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Impacts of Soybean Imports on Indian Processors, Farmers, and Consumers

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India is one of the world's largest importers of vegetable oils in part because of low domestic oilseed production, and tariff and nontariff barriers preventing oilseed imports. Simulation results indicate that India could lower its barriers to soybean imports without adversely affecting farmers, since imports are economically attractive to crushers even when subject to modest tariffs which sustain pre-liberalization farm and wholesale prices. Soybean processors in India achieve higher rates of capacity utilization and lower unit costs using imported oilseeds. Moreover, it is possible to partially redistribute to consumers the sizable gains processors experience by lowering the soybean oil tariff.

Key Words: India, oilseeds, processing cost, soybeans, trade liberalization

Spurred by rapid income growth and sharp reductions in trade barriers in the mid-1990s, India has emerged as one of the world's largest importers of vegetable oils. With relatively low per capita consumption of vegetable oils (approximately 10 kilograms per person per year, versus 33 kilograms for the United States), there is potential for growth in consumption and imports. India is also a significant exporter of soybean meal, in competition with South America and the United States, which further underscores the value of investigating the underlying dynamics of the Indian oilseed complex, as well as the role of Indian policy makers in influencing the performance and competitiveness of the sector. Despite its importance, India's oilseed sector has received only limited recent coverage (e.g., Srinivasan, 2004; Dohlman, Persaud, and Landes, 2003; Chaudhary, 1997; World Bank, 1997; Gulati, Sharma, and Kohli, 1996; Gulati and Phansalkar, 1994; Chandvaria, 1991; Dey and Banerjee, 1991; Narappanavar, 1989).

One distinctive feature of the Indian market is that although imports of vegetable oils are sizable, India's tariff and nontariff barriers to oilseed imports[1] effectively

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[1] Import tariffs on whole oilseeds are 30%, but oilseed imports, even if assessed low tariff rates, are effectively blocked by phytosanitary and import licensing rules. Phytosanitary rules require that soybeans be split (rendered unusable as seed) prior to importation, making it impractical to export soybeans to India.

prevent imports of raw materials, favoring farmers at the expense of vegetable oil consumers and oilseed processors. Additionally, farm support policies favoring competing crops tend to discourage domestic production of oilseeds, which are grown predominantly for their oil, rather than meal, value. Low supplies of domestically produced oilseeds, which underlie India's substantial imports of vegetable oils, also limit capacity utilization rates among India's generally small-scale processors to roughly 30–40% (Dohlman, Persaud, and Landes, 2003). The result is relatively high crushing costs, which are covered by domestic oil prices that are substantially above world prices, clearly at the expense of consumers.

The objective of this study is to develop alternate policy scenarios to examine the impacts of soybean trade liberalization on crushing efficiency and oil imports. This analysis uses an open economy structural representation of the Indian soybean sector, including equations for soybean acres planted, the domestic usage of soy oil and soy meal, and the cost of crushing.[2] The soybean sector is important because soy oil is the most heavily imported oil for which India also has a substantial domestic production base, which it seeks to protect from foreign competition through restrictive policies on imports of oilseeds and oils.

A key result is that soybean imports need not occur at the expense of farmers since imports are still economically attractive even when modest tariffs and/or transport costs raise the landed (tariff-inclusive) import price above the autarchy level. Crushers benefit because they use imported oilseeds to expand their sales volumes of oil and meal, leading to increases in revenues and capacity utilization, lower unit crushing costs, and lower imports of soy oil. Moreover, it is possible to partially redistribute to consumers the sizable gains processors experience by lowering the soybean oil tariff. Crushers earn less *per unit* of soybeans processed, but they are still better off because they make it up on volume as revenue rises with expanding sales. Thus, it is possible to develop a policy package allowing the Indian soybean sector to emerge as a high-volume, low-margin business, where adjustments to the oilseed and oil tariffs is a key mechanism for redistributing to farmers and consumers the gains from permitting oilseed imports.

The following section of this study provides an overview of the structural characteristics of the Indian oilseed processing sector. The simulation model is then presented, and incorporates the soybean processing sector, the farm supply of soybeans, and the domestic demands for soy meal and soy oil. We examine potential impacts of liberalizing soybean imports under various policy scenarios, and in particular, we show that improved access to oilseed imports can compensate Indian crushers for reduced duties on soy oil imports, while leaving farmers and consumers as well or better off. Concluding remarks are offered in the final section.

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[2] The cost data and information on the Indian crushing industry are based primarily on USDA/Economic Research Service field research in India in 2004, conducted by Suresh Persaud and Maurice Landes.

The Indian Oilseed Processing Sector

India's oilseed processing/crushing sector, which is currently fragmented and small scale, operates at low rates of capacity utilization due to policy distortions and poor infrastructure. Excess oilseed processing capacity is related to tax and other incentives that stimulated over-investment in many rural areas, coupled with tariff and phytosanitary barriers that prevent oilseed imports. Ghanis (traditional, very small-scale processors) and small-scale expellers usually operate at just 10–30% of capacity (World Bank, 1997), and even the more modern solvent extractor industry, comprised of approximately 600 plants, typically uses less than 40% of capacity on average (Dohlman, Persaud, and Landes, 2003). This contrasts with the 92–96% utilization rates reported for U.S. plants (Reca, 2003). According to the World Bank (1997), low capacity utilization for solvent extractors has resulted in per unit soybean processing costs in India which are 40% higher than in China and 90% greater than in the United States.

However, there are a small number of Indian firms, as well as multinational corporations (MNCs) that operate at higher plant utilization rates. Their financial resources and lower borrowing costs give advantages at procuring and then storing the raw material (oilseeds), leading to higher utilization rates and further cost advantages. Tariff-hopping also appears to be a determinant of such foreign direct investment flows in oilseed crushing, as India maintains substantial tariffs on imports of edible oils. MNCs can choose either to export the soy oil to India (subject to the 45% duty), or they can acquire existing underutilized plants in India and produce and sell the oil within the country, thereby avoiding the oil tariff. In the latter approach, MNCs tend to acquire existing small-scale plants rather than construct large-scale crushing units, which is perhaps indicative of substantial advantages from operating close to full capacity, as well as a lower optimal plant size in India stemming from infrastructure limitations. Nevertheless, it remains to be seen whether foreign direct investment (FDI) in oilseed crushing will substitute for exports of edible oils to India in a substantial way.

One factor preventing the rationalization and consolidation of the crushing sector to a smaller number of more efficient, medium-sized plants is India's small-scale industry (SSI) reservation policies. The SSI policies confine processing of traditional oilseeds—such as peanuts, rapeseed, sesame, and safflower, but not soybean and sunflower—to small firms, thus allocating a large share of edible oil production to relatively inefficient producers. However, more recent exposure to competition from vegetable oil imports is pressuring small and less efficient processing units to modernize or close. Although SSI policies remain in place, efficiency gains are occurring due to the growing share of domestic production by modern solvent extractors.

In addition to policy factors, poor infrastructure and low farm yields are key factors inhibiting the rapid development of a large-scale industry. Although larger plants could achieve size economies and lower crushing costs, these efficiency benefits tend to be outweighed by higher procurement costs. Large-scale processors would have to procure and transport oilseeds over a large land area since farm yields are low, thus placing greater demands on India's poor infrastructure. Hence, the elimination of India's SSI policies is not in itself likely to lead to a large-scale crushing industry on par with other countries. This is evidenced by the fact that even Indian processors not covered by SSI policies—such as soybean processors and solvent extractors—remain small by international standards, and that MNCs tend to acquire existing small-scale plants rather than building large units. Although some Indian soybean processors have a capacity of about 1,500 metric tons (mt) per day, most plants have a capacity in the range of 170 mt per day. In comparison, the average crushing capacity of the five newest U.S. plants is 100,000 bushels (2,700 mt) per day, slightly below the capacity of Brazil's newest plants. Argentine plants that came on line during 1995–97 are substantially larger, with the capacity to process 165,000 bushels (4,455 mt) per day (Reca, 2003).

Barring any changes to policy, it appears likely that any further efficiency gains would require fundamental longer-term changes leading to higher oilseed yields and production, industry consolidation to eliminate excess capacity, and improved transport infrastructure. However, perhaps the most immediate and important solution would be less restrictive policies on the import of oilseeds to augment domestic supplies. The increased availability of oilseeds would allow processing plants in coastal regions to operate at a higher level of capacity utilization using imported oilseeds. Plants located in the interior could increase capacity utilization using domestically produced oilseeds.

Processors gain from oilseed trade liberalization in two key ways: their unit costs fall as they move down their cost curves and their sales volumes increase. Processors' profits would tend to increase sharply, and these benefits from liberalizing imports of raw materials can be partially transferred to consumers by lowering the tariff on soybean oil. Subsequent sections of this study investigate possible impacts on processors, consumers, and farmers of permitting imports of the raw material (oilseeds), using a structural model of India's soybean complex.

Oilseed Model Characteristics

In addition to oilseed trade policies and structural characteristics of the crushing industry, key variables affecting the Indian oilseed complex include growth in income, crop area, farm yields, and world prices of oils and meals. We develop projections through the year 2010 using a structural model to examine the likely impacts of these key variables on India's projected consumption, production, and imports of soybean oil, as well as India's production, domestic usage, and exports of soy meal. This section describes the components of the model,[3] beginning with the cost of crushing. This serves as the basis for the reference and policy scenario results outlined in the next section.

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[3] Additional information on the equation structure and model specification is available from the authors upon request.

Cost of Crushing

Based on field research, the World Bank (1997) demonstrates that higher capacity utilization in softseed and soybean crushing can improve India's international cost competitiveness. Using crush costs in the U.S. as the benchmark, the relative costs of crushing in India at different levels of capacity utilization are specified. For example, as capacity utilization in India's soybean crushing plants increases from 25% to 30% to 50%, India's disadvantage in costs is diminished, but not eliminated. For the softseed category, India approaches the U.S. standard at 66% utilization, with costs only 1% above those in the United States.

The World Bank (1997) is remarkably thorough in its coverage of the Indian oilseeds complex. However, although its information on relative costs is valuable, it is not directly applicable to the current study, which requires actual costs rather than data based on an index. The current study also requires information on the behavior of soybean crushing costs over a wider range of capacity utilization levels, beyond 50%. It is unlikely that average costs attain a minimum at 50% utilization, implying the three data points should be more widely spaced to more completely reflect the curvature of the cost relationship. (A larger number of data points, though also preferable, are difficult to obtain, particularly when relying on field research.)

Consequently, we obtained cost data and information from individual firms and industry representatives that are more tailored to the requirements of the current study. Data were gathered during field research conducted as part of the USDA's Emerging Markets program for India. Operating costs in India reportedly fall by almost half to 475 rupees per mt, when moving from 40% utilization to full capacity, attaining a minimum at approximately 80% utilization.

The quadratic equation that fits the three data points is given by:

$$(1) \qquad CRcost_1 = CR_1^1 \times CapUtil_1{**}2 + CR_1^2 \times CapUtil_1 + CR_1^0$$
$$= 0.3363 \times CapUtil_1{**}2 - 54.17 \times CapUtil_1 + 2{,}528.7,$$

where $CRcost_1$ is the average variable cost of crush, $CapUtil_1$ is capacity utilization, and "**2" indicates squared. Total crush costs ($TCRcost_1$) are represented by:

$$(2) \qquad TCRcost_1 = SCrush_1 \times \Big(0.3363 \times (SCrush_1/Cap){**}2$$
$$- 54.17 \times (SCrush_1/Cap) + 2{,}528.7\Big) + FC,$$

where $SCrush_1$ is the quantity of soybean crush, FC is the fixed cost, and Cap is the soybean crush capacity, such that capacity utilization ($CapUtil_1$) is given by $SCrush_1/Cap$ in (2).

Table 1. Indian Soybean Model Results

Variable	Unit	Base Year 2001
Soybeans:		
Production	metric tons	5,400,000
Imports	metric tons	0
Crush	metric tons	4,629,000
Farm Price	rupees/metric ton	9,545
Processing Sector:		
Utilization	percent	40%
Crush Margin	rupees/metric ton	2,257
Processing Cost:	rupees/metric ton	11,062
< Seed Cost	rupees/metric ton	9,924
< Unit Crush Cost	rupees/metric ton	1,138
Unit Surplus	rupees/metric ton	1,119
Total Surplus	million rupees	5,178
Soy Oil Sector:		
Consumption	metric tons	2,405,000
Production	metric tons	855,000
Imports	metric tons	1,550,000
Wholesale Price	rupees/metric ton	30,818
Soy Meal Sector:		
Consumption	metric tons	1,250,000
Production	metric tons	3,700,000
Exports	metric tons	2,450,000
Wholesale Price	rupees/metric ton	8,118

Source: India soybean simulation model.

[a] Scenario definitions are as follows: (zero, 45) indicates that tariffs on soybeans and soy oil are zero and 45%, respectively; (zero, 35) indicates that tariffs on soybeans and soy oil are zero and 35%, respectively; and (four, 45) indicates that tariffs on soybeans and soy oil are 4% and 45%, respectively.

Demand and Supply Elasticities

Existing literature does not provide formal estimates of income or own-price elasticities of demand for soybean oil in India. Time-series price data provide relatively few observations for econometric estimation. In a recent study, Kumar (1998) estimated demand elasticities for "oil" as an aggregate commodity group, with expenditure elasticities of 0.389 (rural) and 0.234 (urban), and own-price elasticities of !0.567 (rural) and !0.522 (urban). However, given the relatively fast growth in soy oil consumption, the current study uses 0.77743 and !0.5375 for the income and own-price, respectively (table 1). These elasticities are in line with Dev et al.'s (2004) estimates for the commodity group "edible oil": 0.85 (rural) and 0.3662 (urban) for the expenditure elasticities, and !0.5698 (rural) and !0.3547 (urban) for

Table 1. Extended

	Scenario Projections for Year 2010 [a]			
	Reference	Oilseed Imports (zero, 45)	Oilseed Imports (zero, 35)	Oilseed Imports (four, 45)
Soybeans:				
	7,136,586	7,209,292	7,209,292	7,353,597
	0	5,149,120	4,583,496	4,458,524
	6,097,092	11,311,258	10,745,633	10,749,761
	10,648	10,978	10,978	11,386
Processing Sector:				
	53%	98%	93%	93%
	1,908	1,578	1,168	1,170
	11,816	11,902	11,858	12,266
	11,027	11,357	11,357	11,765
	789	544	501	501
	1,119	1,033	666	669
	6,820	11,689	7,162	7,192
Soy Oil Sector:				
	2,793,163	2,793,163	2,886,349	2,793,163
	1,126,164	2,089,247	1,984,773	1,985,536
	1,666,998	703,915	901,575	807,627
	40,433	40,433	38,211	40,433
Soy Meal Sector:				
	2,214,725	2,214,725	2,214,725	2,214,725
	4,873,459	9,041,187	8,589,078	8,592,378
	2,658,734	6,826,462	6,374,353	6,377,653
	6,839	6,839	6,839	6,839

the own-price. The scenarios developed in the current study hold constant the prices of substitutes and complements, such that demand is influenced only by changes in own-price and income.

Just as in the case of soy oil, existing literature does not provide formal elasticity estimates for India's domestic usage of soy meal. Soy meal consumption is specified as a function of the own-price and income. India's domestic use of soy meal is driven by poultry and egg production (Landes, Persaud, and Dyck, 2004). The income elasticity of soy meal demand (1.78) used in the simulation model is computed from the poultry and egg model developed in Landes, Persaud, and Dyck by calculating the impact of a 1% gross domestic product (GDP) shock on soy meal usage. The own-price elasticity (! 0.12) was computed from a 1% shock to the wholesale price of soy meal. We hold constant the prices of substitutes and complements in the projections.

The soybean area response elasticity from the USDA baseline (USDA/Office of the Chief Economist, 2004) is 0.6, which is used as the long-run elasticity in the current study, while the short-run area response in the current study is 0.2. In this analysis, yield grows at a trend rate of 1% per annum, and prices of competing crops are held constant. Farm production of oilseeds is computed as the product of area and yield. Note that the policy experiments hold constant the prices of competing crops in the area equation.

Base Year Prices and Quantities

Due to the behavior of India's monsoons as well as data limitations, the model uses a base year of 2001. The year 2002 saw one of the worst monsoon seasons in more than a decade, while 2003 was one of the best. This led to atypically poor agricultural performance followed by a sharp improvement in the following year. Because the most recently available data approximating a typical crop year are for 2001, this year is better suited for the base. The model parameters replicate India's domestic prices and quantities in the base period. In the year 2001, India's oil and meal extraction rates, domestic supply, and uses for soybeans, soybean meal, and soybean oil are computed from the USDA's PS&D database [USDA/Foreign Agricultural Service (FAS), 2004]. The domestic wholesale prices of soybeans and soy oil are for Madhya Pradesh, published by the Government of India, Ministry of Agriculture (2003). The domestic price of soy meal is taken from the Solvent Extractors' Association (SEA) of India (2003).

Projected Prices and Quantities

Through the projection period, India's real domestic wholesale prices of soybean oil are obtained from the vector of real world prices generated by the USDA baseline, adjusted for tariffs and the estimated transport and marketing costs used to replicate the base period. Because India does not impose taxes on soy meal exports, the domestic soy meal prices are determined more simply by adjusting the real-world prices from the USDA baseline by estimated transport and marketing costs. This analysis employs the small country assumption, i.e., the quantity of India's meal (oil) exports (imports) do not affect the prices they receive (pay), implying the domestic prices of meal and oil are exogenous. World prices for the oilseeds, the exchange rate for the rupee, and the GDP deflators through 2010 are from USDA/FAS (2004). The policy changes that occur in the alternate scenarios are enacted in 2005 and maintained through the terminal year of the simulation exercise (2010).

Prospects for India's Oilseed Sector: Projections Through 2010

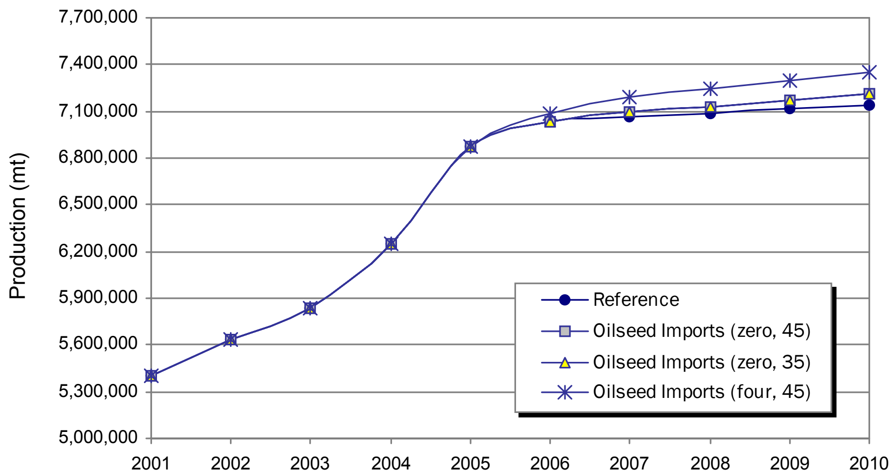
The analysis begins with a "reference" scenario that projects the impacts on farmers, processors, and consumers of maintaining 4% growth in per capita income, while keeping in place current policies on imports of edible oils, as well as trade barriers that prevent oilseed imports. This "business as usual" projection serves as a benchmark against which we investigate the impacts of eliminating nontariff barriers on oilseeds, combined with reductions in tariff. Rather than making policy recommendations or arguing for particular point estimates, the alternate policy scenarios are designed to underscore key conclusions of our welfare analysis, while taking into account that decision makers must often weigh competing interests of various stakeholders in their food systems.

Reference Scenario (*Oilseed Autarchy*)

In the absence of soybean imports, oilseed crush is simply a residual equal to the predetermined level of domestic oilseed production less the exogenous quantities of seed, feed, waste, and food uses. The stock of crush capacity remains constant throughout the projection period, implying that once the quantity of crush is known, capacity utilization can be computed. We assume nonfarm input costs of crushing, such as labor, hexane, and energy expenses, are constant in real terms (they grow at the same rate as inflation). Thus, capacity utilization is the only variable that causes the real cost of crushing to vary throughout the projection period. Given the level of capacity utilization, the model computes the cost of crush. The autarchy wholesale price of soybeans is formed by subtracting the cost of crushing from a weighted sum of the oil and meal prices, where the weights are the oil and meal extraction rates. The farm price of the oilseed is then computed by subtracting a margin from the autarchy wholesale price of the oilseed. The farm price will determine the production of oilseeds in the subsequent period.

In the reference scenario, real world prices of soybeans, soy oil, and soy meal increase sharply through 2004, then decline steadily thereafter through 2010, as per the USDA baseline projections. Although India does not import soybeans under the reference scenario, the domestic price of soybeans rises along with the world price of meal and the tariff-adjusted world price of oil, implying soybean production (figure 1), which responds to lagged prices, exhibits strong growth through 2005 before leveling off. These initial gains in the production of soybeans are not sufficient to offset decreasing soy oil imports (figure 2), leading to falling consumption through 2004, followed by subsequent rapid growth in imports and consumption. Consumption of soy oil increases by 16.1%, from 2.4 million metric tons (mmt) in year 2001 to 2.8 mmt in 2010. India's exports of soy meal peak at 3.1 mmt in year 2005 (figure 3) and decline steadily thereafter. By year 2010, soy meal exports are barely above the base year (2001), as India's consumption rises faster than domestic production.

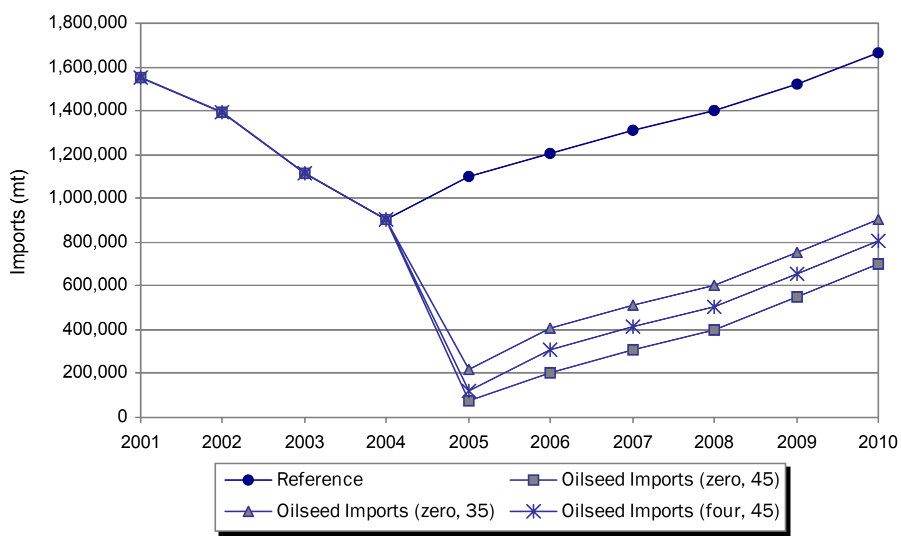
Although the stock of crush capacity remains constant, domestic production of soybeans grows from 5.4 mmt in the base year to 7.1 mmt in the terminal year (table 1), allowing an improvement in capacity utilization from 40% to 53%. The analysis holds constant the real prices of the nonmaterial inputs used in the crushing industry, so that capacity utilization is the only variable influencing real crush costs. Thus, real unit crush costs (exclusive of the raw material but including the fixed costs) fall from 1,138 rupees ($24 U.S.) per metric ton in the base year to 789 rupees per metric



Source: India soybean simulation model.

Note: Scenario definitions are as follows: (zero, 45) indicates that tariffs on soybeans and soy oil are zero and 45%, respectively; (zero, 35) indicates that tariffs on soybeans and soy oil are zero and 35%, respectively; and (four, 45) indicates that tariffs on soybeans and soy oil are 4% and 45%, respectively.

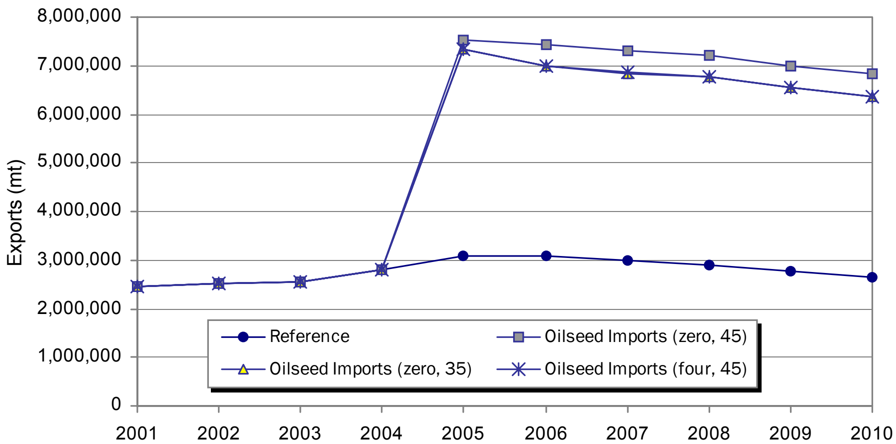
Figure 1. Soybean production under the four scenarios



Source: India soybean simulation model.

Note: Scenario definitions are as follows: (zero, 45) indicates that tariffs on soybeans and soy oil are zero and 45%, respectively; (zero, 35) indicates that tariffs on soybeans and soy oil are zero and 35%, respectively; and (four, 45) indicates that tariffs on soybeans and soy oil are 4% and 45%, respectively.

Figure 2. Soybean oil imports under the four scenarios



Source: India soybean simulation model.

Note: Scenario definitions are as follows: (zero, 45) indicates that tariffs on soybeans and soy oil are zero and 45%, respectively; (zero, 35) indicates that tariffs on soybeans and soy oil are zero and 35%, respectively; and (four, 45) indicates that tariffs on soybeans and soy oil are 4% and 45%, respectively.

Figure 3. Soy meal exports under the four scenarios

ton in year 2010, or 31%. However, processors' surplus per unit of production does not change in real terms from its base year level of 1,119 rupees, since benefits of cost reductions are passed on to farmers in the form of higher real oilseed prices. Real domestic wholesale prices of oilseed grow faster than world prices. Although crushers do not realize higher per unit surplus, they nevertheless benefit from higher total surplus, due to increases in the volume of their sales. Thus, total processors' surplus expands by the same amount as the quantity of crush, 31.7%.

Oilseed Import Scenario: Benefiting Farmers and Processors (*zero, 45*)

This policy experiment demonstrates that the removal of barriers to soybean imports may confer sizable gains to processors. We denote this scenario as (zero, 45) in table 1, because we completely eliminate *in year 2005* tariff and nontariff barriers to imports of soybeans, while maintaining the soy oil duty of 45%. (Per capita income grows at 4% per annum as before.) A key implication is that now India's wholesale price of soybeans is determined from the freight-adjusted world price,[4] and, with transport costs of 1,880 rupees per mt, the wholesale price in 2010 (11,357 rupees) turns out to be 3% greater than the autarchy price realized in the reference scenario (11,027 rupees). In effect, this policy experiment investigates whether processors' willingness to pay for oilseeds actually exceeds the autarchy prices from the reference.

[4] Moreover, because the wholesale price of soybeans moves in lockstep with world prices, improvements in crushing efficiency are no longer passed through as higher wholesale and farm prices.

When oilseed imports are permitted, the optimal crush quantity cannot be computed as a residual, since optimal oilseed crush may exceed domestic production. The optimizing framework computes the level of soybean crush to maximize processors' surplus, subject to the cost equation, and given the output and input prices:

$$\text{(3)} \qquad \underset{SCrush_1}{\text{Max}} \Big\{ OEXT_1 \times OPriceW_1 \ \% \ MEXT_1 \times MPriceW_1 \ \& \ TCRcost_1 \ \& \ SPriceW_1 \Big\},$$

where $OEXT_1$ is the soybean oil extraction rate, $OPriceW_1$ is the domestic price of soy oil, $MEXT_1$ is the soybean meal extraction rate, $MPriceW_1$ is the domestic price of soy meal, and $SPriceW_1$ is the domestic price of the raw material (soybeans). Substituting (2) into (3) for the crush cost yields:

$$\text{(4)} \qquad \underset{SCrush_1}{\text{Max}} \Big[OEXT_1 \times OPriceW_1 \ \% \ MEXT_1 \times MPriceW_1 \ \& \ SPriceW_1 \ \& \Big\{ SCrush_1 \times \big(0.3363 \times (SCrush_1 / Cap)^{**}2 \ \& \ 54.17 \times (SCrush_1 / Cap) \ \% \ 2{,}528.7\big) \ \% \ FC \Big\} \Big].$$

Rather than solving explicitly for the crush demand, the optimization framework used in this study iterates to compute the profit-maximizing quantity of oilseed crush. A non-deterministic approach is preferable, since the cost curves are nonlinear, and it is difficult to obtain closed-form solutions. Crush levels that exceed the predetermined quantity of domestic production give rise to oilseed imports. Domestic oil, meal, and oilseed prices, which are influenced by world prices, transport costs, and tariff levels in the case of the oil and oilseed, will affect the profit-maximizing quantity of oilseed crush. Additionally, the ratio of the tariffs on oils to oilseeds will affect the crush and oilseed import decision. All other things equal, an increase in the oil tariff relative to the oilseed tariff tends to favor oilseed imports. Similarly, the ratio of the world prices of the outputs (oil and meal) to the world oilseed prices, coupled with the ratio of the transport costs of oils to oilseeds, will influence the oilseed import decision. This information is summarized in the crush margins that prevail in the domestic market.

Beginning in year 2005, crushers are free to expand production to levels that are substantially above those in the reference scenario, since their supplies of raw materials are no longer constrained. Soybean imports occur, and unit-crushing costs decrease at a faster rate than in the reference, due to stronger growth in capacity utilization. Nevertheless, surplus *per unit* falls even with the observed decreases in unit costs of crushing, because processors, who previously paid the autarchy price for oilseeds, must now pay an even higher price for raw materials. Although processors earn less per unit of output, they make it up on volume by greatly increasing sales. Thus, total surplus in processing is higher than under the reference, despite decreases in surplus per unit—a key result of sharply expanding production using imported raw materials.

Processors can afford to pay somewhat more for oilseeds if it allows them to expand output. Therefore, oilseed trade liberalization is consistent with higher farm prices of soybeans that can be enforced by setting and defending farm support prices in line with the relatively high freight-adjusted world prices. The result would be a constant margin between the wholesale price of soybeans (which is determined from the freight-adjusted world price) and the farm price, whereby movements in farm prices track wholesale prices. Consequently, farm prices and production are higher than in the reference scenario. India's domestic production of oil and meal exceed the levels in the reference, as increased domestic production of soybeans is further augmented by imports of soybeans.

When oilseed imports are permitted, India's soy oil imports (figure 2) decrease sharply in 2005 (the year in which the trade liberalization is implemented), in an almost parallel downward shift, while soy meal exports rise sharply in 2005 (figure 3). During subsequent years, oil imports grow at roughly the same rate as under the reference, and meal exports decline steadily. Thus, oilseed trade liberalization acts as an intercept shifter. Note that the post-2005 growth in soy oil imports and the decreases in soy meal exports are consequences of maintaining a fixed stock of crush capacity throughout the projection period in the face of growing domestic demands for soy oil and meal. The assumption of zero growth in crush capacity is not a prediction or a forecast, but rather is part of the scenarios. Sensitivity analysis shows that if crush capacity grows in line with the demand for oil after 2005, oil imports stabilize at a low level.

Oilseed Import Scenario: Maximum Benefits to Farmers (*four, 45*)

The analysis of soybean imports is further developed by imposing a 4% duty on soybean imports.[5] The 45% tariff on soy oil is maintained, while per capita income continues to grow at 4% per annum. This scenario, which is denoted as (four, 45) in table 1, illustrates the possibility of liberalizing soybean imports while at the same time benefiting farmers with approximately neutral effects on processors. Processors now pay even more for the raw material, and surplus per unit falls sharply. However, total surplus is about the same level as in the reference scenario, implying that the 4% soybean duty has transferred almost all of the processors' benefits from improved access to raw materials to farmers. This policy package provides the largest benefits for farmers without harming processors.

Oilseed Import Scenario: Benefiting Consumers, Farmers, and Processors (*zero, 35*)

We now illustrate a consumer-oriented policy package that benefits all stake-holders—consumers, farmers, and processors. This policy experiment is denoted as

[5] In year 2005, the 4% soybean duty has the same effect as increasing the real transport cost by approximately 423 rupees per mt.

(zero, 35) in table 1, because we completely eliminate tariff and nontariff barriers to imports of soybeans, while reducing the soy oil duty to 35%. Per capita income grows at 4% per annum as before. In the terminal year of the projection period, the domestic price of soy oil is 5.5% lower than under the reference scenario, while consumption expands less than proportionately, i.e., by 3.3%. The extent to which oil consumption increases in response to the reduced tariff is clearly a function of the magnitude of the own-price elasticity, as confirmed by experiments with own-price elasticities that are larger in absolute value. Although the reduction in the soy oil tariff transfers to consumers almost all of the benefits of oilseed trade liberalization, processors and farmers are still better off than in the reference, as indicated by increases in farm prices and in total processor surplus.

Conclusions

India is a significant producer of oilseeds, but its demand for edible oils far outstrips its current capacity to supply oil from domestic output. Nevertheless, market developments in the sector are heavily influenced by domestic and trade policies, as policy makers attempt to weigh competing priorities of different interest groups. Indian policy makers have simultaneously attempted to protect consumers from food price inflation, in part through increased imports of edible oils, while at the same time protecting India's sizable domestic production base of oilseeds from foreign competition through fluctuating edible oil tariffs and policies that prevent whole oilseed imports. By effectively prohibiting oilseed imports, the government of India may have given up a measure of policy flexibility that could in fact balance the interests of farmers, consumers, and processors to the advantage of all three groups. Limited supplies of oilseeds constrain processors to operate at low rates of capacity utilization, contributing to relatively high crushing costs and foregone sales and profits.

Under several scenarios, we show the potential cost savings and associated gains in processor surplus stemming from the ability to import soybeans and improve utilization rates. We also demonstrate the means to distribute those gains by altering the ratio of oil and oilseed tariffs. The gains in processors' surplus may be sufficiently large to permit welfare-enhancing transfers to farmers and consumers while still leaving processors the same or better off, where adjustments to the oilseed tariffs is the mechanism for redistributing the gains from partial liberalization of India's oilseed trade.

Finally, a useful extension of this study involves investigating whether the United States is likely to gain more from improved access to the Indian market for oilseeds than for edible oils. Thus far, U.S. exports of soy oil to India have been limited by competition from South America and the availability of low-priced palm oil from Southeast Asia (Dohlman, Persaud, and Landes, 2003). However, if India were to allow imports of oilseeds, not only would its crushing industry gain, but it may also benefit the U.S., which tends to be more competitive at exporting soybeans than soy oil. Although the United States would still face considerable competition from South American soybeans, oilseed trade liberalization would effectively reduce the competitive threat faced by the U.S. from South American soy oil exports—India's imports of soybeans would substitute for its soy oil imports.

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