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Impact of India's National Food Security Act on Domestic and International Rice Markets

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ABSTRACT

Policy making in food security is at a crossroads in India, particularly for the rice crop. Whereas India has emerged has a leading rice exporter over the last two years, the government has also introduced a large food subsidy program called the National Food Security Act. The program requires that 33.6 million metric tons of rice per year be distributed to the marginalized rural and urban populations of the country. In this study, we analyze the long-term impact of India's Food Security Act on its domestic rice market and the international market for rice. We specify and apply a structural demand-and-supply model to India's rice market and link it with the world rice market, as part of a broad partial equilibrium modeling system of international agriculture commodity markets. We specifically focus on three different scenarios—subsidy as a price effect, subsidy as an inelastic income effect, and subsidy as an elastic income effect—under the broader framework of the National Food Security Act. We find that at the end of the projection period (the 2024/2025 crop year), as a result of the rice subsidy program, the consumption of rice increases significantly by 6,831 thousand metric ton (MT) in the case of the price effect while the inelastic income effect has little on production, consumption which increase by 265 thousand MT and 269 thousand MT, respectively and no impact on rice export of India.

Keywords: India rice model, National Food Security Act, price effect, inelastic and elastic income effect

JEL classification codes: C15, C53, Q11, Q17, Q18, Q31

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ABBREVIATIONS

FAO	Food and Agriculture Organization
FAPRI	Food and Agricultural Policy Research Institute
GDP	gross domestic product
INR	Indian rupee
MT	Metric tons
NFSA	National Food Security Act
PDS	Public Distribution System
TPDS	Targeted Public Distribution System
USD	United States dollar

1. INTRODUCTION

Food subsidy interventions continue as a major policy instrument for reducing hunger and malnutrition in several developing countries. Such interventions constitute a large share of some social safety net programs, particularly in countries where the government procures food grains from farmers at an assured price and distributes them to poor consumers and vulnerable groups at a subsidized price. High levels of inefficiency continue to plague implementation of food subsidy programs due to poor targeting, leakages, and rent seeking along the procurement and distribution channels. The case of India is typical. Along with the long-standing food subsidy program implemented through the Public Distribution System (PDS), India recently adopted the National Food Security Act (NFSA), which expands the coverage of subsidized food grains to a larger share of the population, increasing the need for a higher volume of procurement, stock, and distribution. In addition, India has emerged as a leading rice exporter. The competing goals of an increased local demand for rice and an export orientation have increased the concern of policy makers about India's ability to sustain a higher level of subsidy and the country's future position in the international rice market.

The paper is organized as follows. In the next section, we describe the NFSA and the implementation of the PDS in India. Section 3 discusses India's position in the global rice market. The implications of the NFSA for the rice market are discussed in Section 4. A structural model based on the behavioral equations is developed in Section 5. In Section 6, we apply the model and show three possible subsidy scenarios under the NFSA. Section 7 presents baseline results and the different possible elasticity scenarios. Section 8 consists of the results and discussion, and conclusions and policy recommendations follow in Section 9.

2. NATIONAL FOOD SECURITY ACT AND THE PUBLIC DISTRIBUTION SYSTEM

India has a long history of subsidizing food grains beginning in the colonial era. During World War II, subsidized food, known as a “ration,” was first introduced in India. After independence and through the 1960s, the government of India started major food subsidy and farmer support initiatives that included the Public Distribution System, or PDS, a minimum support price for agricultural commodities, and much more (Chand 2003). Introduced at the beginning of the First Five Year Plan (1951–1956), the public distribution of food grains remains the backbone of India’s social protection policies. By the Second Five Year Plan, the PDS had been transformed from a traditional rationing system into a social safety system, making food grains available to the consumer at a “fair price.” The major objective of the PDS is to control the price of food grains and remove speculative tendencies in the market that may affect poor consumers through high price volatility (Ahluwalia 1993; Suryanarayana 1995a, 1995b; Mahendra Dev1998). Within the PDS the government purchases food grains (mainly wheat and paddy) from farmers at the minimum support price that the Commission for Agricultural Costs and Prices announces at the beginning of every cropping season. Once food grains are procured by the respective state governments with the assistance of the central government, they are stored in government-owned storage facilities and finally distributed to the consumer at a subsidized price through the PDS. Therefore, the net subsidy incurred by the government is the difference between the procurement, storage, and handling cost price and the selling price of the grains (Suryanarayana 1995a, 1995b; Ahluwalia 1993).

In 1997, the Indian government revisited the PDS and introduced the Targeted Public Distribution System (TPDS). With the TPDS, the focus shifted from providing price stability to the consumer to reducing poverty and malnutrition. The word “targeted” indicates that the focus is the poor and vulnerable sections of society, making the PDS a pro-poor food policy intervention. However, that shift in objective has tremendously increased the costs of food subsidy in India. Sharma and Munish (2013) pointed out that the total food subsidy incurred by the government increased by 42 percent during 1991/1992 to 2011/2012. To date, the Indian government allocates a significant portion of its annual budget to providing the food subsidies. According to the *Economic Survey 2014–15,* USD 19 billion was spent on subsidizing rice and wheat alone (India, Ministry of Finance 2015). That is 80 times the entire food subsidy budget for Bangladesh for the 2014/2015 year (Bangladesh, Ministry of Finance 2014).

In recent years, especially in developing countries, rising food prices have been a concern for policy makers, and an increasing rice price in India is no exception. Food security is a top policy priority for the Indian government (India, Planning Commission 2013). In 2013, the Indian parliament passed the National Food Security Bill into law. The recently passed NFSA aims to include up to 75 percent of the rural population and up to 50 percent of the urban population (around 820 million people) under the coverage of subsidized food grain distribution through the TPDS. According to the NFSA, each eligible person is entitled to receive 5 kilograms of foodgrains composed of some combination of rice, wheat and coarse grains per month at a subsidized rate of Indian rupees (INR) 3 per kilogram of rice, INR 2 per kilogram of wheat, and INR 1 per kilogram of coarse grains (India, Ministry of Consumer Affairs 2013). The entire food subsidy program is executed through the existing TPDS like other previously executed food security–related programs such as the Antyodaya Anna Yojana.

As in many other developing nations, India’s food subsidy programs are just partially subsidized—that is, eligible consumers receive fixed portions of rice, wheat, and other basic commodities, such as sugar and cooking oil, from the government at a subsidized rate but must pay the market price to meet the remaining portion of their food demand (Ahmed 1988; Yitzhaki 1990). As Sicular (1988) pointed out, the income transfer resulting from the food subsidy could result in increasing demand for all goods, including food, and thus may raise food prices. Therefore, in general, if consumer demand is driven by an income effect, then less subsidy means less income and less demand for food, which will result in reduced food prices.

In the absence of trade in the wheat market, Ramaswami and Balakrishnan (2002) found that the subsidy program helps in reducing the wheat price in the open market. They pointed out that even though the market price may fall due to a reduction in subsidy, demand would not change as long as the market price remains above the subsidy price. Kishore and Chakrabarti (2015) note that in the states where the NFSA has been effectively implemented, the average rice purchased increased by 3 kilograms per month compared to the states where the NFSA is yet to be implemented. However, the supply response to a lower market price and the trade component were not considered in these studies. In this study, instead of focusing on the implementation of the food subsidy program, we shed light on the consequences of the NFSA on the market price of rice and its impact on the international rice market.

3. INDIA IN THE CONTEXT OF THE WORLD RICE MARKET

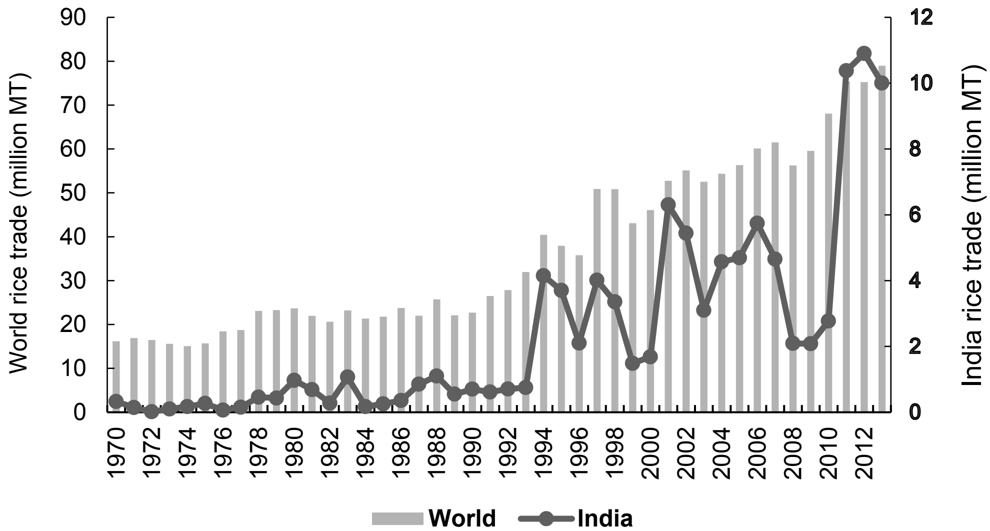
Food security has been the most important policy concern for the government of India. The government has always prioritized supplying India's domestic market at the expense of foreign markets by restricting exports. And rice is no exception, despite India's position as a major net rice exporter. Many researchers, including Timmer (2008), Gilbert (2010, 2011), Gilbert and Morgan (2010), and Dawe and Slayton (2011), have argued that the rice price spike during the 2007/2008 food crisis was not caused by low stocks or crop failure but rather by export restrictions by some major rice-exporting countries. In a study of rice prices in Bangladesh, Dorosh and Rashid (2013) using partial equilibrium simulations showed that a relatively small increase in consumption of rice rise stocks of rice by around 900,000 metric tons (MT), the equivalent of about two weeks of normal consumption, reduces the supply and increases domestic rice prices by about 45 percent. This increased price matched the historic price rise for the rice crop during the food crisis of 2007/2008 in Bangladesh. Another study, by John (2013), showed that in the case of Thailand, being a major rice-exporting nation did not isolate its domestic market from its export market. In fact, he found that even with the existence of domestic price distortion policies, Thailand's rice markets were competitive and thus its domestic pricing programs were not heavily distorting world rice markets.

Since trade liberalization under the Uruguay Round Agreement on Agriculture in 1995, the rice trade in the international market has doubled, and India has been a major contributor to that increase (Figure 3.1). However, even now, unlike other agricultural commodities such as wheat, soybean, and maize, only a small portion of the world's rice production is exported due to domestic policy objectives. According to the US Department of Agriculture (USDA PS&D 2014), in 2013 global rice exports accounted for about 8.6 percent of production, whereas soybean, maize, and wheat exports made up 32.6 percent, 11.8 percent, and 22.7 percent, respectively. India, the second-largest producer, consumer, and exporter of rice (Wailes 2005), displayed similar trends, with national government interventions in the market through price supports, public procurements and distribution of rice, trade subsidies, and trade restriction. Most recently, the Indian government imposed a consecutive three-year ban starting in 2008 on non-basmati-rice exports, resulting in a further increase in the global rice price during late 2007 to early 2008 (IRRI 2013). The head of the social science division of IRRI, Dr. Mohanty suggests that with the greater participation of India and China in the global rice market, the volume of trade is likely to increase, which would make the rice market more stable. He mentioned that in the future, the rice trade may account for 15 to 20 percent of total production, up from its current 6 to 8 percent (IRRI 2013).

According to the *FAO Rice Market Monitor* (FAO 2015), in the crop marketing year 2013/2014 India exported 10.5 million MT of rice, surpassing Thailand's rice export. In 2014/2015, too, India exported 12.1 million MT of rice, against Thailand's 10.5 million MT. In fact, the FAO forecasted that India will surpass Thailand in the rice export market in the 2015/2016 marketing year, too. The Southeast Asian countries, including Bangladesh, Nepal, and Sri Lanka, are the major importers of Indian rice. However, India's rice exports face tough competition in the price-sensitive African markets, where they have been regularly displaced by Thailand. It is plausible to imagine a situation where the supply of rice is tighter due to the expansion of government procurement under the implementation of the NFSA.

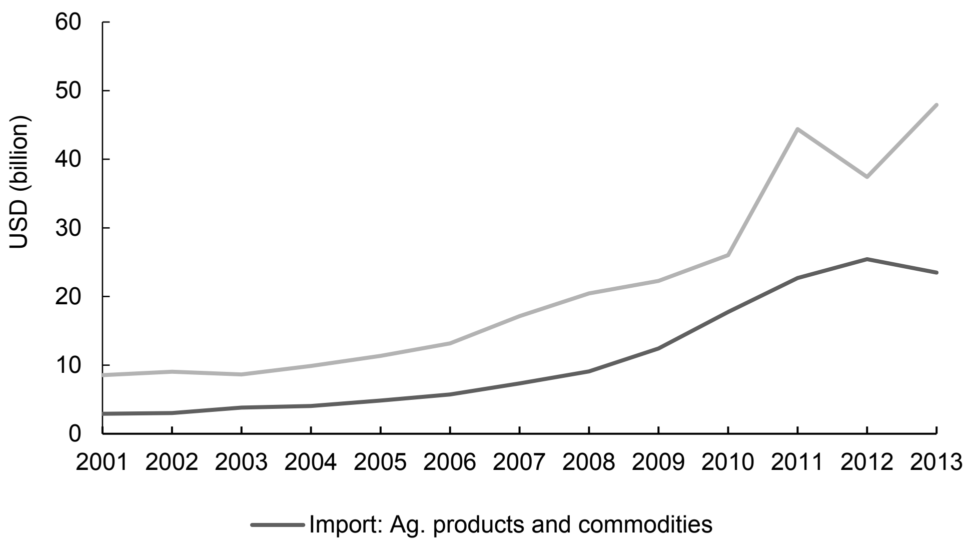
In recent decades, India's trade balance in agricultural commodities and products has been positive. Figure 3.2 shows a positive difference between the value of agricultural exports and agricultural imports. Among the major agricultural commodities, India's rice exports play a significant role. During fiscal year 2012–2013, India's net rice exports added USD 8.2 billion to the total agricultural products and commodities trade balance of USD 24.5 billion, hence constituting a handsome 33.5 percent (ITC 2013). However, the objective of providing subsidized food for the poorest of the poor people and the 2007/2008 non-basmati-rice export ban may have consequences for India's agricultural trade policy. Since rice is a major food grain in India, any governmental policy related to food security is likely to hinder India's rice exports.

Figure 3.1 World and India rice net trade



Source: Data compiled from USDA PS&D Online (USDA PS&D 2014).

Figure 3.2 Import and export values of major agricultural products and commodities for India



Source: ITC (2013).

4. IMPLICATIONS OF THE NFSA ON RICE MARKETS

As rice is one of the subsidized food grains under the NFSA, the act may affect India's rice exports and play a role in determining the global rice price. Policy makers are concerned about India's future role in the global agricultural commodity market in the context of this food security act. To achieve the target specified under the NFSA for fiscal year 2012–2013, according to the Ministry of Agriculture's Commission for Agricultural Costs and Prices, an additional 61.55 million MT of food grains, including 27.6 million MT of wheat and 33.6 million MT of rice, would be required (USDA FAS 2013). Based on economic theory and existing literature, the NFSA could raise demand for food grains (mainly wheat and rice), with the intensity of the increase depending on the relative increase in the supply of those commodities. This excess demand pressure could spill over to market prices of food grains.

Therefore, the broader question is whether the NFSA can reduce the persistent food price inflation in the domestic market by improving food consumption and reducing food insecurity. The primary objective of this study is to determine the long-term impact of India's NFSA on rice exports and on the market price of rice. The secondary objective is to determine its consequences across the global agricultural commodity markets. In the next section, we develop our model to understand the effects of the NFSA on domestic and the global rice market.

5. DATA AND SIMULATION MODEL

In this section, we develop a structural demand-and-supply model for India's rice market and apply it to data. The demand side of the rice market consists of consumption (D_t^R), exports (E_t^R), and ending stocks (S_{t+1}^R), while production (O_t^R), imports (I_t^R), and beginning stocks (S_t^R) are the components of the supply side. The following mathematical equation shows the equilibrium condition:

$$S_t^R + O_t^R + I_t^R = D_t^R + E_t^R + S_{t+1}^R . \tag{1}$$

At the equilibrium, all the demand and supply equations interact with each other and solve for the optimal price and quantity.

The production, consumption, and rice trade volume data are primarily obtained from the USDA Foreign Agricultural Service (FAS) Production, Supply, and Distribution (PS&D) dataset. Macroeconomic data are obtained from the International Monetary Fund and IHS Global Insight, while commodity price data are obtained from USDA attaché reports and other sources. Domestic prices of rice and other agricultural commodities of the importing and exporting countries are obtained from the FAO's PriceSTAT database. Each component of equation 1 is specified below.

Rice Production

Rice is mainly considered a *kharif* crop—that is, one that is sown from June to July and harvested from November to December. However, in some parts of India, mainly Assam and West Bengal, *boro* rice is grown as a *rabi* crop with sowing from November to February and harvesting from March to June. Traditionally, rice does not compete with wheat for land because of differences in cropping season, except in places where rice is grown as a *rabi* crop. However, in this study we use a single equation representing the aggregate rice production for India. Therefore, along with soybean as a major *kharif* crop, we consider the *rabi* crop wheat as the substitute crop in the rice production area equation (equation 3). Along with the domestic prices of rice and wheat, the government procurement minimum support prices of rice and wheat are used in simulating the production of rice in the future years. The following equations determine the production of rice:

$$O_t^R = A_t^R * Y_t^R , \tag{2}$$

$$A_t^R = \alpha_0 + \alpha_1 R_{t-1}^R + \alpha_2 R_{t-1}^W + \alpha_3 R_{t-1}^S + \delta \text{ , and} \tag{3}$$

$$Y_t^R = \beta_0 + \beta_1 T_t^R + \lambda , \tag{4}$$

where A_t^R is the area under rice production and Y_t^R is the rice yield in year t. Equation 3 shows that the area under rice production in year t depends on the returns derived in the previous year $t-1$, from rice (R_{t-1}^R), wheat (R_{t-1}^W), and soybean (R_{t-1}^S) production, respectively. α_0, α_1, and α_2 are the slope coefficients of the area harvest equation, and δ is the corresponding error term. Equation 4 shows how rice yields (Y_t^R) depend on the time trends (T_t^R). β_0 and β_1 are intercept and slope coefficients corresponding to the rice yield equation, and λ is the error term. The returns derived from rice (R_t^R), wheat (R_t^W), and soybean (R_t^S) production use the following functional form:

$$R_t^R = \max(M_t^R, P_t^{DR}) - C_t^R , \tag{5}$$

$$R_t^W = \max(M_t^W, P_t^{DW}) - C_t^W \text{ , and} \tag{6}$$

$$R_t^S = P_t^{DS} - C_t^S \, , \tag{7}$$

where M_t^R and P_t^R are the government minimum support price and the domestic market price of rice in year t; M_t^W and P_t^W are the government minimum support price and the domestic market price of wheat in year t; P_t^S is the domestic market price of soybeans (in the case of soybeans, government support is not included); and C_t^R, C_t^W, and C_t^S are the costs of production of rice, wheat, and soybeans in year t, respectively.

Domestic Rice Consumption

The domestic per capita demand for rice in India is subdivided among two broader categories: (1) urban consumption, and (2) rural consumption. Own, cross price, and income elasticities of demand for rice consumption vary across urban and rural consumers. Therefore, instead of modeling the aggregated domestic rice demand equation, we estimated the per capita urban and rural rice demand separately. The elasticities for the per capita domestic urban demand for rice in India are less elastic than the rural consumer's rice demand. Urban and rural per capita rice consumption equations are as follows:

$$D_t^R = D_t^{UR} + D_t^{RR} \, , \tag{8}$$

$$D_t^{UR} = \mu_0 + \mu_1 P_t^{DR} + \mu_2 P_t^{DW} + \eta Y_t^R + \phi \text{, and} \tag{9}$$

$$D_t^{RR} = \nu_0 + \nu_1 P_t^{DR} + \nu_2 P_t^{DW} + \vartheta Y_t^R + \varphi \, , \tag{10}$$

where D_t^{UR} and D_t^{RR} are the urban and rural demand for rice in year t; P_t^{DR} and P_t^{DW} are the domestic market price of rice and wheat in year t; Y_t^R is the real per capita income of the urban and rural consumers; μ_0, μ_1, μ_2, and η are the intercept and slope coefficients and ϕ is the associated error term corresponding to the per capita urban rice demand equation; and ν_0, ν_1, ν_2, and ϑ are the intercept and slope coefficients and φ is the associated error term corresponding to the per capita urban rice demand equation, respectively.

Rice Exports

Based on the fact that in recent years India has become a major exporter of rice, we modeled the net export equation. However, depending on the sign of the net export it can turn into a net import. Both the domestic rice price (P_t^{DR}) and international rice price (P_t^{IR}), which is the Thailand rice price in this case, are included in the export equation. The functional form of the rice export is represented as

$$E_t^R = \kappa_0 + \kappa_1 \frac{P_t^{DR}}{P_t^{IR}} + \kappa_2 \max((P_t^{DR} - P_t^{IR}),0) + \kappa_3 \min((P_t^{DR} - P_t^{IR}),0) + \kappa_4 S_t^R + \psi \, , \tag{11}$$

where κ_0, κ_1, κ_2, κ_3, and κ_4 are the intercept and the slope coefficients of the associated terms within the Indian rice export equation, and ψ is the corresponding error term. All other variables are explained earlier. In the case where India becomes a net importer of rice, the max function (third term) is triggered; the fourth term (min function) is triggered when India exports rice. Since India is a major rice exporter, we assume κ_2 is greater than κ_3 (in the absolute term), which means India's rice import is more price sensitive.

Stocks

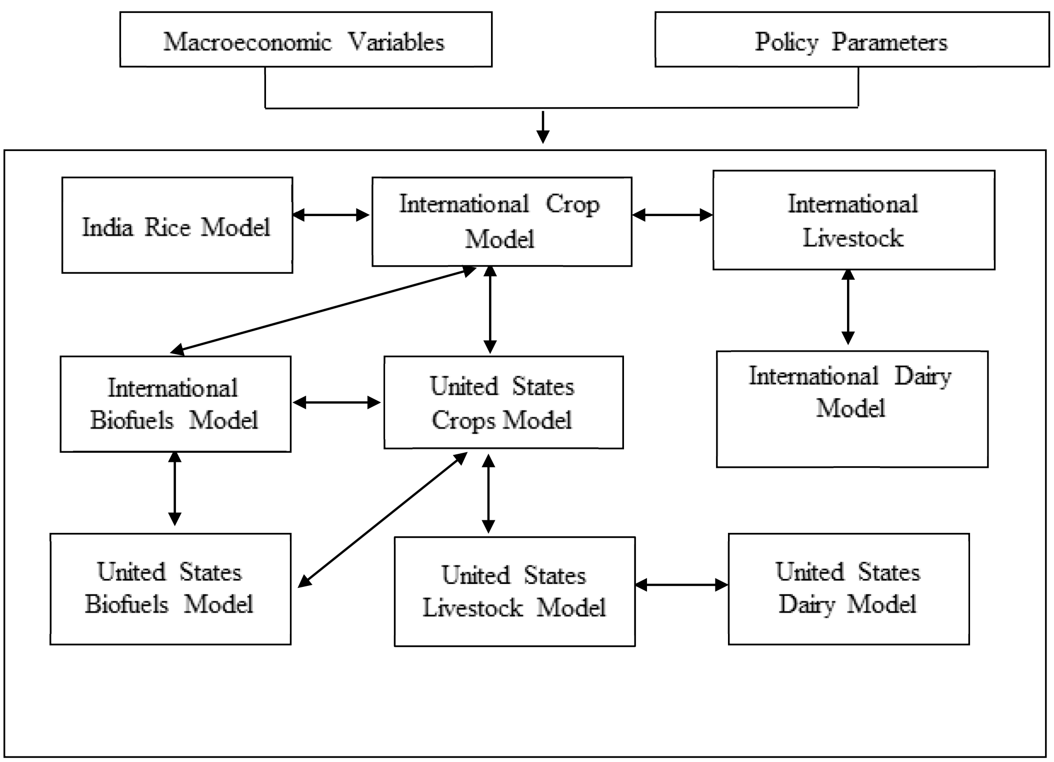
The stocks of rice are driven in the main by two factors: (1) the production of rice (P_t^R), and (2) the domestic market price of rice (P_t^R) in the given year t. Below is the stock equation:

$$S_t^R = \varpi_0 + \varpi_1 P_t^R + \varpi_2 O_t^R + \iota \,, \tag{12}$$

where ω_0, ω_1, and ω_2 are the estimated parameters of the intercept and slope coefficients of the stock equation; O_t^R is the total amount of rice produced in year t; and ι is the corresponding error term.

Based on the above sets of equations, the multimarket, multiregion, partial modeling representing the rice market of India is developed and linked with the existing Food and Agricultural Policy Research Institute (FAPRI) global agricultural modeling system, as shown in Figure 5.1. The model is solved for the market clearing price, taking into account the existing agricultural and trade policies of major rice-producing and -consuming countries. The world rice market is cleared within a broad partial equilibrium modeling system of the international agricultural commodity markets. The rice component is a multimarket model, which includes major world rice-producing and -consuming countries. Similar to India's rice market model, the global agricultural model is developed based on basic economic principles of demand and supply. Following the general structure of the model, the mathematical identity mentioned in equation 1 is satisfied for each country/region and the world. In addition to domestic and trade policies, macroeconomic variables such as petroleum price, population, exchange rate, and gross domestic product (GDP) are considered as the exogenous variables in the model.

Figure 5.1 Linkage between the India rice model and the FAPRI global agricultural modeling system



Source: Authors' compilation.

6. MODELING RICE SUBSIDIES UNDER THE NFSA

The government of India introduced the NFSA in 2013. According to this law, 50 percent of the urban population and 75 percent of the rural population of India should receive 5 kilograms foodgrains in some combination of rice, wheat, or coarse grain (millet) per month at the subsidized price of INR 3 per kilogram (rice), INR 2 per kilogram (wheat), and INR 1 per kilogram (coarse grain). This subsidy can have an income effect and a price effect, both of which are described below.

Subsidy as Inelastic and Elastic Income Effect

Since rice is a staple commodity, a decrease in the (subsidized) price of rice will not directly increase the consumption of rice. However, it will result in an indirect cash transfer—that is, the consumer will have more money to spend (Sicular 1988). Based on this concept, the rice subsidy results in an income effect. The difference between the market price and the subsidized price of rice multiplied by the subsidized quantity of rice is used to derive the additional income terms (shown in equations 13 and 14). After incorporating the government subsidy, the new urban and rural per capita rice demand and income in India are as follows:

$$I_t^U = (P_t^{DR} - P_t^{SR})Q_t^{UR} + (P_t^{DW} - P_t^{SW})Q_t^{UW} + (P_t^{DC} - P_t^{SC})Q_t^{UC}, \qquad (13)$$

$$I_t^R = (P_t^{DR} - P_t^{SR})Q_t^{RR} + (P_t^{DW} - P_t^{SW})Q_t^{RW} + (P_t^{DC} - P_t^{SC})Q_t^{RC}, \text{ and} \qquad (14)$$

$$I_t = U_t \times I_t^U + R_t \times I_t^R, \qquad (15)$$

where the terms and I_t^U and I_t^R are the additional per capita income derived from purchasing; Q_t^{UR} is the allotted quantity of rice in the urban area and Q_t^{RR} is the allotted quantity of rice in the rural area at a subsidized price of P_t^{SR}; Q_t^{UW} is the allotted quantity of wheat in the urban area and Q_t^{RW} is the allotted quantity of wheat in the rural area at a subsidized price of P_t^{SW}; and Q_t^{UC} is the allotted quantity of coarse grains in the urban area and Q_t^{RC} the amount of coarse grains in the rural area at a subsidized price of P_t^{SC} in year *t*, respectively. Equation 15 represents the overall increase in GDP (I_t) due to the NFSA's implementation. R_t and U_t represent the rural population and urban population in year *t*, derived based on the ratio of rural to urban population.

Based on the NFSA subsidized price of rice, wheat, and coarse grain, in this study we introduce the government-subsidized grain prices at INR 3 per kilogram of rice, INR 2 per kilogram of wheat, and INR 1 per kilogram of coarse grain to 50 percent of the urban and 75 percent of the rural population. Under the NFSA, each qualified person will receive 5 kilograms of food grains per month at the above-mentioned subsidized price. In other words, half of the total urban population will receive 60 (5 × 12) kilograms of rice, wheat, and coarse grain in a year and three-fourths of the rural population will receive the same amount of food grains in a year. For simplicity, we convert the subsidy quantity among the entire urban and rural populations—that is, all of the urban population of India will receive 30 (60 × 1/2) kilograms of the food grains each year while all of the rural population will receive 45 (60 × 3/4) kilograms of the food grains in a year at the subsidized rate.

The income subsidy effects are simulated under two scenarios: (1) the subsidy inelastic income effect, and (2) the subsidy elastic income effect. Over the years, many researchers have reported India's income elasticity for rice consumption. Pons (2011) estimated India's income elasticity for rice consumption for rural consumers as −0.42 and urban consumers as −0.14. Kumar et al. (2011) estimated the rice income elasticities for four income groups: the very poor (0.18), the moderately poor (0.10), the nonpoor lower (0.03), and the nonpoor higher (−0.03). Jha, Srinivasan, and Landes (2007) reported the average income elasticity for rural consumers, a group that includes people from the poor, middle, and rich income class categories, as 0.81 and for urban consumers as 0.70. Goyal and Singh (2002) estimated the income elasticity for rice consumption based on 1987/1988 and 1993/1994 data: they reported the 1987/1988 rural and urban elasticity as 0.37 and 0.31, respectively, and the 1993/1994 rural and urban elasticity as 0.21 and 0.20, respectively. Kumar et al. (2009) estimated India's income elasticity for rice consumption for urban consumers as 0.06 and for rural consumers as 0.02.

In this study, we conservatively assume an urban and a rural income elasticity for rice consumption of 0.02 and 0.06 (Kumar et al. 2009) to generate the baseline projection for India's rice consumption path over the next 10-year period. The subsidy inelastic income effect scenario is simulated by including equations 13 through 15. We further test the subsidy elastic income effect scenario by increasing the urban and rural income elasticities of rice consumption to 0.25 and 0.50, respectively, in the baseline, and compare the results with the elastic income effect.

Subsidy as Price Effect

Without knowing how consumers will treat the subsidized prices or considering the fact that consumers will pay the market price for rice that they consume beyond the subsidized quantity, the analysis would be incomplete. Hence, we further simulate the subsidy as a price effect on rice demand where the consumer will pay a price that is lower than the domestic market price. The revised domestic prices are as follows:

$$P_t^{UR} = (P_t^{DR} - SP_t^{U}) \text{ , and} \tag{16}$$

$$P_t^{RR} = (P_t^{DR} - SP_t^{R}) \text{ ,} \tag{17}$$

where P_t^{UR} and P_t^{RR} are the market price of rice in urban and rural India after excluding the government subsidy on rice in urban (SP_t^U) and rural (SP_t^R) India. Even though the rice subsidy is on a volumetric basis, for simplicity the subsidy is incorporated as a price subsidy, that is, the price of subsidized rice multiplied by the allocated quantity of rice under the NFSA. Next, we generate the results for the baseline and use it to derive our results.

7. BASELINE AND SCENARIOS

The first step in the modeling process is the generation of a baseline. The models that form the basis of this analysis were simulated in January 2016 using policies operational at that time and the market information available. The global rice model includes the government policies implemented in the rice sector by all major rice-producing and -consuming countries. Our model assumes that China will continue holding rice stocks in the coming years considering the continuation of existing policies relevant to food security issues. However, since Thailand has already released around 1 million and 1.6 million MT of rice in the 2013/2014 and 2014/2015 crop years, we assume that the Thai government will continue to release the stocks for the 2016/2017 year before it starts slowly building new rice stocks. In 2014, the United States passed the Agricultural Act, commonly known as the Farm Bill. Instead of continuing the Direct and Counter-cyclical Payment Program, the new bill introduced the Average Crop Revenue Election Program and the Price Loss Coverage Program starting with the 2014 crop year. The policies based on the 2014 Farm Bill are included in the baseline simulation.

We analyze three alternative scenarios to evaluate the impact of India's NFSA on the domestic and international rice markets: (1) subsidy inelastic income effect; (2) subsidy elastic income effect; and (3) subsidy price effect.

8. RESULTS AND DISCUSSION

In this paper, we uncover the domestic and global market implications of the large-scale subsidized food distribution system in India. We find that the price of rice in the domestic market changes more when the rice subsidy under the NFSA is introduced as a price effect than when it is introduced as an income effect. However, in the international market even though India is a major exporter of rice, any domestic rice price subsidy policy, including the NFSA, has minimal impact on the Thailand (world) rice price (Table 8.1).

In Table 8.2, we show that when the rice subsidy is introduced as a price effect, the domestic market rice price increases by INR 1.38 per kilogram. If the domestic price is always below the international price, the average rice area harvest in 2023/2024–2024/2025 increases by 2.5 million hectares per year. Domestic consumption is increased by 6.28 percent due to the implementation of the rice subsidy through the NFSA as the price effect results in increasing the rice price in India. The increase in rice consumption in India due to the rice subsidy as a price effect results in a decrease in rice exports by 93,000 MT in 2023/2024–2024/2025. In Thailand, the consequence of India's food subsidy policy for the consumption, production, and exports of rice is limited. Thailand's rice production will increase by 19,000 MT, and its rice exports will increase by 20,000 MT (Table 8.2).

However, in the case of the inelastic income effect, the impact of the rice subsidy is minimal. When we assume an inelastic income effect for both urban and rural consumers in India and introduce the rice subsidy as an income effect, there is no change in the Thailand (world) rice price (Table 8.1). Therefore, the production, consumption, and exports of rice in Thailand remain the same as compared to the baseline scenario. The production and consumption of rice in India increases by 31,460 MT and 31,960 MT, respectively; resulting in a decrease of 360 MT of rice exports (Table 8.2).

We see no significant changes in rice demand or supply in either India or Thailand when we assume an elastic income effect. However, the domestic rice price increases by 0.11 percent in the case of an elastic income effect compared with a 0.02 percent increase in the case of an inelastic income effect scenario. This would result in an increase in production and consumption of rice in India of 265,000 MT and 269,000 MT, respectively, and a 2,000 MT decrease in exports (Table 8.2). The elastic income effect scenario has minimal effect on the Thailand (world) rice price, increasing it by 1 cent (in USD) per MT. That rise in price will cause Thailand's production and exports to increase by 570 and 590 MT and consumption to decrease by 20 MT per year in 2023/2024–2024/2025, respectively.

Table 8.1 Comparison of rice price under baseline and three different subsidy scenarios

		Baseline		Subsidy price effect			Subsidy inelastic income effect			Subsidy elastic income effect		
Country	Unit	Average 2013/2014–2014/2015	Average 2023/2024–2024/2025	Average 2023/2024–2024/2025	Absolute change	%age change	Average 2023/2024–2024/2025	Absolute change	%age change	Average 2023/2024–2024/2025	Absolute change	%age change
India	INR per kg	20.43	28.83	30.21	1.38	4.78%	28.83	0.00	0.02%	28.86	0.03	0.11%
	USD per MT	323.54	435.86	456.69	20.83	4.78%	435.93	0.07	0.02%	436.33	0.47	0.11%
Thailand	USD per MT	441.54	481.59	482.10	0.50	0.10%	481.59	0.00	0.00%	481.60	0.01	0.00%

Source: Authors calculation.
Note: INR= Indian rupees; USD= US dollars; MT= metric tons.

Table 8.2 Comparison of rice production, consumption, and net exports under baseline and three different subsidy scenarios

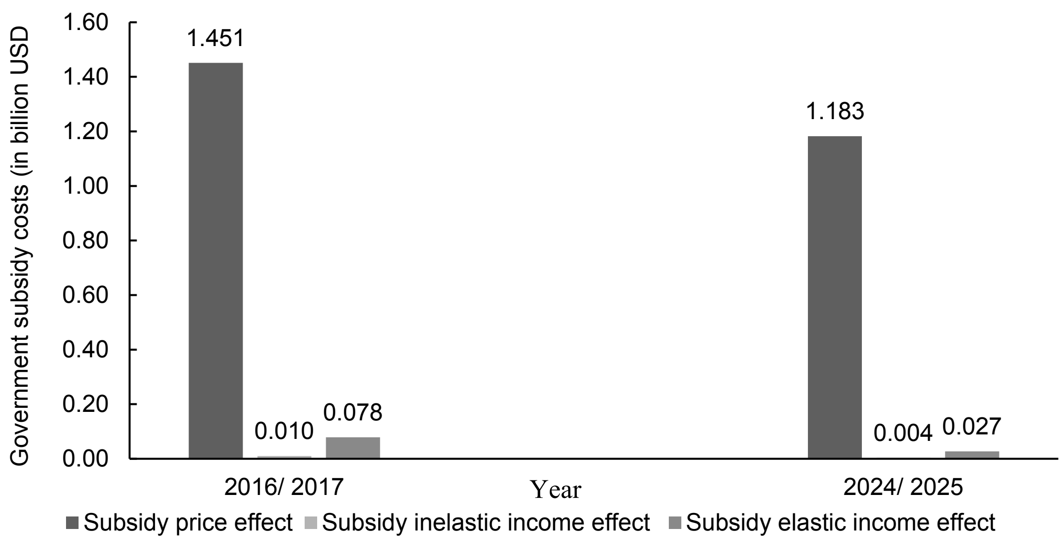
		Baseline		Subsidy price effect			Subsidy inelastic income effect			Subsidy elastic income effect		
	Unit	Average 2013/2014–2014/2015	Average 2023/2024–2024/2025	Average 2023/2024–2024/2025	Absolute change	%age change	Average 2023/2024–2024/2025	Absolute change	%age change	Average 2023/2024–2024/2025	Absolute change	%age change
India												
Area harvest	1,000 ha	43,182	44,544	47,802	2,539	5.70%	44,556	11.84	0.03%	44,644	100	0.22%
Production	1,000 MT	105,562	118,444	125,194	6,750	5.70%	118,476	31.46	0.03%	118,709	265	0.22%
Consumption	1,000 MT	97,070	108,683	115,513	6,831	6.28%	108,715	31.96	0.03%	108,951	269	0.25%
Net exports	1,000 MT	10,963	9,544	9,451	-93	-0.98%	9,544	-0.36	0.00%	9,542	-2	-0.03%
Thailand												
Area harvest	1,000 MT	10,676	11,258	11,269	11	0.09%	11,258	-0.01	0.00%	11,259	0.29	0.00%
Production	1,000 MT	19,803	22,034	22,053	19	0.08%	2,034	-0.02	0.00%	22,035	0.57	0.00%
Consumption	1,000 MT	10,992	11,778	11,777	-1	-0.01%	11,778	0.00	0.00%	11,778	-0.02	0.00%
Net exports	1,000 ha	8,564	10,207	10,227	20	0.19%	10,207	-0.02	0.00%	10,208	0.59	0.01%

Source: Authors calculation.
Note: MT= metric tons.

The expenditure to implement the rice subsidy under the NFSA incurred by the Indian government in the first year (2016/2017) and last year (2024/2025) of the projection period is shown in Figure 8.1. In India, in the 2016/2017 crop year, the rice subsidy program is projected to cost USD 1.45 billion, USD 10 million, and USD 78 million, respectively, when introduced as a price effect, an inelastic income effect, and an elastic income effect. However, in 2024/2025 the costs could decrease to USD 1.18 billion, USD 4 million, and USD 27 million, respectively. The cost of the subsidy decreases by USD 269 million over a period of 10 years when the rice subsidy in India is introduced as a price effect (Figure 8.1). However, this is not the case when the subsidy is introduced as an income effect.

In the case of the inelastic income effect, the cost of the government subsidy drops by USD 6 million from 2016/2017 to 2024/2025, and assuming an elastic income effect the cost decreases by USD 51 million during the same period of time. The implementation of a new food subsidy policy (NFSA) results in higher government expenditure at the beginning of the projection period (2016/2017) compared with the end of the projection period (2024/2025). This trend is consistent across the three different scenarios. Implementation of a new policy always costs more initially. The government expenditure is greater when the subsidy is introduced as a price effect than when the subsidy is introduced as an income effect, and that is consistent across the projection years.

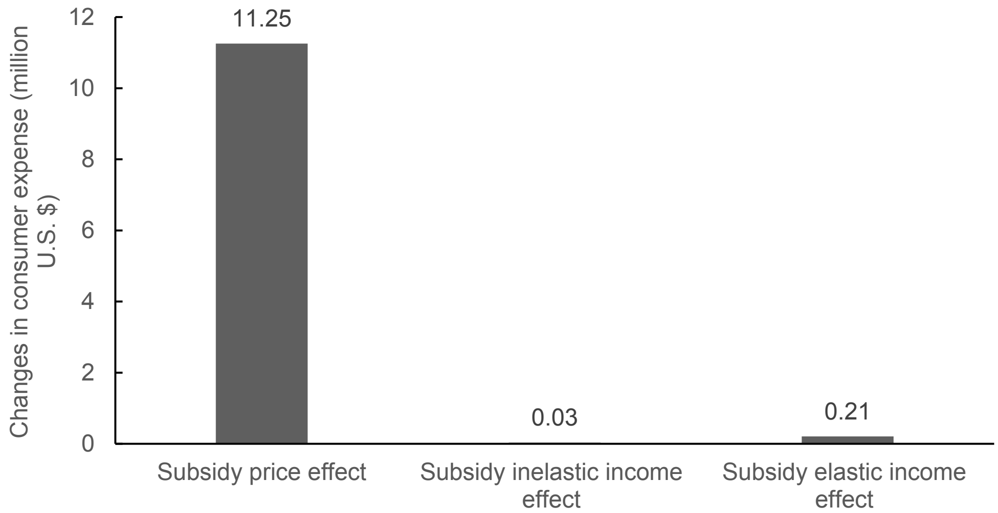
Figure 8.1 Comparison of government costs under the NFSA for 2016/2017 and 2024/2025



Source: Authors calculation.

Figure 8.2 shows that in all three scenarios consumer expenses on rice increase even though the government provides a subsidy. Consumer expenses on rice in 2024/2025 could increase by USD 11.25 million, USD 0.03 million, and USD 0.21 million, respectively, when India introduces the government rice subsidy as a price effect, an inelastic income effect, and an elastic income effect. An increasing domestic rice price is the main factor driving these findings. The increase in consumer expense is the highest when the government rice subsidy is introduced as a price effect and lowest in the case of the inelastic income effect. Table 8.1, Table 8.2, and Figure 8.2 demonstrate that if the NFSA's objective is to increase rice consumption in India, then the outcomes derived from the inelastic and elastic income effects are insignificant while the price effect scenario increases overall rice consumption in India. However, that leads to an increase in the price of rice in India, and consumers end up spending more on rice consumption as the subsidized quantity of rice is only a fraction of their total rice demand.

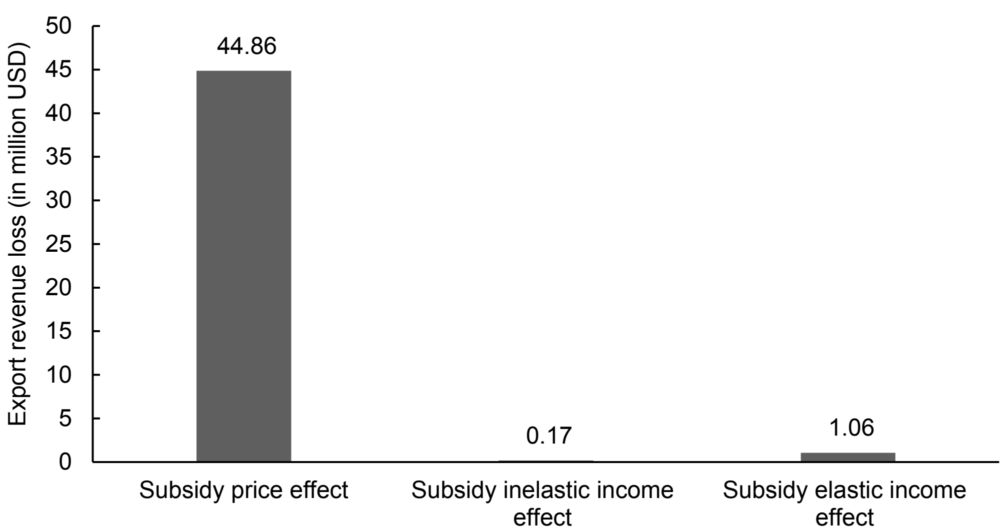
Figure 8.2 Consumer expenses under the three subsidy scenarios



Source: Authors calculation.

The implementation of the NFSA may result in revenue loss due to a reduction in India's exports, as Figure 8.3 shows. The average decline in export revenue associated with rice exports due to the implementation of the NFSA in 2024/2025 could be USD 44.86 million, USD 0.17 million, and USD 1.06 million, respectively, when the rice subsidy in India is introduced as a price effect, an inelastic income effect, and an elastic income effect. The results show the highest export revenue loss under the price effect case, followed by the elastic and inelastic income effect cases. If India is to remain a top rice exporter, its government should decide carefully the best way to introduce and implement the NFSA so as not to hurt the country's rice exports. Our simulation results show that the rice subsidy introduced as an inelastic income effect has the minimum impact on India's export revenue loss. However, the inelastic income effect scenario significantly has no effect on the demand and supply side in India.

Figure 8.3 India's export revenue loss due to the NFSA rice subsidy



Source: Authors calculation.

9. CONCLUSIONS AND POLICY RECOMMENDATIONS

Policy makers in India and other developing countries continue to search for optimal food price policies that will not overly distort the domestic and global food markets and that will ensure food security for all. For this, distribution of subsidized food through public channels remains one of the most widely used food policy interventions. Even as the debate on the efficiency and effectiveness of a food-based intervention versus a cash-based transfer continues, we still do not fully understand the implications of large-scale subsidized food distribution systems.

India's National Food Security Act has generated much debate among policy makers. Although some are highly skeptical that its implementation can fully alleviate poverty and food insecurity in India, political pressure continues to focus on providing broad social safety nets that will leave no one in hunger. In addition, policy makers are seriously considering moving from food-based food security interventions to cash-based entitlements. This is particularly gaining momentum in the context of high use of the banking system to transfer funds directly to intended beneficiaries and the recognition that a good deal of leakage and wastage exists in the current public distribution system. In this paper, we have tried to shed some light on the impact of the NFSA on India's rice market and trade, considering that the country was the largest exporter of rice for two consecutive years, 2013 and 2014 (FAO 2014). We find that when the rice subsidy under the NFSA is introduced as an income (elastic and inelastic) effect, the outcome in terms of rice consumption does not change significantly. However, when the rice subsidy is introduced as a price effect, it causes changes in rice consumption in India resulting in a decrease in the country's rice exports.

Hence, in the long run, the NFSA may have a negative impact on rice, a major agricultural export commodity for India. In fact, since agriculture is the only sector for which India's terms of trade are positive (exports are greater than imports), a policy that reduces agricultural exports may have a negative impact on the country's agricultural terms of trade and on the overall economy. Policy makers need to pay more attention to such indirect consequences of large food subsidy programs on the Indian economy. In addition to the considerable government revenue required to implement the NFSA, policy makers should consider the indirect costs, such as those posed by a reduction in the agricultural exports revenue, associated with the program. Further research is needed to answer the larger question of whether the NFSA could help India's economic growth and alleviate food insecurity and poverty at the household level if it were implemented through a cash transfer program instead of a subsidy.

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