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Trade Liberalization, Poverty, and Food Security in India

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INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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ABSTRACT

This paper attempts to assess the impact of trade liberalization on growth, poverty, and food security in India with the help of a national-level computable general equilibrium (CGE) model. The results show that the gross domestic product (GDP) growth and income-poverty reduction projected to occur following trade liberalization do not necessarily improve the food security and/or nutritional status of the poor. Evidence from simulations of (partial) trade reforms reflecting a possible Doha-like scenario show that the bottom 30 percent of the population in both rural and urban areas would suffer a decline in calorie and protein intake, in contrast to the rest of the population, even as all households increase their intake of fats. The food security / nutritional status outcome with regard to individual nutrients depends crucially on movements in the relative prices of different commodities along with changes in income levels. These results show that trade policy analysis should consider indicators of food security in addition to the overall growth and poverty measures traditionally considered in such studies.

Keywords: food security, nutrition, computable general equilibrium, India

1. INTRODUCTION

After experimenting with a mixed economy model for more than four decades, India adopted wide-ranging economic reform measures in 1991 by liberalizing investment and trade activities. The liberalization process has continued steadily since then, though at a varying pace. The Indian economy has been substantially opened up, as indicated by a rise in the share of merchandise trade from 14 percent of GDP in 1990/91 to 33 percent in 2005/06. The reform process has paid rich dividends in terms of GDP growth, which has averaged above 6.5 percent per annum over the past 15 years. Furthermore, overall economic activity has accelerated further, recording 8–9 percent growth over the past 5 years.

India's GDP stood at US\$793 billion in 2005. Considering a population of 1.1 billion, per capita income in this case is low, at US\$720 (at market exchange rate), compared to the world average of US\$6,280 in 2005. When adjusted for purchasing power parity (PPP), per capita income works out to PPP US\$3,450. The level of living of an average Indian (as reflected in purchasing power) is roughly one-third of the world average and one-tenth of that in developed high-income countries. Hence, along with economic growth, faster poverty reduction and increased food security for the masses have become the basic objectives of reforms in India. Indeed, "growth with social justice" has been the stated guiding principle of economic policy formulation over the past 60 years or so, ever since India gained its independence.

India's policy framework with regard to food security, at both the national and household levels, has been more or less stable since independence. The basic framework is one in which agricultural production, including the production of foodgrains, is largely in the hands of private farmers, with almost no controls on production decisions. However, the government intervenes substantially in all aspects of marketing—that is, procurement, storage, transportation, and distribution of grains. The overall objective of government intervention has been to strike a balance between consumers' desire for low food prices and farmers' need for higher returns. Government procurement at pre-announced procurement prices was designed to protect the farmers from price risk, while government storage was aimed at maintaining sufficient availability of foodgrains in the country and at smoothening prices over time. The government's public distribution system offered limited quantities of grains to consumers at a subsidized price, with a view to ensuring food security at the household level.

Government intervention in the foodgrains markets has been facilitated by a whole host of parastatal agencies, supported by self-serving controls on private trade, both domestically and internationally. On the domestic front, strict controls were placed on the internal movement and storage of foodgrains by private traders in order to ensure that the government's goals with regard to procurement and price control were not subverted by speculation on the part of private traders. On the international trade front, the government imposed severe restrictions on imports and exports of foodgrains in the form of monopoly rights for parastatal trading bodies, imposing strict licensing requirement or banning the private sector from making imports and exports, and high tariffs and quantitative restrictions. Import controls were aimed at cutting off competition from imports, while export controls were maintained to ensure higher domestic availability and lower domestic prices. The consequence of these policies was that Indian farmers were largely unprotected in the sense that the price they received was often less than the prevailing international price.

The economic reforms that began in 1991 started changing the policy framework for the economy as a whole, including the foodgrains sector. Domestically, the government continues to intervene heavily in the foodgrains market through its procurement and storage operations. On the distribution side, the government has moved from a universal public distribution system to a targeted public distribution system (TPDS). Under the TPDS, people "below the poverty line" are entitled to a higher quantum of grains at a higher rate of subsidy than those "above the poverty line." However, the total volume of grains handled through the TPDS continues to be substantial, making the government the single largest trader in the foodgrains market. With regard to private trade in foodgrains, many of the internal movement and

storage controls have been relaxed, though the government recently reimposed some of the storage controls in response to the high food prices seen in 2007/08.

Trade reforms in the foodgrains sector began in 1994/95 with the government opening up exports of rice first and subsequently wheat to the private sector. The initial increase in exports resulted in a rise in domestic prices, especially in the case of wheat, which was beneficial to farmers. However, consumer resistance in the country forced the government to reimpose restrictions on exports. Faced with this dilemma of maintaining a balance between consumers' desire for low food prices and farmers' need for higher returns, the government's policy reaction since the mid-1990s has been a series of impositions and relaxations of export controls. In 2007/08, for example, India brought back export controls as a result of high international food prices. On the import side, the major change in the policy regime came in 2001, when, as part of its commitment to the World Trade Organization (WTO), the government replaced quantitative restrictions on all agricultural products with tariffs. Under this system, India's bound tariffs are among the highest in the world, even though applied tariffs are low for many commodities.

Against this background, we attempt to assess the impact of trade liberalization on poverty and food security in India, with the help of a computable general equilibrium (CGE) model. The following section reviews the broad developments in the spheres of growth, poverty, and nutrition in India over the past few decades. Section 3 describes the salient features of the CGE model used in this paper, Section 4 describes the design of scenarios, Section 5 discusses the main results, and Section 6 concludes.

2. INDIAN ECONOMIC DEVELOPMENTS: GROWTH, POVERTY, AND FOOD SECURITY

Growth

Table 1 shows the average annual growth rates in national income for three broad sectors in India (agriculture, industry, and services) over various periods spanning 1951 through 2006. The Indian economy grew at an average rate of 3.5 percent per annum for about three decades up to 1980. Thereafter, triggered by an expansionary fiscal policy, GDP growth moved into a higher growth trajectory of above 5.5 percent during the 1980s. Economic reforms undertaken after the early 1990s helped sustain and improve this growth rate. The average annual growth rate in per capita income jumped from about 1.5 percent during the period 1951–1980 to 3.5 percent or more after 1980. National income accelerated further thereafter, resulting in a growth rate of about 7 percent per annum since 2000. The acceleration process has been driven mostly by growth in nonagricultural sectors, particularly the service sector. A sustained increase in the average level of living, of about 4 percent per annum for more than a quarter of a century, marks a break from the historical decrease in the average living standard seen over the past several centuries.

Table 1. Average annual growth rates in real GDP (%)

	1951/52 to 1980/81	1981/82 to 1990/91	1991/92 to 1999/2000	2000/01 to 2006/07
Agriculture	2.6	3.8	3.0	2.5
Industry	5.3	7.0	5.7	7.8
Services	4.6	6.7	7.9	8.5
GDP (total)	3.6	5.6	5.8	6.9
Per capita GDP	1.4	3.4	3.6	5.2

Poverty

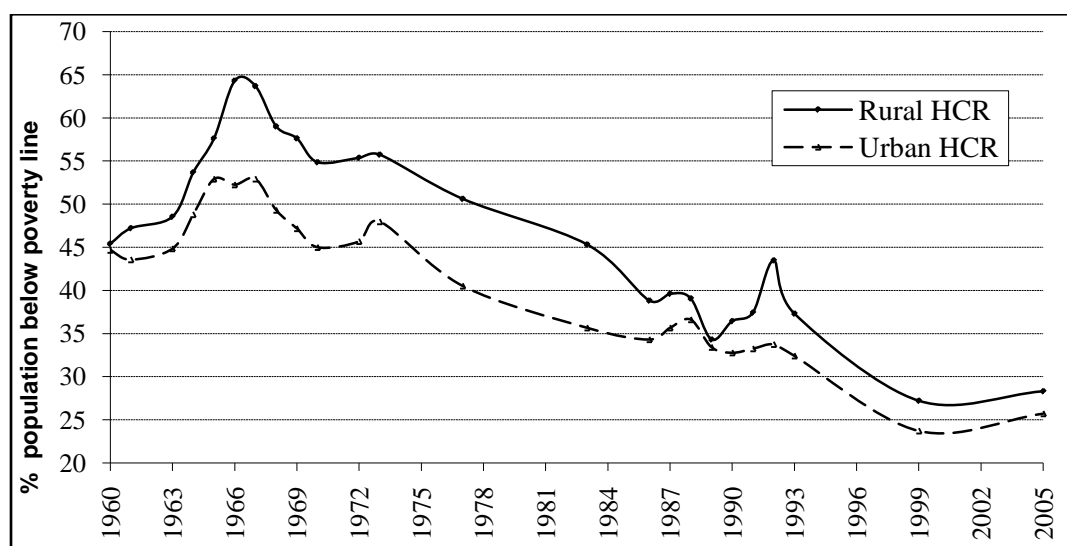
While overall growth has been impressive since the reforms, widespread and intense poverty among a large section of the population still persists in India. The benefit of rapid growth in national income has not reached some sections of the population.¹ Poverty is commonly measured with the help of a poverty line, which is a benchmark income or consumption level used to distinguish the poor from the nonpoor. The Millennium Development Goals (MDGs) of the United Nations use an international poverty line of PPP US\$1 a day. About 35 percent of the Indian population remained below this poverty line in 2004/05. The Indian government’s Planning Commission defined the poverty line as a monthly per capita consumption expenditure (MPCE) of Rs. 49 and Rs. 56 at 1973/74 prices for rural and urban India, respectively, corresponding to a calorie intake level of 2,400 and 2,100, respectively, per day. Based on suitable price indices, the poverty lines for 2004/05 were updated to an MPCE of Rs. 356 for rural areas and Rs. 539 for urban areas. The most commonly used poverty index is the “head-count ratio” (HCR), which refers to the proportion of the total population falling below the poverty line.

Figure 1 shows the long-term trends in poverty HCR in rural and urban areas during the period 1960/61 to 2004/05. The incidence of poverty fluctuated from the beginning of this period until the early 1970s, without any upward or downward trends. Low per capita growth coupled with near invariance of the distribution parameter meant that the poor saw little improvement in their level of living during this period. After 1973/74, there was a clear declining trend in the poverty HCR of both rural and urban areas when the economy entered a phase of higher economic growth, of 5 percent or above. Between 1973/74

¹ International evidence indicates that the poverty effects of growth, including trade-led growth, are extremely circumstance-specific. See, for example, a recent review article by Winters, McCulloch, and McKay (2004).

and 1989/90, the HCR fell from 56 to 34 percent in rural India and from 48 to 33 percent in urban India. During the 1990s, poverty rose slightly right after the reforms were implemented, due in part to a decline in the growth rate and a relatively faster rise in food prices during the transition period (Panda and Ganesh-Kumar 2000). Thereafter, as growth picked up, poverty began to decrease. The proportion of the population below the poverty line decreased to 28 percent in rural areas and 26 percent in urban areas in 2004/05. The number of persons below the poverty line was 302 million, as per official estimates for 2004/05.² India accounts for about a quarter of the poor in the world and thus poses a major challenge for meeting the first MDG of reducing poverty to half the 1990 level by 2015. We might note that the poverty ratios for 1999/2000 and 2004/05 are not strictly comparable, due to changes in the recall period in the consumption expenditure surveys conducted by the National Sample Survey Organization (NSSO) for the two years from which these poverty estimates are derived. The estimates for 1999/2000 are widely believed to be an underestimate (Sen and Himanshu 2004), which could be a contributing factor in what appears to be a slight increase in the poverty ratio during the high-growth phase of the 2000s.

Figure 1. Trends in head-count ratio (HCR) of poverty in rural and urban India



Notably, higher economic growth has not led to a commensurate decrease in poverty, as was initially expected. Between 1993/94 and 2004/05, the poverty HCR fell by only 22 percent, while per capita real income grew by 62 percent. The implied elasticity of poverty with respect to per capita income (NNP) is less than 0.40, which is not very encouraging, to say the least. Accentuation of inequality might have partly neutralized the potential poverty-reducing effects of growth.

Food Security

The poverty lines meet the nutritional norms in the base year and are updated for other years using suitable price indices to ensure the same purchasing power. However, the poverty measures do not directly reflect nutritional adequacy and food security. Consider, for example, that the official poverty line in India is defined as an income level that is just adequate to meet the average calorie norm in the base year of 1973/74. This definition does not imply that (1) all persons above the poverty line meet the calorie intake norm or that (2) all persons below the poverty line are calorie-deficient. Generally speaking, there is an increasing relationship between calorie intake and income or consumption expenditure. Per capita income is a major determinant of calorie intake, but there are also other factors

²The estimates for 2004/05 are based on a uniform recall period of 30 days, comparable to the 1993/94 data. Estimates based on the 1999/2000 survey are not strictly comparable to those for other years, due to the controversy over recall period.

that determine food consumption and energy intake, including household composition, share of food expenditure, tastes and preferences, and the availability of different types of food. Hence, the ranking of households by per capita income (or total consumption expenditure) and per capita calorie intake are not necessarily identical. As shown in Table 2, about 12.5 percent of the total population above the poverty line did not meet the required calorie norm in rural India in 1977/78, while an almost equal percentage of the population below the poverty line was above the calorie norm.

Table 2. Incidence of poverty vs. undernutrition: Rural India, 1977/78 (% of population)

	Below poverty line	Above poverty line	Total
Below calorie norm	45.32	12.47	57.79
Above calorie norm	12.31	29.21	42.21
Total	57.63	42.37	100

Source: Government of India (1993).

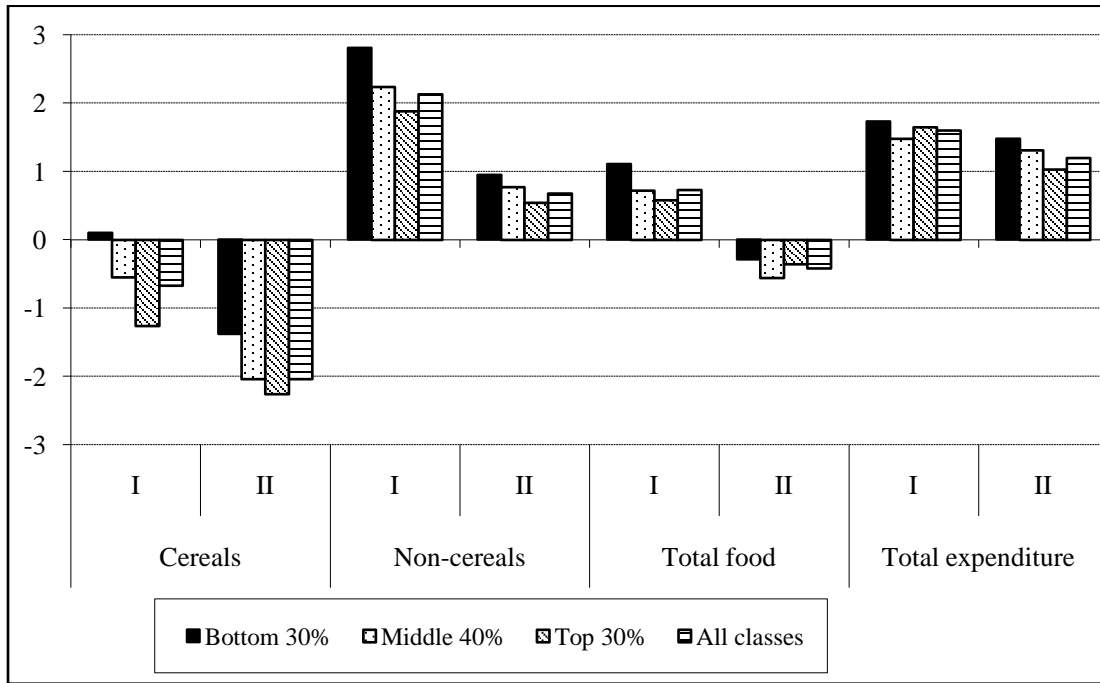
Furthermore, the quantified relationship between calorie intake and income is not necessarily stable over time. An income level that is adequate to meet the calorie norm in the base year is not necessarily sufficient to do so in subsequent years if consumption patterns change due to variations in tastes and preferences, relative prices, and other factors. Indeed, there has been considerable diversification in the consumption patterns of an average Indian consumer from food to nonfood items, within the food group from cereals to noncereal food items, and within cereals from coarse to fine cereals. As Table 3 reveals, the proportion of expenditure allocated for food has decreased over time in both rural and urban areas. Notably, the share of cereals in total consumption expenditure has fallen by more than half over the past three decades. It is to be noted that this diversification in the consumption pattern is seen across different expenditure groups (Figures 2 and 3). Radhakrishna (2005) notes that per capita cereal consumption in India has been on a declining trend over the past three decades. According to data from the NSSO, per capita cereal consumption in rural areas fell from 15.3 kilograms per month in 1970/71 to 12.7 kilograms in 1999/2000, and in urban areas from 11.4 kilograms to 10.4 kilograms per month.

Table 3. Changes in consumption patterns in rural and urban India

Item group	Expenditure on specific group as % of total consumer expenditure			
	1972/73	1983	1993/94	2004/05
RURAL				
Cereals	40.6	32.3	24.2	18.0
Other foods	32.3	33.3	39.0	37.0
Food total	72.9	65.6	63.2	55.0
Nonfood total	27.1	34.4	36.8	45.0
Total expenditure	100.0	100.0	100.0	100.0
URBAN				
Cereals	23.3	19.4	14.0	10.1
Other foods	41.2	39.7	40.7	32.4
Food total	64.5	59.1	54.7	42.5
Nonfood total	35.5	40.9	45.3	57.5
Total expenditure	100.0	100.0	100.0	100.0

Source: NSSO, various rounds.

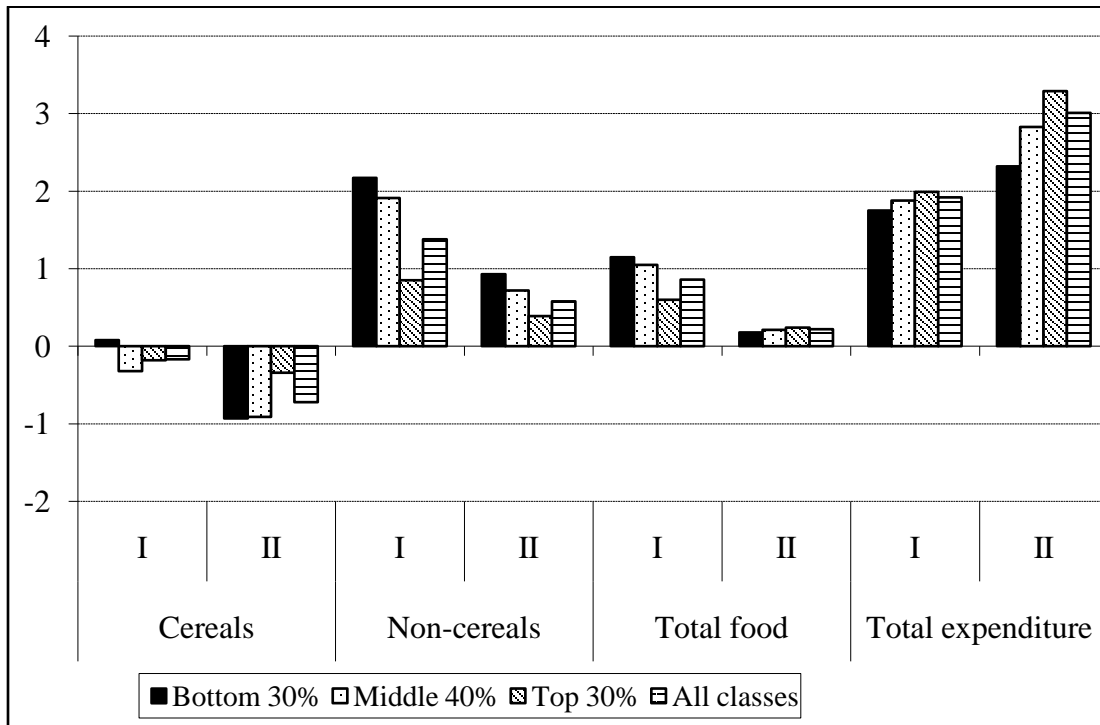
Figure 2. Annual compound growth rate in per capita real expenditure, rural (%)



Source: Radhakrishna (2005).

Note: Period I = 1970–1989; Period II = 1990–2001.

Figure 3. Annual compound growth rate in per capita real expenditure, urban (%)

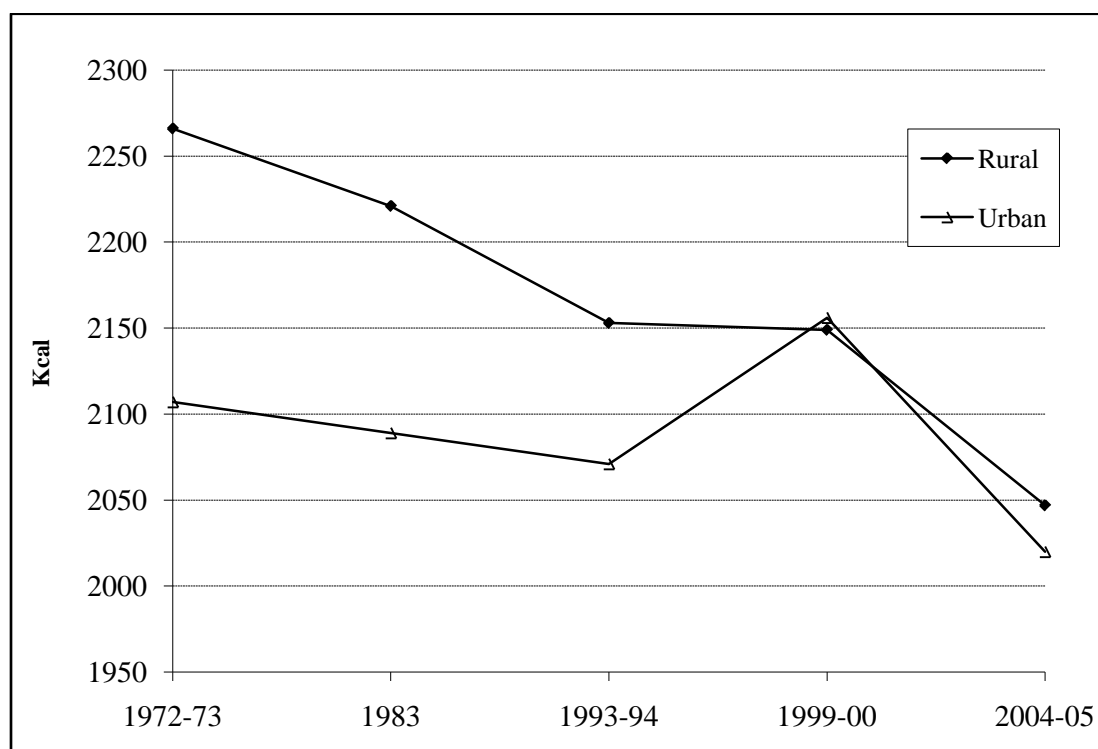


Source: Radhakrishna (2005).

Note: Period I = 1970–1989; Period II = 1990–2001.

This has been accompanied by a decline in calorie intake per capita per day in both rural and urban populations (Figure 4). Per capita intake of protein has also fallen, though fat intake has risen over the years (Figure 5). While per capita cereal consumption and calorie intake are expected to plateau at a high enough income level, such a plateau is not expected at or around the poverty line. Examining the available Indian evidence between 1970/71 and 1999/2000, Radhakrishna (2005) finds that the per capita calorie intake of the bottom 30 percent of the population stratified by per capita income was nearly stagnant over this period, while that of the middle 40 percent substantially declined. The bottom 30 percent of the population had a low per capita calorie intake of 1,600–1,700 kilocalories per day, which falls considerably short of the required norm. From a nutritional standpoint, food diversification might be expected at a certain stage of a county’s development, in an effort to increase noncalorie nutrients. However, as noted above, protein intake fell in India after 1983.

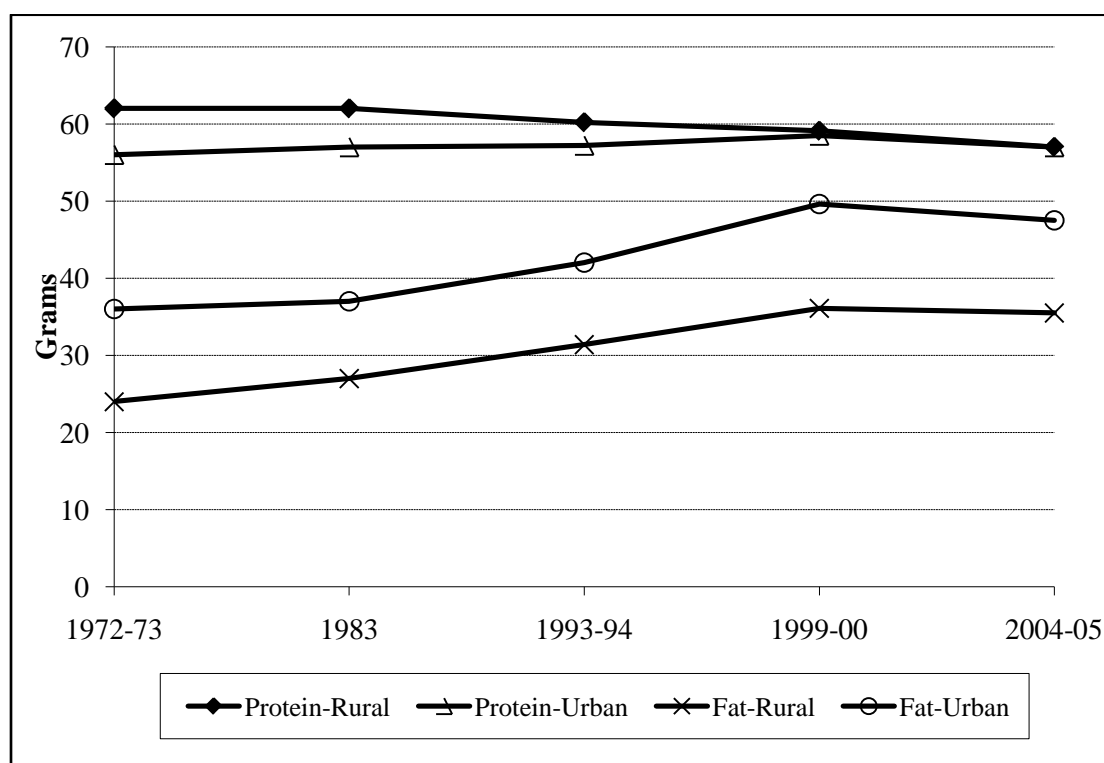
Figure 4. Calorie intake per capita per day (kcal)



Source: NSSO.

Note: Estimates based on the 1999/2000 survey data are not strictly comparable to those for other years due to the controversy over the recall period.

Figure 5. Protein and fat intake per capita per day (grams)



Source: NSSO.

Note: Estimates based on the 1999/2000 survey data are not strictly comparable to those for other years due to the controversy over the recall period mix-up.

The above-mentioned nutritional developments mean that the calorie intake of households at the poverty line has been substantially below the norm in recent years. Panda and Rath (2004) explain the divergence between the calorie-based and price-updated poverty lines in terms of consumer behavior due to changing relative prices. They compute the population below the calorie-based poverty line, which corresponds to an average consumption expenditure required to meet the calorie norm in each year, and the price-updated poverty line, which is the standard official procedure. Table 4 shows that there is a substantial divergence between the two measures; for example, 65 percent of the rural population fell below the calorie-based poverty line in 1993/94, while only about half of this population fell below the price-updated poverty line at this point in time.

Table 4. Divergence between calorie-based and price-updated poverty lines for rural India

Year	Calorie-based poverty		Price-updated poverty		
	millions	(%)	millions	(%)	Calorie intake
1973/74	48.7	54.7	48.7	54.7	2,400
1977/78	62.9	61.0	60.9	58.9	2,341
1983	113.9	64.4	100.7	55.5	2,188
1987/88	154.4	64.0	126.5	47.8	2,084
1993/94	330.8	65.6	222.5	34.1	1,870

Source: Panda and Rath (2004).

The above evidence suggests that GDP growth and poverty reduction do not necessarily translate into improved calorie intake. Thus, from a welfare point of view, trade policy analysis should consider indicators of nutritional status such as calorie intake in addition to overall growth and poverty.

We now describe the CGE model used in this paper to analyze how trade policy changes in the context of the Doha agenda affect income poverty and nutritional status in India.

3. MODEL STRUCTURE

In this section, we describe a CGE model for India that broadly conforms to the Dervis, de Melo, and Robinson (1982) tradition of trade-focused models incorporating Armington-type imperfect substitution between domestically produced and foreign goods.³ A distinctive feature of our model is that it considers some details of income distribution and expenditure patterns, thereby facilitating the direct examination of changes in the income and nutritional intake status of both poor and rich groups.

The model is based on a slightly modified version of the social accounting matrix (SAM) for the year 2003/04 prepared by Saluja and Yadav (2006).⁴ Our modifications of the Saluja and Yadav SAM pertain to sectoral aggregation and to the merging of private and public enterprise accounts with household and government accounts, respectively. Further, the indirect tax collections reported by Saluja and Yadav have been broken down into import tariffs and domestic indirect taxes. The SAM used here distinguishes 37 commodities or sectors (12 agricultural and allied sectors and 16 industrial sectors, with the rest as service sectors), two factors (labor and capital), and 10 household classes (5 each in rural and urban areas). Table A.1 in the appendix lists the sectoral and household disaggregations we use in the SAM/CGE model. The macro data in the SAM are consistent with the National Accounts Statistics prepared by the Central Statistical Organization (CSO) of the government of India. The consumption patterns across household classes are derived from the large-scale consumption surveys of the NSSO.

The model equations are arranged in various blocks and are provided in the appendix. Below, we briefly describe these blocks.

Prices: The first set of equations refers to the different types of prices included in the model. The first equation defines the price paid by consumers for imported goods (PM) as the exogenously given world price (PWM) times the exchange rate (EXR) inflated by the import *tariff* rate (tm). The second equation defines the price producers receive for exports on a similar basis; the variable here is the export *subsidy* rate (te). The composite price (PQ) prevailing in the domestic market is a weighted sum of the domestic price (PD) and the import price (PM), with corresponding shares in total absorption (Q) as weights. The unit sales price (PS) received by producers is a weighted sum of the domestic sales and export prices. The net price is defined as the sales price less the sum of the intermediate costs.

Sectoral domestic prices play the equilibrating role in bringing about supply and demand balance in each sector. The overall domestic price (PD) is exogenously given and serves as a numeraire. All prices determined by the model, including wage and exchange rates, are thus relative prices—relative to the given overall domestic price. The wage and exchange rates are real variables in this sense.

Production: Output in a sector is specified through a constant elasticity of substitution (CES) production function, with labor and capital as arguments. Given the static character of the model, capital stock is assumed to be sector-specific, but labor is mobile across sectors. Labor demand is derived from the first-order condition of profit maximization with respect to labor use.

Factor Income: Sectoral wage income is determined based on factor employment and the market-clearing wage rate. The total supply of labor is assumed to be fixed. Capital (nonwage) income in a sector is taken as value-added less the wage bill. The nontax revenue of the government (which mostly consists of earnings from public sector undertakings) is deducted from the capital income to compute the component accruing to households. Further, net factor income (NFI) from abroad is added to both the wage and nonwage incomes of households.⁵

³ Subramanian (1993), Panda and Quizon (2001), and Polaski et al. (2008) have developed CGE models for India with Armington assumptions. Taylor (1983); de Janvry and Subbarao (1986); Narayana, Parikh, and Srinivasan (1991); Panda and Sarkar (1990); Storm (1993); and Ganesh-Kumar, Panda, and Burfisher (2006) have also published CGE models for India.

⁴ The SAM by Saluja and Yadav (2006) is an updated version of the SAM appearing in Pradhan, Saluja, and Singh (2005) and is based on the same methodology as the latter.

⁵ In recent years, NFI has been negative for both wage and capital income in India.

Household Income and Expenditure: We next allocate the above-mentioned factor income to households by income class. This step plays a crucial role when we discuss the results of various simulation experiments. As noted, we consider 10 income classes, 5 each for rural and urban populations. The link from factor income to rural and urban household class by size of per capita income is established by the initial endowment (factor income) in the SAM. This link is represented by the parameter sy_{hf} , the share of household h from factor income of category f . The total wage and nonwage income thus derived is distributed to households in proportion to their initial endowments (wage and nonwage income). In addition, households receive transfer payments from the government (TRANS) and remittances from abroad (REM).

In terms of income use, different household classes save different proportions of their incomes after payment of income taxes in fixed proportions. The income net of taxes and savings determines the total private consumption expenditures of the households. Sectoral private consumption is modeled using the Linear Expenditure System (LES) with underlying Stone-Geary-type log-linear utility functions. Sectoral demand is thus a function of income and all prices. The parameters of the LES are class-specific, so consumption pattern differences across classes are captured adequately in demand estimates. The implied Engel elasticities for different household groups come from available econometric studies on consumer behavior, based on household consumption survey data by the National Sample Survey in India. The estimates given by Radhakrishna and Ravi (1992) for various rural and urban quartile groups were a helpful guide in this regard. The consumer price index (CPI) is computed for each income class as a weighted average of the sectoral composite prices, the weights being class-specific base consumption weights. The real income for each household class is then determined by deflating the quartile income by the class-specific CPI.

International Trade: International trade specifications follow the Armington assumption that goods produced by the same sector at home and abroad are close but not perfect substitutes. Domestic output and imports (or exports) in a sector are thus two different goods. The Armington formulation defines demand in terms of a composite commodity comprising a CES aggregation of the demand for domestically produced goods and the level of imports. The ratio of imports to domestic demand is obtained as a function of the ratio of domestic price (PD) and import price (PM) using the first-order conditions. Similarly, total output produced is specified as a constant elasticity of transformation (CET) aggregate of exports and domestic demand. The ratio of domestic supply to exports depends on the ratio of export prices to domestic prices. Note that this formulation is based on a small-country assumption, in that it assumes a horizontal export demand curve at given world prices.

Investment: The model follows the neoclassical closure in which total capital formation (TINV) is determined by total savings in the economy. Savings come from three sources: private savings (S_p), government savings (S_g), and foreign savings (S_f). Investment by sector of origin is determined from total investment by applying fixed base proportions on total investment. Since the model is static, it considers investment only by origin, not by destination.

Government Account: The government account does not involve any behavioral relationship. Total government revenue is the sum of direct taxes, domestic indirect taxes, import tariffs, and nontax revenues such as profit from public sector undertakings. Government total current expenditure consists of consumption expenditure, transfer payments, interest payments, and subsidies. The difference between current revenue and current expenditure gives government savings.

Equilibrium Conditions: The final block of equations contains market equilibrium conditions for the product, labor, and foreign exchange markets. The product market equilibrium condition is stated in terms of demand for composite commodity, and its supply as defined in the trade block. Demand for composite commodity consists of intermediate demand, private consumption demand, government consumption demand, and investment demand. In the product market, domestic prices play the equilibrating role to achieve demand and supply balance. The demand and supply balance for foreign exchange is obtained through variations in the exchange rate. Lastly, the wage rate clears the labor market with exogenously given total labor supply and labor demand from the production block.

4. SCENARIOS

Base Scenario: The base scenario reflects the structure of the Indian economy as described in the SAM for 2003/04. Thus, in this scenario the tariff rates correspond to the collection rates prevailing in 2003/04.

Policy Scenario: We study the impacts of “Doha trade liberalization” as per IFPRI’s specification of the possible outcome of the Doha round negotiations. According to this specification, India is likely to implement partial reductions in tariffs across all sectors. Table A.2 in the appendix reports the tariff reductions projected for various sectors. These percentage reductions come from IFPRI, through its simulations using the MIRAGE (Modeling International Relationships in Applied General Equilibrium) model, in which the sectoral disaggregation matches the sectors we use in the Indian SAM/model. Two variants of this Doha trade liberalization scenario are examined, as follows:

Experiment 1: This scenario reflects unilateral trade liberalization by India. We implement the tariff cuts shown in Table A.2 in a context in which no other country has implemented any tariff cuts.⁶ In this variant, the world prices are the same as in the base scenario.

Experiment 2: This is a multilateral Doha trade liberalization scenario, in which all countries cut tariffs at different rates, resulting in global changes in trade flows and prices. These global-level price changes are taken from IFPRI, as generated using the MIRAGE model; from those results, we incorporate the changes in world prices applicable to India’s imports and exports (Table A.2) into our national model, in order to study the impacts on key macro and household distributional indicators.⁷ The impacts are reported below as percentage changes in the variables of interest from their base values.⁸

⁶ Note that trade liberalization here refers only to tariff cuts. This may be justified, as India replaced all quantitative restrictions with tariffs in 2001, and the base tariffs are for 2003/04.

⁷ There is no standard approach to passing on results from a global CGE model to a national CGE mode. Robilliard and Robinson (2006) argue (footnote 3) that when export prices are assumed to be exogenous and fixed in a national model, passing on price changes from a global model to the national model would yield an optimal tariff. Our national model meets this requirement and hence our approach may be justified.

⁸ The base values are in billion rupees at 2003/04 prices for the quantity variables, with prices normalized to 1.

5. RESULTS

Macro Impacts

Table 5 reports the impacts of the above experiments on key macro indicators. We see that the limited trade reforms studied here have a negligible impact on the country's GDP. This is in contrast to some earlier studies that predicated an additional GDP gain of 0.5 to 1 percent due to trade liberalization by India.⁹ The difference between our results, especially those of Experiment 1, and the earlier findings can be attributed to two factors. First, the tariff rates for 2003/04 we use are much lower than those used in the other studies, which pertained to an earlier period. This reflects the fact that India has already carried out substantial tariff reforms; thus, GDP gains from further liberalization could indeed be small. Second, we project only partial trade reforms here, whereas some of the earlier studies examined full trade liberalization. In addition, it is notable that national models generally assume given world prices, whereas we consider changes in world prices (Experiment 2).

Table 5. Macro impacts (% change from base levels)

	Base	Exp 1	Exp 2
GDP (Rs. billions)	25,243.8	0.005	0.003
GDP agriculture (Rs. billions)	5,738.1	0.022	0.119
GDP nonagriculture (Rs. billions)	19,505.7	-0.001	-0.031
Private consumption (Rs. billions)	18,724.9	0.36	0.12
Investment (Rs. billions)	6,099.2	3.54	2.48
Exports (Rs. billions)	4,409.9	-0.39	-5.14
Imports (Rs. billions)	4,339.0	5.22	3.01
CPI rural	1.0	0.14	0.18
CPI urban	1.0	0.22	0.20
CPI cereals	1.0	0.46	0.30
CPI noncereal food crops	1.0	0.54	0.39
CPI dairy, meat, and fish	1.0	0.72	0.42
CPI processed foods	1.0	0.24	0.30
CPI nonfoods	1.0	-0.08	0.06
Wage rate	1.0	0.82	0.43

At a disaggregated level, the agricultural GDP contributes to the marginal increase in overall GDP, especially under a multilateral Doha scenario (Experiment 2). In contrast, nonagricultural GDP hardly changes in both the experiments. This result again counters the earlier studies mentioned above, all of which reported that GDP gain was dominated by nonagricultural expansion. The near invariance of nonagricultural GDP seen herein is due to a decline in exports (especially in Experiment 2) along with a rise in imports. This expansion in net imports neutralizes the expansion in domestic demand due to investments and private consumption.

The trade reforms considered in the two experiments increase both consumer prices and the wage rate. The rise in consumer prices is larger in urban areas than in rural areas. Furthermore, food items become relatively more costly following trade liberalization, which could have adverse implications for

⁹ See, for example, Parikh et al. (1997); Panda and Quizon (2001); Ganesh-Kumar, Panda, and Burfisher (2006); and Polaski et al. (2008).

the food security of poorer households. The relative rise in food prices is due to (1) the lower base tariff of several food items compared to nonfood items and (2) the relatively small magnitude of the cut in tariffs for food items compared to nonfood items, even though the percentage cut in tariffs is large across several sectors. For example, for major food items such as paddy and wheat, the percentage cuts in tariffs are 32 and 20 percent over base tariffs of only 1.76 and 13.19 percent, respectively (Table A.2). In contrast, for several nonfood items the base tariffs are well above 10 percent and the cuts are also large, exceeding 40 percent. Consequently, the CPI for several food groups rises. The overall CPI for rural and urban households rises, reflecting the changes in the relative prices of different commodities, as well as the larger weight of the food items in the index.¹⁰

The wage rate increases in both experiments, although the increase seen in Experiment 2 is only about half of that seen in Experiment 1. With labor supply being fixed, this essentially reflects the increase in labor demand due to the expansion of labor-intensive agricultural production. In Experiment 2, the contraction in nonagricultural output mutes the increase in labor demand, yielding a smaller wage rate increase.

The details of sectoral output and price changes are reported in Table A.3 in the appendix. In general, output expansion is seen for most agricultural sectors and some service sectors, while most manufacturing sectors contract. Furthermore, this expansion (contraction) is generally larger (smaller) in Experiment 2 than in Experiment 1. Changes in composite prices show a similar pattern across the two experiments.

Distributional Impacts

The impacts of the two trade liberalization scenarios on the distribution of income across different household classes are reported in Table 6. The household classes are defined based on the distribution of monthly mean per capita expenditure within rural and urban areas separately (Table A.1). For each household, real income is defined as its nominal income deflated by the household-specific CPI. The CPI for a household is computed as the weighted average of composite prices, with weights being the base consumption shares across different commodities for that household.

Table 6. Income distribution (% change from base levels)

	Real income			Nominal income		CPI	
	Base value Rs. billions	Exp 1	Exp 2	Exp 1	Exp 2	Exp 1	Exp 2
Rural 1	311.8	0.43	0.05	0.60	0.25	0.17	0.20
Rural 2	1,054.6	0.47	0.06	0.66	0.27	0.18	0.21
Rural 3	3,707.4	0.35	0.32	0.54	0.54	0.19	0.22
Rural 4	4,430.8	0.48	0.18	0.54	0.29	0.07	0.11
Rural 5	6,198.7	0.41	0.03	0.56	0.21	0.14	0.18
Urban 1	175.6	0.41	0.07	0.67	0.30	0.26	0.23
Urban 2	678.3	0.46	0.09	0.72	0.32	0.26	0.23
Urban 3	2,823.5	0.45	0.25	0.69	0.46	0.24	0.22
Urban 4	3,347.8	0.47	0.16	0.69	0.36	0.22	0.20
Urban 5	4,827.3	0.47	0.11	0.67	0.30	0.20	0.19

¹⁰ As already noted, CGE models determine only relative prices (relative to the numeraire), and hence all price changes reported here should be interpreted as relative to the overall domestic price, which is the numeraire here.

Turning to the results for income changes, we see that under both experiments all households experience increases in real incomes, suggesting that income-metric poverty in India will decline as a result of these partial trade reforms, whether carried out unilaterally (Experiment 1) or as part of a multilateral agreement (Experiment 2).¹¹ These results also show that the real income gains are larger for all households in Experiment 1 than in Experiment 2. Among rural households, no obvious shift in the distribution of real incomes is seen in Experiment 1, while in Experiment 2 the gains are relatively larger for rural household classes 3 and 4 (i.e., households falling between the 4th and 9th deciles in ascending order of income distribution). In urban areas, however, the results point to a slight rise in income inequality even as poverty declines in both experiments. However, we must then ask whether the increases in real incomes across all classes and the decline in income poverty yield an improvement in the food security and/or nutritional status of households. As we see below, this depends on the price changes of commodities that are important in the households' consumption baskets.

The results for changes in CPI show that rural households in general face higher prices in Experiment 2 than in Experiment 1, while the reverse is seen for urban households. Furthermore, under both experiments, the bottom three classes in both rural and urban areas face somewhat higher prices for the items in their consumption baskets compared to the top two classes. As will be discussed below, this has important implications for the food security and nutritional status of the lower classes in both rural and urban areas.

Impacts on Household Food Security

To assess the impact on food security at the household level, we need to examine changes in consumption patterns consequent to the policy changes. Given the tastes and preferences of consumers, changes in consumption patterns can be expected following (1) a rise in real income levels and (2) changes in the relative prices of different commodities. We noted earlier that the real incomes of all households, including the poor, rise under both experimental scenarios. The price changes, however, are less favorable to the poor, as seen in the household-specific CPI reported in Table 6. Furthermore, as noted earlier, the prices of food items increase relatively more than those of nonfood items in the two experiments (Table 5). Within food items, the rise in the prices of processed foods (which include vegetable oils and other processed foods) is lower than that of cereals, noncereal food crops, dairy products, meat, and fish. It may be noted that processed foods are a major source of fat, while cereals, noncereal food crops, dairy products, meat, and fish are major sources of calories and proteins. The impact of these changes on the consumption patterns of all household classes is reported in Table 7 (Experiment 1) and Table 8 (Experiment 2).

Looking first at the results of Experiment 1, we see that the rise in real incomes across all households does not yield a rise in consumption of all commodities across all household classes (Table 7). Indeed, several household classes witness a decline in their consumption of important food items, such as paddy rice, wheat, coarse cereals, other crops (which include pulses, an important source of protein in the Indian context), animal products (meat), dairy products, and fish, even as they increase the consumption of vegetable oils and (processed) food products. The results for Experiment 2 (Table 8) are qualitatively similar, differing only in the magnitude of change. Notably, therefore, while the rise in real incomes suggests a decline in income poverty, the decline in consumption of several important food items suggests that the food security and/or nutritional status of several household classes might actually worsen in the tested scenarios.

To assess this, we compute the intake of calories, proteins, and fats for all the households, as implied by their consumption of different food items. The NSSO provides information on the percentage distribution of intake of calories and proteins (but not fats) sourced from different food groups for

¹¹ In this paper, the household classes are defined in terms of population percentiles. Decreases in income-gap measures of poverty are directly evident from the rise in the mean incomes of the bottom households. If we use an absolute poverty line and compute the proportion of people below that poverty line, the resulting poverty HCR would obviously fall due to income mobility across all the classes.

different household classes. This information is used to compute commodity-wise weights in the intake of calories and proteins by different households. In the case of fats, uniform weights across households are specified for various food items. We then compute changes in the intake of calories, fats, and proteins in the two experiments, compared to the base levels.

Table 7. Percentage changes in real consumption, Experiment 1

Sector		Rural 1	Rural 2	Rural 3	Rural 4	Rural 5	Urban 1	Urban 2	Urban 3	Urban 4	Urban 5
1.	Paddy	-0.05	-0.07	0.03	0.05	0.03	-0.03	-0.03	0.03	0.02	0.00
2.	Wheat	-0.07	-0.09	0.06	0.06	0.06	-0.03	-0.02	0.09	0.08	0.05
3.	Other cereals	0.05	0.07	0.04	0.06	0.03	-0.04	-0.08	0.04	0.04	0.02
4.	Other crops	-0.07	-0.11	0.04	0.02	0.02	-0.06	-0.03	0.05	0.03	0.00
5.	Sugarcane	0.04	0.08	0.01	-0.02	-0.02	0.03	0.09	0.02	0.00	-0.03
6.	Oilseeds	0.06	0.10	0.03	0.01	0.01	0.05	0.11	0.04	0.03	-0.01
8.	Animal products	-0.03	0.03	0.00	-0.03	-0.01	-0.02	0.00	0.00	-0.01	-0.04
9.	Dairy	0.01	0.04	-0.03	-0.06	-0.02	-0.01	0.02	-0.02	-0.04	-0.07
10.	Forestry	0.07	0.11	0.04	0.01	0.01	0.06	0.12	0.05	0.03	0.00
11.	Fishing	0.04	0.09	0.02	-0.01	-0.01	-0.05	0.01	0.02	0.01	-0.03
12.	Primary products	0.00	0.00	0.00	0.00	0.00	1.21	1.38	1.44	1.47	0.00
13.	Vegetable oils and fats	0.13	0.20	0.42	0.37	0.40	0.15	0.22	0.38	0.36	0.31
14.	Food products	0.15	0.18	0.32	0.26	0.28	0.23	0.21	0.34	0.31	0.24
15.	Sugar	-0.16	0.21	0.09	0.02	0.02	0.03	0.18	0.06	0.04	-0.01
16.	Textiles	1.10	1.32	1.18	1.12	1.22	1.06	1.31	1.20	1.19	1.13
17.	Wearing apparel	2.08	2.44	2.30	2.25	2.46	2.04	2.40	2.33	2.34	2.30
18.	Leather products	1.12	1.32	1.24	1.20	1.31	1.09	1.30	1.26	1.26	1.22
19.	Wood products	0.00	0.00	0.00	1.55	1.70	0.00	0.00	1.60	1.62	1.58
20.	Paper products	1.82	2.10	2.05	2.03	2.21	1.78	2.05	2.08	2.10	2.08
21.	Petroleum products	1.58	1.85	1.74	1.69	1.85	1.54	1.82	1.77	1.77	1.73
22.	Chemicals	1.54	1.76	1.76	1.75	1.90	1.51	1.72	1.78	1.81	1.80
23.	Mineral products	3.15	3.57	3.63	0.00	3.97	0.00	0.00	0.00	3.75	3.76
26.	Metal products	1.24	1.46	1.38	1.35	1.47	1.21	1.43	1.40	1.41	1.37
27.	Transport equipment	0.89	1.07	0.97	0.93	1.01	0.87	1.06	0.99	0.98	0.93
28.	Other manufacturing	2.81	3.19	3.22	3.23	3.52	2.78	3.11	3.26	3.33	3.33
29.	Utilities	0.56	0.69	0.58	0.54	0.59	0.53	0.69	0.60	0.59	0.54
31.	Trade	0.13	0.22	0.07	0.01	0.01	0.11	0.24	0.08	0.05	-0.02
32.	Transport	0.43	0.56	0.43	0.38	0.41	0.41	0.56	0.44	0.42	0.36
33.	Communication	0.00	0.00	0.14	0.09	0.10	0.00	0.28	0.15	0.13	0.07
34.	Financial services	0.11	0.19	0.06	0.01	0.00	0.09	0.20	0.07	0.04	-0.02
35.	Other services	0.39	0.50	0.39	0.35	0.38	0.37	0.50	0.40	0.39	0.34
36.	Public administration	0.14	0.22	0.09	0.04	0.04	0.12	0.23	0.10	0.07	0.01
37.	Dwellings	0.00	0.00	0.01	-0.08	-0.09	0.09	0.27	0.03	-0.02	-0.13

Table 8. Percentage changes in real consumption, Experiment 2

Sector	Rural 1	Rural 2	Rural 3	Rural 4	Rural 5	Urban 1	Urban 2	Urban 3	Urban 4	Urban 5
1. Paddy	-0.07	-0.06	0.01	0.03	0.01	-0.02	-0.02	0.05	0.04	0.03
2. Wheat	-0.05	-0.04	0.04	0.03	0.01	-0.02	-0.01	0.08	0.12	0.06
3. Other cereals	-0.01	-0.01	0.02	0.01	0.01	-0.02	-0.01	0.10	0.02	0.01
4. Other crops	-0.06	-0.04	0.04	0.05	0.08	-0.04	-0.02	0.09	0.03	0.07
5. Sugarcane	-0.05	-0.04	0.10	0.04	-0.01	-0.04	-0.02	0.04	0.03	0.06
6. Oilseeds	-0.03	-0.01	0.08	0.04	-0.01	-0.03	-0.04	0.05	0.10	0.09
8. Animal products	-0.03	-0.02	0.05	0.09	0.00	-0.02	-0.04	0.01	0.10	0.09
9. Dairy	-0.04	-0.05	0.08	0.09	0.07	-0.02	-0.03	0.01	0.08	0.08
10. Forestry	-0.12	-0.11	0.02	0.12	0.17	-0.11	-0.09	0.07	0.11	0.15
11. Fishing	-0.03	-0.03	0.09	0.03	0.09	-0.01	-0.01	0.03	0.09	0.05
12. Primary products	0.00	0.00	0.00	0.00	0.00	0.24	0.30	0.39	0.34	0.00
13. Vegetable oils and fats	0.14	0.16	0.17	0.12	0.28	0.22	0.18	0.40	0.41	0.41
14. Food products	0.02	0.05	0.23	0.12	0.12	0.01	0.08	0.37	0.40	0.32
15. Sugar	-0.13	-0.09	0.38	0.10	0.19	-0.06	-0.02	0.09	0.04	0.09
16. Textiles	0.42	0.53	1.01	0.59	0.54	0.45	0.58	0.75	0.64	0.56
17. Wearing apparel	1.20	1.41	2.05	1.54	1.56	1.24	1.44	1.73	1.61	1.55
18. Leather products	0.55	0.65	1.04	0.72	0.71	0.57	0.68	0.84	0.77	0.71
19. Wood products	0.00	0.00	0.00	2.30	2.45	0.00	0.00	2.41	2.38	2.37
20. Paper products	0.56	0.67	1.08	0.73	0.72	0.58	0.70	0.86	0.78	0.72
21. Petroleum products	0.74	0.88	1.39	0.97	0.95	0.77	0.91	1.12	1.02	0.96
22. Chemicals	0.78	0.90	1.22	0.99	1.02	0.79	0.90	1.08	1.03	1.00
23. Mineral products	1.88	2.13	2.63	0.00	2.46	0.00	0.00	0.00	2.41	2.39
26. Metal products	0.56	0.67	1.06	0.73	0.72	0.58	0.69	0.86	0.78	0.73
27. Transport equipment	0.27	0.35	0.71	0.38	0.34	0.29	0.38	0.51	0.42	0.36
28. Other manufacturing	1.45	1.66	2.12	1.81	1.89	1.47	1.65	1.92	1.88	1.85
29. Utilities	0.07	0.12	0.42	0.13	0.08	0.09	0.16	0.25	0.17	0.11
31. Trade	-0.09	-0.05	0.26	-0.06	-0.14	-0.07	-0.01	0.07	-0.03	-0.10
32. Transport	-0.08	-0.04	0.28	-0.04	-0.12	-0.05	0.01	0.08	-0.01	-0.08
33. Communication	0.00	0.00	0.27	0.00	-0.07	0.00	0.04	0.11	0.03	-0.03
34. Financial services	-0.11	-0.08	0.19	-0.09	-0.16	-0.09	-0.04	0.02	-0.06	-0.13
35. Other services	-0.14	-0.12	0.15	-0.13	-0.21	-0.12	-0.08	-0.02	-0.10	-0.17
36. Public administration	-0.08	-0.04	0.23	-0.05	-0.12	-0.06	0.00	0.06	-0.02	-0.08
37. Dwellings	0.00	0.00	0.39	-0.09	-0.20	-0.10	-0.01	0.10	-0.04	-0.14

As expected, changes in the intake of nutrients vary across households and across the nutrients themselves (Figures 6 and 7). In both experiments, the bottom two classes in both rural and urban areas witness a decline in the intake of both calories and proteins, while the other groups increase their intake of these two nutrients. In contrast, all households witness a rise in fat intake. Between the two experiments, the decline (rise) in the intake of calories and proteins (fats) by the bottom two rural household groups is

less (more) in Experiment 1 than in Experiment 2 (see Table 9). This is reversed across the two experiments for the bottom two urban groups. For the top three classes in rural areas, the increase in the intake of all three nutrients is less in Experiment 2 than in Experiment 1, which is opposite to the result seen for the top three urban classes. These differences in nutritional intakes across rural and urban groups, across different households, and also across the different nutrients themselves, are consistent with the relative price changes discussed above.

Figure 6. Changes in nutrient intake, Experiment 1

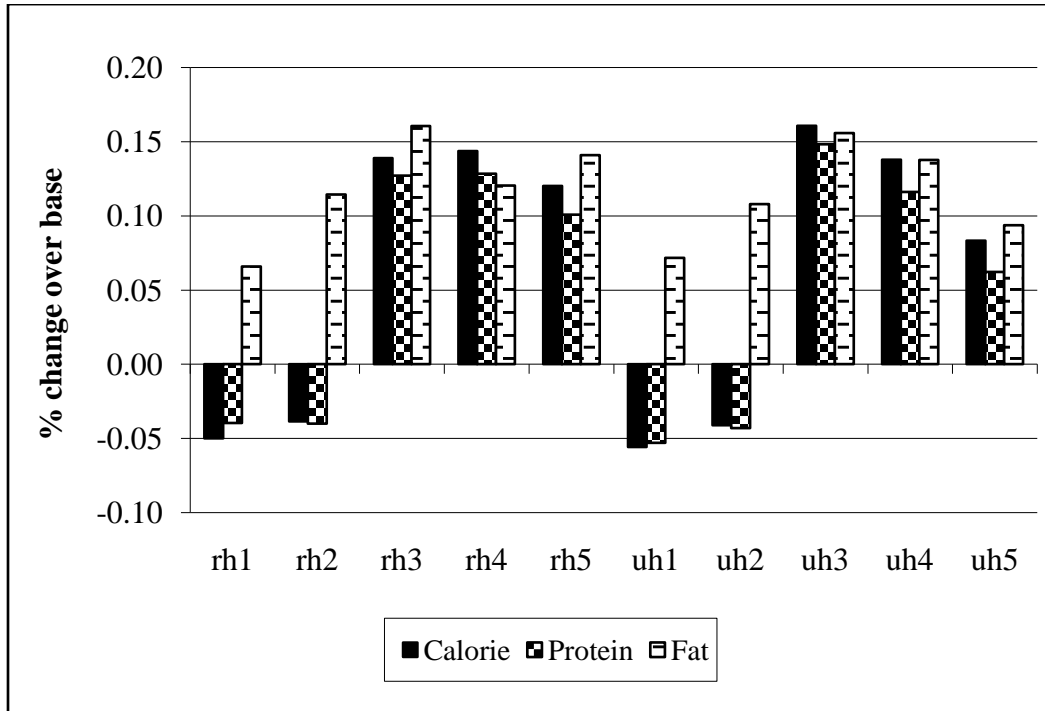


Figure 7. Changes in nutrient intake, Experiment 2

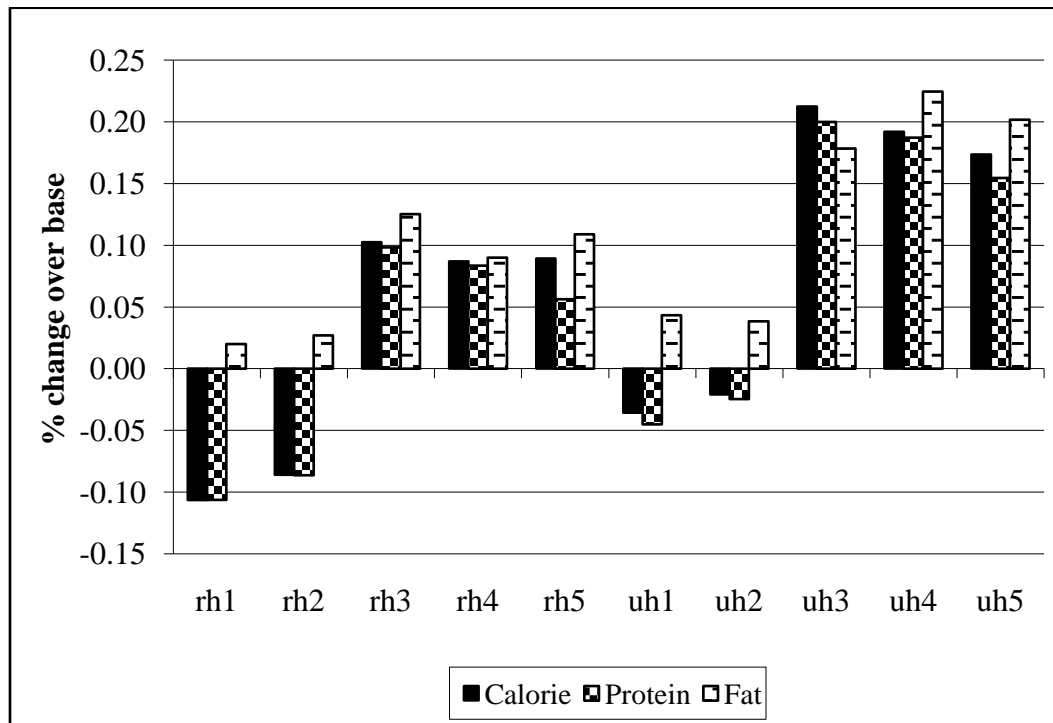


Table 9. Nutrient intake (% change from base levels)

	Exp 1			Exp 2		
	Calorie	Protein	Fat	Calorie	Protein	Fat
Rural 1	-0.05	-0.04	0.07	-0.11	-0.11	0.02
Rural 2	-0.04	-0.04	0.11	-0.09	-0.09	0.03
Rural 3	0.14	0.13	0.16	0.10	0.10	0.13
Rural 4	0.14	0.13	0.12	0.09	0.08	0.09
Rural 5	0.12	0.10	0.14	0.09	0.06	0.11
Urban 1	-0.06	-0.05	0.07	-0.04	-0.05	0.04
Urban 2	-0.04	-0.04	0.11	-0.02	-0.02	0.04
Urban 3	0.16	0.15	0.16	0.21	0.20	0.18
Urban 4	0.14	0.12	0.14	0.19	0.19	0.22
Urban 5	0.08	0.06	0.09	0.17	0.15	0.20

6. CONCLUSIONS

This paper attempts to assess the impact of trade liberalization on growth, poverty, and food security with the help of a computable general equilibrium (CGE) model built for India. It argues that the GDP growth and income-poverty reduction that might occur following trade liberalization do not necessarily result in improvement of the food security and/or nutritional status of the poor. In order to examine this, the impact of a possible Doha-like (partial) trade liberalization scenario is studied here. Two experiments are carried out: in the first, India unilaterally undertakes limited tariff cuts for a number of commodities; in the second, the tariff cuts are carried out in the context of a multilateral agreement that changes the world prices that India faces. The tariff cuts and the changes in world prices specified in this paper come from IFPRI and are based on simulations made using the MIRAGE model. The experiments are carried out using a national CGE model based on a social accounting matrix (SAM) for the year 2003/04, applying the tariff rates that prevailed in that year. The national CGE model has a standard simple specification of market-clearing prices for all sectors, including food, which means that issues relating to domestic market structure for the food sector and changes in the same due to reforms cannot be studied using this model. Another major limitation of this study is that the SAM used here considers only one type of labor used in all sectors. Thus, labor market segmentation (such as farm/nonfarm, skilled/unskilled, etc.), which is a reality in India, is not captured in the model.

The simulation results show that (partial) trade liberalization representing a Doha-like agreement has only a negligible impact on GDP growth. Significantly, it is agriculture that shows some small gains in GDP (about 0.02 percent under unilateral liberalization and about 0.12 percent under multilateral liberalization). In contrast, nonagricultural GDP remains invariant under unilateral liberalization, and in fact declines by about 0.03 percent under multilateral liberalization. The decline in nonagricultural GDP is primarily due to the simultaneous decline in exports and sharp rise in imports. The limited trade reforms increase consumer prices more sharply in urban areas than in rural areas. Furthermore, the prices of all food commodities rise in general relative to nonfood commodities. With wage rates increasing faster than prices, the real incomes of all households in both rural and urban areas rise, suggesting a countrywide decline in income poverty. The magnitudes of the changes in real incomes and relative prices are such that several household classes reduce their consumption of important food items, including paddy rice, wheat, coarse cereals, other crops (which include pulses, an important source of proteins in the Indian context), animal products (meat), dairy products, and fish, even as they increase their consumption of vegetable oils and (processed) food products. Consequently, the impacts in terms of intake of major nutrients (calories, proteins, and fats) vary across households and across the nutrients themselves. In both experiments, the bottom two classes in both rural and urban areas witness a decline in the intake of both calories and proteins, while the other groups increase their intake of these two nutrients. In contrast, all households increase their fat intake.

The above results provide evidence that a rise in real incomes or decline in income poverty following trade reforms will not necessarily translate into improved food security and/or better nutritional status for households. The outcome in terms of food security and/or nutritional status will depend crucially on relative price movements along with changes in income levels. These results show that trade policy analysis should consider indicators of food security in addition to the overall growth and poverty measures traditionally considered in such studies.

APPENDIX A: MODEL EQUATIONS

Price Block

1. $PM_i = PWM_i \cdot EXR \cdot (1 + tm_i)$
2. $PE_i = PWE_i \cdot EXR \cdot (1 + te_i)$
3. $PQ_i = (XD_i / Q_i) \cdot PD_i + (M_i / Q_i) \cdot PM_i$
4. $PS_i = (XD_i / X_i) \cdot PD_i + (E_i / X_i) \cdot PE_i$
5. $PN_i = (PS_i / (1 - t_i)) - \sum_j a_{ji} \cdot PQ_j$
6. $\bar{P} = \sum w_{X_i} \cdot PD_i$

Production

7. $X_i = \alpha_i [d_i L_i^{-\rho_n} + (1 - d_i) K_i^{-\rho_n}]^{-1/\rho_n}$
8. $L_i = X_i \cdot \alpha_i^{\sigma_i - 1} \left[\frac{d_i \cdot PN_i}{W_i} \right]^{\sigma_i}$

Factor Income

9. $YF_w = \sum w L_i + NFI_w \cdot EXR$
10. $YF_k = \sum (PN_i X_i - w L_i) - GNTR \cdot \bar{P} + NFI_k \cdot EXR$

Household Income and Expenditure

11. $YH_h = \sum YF_f \cdot ENDOW_{h,f} + TRANS_h \cdot \bar{P} + REM_h \cdot EXR$
12. $CPI_h = \sum w_{ch_i} \cdot PQ_i$
13. $YHR_h = YH_h / CPI_h$
14. $S_h = \alpha_{sh} + \beta_{sh} \cdot YH_h (1 - td_h)$
15. $TC_h = YH_h (1 - td_h) - S_h$
16. $CH_{ih} = \theta_{ih} + \left[\frac{m_{ih}}{PQ_i} \right] \cdot [TC_h - \sum_j \theta_{jh} \cdot PQ_j]$
17. $C_i = \sum_h CH_{ih}$

International Trade

$$18. Q_i = \alpha_{qi} \left[d_{qi} M_i^{\rho_{qi}} + (1 - d_{qi}) X D_i^{\rho_{qi}} \right]^{1/\rho_{qi}}$$

$$19. \frac{M_i}{X D_i} = \left[\frac{d_{qi} \cdot P D_i}{(1 - d_{qi}) \cdot P M_i} \right]^{\sigma_{qi}}$$

$$20. X_i = \alpha_{xi} \left[d_{xi} E_i^{\rho_{xi}} + (1 - d_{xi}) X D_i^{\rho_{xi}} \right]^{1/\rho_{xi}}$$

$$21. \frac{E_i}{X D_i} = \left[\frac{(1 - d_{xi}) \cdot P E_i}{d_{xi} \cdot P D_i} \right]^{\sigma_{xi}}$$

Investment

$$22. S_p = \sum_h S_h$$

$$23. TINV = S_p + S_g + S_f \cdot EXR$$

$$24. Z_i = w z_i \cdot TINV$$

Government Account

$$25. GR_d = \sum t_{dh} \cdot Y H_h$$

$$26. GR_m = \sum P W M_i \cdot t m_i \cdot EXR \cdot M_i$$

$$27. GR_t = \sum_i t_i \left(\sum_j a_{ji} P Q_j X_i + P N_i X_i \right)$$

$$28. GR = GR_d + GR_m + GR_t + G N T R \cdot \bar{P}$$

$$29. G S_{ex} = \sum t e_i \cdot P W E_i \cdot EXR \cdot E_i$$

$$30. GS = G S_a + G S_e$$

$$31. GE = \sum G_i \cdot P Q_i + T R A N S \cdot \bar{P} + G I N T \cdot \bar{P} + GS$$

$$32. S_g = GR - GE$$

Market Equilibrium Conditions

$$33. Q_i = \sum_j a_{ij} X_j + C_i + G_i + Z_i$$

Labor Demand and Supply

$$34. \sum L_i = \bar{L}$$

$$35. \sum PWM_i \cdot M_i = \sum PWE_i \cdot E_i + \sum NFI_h + \sum REM_h + S_f$$

APPENDIX B: VARIABLE DEFINITIONS

Endogenous Variables

PM_i	=	Price of imports in domestic currency
PE_i	=	Price of exports in domestic currency
PQ_i	=	Composite price paid by domestic users
PS_i	=	Composite sales price received by producers
PN_i	=	Net price received by factors of production
PD_i	=	Domestic price of domestic produce
X_i	=	Output level
L_i	=	Labor demand in sector i
W	=	Wage rate
YF_f	=	Income of factor income category f
YH_h	=	Income of household class h
CPI_h	=	Consumer price index for household class h
YHR_h	=	Real income of household class h
S_h	=	Savings of household class h
TC_h	=	Total consumption expenditure of household class h
CH_{ih}	=	Consumption on item i by household class h
C_i	=	Consumption of item i by all households
Q_i	=	Composite demand for commodity i
M_i	=	Import demand
XD_i	=	Demand for domestically produced good
E_i	=	Export
S_p	=	Private savings
S_g	=	Government savings
S_f	=	Foreign savings
Z_i	=	Investment demand by sector of origin
GR_d	=	Government revenue from direct taxes
GR_m	=	Government revenue from import tariffs
GR_t	=	Government revenue from indirect taxes
GR	=	Government revenue total
GS	=	Government subsidy
GE	=	Government expenditure total

Exogenous Variables and Parameters

PWM_i	=	World price of imports in foreign currency
PWE_i	=	World price of exports in foreign currency
EXR	=	Exchange rate
G_i	=	Government consumption
\bar{P}	=	Overall price index
\bar{L}	=	Total labor supply
$TRANS$	=	Transfers from government to households
REM	=	Remittances from abroad
$GNTR$	=	Government nontax revenues
NFI	=	Net factor income from abroad
K_i	=	Capital stock in sector i
tm_i	=	Import tariff rate
te_i	=	Export subsidy rate

t_i	=	Indirect tax (or subsidy) rate
a_{ij}	=	Input-output coefficient
wc_{ik}	=	Consumption weights in consumption basket of class k
wx_i	=	Output weight in overall price index
sy_{hf}	=	Share of household h in factor income category f
m_{ih}	=	Marginal budget share of item i by household h
θ_{ih}	=	Committed consumption of sector i by household h in LES
β_{sh}	=	Marginal propensity to save by household h

APPENDIX C: SUPPLEMENTARY TABLES

Table A.1. Sectoral and household disaggregations in the SAM/model

Sectors	
1. Paddy	20. Paper products
2. Wheat	21. Petroleum products
3. Other cereals	22. Chemicals
4. Other crops	23. Mineral products
5. Sugarcane	24. Ferrous metal
6. Oilseeds	25. Metals n.e.c.
7. Plant-based fibers	26. Metal products
8. Animal products	27. Transport equipment
9. Dairy	28. Other manufacturing
10. Forestry	29. Utilities
11. Fishing	30. Construction
12. Primary products	31. Trade
13. Vegetable oils and fats	32. Transport
14. Food products	33. Communication
15. Sugar	34. Financial services
16. Textiles	35. Other services
17. Wearing apparel	36. Public administration
18. Leather products	37. Dwellings
19. Wood products	
Households	
1. Rural 1	Bottom 10 percent of rural population in terms of monthly mean per capita expenditure
2. Rural 2	10th–30th percentile of rural population in terms of monthly mean per capita expenditure
3. Rural 3	30th–70th percentile of rural population in terms of monthly mean per capita expenditure
4. Rural 4	70th–90th percentile of rural population in terms of monthly mean per capita expenditure
5. Rural 5	Top 10 percent of rural population in terms of monthly mean per capita expenditure
6. Urban 1	Bottom 10 percent of urban population in terms of monthly mean per capita expenditure
7. Urban 2	10th–30th percentile of urban population in terms of monthly mean per capita expenditure
8. Urban 3	30th–70th percentile of urban population in terms of monthly mean per capita expenditure
9. Urban 4	70th–90th percentile of urban population in terms of monthly mean per capita expenditure
10. Urban 5	Top 10 percent of urban population in terms of monthly mean per capita expenditure

Table A.2. Percentage change in tariffs and world prices applicable to India

	Sector	Base tariff rates	Tariff cut (%)	PW-imports	PW-exports
1.	Paddy	0.0176	-32.03	-0.52	-0.91
2.	Wheat	0.1319	-19.62	1.09	-1.61
3.	Other cereals	0.1657	-21.02	2.79	-1.88
4.	Other crops	0.1771	-5.36	0.21	-1.75
5.	Sugarcane	0.0206	0.00	-0.61	-1.80
6.	Oilseeds	0.1897	-0.85	2.57	-1.77
7.	Plant-based fibers	0.0310	-2.44	0.68	-0.78
8.	Animal products	0.0410	-12.46	1.46	-1.72
9.	Dairy	0.0364	-0.62	4.66	-1.99
10.	Forestry	0.0196	-40.00	-0.04	-2.67
11.	Fishing	0.0740	-47.03	-0.02	-2.94
12.	Primary products	0.4412	-3.10	-0.06	-5.35
13.	Vegetable oils and fats	0.3131	-25.44	-0.11	-2.49
14.	Food products	0.2467	0.00	0.22	-2.73
15.	Sugar	0.1401	-48.59	1.39	-2.36
16.	Textiles	0.1663	-53.10	-0.79	-3.06
17.	Wearing apparel	0.1415	-44.84	-1.42	-3.26
18.	Leather products	0.1727	-45.32	-1.04	-3.65
19.	Wood products	0.1097	-43.16	-0.10	-2.95
20.	Paper products	0.0886	-39.63	0.02	-3.88
21.	Petroleum products	0.1524	-49.35	-0.15	-6.66
22.	Chemicals	0.1720	-50.27	-0.07	-4.66
23.	Mineral products	0.1848	-43.31	-0.02	-4.10
24.	Ferrous metal	0.1770	-51.79	-0.04	-4.26
25.	Metals n.e.c.	0.1808	-46.54	-0.06	-5.60
26.	Metal products	0.1008	-63.52	-0.07	-4.73
27.	Transport equipment	0.1390	-55.39	-0.15	-4.48
28.	Other manufacturing	0	0	-0.04	-4.80
29.	Utilities	0	0	-0.07	-3.92
30.	Construction	0	0	0.09	-3.52
31.	Trade	0	0	0.23	-2.91
32.	Transport	0	0	0.04	-3.77
33.	Communication	0	0	0.11	-3.07
34.	Financial services	0	0	0.11	-2.86
35.	Other services	0	0	0.09	-3.52
36.	Public administration	0	0	0.01	-2.59
37.	Dwellings	0	0	0.15	-3.01

Table A.3. Sectoral impacts (% change from base levels)

Sector	Sectoral real output			Composite price	
	Base value Rs. billions	Exp 1	Exp 2	Exp 1	Exp 2
1. Paddy	903.8	0.213	0.342	0.523	0.364
2. Wheat	602.5	0.032	0.078	0.376	0.217
3. Other cereals	188.9	0.039	0.046	0.432	0.249
4. Other crops	2317.1	-0.040	0.068	0.536	0.383
5. Sugarcane	235.8	0.103	0.126	0.639	0.369
6. Oilseeds	530.3	0.155	0.472	0.562	0.455
7. Plant-based fibers	207.2	-0.081	-0.006	0.385	0.231
8. Animal products	716.5	0.095	0.161	0.678	0.459
9. Dairy	1143.2	-0.005	-0.006	0.766	0.417
10. Forestry	304.7	-0.178	0.031	0.540	0.627
11. Fishing	316.9	-0.038	0.039	0.626	0.344
12. Primary products	822.4	-1.657	-0.608	-2.695	-0.514
13. Vegetable oils and fats	530.6	0.084	0.340	0.036	0.668
14. Food products	1991.0	0.252	0.150	0.256	0.194
15. Sugar	240.9	0.255	0.302	0.560	0.352
16. Textiles	1002.2	-0.404	-0.448	-0.559	-0.367
17. Wearing apparel	606.2	-0.497	-0.734	-1.265	-1.036
18. Leather products	145.6	-1.379	-1.606	-1.029	-0.735
19. Wood products	147.9	-0.872	-1.615	-1.378	-2.653
20. Paper products	460.6	-1.742	-0.912	-1.919	-0.684
21. Petroleum products	1697.5	0.153	-0.131	-1.138	-0.752
22. Chemicals	2604.1	-1.858	-1.482	-2.537	-1.552
23. Mineral products	501.9	-2.996	-3.085	-4.114	-2.816
24. Ferrous metal	1315.7	-0.717	-0.650	-1.346	-0.789
25. Metals n.e.c.	498.7	-2.803	-2.169	-5.155	-3.341
26. Metal products	441.1	-0.210	-0.514	-1.217	-0.754
27. Transport equipment	839.4	1.492	1.289	-0.660	-0.281
28. Other manufacturing	2500.8	-0.271	-0.177	-3.589	-2.141
29. Utilities	1468.4	-0.168	-0.217	-0.253	0.024
30. Construction	3809.8	2.217	1.273	-0.260	0.869
31. Trade	4563.1	-0.026	-0.019	0.570	0.318
32. Transport	3866.5	0.187	0.106	0.049	0.293
33. Communication	596.4	-0.003	-0.040	0.436	0.237
34. Financial services	2242.4	-0.043	-0.040	0.575	0.384
35. Other services	3695.5	0.176	0.279	0.019	0.448
36. Public administration	4066.3	0.023	-0.013	0.525	0.314
37. Dwellings	1276.3	-0.022	-0.036	0.663	0.314

Table A.4. Social Accounting Matrix, 2003/04 (Rs. 100,000)

	1	2	3	4	5	6	7	8	9
1. Paddy	846852.5	7993.8	2.4	119808.7	0.0	0.0	0.0	51018.7	0.5
2. Wheat	6027.1	502612.6	3.1	157454.1	0.0	0.0	0.0	43955.8	6447.5
3. Other cereals	51.2	4418.5	13665.1	7570.3	0.0	0.0	0.0	57782.8	3459.3
4. Other crops	7454.6	51901.2	8.5	334474.3	1.5	0.0	0.2	2183174.6	1090924.7
5. Sugarcane	0.1	0.6	0.0	4905.7	103752.6	0.0	0.0	0.0	39133.5
6. Oilseeds	208.0	221.0	1.0	5498.8	0.0	163813.9	2.1	65.4	13.4
7. Plant-based fibers	465.9	21.5	0.0	4554.3	0.0	0.2	7799.7	0.8	0.1
8. Animal products	193405.9	116563.5	171767.2	879616.7	30384.0	308655.0	84754.5	1307.1	19.9
9. Dairy	234.8	1100.8	4.8	5202.8	0.0	0.0	0.0	93.5	14349.4
10. Forestry	3.6	8.2	0.0	467.6	0.7	0.0	0.8	230.7	4191.3
11. Fishing	34.8	161.1	0.7	767.0	0.0	0.0	0.0	77.2	0.0
12. Primary products	18.1	86.0	0.3	471.8	0.1	0.4	1.4	900.7	143.5
13. Vegetable oils and fats	121.0	95.1	0.4	1532.8	0.0	5.2	0.0	145031.2	104365.8
14. Food products	1102.6	1037.2	4.6	5833.5	1.0	0.1	0.4	48449.3	5868.0
15. Sugar	49.8	247.7	1.0	1210.3	0.2	0.0	0.0	22.5	5.6
16. Textiles	20043.4	10750.2	0.1	13622.6	0.0	0.3	983.2	2584.0	47741.2
17. Wearing apparel	74.5	55.4	6.5	113.8	8.4	10.1	29.1	172.7	80.7
18. Leather products	2.3	5.4	0.0	7.6	0.0	0.0	2.4	1422.2	4.1
19. Wood products	129.2	150.7	13.6	463.4	17.4	20.2	28.4	232.4	79.7
20. Paper products	1986.9	1745.8	221.2	2897.7	288.9	343.7	373.0	230.2	215.2
21. Petroleum products	141636.2	154232.0	43619.3	189623.6	8642.6	30728.1	27282.4	574.6	521.4
22. Chemicals	752341.4	570259.7	161289.0	1204954.7	130995.9	429159.4	207810.8	33846.5	6501.8
23. Mineral products	5.3	22.5	0.1	315.0	0.4	0.0	11.0	54.9	61.4
24. Ferrous metal	1.1	0.3	0.0	14.5	0.0	0.0	99.8	1521.9	1775.2
25. Metals n.e.c.	7.5	25.0	0.1	161.3	0.1	0.1	8.9	4123.5	423.7
26. Metal products	8.5	118.0	12.8	372.4	16.8	20.0	31.2	4214.9	1271.5
27. Transport equipment	2308.1	1376.9	824.8	4218.8	342.5	948.7	495.6	22.6	978.1
28. Other manufacturing	10348.9	6226.9	4656.3	28704.6	2214.2	3887.3	2847.1	2018.5	870.4
29. Utilities	152768.1	170220.9	11769.2	126050.4	20597.7	8929.2	20448.3	725.5	975.3
30. Construction	35760.5	38690.4	23947.8	61273.8	11447.6	18553.1	15813.0	6422.3	1397.9

Table A.4. Continued

	1	2	3	4	5	6	7	8	9
31. Trade	283854.6	198257.4	43120.9	350394.3	47903.8	103747.3	47569.2	392958.4	208481.1
32. Transport	177573.2	130522.6	72871.9	422845.1	26056.1	133143.4	44913.2	107459.2	51564.1
33. Communication	2395.9	2035.1	268.9	2577.1	350.9	418.3	440.3	171.3	150.9
34. Financial services	106174.7	66073.4	23245.6	161028.2	28621.4	59980.8	23253.8	16046.5	28128.7
35. Other services	493.1	550.2	50.5	2068.1	66.2	79.0	87.7	583.9	1220.3
36. Public administration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37. Dwellings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38. Labor	3608133.9	2303643.0	732392.6	10599770.5	1097020.8	2221635.2	900486.6	2187166.5	5236991.4
39. Capital	2866826.4	1830273.9	581932.5	8421590.8	871653.5	1765237.8	715451.1	1738549.6	4162394.8
40. Rural 1									
41. Rural 2									
42. Rural 3									
43. Rural 4									
44. Rural 5									
45. Urban 1									
46. Urban 2									
47. Urban 3									
48. Urban 4									
49. Urban 5									
50. Private enterprise									
51. Government									
52. Indirect tax	-358881.1	-318350.6	-60770.6	-458447.4	-52092.8	-155344.5	-59147.1	-31219.0	-5091.7
53. Capital account									
54. ROW account	27.1	25.0	148.0	514517.2	2290.8	153.8	9766.2	36439.3	0.0
55. Total	8860049.7	5853378.7	1825080.4	23178506.5	2330583.4	5094126.0	2051644.3	7038432.6	11015659.6

Table A.4. Continued

	10	11	12	13	14	15	16	17	18
1. Paddy	0.0	0.0	6.3	2363.1	594244.8	40.1	257.1	30.0	0.0
2. Wheat	0.0	0.0	8.3	2919.8	772926.3	52.1	243.6	168.7	0.0
3. Other cereals	0.0	0.0	1.0	224.9	91227.0	6.1	0.8	0.0	0.0
4. Other crops	256.1	838.3	23.4	12423.9	2579980.9	45579.8	28433.9	6895.4	6447.6
5. Sugarcane	0.0	0.0	1393.8	1.5	73858.9	1457545.4	0.0	0.0	0.0
6. Oilseeds	0.2	0.0	14.3	2665911.7	239610.6	20.1	10148.2	29668.6	8.8
7. Plant-based fibers	0.0	0.0	0.1	14118.8	341.4	0.0	1363871.0	183360.3	2.5
8. Animal products	0.0	0.0	3.7	2320.0	338738.0	22.5	97944.8	8049.6	96497.5
9. Dairy	0.0	0.0	12.6	2942.3	1157809.5	79.6	22.2	0.0	128.0
10. Forestry	12213.4	0.0	7.2	1915.4	250667.8	0.7	8086.7	12582.8	4003.6
11. Fishing	0.0	39584.7	1.9	435.2	172603.8	11.8	10.9	69.6	7.8
12. Primary products	0.0	0.0	55810.5	20340.1	111750.0	8.1	39664.9	12244.4	1258.8
13. Vegetable oils and fats	0.0	0.0	2.1	272761.9	85174.8	17.6	972.3	0.0	6.8
14. Food products	0.0	11197.4	12.1	6816.0	1437636.5	1176.8	14224.9	3446.1	517.4
15. Sugar	0.0	0.0	2.7	942.8	299421.0	16.8	251.7	0.0	0.0
16. Textiles	77.1	18317.8	34.7	16234.5	40140.3	30032.1	1353782.9	1570063.2	3548.1
17. Wearing apparel	3153.9	66767.7	76.7	4172.6	12931.1	2127.1	25779.6	101744.0	15789.4
18. Leather products	0.1	0.0	0.0	7.9	1636.8	0.1	1067.5	12597.0	319657.5
19. Wood products	153.0	11725.1	24280.4	11031.5	103826.6	3.8	15832.1	5288.6	5996.0
20. Paper products	7137.4	0.0	7290.3	23282.6	341431.2	2595.9	43504.6	29317.9	7143.0
21. Petroleum products	29245.4	74404.1	124796.7	26297.0	235735.8	15603.2	75764.6	27785.7	9686.1
22. Chemicals	6338.3	9679.2	161152.7	220352.9	565622.4	21542.1	863569.5	358714.2	109571.9
23. Mineral products	13.0	0.0	24142.0	823.2	141668.2	1.7	4785.2	2960.9	1588.6
24. Ferrous metal	152.5	596.5	427.4	2130.9	6260.2	0.0	10373.4	9214.0	921.6
25. Metals n.e.c.	0.0	233.1	5.7	6898.0	52066.9	1.8	8856.2	18514.7	3854.9
26. Metal products	8073.7	12063.1	62560.7	11472.5	105716.5	9242.8	20760.7	17649.0	8417.6
27. Transport equipment	5887.0	57899.6	22841.6	40.9	1847.1	8.1	77.5	30.4	454.9
28. Other manufacturing	10388.7	0.0	261151.0	7434.4	141441.4	3264.5	82125.7	54728.0	15105.7
29. Utilities	2191.4	2433.0	208919.0	111967.2	116582.2	23295.4	697857.5	119210.9	19710.9
30. Construction	73255.6	0.0	74580.4	3048.8	68576.2	5845.0	20602.3	16420.9	3700.9

Table A.4. Continued

	10	11	12	13	14	15	16	17	18
31. Trade	10027.3	39125.0	90330.4	372212.0	1590027.2	291188.7	801736.5	561747.0	189810.8
32. Transport	57416.2	27665.1	182826.7	133673.8	1064205.1	32008.5	726340.4	317551.3	54690.7
33. Communication	3660.6	0.0	7353.9	6279.2	26839.2	1044.3	13840.1	15529.0	3108.3
34. Financial services	3363.4	12706.1	73315.6	198824.3	901326.5	89408.4	409638.1	233894.1	58295.9
35. Other services	22554.2	26212.4	108005.7	14225.6	617709.8	16196.4	314644.1	119232.4	56128.9
36. Public administration	20649.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37. Dwellings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38. Labor	1426514.7	1605086.8	1987942.8	129246.5	2620421.7	120307.2	1069300.0	1104916.7	270830.9
39. Capital	1245385.5	1037330.9	4327495.5	401472.6	1800583.0	110147.5	1281691.7	631635.3	108132.6
40. Rural 1									
41. Rural 2									
42. Rural 3									
43. Rural 4									
44. Rural 5									
45. Urban 1									
46. Urban 2									
47. Urban 3									
48. Urban 4									
49. Urban 5									
50. Private enterprise									
51. Government									
52. Indirect tax	20692.4	42805.9	167681.2	19143.3	262584.1	59371.7	204484.1	177483.1	35149.9
53. Capital account									
54. ROW account	280069.8	7616.8	11905204.2	1225642.9	115731.6	6365.1	600398.2	529304.6	116080.6
55. Total	3248870.7	3104288.5	19879715.3	5952352.5	19140902.5	2344178.9	10210945.6	6292048.3	1526254.6

Table A.4. Continued

	19	20	21	22	23	24	25	26	27
1. Paddy	16.2	1335.6	2.2	2760.7	45.4	0.0	0.0	1.6	0.0
2. Wheat	8.5	1017.3	0.0	2285.8	19.3	0.0	0.0	1.3	0.0
3. Other cereals	0.0	0.0	0.0	265.0	0.0	0.0	0.0	0.0	0.0
4. Other crops	1603.2	48981.7	1709.2	1078976.9	5281.4	12.4	0.4	193.2	300.1
5. Sugarcane	0.0	0.0	0.0	9023.5	0.0	0.4	0.0	0.0	0.0
6. Oilseeds	12.7	274.5	57.1	58969.0	0.0	11.1	2.1	0.0	0.1
7. Plant-based fibers	3.7	5.8	0.2	202.5	7.3	0.3	1.6	2.5	0.8
8. Animal products	3019.3	1478.7	87.8	41982.6	1213.3	23.1	24.6	306.8	7.7
9. Dairy	0.1	9.8	2.2	4476.0	0.0	0.0	0.0	0.0	0.0
10. Forestry	264434.8	87036.1	146.8	78865.6	13685.0	3172.0	95.1	1629.9	2400.3
11. Fishing	25.7	95.2	17.7	1211.3	566.3	19.9	17.4	226.4	6.6
12. Primary products	3355.0	133833.0	10629433.3	1501558.9	1008520.9	988310.6	491215.8	144929.7	8999.9
13. Vegetable oils and fats	0.0	65.9	14.6	10247.9	37.2	1.1	0.2	1.3	0.0
14. Food products	90.9	4610.4	38.7	24616.7	356.0	561.8	346.5	69.4	5.9
15. Sugar	0.0	111.2	24.6	18319.9	0.0	5.8	0.1	0.4	0.0
16. Textiles	3882.8	22970.3	554.5	205760.5	76300.9	3296.4	15836.0	6040.7	1300.2
17. Wearing apparel	3203.7	23015.3	1112.9	164728.7	43763.2	23809.3	9592.2	14320.4	17528.4
18. Leather products	570.8	24.1	3.2	14133.4	210.4	149.5	415.7	783.3	2185.0
19. Wood products	95254.8	65167.7	7978.8	69837.5	22287.4	16637.6	7476.8	8384.8	42988.8
20. Paper products	12667.6	1094280.6	2646.5	343768.2	8730.2	11089.2	10834.5	10742.2	31121.9
21. Petroleum products	11471.7	34282.8	148742.7	1437056.4	214729.7	258355.1	65493.6	63284.6	121254.2
22. Chemicals	48033.0	325608.0	139935.9	6560997.1	275481.3	669716.1	272095.9	138663.9	477886.3
23. Mineral products	3032.4	13049.9	98.1	62717.3	155440.6	13548.2	2623.9	10516.1	18700.5
24. Ferrous metal	6965.4	4821.2	432.0	46864.4	33519.8	3708260.8	327787.8	1088614.4	1334377.9
25. Metals n.e.c.	8707.3	35129.4	1936.0	145475.0	18353.3	188933.3	871847.6	328874.3	234193.9
26. Metal products	7797.8	12578.0	32102.6	151240.3	25513.5	506062.0	81234.8	127512.1	249488.2
27. Transport equipment	348.2	225.6	7.4	3503.7	189.0	10241.9	209.5	10894.9	625314.3
28. Other manufacturing	15123.2	35349.3	10679.9	219502.5	77748.4	73914.2	41668.1	51766.2	298785.1
29. Utilities	48072.4	166782.9	194948.0	1006621.4	236500.7	443535.8	307056.7	127356.3	375986.4
30. Construction	5882.9	9275.5	9711.2	61153.2	16942.2	18497.3	9315.2	7189.4	17777.8

Table A.4. Continued

	19	20	21	22	23	24	25	26	27
31. Trade	72413.1	249103.7	344227.2	1729193.5	352337.5	1168360.8	260254.2	264441.5	440813.2
32. Transport	46539.3	234716.4	191044.7	1275812.4	477996.0	781331.9	184593.4	155848.2	222238.8
33. Communication	1903.7	15961.3	4140.5	262211.2	11288.0	16732.7	21426.3	10895.3	14476.9
34. Financial services	58582.8	173131.4	382914.9	1112830.5	220531.8	544710.4	209059.5	184516.5	432278.5
35. Other services	19613.2	33373.0	11408.0	273110.4	52085.3	287731.8	17065.9	166275.3	678833.8
36. Public administration	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37. Dwellings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38. Labor	115394.2	829876.6	124669.6	2101469.0	560236.8	856844.2	213802.7	735156.3	1114078.8
39. Capital	595090.7	517131.9	3221222.7	4539387.2	1205308.6	2119157.3	620429.1	497101.5	934551.5
40. Rural 1									
41. Rural 2									
42. Rural 3									
43. Rural 4									
44. Rural 5									
45. Urban 1									
46. Urban 2									
47. Urban 3									
48. Urban 4									
49. Urban 5									
50. Private enterprise									
51. Government									
52. Indirect tax	32558.3	189188.6	1273399.1	988970.6	176618.6	629913.9	225827.0	224183.3	697101.5
53. Capital account									
54. ROW account	42660.3	1493917.8	972300.0	5339070.4	961600.0	906066.8	3545893.0	265232.0	507048.8
55. Total	1528339.8	5857816.3	17707750.7	30949176.9	6253445.4	14249015.1	7813543.5	4645956.3	8902032.0

Table A.4. Continued

	28	29	30	31	32	33	34	35	36
1. Paddy	6.2	0.0	96.3	5024.5	226.3	0.0	0.0	389572.5	9145.3
2. Wheat	114.2	0.0	123.3	2944.1	10498.5	0.0	0.1	230872.7	10687.1
3. Other cereals	0.1	0.0	14.3	332.6	0.0	0.0	0.0	3494.2	0.0
4. Other crops	5576.1	108.6	720743.7	42202.8	202522.4	0.0	0.0	1824425.6	36503.4
5. Sugarcane	0.3	3.4	1269.6	16147.3	0.0	0.0	0.0	20.8	0.0
6. Oilseeds	261.2	7.5	545.0	21537.8	0.0	0.0	0.0	96870.5	0.0
7. Plant-based fibers	619.0	0.0	1343.0	12218.5	0.0	0.0	0.0	131624.5	0.0
8. Animal products	41986.8	68812.7	22561.6	9393.3	0.0	0.0	0.0	184449.8	12010.2
9. Dairy	4.3	0.0	183.0	3990.8	0.0	0.0	0.0	284225.2	34716.7
10. Forestry	13583.6	0.5	143327.3	11813.6	20.7	0.0	0.0	111051.9	0.0
11. Fishing	35860.4	0.5	38.2	1205.4	0.0	0.0	0.0	32517.9	0.0
12. Primary products	145157.2	1767165.1	1614535.5	61026.6	5000.8	0.1	0.0	926233.1	1.3
13. Vegetable oils and fats	23.6	0.8	68.9	2417.9	556.6	0.0	0.0	207412.8	0.0
14. Food products	396.6	0.0	268.0	8084.7	891.5	0.0	2026.5	939995.8	0.0
15. Sugar	82.8	0.0	64.6	1689.3	0.0	0.0	0.0	56823.0	0.0
16. Textiles	32218.0	0.1	67099.8	88450.1	16591.9	0.1	2937.2	519724.1	2.6
17. Wearing apparel	106561.4	1364.3	5658.3	11294.8	30926.1	994.7	3040.8	94717.0	14076.5
18. Leather products	10503.6	99.4	613.4	13703.9	2904.6	0.0	0.1	39066.8	0.1
19. Wood products	184233.4	4002.3	945887.8	91513.3	12711.4	2025.3	9042.4	144676.0	47388.9
20. Paper products	148749.1	69016.8	35268.0	96770.2	147356.1	49736.6	174153.7	299568.7	106471.6
21. Petroleum products	248636.9	991456.9	530652.7	653393.0	5834260.7	41449.3	88918.3	329516.6	47794.8
22. Chemicals	1197443.3	38941.8	1900512.6	255623.2	1105429.4	4162.4	7162.4	1104458.3	2075009.5
23. Mineral products	85326.0	1892.8	3414080.2	7551.7	25742.2	0.1	4.9	58731.9	1.8
24. Ferrous metal	3530807.7	1889.1	3055393.3	168927.8	707.4	6.2	0.0	887650.4	0.2
25. Metals n.e.c.	3036084.7	0.4	5972.6	75509.1	146.6	2.1	0.0	367409.7	0.4
26. Metal products	284096.0	3522.3	477358.4	271919.6	128615.2	3428.3	15684.1	184563.1	6149.7
27. Transport equipment	23133.9	12283.7	11986.2	20044.4	802458.6	9146.5	40607.3	78543.6	6676.8
28. Other manufacturing	2259317.6	664556.4	462535.7	418470.2	700388.7	292409.8	115439.8	2188259.5	61122.2
29. Utilities	591734.5	2241264.9	594685.3	393285.2	2131729.5	152326.2	270325.8	740540.9	30273.5
30. Construction	51335.9	273363.1	223219.8	92236.7	588745.0	222478.0	262108.2	338758.0	171160.9

Table A.4. Continued

	28	29	30	31	32	33	34	35	36
31. Trade	1272027.6	664033.0	2242327.8	309455.9	1088081.4	64742.6	62365.0	1697414.1	528156.7
32. Transport	602630.5	1013894.9	2416352.4	1609951.5	1226752.7	82284.1	204701.2	1020353.4	544811.2
33. Communication	174755.3	68297.2	173099.5	185893.4	428340.6	41323.7	521796.0	213550.5	69928.0
34. Financial services	953711.5	520071.1	1514062.8	1707889.4	1128986.3	29310.9	1272862.2	992333.3	335869.6
35. Other services	571362.8	390032.3	821729.1	2093077.9	3686255.0	311881.2	1788426.7	1122340.3	4183648.8
36. Public administration	2.6	0.0	0.0	0.1	47531.7	3591.4	0.0	0.2	55010.3
37. Dwellings	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38. Labor	2577002.0	4423696.6	12850516.9	12117944.7	9820966.6	1075653.2	4914243.4	10393281.8	25464224.6
39. Capital	2816383.1	987595.8	2842502.9	23480622.7	5777633.5	3383353.8	12112856.7	6933918.8	5081511.7
40. Rural 1									
41. Rural 2									
42. Rural 3									
43. Rural 4									
44. Rural 5									
45. Urban 1									
46. Urban 2									
47. Urban 3									
48. Urban 4									
49. Urban 5									
50. Private enterprise									
51. Government									
52. Indirect tax	1602465.1	253935.0	1737501.6	541546.6	2884387.2	44755.7	220341.3	1195852.7	413975.3
53. Capital account									
54. ROW account	12103237.2	0.0	0.0	0.0	2750347.0	28081.0	359108.1	4402452.8	0.0
55. Total	34707432.0	14461309.6	38834199.6	44905104.6	40587711.8	5843143.5	22448152.1	40767272.7	39346329.8

Table A.4. Continued

	37	38	39	40	41	42	43	44	45
1. Paddy	0.0			340825.5	785016.3	1695339.5	894844.7	465783.5	94968.6
2. Wheat	0.0			160053.6	435905.5	1053952.4	676606.6	409940.6	94348.0
3. Other cereals	0.0			122001.7	268858.9	610307.8	312563.3	131273.8	22101.4
4. Other crops	0.0			233697.6	718749.2	2242646.0	1762815.8	1575128.9	246197.3
5. Sugarcane	0.0			18906.3	58089.1	180480.6	138448.9	101537.5	10954.9
6. Oilseeds	0.0			25397.7	68754.6	187302.5	128236.3	85261.1	11656.7
7. Plant-based fibers	0.0			0.0	0.0	0.0	0.0	0.0	0.0
8. Animal products	0.0			78735.4	255655.4	852125.3	654086.0	516503.0	45712.0
9. Dairy	0.0			61814.2	303840.3	1425430.9	1520726.4	1407926.8	61814.2
10. Forestry	0.0			126989.1	298271.1	741081.1	454783.2	229272.2	40871.6
11. Fishing	0.0			46789.6	151926.8	506387.4	388699.8	306939.1	27165.0
12. Primary products	0.0			0.0	0.0	0.0	0.0	0.0	7073.7
13. Vegetable oils and fats	0.0			149663.5	405156.6	1103734.9	755670.0	502426.3	68690.3
14. Food products	0.0			499075.1	1367071.7	3779015.3	2673100.3	2031682.5	211205.6
15. Sugar	0.0			41726.0	128202.0	398318.4	305555.0	224092.1	24177.4
16. Textiles	0.0			166158.3	452358.8	1165906.4	835380.9	630312.1	67174.7
17. Wearing apparel	0.0			21649.5	62221.5	172012.4	2225033.6	112555.8	10081.2
18. Leather products	0.0			1130.8	9706.3	75691.0	77416.5	106769.0	3694.3
19. Wood products	0.0			0.0	0.0	0.0	42628.0	86109.9	0.0
20. Paper products	0.0			14177.0	49905.8	168581.9	154467.8	212363.6	10992.7
21. Petroleum products	0.0			30926.5	75794.6	230278.0	271365.7	465460.9	25452.9
22. Chemicals	0.0			80268.0	237278.3	703839.8	570198.2	519905.3	38430.3
23. Mineral products	0.0			18171.7	20847.1	22749.4	0.0	31704.9	0.0
24. Ferrous metal	0.0			0.0	0.0	0.0	0.0	0.0	0.0
25. Metals n.e.c.	0.0			0.0	0.0	0.0	0.0	0.0	0.0
26. Metal products	0.0			19127.7	56360.4	174832.0	144491.3	129942.0	9576.4
27. Transport equipment	0.0			6534.5	19936.9	63351.4	77934.5	280750.0	3225.1
28. Other manufacturing	0.0			11339.9	39404.1	177436.9	273919.4	563417.6	10691.8
29. Utilities	0.0			11909.1	44261.6	184840.3	229706.0	230332.4	22391.1
30. Construction	857192.4			0.0	0.0	0.0	0.0	0.0	0.0

Table A.4. Continued

	37	38	39	40	41	42	43	44	45
31. Trade	0.0			238245.1	730522.2	2447885.2	2440753.9	3232481.9	119480.7
32. Transport	0.0			209558.0	716446.4	2921188.9	3081407.9	3401823.1	109890.9
33. Communication	0.0			0.0	0.0	16722.9	107027.7	432310.2	0.0
34. Financial services	0.0			97901.4	300191.4	1005902.5	1002972.0	1328314.6	49097.8
35. Other services	0.0			231027.9	729911.0	2375006.4	2103300.4	2514872.9	125385.1
36. Public administration	0.0			49236.4	248492.8	1240872.9	2057842.5	3950136.4	55175.1
37. Dwellings	0.0			0.0	0.0	31807.2	84307.9	228616.0	294073.1
38. Labor	1523254.2								
39. Capital	9883745.8								
40. Rural 1		1734545.5	502311.0						
41. Rural 2		6256720.5	2077382.8						
42. Rural 3		16520023.7	8985829.8						
43. Rural 4		11525628.0	18560903.0						
44. Rural 5		17581809.0	24828256.0						
45. Urban 1		1171429.0	257841.4						
46. Urban 2		4835667.8	1076112.6						
47. Urban 3		19890058.7	4186445.8						
48. Urban 4		22235849.3	6115236.6						
49. Urban 5		28969788.7	10596588.6						
50. Private enterprise		0.0	34920981.0						
51. Government		0.0	8244200.0	20192.3	35556.2	1727544.5	312118.9	103167.7	0.0
52. Indirect tax	2407.6			108457.0	314919.9	973942.0	921380.1	921369.1	66953.0
53. Capital account				-357741.6	201086.1	2578519.3	8802024.0	24072655.8	-347416.9
54. ROW account	0.0								
55. Total	12266600.0	130721520.3	120352088.6	2883944.9	9590698.8	33235033.3	36481813.2	51543138.4	1641286.2

Table A.4. Continued

	46	47	48	49	50	51	52	53	54	55
1. Paddy	231729.4	519867.2	297209.9	152149.9		25749.1		921323.9	404391.4	8860049.7
2. Wheat	197491.3	464311.6	260878.9	153081.5		28583.7		-96063.3	262897.1	5853378.7
3. Other cereals	42595.2	73559.3	22642.4	7481.0		52.0		-2693.4	31824.1	1825080.4
4. Other crops	685290.8	2052590.4	1539474.6	1287479.6		36915.3		-202938.6	682499.5	23178506.5
5. Sugarcane	29432.3	80462.8	51123.6	30464.1		0.0		-85773.2	9399.1	2330583.4
6. Oilseeds	32560.7	95187.7	64957.6	41230.3		0.0		553515.1	506311.3	5094126.0
7. Plant-based fibers	0.0	0.0	0.0	0.0		0.0		279521.0	51557.2	2051644.3
8. Animal products	156116.6	493946.9	360694.6	258235.6		72661.2		551583.2	24968.9	7038432.6
9. Dairy	303840.3	1425430.9	1520726.4	1407926.8		66594.1		0.3	0.0	11015659.6
10. Forestry	79035.8	97889.3	21907.3	5481.3		0.0		-7032.3	134677.0	3248870.7
11. Fishing	92774.5	293534.9	214347.8	153460.1		0.0		154017.7	482670.3	3104288.5
12. Primary products	20331.7	36464.1	7494.7	0.0		11115.1		-261563.6	386823.4	19879715.3
13. Vegetable oils and fats	191873.3	560921.3	382781.5	242961.4		31546.9		471199.7	254791.0	5952352.5
14. Food products	583509.1	1678247.2	1210780.0	966470.1		66713.7		662928.9	891419.7	19140902.5
15. Sugar	64956.7	177580.5	112829.1	67233.9		0.0		310235.2	109979.0	2344178.9
16. Textiles	177060.0	552932.6	425737.2	346443.8		22.6		-201534.0	1402069.9	10210945.6
17. Wearing apparel	28220.5	96128.0	84689.3	86465.4		5356.6		-231.4	2585064.4	6292048.3
18. Leather products	14624.3	70347.6	68285.8	70087.4		0.2		-56315.0	663038.2	1526254.6
19. Wood products	0.0	18657.5	36966.2	65024.7		21174.8		-799264.6	100276.2	1528339.8
20. Paper products	35026.6	227793.5	286670.8	326581.1		295888.2		-0.4	952390.7	5857816.3
21. Petroleum products	97162.9	486406.8	538926.4	961796.1		288586.2		452548.9	1446116.0	17707750.7
22. Chemicals	111897.8	356999.2	376684.4	278016.2		262229.8		417962.5	4584604.4	30949176.9
23. Mineral products	0.0	0.0	17682.9	30784.6		9.8		-1370011.0	3431994.1	6253445.4
24. Ferrous metal	0.0	0.0	0.0	0.0		9.2		-781312.1	799803.0	14249015.1
25. Metals n.e.c.	0.0	0.0	0.0	0.0		0.0		1831602.3	568184.0	7813543.5
26. Metal products	29906.1	105160.3	90988.6	81400.5		12853.6		202851.4	757577.4	4645956.3
27. Transport equipment	9020.1	53260.4	115373.0	476756.2		73955.5		5159234.7	806281.3	8902032.0
28. Other manufacturing	40905.2	265080.5	352748.0	558559.4		1823976.2		15936388.4	6029114.3	34707432.0
29. Utilities	95251.7	396596.8	307550.6	533507.9		766689.9		-229406.3	0.0	14461309.6
30. Construction	0.0	0.0	0.0	0.0		1508509.2		33610011.2	0.0	38834199.6

Table A.4. Continued

	46	47	48	49	50	51	52	53	54	55
31. Trade	404035.0	2002641.7	2675068.4	4100893.1		407813.0		2398010.9	5275033.0	44905104.6
32. Transport	462878.8	2396627.4	2595793.9	2753326.6		746168.6		863179.5	4274242.0	40587711.8
33. Communication	5739.4	287532.8	710957.2	1345774.8		567527.1		0.1	47068.0	5843143.5
34. Financial services	166028.9	822939.9	1099258.2	1685168.3		421653.1		-0.1	201745.0	22448152.1
35. Other services	415895.7	1721580.3	2059038.5	3289560.8		1068517.8		693606.5	5631209.1	40767271.7
36. Public administration	270303.1	1949135.0	2534878.0	3366541.9		23496929.0		-0.3	0.0	39346328.8
37. Dwellings	898713.3	3298368.8	3226157.0	4204556.7		0.2		-0.2	0.0	12266600.0
38. Labor									-312600.0	130721520.3
39. Capital									-1095200.0	120352090.4
40. Rural 1						647088.2			0.0	2883944.7
41. Rural 2						1256595.5			0.0	9590698.9
42. Rural 3						3289059.1			4440120.6	33235033.2
43. Rural 4						4124693.3			2270589.0	36481813.3
44. Rural 5						8009074.5			1123999.0	51543138.5
45. Urban 1						212015.5			0.0	1641285.9
46. Urban 2						389988.5			0.0	6301769.0
47. Urban 3						819120.9			1510324.7	26405950.1
48. Urban 4						1726843.3			758855.5	30836784.6
49. Urban 5						3830913.3			377389.2	43774679.7
50. Private enterprise										34920981.0
51. Government	0.0	2069449.5	1444061.0	639410.0	6099400.0		24616465.0		-248200.0	45063365.0
52. Indirect tax	208139.3	806826.0	824703.7	1022024.0		685090.0		5094808.4	-157127.1	24616465.0
53. Capital account	119422.8	371491.2	4896717.1	12778344.4	28821581.0	-12034919.0			-3431374.2	66470390.0
54. ROW account										49026796.5
55. Total	6301769.2	26405950.1	30836784.6	43774679.3	34920981.0	45063364.8	24616465.0	66470389.8	49026796.5	1244888053.8

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