Chapter 8

ECONOMYWIDE EFFECTS AND IMPLICATIONS OF ALTERNATIVE POLICIES

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The preceding chapters have focused on specific policy challenges and opportunities for transforming the domestic rice economy with regard to consumption, production, milling, marketing, and trade. This chapter considers the economywide effects of these policies on the sector's competitiveness with imports and income growth, as well as on the broader economy. Depending on how the rice sector is integrated into the rest of the agricultural sector and economy, policies targeted at the sector can significantly impact economic welfare through the effects on producer prices, food prices, rural and urban incomes, and overall economic performance. This is especially true for Nigeria, given that many staple crops may substitute for rice from both production and consumption perspectives.

The objective of this chapter is to assess the potential economywide effects of rice-sector policies on sector output growth and competitiveness with imports, changes in the sector and overall food prices, rural income growth, and overall economic performance. More specifically, we ask the following questions: (1) Which policies are likely to increase rice production and substantially reduce rice imports? (2) What are the characteristics of such production growth? (3) How will these policies affect production in the agricultural sector generally, food price inflation, food consumption, and other economywide effects? We use an economywide multimarket (EMM) model developed for Nigeria to analyze these questions. The chapter also briefly discusses the potential opportunity costs of pursuing a rice import substitution policy, in order to provide some partial insights into the cost of implementing key policies identified through the model's simulations.

The chapter begins with a brief introduction of the EMM model, its appropriateness for addressing the broad policy questions being asked, and the policy scenarios to be simulated by the model to reflect these. Three broad scenarios are considered: increased productivity from improved technology use, reduced marketing costs from market improvements, and import restrictions. Results are presented in the sections that follow and according to each scenario. We find the combination of the first two scenarios, adoption of improved technologies and improved markets, to have the highest potential impact on output growth, competitiveness with imports, and overall economic welfare. Nevertheless, because of the desire by the government to protect local rice producers through import restrictions during these early stages of transforming the domestic rice sector, we also offer a discussion of its utility as a policy instrument for promoting import substitution or price stabilization. The final section summarizes and concludes the chapter based on the model simulation results and discussion.

An Economywide Multimarket Model for Nigeria

An EMM model developed for Nigeria is particularly suitable for our purposes, as it not only captures the detailed structure of the agricultural sector but can be particularly useful for dealing with data limitations at the economywide level. Normally, a computable general equilibrium (CGE) model is more suitable for assessing economywide impacts of policy changes, as it builds on the entire structure of the economy. However, it does not break down the agricultural sector in as much detail as the EMM model or other types of agricultural sector models are able to. Moreover, the CGE model requires a detailed and accurate social accounting matrix, which is not always available due to data limitations. This was also the case for Nigeria. Therefore, for our purposes given data limitations, the EMM model proved to be the most appropriate approach. This type of model has been applied in several contexts in Africa south of the Sahara to analyze the agricultural growth options of a country or region (see, for example, Diao and Nin-Pratt 2007 for Ethiopia; Nin-Pratt et al. 2011 for the West African region; and Omamo et al. 2007 for the East and central African regions).

The generic EMM model, like other multimarket economic models, is derived from neoclassical microeconomic theory and designed to analyze the impact of a wide range of sectoral policies by measuring the interaction and interrelationships among markets in the economy. These economic relationships rely on estimates of actual demand and supply behavior in response to price and income changes. These models are easily adaptable to different specifications and level of detail within a sector or across multiple sectors with respect to production, demand, and price relationships.[1] For the Nigerian

1 For interested readers, Diao et al. (2007) provide more detail on the mathematical derivation of the generic EMM model developed at the International Food Policy Research Institute and adapted for the analysis in this chapter.

model, for example, a more detailed rice sector is specified for both demand and supply to enable a more accurate assessment of the likely responses to policy changes.

The Nigerian EMM model is designed to incorporate a detailed agricultural sector, including a more elaborate rice subsector, together with the rest of the economy. Within agriculture, there are 41 subsectors or commodities in total: 26 crops, 5 livestock products, 2 fishery products, and 8 animal products.[2] For the rest of the economy, two aggregate nonagricultural sectors are specified. An aggregate production function for each agricultural and nonagricultural sector has prices as its arguments. Production functions at the commodity level explicitly incorporate both a yield and an area of cultivation function and are defined at the state level (37 states in total). We do so in order to investigate the sources of output changes—yield increases or acreage expansion. The production function for rice is further disaggregated into four production subsystems: upland, lowland, irrigated rice, and other (a residual that represents all other types of rice production subsystems, such as deepwater or swamp rice).

Six types of demand are considered: food, seed, feed, processed, waste, and other. While food demand for a particular product is a function of prices and per capita income, other types of demand are assumed to be proportional to either own-production (for example, seed demand) or the relevant primary production (for example, feed demand proportional to livestock production and processed demand for livestock proportional to meat production). The food demand function for a particular good is defined for rural and urban population respectively, and total food demand is the sum of rural and urban demand. The domestic price for a given product is endogenously determined by the equilibrium between domestic supply and demand when that price is a departure from either import or export parities, which are defined as import or export prices adjusted for import or export tariffs and trade margins. For import (export) commodities (such as rice and wheat), prices are determined as the sum import (export) parities plus (minus) import (export) taxes and trade margins. A detailed description of an EMM model can be found in Diao and Nin-Pratt (2007).

Data used to construct the Nigerian EMM model are obtained from various sources. The agricultural production data at state level are from the Nigerian National Bureau of Statistics (NBS) (Nigeria, NBS 2013b), while FAO (2012) data are used for crops or livestock products not included in the

2 The full list of 41 agricultural sectors is provided in Appendix G.

NBS data. The two nonagricultural sectors are defined as industry and service value-added using data from the World Development Indicators (2012). With the exception of rice, the commodity trade data and data for the six types of demand are also from FAO (2012). We use COMTRADE data (UN Statistics Division 2012) to calculate rice imports. Finally, we use the Living Standards Measurement Study–Integrated Surveys on Agriculture (LSMS–ISA) (Nigeria, NBS and World Bank 2011) to calculate rural and urban food demand. We chose 2010 as the base year for the model partly because the LSMS–ISA (2011) were collected in the harvest season of 2011. Production, consumption, and trade patterns in this year are therefore likely to reflect the 2010 conditions.

As a policy simulation tool, the choice of elasticities for both the supply and demand specifications of the Nigerian EMM model will affect results. Ideally, the elasticities should be econometrically estimated if sufficient data are available. When such data are not available, the elasticities can be obtained from evidence in the literature or calibrated from the model itself. For demand, elasticities were based on model calibrations using income elasticities of demand as a basis for the calculations. The income elasticities are derived from econometric estimates using the LSMS–ISA (2011) described in Chapter 2. With more than 40 agricultural sectors included in the model and substantial data limitations, it is impossible to estimate the supply elasticity econometrically for all crops. Instead we use an estimated direct or own-price elasticity of 0.2 for rice based on the analysis presented in Chapter 4. In the supply functions for all other crops, we chose to use the same own-price elasticity value of 0.2, as this corresponds well with others in the literature despite variations around this mean (see, for example, Thiele 2000, 2003; Alemu, Oosthuizen, and van Schalkwyk 2003; Abrar, Morrissey, and Rayner 2004; Leaver 2004; and Olubode-Awosola, Oyewumi, and Jooste 2006). Cross-price elasticities were calculated for all crops by multiplying the direct or own-price elasticity by the share of the relevant sector's production in the total value of agricultural production. Given the economywide feature of the EMM model, the simulation results are generally not sensitive to the choice of the own-price supply elasticity in a range from minus 50 percent to plus 50 percent of the value we chose. We use the budget expenditure shares and income elasticities estimated in Chapter 2 to derive price elasticities of demand, assuming a linear expenditure demand system for which the budget constraint is satisfied for each demand function.

Rice is the focus of this book, and we therefore pay greater attention to the design of the rice sector in the model. We distinguish two types of rice—low-quality rice (standard) and high-quality rice (premium), as discussed in

Chapter 5. From Chapter 2, we found that many local varieties of rice are only weakly substitutable with imported rice due to their poor quality. Thus, we assume that the low-quality varieties of rice (or standard local rice) do not provide strong competition for imported rice. On the other hand, there are high-quality local rice varieties that are highly substitutable with imported rice (premium local rice). These two assumptions imply that the low-quality rice is produced and consumed domestically and its price is endogenously determined by the equilibrium condition in the domestic market, while the price for the high-quality rice (local and imported) is determined by import parity. Although low, we assume some degree of substitutability between the two types of rice, which is reflected in the model by non-zero cross-price elasticities of demand. This is a fair assumption, not only in order to be consistent with our findings in Chapter 2 of a weak substitutability between local and imported rice, but because we have assumed the premium local variety competes directly with the imported one, their interrelationship with the low-quality variety must be the same. To the extent that increases in the price of low-quality rice induce producers to increase production of low-quality rice and therefore decrease the need for imported rice, the two can be considered substitutes in production.

As noted in Chapter 6, there is very little data on the production shares of high-quality rice. The estimate of 18.3 percent was calculated for the milling model in Chapter 6 based on the maximum capacity of large-scale milling operations that existed in Nigeria; this percentage can be used as a rough indicator of the share of high-quality rice in the country because typically such rice is produced predominantly in large-scale mills (Table E.2 in Appendix E). For the EMM model, we chose to define "premium" according to the rate at which high-quality paddy varieties, and in particular certified seeds, were in use in Nigeria by 2010. Use of certified seeds improves the uniform quality of final grains processed by modern mills and therefore increases its competitiveness with higher-quality imports. A study by Bentley, Ajayi, and Adelugba (2011) suggests that between 2005 and 2009, about 4,000 tons of certified rice seeds were provided to farmers each year. According to FAO (2014), a total of 120,000 tons of rice seeds were used during this period. If these numbers are correct, the share of certified seeds in use by 2010 was about 3 percent. Further assuming, for simplicity, that yields of the two types of rice varieties are the same, then the area cultivated by certified seed is also 3 percent.

Four alternative policy scenarios are considered in the model for expanding rice production. The first scenario (S1) focuses attention on increasing rice yields and expanding the area devoted to high-quality rice varieties; we define this as a technological change policy scenario. The second scenario (S2) reduces marketing margins only; we call it a market improvement policy scenario. The third scenario (S3) combines S1 and S2. The final scenario (S4) raises the tariff for imported rice with no other policy interventions; we refer to this simply as an import restriction policy. Because we are only interested in comparing and contrasting the effects of different policy scenarios, we chose to assume that any policy instruments or public-sector interventions chosen under each scenario will be implemented effectively. This means ignoring the ineffectiveness of higher tariffs on rice imports in Nigeria due to smuggling, as pointed out in Chapter 7. Incorporating implementation inefficiencies would simply reduce the overall effects of any tariffs above 70 percent.

For all four alternative scenarios, we consider two magnitudes of policy changes: an average effort and an accelerated effort. As abstract terms, they simply refer to the extent or intensity to which a combination of policies and/or public-sector investments under each policy scenario is implemented. The "efforts" here correspond to the changes in key parameters in the model. Because we assume that much of the focus of needed public interventions will be for the production of premium local rice if the objective of reducing rice imports is to be achieved, we assume higher yield and area increases for the superior paddy variety as a result of policy changes.[3] Because superior paddy attracts a premium price, as discussed in Chapter 4, it also encourages farmers to adopt more intensive production practices and make technological improvements for high-quality rice relative to low-quality rice.

Table 8.1 summarizes these different magnitudes of policy change for each of the scenarios in terms of their effect on particular exogenous shocks in the model. For example, the table shows an "Average" policy effect under the S1 policy scenario as raising yields of high-quality paddy from 1.9 metric tons per hectare (MT/ha) in the "Base" to 2.2 MT/ha (about a 16 percent change from the base), as well as expanding the area under cultivation from 3 to 5 percent. An "Accelerated" policy effect of the same policy change is assumed to increase yields even further to 2.5 MT/ha (about a 32 percent increase from the base), and the area under cultivation also rises substantially more, from 3 to 8 percent as a share of total rice area. Such higher yields are achievable if government policy focuses on providing improved seeds, increased application of fertilizer, expanding irrigation, and improving farming practices, as we argued in Chapter 4. The "Base" case characterizes current conditions of low productivity, low adoptions

3 We refer to "superior paddy varieties" here to be consistent with its reference as a high-quality and high-yielding seed variety for paddy rice production in Chapter 4. "Premium rice varieties," on the other hand, refers to the higher-quality milled rice that relies on modern milling methods but also to the use of the superior paddy variety.

TABLE 8.1 **Assumptions and targets of alternative scenarios applied in the Nigerian economywide multimarket model simulations**

Alternative Scenario		Exogenous parameters shocked in the model	Targeted key endogenous variables in the model	Magnitude of policy change and effect for each relevant scenario		
				Base	Average	Accelerated
S1	Technology change—standard rice (low-quality paddy)	Yield	Level of yield (MT/ha)	1.9	2.0	2.1
			% change from base		*5*	*11*
		Area	% of total rice area	97	95	92
			% change from base		*–2*	*–5*
	Technology change—premium rice (high-quality paddy)	Yield	Level of yield (MT/ha)	1.9	2.2	2.5
			% change from base		*16*	*32*
		Area	% of total rice area	3	5	8
			% change from base		*67*	*167*
S2	Market improvement	Marketing margins		70	60	51
S3	S1 + S2	Improving rice competitiveness		*All changes and effects above*		
S4	Import restrictions	Change in tariff rate only (%)		50	100	200

Source: Author's calculations for Nigerian economywide multimarket model simulations.

Note: MT = metric tons. A tariff rate of 200 percent is selected for S4. Nigeria's current average bound tariff levels for the agricultural sector notified to the World Trade Organization are 150 percent, with slightly higher rates for some commodities (Kreinin and Plummer 2012).

of high-quality paddy, and high marketing margins due to poor road infrastructure and inefficient processing sectors, as described in the previous chapters.

While the scenarios are designed to affect changes in rice production, the economywide nature of the EMM model allows us to simultaneously solve for the effects on all other economic indicators and across all sectors as a new multimarket equilibrium sets in, such as changes in prices, import volumes, and consumption. After all, production and consumption of non-rice sectors as well as the aggregated food price index can be affected when household incomes change following a change in rice production and rice prices. Model results under each scenario are reported in terms of their effect on changes in rice volumes (production, consumption, and imports), prices (food price index), and incomes (total agricultural real income and household income) to enable us to weigh their overall effect on the government's goals of expanding rice output and improving economic welfare. Due to data limitations, we do not assess the feasibility or costs associated with each intervention but address this later in the chapter when we consider policy tradeoffs.

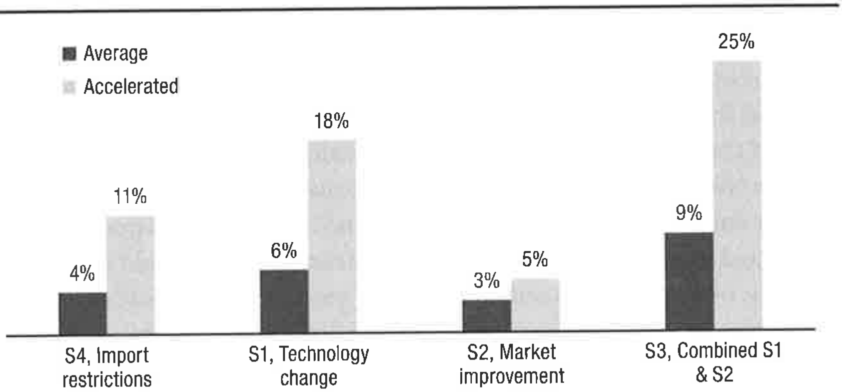
Finally, it is important to highlight that the EMM model and selected policy scenarios introduced in this chapter—including model parameter values, underlying assumptions, and model structure—are all intended to help illustrate the broader economywide implications of alternative policy instruments on overall domestic rice production, consumption, imports, and household welfare (as measured by changes in prices and incomes). The simulation results reported here, then, are not designed to predict actual future values but rather to project the potential magnitude and direction of change that can occur among economic indicators as a result of the policy change. For this reason, we do not consider modeling the potential effects of ineffective implementation for any of the alternative policies being considered, despite evidence to the contrary (e.g., the problems of tariff evasion highlighted in Chapter 7). Instead, we discuss some of the implications of poor implementation in drawing any final conclusions.

Increasing Rice Production

The EMM model simulation results underline the importance of technological change as the key for improving rice competitiveness in Nigeria. Figure 8.1 presents the resulting changes in total rice production under each of the four scenarios. For each scenario, results are reported under the two different magnitudes of policy change: average and accelerated. For example, for the S1 scenario, the results denote the combined effect of raising rice yields and area cultivated for both standard and premium rice types.

Referring to Figure 8.1, results for the first scenario (S1) show that rice production increases by 6 percent and 18 percent under average and accelerated

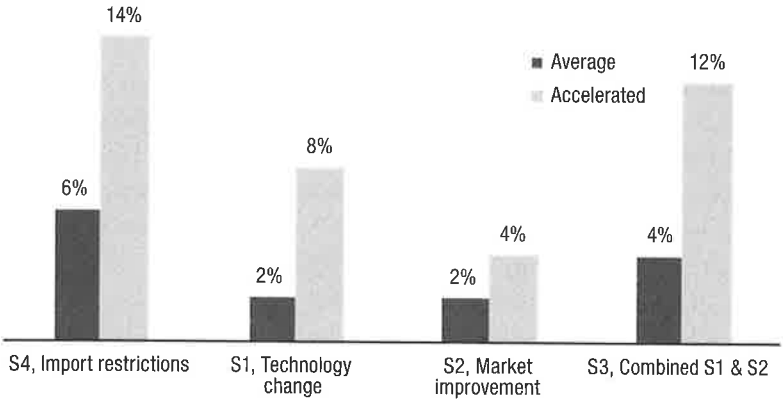
FIGURE 8.1 **Change in total rice production under alternative scenarios (percent change from base year)**



Source: Nigerian economywide multimarket model simulations.

Note: Because of synergies, the accelerated percentage in S3 is greater than the sum of the accelerated percentages for S1 and S2.

FIGURE 8.2 Change in cultivated rice area under alternative scenarios (percent change from base year)



Source: Nigerian economywide multimarket model simulations.

levels of effort, respectively. The figure also shows the importance of market improvement in combination with the technology intervention. Without technological change or import restrictions, market improvements (S2) alone increase domestic supply by 3 percent and 5 percent, respectively, for average and accelerated efforts. Combining technical change and market improvement strategy (S3) increases local rice production by 9 percent and 25 percent under the two effort levels. Under the policy of import restrictions (with no technical change and market improvement), domestic rice production increases by 4 percent and 11 percent, respectively, under average and accelerated efforts.

Figure 8.2 shows the response of areas devoted to rice cultivation under different policies. It shows that under S1, acreage increases by 2 percent and 8 percent for the average and the accelerated efforts, respectively. Under S2, acreage under rice cultivation increases by 2 percent and 4 percent for the average and the accelerated efforts, respectively, while under S3 it increases by 4 percent and 12 percent under the two effort levels, respectively. Under the policy of increased import tariff (S4), the acreage devoted to rice production increases by 6 percent and 14 percent under average and accelerated efforts, respectively. Production increases under S2 and S4 are mostly due to increases in the farmgate price. Production increases under S1 and S3 are driven by an outward shift of the supply function. While production increases induced by price changes are limited if supply is inelastic, supply shifts can be sizable if new technologies help to lower the unit production costs substantially.

When rice growth strategies are centered on technology change, increased rice production will not be at the cost of reducing production of other crops. This can be assessed by changes in rice production areas under alternative growth strategies simulated in the model. As shown in Figure 8.2, the cultivated rice area rises modestly under S1, the technology change scenario. The maximum increase in rice area is 12 percent when technology is combined with the market improvement in S3 under accelerated efforts of intervention. Area increases only modestly because of the production structure changes due to the new technology that allow each hectare of land to produce more output than the old technology. This means that this policy is unlikely to result in an expansion of rice production that replaces other crops.

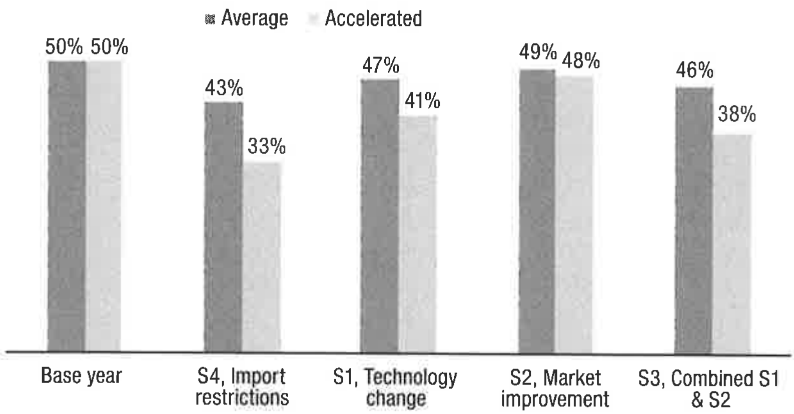
The results from Figures 8.1 and 8.2 suggest that most of the increase in total rice production under S1 to S3 stems from increased yield/ha (increased land productivity), while under S4 most of the increased rice production comes from acreage expansion, as there is no technical change. Here there is potential for decreased yields per hectare of land; acreage expansion is more likely to displace the production of other local food staples.

Raising Import Tariffs

We now turn to the discussion of raising import tariffs. Increasing the tariff rate is intended to reduce rice imports by making rice imports more expensive relative to domestically produced rice and hence induce consumers to substitute locally produced for imported rice in consumption and producers to increase production of local rice. This has been referred to as the "infant industry argument"—the idea of using tariffs to protect an "infant industry" until it is able to compete on its own. In Nigeria, this seems to be the goal as well, to promote local production and eventually achieve rice self-sufficiency.[4] However, the prospect of achieving self-sufficiency in rice production is unclear if supply response is weak, as Chapter 4 suggests. Moreover, we also argued in Chapter 7 that it is very difficult to enforce tariff policies in Nigeria due to tariff evasion, either through underreporting or smuggling. Therefore, assessing whether higher tariffs can significantly reduce rice imports would seem to be impractical for Nigeria in this case. However, we chose to ignore this for our own illustrative purposes by assuming that policymakers will

4 This can be inferred from public pronouncements of Nigerian government officials. For example, see Nnabuife (2014) and the February 6, 2013, circular released by the Central Bank of Nigeria (CBN) on the subject (*Nation* 2013). Note that the degree of protection is made up of the 10 percent duty + 100 percent levy, for a total tax rate of 110 percent.

FIGURE 8.3 Ratio of rice imports to consumption under alternative scenarios (percent)



Source: Nigerian economywide multimarket model simulations.

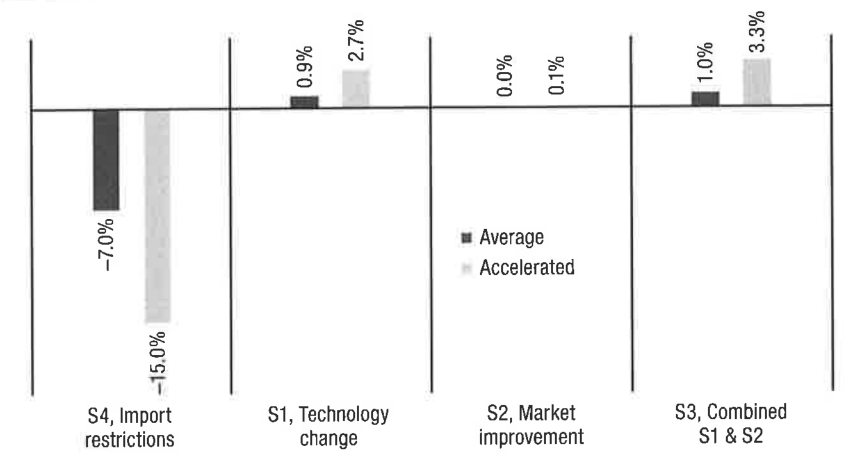
become more effective in implementing these tariff policies and that higher tariff rates will consequently be binding. Additionally, given that rice imports tend not to be very sensitive to small changes in tariff rates, we chose to introduce larger discrete changes in tariffs to test whether tariff increases can help achieve the desired result of significantly reducing rice imports, irrespective of the political feasibility for introducing them.

Figure 8.3 presents the model results of rice import-consumption ratios under alternative scenarios. In the base year (2012, with a tariff rate of 50 percent) of the model, imports account for about half of total rice consumption in Nigeria.[5] When the rice tariff rate increases to as high as 200 percent (S4 scenario) from the current 50 percent, the import-consumption ratio falls to about 33 percent of total consumption.[6] When the tariff rate increases from 50 to 100 percent (average level in 2013), the import-consumption ratio only decreases to 43 percent. This shows that tariff increases alone may be ineffective in reducing rice imports. Because we also assumed that the tariff policy is implemented effectively in these scenarios—that is, with no smuggling or underreporting—its overall effect on imports would be less, and thus even more ineffective, if we remove this assumption.

5 We chose 2012 as the base year when the tariff rate was 50 percent and a policy of increasing the rate to a 100 percent was being debated in parliament. The tariff rate on imported milled polished rice was increased to 110 percent effective January 1, 2013.

6 Given the political economy of tariff policy, we admit that this high tariff rate may be politically and practically impossible to implement. Indeed, the 110 percent tariff rate on milled rice imposed in January 2013 was eventually reduced to 60 percent in 2014.

FIGURE 8.4 Change in rice demand under alternative scenarios (percent change from base year)

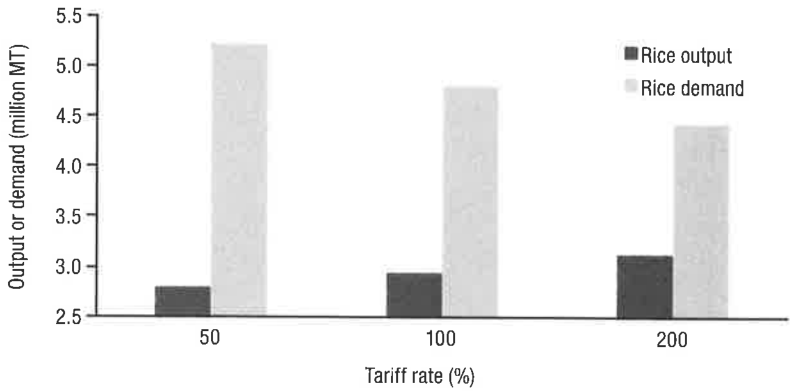


Source: Nigerian economywide multimarket model simulations.

As shown in Figure 8.4 (and Figure 8.1), the decline in the rice import dependency ratio due to increased tariff is a combined result of increasing domestic rice production and reducing rice consumption due to higher prices of rice; that is, the decline in the import–consumption ratio comes partly at the expense of the consumers. For example, rice consumption is reduced by 15 percent with the accelerated tariff rate of 200 percent. In contrast, consumption increases by about 3 percent under the scenario of both increases in productivity and reduced marketing margins (S3), thanks to reduced production costs and thus prices of premium- and standard-quality rice. To further understand the relationship between rice production and consumption at different rice tariff rates, we run a series of additional scenarios with different rice tariff rates, ranging from 50 to 200 percent. Figure 8.5 presents these results.

As shown in Figure 8.5, in the base year, with a 50 percent tariff rate, Nigeria consumes about 5.2 million MT of rice, of which 2.8 million MT are produced domestically, with about 2.4 million MT imported. When the tariff rate rises to 100 percent (2013 tariff rate) from the base rate of 50 percent, domestic rice production increases only modestly, to 2.9 million MT, while demand falls to below 4.8 million MT, which is a 4:1 consumption decline/production increase ratio. This is consistent with the findings from Chapters 2 and 4; while the own-price elasticity of demand for rice is generally low as in Chapter 2 (Table 2.8), the elasticity of supply is even lower at 0.2. At a tariff rate of 200 percent, rice

FIGURE 8.5 Rice production and demand under different tariff rates

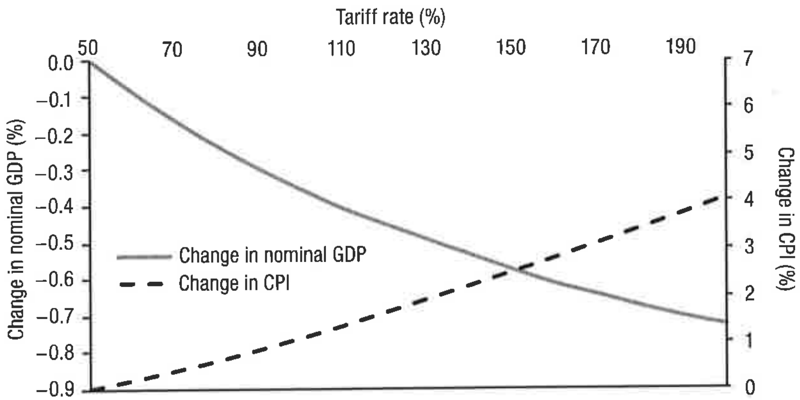


Source: Nigerian economywide multimarket model simulations.
Note: MT = metric tons.

production increases to 3.1 million MT but is still far below the level of rice consumption (4.4 million MT). Thus, under a high tariff policy, the gap between domestic supply and rice consumption would remain, albeit smaller. But even more importantly, the reductions in the size of the gap would be driven mainly by the decline in rice consumption as consumers face big price hikes, a reduction of up to 15 percent. The political feasibility of such a policy, therefore, would need to be seriously considered. Even if this policy option is feasible, there are very large consumer welfare losses associated with it.

The overall effect of the high tariff policy on the economy might be negative. As shown in Figure 8.6, with high tariff rates on rice, the consumer price index (CPI) rises. This increase in CPI is not due to increased demand for goods but to the higher rice prices. The increased food price is driven by two reinforcing factors: a higher domestic price of rice due to the higher tariff and increased prices of domestic staples whose production declines as a result of shifting domestic agricultural resources to produce rice inefficiently. Demand for nontraded products (such as staples) may fall, but increased resource allocation to rice production induced by higher rice prices also raises production costs for these nontraded products. Real gross domestic product (GDP) would also be negatively affected by the rising CPI and misallocation of agricultural resources to the production of rice. Figure 8.6 presents these results. At the tariff rate of 200 percent, nominal GDP falls by more than 0.7 percent while CPI rises by almost 4 percent. Given that rice production increases and its contribution to agriculture—and hence to GDP—is positive with high tariff rates, the decline

FIGURE 8.6 Changes in real GDP and consumer price index under different tariff rates



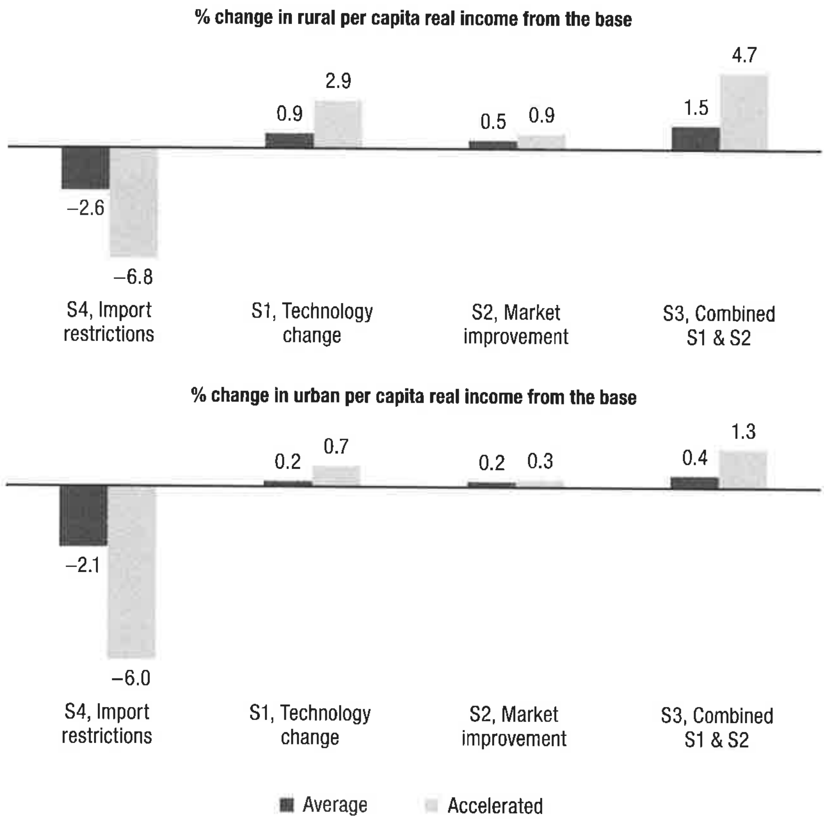
Source: Nigerian economywide multimarket model simulations.
Note: GDP = gross domestic product; CPI = consumer price index.

in GDP implies that other agricultural sectors (that is, aside from rice production) and the nonagricultural sector will be negatively affected by the rice tariff policy. Although one may argue that increased tariff revenues could be used to offset some of these welfare costs, this will depend on how well the government can effectively collect tariff revenues and ensure the transfers. As is shown in Chapter 7, very little tariff revenue is effectively collected in reality.

In Figure 8.7, we assess the impact of alternative rice growth strategies by examining the impact on the incomes of rural and urban households. This provides an indication of the overall welfare effect of different policies. Changes in households' real incomes are measured as their per capita nominal incomes deflated by the CPI in each simulation against the corresponding base-year levels. As shown in Figure 8.7, both rural and urban households are hurt by the import restriction policy, while both gain significantly under the policies that promote technology change and improved market efficiency.

For both urban and rural households, the negative welfare effect under a restrictive import policy is due to declines in nominal income and increases in CPI. For example, at a tariff rate of 200 percent, rural and urban nominal household incomes fall by about 2.7 and 2.0 percent (not shown in the tables), respectively, while CPI rises by 4 percent (Figure 8.6). Declines in nominal incomes are the result of a fall in agricultural and nonagricultural production. Given the low price elasticity of demand, consumers are likely to consume nearly the same amount of rice even at a higher price, which reduces the demand for other agricultural and nonagricultural products. The prices of

FIGURE 8.7 Changes in rural and urban per capita real income under alternative scenarios



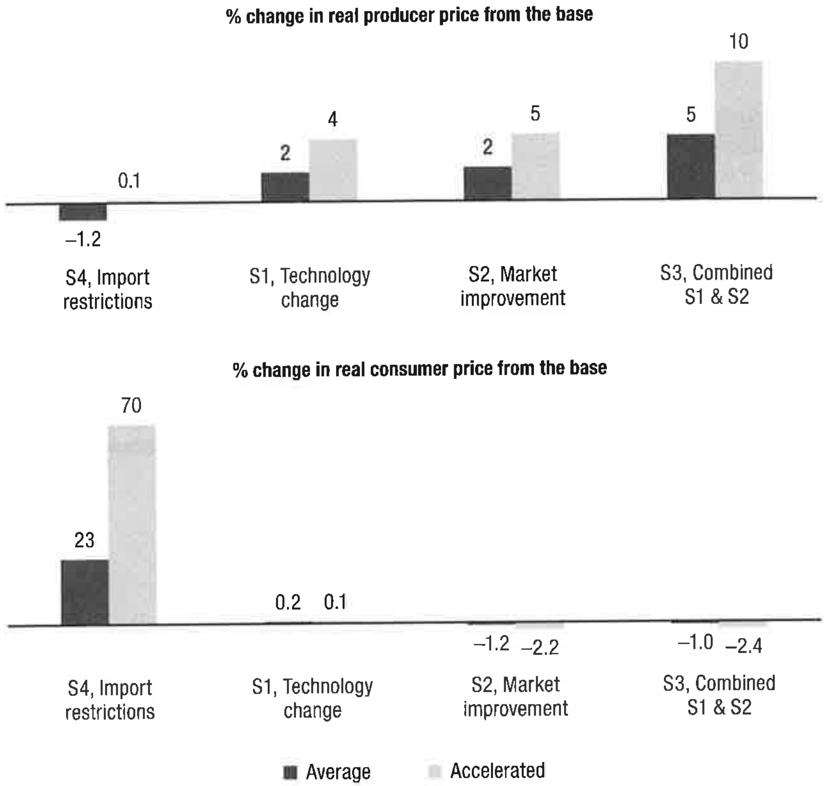
Source: Nigerian economywide multimarket model simulations.

Note: Because of synergies, the percentages in S3 might be greater than the sum of the percentages for S1 and S2.

those commodities produced mainly for domestic markets fall, generating a negative supply response.

Policies that promote technological change and/or improved market efficiency, such as those under scenarios S1 to S3, benefit both rural and urban households, with rural households benefiting more. Under these scenarios, while CPI also rises, nominal incomes of rural and urban households rise even more. For example, under S3, with the accelerated level of productivity change and reductions in marketing margins, rural and urban households' nominal incomes increase by 6.8 and 3.4 percent, respectively, while CPI increases by 2.1 percent. As a result, increases in real income turn out to be 4.7 and 1.3 percent for rural and urban households, respectively (Figure 8.7).

FIGURE 8.8 Changes in relative rice prices under alternative scenarios (percent change from base year)



Source: Nigerian economywide multimarket model simulations.

Note: Real prices are defined here as the nominal rice price deflated by the consumer price index. Because of synergies, the percentages in S3 might be greater than the sum of the percentages for S1 and S2.

Figure 8.8 also reports this phenomenon for changes in real producer and consumer prices of rice. Technical changes in rice production and increased income from rice production further increase demand for local rice relative to other crops, which raises producer incomes of rice relative to CPI. The combined technology changes and reduction in marketing margins increase the incomes of rice producers while marginally reducing the price consumers pay (both deflated by the CPI).

If the tariff policy (S4) is maintained together with the combined technology change and reduction in marketing margins (S3), we would expect the prices consumers pay to be higher but still significantly lower than under the tariff regime scenario alone. In this case, a rice import tariff may be justifiable under the "infant industry" argument—especially if such a combination helps to transform the country's domestic rice sector through productivity and output growth. The challenge for the Nigerian government under such a scenario would be as follows: (1) ensuring consistency in tariff policies (for example, to avoid using tariffs simply as an instrument for domestic price stabilization); (2) effectively enforcing the tariff (given the leakages observed in Chapter 7); (3) committing sufficient resources to transform the sector; and (4) committing to a credible exit strategy to avoid a budgetary crisis on account of increasing an unsustainable support of the industry. More important, it is necessary for the government to provide infrastructure in order to attract private-sector investment.

An Import Tariff for Price Stabilization or Self-Sufficiency

A combined strategy of improving rice competitiveness and protecting the sector through import tariffs may have greater effects on rice production than when each one is pursued individually. As noted earlier, such a dual strategy is often adopted using the "infant industry" argument, as the Nigerian government was trying to do under the Agricultural Transformation Agenda strategy of President Jonathan. Aside from introducing tariffs, the government also focused attention on raising the productivity of rice production and processing. However, as the evidence from Chapters 4 and 6 show, much of the focus has been on expanding the large-scale milling sector, with less attention being given to the development and diffusion of improved and superior-quality paddy varieties, as well as improved access to technologies and infrastructure for the more dominant small milling sector. As we found in Chapter 6, while the large-scale milling sector has a greater potential to compete with imports, it will always more likely require a protective tariff policy in place unless significant and sustainable improvements in productivity occur. This is a real challenge, considering the high costs of capital and the current state of paddy production in Nigeria. The small milling sector, on the other hand, is shown to be far more resilient to shifts in policy than the large-scale sector and thus more sustainable in the long run. This becomes important if prices become volatile either because of a sudden change in global markets or in the domestic supply of paddy or stocks of milled rice.

In the long run, it is important to maintain a transparent and predictable tariff policy. The challenge is not so much about justifying a tariff policy per se but more about determining the optimal level of protection needed to maintain sufficiently stable prices without overly distorting the economy. The "infant industry" argument can be justified if policies are consistent with efficient resource allocation over time and across sectors. Overall, welfare costs and benefits to the economy that are likely to occur as a result of the policy must be weighed. As demonstrated in Chapters 2 and 7, the costs of managing a high import tariff rate in Nigeria are likely to be considerable, both with respect to their effects on prices and on consumer welfare. The benefits are also very low, considering the current poor record of tariff implementation and revenue collection. As discussed in Chapter 7, beyond some level of high tariff rate, a very large proportion of rice imports to Nigeria flows through unofficial channels; similarly, low tariff rates may not be enough to provide farmers and millers the protection they need under the "infant industry" argument. It is very likely that there is a threshold at which the cost of a certain tariff just equals its benefits. More research may be needed to determine such an optimal tariff rate.

Opportunity Costs of Pursuing Rice Self-Sufficiency through Technological Change

Technological change in rice production and market improvement both lead not only to more efficient domestic rice production growth, but they also have positive effects on the economy even without the import tariff. Investments required for these policies may, however, involve substantial opportunity costs. While a rigorous assessment of such costs is beyond the scope of this book, we highlight the importance of weighing in these costs in this section.

As discussed in Chapter 4, some of the key investments needed are in rice research and development (R&D) and irrigation infrastructure development. Rice R&D in Sri Lanka provides a useful insight. While starting from 50 percent import dependency on rice in the 1960s, Sri Lanka had achieved self-sufficiency by the mid-1980s. In the late 1990s, the country had invested approximately five to seven times more into rice R&D per rice area than Nigeria. As presented in Table D.3 in Appendix D, the rice R&D expenditure in Nigeria in 1998 was 0.3–0.5 (2010 US$ purchasing power parity) per rice hectare, while it was 2.1 in Sri Lanka. In addition, Nigeria had only six rice scientists for 1 million ha of rice land in 1999, while many Asian countries (including Sri Lanka) had approximately 10–20 rice scientists per 1 million ha in 1983 and 1999 (Takeshima 2014). Roughly speaking, R&D in rice production and processing in Nigeria must increase by a multiple of several times from existing levels to realize the varietal seed development and productivity growth needed to achieve the Nigerian government's goal of rice self-sufficiency. We will come back to this in the next chapter when discussing some of the costs and benefits associated with the rice self-sufficiency goal.

Similarly, as with R&D investments, if Nigeria were to expand the irrigated area under rice from the current 5 percent to 50 percent (approximately 1 million ha), which is closer to the ratio in many South and Southeast Asian countries, it will need to rehabilitate 63,000 ha of existing irrigation schemes and construct new ones of up to 900,000 ha, according to one estimate (see Enplan Group 2004). This can be very expensive, as costs of building irrigation schemes in Africa are generally very high. Estimates by Inocencio et al. (2007) suggest a cost of US$13 billion (nominal). In addition, operations and maintenance (O&M) costs of about US$50 million will be needed annually.[7] At these cost levels, it could take approximately 80 years to meet these costs if current total spending levels of US$160 million per year for irrigation schemes are maintained (Foster and Pushak 2011). While substantially more public funding is needed for rice R&D and irrigation expansion, this should not come at the cost of ignoring investments in agricultural extension and rural infrastructure, particularly rural feeder roads (Fan 2008).

Given scarce public-sector resources, the decision to allocate more resources to the development of the rice sector must be made carefully as it will likely affect investments in other sectors. It may require, for example, reducing spending for fertilizer subsidies, which until recently accounted for a significant share of the agricultural budget. It may also require reducing expenditures on other crops for which Nigeria may have greater competitive advantages, such as cassava and sorghum. Spending in other major sectors such as education, defense, and health could also be affected, all of which have traditionally accounted for a significant share of the federal government's budget (Mogues et al. 2008). Although resources could come from increased taxation, this is hardly an option considering current low incomes, difficulties of income tax collection, and its effects on reducing private investment. Alternative sources, such as revenues from petroleum exports and any import tariffs in place, offer the best option. Ultimately, the push for achieving self-sufficiency in rice is not going to be cheap; indeed, the opportunity costs of such a policy, such as the returns from alternative investments, may exceed its benefits. The Nigerian government must carefully weigh all these costs and benefits.

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7 Applying O&M costs in Asian countries in the 1980s (Gupta, Miranda, and Parry 1995) and converting them to the current US dollar, typical O&M costs in these countries were $50 per hectare.

Conclusion

This chapter assesses how various policies may affect rice production, import dependency, and overall economic welfare. Our analysis suggests that, given the importance of rice as a major food staple in Nigeria, rice policies will have significant effects on GDP, consumer prices, and real incomes. This indicates that appropriate rice policies will need to be carefully identified.

Historical trade data analyzed in Chapter 7 indicate that import tariffs may not be effective in reducing rice imports and increasing rice production in Nigeria. The modeling analysis in the current chapter further suggests that even if the tariff were effective, its impact may be limited due to inelastic supply and demand for rice, while welfare effects can be substantially negative. The tariff-induced supply response occurs through rice area expansion without yield growth, which implies that production of other crops can be negatively affected, including overall effects on welfare. Both rural and urban households can be hurt by high import tariffs. Finally, despite the reduced consumption that occurs after introducing very large tariffs (e.g., at 200 percent and assuming tariffs are effective), imports would still account for a significant share (up to 33 percent) of total consumption. Evidently, even with no tariff evasion, achieving self-sufficiency through increased tariffs is unlikely to be successful.

According to the model results, alternative rice growth strategies that focus on technological change and market improvement offer the best options to transform the domestic rice sector. With a modest increase in rice yield of about 16 percent per hectare—so long as it is in conjunction with the expansion of superior-quality varieties that replace low-quality ones—the competitiveness of local rice can increase substantially. In fact, rice output can potentially rise to levels close to those that can be achieved under a highly protectionist policy. Similarly, the import dependency ratios also fall under both scenarios, in the range of 33 to 38 percent from the current 50 percent. The difference between the two, however, is their effects on rice consumption and incomes among both rural and urban households. With high import restrictions, overall consumption and real per capita urban and rural incomes could fall by 15 percent and 6.8 percent and 6.0 percent, respectively, hurting consumers the most. In sharp contrast, they could rise with technology change and market improvement: for consumption, by 3.3 percent and for real incomes by 4.7 and 1.3 percent for rural and urban incomes, respectively.

Aside from the positive effects of technology change and market improvement on production, consumption, incomes, and trade, the economywide impact effects are also positive. Other crop production will not be hurt, and some crops even benefit from the expansion of rice production. With income gains going to both rural and urban populations, including rice producers, as the rice growth is not accompanied by domestic food price inflation (of an overall rise in food prices), consumers will have more disposable income to spend on other goods and services and contributing to overall GDP growth.

The challenge, however, is how to go about investing in technology change and market improvement, as these also come with significant costs. No matter what policies and investments are pursued, a careful cost-benefit analysis will be needed to select the best mix to produce the greatest return to economic and social welfare in the long run. In the short run, if the government still considers the tariff policy as politically imperative using the "infant industry" argument, it will be essential to determine an optimal and consistent tariff that can be effectively managed. In the meantime, public investments in the rice sector must be maintained. As part of this, it will be important also to attract private-sector investments, not only in partnership with the public sector, but to help ensure productivity growth and improved competitiveness over the long term so that tariffs would no longer be needed in the future. This is important, as history shows that it is not so easy for governments to stop supporting an "infant industry": powerful interests within the affected industry tend to fight against ending the protection they have come to rely on.