Investing in India's Agricultural Markets: A Source of Growth and Equity?

Maurice Landes, Economic Research Service/U.S. Department of Agriculture
Mary E. Burfisher, United States Naval Academy

Introduction

Growth in real incomes in India has accelerated sharply since the early 1990s, when a balance of payments crisis instigated major liberalizing reforms to exchange rate, trade, and domestic regulatory policies. But, despite the resulting expansion in food demand, growth in India's farm sector—which accounts for about 21 percent of GDP and 58 percent of employment—has been slowing, raising concerns about the lagging rural sector and the sustainability of this higher growth path. The successful reforms of the early 1990s enhanced the competitiveness and growth of India's manufacturing and service sectors, but political consensus on a "second round" of reforms to stimulate the rural sector and more directly address the needs of the bulk of India's poor has remained elusive. The major package of credit concessions and outlays for agriculture announced in the 2008/09 government budget is evidence of the concern with farm sector performance.

Policy intervention in India's agricultural sector has been and continues to be substantial, with important government roles in production, marketing, and trade of most major farm commodities. Most obvious—and most studied—have been India's border measures, including relatively high bound and applied tariffs and export controls for farm products, and its burgeoning subsidies on farm inputs and on producer and consumer prices of wheat and rice. Less obvious—and less studied—have been India's extensive array of central and state regulations that affect the movement, storage, marketing, and processing of farm commodities. This regulatory environment has corresponded with relatively low levels of public and private investment in agriculture and agribusiness, as well as a predominately small-scale, nonintegrated, and inefficient marketing system that taxes both producers and consumers of farm products (Landes, 2008; Landes and Gulati, 2004).

In this paper, our goal is to compare and contrast the economy-wide implications of measures to improve marketing efficiency in Indian food and agriculture with more "traditional" reforms to agricultural subsidies and import tariffs. We first devise an approach for analyzing the effects of improvements in marketing efficiency that might be associated with reforms that strengthen the climate and incentives for private investment in agriculture and agribusiness. We then compare these results with the impacts of more "traditional" reform scenarios involving the elimination of agricultural subsidies and tariffs. Because the equity implications of reform are a key consideration for Indian policymakers, we use a framework that disaggregates the household sector between rural and urban, and by income class.

Marketing Efficiency and Agricultural Investment in India

Policies that affect investment in and efficiency of domestic agricultural markets are generally less prominent in analyses of policy reform than are subsidy and border protection policies. However, inefficient marketing systems that tax producers by increasing input costs or placing downward pressure on farm gate prices, and tax consumers by raising retail prices, also represent a potentially important target for reform. In a developing country such as India, where agriculture accounts for a relatively large share of output and employment and food accounts for a relatively large share of consumer budgets, the economy-wide impacts of improved marketing efficiency are potentially more significant than in more developed countries. Improved performance of agricultural markets that reduces food costs for low income rural and urban consumers, who allocate relatively large shares of their budget for food, may also have desirable equity outcomes.

The role of India's marketing costs as a tax on farm output is evident in past studies that have quantified government intervention in Indian agriculture (USDA, 1994; Mullen, et al., 2005). There is evidence that an array of central and state government policies have tended to undermine incentives for private investment by farmers and agribusinesses, contributing to the existence of an inefficient marketing system characterized by small-scale, non-integrated marketing and processing enterprises. Policy measures that potentially interfere with investment incentives in agriculture include:

- *Movement, storage, and pricing restrictions on food commodities.* The Essential Commodities Act allows central and state governments to administratively impose movement, storage, pricing, and quality restrictions on most food commodities. This is a major source of policy risk for agribusiness investment, particularly in larger scale firms operating across state borders.

- *Agricultural marketing restrictions.* State agricultural marketing laws have historically required all farm produce to be sold in government regulated markets and prohibited private investment in markets and vertical coordination or integration between agribusinesses and farmers. These rules are now in the process of reform, but government-regulated markets continue to dominate agricultural marketing throughout the country.

- *Land tenure policies.* In addition to ceilings on land ownership, many states either prohibit or provide insufficient legal protections for farm land rental. This impedes the formation of economic operational holdings and access to credit by farmers.

- *Scale limitations on agribusinesses.* Until the late 1990's most agribusinesses were required to be "small scale industries," restricted to fixed capital assets of no more than Rs10 million (about $247,000). Most scale restrictions are now removed, but agricultural marketing and processing remain dominated by small scale firms.

- *Credit policies.* The high cost and limited availability of credit for agriculture and agribusiness likely restricted new investment during the 1990s. Terms and availability for institutional credit have improved significantly since 2000, but a large share of farmers remains dependent on high-cost credit from traditional moneylenders.

- *Tax policies.* Until 2000, high excise tax rates of 8-16 percent on most processed agricultural products raised costs and deterred investment in food processing, but these tax rates have been reduced sharply during 2001-2007.

This policy environment, while beginning to change, remains unfriendly to private investment in agriculture, particularly larger, integrated agribusiness, and it has corresponded with sluggish investment in Indian agriculture and agribusiness. During 2003-2005, the share of investment in India's Gross Domestic Product (GDP) was 27 percent for the economy as a whole, but just 15 percent for agriculture.[1] Further, while total investment in the Indian economy has been accelerating and grew about 6.5 percent annually in real terms during 1997-2004, investment in agriculture has been slowing and grew just 2.2 percent annually during the same period. As additional evidence of the low levels of investment in Indian agribusiness, the share of crop output that is processed is estimated at just 4 percent (CII and McKinsey, 1997), the average scale of India's soybean processing plants (157 tons/day) is far below that in countries such as the United States and Brazil (Persaud and Landes, 2006), and only 1-2 percent of food products are sold through modern, chain retail establishments (USDA, 2006).

The strong expansion of consumer food demand, along with the regulatory, credit, and tax reform measures implemented since 2001, have improved the climate for investment in Indian agriculture, There is also evidence of a significant increase in new investment in food marketing and supply chains by domestic and multinational firms announced in the last several years (Landes, 2008; Reardon and Gulati, 2008), and in more efficient delivery of inputs and marketing services for farmers. Research on Indian markets indicates that these new private investment could lead to significant gains in market efficiency:

- Vertical integration in India's broiler industry is leading to efficiency gains in production and, particularly, marketing. Variable production costs averaged 10 percent lower, and producer-to-retail marketing margins 60 percent lower, in regions where vertical integration accounted for the largest shares of production (Landes and Persaud, 2003).

- Domestic markets for wheat and rice are inefficient because of large numbers of intermediaries, high physical losses, and disincentives for private investment (World Bank, 1999). The average producer-to-retail markup for unprocessed, ungraded, bulk

[1] Inter-country comparisons are complicated by data limitations and differences in definitions. Using comparable broad definitions of investment in agriculture, India's agricultural investment-to-GDP ratio of 15 percent for 2003-05 falls well below Brazil's 48 percent. Using comparable narrow definitions, India's investment-to-GDP ratio of 7 percent also falls below China's 10 percent (Landes, 2008).

wheat is estimated at 52 percent of the producer price in the private sector, with the producer-to-wholesale markup for the public sector Food Corporation of India (FCI) estimated at 51 percent of the producer price (Gandhi and Koshy, 2007). Reducing the role of the FCI and increased investment by the private sector has the potential to increase marketing efficiency and reduce costs (Srinivasan, et al., 2007).

- Oilseed and product marketing costs in India are inflated because the scale, technology, and capacity utilization rates of oilseed processing plants are well below international standards. Efficiency gains associated with deregulation of marketing and processing of India's major oilseeds have been estimated at 22-44 percent (World Bank, 1997).

- The efficiency of India's horticultural product markets is impeded by high logistical costs, produce wastage rates of 20-40 percent, and low domestic quality standards. India growers, on average, receive 12-15 percent of the retail price of horticultural produce, compared with 30-40 percent in the United States, despite the fact that little value addition occurs in the Indian market (World Bank, 2007).

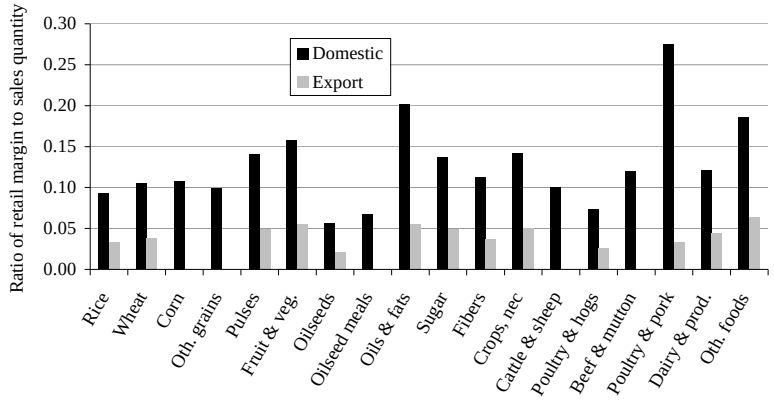
Estimated Marketing Margins in Indian Agricultural and Food Retailing and Production

Marketing margins are the costs of wholesale and retail trade services incurred in bringing domestically-produced goods from the producer to the point of retail sale. In India's food markets, the marketing chain typically consists of a primary market, where farm producers sell their product; wholesale markets, where wholesalers who purchase from primary markets sell to processors and retailers; and retail markets, where retailers sell to consumers. The costs of these wholesale and retail marketing services are embedded in the retail prices paid by firms for intermediate inputs; by households for domestic private consumption, by government and investors; and for exports.

In this paper, we focus on two aspects of marketing margins in Indian food and agriculture. First are the marketing margins used to bring domestically-produced agricultural and food products from the farmgate or food processor to domestic and export retail sales. We estimate these *retail food marketing margins* by commodity for domestic and export sales of agricultural and food items using multiple sources.[2] Measured as a ratio of retail margin services to quantity of food and agriculture sold, estimated domestic retail margins in India are highest for poultry and pork, oils and fats, other processed foods, fresh fruits and vegetables, and pulses (fig. 1). The estimated retail marketing margins for India's export sales are highest for fresh fruits and vegetables, other processed foods, pulses, and crops not elsewhere classified.

[2] The data used in this study are drawn from the Global Trade Analysis Project (GTAP), version 6.1 for 2001, and Saluja and Yadav (2006), who developed a social accounting matrix for India for 2003/04. Author calculations to develop estimated marketing margins are described in the Appendix.

Figure 1. Estimated food retail marketing margins in India



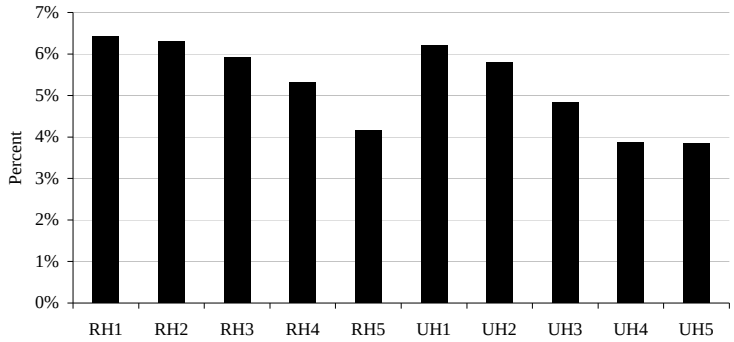
Source: Saluja and Yadav, 2006; GTAP v.6; and author calculations.

Retail marketing margins influence retail prices directly by increasing the cost of foods relative to the producer price. They influence retail prices indirectly by affecting producer input costs—since producers pay retail marketing margins on their food and agricultural intermediate inputs—and the producer price set for products in a competitive market. Increased retail marketing efficiency should lower retail prices and stimulate increased demand, creating upward pressure on producer prices. At the same time, lowering the costs of production should create some downward pressure on producer prices.

In addition to the retail marketing margins that agricultural and food producers incur when they purchase agricultural and food inputs, they pay for marketing services embedded in their purchases of all other types of inputs, such as fertilizer and chemicals. The efficiency of marketing services for these inputs directly affects input prices and farmers' costs of production. To capture these marketing margins, we estimate *agricultural producer marketing margins.* These marketing margins are a residual that includes all wholesale and retail services required in agricultural and food production activities except those associated with their purchase of food and agricultural inputs. This is an aggregate bundle of marketing margins that we do not describe on a commodity basis. These marketing margins are an intermediate input cost; increased marketing efficiencies related to firm purchases of non-agricultural inputs should create downward pressure on both producer and retail agricultural and food prices.

Retail marketing margins for agricultural and food products in India account for a substantial proportion of household expenditure. Retail food marketing margins comprise an estimated 5 percent of aggregate Indian household expenditure on all goods and services. The expenditure share is highest for lower-income households (fig. 2). These households tend to purchase primary products with relatively low retail trade margins, but food accounts for a larger share of their expenditure bundle compared to higher-income households.

Figure 2. Food retail margins as share of household consumption expenditure



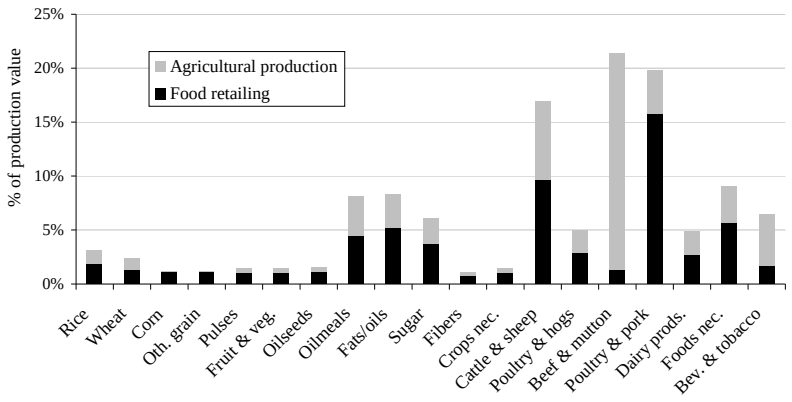
Source: Saluja and Yadav, 2006; GTAP v6; author calculations.

On the production side, we estimate that marketing margins associated with firm purchases of agricultural inputs account for 2 percent of the value of total food and agricultural production (fig. 3). Sectors that have relatively high marketing expenditures include cattle and sheep, poultry meat and pork, oilmeals, fats and oils, processed foods, and sugar. Both agricultural retail and producer marketing efficiency gains should affect sectors differently depending on their utilization of each type of marketing service, with the most potential for lowering production costs and retail prices by margin-intensive commodities.

India's Farm Subsidies and Tariffs

The cost of India's major agricultural input subsidies on electrical power, fertilizer, and irrigation water has grown about 6 percent annually in real terms since 1990, reaching nearly 500 billion rupees (about $10 billion) in 2002/03 (fig. 4) (Mullen, et al.; Gulati

Figure 3. Marketing margins as share of production value in India



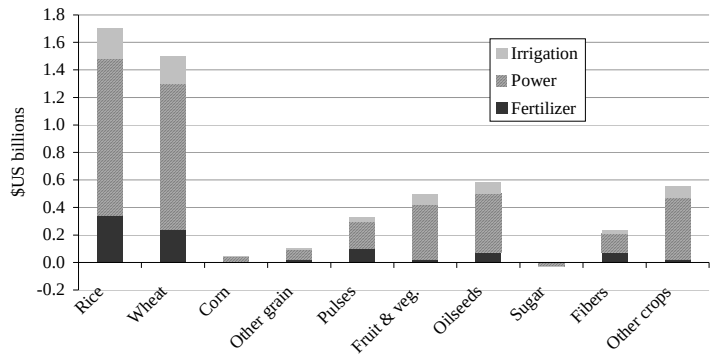
Source: Saluja and Yadav, 2006; GTAP v.6; and author calculations.

and Narayanan). The cost of providing free or subsidized (depending on the State) electricity for agriculture accounts for more than two-thirds of total input subsidies, as well as most of the growth since 1990. Irrigation is a key factor in boosting crop yields, but this policy is also now widely acknowledged to be promoting inefficiency in water use and over-pumping of groundwater. Fertilizer subsidies are provided to farmers in the form of price subsidies for domestic and imported fertilizers, and to the fertilizer industry in the form of preferential prices to offset the losses of higher-cost plants. The portion of the fertilizer subsidy going to farmers amounted to about Rs70 billion ($1.4 billion) in 2002/03, and has tended to decline since the mid-1990s. Subsidies on irrigation water were about Rs60 billion ($1.2 billion) in 2002/03, but have shown little growth.

The rising outlays on input subsidies, which were equivalent to about 11 percent of total agricultural output in 2002/03, are of growing concern for Indian policy makers. By comparison, public investment in agriculture and agricultural infrastructure amounted to just 5 percent of agricultural GDP in 1999-2000 (the most recent period available), and has shown relatively sluggish real annual growth of less that 1 percent since 1990. Although reform of India's subsidy policies would potentially make available more public resources for productive investments in irrigation, research, and market services and infrastructure, it has proven difficult the withdraw the subsidies because of their popularity with rural voters and, in the case of power and water subsidies, the state government's that administer them.

The Government of India has also been incurring substantial and rising budgetary costs for operating the system of minimum support prices (MSPs), public distribution, and storage for wheat and rice. The real cost of what is called the "food grain subsidy" has climbed steadily since the late 1990s, reaching an average of Rs242 billion ($5.5 billion) during 2004/05-2006/07 (Source: Government of India, 2008). Rising costs have stemmed from increased government procurement and storage costs associated with defending higher support prices, and with the introduction new and more highly subsidized distribution programs for poor and disadvantaged groups.

Figure 4. Major Indian crop input subsidies



Sources: GTAP v.6. and author calculations.

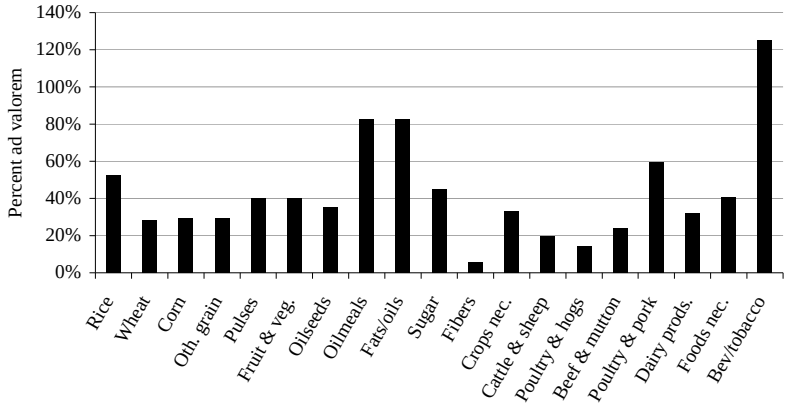
Despite these substantial and rising costs, the food grain subsidy is not specifically included in the data and subsidy reduction scenario used in this study for two reasons. First, the system of supporting MSPs is combined with border policies, such as export restrictions, and domestic measures, such levies on rice millers and grain movement restrictions, that can also tax producers. Calculations of producer subsidy equivalents (USDA, 1994) and producer support estimates (Mullen, et al.) that incorporate careful comparisons of world prices and Indian domestic prices show that these policies net out as subsidies in some years and taxes in others. According to this evidence, there is no clear rationale for characterizing the bundle of expenditures and policies called the food grain subsidy as a subsidy (or tax) on producers. Second, India's domestic marketing costs are an important factor in assessing levels of market price support, and the impacts of these costs are already being studied separately.

Agricultural Tariffs

India completed the elimination of quantitative restrictions on agricultural imports in 2001, but maintains relatively high bound tariffs on most agricultural commodities (fig. 5). Reductions in India's agricultural tariffs have been an important target of the United States and other trading partners in bilateral and multilateral settings, including the current Doha Round.

India remains reluctant to commit to reducing bound agricultural tariffs that afford protection to its large number of small-scale farmers and agribusinesses. However, the Government has made unilateral reductions in applied rates to facilitate imports and contribute to increased price stability for commodities in short supply, including pulses, vegetable oils, and, most recently, wheat (Landes, 2008). Further, there is evidence that reductions in at least some currently prohibitive tariffs could yield significant boost to industries, such as broiler production and oilseed processing, that lack access to

Figure 5. Indian applied agricultural import tariffs



Sources: GTAP v.6.

raw materials, and to producers who are now isolated from world market prices (Persaud and Landes; Landes and Persaud).

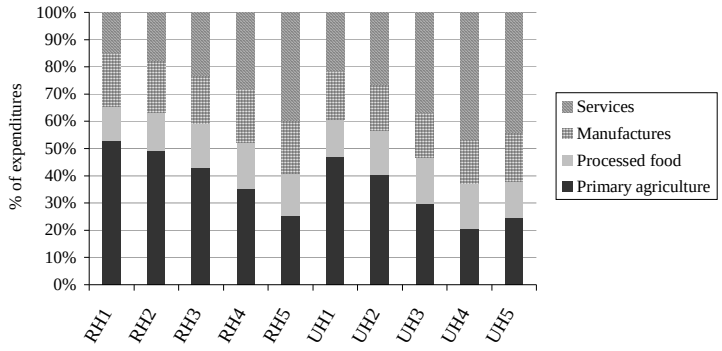
Household Differences in India

The large shares of income, employment, and consumer expenditure associated with food and agriculture in India suggest significant potential for economy-wide impacts from measures that affect agricultural costs and prices through changes in marketing efficiency, farm subsidies, or import barriers. The aggregate and distributive outcomes of such changes will also be influenced by the economic diversity of Indian households. Of most concern is whether any households may stand to lose from a policy change, or if new policies may tend to yield benefits to poor households. To permit exploration of these distributional issues in our analysis, we draw on a database developed by Saluja and Yadav (2006) to disaggregate our GTAP data on private consumption into ten household types. We define five urban (U) and five rural (R) households and 5 income categories: abject poverty (R1, U1), poverty (R2, U2), middle income (R3, U3), upper income (R4, U4) and high income (R5, U5).

Household Expenditures on Food and Retail Services

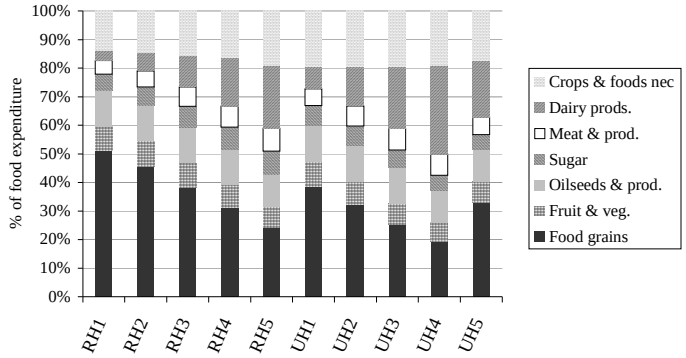
Expenditures on food, comprised of primary agricultural products and processed foods, accounts for 47 percent of India's private consumption expenditure on goods and services (excluding savings and taxes). In general—and as expected in a developing country like India—rural households spend a larger share of income on food than urban households, and poorer households spend proportionately more on food than do wealthier households in both rural and urban areas (fig 6). Also as should be expected, the composition of food expenditures varies across income. In general, poor households consume more whole grains and other unprocessed agricultural products than high income households. At higher incomes, households have greater consumption of dairy, poultry and other processed foods, as opposed to primary agricultural products (fig. 7).

Figure 6. Expenditure shares for Indian households



Sources: Saluja and Yadav, 2006; GTAP v.6.

Figure 7. Indian household foodbasket shares



Sources: Saluja and Yadav, 2006; GTAP v.6.

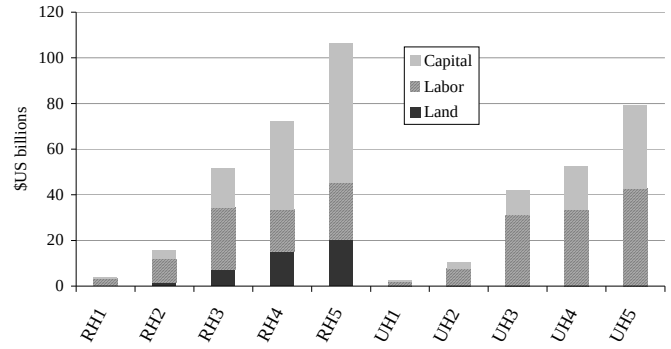
Consistent with the pattern of consumption for higher-value and processed foods, the proportion of food expenditures spent on food retail marketing services tends to rise slightly with household income. For all households, expenditure on retail food marketing services is about 11 percent of the food budget. Overall, food retail marketing services account for 5 percent of household spending on total goods and services. But, for the poorest rural and urban households, retail margins account for 6 percent of total consumption expenditure compared with 4 percent for the wealthiest rural and urban households.

These household expenditure patterns confirm that policy changes that affect food prices can, other things being equal, be expected to have the largest impacts on lower income and rural households, because food is a large share of their budget outlay. They also confirm that, because of dietary variation among households, changes in relative commodity prices that might be associated with alternative policies can lead to differential impacts on different types of households. Finally, the expenditure patterns suggest that changes in the cost of retail services should tend to have large impacts on higher income households because they consume retail service-intensive foods.

Sources of Household Income

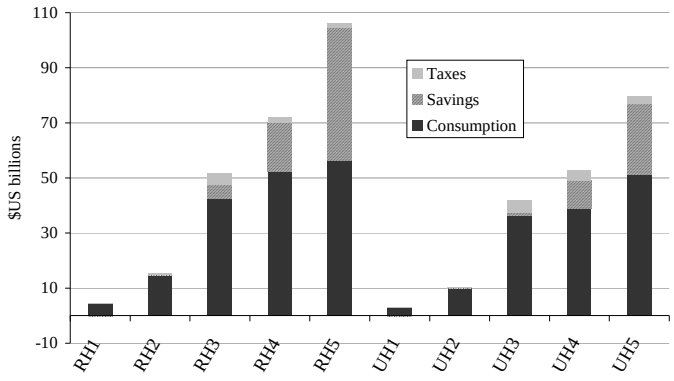
Household level impacts of policy change also depend on differences in the sources of income—returns from land, labor, and capital—for various types of households. Unsurprisingly, the Indian data indicate that wages are the more important income source for poorer households, but the role of capital and land-based earnings rises with income (fig. 8). Household savings and tax rates also differ substantially across Indian households. Savings rates are either negative or negligible in lower income rural and urban households, but rise with income: the highest income rural (R5) and urban households (U5) save 33 percent and 23 percent of their respective after-tax incomes (fig 9). Taxes (including both direct and indirect taxes) are relatively small for all Indians, but tend to be highest for middle income rural and urban households.

Figure 8. Sources of income for Indian households



Sources: Saluja and Yadav, 2006; GTAP v.6.

Figure 9. Indian household consumption, savings, and taxes



Sources: Saluja and Yadav, 2006; GTAP v.6.

Differences among Indian households in the sources and uses of income can be expected to affect the distributive effects of changes in marketing efficiency or other policies across household types. Changes is wage incomes are likely to have the most impact on lower income rural and urban households, while changes in returns to capital -and to land—will be felt mostly by higher income households. Changes in tax and savings components of household expenditure are relevant not only because of their immediate distributive impacts, but because they can lead, in turn, to changes in private and public savings and investment. In India, policy changes that tend to boost incomes for higher income households will tend to increase national savings and investment, while boosting income in lower income households will tend to raise consumption. The model used in this study is not dynamic and will not account for the future impacts of any changes in current savings and investment by households. However, changes in current household savings and investment are important to consider in evaluating the results because of the implications for future periods.

The Potential Impacts of Marketing Efficiency Gains

To analyze the implications of gains in marketing efficiency, and to compare them with the impacts of subsidy and tariff reform scenarios, we develop a single-country, computable general equilibrium (CGE) model of India (see Appendix for a detailed description). We use the IFPRI standard model, which specifies retail marketing margins (Lofgren, et al., 2002). The model defines a fixed input-output quantity ratio between retail marketing services and sales of domestically-produced food and agricultural goods in domestic and export markets. The retail price for food and agricultural products is defined as the sum of the producer commodity price plus the price of the marketing margin. Any change in the cost of retail marketing services therefore affects the retail price, and through the demand response and changing input costs, may then impact the producer price.

The model is used first to explore the economy-wide impacts of two marketing efficiency scenarios: 1) efficiency gains in retail food marketing margins, which refer to the wholesale and retail trade services used in moving domestic agricultural and food production from the producer to the retail market, and (2) efficiency gains in agricultural producer marketing margins, which refer to wholesale and retail trade services for nonagricultural products, such as fertilizer and chemicals, used as intermediate inputs in the production of agricultural commodities and foods.

For both scenarios, we define efficiency gains as total primary factor productivity growth of 50 percent, implying that the same quantity of labor and capital inputs used to produce marketing services now generates 50 percent more output. Thus, the costs of retail and wholesale marketing services decline. We use 50 percent as an illustrative productivity increase that might be associated with increases in investment, scale, integration, and technology in Indian agribusiness and food marketing, and in the supply of nonagricultural production inputs to farmers and processors. Although it is reasonable to expect that the scope for efficiency gains varies by commodity sector, for simplicity—and due to lack of good detailed information by sector—we assume the same productivity gain across all sectors. A 50-percent increase in productivity may not be feasible in all sectors, but the anecdotal information derived from studies of India food grain, oilseed, poultry, and fruit and vegetable industries suggest that it is a plausible overall average. The model solves for a long-term outcome, after an adjustment of about a decade. From this perspective, the 50-percent gain translates to annual productivity growth in agricultural marketing of about 4.5 percent over 10 years.

Aggregate Impacts

Both scenarios, and particularly the retail marketing scenario, lead to gains in real gross domestic product (GDP), reflecting the increased productivity of India's fixed aggregate factor supplies due to more efficient agricultural markets (table 1). The retail scenario also generates a substantially larger increase in real household consumption—a welfare indicator that accounts for changes in the quantities of household consumption valued at base period prices. Both scenarios—and particularly the retail marketing scenario—also

Table 1. Aggregate impacts of agricultural marketing efficiency gains in India

Variable	Increased marketing efficiency scenario	
	In food retailing	In agricultural production
	Percent change from base	
Real GDP	1.0	0.2
Real household consumption	1.4	0.2
Real investment demand	0.4	0.1
Government revenue	1.0	0.2
Producer price index	0.4	0.0
Land rents	5.6	0.7
Wages	1.6	0.2
Capital rents	0.1	0.0
Exports	0.7	0.1
Agricultural exports	3.9	1.0
Imports	-0.8	-1.4
Agricultural imports	-37.2	-36.6
Exchange rate - rupees/$	0.7	0.1

generate increases in investment that could lead to future increases in output and consumption, although these dynamic impacts are not captured in the model. At the aggregate level, the scenarios have negligible impacts on producer prices, but implications for prices become more significant when the focus shifts to commodity sector impacts.

In both scenarios, increased GDP leads to more government tax revenues. More efficient markets and higher aggregate output boost both agricultural and total exports, as well as reduce imports. Given our assumption of a fixed trade balance, these shifts lead to appreciation of the real exchange rate.

Wages and land and capital rents increase in both scenarios, driven by higher demand and the assumption that labor and the other primary factors are fully employed in all scenarios. With this framework, changes in industries' demand for factors of production—labor for example—lead to a new equilibrium outcome in which any workers who lose employment become reemployed in other industries, while the economy-wide wage adjusts to clear the labor market. In fact, particularly in the case of the labor market, there is substantial unemployment and underemployment in India. Therefore an alternative interpretation of the results is that the upward pressure on wages instead implies an increase in employment.

Agricultural Sector Impacts

The two scenarios differ significantly in their impacts on producer and consumer prices for agricultural and food products (table 2). The retail food marketing efficiency scenario tends to result in larger price impacts than the producer scenario because producer-to-consumer marketing accounts for a comparatively larger component of economic

Table 2 . Price effects of agricultural marketing efficiency gains in India

Selected sectors	Increased marketing efficiency			
	In food retailing		In agricultural production	
	Producer price	Consumer price	Producer price	Consumer price
	Percent change from base			
Rice	1.2	-0.8	-0.1	-0.1
Wheat	1.8	-0.5	0.0	0.0
Corn	2.2	-0.2	0.2	0.2
Fruit,veg.	2.3	-1.0	0.2	0.2
Oilseeds	2.3	1.0	0.2	0.2
Oilmeals	0.5	-0.4	-0.7	-0.4
Oils, fats	0.4	-2.1	-0.6	-0.3
Sugar	1.0	-1.8	-0.4	-0.4
Fibers	2.4	-0.1	0.2	0.2
Poultry & hogs	2.6	0.9	-0.1	0.0
Poultry & pork	2.7	0.6	0.1	0.1
Dairy products	1.9	-0.7	-0.2	-0.2
Food products nec	-0.1	-4.0	-0.7	-0.8
Agric. trade	-22.5	1.7	-22.5	-0.6
Food trade	0.9	-22.6	0.1	-22.2

activity. And, by contrast with the producer scenario, producer prices for agricultural and food products tend to rise and consumer prices tend to fall. The reduced marketing costs between producers and consumers lead to lower consumer prices and increased demand for most agricultural and food products. In this scenario, the efficiency gains in retail marketing are shared between producers and consumers.

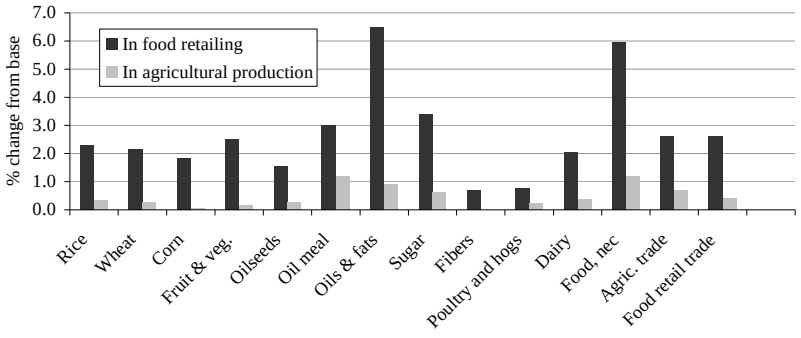
The assumed 50-percent productivity gain in the supply of trade services used to provide non-agricultural inputs to agricultural and food producers results in a new equilibrium price for these services about 22 percent below the base price. When producer and processor costs of production are reduced because of lower-cost marketing services, producer and consumer prices for many agricultural and food product categories fall, although, in some cases, the impacts of cost reductions are offset by increased demand. Producer and consumer price declines are generally proportional to the initial size of estimated marketing margins.

Consistent with the price impacts, both marketing efficiency scenarios result in production gains for agricultural and food products, with the retail marketing efficiency scenario having substantially larger impacts (fig.10). In each case, the largest production gains tend to be in categories such as oilseeds and products, sugar, dairy, and processed products (food, nec), with relatively high current marketing costs.

Distributional Impacts Across Households

In this analysis, the distribution of impacts across households hinges on how changes in returns to land, labor, and capital affect earnings by rural and urban households at different income levels, and how price changes affect the costs of the bundles of goods

Figure 10. Production impacts of marketing efficiency gains in India

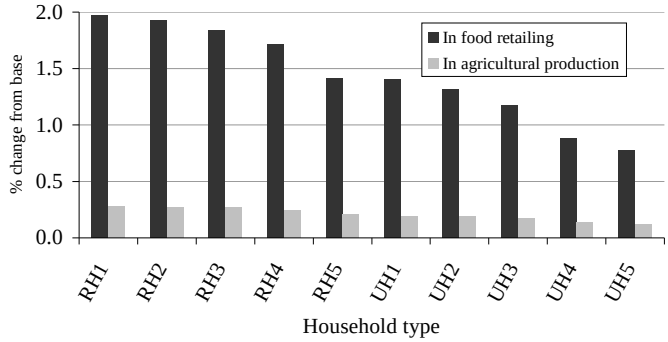


and services purchased by those households. All households benefit in both scenarios. As with the aggregate results, the retail food marketing efficiency scenario has the most impact on household incomes and consumption.

Income changes are proportional to changes in consumption, given the fixed savings and tax rates assumed in our model. Household income and real consumption gains in both scenarios tend to favor rural and poor households (fig. 11). The increase in land returns relative to other factors tends to favor rural households; the increase in wages relative to capital returns tends to favor poorer households.

From the consumption side, lower-income households benefit most from the effects of retail food marketing efficiency gains, which reduce the retail prices of most food items, because they allocate a larger share of their expenditures to food. Higher income households also benefit from retail marketing gains because they tend to spend more than lower income households on foods that use larger amounts of marketing services, such as dairy products and poultry.

Figure 11. Household real consumption impacts of increased marketing efficiency scenarios in India



Lower-income households also benefit most in from improved marketing efficiency in agricultural production, in part because of the reduced retail price of rice—a staple food with a large budget share in their expenditure baskets. Higher income households benefit from the decline in the price of dairy products, a large budget item in their food basket. The retail prices of many other food items increase as a result of higher incomes and demand.

Marketing Productivity Gains vs Reform of Agricultural Subsidies and Tariffs

Reform of India's agricultural subsidy and tariff policies have been topics of debate by Indian policy makers and trade partners since at least the early 1990s. Rising subsidy outlays are often criticized for causing factor market distortions and diverting public resources from productive investments, but have been sustained and even enlarged because of concerns with the welfare of India's many small-scale farmers. High tariffs are challenged in the current multilateral negotiations and elsewhere for imposing high costs on consumers and hindering longer term competitiveness, but liberalizing reforms are strongly resisted…also largely because of concerns with farmer welfare. In some cases, including recent studies by Polaski, et al. (2008) and Ganesh-Kumar, et al. (2006), research has lent support to the view that the benefits to India from participating in a global reform agenda could be limited, while the social costs could be significant.

Here, we compare the potential impacts of measures to increase agricultural marketing efficiency with those of policies to eliminate agricultural subsidies and tariffs. The goal is to assess how aggregate, commodity, and household impacts compare across these policy options, and the extent to which they may tend to have similar or offsetting welfare implications. We use the same model formulation and database employed earlier, including the GTAP data for India agricultural subsidies and import tariffs for 2001. The subsidy reform scenario simulates removal of all agricultural input subsidies, and the tariff reform scenario simulates the removal of all agricultural tariffs.

Impacts of Subsidy and Tariff Removal

With the removal of production subsidies, expenditure in the economy shifts from private consumption to investment as public savings rise (table 3). Higher prices for food and agricultural commodities—particularly wheat and rice which receive the bulk of subsidies—reduce demand for these goods and contract farm output, in turn reducing employment, economy-wide factor incomes, and aggregate consumer expenditure. However, the substantial government savings from eliminating subsidies boosts national savings and investment, thus improving prospects for future growth in output and employment not accounted for in our static framework. With lower factor returns and higher agricultural and food prices, at least in the near term, real consumption—or welfare—declines in all rural and urban households (table 4). Welfare losses are largest in poorer and rural households, reflecting the combination of lower returns to land and labor and substantially higher prices for food staples—wheat and rice (table 5).

Table 3. Aggregate impacts of marketing, subsidy, and tariff reform scenarios in India

	Increased marketing efficiency scenarios		Elimination of agricultural subsidies	Elimination of agricultural tariffs
	In food retailing	In agricultural production		
	Percent change from base			
Real GDP	1.0	0.2	0.1	0.3
Real household consumption	1.4	0.2	-1.3	1.2
Real investment demand	0.4	0.1	4.2	-2.2
Government revenue	1.0	0.2	7.4	-2.3
Producer price index	0.4	0.0	-0.4	1.0
Land rents	5.6	0.7	-5.0	-0.1
Wages	1.6	0.2	-1.4	1.3
Capital rents	0.1	0.0	-0.5	1.2

Table 4. Household real consumption (welfare) impacts of agricultural marketing, subsidy, and tariff reform scenarios in India

Household type	Increased marketing efficiency scenarios		Elimination of agricultural subsidies	Elimination of agricultural tariffs
	In food retailing	In agricultural production		
	Percent change from base			
R1	2.0	0.3	-2.6	1.7
R2	1.9	0.3	-2.3	1.7
R3	1.8	0.3	-1.9	1.5
R4	1.7	0.2	-1.6	1.3
R5	1.4	0.2	-1.2	0.9
U1	1.4	0.2	-1.8	1.7
U2	1.3	0.2	-1.4	1.6
U3	1.2	0.2	-0.9	1.4
U4	0.9	0.1	-0.5	1.0
U5	0.8	0.1	-0.8	1.0

When agricultural tariffs are removed, expenditure in the economy shifts in the opposite direction—from investment to private consumption—as public savings fall. The more efficient allocation of resources leads to increased output, higher returns to labor and capital, and higher real household consumption. But, the decline in government tax revenue leads to lower investment, with negative implications for longer term growth prospects.

The removal of agricultural tariffs has minor price impacts on most sectors and negligible impacts on overall price levels, reflecting relatively competitive domestic prices and generally small amounts of trade in sectors such as food grains, fruits and vegetables, fibers, and dairy. However, more heavily protected sectors with less competitive domestic prices, including oilseed and products, and poultry face significant price and output shocks with the removal of tariffs.

Table 5. Consumer price impacts of agricultural marketing, subsidy, and tariff reform scenarios in India

Household type	Increased marketing efficiency scenarios		Elimination of agricultural subsidies	Elimination of agricultural tariffs
	In food retailing	In agricultural production		
	Percent change from base			
Rice	-0.1	-0.8	5.4	0.9
Wheat	0.0	-0.5	8.7	0.8
Corn	0.2	-0.2	1.1	0.6
Fruit & veg.	0.2	-1.0	0.9	-1.3
Oilseeds	0.2	1.0	1.2	0.6
Oil meal	-0.4	-0.4	-0.5	-22.4
Oils & fats	-0.3	-2.1	-0.6	-21.0
Sugar	-0.4	-1.8	-2.2	0.8
Fibers	0.2	-0.1	1.5	0.3
Poultry & hogs	0.0	0.9	-1.9	-0.4
Poultry & pork	0.1	0.6	-0.7	-34.7
Dairy	-0.2	-0.7	-2.2	0.3
Food, nec	-0.8	-4.0	-0.9	-1.1

Higher returns to labor and capital deliver increased real consumption and welfare in all rural and urban households. Welfare gains are largest in lower income households, driven by higher returns to labor, relatively small impacts on food staple prices, and significant consumer price declines for highly protected items like fats and oils.

Marketing Productivity Gains vs Subsidy and Tariff Removal

Looking across all of the scenarios, the results show that the marketing efficiency scenarios, and particularly improved retail food marketing efficiency, can lead to positive impacts on factor incomes and significant gains in aggregate output and real consumption relative to the other scenarios. The magnitude and distribution of household welfare gains associated with improved marketing efficiency are similar to those in the tariff removal scenario, but in sharp contrast to the potentially adverse consequences of subsidy removal, at least in the near term. Unlike the subsidy and tariff removal scenarios, improvements in retail food marketing efficiency have the potential to provide price benefits for both producers and consumers, particularly for lower income and rural households. In contrast, the analysis indicates that subsidy removal will lead to substantially higher prices for food staples, while tariff removal leads to substantial negative impacts on currently protected sectors, such as oilseed products, poultry, and processed foods.

Finally, at least within a static framework that does not account for the dynamic impacts of new investment on productivity and output, the scenarios differ substantially in their implications for aggregate investment and growth. The marketing efficiency scenarios suggest modest favorable impacts on investment and tariff elimination reduces investment, while the removal of subsidies generates substantial gains in investment and government revenues. However, a dynamic framework would likely indicate stronger

growth and welfare benefits from the new investment enabled by improved marketing efficiency and reduced subsidies, as well as from the more efficient allocation of agricultural resources arising from the removal of trade distorting tariffs.

Conclusions

This analysis highlights some of the dilemmas of Indian policy makers as they face domestic and international pressures for subsidy and tariff reform. Despite any aggregate positive impacts arising from subsidy and tariff reform, particularly in a more dynamic and longer term framework, these measures have the potential to create adverse sectoral and distributional consequences that are difficult to sustain in a democratic polity comprised of a large share of low-income households.

The results here suggest that measures leading to improvements in agricultural marketing efficiency in India, perhaps including strengthening public marketing institutions and improving the regulatory climate for private agribusiness investment, would yield substantial and broadly beneficial economic impacts. Advances in marketing efficiency are shown to have the potential not only to provide economy-wide gains in income and employment, but also positive price impacts for both producers and consumers and distributional gains favoring low income households. These results suggest the potential payoff from giving priority to measures leading to improved marketing efficiency in agriculture, as well as their potential value in complementing and mitigating adjustment costs associated with subsidy and tariff reforms.

Our framework does not permit analysis of the adjustment costs, including potential employment and income losses, that might be incurred if India's traditional marketing system was transformed into a more efficient sector, likely including fewer, larger-scale, vertically integrated, more technologically advanced processing and marketing enterprises. Concerns with these adjustment costs are an important part of the current debate over whether to permit foreign direct investment in retail marketing in India (Mukherjee, 2005). The results of this study indicate that improvements in agricultural marketing efficiency that explicitly entails reduced labor and capital inputs in providing marketing services still leads to upward pressure on returns to labor and capital. Although the economy-wide and distributional impacts appear positive, participants in the traditional marketing system will undoubtedly face adjustment costs.

Analytical issues that would be useful to address in future work include improved data on wholesale and retail marketing costs in Indian food and agriculture. The recent sector studies of India's agricultural markets conducted by the World Bank, USDA/ERS, and others indicate producer-to-retail marketing costs that are substantially higher than what is implied by the data in the Indian SAM. If this is true, then the current study likely underestimates the potential economy-wide gains from improved agricultural marketing efficiency. In addition, as has been noted, the use of a dynamic framework would better capture the potentially significant, long-term growth implications of marketing efficiency gains in Indian food and agriculture.

References

Arndt, C., H. T. Jensen, S.Robinson and F. Tarp. 1999. "*Marketing Margins and Agricultural Technology in Mozambique*." TMD Discussion Paper No. 43, Trade and Macroeconomics Division, International Food Policy Research Institute, Washington.

CII (Confederation of Indian Industry) and McKinsey & Company. 2004. *FAIDA Revisited: Realizing the Potential.*

Ganesh-Kumar, A., M. Panda and M.E. Burfisher. 2006. *Reforms in Indian Agro-Processing and Agriculture Sectors in the Context of Unilateral and Multilateral Trade Agreements*. Working Paper WP-2006-011. Mumbai: Indira Gandhi Institute of Development Research.

Gohin, Alexandre. 2001. *Incorporating Domestic Marketing Margins into GTAP: Data and Modeling.* INRA Working Paper, Rennes, France, April 2001.

Government of India, Ministry of Finance. 2008. Economic Survey, 2007/08.

Gulati, A. and S. Narayanan. 2003. *The Subsidy Syndrome in Indian Agriculture*, Oxford University Press (New Delhi), 297pp.

Jha, S., P.V. Srinivasan, and M. Landes. 2007. *Indian Wheat and Rice Sector Policies and the Implications of Reform.* United States Department of Agriculture, Economic Research Service, ERR No. 41. Washington, DC.

Komen M.H.C. and J.H.M. Peerlings. 1996. *"WAGEM – An Applied General Equilibrium Model."* Waginingen Economic Papers No. 05-96. Department of Agricultural Economics and Policy, Wageningen Agricultural University, Wageningen, The Netherlands

Landes, M.. 2008. The Environment for Agricultural and Agribusiness Investment in India, United States Department of Agriculture, Economic Research Service, ERR, forthcoming.

Landes, M. and A.Gulati. 2004. "Farm Sector Performance and Reform Agenda." Economic and Political Weekly (Mumbai), August 7-13, 2004, pp. 3611-3619.

Landes, M., S. Persaud, and J. Dyck. 2004. India's Poultry Sector: Development and Prospects, Agriculture and Trade Report No. WRS04-03, U.S. Department of Agriculture, Economic Research Service, February, 67 pages.

Löfgren, H., R. L. Harris, and S. Robinson. 2002. A Standard CGE Model in GAMS, International Food Policy Research Institute, Microcomputers in Policy Research Paper No. 5. Washington, DC: IFPRI

Matoo, A., D. Mishra, and A. Narain. 2007. From Competition at Home to Competing Abroad: A Case Study of India's Horticulture, Oxford University Press (New Delhi), 92 pp.

McDonald, S. and K.Thierfelder. 2004. *Deriving a Global Social Accounting Matrix from GTAP Versions 5 and 6 Data.* GTAP Technical Paper No. 22. Purdue University, West Lafayette, Indiana.

Mukherjee, A. and N. Patel. 2005. *FDI in Retail Sector India,* Academic Foundation, New Delhi.

Mullen, K., D. Orden and A. Gulati. 2005. *Agricultural Policies in India: Producer Support Estimates 1985-2002.* Discussion Paper No. 82. International Food and Policy Research Institute, Washington, DC.

National Sample Survey Organization, Ministry of Statistics and Program Implementation, Government of India. 2001. *Consumption of Some Important Commodities in India, 1999-2000.* Report No. 461. India: New Delhi.

Persaud, S. and M. Landes. 2006. The Role of Policy and Industry Structure in India's Oilseed Markets, ERR No.17, U.S. Department of Agriculture, Economic Research Service, April, 52 pages.

Peterson, E. B. 2006. *GTAP-M: A GTAP Model and Data Base that Incorporates Domestic Margins*. TAP Technical Paper No. 26. West Lafayette: Purdue University.

Peterson E.B., T. Hertel and P. Preckel. 1994. "A General Equilibrium Framework for the Food Marketing System. *European Review of Agricultural Economics*, Vol. 21, pp. 37-57.

Peterson, E. B. and Huey-Lin Lee. 2005. *Incorporating Domestic Margins into the GTAP-E Model: Implications for Energy Taxation.* Paper Presented at the 8th Annual Conference on Global Economic Analysis, Lubeck, Germany.

Polaski, S., A. Ganesh-Kumar, S. McDonald, M. Panda and S.Robinson. 2008. *India's Trade Policy Choices: Managing Diverse Challenges.* Carnegie Endowment for International Peace, Washington, DC.

Pradhan, B. K. and P.K. Roy. 2003. *The Well Being of Indian Households: MIMAP – India Survey Report.* Tata McGraw Hill, New Delhi.

Reardon, T. and A. Gulati. 2008. The Rise of Supermarkets and Their Development Implications: International Experience Relevant for India, Discussion Paper 752, International Food Policy Research Institute (IFPRI), Washington, D.C.

Robinson, S., M. Kilkenny and K. Hanson. 1990. "USDA/ERS Computable General Equilibrium Model of the United States." USDA Economic Research Service Staff Report AGES 9049.

Rosenthal, R. E. 2007. *GAMS: A User's Guide*. GAMS Development Corporation, Washington, DC

Saluja, M. R. and B.Yadav. 2006. *Social Accounting Matrix for India 2003-04*. India Development Foundation, New Delhi, India.

Srinivasan, P.V., S. Jha, and M. Landes. 2007. Indian Wheat and Rice Sector Policies and the Implications of Reform, ERR-41, Economic Research Service, U.S. Department of Agriculture, May, 52 pages

U.S. Department of Agriculture, Economic Research Service. 1994. Estimates of Producer and Consumer Subsidy Equivalents: Government Intervention in Agriculture, 1982-92, Statistical Bulletin No. 913, Commercial Agriculture Division, December, 452pp.

U.S. Department of Agriculture. Foreign Agricultural Service. 2006. India Report: Retail Food Sector, Gain Report IN- 6111, December 12, 17pp.

World Bank. 1999. India Foodgrain Marketing Policies: Reforming to Meet Food Security Needs, Vols 1 and 2, Report No. 18329-IN, Rural Development Sector Unit, South Asia Region, August 17.

World Bank. 1999. India Foodgrain Marketing Policies: Reforming to Meet Food Security Needs, Vols 1 and 2, Report No. 18329-IN, Rural Development Sector Unit, South Asia Region, August 17.

World Bank. 1997. The India Oilseed Complex: Capturing Market Opportunities, Vols 1 and 2, Report No. 15677-IN, Rural Development Sector Unit, South Asia Region, July 31.

Appendix: Model and Database

We develop a single-country, computable general equilibrium (CGE) model of India using the IFPRI standard model (Lofgren, et al., 2002) developed in the tradition of the USDA-ERS CGE model of the United States (Robinson, Kilkenny and Hanson, 1990). The IFPRI standard model is structured to explicitly describe the transaction services that link production to retail sales, and that create a price wedge between producer and consumer prices. The India CGE model is implemented in the General Algebraic Modeling System (GAMS) software documented in Rosenthal (2007).

The India CGE model has 30 sectors, of which 12 are crop and livestock sectors in primary agriculture. Seven sectors encompass processed foods, and beverages and tobacco. The five remaining commodity sectors are natural resources, textiles, apparel, and light and heavy manufacturing. There are three trade services sectors: (1) retail trade margin services required for domestic and export retail sales of domestically-produced agriculture and food, (2) residual trade margin services required as an intermediate input into agricultural production, and (3) all other trade services. There are two transport services sectors: transport services required as an intermediate input into agricultural and food production activities, and all other transportation services. The "other services" sector includes all remaining services in the economy.

There are three factors of production – labor, capital, and land – that are fully mobile within the country and fixed in aggregate supply. India is linked to the rest of the world through trade flows; the current account balance is assumed fixed and the real exchange rate is endogenous. Investment is determined by national savings. Private savings varies with changes in household income at fixed savings rates. Public savings (the fiscal deficit/surplus) adjusts with changes in tax revenues and subsidy and transfer payments, given fixed real government expenditure. We use the CPI as numeraire.

The database for our model is the Global Trade Analysis Project (GTAP) version 6 data base with a base year of 2001. We use the data-download program developed by McDonald and Thierfelder (2004) to organize the GTAP data for India and its world trade flows into a 23-sector Social Accounting Matrix (SAM) that is compatible with the IFPRI standard CGE model. We then extend the GTAP SAM for India in four ways:

Commodity Sector Disaggregation

First, we disaggregate these three agricultural and processed food sectors: GTAP "other grain" is divided into other grain and corn; GTAP fruit/vegetable is divided into fruit/vegetable, and pulses; GTAP oils/fats is divided into oils/fats and meal. To disaggregate the sub-sectors, we add activity columns to the SAM in which we describe subsectors' intermediate inputs, factor demands and taxes; and commodity columns in which we describe domestic production, imports, and commodity taxes including import tariffs. We add activity rows, and commodity rows in which the latter report intermediate and final demand for each new subsector. Data used for the agricultural sector disaggregation are drawn from multiple USDA data sources.

Agricultural Subsidy Disaggregation

Our second data adjustment is the disaggregation of GTAP data on total agricultural production subsidies into subsidies for fertilizer, power and electricity. We apply to the total production subsidy expenditure reported by GTAP, the shares of each subsidy in 2001 using data from producer support estimates calculated by Mullen et al. (2005). Rice and wheat receive the largest share of government subsidies, and receive the highest rates of subsidy, at 6 and 10 percent respectively. Overall, the primary agricultural sector in India receives a subsidy that is 4-percent of the value of production.

Disaggregation of Trade Services and Transport Sectors

Our third extension of the GTAP SAM is to disaggregate the trade services and transportation sectors. The GTAP database has one trade services sector. It includes all retail sales, wholesale trade and commission trade, hotels and restaurants, repairs of motor vehicles and personal goods, and retail sale of automotive fuel. Out of the trade services sectors, we create three sub-sectors: trade margin services used in retail sales of domestically-produced food and agriculture to domestic and export markets; residual trade margin services used as an input into agricultural production activities; and all other trade services. The GTAP transport sector includes costs for road, rail, ship and air. Out of the transportation sector, we create transportation demanded by agricultural producers as an intermediate input, and all other transportation.

The purpose of our disaggregation of retail food trade services is to create a link between the total expenditure by firms and final demand (households, government, investment and exports) on trade services reported in the input-output table, and the commodity composition of those trade services. To create this link, we make the assumption that the trade services required for all domestically-produced goods are of equal proportion. Therefore, the control totals for domestic and export food trade services are the shares of total trade services in the GTAP data that are equal to the budget shares of total food and agricultural goods in aggregate domestic and export expenditure on commodities. We then allocate this food trade services expenditure among food and agricultural commodities based on trade margin data from multiple USDA sources. We scale these commodity margin expenditures to meet the control totals for aggregate domestic and export food margin expenditures and the constraint that for any production activity or agent, food margin expenditures cannot exceed the total trade expenditure reported in the GTAP data. For sectors in which base exports are a negligible share of production, we assume zero margin expenditures on export sales. Our calculated margins are reported in appendix table 1. Margins represent the percentage share of the retail price attributable to retail trade costs. In the CGE model, these shares define the fixed input-output coefficients that relate the quantity of trade services to the quantity of domestic or export sales for each commodity.

Other trade services used in agricultural and food production activities are a residual of the GTAP trade service sector. It is defined as total trade services demanded by

agricultural activities as an intermediate input, from the GTAP SAM, minus retail food trade margins consumed in their purchases of agricultural intermediate inputs. For all other agents in the SAM, "other trade services" is the residual of the GTAP services sector minus retail food trade margins.

Appendix table 1. Food trade margins on domestic sales and exports, as a percent of wholesale price

Commodity	Food trade margin on domestic sales of domestically produced goods	Food trade margin on composite exports
Rice	0.09	0.03
Wheat	0.10	0.04
Corn	0.11	-
Other grains	0.10	-
Pulses	0.14	0.05
Fruit and vegetables	0.16	0.06
Oilseeds	0.06	0.02
Sugar	0.14	0.05
Fibers	0.11	0.04
Crops, nec.	0.14	0.05
Cattle	0.10	-
Poultry and hogs	0.07	0.03
Beef, mutton	0.12	0.03
Poultry and pork	0.28	-
Oilseed meals	0.07	-
Oils and fats	0.20	0.06
Dairy products	0.12	0.04
Other foods	0.18	0.06

We restructure the SAM as described in appendix table 2 to include domestic and export trade margin accounts. Food trade service is the production activity that is used to provide domestic and export trade margin services. The sector has production activity row and column accounts, with the latter reporting its production technology as a proportion of and identical to the production of trade services in the original GTAP SAM. Food trade service also has commodity column and row accounts, with the latter reporting demand for the service as an intermediate input for own-use and for use by two trade margin accounts: trade margins on domestic sales of domestic production and trade margins on exports.

The trade margin accounts purchase the food trade services used to deliver domestically-produced food and agricultural commodities to domestic and export retail markets. Commodity-specific domestic and export margin services are demanded by each agricultural and food commodity, in their column accounts, from the trade margin

Appendix table 2. Social Accounting Matrix with Domestic and Export Trade Margins									
	Production activities	Commodities	Trade Margins: Domestic, Export	Factors	Households	Government	Savings-Investment	World	
Production activities		Domestic production							Domestic production
Commodities	Commodities including domestic trade margin; remove expenditure on food. trade services commodity		Food trade services commod-ity		Commodities including domestic trade margin; remove expenditure onfood trade service commodity	Commodities including domestic trade margin; remove expenditure on food trade service commodity	Commodities including domestic trade margin; remove expenditure on food trade services commodity	Commodities including export trade margin; remove expenditure on food trade services commodity	Aggregate expenditure including domestic and export trade margins
Trade Margins: Domestic, Export		Domestic and export trade margin by commodity							Domestic and export trade margin demand
Factors	Value added								Factor income
Households				Factor income					Household income
Government	Production taxes/subsidies	Import tariffs		Factor tax	Income tax				Government income
Savings-Investment					Household savings	Government surplus/deficit		Current account balance	Total savings
World		Imports							Foreign outflows
Total	Domestic production	Domestic supply including domestic and export trade margin	Domestic and export trade margin supply	Factor payme nts	Household expenditure including domestic trade margin	Government expenditure including domestic trade margin	Total investment including domestic trade margin	Foreign inflows including export trade margin	

accounts, so that the value of each food commodity purchase in the SAM now includes its trade margin.

We also define activity and commodity accounts for agricultural production trade services in the SAM. This sector has a production technology that is identical to, and a share of, the original trade services sector in the GTAP SAM. The disaggregation of agricultural production trade services from other trade services facilitates our design of experiments, in which we are then able to assume increased efficiency in the production of trade services used as an intermediate input in agricultural production.

We disaggregate the GTAP transportation services sector into transportation demanded by food and agricultural production activities as an intermediate input into their production, and all other demands for transportation in the economy. The production technology of agricultural transportation services is a proportion of, and identical to, that of transportation services in the GTAP database. As in the case of trade services, the purpose of this disaggregation is to allow us to define experiments in which we assume increased efficiency in the production of transportation services used as an intermediate input in food and agricultural production

Most of the recent CGE analyses of marketing margins have taken a common approach to modeling the supply of trade and transport margin services, but differ considerably in their modeling of margin demand (appendix table 3). Similar to other studies, we assume the production activities of food and agricultural wholesale and retail trade services have the same structure as the other sectors in the model. The IFPRI standard model used for our analysis defines a nested Leontief production function with a CES functional form between labor and capital, and fixed intermediate input coefficients.

The IFPRI model used for this analysis, also used by Arndt et al. (1999) and similar in its margin demand structure to that of Gohin (1998), defines demand for food trade margin services as a fixed proportion of the quantities sold domestically or for export. The price paid by domestic consumers and the export market for a commodity is the sum of the producer price plus the trade margin price. Therefore, a decline in either the producer price or the price of the trade margin service will lower the retail commodity price and lead to increased commodity demand, as described by the Cobb-Douglas utility function in the model and the export demand function. Increased demand for the commodity will lead to increased demand for the marketing input required to bring the commodity from the wholesale to the retail market.

Disaggregation of Consumer Households

Our fourth extension of the GTAP India SAM is the disaggregation of the single consumer household into 10 representative households. Household income and expenditure data are from the 2003/4 India SAM developed by Saluja and Yadav (2006). Using 1999-2000 data from the National Sample Survey Organization (2001), Saluja and Yadav aggregated ten household types that characterize 5 expenditure classes each for rural and urban households. The lowest expenditure classes in rural and urban areas

Appendix table 3. Approaches to analysis of marketing margins in CGE models		
	Supply	Demand
Peterson (2006) – GTAP-M model	4 trade and transport sectors with CES production functions over labor and capital, fixed coefficients for intermediate inputs.	Nested demand structures for intermediate, domestic final demand and exports combine composite imports with composite margin services, and domestic products with composite margin services, and determine the composition of the composite trade margin service.
Peterson and Lee (2005)	Two marketing sectors (trade and transport) with CES production function nests extended to incorporate energy substitution in production.	Nested demand structures for domestic final and intermediate demand that specify demand for composite import and the domestic product at the top level; demand for composite imports plus composite marketing services, domestic good plus composite marketing service at the 2nd level, and demand for trade and transport marketing services at the 3rd level.
Gohin (2002)	One marketing sector with CES production function over labor and capital, fixed coefficients for intermediate inputs.	CES functions for domestic final demand combine imported and domestic producer goods at pre-tax prices, with the domestic marketing service to produce the consumer good.
Arndt, et al. (1999)	One marketing sector with Cobb-Douglas production function over labor and capital, fixed coefficients for intermediate inputs.	Demand quantity for marketing margin service by imports, exports and domestic production defined by fixed input-output coefficients.
Gohin (1998) – MEGAAF model	One composite marketing sector with CES production function over labor and capital, fixed coefficients for intermediate inputs.	Marketing services are combined in fixed proportions with imports, exports and domestically produced goods.
Komen and Peerlings (1996) – WAGEM model	Two marketing sectors (for food final demand, all other demand) with a CES demand for labor and capital and fixed coefficients for intermediate inputs.	Demand for composite marketing services is a fixed ad valorem share of the consumer price.
Peterson, Hertel and Preckel (1994) – GTAP model	27 wholesale/retail activities, corresponding to each sector in the model, produced using a CES function over labor and capital inputs.	Demand functions for domestic final demand combine the composite commodity and marketing services to produce the consumer good.

experience abject poverty; the second lowest rural and urban expenditure classes live in poverty. The middle household classes have national average per capita expenditures in urban and rural areas, while the two upper expenditure classes represent upper income and wealthy households. Saluja and Yadav draw data on sources of factor income by household type from Pradhan and Roy (2003).

We aggregate the 73-sector household income and expenditure data in the Saluja and Yadav SAM to the sectors of our India database and incorporate these income and expenditure shares of the 10 household types directly into our SAM. We use Saluja and Yadav's household income shares share as the control total for household expenditure shares in the economy. Because the Saluja and Yadav SAM includes only labor and capital, whereas our model also includes land, we assume that land income has the same distribution as capital income in the Saluja and Yadav database. Furthermore, we assume that land returns accrue only to rural households.

The sector aggregation of GTAP data for the base model is described in appendix table 4.

Appendix table 4. Mapping GTAP data into India SAM

No.	Sector name	GTAP sector
1	Rice	pdr pcr
2	Wheat	wht
3	Corn	gro
4	Oth grain	gro
5	Pulses	v_f
6	Frt/veg.	v_f
7	Oilseeds	osd
8	Sugar	c_b sgr
9	Fibers	pfb
10	Crops nec	ocr
11	Beef	ctl
12	Poultry/hog	oap wol
13	Nat. Resource	frs fsh coa oil gas omn p_c crp nmm
14	Beef/mutton	cmt
15	Poultry/pork	omt
16	Oilmeals	vol
17	Fats oils	vol
18	Dairy prods	rmk mil
19	Foods nec	ofd
20	Bev tobac	b_t
21	Textiles	tex
22	Apparel	wap
23	Light mfg.	lea lum ppp
24	Heavy nfg.	i_s nfm fmp mvh otn ele ome omf
25	Agric trade services	trd
26	Food trade services	trd

27	Othr trade services	trd
28	Ag. Transp.	otp wtp atp
29	Oth transp.	otp wtp atp
30	Oth services	ely gdt wtr cns cmn ofi isr obs ros osg dwe