present scenario, economy experiences less expansion vector due to lack of re-allocation of capital in the observed economy and unlike earlier case, there are not any more few specialized sector, rather all sectors are active. The expansion factor is now 1.42 and total efficiency is 1/1.42 = 0.70. There is also an increase in inequality in the economy. But it is interesting to see that the increase in inequality has been less than the earlier scenario. Gini coefficient is now 0.3448. This less degree of inequality vis-à-vis the previous scenario could be assigned to the marginal improvement in the income distribution among the rural household groups. On the other hand poverty head-count ratio (P_0) declines for overall rural and urban households (Table 11). The decline is quite significant for the urban household as against the marginal decline for the overall rural households. Like the Scenario 1, this case also change in poverty ratio seems to be dominated by the income effect of household groups.

Each production activity has to produce within its fixed amount of capital along with mobile labour and land. There may be more extensive use of capital at the optimum, as the competition would lead to exploitation of unutilised capital till its full utilization. Rent to capital is determined by interplay of demand and supply of each industry; therefore, we get different optimum rent for different industries. Fixed supply of capital as against the flexible labour drives the capital price more than the wage for most of the sector. In fact, the competitive wage has declined with respect to benchmark. On the other hand, capital rent has declined significantly for most labour-intensive primary sectors: 'food grains, 'crude oil and natural gas' and 'other mining and quarrying' (Table 10). Even we notice non-binding in the capital constraint for 'other agriculture' sector (S2). We also observe two more non-bindings in the capital constraints of two non-tradable sectors, viz. ‘construction’ (S17) and ‘electricity’ (S18). Like the earlier scenario, land constraint is found to be non-binding yielding zero shadow price. We see that sectors pay higher rents to capital because of their increased use of industry-specific capital. At the same time, sectors with low initial utilization rates, experience growth in output. Sector like ‘food and food products’ (S5) has shown significant increase in output with respect to observed level, 2.04, followed by ‘other services’ (S21), 1.92, and ‘metallic products’ (S14), 1.81. It should be kept in mind that these sectors are also open to free trade. Though the ‘electricity’ sector (S18), which is not tradable, has the lowest initial capacity utilization rate, it shows relatively much less increase in output. This could draw upon the fact that when capital is sector-specific, efficiency due to re-orientation of trade plays a significant role in sectoral growth. The relative prices of commodities produced under free trade go up marginally vis-à-vis lower prices of non-tradable commodities. Increase in domestic production has resulted in the marginal increase in exchange rate.

Decline in competitive wage, i.e. with ratio of optimum to observed wage being 0.92, combined with the variation of rent to capital would influence the change in income of household groups at the optimum solution. The slump in wage and capital rent in agricultural sectors has adverse effect on income of rural ‘agriculture labour’ and ‘cultivator’ class respectively. Among the rural household groups, ‘artisan’ household group gains in income distribution and consumption weight. On the other hand, urban household groups have shown relatively better performance in income and hence, consumption weights except for the ‘salaried class’, who has got highest endowment of labour. Income inequality has also increased, but less than the earlier scenario. The reason for less increase in inequality as compared to earlier scenario is that rural household groups, especially the lowest income groups who are responsible for the rural welfare distribution, viz. the ‘agriculture labour’ and other household’, performed better in income ratio and consumption weight distribution than in the previous scenario. This is mainly because of lower decline in wage than in the previous case of capital mobility across sectors. Income effect again plays a significant role in influencing household poverty head count ratio.

Rural household groups, engaged in the agriculture sectors, viz. ‘cultivator’ and ‘agricultural labour’, have experienced increase in poverty ratio. However, the increase in poverty for agricultural labour is much significantly less than that of in case of mobility mobile capital due to improvement in their income level as compared to earlier case. Urban household groups enjoy the decline in poverty ratio, with marginally better than the earlier scenario.

6. Conclusion

This paper discusses the efficiency gain of Indian economy due to efficient re-allocation internal resources as well as re-orientation of free trade. However, we do not direct our analysis towards the degree of contribution of various efficiencies. We go further to look into the impact of the efficiency gain on the income distribution of household groups and their poverty. Income of households changes with the new competitive factor prices. Given the fixed savings rate for individual household group, there is scope for readjustment of consumption weights of household groups until ratio of new optimal propensity consume to observed one equals for all the household groups.

As the economic theory suggest, welfare maximization may not result in positive income distribution in the first best case. Indian economy, so far, has been operating below the efficient resource allocation and lack of competition. Its pursuit for welfare maximization under competitive spirit has no doubt resulted in efficiency gain, but at the cost of adverse income distribution. Rural household groups suffer more than the urban ones. Poverty head-count ratio as measure of poverty of household groups is determined by change in price and income distribution. The study shows that the income effect dominates the in influencing poverty ratio at the optimum allocation. Income distribution worsens in both the cases of capital mobility and sector specificity. This could also be traced in the variation in the poverty ratio across the household groups. Urban household groups, in general gain in welfare distribution with significant decline in poverty headcount ratio as against the rural household groups. The only rural household group, who experiences significant decline in poverty, is the 'artisan'. But, the worst sufferers in all accounts are rural 'agricultural labour' due to resultant poor wage rate at the optimum allocation. Among the urban household groups, relative gain for 'salaried class' is very low. Though degree of inequality and poverty varies with our assumption pertaining to factor capital mobility across the sectors, the intensity of variation is not strikingly different from each other. Nevertheless, capital mobility results in higher productivity growth due to efficient utilization of resources with resultant higher degree of inequality. On the other hand, poverty salutation is marginally better in case sectoral specificity of capital.

The study is, no doubt, not without having some shortcomings. Like many other applied models, our model is great constrained by proper data availability, particularly for the sector-wise capacity utilization rate of capital. We have simplified our model by not incorporating the taxes in the material balance constraint as well as in the objective function. We allowed for free trade without any tariff or non-tariff barriers, which is not very realistic in Indian situation. Our iteration for readjustment of our consumption weights is limited by the fixed saving rate of household group and not allowing for any income transfer among inter-household groups. We take very simplified measure income distribution, Gini, which should have considered large number of household groups. Besides, it does not take into account the intra-household group distribution. Despite all these admitted shortcomings, the study gives a basis to explore more interesting possibilities to link between productivity-efficiency gain and household conditions. Given the vastness of Indian economy and heterogeneous household characteristics, general equilibrium analysis has, no doubt, been appropriate to capture the impacts on the household groups through inter-linkages in the economy.

Table 10: Change in output, prices of Factors and Commodities

		Scenario 1				Scenario 2			
		Ratio of Optimum to Observed				Ratio of Optimum to Observed			
		Factor Prices		Price	Output	Factor Prices		Price	Output
		Labour	Capital			Labour	Capital		
S1	Food grains	0.73	2.24	0.997	1.243	0.92	0.59	1.005	1.235
S2	Other agriculture	0.73	2.24	0.997		0.92		1.005	0.666
S3	Crude oil, natural gas	0.73	2.24	0.997		0.92	0.94	1.005	1.136
S4	Other Mining and quarrying	0.73	2.24	0.997		0.92	1.04	1.005	1.176
S5	Food products, etc.	0.73	2.24	0.997		0.92	2.43	1.005	2.041
S6	Textiles	0.73	2.24	0.997		0.92	2.72	1.005	1.449
S7	Other traditional manufacture	0.73	2.24	0.997		0.92	2.86	1.005	1.724
S8	Petroleum products	0.73	2.24	0.997		0.92	1.36	1.005	1.136
S9	Finished petrochemicals	0.73	2.24	0.997		0.92	1.56	1.005	1.282
S10	Fertiliser	0.73	2.24	0.997		0.92	1.45	1.005	1.111
S11	Other chemicals	0.73	2.24	0.997		0.92	1.70	1.005	1.282
S12	Non-metallic products	0.73	2.24	0.997		0.92	2.25	1.005	1.408
S13	Basic metal industries	0.73	2.24	0.997		0.92	2.06	1.005	1.282
S14	Metallic products	0.73	2.24	0.997		0.92	3.21	1.005	1.818
S15	Capital goods	0.73	2.24	0.997		0.92	2.36	1.005	1.205
S16	Other Manufacturing	0.73	2.24	0.997		0.92	1.96	1.005	1.282
S17	Construction	0.73	2.24	**0.774**	1.31	0.92		**0.610**	1.065
S18	Electricity	0.73	2.24	**1.338**	0.54	0.92		**0.527**	1.369
S19	Infrastructure service	0.73	2.24	0.997		0.92	1.89	1.005	1.333
S20	Financial service	0.73	2.24	0.997		0.92	1.26	1.005	1.000
S21	Other services	0.73	2.24	0.997	7.72	0.92	4.10	1.005	1.923

Note: Land is non-binding in both the scenarios implying zero shadow prices.

Table 11: Household Consumption weights, income inequality and poverty

	Consumption Weights		Ratio of optimum to Observed			Consumption Weights		Ratio of optimum to Observed		
	Benchmark	Optimum	Income	Consumption	Change in Poverty %	Benchmark	Optimum	Income	Consumption	Change in Poverty %
Cultivator	0.244	0.201	0.99	1.21	0.69	0.244	0.191	0.92	1.11	2.79
Rur Ag lab	0.125	0.079	0.76	0.92	17.21	0.125	0.100	0.93	1.13	3.51
Artisan	0.116	0.130	1.35	1.65	-13.79	0.116	0.125	1.26	1.52	-11.69
Rur Other	0.102	0.080	0.94	1.15	3.18	0.102	0.090	1.04	1.25	-2.10
RURAL					**3.61**					**-0.51**
Urb farmer	0.012	0.015	1.50	1.83	-17.78	0.012	0.014	1.36	1.64	-17.39
Urb Nag self	0.121	0.198	1.97	2.40	-17.33	0.121	0.178	1.72	2.08	-16.84
Urb Salary	0.214	0.199	1.12	1.37	-3.60	0.214	0.214	1.17	1.42	-5.67
Urb Casual lab	0.032	0.039	1.49	1.81	-22.00	0.032	0.038	1.41	1.71	-23.86
Urb Other	0.034	0.059	2.07	2.52	-16.26	0.034	0.052	1.79	2.16	-15.42
URBAN					**-10.29**					**-11.46**
Gini Coefficient	**0.2739**				**0.3675**	**0.2739**				**0.3448**
Expansion vector	**1.00**				**1.47**	**1.00**				**1.42**

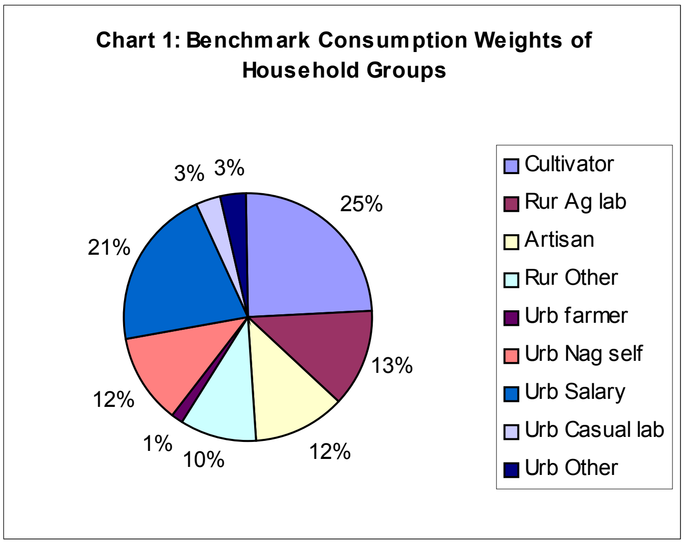

Chart 1: Benchmark Consumption Weights of Household Groups

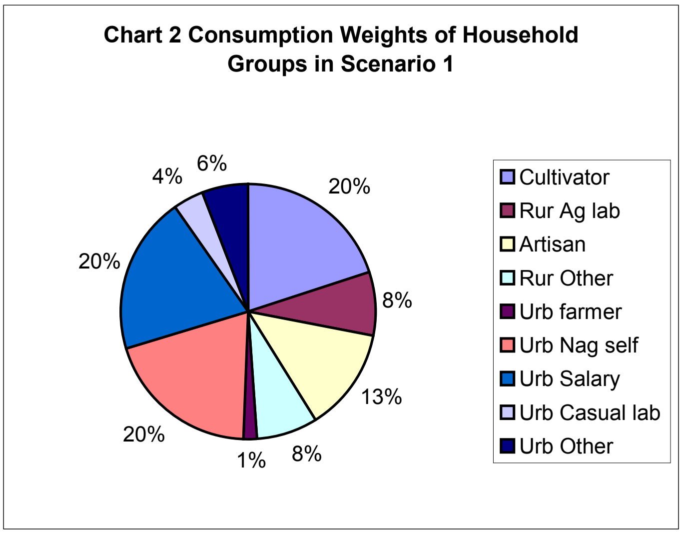

Chart 2 Consumption Weights of Household Groups in Scenario 1

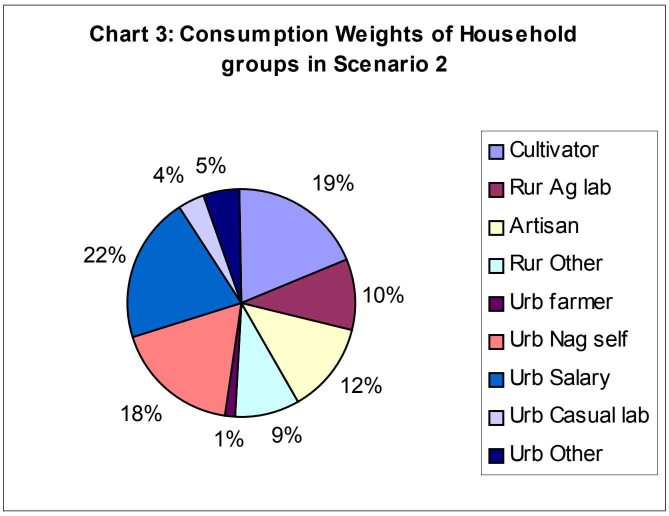

Chart 3: Consumption Weights of Household groups in Scenario 2

References

Adelman, I., and S. Robinson (1978), *Income Distribution Policy in developing Countries: A case study of Korea*, Stanford, CA: Stanford University Press.

Adelman, I., and S. Robinson (1988), "Macro economic Adjustment and Income Distribution- Alternative Models Applied to Two Economies", *Journal of Development Economics*, Vol. 29, 23-44.

Annual Survey of Industries, Central Statistical Organisation (Various Issues), Department of Statistics, Ministry of Planning and Programme Implementation, Govt. of India.

Armington, P.S. (1969), "A Theory of Demand for Products Distinguished by Place of Production", *International Monetary Fund Staff Papers*, Vol. 16, 159-76.

Armington, P.S. (1969), " The Geographic Pattern of Trade and the Effects of Price Changes", *International Monetary Fund Staff Papers* 16, 176-199.

Armington, P.S. (1970), "Adjustment of trade Balances: Some Experiments with a Model of Trade Among Major Countries", *International Monetary Fund Staff Papers*, Vol. 17, 488-523.

Bajpai, N. and J. D. Sachs (1997), "India's Economic Reforms: Some Lessons from East Asia", *Journal of International Trade and Economic Development*, Vol. 6(2), 135-164.

Bhagwati, J. and T.N. Srinivasan (1993), "India's Economic Reform", Paper prepared for the Ministry of Finance, Government of India, Delhi.

Bhagwati, J. (1994), "Free Trade: Old and New Challenges", *Economic Journal*, Vol.104 (423), 231-246.

Cogneau, D. and C. Guenard (2002), Can "Relationship be found between Inequality and Growth", Documents de travail DIAL, in Dial- Paris Development Seminar, Paris.

Debreu, G. (1959), *Theory of value*, Yale University Press, New Haven, CT.

Dervis, K. J. de Melo and S. Robinson (1982), *General Equilibrium Models for Development Policy*, Cambridge, Cambridge University Press.

Datt, G. and M. Ravallion, 1992, "Growth and redistribution components of changes in poverty measures: a decomposition with applications to Brazil and India in the 1980s", *Journal of Development Economics* 38, 275-295.

Datt, G. 1998. Poverty in India and Indian States: An Update. Discussion Paper No. 47. Washington, D.C.: IFPRI

Edwards, S. (1992), "Trade Orientation, Distortions, and Growth in Developing Countries", *Journal of Development Economics*, Vol. 39(1), 31-57.

Fields, G.S. (1991), "Growth and Income distribution", in Psacharopoulos, G (ed), *Essays on Poverty, Equity and Growth*, Oxford: Pergamon Press.

Fischer, Stanley (2002), Breaking out of the Third World: India's Economic Imperative", A speech prepared for delivery at the India Today Conclave, New Delhi, January 22.

Foster, J.E., J.Greer and E.Thorbecke, 1984, "A class of decomposable poverty measures", *Econometrica* 52(3), 761-766.

Government of India, Seventh Five-Year Plan (1985-1990), Planning Commission, New Delhi.

Government of India (1987-88), All India Census for SSI, Hand book of Industrial Policy and Statistics, Office of Economic Advisor, Ministry of Commerce and Industry.

Government of India, 1993, *Report of the Expert Group on Estimates of Proportion and Number of poor*, Planning Commission, New Delhi.

Government of India (1996), Public Sector Undertakings: A Case for Autonomy in Pricing, Ministry of Personnel, Public Grievances and Pensions, New Delhi.

Government of India (1999), *The Economic Survey 1999-2000*, Ministry of Finance, New Delhi.

Government of India (2003), *The Economic Survey 2002-2003*, Ministry of Finance, New Delhi.

Gupta, S.K., P.S. Minhas, S.K. Sondhi, N.K. Tyagi and J.S.P. Yadav (2000), Water Resource Management, International Conference of Managing Natural Resources for the 21st Century, in J.S.P. Yadav and G.B. Sing (eds.), Proceedings Natural Resource Management for Agricultural Production in India, New Delhi.

Handbook of Industrial Policy and Statistics (various Issues), Office of Economic Adviser, Ministry of Commerce and Industry, Government of India.

Indiainfoline.com (September, 2003), Indiainfoline Debate on Construction and Infrastructure.

Jain, L.R. and S. D. Tendulkar, 1990, "The role of growth and distribution in the observed change in headcount ratio measure of poverty: A decomposition excercise for India", *Indian Economic Review* 25(2) (July-December), 165-205.

Kakwani, N. and K. Subarao, 1990, "Rural poverty and its alleviation in India", *Economic and Political Weekly* 25, A2-A16.

Kaldor, N. (1956), "Alternative Theories of Distribution", Reviews of Economic Studies, Vol. 23(2), 94-100.

Kuznets, S. (1955), "Economic Growth and Income Inequality", *American Economic Review*, Vol.45(1), 1-28.

Leontief, W.W. (1937), "Inter-relation of Prices, Output, Savings and Investment", *Review of Economics and Statistics*, 19, pp 109-32.

NCAER (2000), *MIMAP-India Survey Report*, National Council of Applied Economic Research, Vol. 2, New Delhi.

Mattey, H. and Thijs ten Raa (1997), "Primary versus Secondary Production Techniques in U.S. Manufacturing", Review of Income and Wealth, Vol.43 (4), 449-64.

Negishi, T. (1960), "Welfare Economics and Existence of an Equilibrium for a Competitive Economy", *Metrorconomica*, Vol.12, 92-97.

Pananek, G., O. Kyn (1986), "The Effect on Income Distribution of Development, the Groth Rate and Economic Strategy, Journal of Development Economics, Vol. (23), 55-65.

Pradhan, B.K., A. Sahoo and M. R. Saluja (1999), "A Social Accounting Matrix for India, 1994-95", *Economic and Political Weekly*, November 27.

Pradhan, B.K., A. Sahoo and M. R. Saluja (2003), "Impact of Trade Liberalization on Household Welfare and Poverty", Forth coming MIMAP Volume, IDRC, Ottawa, Canada

Ravallion, M. and G. Datt, 1996, "How important to India's poor Is the sectoral composition of economic growth?" *World Bank Economic Review* 10 (1), p1-25.

Rodriguez, F. and D. Rodrik (1999), "Trade Policy and Economic Growth: A Skeptic's Guide to Cross-National Evidence, " NBER Working paper No. W7081.

Rodrik, D. (1999), "Making Openness Work: The New Global Economy and thee Developing Countries, Washington, D.C.: The Overseas Development Council.

Sachs, J.D. and A. Warner (1995), "Economics Reforms and the Process of Global Integration", *Brookings Paper on Economic Activity*, 1-118.

Shestalova, V. (2002), *Essays in Productivity and Efficiency*, Ph.D. Thesis, CentER, University of Tilburg, The Netherlands.

Solow, R. (1957), "Technical Change and the Aggregate Production Function", *Review of Economic and Statistics*, 39(3), 312-320.

Srinivasan, T.N. Nad J. Bhagwati (1999), "Outward-Orientation and Development: Are Revisionists Right?" Center Discission Paper No. 806, Economic Growth Center, Yale University.

Ten Raa, Thijs (1995), *Linear Anaylysis of Competitive Economics*, LSE Hand books in Economics, Prentice Hall-Harvester Wheatsheaf, Hempstead.

Ten Raa, Thijs (2002), A Neoclassical Analysis of TFP using Input-Output Prices.

Ten Raa, Thijs and Debesh Chakraborty (1991) Indian Comparative Advantage vis-à-vis Europe as Revealed by Linear Programming of the two Economies. Economic Systems Research, Volume 3, No.2.

Ten Raa, Thijs, H. Pan (2002), "Competitive Pressure on China: Income Inequality"

Ten Raa, Thijs and P. Mohnen (2001), "The Location of Comparative Advantages on the Basis of Fundamentals Only", *Economic system Research*, Vol. 13 (1).

Ten Raa, Thijs and P. Mohnen (2002), "Neoclassical Growth Accounting and Frontier analysis: A synthesis", *Journal of Productivity analysis*.

Trivedi, A.N., J. Sathaye and M. Mukhopadhaya, (1998), Energy Efficiency and Environmental Management Options in the Indian Fertilizer Industry, ADB Technical Assistance Project (TA-2403-IND), Forest Knol, California.

APPENDIX I

The whole Indian economy is divided into 21 sectors with 2 primary sectors, 16 secondary sectors and 3 service sectors.

Primary Sectors

S1. Food grains (Tradable)
S2. Other agriculture (Tradable)
S3. Crude oil and natural gas (Tradable)
S4. Other mining and quarrying: Coal and lignite, Iron ore and other minerals (Tradable)

Secondary Sectors

S5. Food products and beverages (Tradable, no quota)
S6. Textiles (Tradable)
S7. Other traditional manufacturing goods, viz. wood, paper and leather products (tradable)
S8. Petroleum products (Tradable)
S9. Finished petrochemicals (Tradable)
S10. Fertiliser (Tradable)
S11. Other chemicals (Tradable)
S12. Non-metallic products: cement and other non-metallic mineral products (Tradable
S13. Basic metal industries including iron and steel (Tradable)
S14. Metallic products (Tradable)
S15. Capital goods (Tradable)
S16. Other miscellaneous manufacturing industries (Tradable)
S17. Construction (Non-tradable)
S18. Electricity (Non-tradable)

Service Sectors

S19. Infrastructure services: (Tradable)
S20. Financial services: banking and insurance (Tradable)
S21. Other services (Tradable, due to the Information Technology sector)

Households

A. Rural Households
1. Cultivators (Agricultural self-employed)
2. Agricultural Labour
3. Artisans (Non-agricultural labour)
4. Other Households

B. Rural Households
1. Agricultural households
2. Non-agricultural self-employed
3. Salaried class
4. Non-agricultural labour (Casual labour)
5. Other households

APPENDIX II

In case of all-tradable sectors, the primal condition for our basic model with all sectors tradeable is written as

$$\underset{X,D,T}{Max}\ De^{T} \sum_{h} f_h d_h$$

$s.\ t.\quad X \geq AX + \sum_{h} f_h d_h D + \overline{F} + T, \quad h = 1,...9$ ……………………………………..(1)

$\sum_{s} kX \leq \overline{K} \qquad k = k_1,...,k_{23}$ ………………………………………..(2)

$\sum_{s} nX \leq \overline{N} \qquad n = n_1,...,n_{23}$ ………………………………………..(3)

$\sum_{s} lX \leq \overline{L} \qquad l = l_1,...,l_{23}$ ………………………………………..(4)

$-\pi \mathrm{T}_{19} \leq -\pi \mathrm{T}_{19}^{0} = \mathrm{B}$ (Trade balance) ………………………………………..(5)

$\mathrm{X} \geq 0$ ………………………………………..(6)

We can see that when all sectors are tradable, domestic prices will fall prey to international prices. The second dual constraint gives

$P \sum_{h} f_h d_h = e^{T} \sum_{h} f_h d_h .$ ………………………………………..(i)

The third dual constraint is

$P = \varepsilon \pi$ ………………………………………..(ii)

Using (ii) in (i), we derive

$$\varepsilon \pi \sum_{h} f_h d_h = e^{T} \sum_{h} f_h d_h .$$

As we assume that in the benchmark the terms of trade, i.e. π is unit. This is under the assumption that in tradable sectors, domestically produced commodities are no different from international products and hence, international and domestic prices become same. Then it implies that

$$\varepsilon e^{T} \sum_{h} f_h d_h = e^{T} \sum_{h} f_h d_h \quad \Rightarrow \quad \varepsilon = 1.$$

In our case, this implies

$$P = \pi = e^{T}$$

In this case, we will notice that factor prices will also remain same at the new optimum level. This basic primal model can be expressed in reduced form by re-writing the superfluous equation. By multiplying vector π with the primal constraint (1) gives

$$\pi(A - I)X + \pi \sum_{h} f_h d_h D + \pi T \leq -\pi F$$

Then by using primal constraint (5) in (1a)

$$-\pi\left[(A - I)X + \pi \sum_{h} f_h d_h D + \pi F\right] \leq -\pi T^{0}$$

Hence, the final primal condition to be used in the paper is written as

$$\underset{X,D}{Max}\ De^{T} \sum_{h} f_h d_h$$

s.t. $- \pi\left[(A - I)X + \pi\sum_{h} f_h d_h D + \pi F \right] \le -\pi T^{0}$

$\sum_{s} kX \le \overline{K} \qquad k = k_1,...,k_{23}$

$\sum_{s} nX \le \overline{N} \qquad n = n_1,...,n_{23}$

$\sum_{s} lX \le \overline{L} \qquad l = l_1,...,l_{23}$

$X \ge 0$

The shadow price attached to the first constraint gives the one aggregate terms of trade between domestic and foreign prices, i.e. $\varepsilon = \frac{P}{\pi}$, which in this all-tradable case is unit. However, in reality we find some sectors are non-tradable. We will have additional constraints for non-tradables.

We can consider the case where the economy is closed and there is no trade. In this case, net export is not endogenous. It's fixed in the model. Then, we can drop the trade constraint from our basic model. Then the primal becomes:

$$\underset{X,D}{Max}\ De^{T} \sum_{h} f_h d_h$$

s.t. $X \ge AX + \sum_{h} f_h d_h D + \overline{F} + T^{0}, \quad h = 1,...9$

$\sum_{s} kX \le \overline{K} \qquad k = k_1,...,k_{23}$

$\sum_{s} nX \le \overline{N} \qquad n = n_1,...,n_{23}$

$\sum_{s} lX \le \overline{L} \qquad l = l_1,...,l_{23}$

$X \ge 0$