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Policy Dilemmas in India: The Impact of Changes in Agricultural Prices on Rural and Urban Poverty

by

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Abstract

Trade policy reforms which lead to changes in world prices of agricultural commodities or domestic policies aimed at affecting agricultural prices are often seen as causing a policy dilemma: a fall in agricultural prices benefits poor urban consumers but hurts poor rural producers, while a rise yields the converse. Poor countries have argued that they need to be able to use import protection and/or price support policies to protect themselves against volatility in world agricultural prices in order to dampen these effects. In this paper, we explore this dilemma in a CGE model of India that uses a new social accounting matrix (SAM) developed at the Indira Ghandi Institute of Development Research (IGIDR) in Mumbai. The SAM includes extensive disaggregation of agricultural activities, commodity markets, labor markets, and rural and urban households. This SAM includes 115 commodities, 48 labor types and 352 types of households, (classified by social group, income class, region, and urban/rural). The CGE model based on this SAM can be used to explore the linkages between changes in world prices of agriculture and the incomes of poor rural and urban households, capturing rural-urban linkages in both commodity and factor markets. The results indicate that the inclusion of linkages between rural and urban labor markets is necessary to fully explore, and potentially eliminate, the dilemma. A fall in agricultural prices hurts agricultural producers, lowers wages and/or employment of rural labor, and in some cases spills over into urban labor markets, depressing wages and incomes of poor urban households as well. In these cases both rural and urban poverty increases. The paper explores the strength of these commodity and factor market linkages, and the potential spillover effects of policies affecting agricultural prices.

1. Introduction and Motivation

India's economic growth has accelerated in recent years, and its share of world trade has expanded. Yet, despite these recent positive trends, India remains the largest reservoir of poverty in the world (Figure 1). Its recent high growth has been driven mainly by its modern services sector, which accounts for only a small proportion of overall employment and household incomes. Its agricultural sector, where poverty is concentrated, is in a deep crisis. The country faces daunting challenges and policy decisions to create employment for its burgeoning population and raise incomes across the full range of households, skill levels, sectors, and regions.

India's bound tariffs are still relatively high, although applied tariffs are much lower. Because of this gap, the government currently retains significant policy space with respect to trade and agricultural prices, including the ability to raise and lower tariffs in response to world price changes and prevailing conditions. In the Doha Development Agenda round of negotiations at the World Trade Organization, the Indian government has sought to maintain its policy space with respect to agricultural prices. Specifically, it has sought provisions in the Doha round to treat some agricultural commodities as "special products" that would be subjected to lesser or no tariff cuts based on considerations such as livelihood security. It also seeks a "special safeguard mechanism" through which it would retain the ability to raise tariffs in response to agricultural price drops or import surges.[1]

[1] India's position is supported by a coalition of developing countries known as the G33. The G33 includes the following 46 countries: Antigua and Barbuda, Barbados, Belize, Benin, Bolivia, Botswana, China, Congo, Côte d'Ivoire, Cuba, Dominica, Dominican Republic, El Salvador, Grenada, Guatemala, Guyana, Haiti, Honduras, India, Indonesia, Jamaica, Kenya, Rep. Korea, Madagascar, Mauritius, Mongolia, Mozambique, Nicaragua, Nigeria, Pakistan, Panama, Peru, Philippines, St Kitts and Nevis, St Lucia, St Vincent and the Grenadines, Senegal, Sri Lanka, Suriname, Tanzania, Trinidad and Tobago, Turkey, Uganda, Venezuela, Zambia, Zimbabwe (World Trade Organization, 2007a).

The question of the impact of trade liberalization on poverty has long concerned both policy makers and the research community; however there has been limited research that illuminates the causal relationships. Most *ex* post studies of the relationship between changes in trade and changes in income levels and distribution (sometimes explicitly including poverty) have tended to focus on the manufacturing sector and urban areas. Since most of the world's poor are in rural areas and more are engaged in agriculture than in manufacturing, this body of literature has limited usefulness with respect to poverty implications. A few recent studies that probe the relationship between trade liberalization, including the agricultural sector, and poverty are discussed in Section 5, below.

We use a computable general equilibrium model of the Indian economy to explore the impact on Indian households and poverty of changes in global prices for rice and wheat, which are the most important food grains in India. Global price changes would have a stronger impact on the country's producers and consumers if the government were to lower and bind its agricultural tariffs as a result of the Doha round. We trace the impact of global price volatility on the overall economy, factors of production, and households. Using a new social accounting matrix (SAM) for India, we are able to capture the impacts on highly disaggregated types of labor and households, including information on social groups (castes, tribes, etc.), income levels and location. We believe that this is the first study that looks at the impact of global agricultural price changes—and therefore the potential impact of trade policy change—on poverty at such a detailed and disaggregated level.

The study is organized as follows. Section 2 puts the present study in context by providing an overview of Indian poverty, agriculture, employment, and trade. The following section describes the analytical framework of the study. Section 4 presents the results. As noted,

Section 5 briefly reviews the results from several recent studies that attempt to assess the impact of trade on poverty in India or globally. A final section suggests policy implications of the findings and concludes.

2. The Context: Indian Poverty, Agriculture, Employment, and Trade

Although India's aggregate economy is large, when divided by its 1.1 billion people, the resulting per capita income places it in the ranks of low-income countries. Its GDP per capita stood at $785 in the most recent measure by the International Monetary Fund, ranking it 134th of 185 member countries (International Monetary Fund 2007b). Using the traditional purchasing power parity (PPP) conversion, its GDP per capita stands at about $3,800, similar to the levels of Nicaragua, Angola, and Vietnam. Using newly revised World Bank and Asian Development Bank estimates, GDP per capita is significantly smaller, at about $2,100 (Asian Development Bank 2007).

The vast majority of the population suffers from very low incomes (Figure 1). The new PPP estimates suggest that 792 million people, or 73 percent of the population, live on less than $1 per day, while slightly over a billion people, or 94 percent of the population, live on less than $2 per day.[2] As measured by the national poverty line, the percentage of the population living below the poverty line has fallen in recent years; however due to population growth, the number of poor people has barely decreased. In 2004–2005, 77 percent of the population, totaling 836 million people, had an income below 20 rupees per day (twice the official poverty line), which is approximately 50 cents at the current exchange rate (NCEUS 2007).

[2] Authors' calculations using the World Bank's PovcalNet software, http://iresearch.worldbank.org/PovcalNet.

Poverty in India is concentrated in rural areas, as it is in most of the developing world. Nearly three-quarters of India's poor live in the countryside, where the proportion of the population living at or below the national poverty line is 28.3 percent, compared with 25.7 percent in urban areas (National Sample Survey Organisation 2005). This is driven in large part by deeply rooted problems and slow growth in the agricultural sector, discussed below.

Indian poverty is also characterized by an element of ethnicity and caste. Historically, disadvantaged castes, tribes, and some other classes suffered discrimination and exclusion from many economic opportunities. The Indian Constitution recognizes the groups that have been disadvantaged and the government has accorded compensatory advantages to try to redress the effects. The Constitution and laws establish specific opportunities for groups officially identified as "scheduled tribes" (ST), "scheduled castes" (SC), and "other backward classes" (OBC). Nonetheless, these groups continue to suffer considerably higher levels of poverty and more exclusion than other groups. In the government's 1999–2000 survey, the proportions of people below the official poverty line were 45.8 percent for "scheduled tribes," 35.9 percent for "scheduled castes," and 27 percent for "other backward classes," compared with 15 percent for the rest of the population (Panda (2007a).

Poverty is accompanied by widespread child malnutrition. According to a UNICEF study (2006), 47 percent of children under the age of five years were underweight, among the highest rates in the world (Bangladesh and Nepal have rates of 48 percent). In absolute numbers, India has 57 million underweight young children, the largest concentration in the world. Malnutrition at such levels is a humanitarian tragedy. In economic terms, it also has dire consequences for the country's future, because it is likely to constrain growth and productivity for the foreseeable future. Malnourished children are more likely to die, to suffer recurring illness later in life, and to

have learning impairment. What happens to Indian children today will affect the economy for the next six decades.

India produces about 210 million tons of food grains, mainly rice and wheat, which make up the staple food supply of the country. It was a large importer of food grains until the mid-1970s, but it has been self-sufficient and even a net exporter in most years during the last two decades. This turnaround was the result of the adoption of high-yielding varieties of seeds and chemical fertilizers, along with large public investments in irrigation. These measures made up what has come to be called the "green revolution" and also involved government procurement operations and guaranteed minimum support prices to farmers for food grains in some parts of the country. The increase in agricultural output since 1980–1981 has been mostly due to a rise in yield per hectare attributable to the green revolution, rather than expansion of total area under cultivation.

India has the second-largest potential labor force in the world, after China (ILO 2007). However participation rates are relatively low and unemployment is high. The labor force participation rate was highest among "scheduled tribes" (51 percent), followed by "scheduled castes" (44 percent) and "other backward classes" (43 percent). For other groups, the participation rate was 40 percent.

About 55 percent of the workforce continues to depend on agriculture as the main source of livelihood, although it contributes only 19 percent to overall GDP. The income of a typical worker in agriculture is one-fifth of a counterpart in nonagricultural sectors. The bulk of the rural poor consists of landless laborers and marginal farmers owning less than one hectare of land. The proportion of rural male workers engaged in the agricultural activities declined gradually from

81 percent in 1977–1978 to 67 percent in 2004–2005, whereas for rural female workers, the decline was less, from 88 percent in 1977–1978 to 83 percent in 2004–2005.

Among urban workers, the largest source of employment for males was the "trade, hotel, and restaurant" sectoral grouping, which employed 28 percent of urban male workers, followed by manufacturing at 24 percent and "other services" at 21 percent. Between the 1999–2000 and 2004–2005 surveys, the proportion of urban females employed in the manufacturing sector increased from 24 to 28 percent, while the share employed in the trade, hotel, and restaurant sector fell by 5 percent.

According to projections prepared by the Government of India's Planning Commission (2004), India's labor force is expected to increase by about 160–170 million by 2020, a growth of about 2 percent a year. The report estimates that to absorb this growing workforce as well as to offer employment to the 35 million persons unemployed or underemployed as of 2002, the country will need to generate about 200 million additional employment opportunities by 2020.

Trade policy changes can have important effects on poverty—both positive, through improvements in export opportunities or lower prices, for example, and negative, if cheaper imports reduce the incomes of poor farmers or eliminate employment opportunities in some sectors without creating sufficient jobs in others. The country remains one of the less open economies among large developing countries, with average applied tariffs of 12.1 percent (14.1 percent including ad valorem equivalents) on nonagricultural products and 40.8 percent on agricultural products (World Trade Organization (2007c). Because such a high proportion of India's labor force is still engaged in agriculture, and the sector is still the main reservoir of poverty in the country, liberalization of agricultural trade is likely to have a significant impact on Indian poverty.

3. Analytical Framework

The model: The model of the Indian economy used in this study is the "STAGE" (Static Applied General Equilibrium) model developed by Scott McDonald. It is a member of the class of single-country CGE models that are descendants of the approach to CGE modeling described by Dervis, de Melo, and Robinson (1982) and models reported by Robinson, Kilkenny, and Hanson (1990) and Kilkenny (1991). The model is a social accounting matrix–based CGE model, and the modeling approach has been influenced by Pyatt's "SAM Approach to Modeling" (Pyatt 1987). We vary the standard closure of full employment of all labor with an alternative labor market closure meant to reflect unemployment and underemployment among unskilled laborers in India. The results we report are for this alternative. A short description of the model is presented in Appendix A.

The social accounting matrix: The social accounting matrix (SAM) used in this study was constructed by Scott McDonald, Manoj Panda and A. Ganesh-Kumar. It improves upon earlier SAMs for the Indian economy by incorporating detailed information on sources of incomes at the household level. Previous SAMs included extensive information on consumption expenditures but were less satisfactory regarding sources of household income.

The distribution of Indian households by income, location (rural or urban), and social group as reflected in the model are presented in Tables 1 (countrywide distribution), 2 (rural distribution), and 3 (urban distribution).

A description of the SAM is presented in Appendix B. Table B.1 presents the macroeconomic totals for the SAM, while Table B.2 provides an overview of the Indian economy as represented in the model.

The policy scenarios and simulations: We use the model to simulate the impact on poverty and income distribution of changes in world agricultural prices for some key crops. These changes could arise as the result of trade or agricultural policy changes elsewhere in the world, behavior by private actors, weather, or other causes. They shed light on potential effects of an agreement in the Doha round because such an agreement would require India (as well as other countries) to bind its tariffs at lower levels. As a result, the government would have less scope for raising tariffs to offset negative global price changes that could lower domestic farm incomes, the source of livelihood for a majority of Indian households. On the other hand, households would face lower prices as consumers of these key commodities, which could offset the income effects.

Because of their concerns about the impact of negative price shocks, India and other developing countries for which agriculture is a major source of employment and livelihoods have proposed that they be allowed special treatment in the Doha round to address this vulnerability. As noted above, a coalition known as the Group of Thirty-Three (G33), has proposed that developing countries be allowed to shield a certain number of "special products" from full tariff cuts because of their importance for livelihood security, food security, or rural development. They have also proposed that a "special safeguard mechanism" be created whereby they could temporarily raise tariffs to counter sharp changes in the price or volume of imports that could threaten local livelihoods. Our simulation sheds light on the need for such measures and their potential impact on poverty in India.

Specifically, we simulate the impact on the Indian economy of a 25 percent decrease, a 50 percent decrease, a 25 percent increase, and a 50 percent increase in the world prices for rice and wheat, which are the most important food grains in India in terms of production and

household consumption. These price changes would have stronger effects under a Doha agreement compared to bilateral or regional free trade agreements because Indian tariffs would be lowered toward all trading partners, including the lowest-cost producers. We use the model to probe the differential effects on different types of labor and on households of different social groups, at different income levels, and in rural and urban areas in order to explore the consequences for income distribution and poverty. Although world prices may not be transmitted perfectly to all households, price data for India show a considerable degree of linkage with world prices for rice and wheat (Conforti 2004).[3] In the case of rice, import prices move with world prices and within the domestic market prices are transmitted fairly completely between wholesale and retail and between producer and export prices.

Global agricultural price swings of this magnitude are not uncommon, as seen in Figures 2 and 3. These changes can be caused by an array of factors, including weather, agricultural subsidies, changes in agricultural policy elsewhere in the world, dumping, anticompetitive behavior by private firms with market power, and other causes. In recent years, some agricultural prices have been increasing and may continue to do so in the short to medium term due to increases in demand that have not been matched by supply response. However increased prices are likely to induce supply responses over the medium term, and most economists believe that agricultural prices will continue their long-term declining trend.

[3] Changes in world prices may not be fully transmitted to all producers and households due to market imperfections, poor roads and other causes. However all households are likely to feel some direct effect of world price changes and may also be affected through labor and land markets (Dyer et al 2005, Taylor et al 2003). A reduction in tariffs is likely to increase price transmission (Brooks 2003).

4. Results

We begin our analysis with the impact of changes in the price of rice on the overall Indian economy, including production and private consumption. We then look at the impact on the incomes of households, disaggregated by income level, social type, and location. Finally we examine the impacts on factor markets in order to explore the channels through which the price changes affect poor households' incomes. Specifically, we examine the effects on demand for labor and on the income to factors, with labor disaggregated by education level and social type. We then examine the impact of changes in the price of wheat.

Changes in the world price of rice have strong effects on India. Both a 25 percent and a 50 percent decrease in the price have negative effects on all major components of the macroeconomy, including private consumption, government spending, investment, exports, imports, and total domestic production (Table 4). Interestingly, a 25 percent decrease in price has a negative impact that is more than half as large as a decrease of 50 percent; for most of the macroeconomic measures, the impact is two-thirds or more of the larger decrease. By contrast, increases of 25 percent or 50 percent in rice prices have positive effects on all macroeconomic measures and the increases are larger than the negative effects of corresponding price decreases, except for exports, where a price decline leads to a sharper drop in exports than the increase elicited by a price rise. The relative impact of different price increases also differs from that of price decreases; a 50 percent increase has an impact that is up to three times as large as that of a 25 percent increase.

Turning to the impact on the welfare of Indian households, 78 percent of households experience real income losses from a decrease of either 25 or 50 percent in world rice prices

(Table 5, Figure 4).[4] The distributional impact is regressive. Real income falls for all rural households except the richest 10 percent as a result of either price decrease, with the poorest households losing the most. The losses are most pronounced for disadvantaged groups in rural areas, including "scheduled tribes," "scheduled castes," and "other backward classes." Rice cultivation is an important source of income for most poor rural Indian households, and these results suggest that even moderate declines in the world price of rice would increase rural poverty.

In urban areas, where households are net consumers of rice, the lowest income brackets of disadvantaged groups also experience small income losses. Most urban households feel little impact from the price declines. Only middle- and upper-income households realize gains of 0.1 percent or more.

The likely channel through which the decrease in the price of rice affects poor urban households is the labor market.[5] The drop in rice prices reduces demand for unskilled labor in rice production sharply, by almost 12 percent in the case of a 50 percent decline, and reduces overall demand for labor in the agricultural sector (Figure 5). Displaced rural laborers spill over into urban unskilled labor markets. Although demand for labor increases slightly in manufacturing and services (in response to capital and other factors leaving rice for other sectors), the combined demand in those sectors grows less than the decrease in demand in

[4] Real income in the model incorporates both earning and consumption (price) effects. The change in real income (also called welfare) is calculated as the Slutsky equivalent variation, a measurement of the minimum amount that one who gains from a change would be willing to accept to forgo the change. Other researchers have found that, in general, trade affects households more strongly through the income channel (as producers and wage earners) than through the expenditure channel, as consumers (Hertel and Reimer 2004).

[5] Other recent work demonstrates how agricultural price shocks can be transmitted through labor and land markets. See, e.g., Dyer, Boucher, and Taylor (2005).

agriculture. In the face of increased competition in the unskilled labor market, the incomes of illiterate workers (typically the least skilled) in urban areas decline, as is seen in Table 6.

The distributional impact of an increase in world rice prices on Indian households is progressive and is larger than that induced by price declines (Table 5, Figure 6). The poorest rural households see real income gains of 1.4 to 2.2 percent from a 25 percent price increase and gains of 4 to 6.4 percent from an increase of 50 percent, with the disadvantaged groups gaining most. All rural households except the richest 10 percent would gain. Similarly, labor income increases for rural workers at all education levels and for both men and women; the largest gainers are illiterate workers and disadvantaged groups. The impact of a price increase on the incomes of urban households is more varied. Some poor households gain while others lose. The richest households are net losers. Illiterate urban workers from all disadvantaged groups see their incomes rise, while the results for other urban workers show a mix of small gains and small losses with no consistent pattern.

Changes in the world price of wheat have much more muted impacts on the Indian economy than variations in the price of rice. Most macroeconomic variables are almost unchanged, except for imports, which increase by 1 percent in the case of a 50 percent price decline (Table 7). Effects at the household level are also smaller than for rice. The negative impact of a decrease in world wheat prices on rural households is much smaller than that of a decline in the price of rice, although the pattern is somewhat similar: poor households lose while richer households gain (Table 8, Figure 7). Urban households experience small gains at all income levels. Nonetheless, the overall effect could be to increase poverty, as 92 million rural households in the bottom six deciles of income experience some real income loss, while only 32 million urban households in the same deciles experience income gains (Tables 8, 1).

Increases in the world price of wheat produce small gains for the poorest groups in rural areas and small losses for other rural and all urban households (Table 8, Figure 8).

The increase in agricultural prices as simulated here comes through changes in world market prices, which would have stronger effects on India after it lowers its tariffs. However another study of the proposals for "special products" and a "special safeguard mechanism" in the Doha Round treats price increases as a surrogate for government action to mitigate global price declines through tariff measures (Ivanic and Martin 2006). In our view, an increase in world prices is not equivalent to a policy-induced domestic price change. However if the surrogate approach is taken, the impact of Indian government action to shield its domestic producers from a decline in the world price of rice would unambiguously be to reduce poverty and improve income distribution. In the case of wheat, government action could also have a net poverty reducing effect, although the determination would require a careful analysis of the extent of gains and losses in poor and near-poor households.

5. Results of Other Studies of Trade Liberalization and Poverty

Topalova (2005) conducts an *ex post* study of India's trade liberalization in the 1990s using a difference-in-difference approach to poverty reduction across Indian districts. She finds that regions which were more exposed to trade had less poverty reduction and that the results were driven by reductions in agricultural rather than manufacturing trade protection.

Hertel et al (2008) conduct *ex ante* simulations of trade liberalization across fifteen developing countries (not including India) and find mixed results for poverty. Full global trade liberalization would reduce poverty in a majority (nine) of the countries studied, while a more modest Doha round scenario would see poverty increase in a majority (eight) of countries.

Decomposing the drivers of poverty changes under Doha, the authors find that rich country agricultural reforms increase or leave poverty unchanged in ten countries, while poor country agricultural reforms do so in five countries. The strongest poverty alleviating effects (greater than one percent reduction in the poverty headcount at $1/day) come from increased earnings for agricultural labor in the leading agricultural exporting countries in the study (Brazil, Chile, Thailand) as a result of rich countries' reform of their agricultural policies. These gains are offset to some degree by increases in cost-of-living in those countries as a result of the same reforms, as more food is exported rather than sold at in the domestic market. Agricultural trade reforms by poor countries have more muted effects, with the largest poverty reduction (for Thailand) amounting to about one-third of one percent.

Parikh et al (1995, 1997) and Panda and Quizon (1999) use country-level models of India to probe the effects of trade liberalization on income distribution and poverty. These studies found that, in the short run, trade liberalization adversely affects both growth and equity. In the long run, the liberalization of agriculture and manufacturing both have positive effects on growth, but their distributional effects differ. Liberalization in the manufacturing sector increases the real incomes of all groups, rich as well as poor, in both rural and urban sectors. However liberalization in the agricultural sector benefits only upper-income groups in rural areas and adversely affects all classes in urban areas. The simulation experiments show that the poor would need to be protected by safety net mechanisms, such as an expansion of public employment programs. Trade liberalization coupled with safety nets could lead to a Pareto-improving situation where both rich and poor in both rural and urban areas gain. In the long run, liberalization helps to modestly accelerate GDP growth (by about 0.6 percent) through a more efficient allocation of resources across sectors and through an increase in the real investment

rate. This occurs because the same nominal savings or investment rate leads to a higher real investment rate after the relative price of investment goods falls with the removal of protection on capital goods. The extent of poverty is reduced in the long run.

Anderson, Martin, and van der Mensbrugghe (2006) carry out an analysis of the impact of *full* global free trade in merchandise projected to 2015, using the World Bank's recursive dynamic model, known as LINKAGE. Their results show very muted gains for India (which is the largest country in their "South Asia" aggregation), with real income only 0.4 percent higher in 2015 compared with the baseline case without reform. Agricultural and food products imports rise by 165 percent, while exports rise by just 53 percent, resulting in an output loss of about 3.7 percent. Nevertheless, the authors find that the country's food self-sufficiency levels remain more or less intact and that there are welfare gains for unskilled labor and farmers. These results depend strongly on the assumptions chosen by the authors. In a sensitivity analysis, van der Mensbrugghe, one of the study's authors, finds losses for India (that is, "South Asia") in comparative static results that do not include the dynamic model's assumption that trade will induce additional investment and productivity gains (van der Mensbrugghe 2006a, 2006b). India also loses if standard GTAP assumptions about the elasticity of trade are used, rather than the more responsive elasticities chosen by Anderson, Martin, and van der Mensbrugghe.

Given the relatively high levels of protection in the Indian economy, it might be expected that greater opening to trade would lead to much faster growth for the economy overall, which could contribute to poverty alleviation. However the result of these and other studies, (e.g., Ganesh-Kumar, Panda, and Burfisher 2006, Polaski 2006) show that the gains for the Indian economy from multilateral trade liberalization are surprisingly modest. The distributional and

poverty consequences of trade policy changes that expose the economy to greater price volatility in world agricultural markets thus loom larger against this backdrop.

6. Conclusions

This paper has examined the impact of changes in world agricultural prices on poverty and income distribution in India. We find that a price decrease for rice, a key crop, lowers incomes of the poor, with sharp impacts on the poorest households. The negative effects also carry over to the poorest urban households through the labor market channel. The impacts are of a magnitude that they could potentially offset most of the gains from Doha Round found in other studies. Given the very low incomes of most Indian households and the country's high poverty rate, this suggests that the question of agricultural trade liberalization should be evaluated carefully by the Indian government, as even short-term welfare losses for these households would be highly damaging.

More broadly, our results demonstrate that the impact of world agricultural price changes on incomes and poverty depends on the specific patterns of production and consumption in a country and the specific distribution of poverty. We demonstrate that factor markets, particularly labor markets, must be examined in order to understand the full impact of food price changes on poverty in both rural and urban areas. This focus has been absent in most studies and in popular discourse on the topic.

It is probable that the poverty impact of agricultural price changes will vary among developing countries depending on the distribution of poverty, patterns of agricultural production and consumption, and unskilled labor market characteristics. Therefore generalizations about the impact of agricultural price changes on poverty are likely to be misleading. However, given the

concentration of poverty in rural areas and in agriculture in most developing countries, there should be at least an initial presumption that agricultural price decreases could increase poverty. The presumption currently popular among many commentators and some economists that policy interventions in agricultural prices—such as tariffs and price supports—are likely to be poverty increasing finds little support in careful research and cannot be generalized to all developing countries.

The assumption that the urban poor will always benefit from lower food prices is found in this study to be invalid for the poorest urban households in India. Other careful studies of the distributional impact of agricultural price declines induced by trade policy changes find that the overall impact on poverty can be negative even when the urban poor gain, because of the greater concentration of poverty in the countryside or other reasons (e.g., Ravallion and Lokshin 2004; Hertel and Keeney 2006; Hertel et al. 2006).

There are practical implications for the Doha round negotiations. At least for India, our findings that decreases in the price of rice, and to a lesser extent, wheat, could increase and deepen poverty suggest that the government's concern over potential negative effects of a Doha agreement on poverty and rural development is well founded. The ability to use a "special products" designation and invoke a "special safeguard mechanism" would be necessary instruments for the Indian government to avoid negative effects on the poor in the face of global price declines. Given the varied impact of agricultural price changes on the poor in developing countries with differing patterns of poverty, production and consumption, policy discretion should be left to individual countries to deal with the specific impacts of world agricultural price changes on poverty, rather than having rigid disciplines imposed in advance.

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Appendix A. Description of the India Country Model

The STAGE (Static Applied General Equilibrium) model (CGE) model[6] is a member of the class of single country computable general equilibrium (CGE) models that are descendants of the approach to CGE modeling described by Dervis *et al*., (1982) and models reported by Robinson *et al*., (1990) and Kilkenny (1991). The model is implemented using the GAMS (General Algebraic Modeling System) software. The model is a SAM based CGE model, and the modeling approach has been influenced by Pyatt's "SAM Approach to Modeling" (Pyatt, 1988).

The description of the model proceeds in two stages. The first stage is the identification of the behavioural relationships; while the second stage illustrates the price and quantity systems embodied within the model.

Behavioral Relationships

The behavioral relationships in this model are a mix of non-linear and linear relationships that govern how the model's agents will respond to exogenously determined changes in the model's parameters and/or variables.

Households choose the bundles of commodities they consume to maximise utility where the utility function is a Stone-Geary function that allows for subsistence consumption expenditures, which is an arguably realistic assumption when there are substantial numbers of very poor consumers. The households choose their consumption bundles from a set of 'composite' commodities that are Constant Elasticity of Substitution (CES) aggregates of domestically produced and imported commodities, which are imperfect substitutes. This is the so-called Armington "insight" (Armington, 1969), which allows for product differentiation via the assumption of imperfect substitution (see Devarajan *et al*., 1994). The assumption has the

[6] The STAGE model is fully documented in McDonald 2006, available from the author: smcdonald@brookes.ac.uk

advantage of rendering the model practical by avoiding the extreme specialisation and price fluctuations associated with other trade assumptions. In this model the country is assumed to be a price taker for all imported commodities.

Domestic production uses a two-stage production process. In the first stage aggregate intermediate and aggregate primary inputs are combined using CES technology. At the second stage intermediate inputs are used in fixed proportions relative to the aggregate intermediate input used by each activity, while primary inputs are combined to form aggregate value added using CES technologies, with the optimal ratios of primary inputs being determined by relative factor prices. The activities are defined as multi-product activities with commodities differentiated by source activity. Total commodity demands are determined by the domestic demand for domestically produced commodities and export demand. Assuming imperfect transformation between the domestic and export commodities the optimal distribution between the domestic and export markets is determined using Constant Elasticity of Transformation (CET) functions. The model can be specified as a small country, i.e., price taker, on all export markets, or selected export commodities can face downward sloping export demand functions, i.e., a large country assumption.

The model is set up with a range of flexible closure rules. The base model contains the assumption that all factors are fully employed and mobile; however this assumption is questionable with respect to unskilled labor in India. We vary the standard assumption with an alternative labor market closure for unskilled labor in which the real wage is held constant and the supply of unskilled labor is assumed to be infinitely elastic at that wage. As a result, it is labor supply that clears the market, and any shock that would otherwise increase (decrease) the

equilibrium wage will instead lead to increased (decreased) employment. The results we report are for this alternative.

Price and Quantity Relationships

Figures A.1 and A.2 provide an overview of the interrelationships between the prices and quantities. The supply prices of the composite commodities (PQS_c) are defined as the weighted averages of the domestically produced commodities that are consumed domestically (PD_c) and the domestic prices of imported commodities (PM_c), which are defined as the products of the world prices of commodities (PWM_c) and the exchange rate (ER) uplifted by *ad valorem* import duties (tm_c). Consumer prices for commodities (PQD_c) are defined as supply prices plus (*ad valorem*) sales taxes (ts_c). The producer prices of commodities (PXC_c) are weighted averages of the prices received for domestically produced commodities sold on domestic and export (PE_c) markets. The prices received on the export market are the products of the world price of exports (PWE_c) and the exchange rate (ER) less any *ad valorem* export duties (te_c).

The average price per unit of output received by an activity (PX_a) is defined as the weighted average of the domestic producer prices. The prices of value added (PVA_a), i.e., the amount available to pay primary inputs, are defined as activity prices less indirect taxes (tx_a) and payments for intermediate inputs ($PINT_a$), where the (aggregate) intermediate input prices are defined as the weighted sums of the prices of the inputs (PQD_c).

Total demands for the composite commodities, QQ_c, consist of demands for intermediate inputs, $QINTD_c$, consumption by households, QCD_c, enterprises, $QENTD_c$, and government, QGD_c, gross fixed capital formation, $QINVD_c$, and stock changes, $dstocconst_c$. Supplies from domestic producers, QD_c, plus imports, QM_c, meet these demands. Commodities are delivered to both the domestic and export, QE_c, markets subject to equilibrium conditions that exhaust all

domestic commodity production, QXC_c. Domestic production by commodity is an aggregate of the quantities of that commodity produced by a number of different activities ($QXAC_{a,c}$).

Production relationships by activities are defined as nested CES production functions. The nesting structure is illustrated in lower part of Figure A.2, where, for illustration purposes only, two intermediate inputs and three primary inputs ($FD_{k,a}$, $FD_{11,a}$ and $FD_{l2,a}$) are identified. Activity output is a CES aggregate of the quantities of aggregate intermediate inputs ($QINT_a$) and value added (QVA_a), while aggregate intermediate inputs are a Leontief aggregate of the (individual) intermediate inputs and aggregate value added is a CES aggregate of the quantities of primary inputs demanded by each activity ($FD_{f,a}$).

Appendix B. Description of the Social Accounting Matrix (SAM) and Data for the Model

The Social Accounting Matrix (SAM) reports all the flows of receipts accruing to and expenditures incurred by all the agents in the economy for a particular year. The agents in the economy are typically the production sectors, social groups (households), firms, government and the foreign sector. These flows take place on account of commodity transactions (buying-selling) between the agents for purposes of consumption, intermediate use, investment, etc., and by way of inter-agent transfers. The SAM is constructed in two stages. The first is a 'macro SAM' that presents the aggregates of these flows for the economy as a whole. Next is the 'micro SAM' that disaggregates the commodities, activities, factors and households into their respective components. This top down approach is adopted in preference to the UN System of National Accounts preferred bottom-up method to ensure that the final micro SAM is consistent with the published national accounts aggregates.

The Macro SAM

Table B.1 gives the structure of the macro SAM, and the flow values for the year 1998-99. Most of the data for the macro SAM come from the Input-Output (IO) Table for 1998-99 and from the National Accounts Statistics (NAS), both prepared by the Central Statistical Organization (CSO), Government of India. It must be noted here that the IO Table is balanced and is consistent with the NAS data available at the time of its preparation. However, all the revisions that the NAS undergoes after the preparation of the IO Table are not carried over to the IO Table. Thus, there are some small differences in the macro aggregates between these two sources. Where such differences are observed, we defer to the values in the IO Table due to its internal consistency across its rows and columns. These two data sources are supplemented with data on government transfers from Pradhan et al (2005).

Some of the entries of the macro SAM are derived residually to maintain row – column balance. In the rest of world (RoW) account, data are available for all the row entries, and for all the column entries except capital transfers to RoW. The latter was then obtained residually as the difference between the row total and sum of column entries for which we have data. Next, we worked out the net household savings in the gross fixed capital account row residually as the difference between the column total (for which we had all the information) and the sum of the row entries for which we had data. Factor payments to households, firms and government were also derived sequentially following a similar procedure.

The Micro SAM

The macro SAM gives a snap shot of the economy and also provides several control totals for the micro SAM. The micro SAM distinguishes 115 commodities, 115 activities, 49 factors and 352 households. The 115 commodities and 115 activities directly correspond to the IO Table. With regard to factors, we distinguish 1 capital (non-labor) and 48 labor types based on the following characteristics:

- location (rural / urban)
- social group ("scheduled tribes" / "scheduled castes" / "other backward classes"/ others)
- education level (illiterate / education up to high school / graduates and above)
- sex (male / female).

Households are distinguished into 352 types based on the following characteristics:

- location (rural / urban)
- social group ("scheduled tribes" / "scheduled castes" / "other backward classes" / others)
- region (north / east / west / south)

- eleven mean per capita expenditure (MPCE) classes (the first nine deciles in the sample, and the top decile further split into 91-95 percentile and 96 to 100 percentile).

Database

The data for the micro SAM are from (a) the IO Table mentioned earlier, (b) unit (household) level data from sample surveys on Consumer Expenditure and Employment / Unemployment 55th Round for 1999-2000 carried out by the National Sample Survey Organization (NSSO), (c) Pradhan and Roy (2003), and (d) Pradhan et al (2005). The IO Table gives data on intermediate flows (use matrix), sectoral value added, the commodity composition (make) matrix, and commodity-wise total private consumption and other final demand vectors. Of these, the use matrix, make matrix, and the final demands (except private) are used directly in the micro SAM.

Distribution of Factor Income

The sectoral value added from the IO Table is distributed first into labor and capital (non-labor) based on the labor-capital shares derived from Pradhan et al (2005). The value added accruing to labor is then distributed to the 48 labor types based on information from the NSSO Employment / Unemployment survey. The survey provides information on household characteristics (location, social group, region and mean per capita expenditure), characteristics of each household member (age, sex and education level), employment status (usually employed / unemployed) and for those who are employed, the sector of usual employment (at NIC 5-digit level) and the total wages received during the week preceding the survey. From the unit level data, we first generate the labor types as described earlier. Second, for each labor type the sector of employment was mapped from the NIC 5-digit level to our 115 sector level, and the deployment of each labor type by sector was generated. Third, for each labor type an average daily wage rate was constructed from the data on wages available at the unit level. With the

sectoral employment and average wage information we could obtain sectoral wage income for each labor type. The structure implied by this data was used to disaggregate the total sectoral labor value added from the IO Table across our 48 labor types by adjusting the wage rate for each labor type.

Household Labor Endowment

The household characteristics reported in the Employment / Unemployment survey enables us to construct household groups as defined above. For each of these household categories, we then develop the total endowment of different types of labor from the unit level information. Given the characteristics used to classify labor types, every household category will have more than one labor type. This information on labor endowments and the wage rates obtained above are used to generate total labor income for each household category.

Household Consumption Expenditure

The NSSO Consumption Expenditure provides information on household characteristics (location, social group, region and mean per capita expenditure) and also detailed information on commodity-wise consumptions at the household level. The common information on household characteristics from the two NSSO surveys enables us to use a consistent definition of household categories across both surveys. Thus, for our 352 household categories we develop the commodity-wise consumption expenditures by mapping the detailed commodity list in the survey to the 115 commodities in the IO Table. It is well known that the aggregate total consumption expenditure from survey usually do not tally with the estimates of consumption from the NAS data due to differences in the methodology of the two approaches and their coverage. Since the IO Table is the main basis for the SAM, we use the consumption structure across households from the survey and apply them on the commodity-wise total private

consumption expenditure reported in the IO Table. This enables us to maintain internal consistency in the SAM.

Household Income Expenditure Balance

Thus far we have only labor income and consumption expenditure for each household, which is insufficient to close the income-expenditure accounts for households. Detailed data on savings, transfers, and non-labor income are not available for our household categories. The NCAER-MIMAP Survey (Pradhan and Roy 2003) allows us to compute decile-wise savings / dis-savings rates for rural and urban areas separately. We have assumed that these rates prevail for each decile within rural and urban independent of other household characteristics namely region and social group. Thus we could generate household savings. Total household income was then obtained with certain assumptions on the distribution of direct taxes and transfers. Given this total income and the wage income estimated earlier, income from capital (non-labor factors) was obtained for all the household categories.

Table 1. Distribution of Households in the Indian Population, Total

Household Group	Number	Share
Rural		
Rural "scheduled tribes," income 0-30 percent	8,070,164	4.28
Rural "scheduled tribes," income 31-60 percent	4,119,474	2.19
Rural "scheduled tribes," income 61-90 percent	2,378,644	1.26
Rural "scheduled tribes," income >90 percent	372,694	0.20
Rural "scheduled castes," income 0-30 percent	13,393,888	7.11
Rural "scheduled castes," income 31-60 percent	9,300,193	4.94
Rural "scheduled castes," income 61-90 percent	5,545,583	2.94
Rural "scheduled castes," income >90 percent	923,481	0.49
Rural "other backward classes," income 0-30 percent	17,932,008	9.52
Rural "other backward classes," income 31-60 percent	16,982,923	9.01
Rural "other backward classes," income 61-90 percent	13,312,988	7.07
Rural "other backward classes," income >90 percent	2,697,944	1.43
Other rural, income 0-30 percent	9,042,016	4.80
Other rural, income 31-60 percent	13,205,395	7.01
Other rural, income 61-90 percent	14,608,818	7.75
Other rural, income >90 percent	5,278,772	2.80
Urban		
Urban "scheduled tribes," income 0-30 percent	860,491	0.46
Urban "scheduled tribes," income 31-60 percent	515,517	0.27
Urban "scheduled tribes," income 61-90 percent	341,136	0.18
Urban "scheduled tribes," income >90 percent	77,309	0.04
Urban "scheduled castes," income 0-30 percent	3,736,578	1.98
Urban "scheduled castes," income 31-60 percent	2,110,141	1.12
Urban "scheduled castes," income 61-90 percent	1,110,004	0.59
Urban "scheduled castes," income >90 percent	160,863	0.09
Urban "other backward classes," income 0-30 percent	6,256,092	3.32
Urban "other backward classes," income 31-60 percent	4,850,576	2.57
Urban "other backward classes," income 61-90 percent	3,604,215	1.91
Urban "other backward classes," income >90 percent	730,890	0.39
Other urban, income 0-30 percent	6,114,311	3.24
Other urban, income 31-60 percent	7,802,559	4.14
Other urban, income 61-90 percent	9,314,989	4.94
Other urban, income >90 percent	3,680,458	1.95
All households	188,431,114	100.00

Table 2. Distribution of Rural Households

Household Group	Number	Share
Rural "scheduled tribes," income 0-30 percent	8,070,164	5.88
Rural "scheduled tribes," income 31-60 percent	4,119,474	3.00
Rural "scheduled tribes," income 61-90 percent	2,378,644	1.73
Rural "scheduled tribes," income >90 percent	372,694	0.27
Rural "scheduled castes," income 0-30 percent	13,393,888	9.76
Rural "scheduled castes," income 31-60 percent	9,300,193	6.78
Rural "scheduled castes," income 61-90 percent	5,545,583	4.04
Rural "scheduled castes," income >90 percent	923,481	0.67
Rural "other backward classes," income 0-30 percent	17,932,008	13.07
Rural "other backward classes," income 31-60 percent	16,982,923	12.38
Rural "other backward classes," income 61-90 percent	13,312,988	9.71
Rural "other backward classes," income >90 percent	2,697,944	1.97
Other rural, income 0-30 percent	9,042,016	6.59
Other rural, income 31-60 percent	13,205,395	9.63
Other rural, income 61-90 percent	14,608,818	10.65
Other rural, income >90 percent	5,278,772	3.85
All rural households	137,164,985	100.00

Table 3. Distribution of Urban Households

Household Group	Number	Share
Urban "scheduled tribes," income 0-30 percent	860,491	1.68
Urban "scheduled tribes," income 31-60 percent	515,517	1.01
Urban "scheduled tribes," income 61-90 percent	341,136	0.67
Urban "scheduled tribes," income >90 percent	77,309	0.15
Urban "scheduled castes," income 0-30 percent	3,736,578	7.29
Urban "scheduled castes," income 31-60 percent	2,110,141	4.12
Urban "scheduled castes," income 61-90 percent	1,110,004	2.17
Urban "scheduled castes," income >90 percent	160,863	0.31
Urban "other backward classes," income 0-30 percent	6,256,092	12.20
Urban "other backward classes," income 31-60 percent	4,850,576	9.46
Urban "other backward classes," income 61-90 percent	3,604,215	7.03
Urban "other backward classes," income >90 percent	730,890	1.43
Other urban, income 0-30 percent	6,114,311	11.93
Other urban, income 31-60 percent	7,802,559	15.22
Other urban, income 61-90 percent	9,314,989	18.17
Other urban, income >90 percent	3,680,458	7.18
All urban households	51,266,129	100.00

Note: Data for Tables 1, 2, and 3 are from the "Household Schedule: Consumer Expenditure" in National Sample Survey Organisation, National Sample Survey (55th Round), July 1999-June 2000. The number of households in each category are scaled from the sample to the population level using the multipliers given in the survey.

Table 4. Impact of a Change in the World Price of Rice on India's Economy
(percent change from baseline)

Macroeconomic indicator	World price of rice decreases by 25 percent	World price of rice decreases by 50 percent	World price of rice increases by 25 percent	World price of rice increases by 50 percent
Private consumption	-0.16	-0.24	0.30	0.84
Government consumption	-0.09	-0.12	0.17	0.52
Investment consumption	-0.19	-0.28	0.39	1.20
Absorption	-0.16	-0.24	0.31	0.89
Import demand	-0.88	-1.28	1.82	5.62
Export supply	-0.64	-1.24	0.60	1.08
Total domestic production	-0.12	-0.17	0.23	0.70

Table 5. Impact of a Change in the World Price of Rice on the Real Incomes of Indian Households (percent change in real income relative to baseline nominal income to households)

Household Group	World price of rice decreases by 25 percent	World price of rice decreases by 50 percent	World price of rice increases by 25 percent	World price of rice increases by 50 percent
Rural				
Rural "scheduled tribes," income 0-30 percent	-1.13	-1.65	2.20	6.40
Rural "scheduled tribes," income 31-60 percent	-0.60	-0.89	1.16	3.32
Rural "scheduled tribes," income 61-90 percent	-0.20	-0.29	0.36	0.98
Rural "scheduled tribes," income >90 percent	0.01	0.02	-0.04	-0.17
Rural "scheduled castes," income 0-30 percent	-0.95	-1.40	1.85	5.36
Rural "scheduled castes," income 31-60 percent	-0.76	-1.12	1.49	4.35
Rural "scheduled castes," income 61-90 percent	-0.31	-0.46	0.59	1.69
Rural "scheduled castes," income >90 percent	0.02	0.03	-0.05	-0.19
Rural "other backward classes," income 0-30 percent	-0.78	-1.14	1.50	4.33
Rural "other backward classes," income 31-60 percent	-0.70	-1.03	1.38	4.02
Rural "other backward classes," income 61-90 percent	-0.46	-0.67	0.90	2.64
Rural "other backward classes," income >90 percent	0.00	0.00	-0.01	-0.06
Other rural, income 0-30 percent	-0.73	-1.08	1.41	4.05
Other rural, income 31-60 percent	-0.62	-0.91	1.21	3.49
Other rural, income 61-90 percent	-0.46	-0.67	0.89	2.60
Other rural, income >90 percent	-0.07	-0.10	0.12	0.34
Urban				
Urban "scheduled tribes," income 0-30 percent	-0.12	-0.18	0.20	0.50
Urban "scheduled tribes," income 31-60 percent	-0.04	-0.06	0.05	0.09
Urban "scheduled tribes," income 61-90 percent	0.01	0.01	-0.03	-0.11
Urban "scheduled tribes," income >90 percent	0.02	0.03	-0.05	-0.18
Urban "scheduled castes," income 0-30 percent	-0.10	-0.15	0.17	0.43
Urban "scheduled castes," income 31-60 percent	-0.02	-0.03	0.01	-0.02
Urban "scheduled castes," income 61-90 percent	0.01	0.01	-0.03	-0.13
Urban "scheduled castes," income >90 percent	0.02	0.03	-0.05	-0.17
Urban "other backward classes," income 0-30 percent	-0.02	-0.03	0.01	-0.04
Urban "other backward classes," income 31-60 percent	0.05	0.07	-0.13	-0.42
Urban "other backward classes," income 61-90 percent	0.07	0.10	-0.16	-0.50
Urban "other backward classes," income >90 percent	0.04	0.06	-0.10	-0.31
Other urban, income 0-30 percent	0.03	0.05	-0.10	-0.37
Other urban, income 31-60 percent	0.09	0.13	-0.20	-0.63
Other urban, income 61-90 percent	0.11	0.16	-0.23	-0.72
Other urban, income >90 percent	0.09	0.13	-0.19	-0.58
Total	-0.13	-0.19	0.23	0.64

Table 6. Impact of a Change in the World Price of Rice on the Income to Factors in India
(baseline in billion rupees, percent change from baseline)

Factor	Baseline	World price of rice decreases by 25 percent	World price of rice decreases by 50 percent	World price of rice increases by 25 percent	World price of rice increases by 50 percent
Capital	8483.87	-0.05	-0.08	0.08	0.17
Rural labor					
Rural "scheduled tribes," illiterate males	78.97	-1.01	-1.47	2.03	6.06
Rural "scheduled tribes," illiterate females	60.00	-1.10	-1.60	2.22	6.62
Rural "scheduled tribes," some school males	144.56	-0.91	-1.32	1.82	5.45
Rural "scheduled tribes," some school females	32.82	-0.98	-1.43	1.97	5.90
Rural "scheduled tribes," graduate males	23.59	-0.33	-0.49	0.64	1.83
Rural "scheduled tribes," graduate females	1.75	-1.07	-1.56	2.14	6.37
Rural "scheduled castes," illiterate males	134.00	-0.96	-1.39	1.93	5.76
Rural "scheduled castes," illiterate females	73.52	-1.14	-1.66	2.30	6.87
Rural "scheduled castes," some school males	255.35	-0.79	-1.15	1.59	4.73
Rural "scheduled castes," some school females	37.21	-0.81	-1.18	1.62	4.83
Rural "scheduled castes," graduate males	40.03	-0.44	-0.65	0.87	2.53
Rural "scheduled castes," graduate females	3.74	-0.32	-0.48	0.61	1.73
Rural "other backward classes," illiterate males	184.27	-0.89	-1.30	1.79	5.35
Rural "other backward classes," illiterate female	111.60	-1.00	-1.45	2.01	6.01
Rural "other backward classes," some school males	460.39	-0.69	-1.01	1.39	4.14
Rural "other backward classes," some school females	98.46	-0.72	-1.06	1.45	4.33
Rural "other backward classes," graduate males	85.99	-0.47	-0.70	0.93	2.70
Rural "other backward classes," graduate female	7.32	-0.39	-0.57	0.75	2.16
Other rural illiterate males	123.14	-0.91	-1.32	1.83	5.46
Other rural illiterate females	77.63	-0.86	-1.25	1.72	5.12
Other rural some school males	566.43	-0.72	-1.05	1.44	4.28
Other rural some school females	168.06	-0.63	-0.93	1.26	3.74
Other rural graduate males	222.37	-0.41	-0.60	0.80	2.32
Other rural graduate females	20.41	-0.30	-0.44	0.56	1.59

Table 6. Impact of a Change in the World Price of Rice on the Income to Factors in India (Continued)
(baseline in billion rupees, percent change from baseline)

Factor	Baseline	World price of rice decreases by 25 percent	World price of rice decreases by 50 percent	World price of rice increases by 25 percent	World price of rice increases by 50 percent
Urban labor					
Urban "scheduled tribes," illiterate males	23.41	-0.15	-0.22	0.28	0.80
Urban "scheduled tribes," illiterate females	6.97	-0.34	-0.50	0.68	2.01
Urban "scheduled tribes," some school males	91.50	-0.02	-0.04	0.02	-0.01
Urban "scheduled tribes," some school females	14.84	0.01	0.02	-0.05	-0.21
Urban "scheduled tribes," graduate males	48.78	0.01	0.02	-0.06	-0.27
Urban "scheduled tribes," graduate females	8.68	-0.02	-0.04	0.01	-0.04
Urban "scheduled castes," illiterate males	80.73	-0.08	-0.12	0.14	0.38
Urban "scheduled castes," illiterate females	31.36	-0.22	-0.33	0.43	1.25
Urban "scheduled castes," some school males	247.87	0.01	0.01	-0.04	-0.17
Urban "scheduled castes," some school females	20.94	-0.10	-0.15	0.17	0.43
Urban "scheduled castes," graduate males	67.39	-0.03	-0.05	0.02	-0.02
Urban "scheduled castes," graduate females	6.67	-0.16	-0.24	0.28	0.74
Urban "other backward classes," illiterate males	99.97	-0.05	-0.07	0.08	0.21
Urban "other backward classes," illiterate female	34.42	-0.09	-0.13	0.17	0.48
Urban "other backward classes," some school males	435.56	0.06	0.08	-0.14	-0.45
Urban "other backward classes," some school females	52.79	0.03	0.04	-0.08	-0.27
Urban "other backward classes," graduate males	173.31	-0.04	-0.06	0.04	0.04
Urban "other backward classes," graduate female	22.39	-0.12	-0.18	0.20	0.49
Other urban illiterate males	89.77	0.02	0.02	-0.05	-0.19
Other urban illiterate females	25.08	-0.03	-0.05	0.05	0.13
Other urban some school males	644.03	0.13	0.18	-0.28	-0.88
Other urban some school females	99.96	-0.01	-0.01	-0.02	-0.12
Other urban graduate males	672.88	0.04	0.06	-0.12	-0.42
Other urban graduate females	153.37	-0.08	-0.13	0.13	0.30
All labor	6164.27	-0.36	-0.52	0.70	2.05

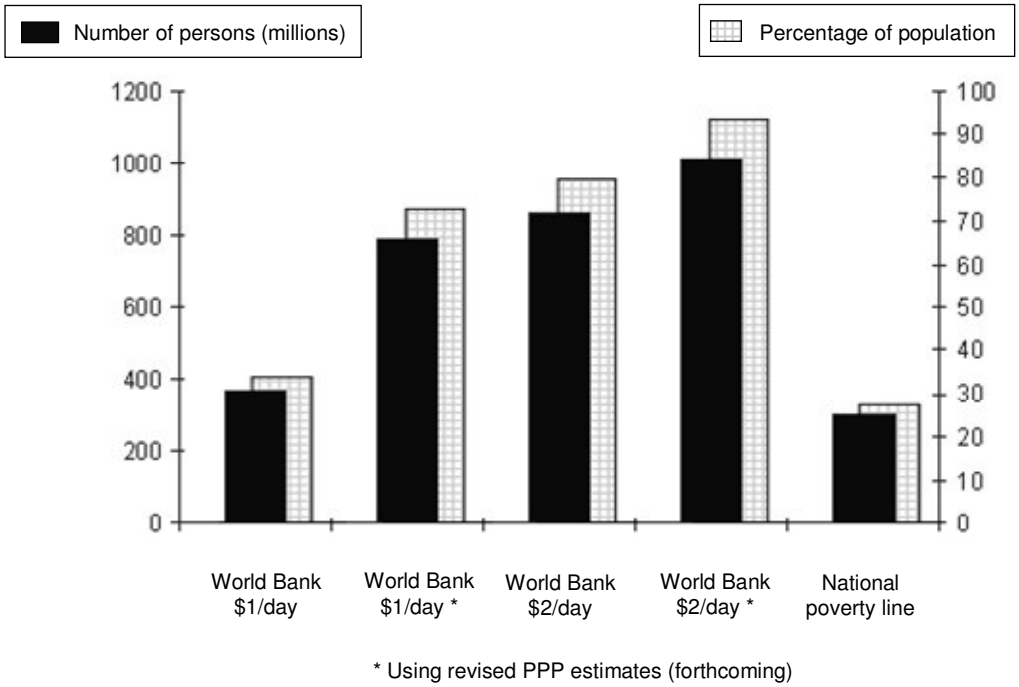
Table 7. Impact of a Change in the World Price of Wheat on India's Economy
(percent change from baseline)

Macroeconomic indicator	World price of wheat decreases by 25 percent	World price of wheat decreases by 50 percent	World price of wheat increases by 25 percent	World price of wheat increases by 50 percent
Private consumption	0.03	0.10	-0.02	-0.03
Government consumption	0.00	0.01	0.00	0.00
Investment consumption	0.00	0.00	0.00	0.00
Absorption	0.02	0.06	-0.01	-0.02
Import demand	0.27	1.00	-0.12	-0.19
Export supply	0.12	0.33	-0.07	-0.13
Total domestic production	0.00	0.01	0.00	0.00

Table 8. Impact of a Change in the World Price of Wheat on Real Incomes of Indian Households (percent change in real income relative to baseline nominal income to households)

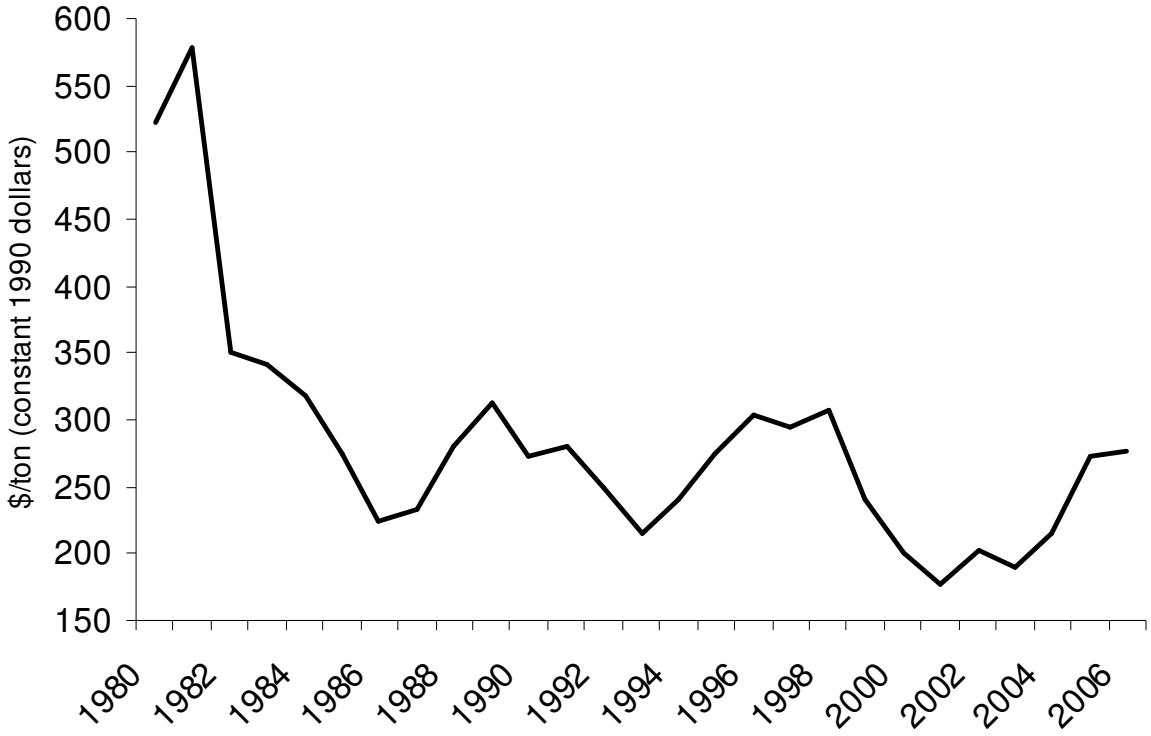
Household Group	World price of wheat decreases by 25 percent	World price of wheat decreases by 50 percent	World price of wheat increases by 25 percent	World price of wheat increases by 50 percent
Rural				
Rural "scheduled tribes," income 0-30 percent	-0.08	-0.22	0.05	0.09
Rural "scheduled tribes," income 31-60 percent	-0.01	-0.01	0.00	0.01
Rural "scheduled tribes," income 61-90 percent	0.04	0.11	-0.02	-0.04
Rural "scheduled tribes," income >90 percent	0.04	0.10	-0.02	-0.04
Rural "scheduled castes," income 0-30 percent	-0.04	-0.10	0.02	0.04
Rural "scheduled castes," income 31-60 percent	-0.04	-0.11	0.03	0.05
Rural "scheduled castes," income 61-90 percent	0.01	0.04	-0.01	-0.01
Rural "scheduled castes," income >90 percent	0.04	0.11	-0.02	-0.04
Rural "other backward classes," income 0-30 percent	-0.02	-0.04	0.01	0.02
Rural "other backward classes," income 31-60 percent	-0.04	-0.11	0.03	0.05
Rural "other backward classes," income 61-90 percent	-0.03	-0.09	0.02	0.04
Rural "other backward classes," income >90 percent	0.03	0.08	-0.02	-0.03
Other rural, income 0-30 percent	-0.01	-0.02	0.01	0.01
Other rural, income 31-60 percent	-0.02	-0.04	0.01	0.02
Other rural, income 61-90 percent	-0.02	-0.06	0.02	0.03
Other rural, income >90 percent	0.01	0.04	-0.01	-0.01
Urban				
Urban "scheduled tribes," income 0-30 percent	0.06	0.18	-0.04	-0.06
Urban "scheduled tribes," income 31-60 percent	0.05	0.14	-0.03	-0.05
Urban "scheduled tribes," income 61-90 percent	0.04	0.11	-0.02	-0.04
Urban "scheduled tribes," income >90 percent	0.03	0.09	-0.02	-0.03
Urban "scheduled castes," income 0-30 percent	0.07	0.19	-0.04	-0.07
Urban "scheduled castes," income 31-60 percent	0.06	0.16	-0.03	-0.06
Urban "scheduled castes," income 61-90 percent	0.04	0.12	-0.03	-0.05
Urban "scheduled castes," income >90 percent	0.03	0.09	-0.02	-0.03
Urban "other backward classes," income 0-30 percent	0.07	0.20	-0.04	-0.07
Urban "other backward classes," income 31-60 percent	0.06	0.18	-0.04	-0.07
Urban "other backward classes," income 61-90 percent	0.05	0.14	-0.03	-0.05
Urban "other backward classes," income >90 percent	0.03	0.09	-0.02	-0.04
Other urban, income 0-30 percent	0.07	0.21	-0.05	-0.08
Other urban, income 31-60 percent	0.06	0.18	-0.04	-0.07
Other urban, income 61-90 percent	0.05	0.15	-0.03	-0.06
Other urban, income >90 percent	0.04	0.12	-0.03	-0.05
Total	0.03	0.07	-0.02	-0.03

Figure 1. Poverty in India, 2004-2005



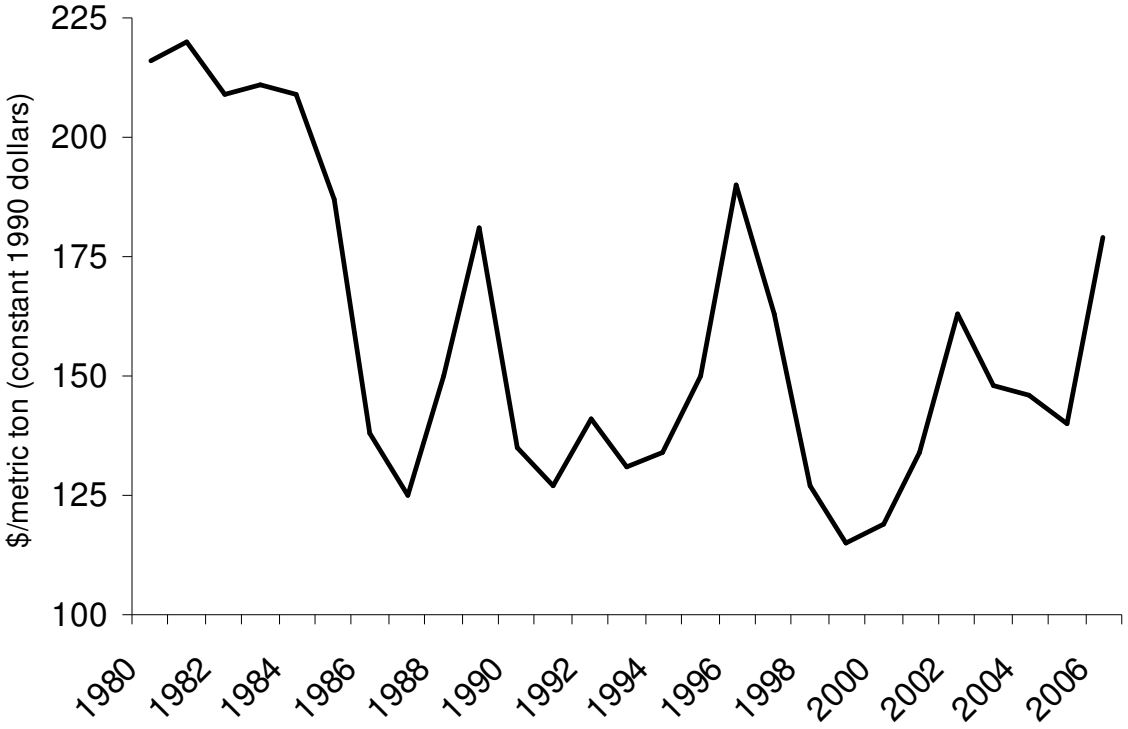
* Using revised PPP estimates (forthcoming)

Figure 2. The World Price of Rice, 1980-2006



Note: Figures given are for Thai 5 percent broken milled rice.
Source: World Bank, "Commodity Markets Briefs: Rice."

Figure 3. The World Price of Wheat, 1980-2006



Note: Figures given are for U.S. hard red winter wheat varieties.
Source: World Bank, "Commodity Markets Briefs: Wheat."

Figure 4. Impact of a Decrease in the World Price of Rice on Indian Households
(percent change in real income relative to baseline nominal income to households)

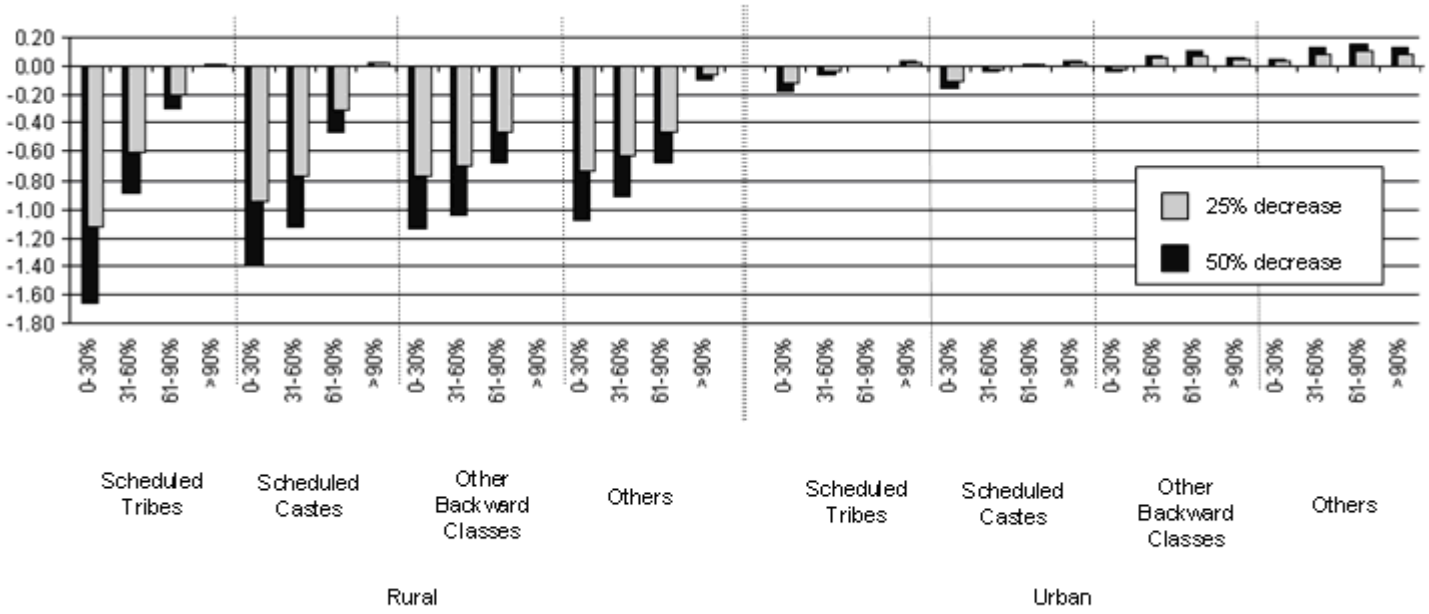


Figure 5. Impact of a Decrease in the World Price of Rice on the Demand for Indian Labor
(percent change in demand for labor relative to baseline)

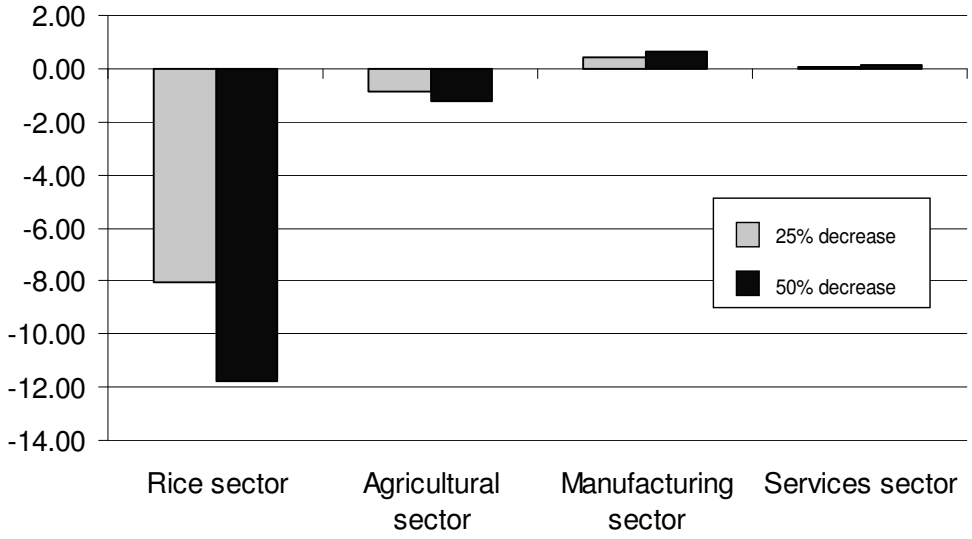


Figure 6. Impact of an Increase in the World Price of Rice on Indian Households
(percent change in real income relative to baseline nominal income to households)

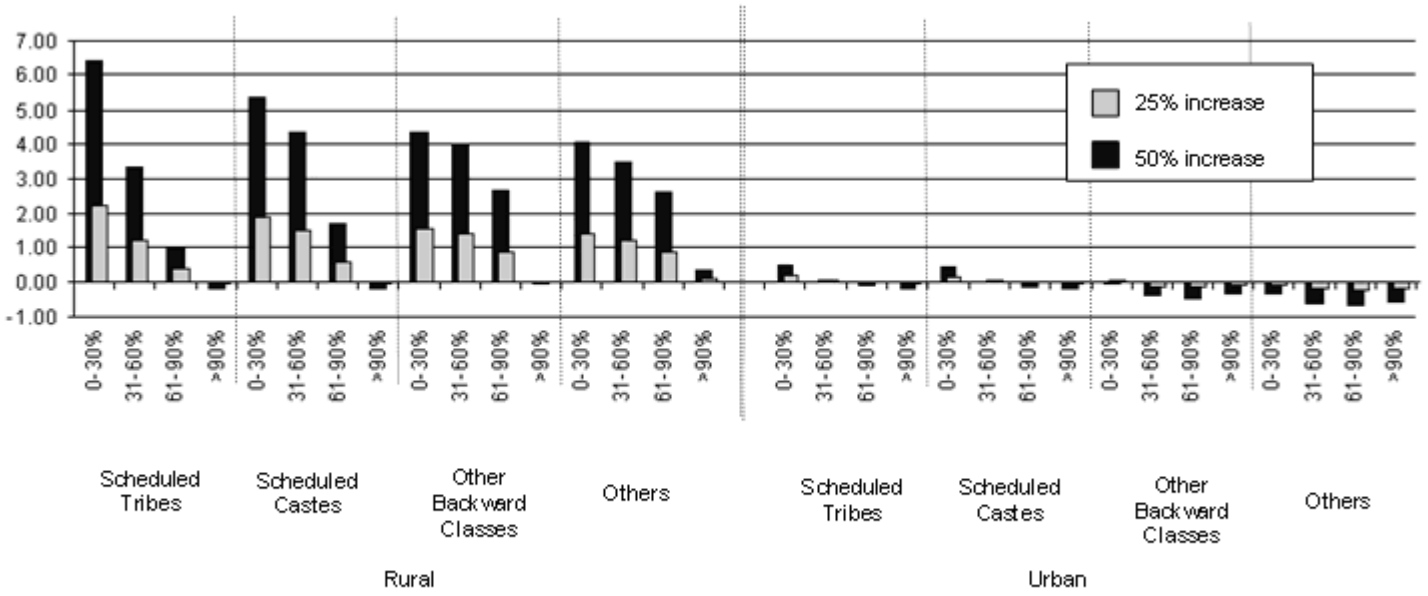


Figure 7. Impact of a Decrease in the World Price of Wheat on Indian Households
(percent change in real income relative to baseline nominal income to households)

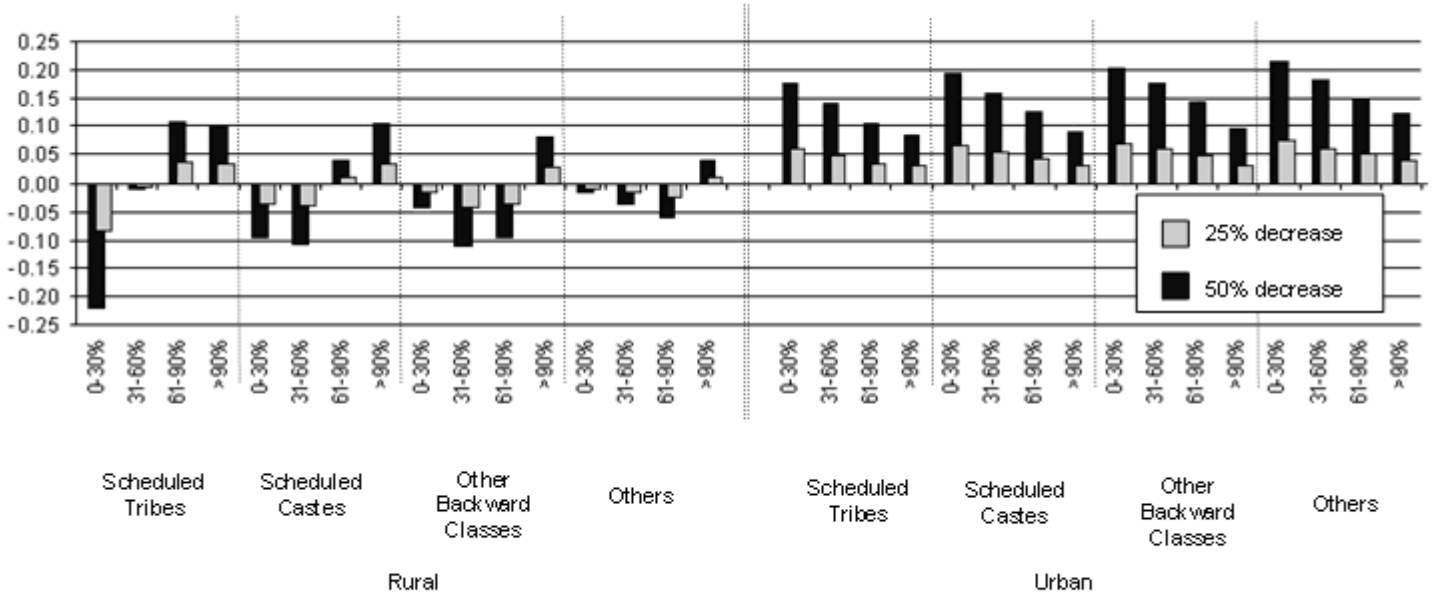


Figure 8. Impact of an Increase in the World Price of Wheat on Indian Households
(percent change in real income relative to baseline nominal income to households)

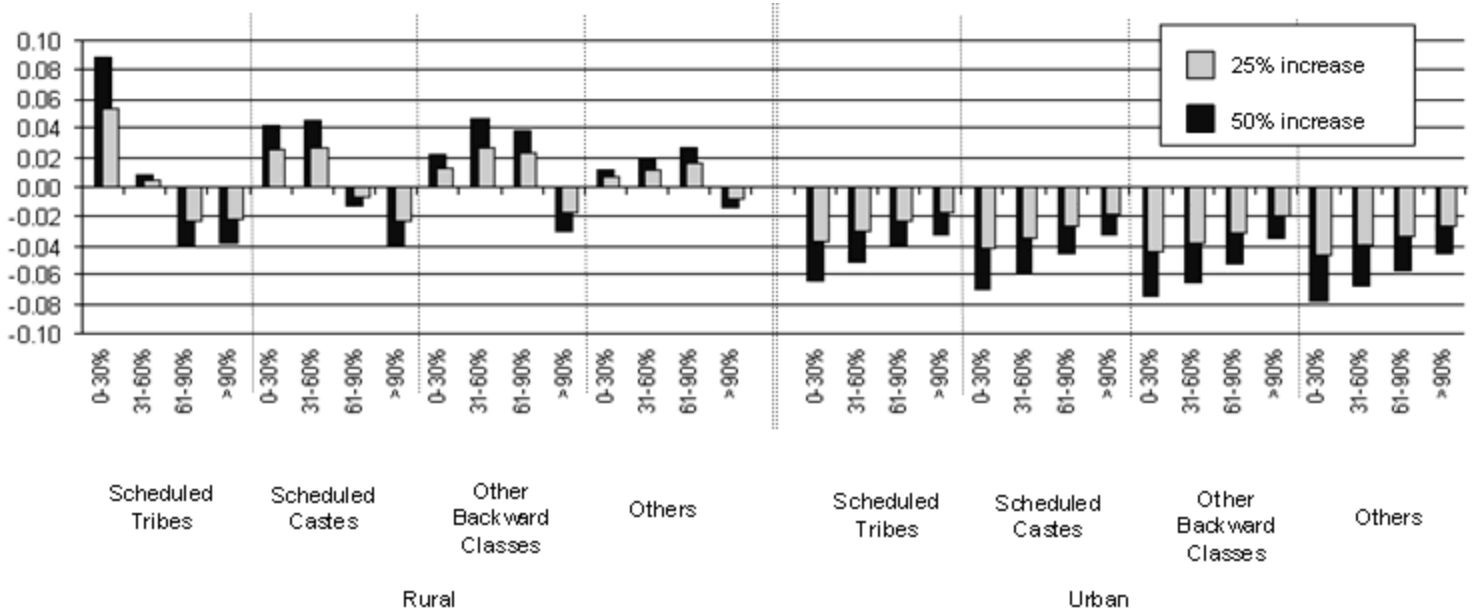


Table B.1. Macroeconomic Social Accounting Matrix for India, 1998-99
(Rupees crore)

	Commod-ity	Activity	Factors	Households	Private Firms	Public Firms	Direct taxes	Import duties	Export subsidies	Domestic net indirect taxes	Govern-ment	Gross fixed capital	Changes in stocks	Rest of world	Total
Commodity	0	1400115	0	1189267	0	0	0	0	0	0	214032	395147	-2125	199691	3396127
Activity	2998241	0	0	0	0	0	0	0	0	0	0	0	0	0	2998241
Factors	0	1598127	0	0	0	0	0	0	0	0	0	0	0	8133	1606260
Households	0	0	1322790	0	0	0	0	0	0	0	118430	0	0	43242	1484463
Private Firms	0	0	40250	0	0	0	0	0	0	0	5722	0	0	0	45972
Public Firms	0	0	15129	0	0	0	0	0	0	0	0	0	0	0	15129
Direct taxes	0	0	0	28317	24529	0	0	0	0	0	0	0	0	0	52846
Import duties	40668	0	0	0	0	0	0	0	0	0	0	0	0	0	40668
Export subsidies	-697	0	0	0	0	0	0	0	0	0	0	0	0	0	-697
Domestic net indirect taxes	111587	0	0	0	0	0	0	0	0	0	0	0	0	0	111587
Government	0	0	36923	0	0	0	52846	40668	-697	111587	0	0	0	0	241327
Gross fixed capital	0	0	168066	266879	21443	15129	0	0	0	0	-99530	0	0	21035	393022
Changes in stocks	0	0	0	0	0	0	0	0	0	0	0	-2125	0	0	-2125
Rest of world	246327	0	23101	0	0	0	0	0	0	0	2673	0	0	0	272101
Total	3396126	2998242	1606260	1484463	45972	15129	52846	40668	-697	111587	241327	393022	-2125	272101	

Note: 1 crore = 10 millions.

Table B.2. Overview of the Indian Economy as Represented in the India Model
(Domestic production by industry in rupees and percent share)

Industry	Rupees (billion)	Share of total economy
Rice	641.60	2.23
Wheat	449.54	1.56
Plant-based fibers	143.72	0.50
Oil seeds	168.08	0.58
Other crops	1,645.26	5.72
Other animal products	558.36	1.94
Coal	246.22	0.86
Oil and gas	131.49	0.46
Dairy products	478.16	1.66
Vegetable oils and fats	376.14	1.31
Other food products	1,613.64	5.61
Textiles	1,067.74	3.71
Wearing apparel	129.81	0.45
Petroleum products	498.72	1.73
Chemicals	1,856.07	6.45
Minerals and metals	1,428.50	4.97
Vehicles and other transport equipment	509.17	1.77
Other manufacturing	2,711.53	9.43
Utilities	1,205.66	4.19
Construction	2,085.46	7.25
Trade and transportation	4,938.71	17.17
Dwellings	805.57	2.80
Public administration	2,151.50	7.48
Services	2,919.27	10.15
Total production	28,759.92	100

Figure A.1: Price Relationships for the Model with Commodity Exports

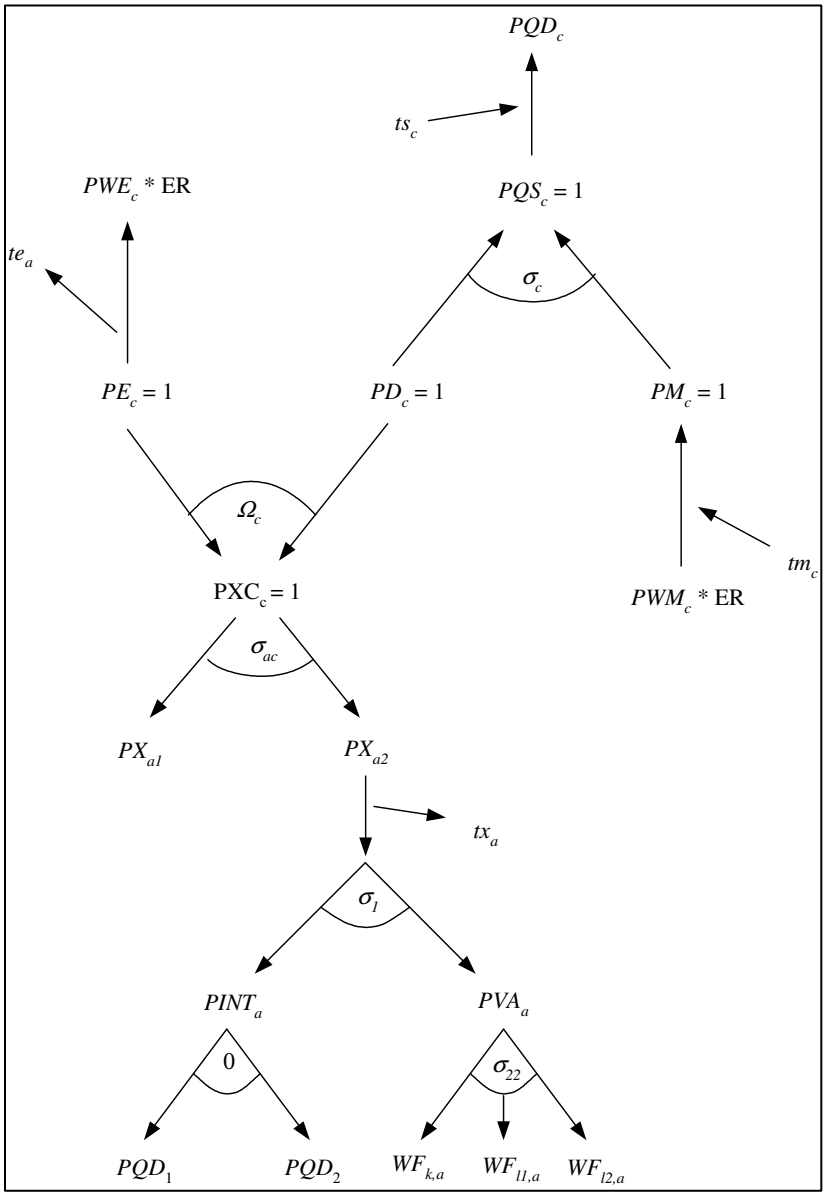


Figure A.2: Quantity Relationships for the Model