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Reducing Rice Imports in Côte d'Ivoire: Is a Rise in Import Tariff the Solution?

Jeanne Y. Coulibaly, Nakelse Tebila, and Aliou Diagne

The first-difference version of a source-differentiated almost ideal demand system is used to estimate demand for Ivorian rice imports. The results indicate that Thailand will benefit most from an expansion of imports of luxury rice and broken rice products. Vietnam will gain from growth in the market for standard rice. The results also suggest that adoption of a new 35 percent tariff policy to protect the domestic industry will not be enough to improve social welfare in Côte d'Ivoire in spite of increased production value.

***Key Words*:** almost ideal demand system, Ivorian imports, rice quality demand, source differentiation, tariff, welfare

Rice is a major source of cereal consumed in Côte d'Ivoire and other West African countries. The share of household expenditures for rice there shows that it plays an essential role in household consumption. In 2008, expenditures for food in Côte d'Ivoire were estimated at €3,380 million and 17 percent of those expenditures were for rice (Directorate of Statistics, Documentation, and Information (DSDI) 2011). Consumption of rice has been growing rapidly as a result of increasing urbanization and a growing Ivorian population, and Côte d'Ivoire's production is not adequate to meet the rising demand. In 2011, the country imported 935,000 metric tons of rice, which represented more than 60 percent of the nation's consumption (Programme National Riz (PNR) 2012), making Côte d'Ivoire Africa's third-largest rice-importing country after Nigeria and Senegal.

This increasing dependence on the world market to satisfy domestic consumption likely is not sustainable over time. In 2008, for instance, this import-oriented policy had an adverse effect on the national economy following a surge in the international price of rice. International price hikes translated directly into substantial increases in domestic prices that then had a negative impact on consumer welfare. Dimova and Gbakou (2012) used 2008 household survey data and found that middle-income households in Côte d'Ivoire were hardest hit by price shocks because of their inability to smooth out price increases by consuming and producing alternative crop varieties. In addition, rice prices did not return to pre-2008 levels and remained on an upward trend (Seck et al. 2010) despite the increase in area planted and local yields of rice.

The rapid expansion of rice imports in many West African countries has been classified as a perverse effect of trade liberalization on smallholder producers' livelihoods and a hindrance to development of the domestic rice sector (Oxfam 2005). As a result, producers, along with development and lobbying

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organizations in the Economic Community for West African States (ECOWAS)[1] customs union, are pushing hard for greater protection of the domestic rice sector through an increase in the import tariff. This type of restrictive trade policy could present an opportunity to reduce imports and revamp the local industry. However, a higher import tariff on rice also would result in higher retail prices, and given the extensive reliance on imports to meet rapidly increasing domestic demand for rice, the policy could hurt consumers in Côte d'Ivoire and other import-dependent countries. Several studies have shown that households suffer from rising food prices mainly because they are net food buyers (Ivanic and Martin 2008, Minot and Dewina 2013), but the impact is country-specific and depends on macroeconomic conditions and household food production and consumption patterns (Cudjoe, Breisinger, and Diao 2010).

Despite the importance of rice in consumption patterns, little has been done in West Africa to estimate the elasticity of demand for imports or the impacts of an increase in the rice import tariff on the welfare of rice consumers. It has often been argued, without providing any quantitative estimates of the demand elasticities, that the demand for imported rice is inelastic in sub-Saharan Africa and that import-dependent countries will therefore be harmed by higher import tariffs and/or higher international prices. The lack of quantitative estimates, however, prohibits an assessment of the true impact of policy changes on domestic demand for rice and consumer welfare. Therefore, an in-depth analysis is needed to inform policymakers and producers about the effects such an increase in the import tariff would be likely to have on demand for imported rice and consumer welfare.

Since Côte d'Ivoire has been viewed as particularly vulnerable to price shocks in global rice markets (Dimova and Gbakou 2012), the objective of this study is to estimate demand elasticities for rice of varying qualities imported into Côte d'Ivoire from different points of origin and the welfare impact of the suggested increase in the import tariff. Source differentiation allows for an investigation of the influence of the origins of imports on demand. The study involves a source-differentiated almost ideal demand system, which, to the best of our knowledge, has not previously been used to estimate import demand elasticities for agricultural commodities in West Africa. We then use the estimates of price elasticity to quantify impacts of the higher tariff on the quantity of rice imported. Finally, we evaluate the impact of a potential change in trade policy on consumer welfare using an equivalent variation approach.

Rice Policies in Côte d'Ivoire

Economic and trade policies for rice in Côte d'Ivoire have gone through several development periods. Between 1960 and 1977, the nation's rice policy was essentially producer-oriented. The government made large public investments to boost the rice sector in an effort to achieve self-sufficient production. Two

[1] ECOWAS was founded in 1975 to achieve "collective self-sufficiency" for its member states by creating a single large trading bloc through an economic and trade union. As part of the goal of economic integration of West African states, ECOWAS plans to establish a common external tariff and commercial policy against non-ECOWAS member states. Presently, the organization plans to adopt a 10 percent tariff against non-ECOWAS member states to stimulate imports of rice because West African countries are not yet self-sufficient in terms of production, but producer organizations are lobbying against the policy.

parastatal companies, Société pour le Développement du Riz (SODERIZ) and Société D'Assistance pour la Modernisation de l'Agriculture de la Côte d'Ivoire (SATMACI), were in charge of leading development of the rice supply chain. At the upstream end of the supply chain, the companies were involved in distributing inputs (herbicides, fertilizers, and improved seeds) to increase productivity and in facilitating access to mechanization to modernize rice production systems. Downstream, SODERIZ implemented institutional purchases of rice at a floor price to provide an incentive to producers to invest in production, and processing was handled by modern mills that were controlled by SODERIZ. These investments paid off; imports of rice declined to 2,000 tons per year by 1977 after peaking at 47,800 tons per year before 1970 (West African Rice Development Association (WARDA) and Reseau d'Etudes d'Impact (REI) 2005). The imports originated chiefly from Thailand and Taiwan, but some came from Italy. The success of the rice development programs allowed Côte d'Ivoire to export 32,000 tons of rice in 1976. However, this golden age of local rice production lasted only a few years; in 1977, SODERIZ was dismantled because of managerial difficulties.

Between 1978 and 1994, government intervention in the rice sector steadily declined in response to flagging public support. Greater private investment was allowed, and the private sector began to get involved in processing and marketing activities. These changes coincided with a decline in the international market price for rice, which encouraged Côte d'Ivoire to turn to the world market to meet its domestic demand. Thus, the nation's price policy primarily aimed to provide rice at an affordable price to consumers and augment public finances through import tariffs. Imports rose from an average of 57,800 tons per year in the 1970s to an average of 350,000 tons per year in the 1980s and 1990s (WARDA and REI 2005). During this period, the United States became the dominant supplier of rice to Côte d'Ivoire (36 percent of imports). The rest came from Thailand, Vietnam, and Pakistan.

Liberalization and privatization were phased in between 1995 and 2008. Under prevailing structural adjustment programs and with devaluation of the local currency (CFA francs), Bretton Woods institutions[2] pressed for full liberalization of the rice sector. Production, processing, and marketing activities were privatized. Rice imports were liberalized and were extended to include brown rice and broken rice. Total liberalization of the rice sector occurred in 1997 with elimination of annual quotas on imports. The rice import tariffs were reduced between 1997 and 1999 and then remained stable after 2000 (see Table 1), although they were revised to reflect realities on the ground. Rice imports increased substantially—to 616,530 tons per year in 2008. The imports were essentially comprised of four types: brown rice; white rice containing 0–15 percent broken kernels, known as luxury rice; white rice containing 16–35 percent broken kernels, known as standard rice; and white rice containing more than 35 percent broken kernels, known as broken rice, which represented 74 percent, on average, of the imports (PNR 2012). Imports from the United States decreased and were replaced by imports from Asian countries such as Thailand, India, Pakistan, and Vietnam.

[2] "The Bretton Woods institutions were created in Bretton Woods, New Hampshire in 1944 during the United Nations Monetary and Financial Conference at the Mount Washington Hotel. At the conference, member nations agreed to create a family of institutions to address critical issues in the international financial system" (www.brettonwoods.org/page/about-the-bretton-woods-institutions).

Table 1. Ivorian Import Duties (duty or tariff, including taxes) for Rice for 1996–2001

	Percent Tariff Imposed			
	1996	**1997**	**2000**	**From 2001**
Luxury rice: 0–15 percent broken	25	25	10	10
Standard rice: 15–35 percent broken	15	15	10	10
Broken rice: greater than 35 percent broken	15	15	10	10

Source: WARDA and REI (2005).

In 2008, Côte d'Ivoire experienced a painful food crisis that prompted the Ivorian government to reduce its reliance on imported rice and provide a significant boost to domestic production. The government drafted an emergency plan for development of the rice sector that mainly emphasized production in distributing seeds, fertilizers, and agricultural equipment to farmers. However, implementation of the program was limited by funding issues and its impact on domestic production was small. Côte d'Ivoire has continued to import large quantities of rice; imports in 2011 were estimated as representing 64 percent of rice consumed (PNR 2012). In 2012, the 2008 program was revisited to formulate objectives that could realistically be achieved within a specific timeframe and to address the main challenges associated with different nodes of the value chain. This resulted in a national development strategy for rice for 2012 through 2020. Reducing imports continues to be the main challenge; they averaged 862,165 tons per year for 2008 through 2011. Standard rice still leads imports in terms of quality and Thailand is the main supplier.

The Empirical Model

This study uses a source-differentiated linear approximation of the almost ideal demand system (AIDS) to estimate demand elasticities for imported rice by quality and origin. The model was first developed by Deaton and Muellbauer (1980) as the linear approximation of an AIDS (LA/AIDS). It has been used extensively (Eales and Unnevehr 1988, Green and Alston 1990, Fulponi 1989, Hayes, Wahl, and Williams 1990) because it provides a flexible functional form and is relatively easy to estimate. Moreover, it offers an arbitrary first-order approximation to any demand system, satisfies the axiom of choice, and, under certain conditions, aggregates perfectly over consumers. Yang and Koo (1994) extended the model by specifying a source-differentiated AIDS (SDAIDS) model; differentiation by origin often is an important consideration when analyzing demand for imports. Other models, such as the Armington and the Rotterdam, have been used for such analyses. However, SDAIDS has an advantage over Armington because it does not impose block separability. That assumption can be tested within the framework of the SDAIDS model. The Armington model also imposes restrictive assumptions of a single constant elasticity of substitution (CES) and homotheticity, which can generate biased parameter estimates (Yang and Koo 1994).

Our approach closely follows the SDAIDS model proposed by Yang and Koo (1994). The unrestricted SDAIDS model is expressed as

$$w_{i_h} = \alpha_{i_h} + \sum_j \sum_k \gamma_{i_h j_k} lnp_{j_k} + \beta_{i_h} \ln(E / P) \tag{1}$$

where α, β, and γ are parameters; the subscripts *i* and *j* denote the quality of the rice imported; *h* and *k* represent the imports' origins; w_{i_h} denotes the budget share for good *i* imported from origin *h*; p_{j_k} represents the price of imported commodity *j* from country *k*; *E* is total expenditure on all products in the demand system; and *P* is the Stone price index, which is identified as

$$\ln(P) = \sum_i \sum_h w_{i_h} \ln(p_{i_h}).$$

To avoid the problem of simultaneity caused by the presence of w_{i_h} on the right and left sides, we use lagged share as in Eales and Unnevehr (1988).

Common conditions of adding up, homogeneity, and symmetry are imposed to satisfy the general demand theory:

$$\sum_i \sum_h \alpha_{i_h} = 1; \quad \sum_i \sum_h \gamma_{i_h j_k} = 0; \quad \sum_i \sum_h \beta_{i_h} = 0 \quad \text{: Additivity} \tag{2}$$

$$\sum_j \sum_k \gamma_{i_h j_k} = 0 \quad \text{: Homogeneity} \tag{3}$$

$$\gamma_{i_h j_k} = \gamma_{j_k i_h} \quad \text{: Symmetry.} \tag{4}$$

The Marshallian uncompensated price elasticity can be written as

$$\varepsilon_{i_h j_k} = -\delta_{i_h j_k} + \gamma_{i_h j_k} / w_{i_h} - \beta_{i_h} (w_{j_k} / w_{i_h}) \tag{5}$$

where $-\delta_{i_h j_k}$ equals 1 if $i = j$ and $h = k$ and equals 0 otherwise.

The expenditure elasticity is defined as

$$n_{i_h} = 1 + \beta_{i_h} / w_{i_h}. \tag{6}$$

Previous empirical studies (Eales and Unnevehr 1988, Henneberry and Hwang 2007) found that dynamic adjustments driven by changes in consumer behavior are important and should be represented in demand models. Thus, the model includes dynamic changes following Eales and Unnevehr (1988) in the form of first difference:

$$\Delta w_{i_h} = \sum_j \sum_k \gamma_{i_h j_k} \Delta lnp_{j_k} + \beta_{i_h} \Delta \ln(E / P). \tag{7}$$

Although the role of local tuber products such as cassava and yam and of plantains has been recognized in purchase decisions of Ivorian rice consumers (Akindes 1999), we focus our analysis on the rice commodity because of the availability of data and use a multi-stage budgeting process also known as a utility tree approach (Barten 1977). Total expenditures are first allocated to two categories: rice and all other consumption commodities. Next, total rice expenditures are assigned to the four quality/type categories. Finally, the expenditures for each quality/type of rice are assigned to categories of origin. Block independence between rice and the other commodities is assumed, which allows estimation of demand for rice independently of demand for all other commodities.

Data and Estimation Procedure

The study uses data on imported and domestically produced rice for 1996 through 2011. Although researchers often limit their analyses of import demand to data on imported commodities by assuming weak separability between imported and domestic products (Weatherspoon and Seale 1992, Henneberry and Hwang 2007, Balagtas et al. 2007), we needed to include data on domestic rice since consumption of local rice represents a significant share of total consumption (40 percent) (PNR 2012). Inclusion of local rice in the model is an opportunity to test the hypothesis of weak separability between domestically produced and imported rice. Thus, domestic rice from Côte d'Ivoire was included as a place of origin. The data on imported rice consist of quantities, values, and tariff rates for the three predominant qualities of long-grain imported rice: luxury (0–15 percent broken), standard (16–35 percent broken), and broken (greater than 35 percent broken). Each type of rice was imported from more than one country.

In the analysis, brokenness serves as a measure of quality and monthly unit values of rice imported serve as a proxy for market prices because retail prices for imported rice by origin were not available. The source-differentiated data for imported rice were provided by the Statistics Department of the Ivorian Customs Service (2012). Information on annual domestic production and monthly consumer prices for domestic rice for 1996 through 2011 were provided by the National Institute of Statistics. Local annual paddy production was converted to a milled-rice equivalent that was used as a proxy for domestic rice consumption when assuming that no domestic *stock* exists, which is realistic since domestic rice production in Côte d'Ivoire is generally less than the country's demand for rice. Annual rice consumption was divided by twelve to generate the amount of locally produced rice consumed per month when the consumption rate is held constant throughout the year. Because Ivorians generally do not have the equipment needed to sort rice into specific grain sizes, the rice it produces is marketed as a heterogeneous product consisting of different sizes of grains. Consequently, the model does not differentiate local rice by quality.

Since local production and imports of rice may be influenced by seasonal factors, all of the variable series in the model were seasonally adjusted using the Stata S operator. Augmented Dickey-Fuller and Phillip-Perron tests were then performed to evaluate the stationarity of the series over time (Table 2).

Summary statistics for the variation in quality of imported rice by origin are reported in Table 3. The rest-of-the-world import category represents less than 10 percent of total import origins by volume. As expected, the rice market in Côte d'Ivoire is dominated by imported rice, which represents 54 percent of rice consumed there. In terms of the quality of the rice imported, standard rice (16–35 percent broken rice) is predominant, which is in line with prior empirical findings (U.S. Agency for International Development (USAID) 2009). However, the amount of standard rice imported has decreased relative to imports of broken rice over time. Vietnam and Thailand are the main exporters of standard rice to Côte d'Ivoire, followed by India and China. Broken rice (greater than 35 percent broken kernels) is the second most-often consumed rice in the country. Thailand has a near monopoly in supplying broken rice to Côte d'Ivoire with a market share of more than 90 percent. Luxury rice, which

Table 2. Tests for Unit Roots of Seasonally Adjusted Series

	Augmented Dickey-Fuller		Phillips-Perron	
	Price	**Share**	**Price**	**Share**
Luxury Rice				
Thailand	–7.632***	–15.593***	–10.177***	–23.489***
United States	–7.682***	–15.627***	–14.272***	–15.276***
Vietnam	–7.810 ***	–22.561***	–11.309 ***	–14.303***
Rest of the world	–14.713***	–17.561***	–8.871***	–15.826***
Standard Rice				
China	–6.970***	–21.656***	–8.836 ***	–17.491***
India	–6.715***	–23.647 ***	–11.877***	–14.265***
Thailand	–9.131***	–25.742***	–12.946 ***	–13.472***
Vietnam	–7.485 ***	–20.522***	–11.411***	–7.503***
Rest of the world	–7.905***	–13.528***	–12.247***	–20.357***
Broken Rice				
Thailand	–13.02***	–15.740***	–6.686***	–29.460***
Rest of the world	–9.659***	–18.062***	–28.742***	–24.664***
Local rice	–8.541***	–15.432***	–14.582***	–25.333***
Total expenditure	—	–14.317***	—	–22.427***

Notes: The values are based on 191 observations. "Rest of the world" relates to import sources representing less than 10 percent of the total import origins. MacKinnon approximate P-value for $Z(t)$: statistical significance at the 1 percent level is noted by ***.

comes mostly from Thailand, Vietnam, and the United States, accounts for a small proportion of the market at just 3 percent.

The estimation procedure is based on a seemingly unrelated regression (SUR) system with one equation (standard rice from the rest of the world) dropped from the model to prevent singularity in the equations (dropping a different equation did not change the results). The coefficients of the dropped equation were retrieved using the additivity condition.

Product Aggregation

In this study, imports of rice are disaggregated by origin since prices for rice from different sources are not likely to be homogeneous and quality attributes related to the rice's origin may influence consumers' choices. This assumption is supported by the observation that trademarks for imported rice in Côte d'Ivoire are often associated with the country of origin and are used by companies as a marketing tool to differentiate their products from those of their competitors and promote their products to buyers. The assumption of product aggregation is tested following Yang and Koo (1994). The null hypothesis is that there is no source-differentiation and that each rice product can be aggregated

Table 3. Summary Statistics for Expenditure Share of Ivorian Rice Imports for 1996–2011

Variable	Mean	Standard Deviation	Minimum	Maximum
Luxury rice	0.0355	0.0619	0.0000	0.4207
Thailand	0.0195	0.0302	0.0000	0.1653
Vietnam	0.0072	0.0451	0.0000	0.3726
United States	0.0045	0.0172	0.0000	0.1644
Rest of the world	0.0043	0.0173	0.0000	0.1530
Standard rice	0.3901	0.1365	0.0001	0.7608
Vietnam	0.0489	0.0690	0.0000	0.2803
Thailand	0.0511	0.0966	0.0000	0.5709
India	0.0911	0.0976	0.0000	0.4009
China	0.0998	0.1226	0.0000	0.5299
Rest of the world	0.0993	0.0900	0.0000	0.5512
Broken rice	0.1130	0.0893	0.0000	0.4213
Thailand	0.1044	0.0871	0.0000	0.4213
Rest of the world	0.0085	0.0196	0.0000	0.1029
Local rice Côte d'Ivoire	0.4614	0.1510	0.1810	0.9918

Notes: "Rest of the world" relates to import sources representing less than 10 percent of the total import origins.
Source: Authors' calculations using data from Ivorian Customs Service, Department of Statistics (2012).

across sources to obtain the three levels of quality previously described. The restrictions for the test are

$$\alpha_{i_h} = \alpha_i \;\forall\; h \in i \tag{8}$$

$$\gamma_{i_h j_k} = \gamma_{ij} \;\forall\; h, k, \in i, j$$

$$\beta_{i_h} = \beta_i \forall\; h \in i$$

where α_{i_h}, $\gamma_{i_h j_k}$, γ_{ij}, and β_{i_h} are the estimated intercept, own-price coefficient, cross-price coefficient, and expenditure coefficient from the source-differentiated model; α_i, γ_{ij}, and β_i are the estimated parameters from a non-source-differentiated aggregate AIDS model.

Block Separability

This work also tests for quasi-separability of the cost function for the SDAIDS model following the methodology developed by Hayes, Wahl, and Williams (1990) and applied by Yang and Koo (1994) and Mutondo and Henneberry (2007). The restriction implied by quasi-separability of the cost function is given as

$$\gamma_{i_h j_k} = \bar{w}_{i_h} \bar{w}_{j_k} \gamma_{ij} \tag{9}$$

where $\gamma_{i_h j_k}$ is the cross-price parameter between quality *i* of rice imported from source *h* and quality *j* of rice imported from source *k*; $\bar{w}_{i_h}$ and $\bar{w}_{j_k}$ are the mean budget shares of rice *i* imported from source *h* and rice *j* imported from source *k*, respectively; and γ_{ij} is the cross-price coefficient between groups *i* and *j* from an aggregate AIDS model.

From equation 9, groups *i* and *j* may be considered as separable if substitutions between the two groups due to a change in price are proportional to their expenditure shares.

The idea behind the test of separability is to determine whether the four levels of rice quality, when their origins are aggregated (non-source-differentiated), can be separated from each other and demand for a specific quality of rice can be analyzed independently. The null hypothesis for this test is that each block of rice is separable from all other blocks. Rejection of the null hypothesis for, for example, luxury rice and standard rice would imply that those two qualities of rice cannot be analyzed separately.

Welfare Estimation

The welfare measure to assess the impact of an increase in the tariff on consumers is equivalent variation (*EV*), which is calculated using the estimated demand parameters together with simulated prices and expenditures for various changes in the tariff:

$$EV = c(\bar{u}, \bar{p}) - c(\bar{u}, p). \tag{10}$$

Equivalent variation represents the net amount consumers are willing to pay at a new level of utility, $\bar{u}$, to avoid the price change, and p and $\bar{p}$ represent the price vectors before and after the tariff change. *EV* is thus expected to be negative after a price increase since it represents expenditures that consumers will make for their reduced utility after the price rises.

With the SDAIDS function, equivalent variation is written as

$$EV = \bar{I}\exp\left\{\beta_0 \prod_i \prod_h p_{ih}^{\beta ih}[V(I,p) - V(\bar{I}, \bar{p})]\right\} - \bar{I}. \tag{11}$$

In this equation, $\bar{I}$ and I represent the consumer's total expenditure after and before the change in the import tax, respectively, and $V(I, p)$ represents the indirect utility function before the change in tariff, which is defined as

$$V(I,p) = [lnI - \alpha_0 - \sum_i \sum_h \alpha_{ih} \ln(p_{ih}) - 0.5 \sum_i \sum_h \sum_j \sum_k \gamma_{ihjk} \ln(p_{ih}) \ln(p_{jk})] / \beta_0 \prod_i \prod_h p_{ih}^{\beta ih}. \tag{12}$$

We first evaluated the indirect utility level and equivalent variation for the current 10 percent import tax and then incrementally increased the import tax to 35 percent to measure the impact of each tariff level.

We also simulated the impact of higher tariffs on the value of rice produced domestically to examine producers' responses to such tariffs and identify the level of tariff at which the country could benefit from protection of the local industry:

$$Y_i = \varepsilon_{is} \bar{\gamma}_{ij} \Delta P_j Q_i$$

where Y_i is the value of production of domestic rice *i* as a result of the increase in the tariff on imported rice, ε_{is} is the own-price farm supply elasticity[3] for domestically produced rice, $\bar{\gamma}_{ij}$ is the mean cross-price elasticity between domestically produced rice and group *j* of imported rice, ΔP_j is the percent change in the price of group *j* imported rice due to the increase in the tariff, and Q_i is the quantity of paddy rice produced in 2011.

Results and Discussion

Table 4 presents the results for product aggregation and block separability. The Wald test for product aggregation rejects the null hypothesis that products can be aggregated across sources of supply at a 1 percent level of confidence for luxury rice, standard rice, and broken rice. Thus, the test results support estimation of an SDAIDS model for Ivorian rice demand and suggest that a complete understanding of demand for rice in Côte d'Ivoire requires disaggregation of the data by origin.

The tests reject the null hypotheses that the levels of quality of imported rice (luxury, standard, and broken) are separable from all other qualities of rice at a 5 percent level of confidence for luxury and broken rice and at a 10 percent level of confidence for standard rice. These findings support estimation of the source-differentiated model with prices for three levels of quality for imported rice included. However, there is little support for rejecting the separability of local and imported rice.

These results support the assumption of weak separability between domestic and imported rice and specification of an SDAIDS model for imported rice. This outcome fits our expectations. Although locally produced rice represents

[3] Given the lack of a published supply elasticity for domestic rice in Côte d'Ivoire, we used the pre-existing own-price supply elasticity for Benin reported in Allodehou et al. (2013). This supply elasticity should be very close to that of Côte d'Ivoire since the two countries have almost identical rice production systems.

Table 4. Test Results for Ivorian Source-differentiated AIDS Model

	Wald Chi Statistic	Degrees of Freedom
Product Aggregation		
H0: Luxury rice can be aggregated	146.21***	36
H0: Standard rice can be aggregated	145.55***	44
H0: Broken rice can be aggregated	158.58***	21
Block Separability		
H0: Luxury rice is separable from all other qualities of rice	42.37**	28
H0: Standard rice is separable from all other qualities of rice	36.98*	26
H0: Broken rice is separable from all other qualities of rice	33.40**	18
H0: Local rice is separable from all other qualities of rice	11.05	11

Notes: Statistical significance is noted by * at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level.

almost 40 percent of the country's rice consumption, the market is segmented in terms of distribution; local rice is mostly sold by small-scale retailers in rural marketplaces while imported rice is distributed through multiple channels (wholesalers, semi-wholesalers, retailers in grocery stores, and small outlets) throughout the country. The Ivorian rice market consists primarily of standard rice that is clean-grained and homogeneous in size, and the local rice industry has difficulty competing. This empirical evidence of market segmentation is supported by Lançon and Benz (2007), which reported that the West African rice market is primarily segmented on quality attributes that match varying requirements and preferences among consumers.

Expenditure and Price Elasticities

Estimates of the Marshallian demand elasticity for rice imported from different sources show positive expenditure elasticities for standard and broken imported rice regardless of origin and for luxury rice imported from Thailand (Table 5). In the luxury rice market, Thai imports exhibit the largest positive value and significant estimate of elasticity (0.936). This result is consistent with consumers' strong preference for this product, which is known as jasmine luxury rice because of its attractive aromatic and sweetness attributes. Concerning the standard rice market, the expenditure elasticities are all positive and statistically highly significant ($P < 0.01$). Demand for standard rice from Vietnam will increase, as demonstrated by the large expenditure elasticity (1.112). This too is in line with consumers' strong preference for this type of rice because of features unrelated to price (aroma, fragrance, cooking time, etc.).

For broken rice, the largest positive, statistically significant estimate of elasticity is for rice from Thailand (1.114). Therefore, an increase in Ivorian expenditures for broken rice will translate into additional imports of rice from Thailand, once again confirming consumers' preference for Thai jasmine rice products. Furthermore, the expenditure elasticity for broken rice from Thailand is the highest of all of the expenditure elasticities. So, as total expenditures on rice increase, Côte d'Ivoire will import more broken rice from Thailand than any other type of rice from any other source. This result is unexpected;[4] economic theory suggests that consumer preferences would be oriented toward luxury rice as income increases. However, this result is consistent with the trend of actual consumer preferences in Côte d'Ivoire, which are increasingly oriented toward consumption of inexpensive, mostly jasmine broken rice from Thailand. This 100-percent-broken long-grain white rice is appreciated for the uniformity of its broken grains, its cooking attributes, and its aroma. It is suitable and often used for a rice dish eaten with fish called *Céébu jën* that originated in Senegal and is cherished by the Ivorian people. Furthermore, its aroma is similar to that of luxury Thai jasmine rice; the main difference between them is the proportion of broken kernels. Consequently, the cheaper, 100-percent-broken product provides an opportunity for poorer households that cannot afford to pay for luxury jasmine rice to consume a favorite aromatic rice. This inclination to favor cheaper aromatic rice products over time, as depicted in Figure 1,[5]

[4] Such an unexpected result may stem from estimation of the AIDS without considering different income classes. A quadratic AIDS model might have addressed this issue as well, a question left to future work.

[5] Imports of broken rice have evolved rapidly in recent years and it is becoming a major rice product imported into the Ivorian rice market, competing with imports of standard rice

Table 5. Marshallian Price and Expenditure Elasticity Results

	Price: Luxury Rice				Price: Standard Rice					Price: Broken Rice		Price: Local Rice
	Thailand	United States	Vietnam	Rest of World	Vietnam	Thailand	India	China	Rest of World	Thailand	Rest of World	Côte d'Ivoire
Luxury Rice												
Thailand	–1.105***	–0.010	0.597**	0.167	0.008	–0.027*	0.062**	–0.007	–0.006	–0.027*	0.029***	–0.052
United States	–0.010	–0.582*	1.174***	–0.112	0.015	–0.023	–0.038	–0.002	–0.016*	0.004	0.009	0.040
Vietnam	0.134**	0.692***	–1.144***	–0.184	0.011	–0.006	0.007	–0.002	–0.020***	0.013	–0.003	0.038
Rest of world	0.035	–0.058	–0.164	–1.030***	–0.005	0.002	0.027**	–0.003	–0.004	0.001	0.010*	0.028
Standard Rice												
Vietnam	0.055	0.298*	0.395**	–0.078	–1.103***	0.010	0.031	0.072	–0.005	0.022	–0.003	0.014
Thailand	–0.118	–0.199	0.009	0.081	0.008	–1.086***	–0.095*	0.105*	0.014	–0.032	0.003	0.848***
India	0.166**	–0.218	0.144	0.346**	0.010	–0.058*	–0.896***	–0.074	0.015	–0.025	–0.027**	0.135
China	–0.012	0.033	0.047	–0.020	0.072	0.054*	–0.063	–1.060***	–0.006	–0.017	0.002	0.191
Rest of world	–0.102	–0.545	–1.286***	–0.261	–0.052*	0.038	0.141*	–0.087	–0.976***	–0.008	–0.011	0.290
Broken Rice												
Thailand	–0.123	0.139	0.416*	0.051	0.021	–0.033	–0.037	–0.034	0.005	–0.997***	0.015	–0.058
Rest of world	0.158***	0.213	0.070	0.292*	–0.014	–0.006	–0.055**	–0.005	–0.006	0.005	–0.989***	–0.048
Local Rice												
Côte d'Ivoire	–0.052	0.039	0.070	0.047	–0.011	0.065**	0.011	0.022	–0.006	–0.018	–0.016*	–1.057***
Expenditure	0.936***	–0.158	–0.920	0.566	1.112***	1.099***	0.963***	1.109***	1.016 ***	1.114***	0.973***	–0.978***

Notes: Statistical significance is noted by * at the 10 percent level, ** at the 5 percent level, and *** at the 1 percent level. Rest of the world: import sources representing less than 10 percent of the total import origins.

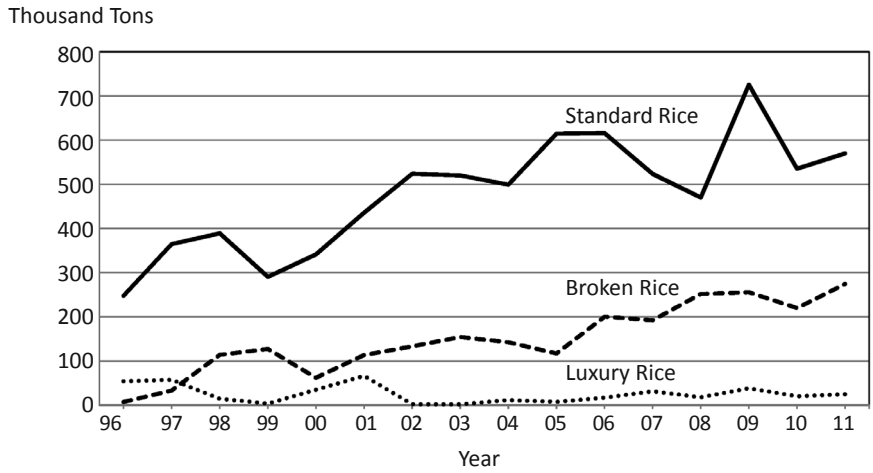

Figure 1. Imports of Rice for 1996–2011

Source: Author's design based on data from the Department of Statistics of the Ivorian Customs Service (2012).

has been accentuated by the loss of purchasing power by many households because of civil armed conflict that broke out in the country in 2002 and drove large numbers of residents from rural to urban areas, increasing the size of the unemployed unskilled labor force and demand for less expensive rice products. This trend is corroborated by Dimova and Gbakou (2012), which found that poor households in urban areas of Côte d'Ivoire were characterized by the greatest dependence on purchased rice that was mostly poor-quality imported rice.

Overall, the revealed preference for rice from Thailand and Vietnam confirms the growth of the West African market for aromatic rice, which is dominated by those countries, in response to increasing urbanization (USAID 2009).

The lack of significance for the expenditure elasticity for local rice is not surprising since that product is perceived as being of lesser quality because of its lack of cleanliness (it contains impurities and stones), grain uniformity, and flavor.

The own-price elasticity is negative and highly significant (see Table 5), which is consistent with demand theory. In the luxury rice market, own-price elasticities are relatively elastic between –1.030 and –1.444; the exception is luxury rice from the United States, which has an inelastic demand estimated at –0.582. Therefore, demand for luxury rice from the United States is less price-sensitive than demand for luxury rice from Thailand and Vietnam, which indicates that U.S. luxury rice is perceived as a higher-quality product. When we consider the market for standard rice, we find that the own-price elasticities fall within a range of –0.896 to –1.103 and that standard rice from India is the most inelastic. Thus, an increase in the price of standard rice from India will result in a less than proportionate decrease in the quantity of that rice imported into Côte d'Ivoire. The price inelasticities identified for luxury rice from the United

traditionally preferred by consumers in Côte d'Ivoire.

States, standard rice from India, and standard rice from the rest of the world suggest that consumers may find it relatively difficult to find substitutes for those products and, as a result, may be less sensitive to changes in their prices. Indeed, many such countries have specialized in exports of specific types of rice unlike countries like Thailand and Vietnam that supply a variety of products with diverse qualities. For instance, the United States essentially exports only luxury rice to Côte d'Ivoire; India focuses primarily on standard basmati rice. Thailand and Vietnam supply numerous rice products of similar quality that can be easily substituted for each other.

The own-price elasticities calculated for broken rice were nearly unitary, and local rice was found to be unit elastic. Therefore, a 1 percent increase in the own-price will cause imports to decrease by 0.989 percent for broken rice from Thailand, 0.997 percent for broken rice from the rest of the world, and 1.057 percent for local broken rice. Although the demand for local rice is almost elastic, we expect it to be more price-sensitive given the perceived lower quality of local rice compared to imported rice and availability of imported rice as a substitute. But this unitary price elasticity may actually indicate imperfect substitutability between local and imported rice, and it confirms the existence of market segmentation for these two origins with differentiated demand, which was also found by Demont and Rizotto (2012) in their study of Senegal. The local rice supply is characterized by seasonality, insufficient quantities, poor quality, and restriction to mostly rural marketplaces because of the small volume. Conversely, imported rice has a reliable supply chain and dominates end markets with products that are tailored to consumer preferences.

The cross-price elasticities indicate a significant number of substitutability relationships between products of different origins (Table 5). Complementarity relationships would not be expected and could be difficult to justify since all of the products emanate from the coarse-grain commodity. In the market for luxury rice, products from Thailand and Vietnam can be substitutes. This is consistent with expectations since Thailand and Vietnam produce similar products and are the leading exporters to Côte d'Ivoire. Luxury rice from the United States shows a significant strong substitution relationship with luxury rice from Vietnam. This competitive relationship is validated by the results of WARDA and REI (2005), which found that increases in the price of rice imported from the United States had, by mid-1995, led to a progressive decline of the U.S. market share for this product and benefited Vietnam and Thailand. Our results confirm this competition with Vietnam but not for Thailand.

In the market for standard rice, products from China and Thailand have a weakly competitive relationship while products from India and Thailand have an unexpected complementary relationship.

In the market for broken rice, we find no significant relationships among the products. This is expected since Thailand has a monopoly in this market segment. A change in prices for broken rice imported from the rest of world has no significant impact on consumption of rice from Thailand.

Concerning the cross-price relationships between different qualities of rice (e.g., luxury and standard, luxury and broken), luxury rice from Thailand has a substitution relationship with standard rice from India. This substitutability is unexpected because of the difference in quality between the products. India exports primarily basmati standard rice to Côte d'Ivoire, rice that is characterized by relatively long grains and a drier texture, while Thailand's luxury rice exports are jasmine rice that has relatively short grains and a

sticky texture. These products, then, match different tastes and preferences. Luxury rice from Thailand and broken rice from the rest of the world are also substitutes.

Luxury rice from the United States is a substitute for standard rice from Vietnam. Luxury rice from Vietnam is a substitute for standard rice from Vietnam and broken rice from Thailand but is a complement to standard rice from the rest of the world.

Surprisingly, local Côte d'Ivoire rice is a substitute for standard rice from Thailand while it is a complement to broken rice from the rest of the world. Apart from these two relationships, most of the cross-price relationships for local rice are not significant. This result is expected given the imperfect substitutability between domestically produced rice and imported rice, which are generally sold in different market segments that do not compete with each other.

Welfare Analysis

Prior to estimating the welfare impacts of a change in the import tariff, we used the own-price and cross-price demand elasticities to compute the effects of an increase in the tariff on imports of rice. Monthly average prices and quantities for 1996 through 2011, when the current 10 percent tariff applied, were used as the initial equilibrium prices and quantities. Increasing the tariff to 35 percent causes a net increase in the landed price of rice. The 35 percent tariff represents a significant tax increase but is what producer organizations have advocated to protect the local sector from massive quantities of cheap imports and enhance development of domestic production. Table 6 reports the results of this analysis. In response to the high tariff, demand for imports shifts downward and the magnitude of the shift is dictated by the own-price and cross-price elasticities. The largest reduction in demand is for standard rice imported from the rest of the world—10,577 tons per month—and stems from more-elastic own-price and cross-price elasticities. Luxury and standard rice products from Vietnam and broken rice products from the rest of the world are least impacted because of their relatively limited price responsiveness.

Table 7 lays out the results of changes in utility and welfare as the import tariff rises from 10 percent to 35 percent. Indirect utility declines, meaning that consumers are becoming worse off. As expected, the estimates of equivalent variation are negative, indicating that Ivorian consumers will suffer welfare losses from a 35 percent import tax. The losses are estimated at almost 31 billion CFA francs per month, which is equivalent to 66 million U.S. dollars at the average exchange rate of CFA471.86 to USD1 in 2011 (World Bank 2013). Since rice is a strategic staple commodity in Côte d'Ivoire, this welfare loss is considerable and explains government reticence to support the proposed import policy. This result is consistent with findings for other large rice-importing countries such as Nigeria: a substantial increase in the rice import tariff will hurt consumers, particularly those in urban areas (Obi-Egbedi et al. 2012).

Given the poor substitutability between local rice and imported rice and the low own-price supply elasticity for local rice, our results reveal that a social benefit from protecting the local rice industry will not emerge until the tariff is at least 58 percent (see Figure 2). At that tariff point, there is a balance between the benefit of protecting the local industry and the loss in consumer welfare. Therefore, the increase in the value of domestic production triggered by a

35 percent increase in Côte d'Ivoire's import tariff likely will not be sufficient to compensate for the loss in consumer welfare.

Table 6. Modeled Impact of a 35 Percent Tariff on Imported Rice Products

	Initial Quantity (kilograms)	Initial Price (CFA francs per kilogram)	Change in Quantity (kilograms)	Percentage Change
Luxury Rice				
Thailand	1,085,399	417	–350,258	–32
United States	303,096	396	–127,619	–42
Vietnam	425,577	325	–18,619	–4
Rest of the world	282,488	449	–79,690	–28
Standard Rice				
China	5,274,123	188	–1,910,551	–36
India	5,337,252	200	–3,005,673	–56
Thailand	7,870,647	297	–3,564,616	–45
Vietnam	10,800,000	223	–1,379,700	–13
Rest of the world	10,600,000	224	–10,577,210	–100
Broken Rice				
Thailand	11,400,000	217	–2,405,970	–21
Rest of the world	1,132,086	220	–163,590	–14

Note: Rest of the world relates to import sources representing less than 10 percent of the total import origins.

Table 7. Change in Utility and Welfare with an Increased Import Tariff

Import Tariff		Utility	Equivalent Variation in Thousand CFA Francs
10 percent	Mean	–33.88***	–19,076,200***
	Standard deviation	(0.291)	(–17,382)
15 percent	Mean	–34.99***	–27,113,100***
	Standard deviation	(0.350)	(–12,459)
20 percent	Mean	–36.48***	–30,193,600***
	Standard deviation	(0.437)	(–4,875)
25 percent	Mean	–38.32***	–30,954,800***
	Standard deviation	(0.558)	(–1,185)
30 percent	Mean	–40.49***	–31,083,200***
	Standard deviation	(0.717)	(–192)
35 percent	Mean	–42.96***	–31,098,600***
	Standard deviation	(0.921)	(–22)

Note: Statistical significance at the 1 percent level is noted by ***.

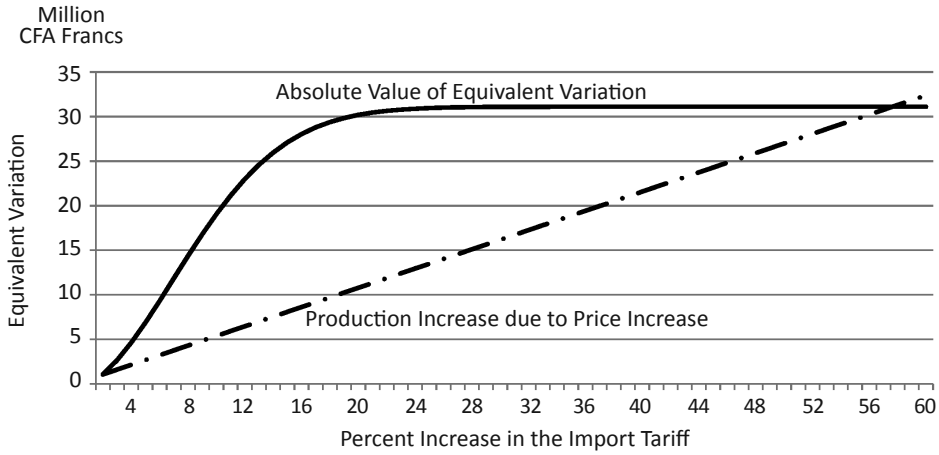

Figure 2. Simulation of the Increase in Import Tariff on Equivalent Variation and Value of Local Production

Conclusion and Policy Implications

Côte d'Ivoire is a small player in the international rice market and is exposed to adverse effects of policies implemented by rice-exporting countries. Current debates about trade policy in the ECOWAS customs union revolve around increasing the rice import tariff with the aim of regulating the flow of imports and stimulating development of the local rice economy. In that context, this study assesses the impact of the quality and source of imported rice on Ivorian demand to predict the welfare effect of a higher import tariff. A source-differentiated almost ideal demand system is used to achieve this objective.

Product aggregation and block separability hypotheses were tested to assure that the model specification was suitable for the analysis. The results supported use of the AIDS model differentiated by the quality of imported rice and the origin of the rice. The hypothesis of weak separability was confirmed for local rice and imported rice, supporting the existence of two market segments based on quality attributes.

The estimated expenditure and price elasticities confirmed consumers' preferences for Thai rice, and, in particular, current trends favor broken rice over traditional standard rice. Demand for luxury rice imported from the United States and for standard rice from India and the rest of the world is found to be inelastic while imports from the other sources are relatively price-responsive.

Adoption of a 35 percent import tariff has a depressive impact on demand for imported rice, but the extent of the effect depends on the magnitudes of the own-price and cross-price elasticities. Import demand for price-elastic products such as standard rice from the rest of the world is found to decline significantly.

The welfare results reveal that consumers will incur a high cost under the potential change in trade policy of a 35 percent tariff. Thus, while imposing the higher tariff will certainly achieve the objectives of reducing the nation's dependence on imports and stimulating domestic production, it will not improve social welfare given the current weak substitutability between low-quality local rice and imported rice. Therefore, given the current elasticity

of substitution between local rice and imported rice and the own-price supply elasticity for domestic rice, the country will need an even higher tariff, a minimum of 58 percent, to balance the benefit of protecting the domestic rice industry and the loss in consumer welfare.

Other studies (Reardon et al. 1997, Akindes 1999, Diagana and Reardon 1999) have concluded that producers in West Africa are relatively unresponsive to price policies, which constrains the effectiveness of such policies. Thus, it is important that the government does not lose sight of non-price attributes. The quality of locally produced rice must improve to compete successfully with imported rice.

The main challenge in the local rice economy is not so much productivity as quality in postharvest operations. Progress has been made in adopting higher-yielding rice varieties, and diffusion of improved agronomic technologies has led to higher yields (AfricaRice *forthcoming*) and greater producer efficiency. These developments allowed Ivorian producers to be more competitive in terms of production and a lower domestic cost ratio in 2009 compared to the 1980s (Pearson, Stryker, and Humphreys 1981, AfricaRice and Michigan State University 2011).

The battle now is to emphasize enhancing the quality of postharvest handling, processing, and marketing techniques. Improving postharvest handling will require greater mechanization through upgraded harvesters and threshers to preserve homogeneity of the grains. More-efficient processing practices will require investment in milling machines that have destoning, polishing, and sorting capacities (AfricaRice 2011). To improve marketing of local rice, roads must be extended to link rural and urban markets, storage facilities should be developed to increase the availability of local rice year-round, and packaging and local branding should be promoted so that local products can compete with imported products.

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