General and Partial Equilibrium Analysis of the Impact of the Central America Free Trade Agreement on the U.S. Rice Sector

Alvaro Durand-Morat and Eric J. Wailes
Research Specialist and L.C. Carter Professor
Department of Agricultural Economics and Agribusiness
Division of Agriculture, University of Arkansas.
Contact: adurand@uark.edu

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Introduction

Negotiations towards a Central America Free Trade Area (CAFTA) were launched in January 2003. Ministers from Costa Rica, El Salvador, Guatemala, Honduras, Nicaragua, and the U.S. agreed to remove barriers to trade, eliminate tariffs, open markets, and promote investment, economic growth and opportunity for all countries. Negotiations concluded in December 2003, and CAFTA was signed on May 28th 2004. On August 2004 the Dominican Republic joined CAFTA, thus potentially creating the second largest free trade zone in Latin America for U.S. exports.

The agreement will eliminate most tariffs immediately, and will establish duty free bilateral trade in consumer and industrial goods within ten years and for virtually all agricultural products within a maximum of fifteen years, except for rice, dairy, and poultry products for which longer periods are scheduled (U.S. Trade Representative, USTR, 2004 a).

This study provides an analysis of the impact that changes in trade policies provided by CAFTA may have on the U.S. rice industry using partial and general equilibrium models. It is also aimed to comparing partial and general equilibrium results and analyzing their relative strengths for studies of the U.S. rice industry.

Rice in the CAFTA Region

Rice production and consumption in Central America is mainly long grain non-aromatic rice, although small quantities of medium grain rice imports have been reported. The rice industry in this region is small compared with the U.S. rice industry. Table 1 shows comparative data for the rice industries of the U.S. and Central America plus Dominican Republic.

Table 1. Comparative statistics of the U.S. and Central American rice industries.

	U.S.	Central America[1]
Area harvested (1,000 ha) [2]	1,310	271
Average yield (mt / ha) [2]	4.94	2.48
Production (1,000 mt) [2]	6,463	671
Annual Imports (1,000 mt) [2]	405	408
Annual Exports (1,000 mt) [2]	3,100	6

1. Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, and Nicaragua.
2. Annual averages for 1998-2004. All rice quantities are in milled equivalents.

Source: USDA, FAS (2004 a).

The CAFTA region has become an important destination for U.S. rice exports. According to USDA FAS (2004 b), the U.S. shipped an annual average of 462 tmt of milled and paddy rice to the CAFTA region from 1998 to 2003, which represents approximately 12 percent of the total U.S. volume of rice exports. Approximately 80 percent of U.S. rice exports to CAFTA is paddy rice, 16 percent milled rice, and 4 percent brown rice. The value of U.S. rice exports to CAFTA averaged approximately USD 87 million annually from 1998 to 2003, which represents approximately 9 percent of the annual value of U.S. rice exports[1]. The lower share on the total value of U.S. rice exports relative to quantity share is explained by the large share of rough rice exports with respect to exports of other value-added products, namely, brown and fully milled rice.

Rice Trade Policies in CAFTA

Despite the significant impact of multilateral, regional, and bilateral trade negotiations in lowering trade barriers (Wailes, 2002; Sumner and Lee, 2000), the world rice market remains among the most protected worldwide. While international markets for most grains and oilseeds represent an important portion of the total production, the international market of

[1] Value of exports evaluated at f.o.b. prices.

rice involves a relatively small percent of the global consumption, only slightly more than 6 percent on average over the last several years. Among the reasons for such a low share is the high level of protection in the global rice market. The average trade-weighted import tariff on rice was estimated at 43.3 percent in 2000. Most of the distortion in the global rice market comes from import tariffs, commonly used by developing countries for domestic market protection and government revenue purposes, and tariff-rate-quotas used by some important market players such as Japan, South Korea, and Taiwan.

In the CAFTA region, rice trade among the Central American Common Market (CACM) members -- Costa Rica, El Salvador, Guatemala, Honduras, and Nicaragua is subject to very low levels of import tariffs. However, rice industries in CACM are highly protected from the international market through ad-valorem import tariffs. The scheme of import tariffs, characterized by significant tariff escalation, is designed to protect domestic milling industries against direct competition from more efficient foreign rice industries. Table 2 shows the schedule of import tariffs used by CAFTA members during 2002.

Table 2. Schedule of rice import tariffs applied in the CAFTA region during calendar year 2002.

	Paddy Rice	Brown Rice	White Rice
Costa Rica	35%	35%	35%
Dominican Republic	15%	20%	20%
El Salvador	40%	40%	40%
Guatemala	35%	35%	35%
Honduras	25%	45%	45%
Nicaragua	45%	62%	62%
U.S. (USD / mt)	18	21	14 / 8[1]

1. USD 14 / mt and USD 8 / mt for long grain non-aromatic and aromatic rice, respectively.
Source: USDA, FAS (2004 c); Secretaria de Integración Económica Centroamericana (SIECA), FTAA-ALCA database.

Table 3 shows the producer and wholesale (milled) prices in each of the countries in the region during 2002. It is important to notice that whereas the market and producer price in CACM and the Dominican Republic are basically the same, the situation in the U.S. is significantly different, with an average paddy market price at USD 90 per mt and a producer price at USD 164 per mt when price supports from the loan deficiency payment program are included. As can be seen, the differences in wholesale market prices between the U.S. and other CAFTA rice markets are significant. However, the U.S. rice industry cannot fully benefit from this price differential and the relatively cheap transportation costs to the region due to the presence of such high import tariffs.

Table 3. Producer and wholesale prices in CAFTA nations during 2002.

Country	Producer Price (USD / mt)	Wholesale Price (USD / mt)
Costa Rica	234	380
Dominican Republic	180	340
El Salvador	209	420
Guatemala	230	410
Honduras	210	388
Nicaragua	222	405
U.S.	90 + 74[1]	198 / 264[2]

1. Market price for paddy rice in the U.S. was USD 90/mt and the average loan deficiency payment was USD 74/mt during 2002.
2. USD 198/mt and USD 264/mt of white long grain non-aromatic (f.o.b. mills Arkansas) and medium grain rice (f.o.b. mills California), respectively.

Source: USDA, FAS (2004 c); FAOSTAT (2004); Consejo Nacional de Producción de Costa Rica; Secretaria de Agricultura y Ganadería de Honduras; Ministerio Agropecuario y Forestal de Nicaragua; Ministerio de Agricultura, Ganadería y Alimentación de Guatemala.

CAFTA Rice Trade Policy Provisions

CAFTA members have agreed upon a schedule for achieving free rice trade in the region. All Central American tariffs will be eliminated in 18 years (20 years for Costa Rica). Imports within the quota are subject to no import tariffs, whereas out-of-quota tariff cuts will be backloaded, with an expected 33 percent decrease by year 15 and complete removal by year 20 (U.S. Trade Representative, 2004 b). TRQ bases and annual incremental rates will be established for paddy and milled rice according to the schedule presented in table 4.

Table 4. CAFTA agreement on TRQ requirements and volume of trade with the U.S. in 2002.

	Paddy Rice TRQ		Milled Rice TRQ		Performance Requirements	2002 U.S. Rice Trade (paddy/milled, mt)
Country	Base (mt)	Rate (%)	Base (mt)	Rate (%)		
Costa Rica	51,000	2%	5,000	5%	Yes	121,800 / 0
El Salvador	61,000	2%	5,250	*	Yes	87,000 / 12,200
Guatemala	52,000	5%	8,000	5%	No	59,500 / 4,300
Honduras	90,000	2%	8,500	5%	Yes	138,600 / 1,700
Nicaragua	90,000	3%	13,000	5%	No	106,700 / 16,000

*. Increases by 375 mt/year 1-5 years, 1000 mt in year 6, and 325 mt/year thereafter.
Source: USTR (2004 b); USDA, FAS (2005).

Based on trade figures for calendar year 2002, all TRQs on paddy rice would be binding, most significantly in Costa Rica and Honduras. As for TRQs on milled rice, only those in El Salvador and Nicaragua would be binding if applied to 2002 trade figures.

Objectives

The main objective of this study is to analyze the impact of CAFTA on the U.S. rice industry using general and partial equilibrium approaches. It has been argued that CAFTA might benefit the U.S. rice industry by expanding the international market for U.S. rice and also by changing the composition of exports in favor of value-added products such as brown and white rice (Wailes, Durand-Morat, Hoffman, and Childs, 2004). This study is intended to expand those findings by estimating potential effects on the prices for rice and the factors of production used by the rice industry, production and consumption volumes, usage of factors of production, and welfare impact on the relevant actors involved, namely, producers, consumers, and government.

Modeling Framework

Partial and general equilibrium models are used for the analysis in this study. The objective is to take advantage of the strengths of each of these approaches to obtain more detailed results about the potential impacts of CAFTA on the U.S. rice industry. Partial equilibrium models are easier to construct, less demanding in terms of theoretical assumptions and data, and may allow for introducing more details than general equilibrium models. On the other hand, general equilibrium models allow for cross-sectoral and income effects to be analyzed, and therefore assess the impact of economy-wide changes on the sector under analysis that partial equilibrium does not allow (Francois and Reinert, 1997; Hertel, 1997).

Partial Equilibrium Analysis

A spatial price equilibrium model is used for the analysis according to Takayama and Judge (p 250). The model is constructed to maximize the net social monetary gain, defined as the total social revenue minus the total social production cost, transportation cost, as well as cost of domestic and trade policies. At the equilibrium, the objective function value must be zero given the zero profit assumptions introduced by the constraints.

The rice market is disaggregated into three different types of rice, namely, medium grain, long grain non-aromatic, and long grain aromatic rice. Flows of the first two types are possible either as paddy, brown, or milled rice, whereas flows of aromatic rice are limited to milled. This assumption on flows is consistent with the observed market behavior.

The structure of the optimization problem is to

$$
\begin{aligned}
\max \quad & \sum_i FC_i^k \cdot PW_i^k + \sum_j FC_j^k \cdot PW_j^k - \sum_i PRD_i^k \cdot PP_i^k - \sum_j PRD_j^k \cdot PP_j^k - \sum_i MCPB_i^k \cdot QPMD_i^k \Big/ MRPB_i^k - \\
& \sum_i MCBW_i^k \cdot QBMD_i^k \Big/ MRBW_i^k - \sum_j MCPB_j^k \cdot QPMD_j^k \Big/ MRPB_j^k - \sum_j MCBW_j^k \cdot QBMD_j^k \Big/ MRBW_j^k - \\
& \sum_{ij} FLW_{ji}^k \cdot TCW_{ji}^k - \sum_{ij} FLB_{ji}^k \cdot TCB_{ji}^k - \sum_{ij} FLP_{ji}^k \cdot TCP_{ji}^k - \sum_{ij} FIMPTW_{ij}^k \cdot FLW_{ji}^k - \sum_{ij} FIMPTB_{ij}^k \cdot FLB_{ji}^k - \\
& \sum_{ij} FIMPTP_{ij}^k \cdot FLP_{ji}^k - \sum_{ij} VAVMTW_{ij}^k - \sum_{ij} VAVMTB_{ij}^k - \sum_{ij} VAVMTP_{ij}^k + \\
& \sum_{ij} FEXPSW_{ji}^k \cdot FLW_{ji}^k + \sum_{ij} FEXPSB_{ji}^k \cdot FLB_{ji}^k + \sum_{ij} FEXPSP_{ji}^k \cdot FLP_{ji}^k + \\
& \sum_{ij} VAVXSW_{ji}^k + \sum_{ij} VAVXSB_{ji}^k + \sum_{ij} VAVXSP_{ji}^k
\end{aligned}
$$

subject to:

Material balance equations:

$(1) \quad FC_i^k - QWDS_i^k - \sum_j FLW_{ji}^k \leq 0$ $\qquad (2) \quad FC_j^k - QWDS_j^k + \sum_i FLW_{ji}^k \leq 0$

$(3) \quad QPD_i^k - PRD_i^k - \sum_j FLP_{ji}^k \leq 0$ $\qquad (4) \quad QPD_j^k - PRD_j^k + \sum_i FLP_{ji}^k \leq 0$

$(5) \quad QBD_j^k - QBDS_j^k + \sum_i FLB_{ji}^k \leq 0$ $\qquad (6) \quad QBD_i^k - QBDS_i^k - \sum_j FLB_{ji}^k \leq 0$

Price equations:

$(7) \quad PP_j^k \geq MRPB_j^k \cdot PB_j^k - MCPB_j^k$

$(8) \quad PW_j^k \leq \left(PB_j^k + MCBW_j^k\right) / MRBW_j^k$

$(9) \quad PP_i^k \geq MRPB_i^k \cdot PB_i^k - MCPB_i^k$

$(10) \quad PP_i^k \leq \left(PP_j^k \cdot \left(1 - AXSP_{ji}^k\right) + TCP_{ji}^k + FIMPTP_{ij}^k - FEXPSP_{ji}^k\right) \cdot \left(1 + AVTP_{ij}^k\right)$

$(11) \quad PW_i^k \leq \left(PB_i^k + MCBW_i^k\right) / MRBW_i^k$

$(12) \quad PB_i^k \leq \left(PB_j^k \cdot \left(1 - AXSB_{ji}^k\right) + TCB_{ji}^k + FIMPTB_{ij}^k - FEXPSB_{ji}^k\right) \cdot \left(1 + AVTB_{ij}^k\right)$

$(13) \quad PW_i^k \leq \left(PW_j^k \cdot \left(1 - AXSW_{ji}^k\right) + TCW_{ji}^k + FIMPTW_{ij}^k - FEXPSW_{ji}^k\right) \cdot \left(1 + AVTW_{ij}^k\right)$

where:

i: importing regions
FC: final consumption of milled rice
j: exporting regions
PRD: domestic rice production (paddy rice)
k: rice types
QPMD: quantity of paddy rice milled domestically
QWDS: quantity of milled rice supplied by the domestic milling industry
QBDS: quantity of brown rice supplied by the domestic milling industry
QBD: quantity of brown rice demanded by the domestic milling industry
QPD: quantity of paddy rice demanded by the domestic milling industry
MCPB: milling cost paddy to brown
QBMD: quantity of brown rice milled domestically
MCBW: milling cost brown to white
FIMPTP: value of fixed import tariff on paddy rice
MRPB: milling rate paddy to brown
FIMPTB: value of fixed import tariff on brown rice
MRBW: milling rate brown to white
FIMPTW: value of fixed import tariff on white rice
FLP: trade flow paddy rice
VAVMTP: value ad-valorem import tariff on paddy rice
FLB: trade flow brown rice
VAVMTB: value ad-valorem import tariff on brown rice
FLW: trade flow white rice
VAVMTW: value ad-valorem import tariff on white rice
TCP: transportation cost paddy rice
VAVXSP: value ad-valorem export subsidy on paddy rice
TCB: transportation cost brown rice
VAVXSB: value ad-valorem export subsidy on brown rice
TCW: transportation cost white rice
VAVXSW: value ad-valorem export subsidy on white rice
PP: market price for paddy rice
FEXPSP: value fixed export subsidy on paddy rice
PB: market price for brown rice
FEXPSB: value fixed export subsidy on brown rice
PW: wholesale price for white rice
FEXPSW: value fixed export subsidy on white rice

Estimation of the Domestic Demand Equations

An important assumption of this model is that all rice is finally consumed as milled rice. This assumption is consistent with the actual market situation except for very small amounts that are consumed as brown rice. The estimation of demand equations for milled rice is based on a modification of the formulas developed by Armington. For each region r (r = i,j), φ_r denotes the overall rice domestic demand elasticity and $\theta_r^{kk^*}$ and $\theta_r^{kk^{**}}$ the elasticity of substitution between rice types *k* and k^* and *k* and k^{**}, respectively. ν_r^k represents the market share of type *k* during the baseline period. According to Armington, the direct price elasticity for rice type *k* is defined as

$$\varepsilon_r^k = \sum_{k^* \neq k} \left[-\left(1 - \nu_r^k\right) \cdot \theta_r^{kk^*} \right] + \nu_r^k \cdot \varphi_r$$

and the cross-price elasticity with respect to type k^* and k^{**} as

$$\varepsilon_r^{kk^*} = \nu_r^k \cdot \left(\varphi_r + \theta_r^{kk^*} \right)$$

$$\varepsilon_r^{kk^{**}} = \nu_r^k \cdot \left(\varphi_r + \theta_r^{kk^{**}} \right)$$

The relative magnitudes of the overall price elasticity φ_r and the elasticity of substitution $\theta_r^{kk^*}$ and $\theta_r^{kk^{**}}$ determine the sign of the cross price effect. For the different types to be substitutes, the absolute value of the substitution elasticity must be greater than the overall demand elasticity. In this study, the substitution elasticities were set to be twice the overall elasticity in absolute value, and the baseline scenario was adjusted based on this assumption. A sensitivity analysis on different values of substitution elasticities, namely, $\theta_r^{kk^*} = \theta_r^{kk^{**}} = 1.5 \cdot \varphi_r$ and $\theta_r^{kk^*} = \theta_r^{kk^{**}} = 3 \cdot \varphi_r$, showed that the model was marginally sensitive to these changes.

Using the direct price and cross-price elasticities estimated above, the linear final consumption function for milled or white rice of type *k*, FC_r^k, is estimated as follows:

$$b_r^k = \varepsilon_r^k \cdot CONS_r^k / PW_r^k \qquad c_r^k = \varepsilon_r^{kk^*} \cdot CONS_r^k / PW_r^{k^*}$$

$$d_r^k = \varepsilon_r^{k^{**}} \cdot CONS_r^k / PW_r^{k^{**}} \qquad a_r^k = FC_r^k - b_r^k \cdot PW_r^k - c_r^k \cdot PW_r^{k^*} - d_r^k \cdot PW_r^{k^{**}}$$

$$FC_r^k = a_r^k + b_r^k \cdot PW_r^k + c_r^k \cdot PW_r^{k^*} + d_r^k \cdot PW_r^{k^{**}}$$

CONS, defined as the quantities of milled rice consumed by type, as well as the prices for milled rice by type, PW, are set at the baseline level (calendar year 2002) for the parameter estimation.

The domestic demand for type k brown rice in region r, QBD_r^k, is derived from FC_r^k. In the framework of this model, brown rice is an intermediate input demanded by the milling industry to produce milled rice. The estimation differs depending on the trade position of the region (importer or exporter). The demand for brown rice by the milling industry in exporting regions takes into consideration not only the domestic final consumption, but also the volume of exports of milled rice. On the other hand, in importing regions the demand for brown rice results from the difference between domestic final consumption and imports of milled rice. For importers (i) and exporters (j), the estimation of QBD_r^k is as follows:

$$QBD_i^k = \frac{1}{MRBW_i^k} \cdot \left(FC_i^k - \sum_j FLW_{ji}^k \right) \qquad QBD_j^k = \frac{1}{MRBW_j^k} \cdot \left(FC_j^k + \sum_i FLW_{ji}^k \right)$$

The domestic demand function for type *k* paddy rice in region r, QPD_r^k, is derived from QBD_r^k. In the framework of this model, paddy rice is an intermediate input demanded by the milling industry to produce brown rice. The estimation is similar to that for QBD_r^k presented above. For importers (i) and exporters (j), the estimation of QBD_r^k is as follows:

$$QPD_i^k = \frac{1}{MRPB_i^k} \cdot \left(QBD_i^k - \sum_j FLB_{ji}^k \right) \qquad QPD_j^k = \frac{1}{MRPB_j^k} \cdot \left(QBD_j^k + \sum_i FLB_{ji}^k \right)$$

Estimation of the Domestic Supply Equations

The linear production equation for type *k* paddy rice in region r, PRD_r^k, is estimated from the baseline production quantity by type ($PROD_r^k$) and producer price (PP_r^k), and the domestic supply elasticity, γ_r^k. The parameters for PRD_r^k are estimated as follows:

$$e_r^k = PROD_r^k - f_r^k \cdot PP_r^k \qquad f_r^k = \gamma_r^k \cdot PROD_r^k / PP_r^k$$

$$PRD_r^k = e_r^k + f_r^k \cdot PP_r^k$$

In the framework of this model, the supply of type *k* paddy rice for domestic milling, $QPSDM_r^k$, must equal the quantity of type *k* paddy rice milled domestically, $QPMD_r^k$. Their estimation is as follows:

$$QPSDM_i^k = QPMD_i^k = PRD_i^k + \sum_j FLP_{ji}^k \qquad QPSDM_j^k = QPMD_j^k = PRD_j^k - \sum_i FLP_{ji}^k$$

The quantity of brown supplied by the domestic milling industry of region *r*, $QBDS_r^k$, results from simply multiplying $QPMD_r^k$ times the milling rate $MRPB_r^k$.

$QBDS_r^k$ can be used by the domestic milling industry as an input in the milling process, or, in the case of exporting regions, exported to other regions. The supply of type *k* brown rice for milling in region *r*, $QBSDM_r^k$ is estimated as follows:

$$QBSDM_i^k = QBMD_i^k = QBDS_i^k + \sum_j FLB_{ji}^k$$

$$QBSM_j^k = QBMD_j^k = QBDS_j^k - \sum_i FLB_{ji}^k$$

As seen above, $QBSDM_r^k$, must equal the quantity of type *k* brown rice milled domestically, $QBMD_r^k$. The quantity of milled rice supplied by the domestic milling industry of region *r*, $QWDS_r^k$, results from simply multiplying $QBMD_r^k$ times the milling rate $MRPB_r^k$.

Definition of the Value Import and Export Policies

The value of the ad-valorem import tariff on type *k* milled rice is estimated using the level of the ad-valorem tariff by milling degree, type of rice, and country of origin, $AVTW_{ij}^k$, $AVTB_{ij}^k$, $AVTP_{ij}^k$, the c.i.f. price, and the volume of trade. Considering the value of the ad-valorem import tariff on white rice as an example, the estimation is as follows:

$$VAVMTW_{ij}^k = \frac{AVTW_{ij}^k \cdot \left(PW_j^k \cdot \left[1 - AVXSW_{ji}^k\right] - FXSW_{ji}^k + TCW_{ji}\right)}{\left(1 + AVTW_{ij}^k\right)} \cdot FLW_{ji}^k$$

The same formula is used for the estimation in the case of paddy and brown rice.

The estimation of the value of the ad-valorem export subsidy takes into consideration the subsidy rate, $EXSW_{ji}^k$, $EXSB_{ji}^k$, $EXSP_{ji}^k$, export price, and volume of trade by type of rice, milling degree, and destination. Considering the value of the ad-valorem export subsidy on white rice as an example, the estimation is as follows:

$$VAVXSW_{ji}^k = EXSW_{ji}^k \cdot PW_j^k \cdot FLW_{ji}^k$$

Definition of the regions for this study

The global rice market is disaggregated into 24 importing and 5 exporting regions. On the import side, country-level rice markets in CAFTA members are specified in the model, to allow for a detailed analysis of the impact of this agreement on the national rice industries. The rest of the world is aggregated into 18 different regions. Detailed domestic market frameworks were also introduced for Brazil, CARICOM, Cuba, Mexico, and the European Union. The exporters were selected based on their share on Central American rice imports and their relevance in the international rice market.

General Equilibrium Analysis

The general equilibrium analysis was conducted using the Global Trade Analysis Project (GTAP) model (Hertel, 1997). Following the suggestions presented by Harrison and Pearson (2002), the GTAP model was modified to handle tariff-rate-quotas. External data on CAFTA's proposed TRQs schedule were gathered from USDA, FAS (2005) and USTR (2004 b). The volumes of the TRQs were already presented in Table 4; in-quota tariffs are to be zero, and over-quota tariffs to be set at the levels applied by January 1st, 2003. The trade-weighted import tariff levels in the Central America region on U.S. paddy and milled rice by January 1st, 2003 were estimated at 25 percent and 51 percent, respectively. The generation of the TRQ data for the GTAP model was conducted following the suggestions by Elbehri and Pearson (2000). Given that the TRQs administrative approach is not contemplated in the agreement, the assumption here is that quota rents accrue to the importing country.

The GTAP 6.0 beta version database was used for this analysis (Dimaranan and McDougall, 2005). This version of the GTAP database corresponds to the global economy in 2001, and divides the world into 87 regions, 57 sectors, and five primary factors of production (land, unskilled labor, skilled labor, capital, and natural resources). For the purpose of this study, the database was aggregated into three regions and five economic sectors. The regions defined for this study are the U.S., the Central American countries, and the Rest of the World, whereas the five sectors are paddy rice, processed rice, other food, manufactures, and services. The Central American region defined in the GTAP database is taken as a proxy for the countries actually involved in CAFTA.

Among the factors of production, unskilled and skilled labor, along with capital, were considered perfectly mobile across sectors, whereas natural resources and land were considered sluggish factors. Land is only used in agriculture, and its mobility is defined by the country and sector-generic elasticity of transformation. For land, an elasticity of transformation of –0.1 was selected.

Demand elasticities for paddy and processed rice were adjusted to reflect the values cited in the literature (Sullivan, 1989). The power of the different trade policies applied on rice was also adjusted to reflect the values reported by the Central American Secretariat of Economic Information (SIECA) and FTAA-ALCA database for calendar year 2002.

The results reported here were obtained using GEMPACK economic modeling software (Harrison and Pearson, 1996).

Trade Policy Scenarios

Five different scenarios are analyzed following the proposed rice TRQ structures. The assumptions in the general equilibrium simulations are that CAFTA trade of all other goods and services are fully liberalized in year 1, and that rice trade policies among Central American countries (7.6 percent import tariff for paddy) are also removed completely during year 1.

Year1: based on actual trade data and proposed TRQ volumes, the assumption for the scenario called year 1 is that the volume of the proposed TRQ on paddy rice represents 67 percent of the actual volume of trade during the baseline. The proposed TRQ volume for milled rice is approximately 57.2 percent of the baseline volume of trade. In-quota trade is subject to no import tariff, whereas the over-quota tariffs are set at the levels used by January 1st, 2003.

Year5: this scenario represents the proposed trade policy situation during the fifth year after TRQs implementation. This implies an increase in the volume of the TRQs from year 1 of approximately 14.5 percent for paddy and 26.7 percent for milled rice. No changes in the over-quota tariff are stipulated in the proposed schedule.

Year10: this scenario represents the trade policy situation proposed for the tenth year of CAFTA. Namely, the volume of both paddy and milled TRQs expands from year 5 levels by an estimated 15.7 percent and 23.3 percent, respectively. Over-quota tariffs still remain unchanged from year 1.

Year15: TRQ volumes are estimated to increase from year 10 by 15.1 percent and 25.5 percent for paddy and milled rice, respectively. The proposed TRQ schedule stipulates the reduction of over-quota tariffs by one third from years 11 to 14 for El Salvador, Guatemala, Honduras, and Nicaragua, and from years 11 to 15 for Costa Rica. The Dominican Republic is scheduled to decrease over-quota tariffs by 40 percent from years 11 to 15.

Year20: in this last scenario, all restrictions on import volume are eliminated, along with over-quota tariffs.

Given limitations in the definition of the model, partial equilibrium results are presented only for year 20, and can be interpreted as an upper bound analysis of CAFTA on the U.S. rice sector.

Results

Partial Equilibrium Analysis

Scenario year 20 represents the complete trade liberalization in the CAFTA region. According to the findings from this simulation, the complete liberalization of rice trade in the CAFTA region would result in a marginal 1.4 percent (milled basis) increase in total U.S. rice exports, which is almost entirely represented by gains in the long grain-non aromatic segment (CAFTA is expected to have very little impact on the global market for medium and fragrant grain). However, a significant 21.8 percent (milled basis) increase on U.S. exports to the CAFTA region is expected after the complete liberalization of trade in the region is achieved.

More important than the expected changes in U.S. total volume of trade is the expected change in the composition of trade. As previously cited, most rice imports by CAFTA members are in the form of paddy rice and, therefore, have attached a low value for the industry in the exporting nation, in this case the U.S. During the 2002 baseline period, approximately 31 percent (milled basis) or 38 percent (actual traded volume) of total U.S. rice exports were as paddy rice, with Mexico as the largest importer followed by the CAFTA region. As a result of CAFTA's complete rice trade liberalization, the share of paddy exports over total U.S. rice exports is expected to decrease to around 24 percent (milled basis) or 29 percent (actual traded volume). In terms of milling activity, the U.S. rice milling industry would likely increase its activity by approximately 440 tmt or 8 percent from the baseline at the expense of milling industries in other CAFTA nations. In dollar terms, this expansion of the processing activity represents approximately a USD 15 million increase in the return to the assets used by the milling industry. U.S. export prices are expected to marginally alter as a result of the market changes proposed by CAFTA. The U.S. paddy export price is expected to increase by 0.8 percent, whereas the export prices for long grain brown and milled rice are estimated to increase by 1.1 and 1.25 percent, respectively. Export prices for medium grain rice are estimated to remain unchanged.

The total value of U.S. rice exports is expected to increase approximately 6.5 percent as a result of a 38 percent decrease in the value of paddy exports and a 46 percent increase in the value of U.S. milled exports. From the information above it can be seen that most of the welfare gains by the U.S. rice industry are the result of export substitution among milling degrees, since changes in total volume (milled basis) and export prices are expected to be marginal.

Welfare changes in the U.S. rice sector are expected to be marginal for consumers (at the wholesale level) due to small changes in wholesale prices and volumes of final consumption. U.S. wholesale prices for milled long grain, medium grain, and fragrant rice are expected to increase by 1.25 percent, 0.20 percent, and 0.07 percent, respectively, whereas the volumes of final consumption are expected to change by -0.32 percent, 0.1 percent, and 0.1 percent, respectively. Thus, rice consumer surplus in the U.S. would likely decrease marginally by 0.38 percent from the estimated baseline value of USD 1.32 billion.

U.S. rice producers are expected to increase their welfare as a result of CAFTA. Producer surplus[2] is estimated to marginally increase in aggregate by 1.6 percent from the baseline value of USD 752 million. This gain is the result of increases in rice production (0.63 percent and 0.07 percent from the baseline for long and medium grain rice, respectively) and producer prices (1.65 percent and 0.26 percent for long and medium grain rice, respectively).

[2] U.S. domestic policies were not considered in this model. Therefore, changes in producer gains are estimated from changes in the market price for paddy rice and volumes of production.

Expanding now the analysis to other nations, it can be said that significant changes can be expected in the rice markets of other CAFTA members, namely, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, and Nicaragua. In aggregate, production in this region would likely decrease by 6.45 percent as a result of the significant 22.4 percent decrease in producer prices (production-weighted). Among them, the Nicaraguan production sector is estimated to be the most affected. In terms of welfare, complete trade liberalization assumed in this study is expected to decrease the aggregate producer surplus in this region by 25 percent from the baseline value of USD 201 million. The activity of the rice milling industry is expected to decrease by 38 percent from the 1.7 mmt of paddy rice processed during the baseline period.

On the other hand, consumer welfare (measured at the wholesale level) is likely to increase in these nations as a result of the trade policy change. In aggregate, consumer surplus in the region is likely to increase by 13 percent from the baseline value of USD 711 million. Consumption is expected to increase by 6.5 percent as a result of a 20.5 percent decrease in wholesale price (consumption-weighted).

Government revenues from rice import tariffs are expected to disappear under the assumption of CAFTA's rice free trade assumption. This means that government welfare would decrease to zero from an estimated USD 33 million in rice import tariff revenues.

As a summary, Table A1 in the appendix presents the absolute and percentage changes in consumption, production, and milling activities in the CAFTA region after complete trade liberalization is achieved.

General Equilibrium Analysis

The table below presents the relevant output from the general equilibrium simulations.

The implementation of CAFTA's TRQ on paddy rice is expected to marginally decrease the aggregate volume and price of U.S. exports. The decrease would likely be more significant in year 1, where aggregate export volume and value are expected to decrease by 1.0 percent and 1.3 percent respectively. As the TRQ volume increases over time, paddy exports increase by 1.1 percent in volume and 1.8 percent in value by year 20. U.S. exports of paddy rice to the CAFTA region are estimated to decrease by 10.7 percent in volume and 11.1 percent in value in year 1 but increase over the baseline figures by year 15. By year 20, after all trade restrictions on rice are removed, U.S. paddy exports to CAFTA are estimated to increase by 19.0 percent in volume and 19.6 percent in value.

The U.S. is expected to export paddy rice over the quota volume proposed by CAFTA during the first 10 years of the TRQ implementation, despite the 25-percent over-quota tariff. As previously explained, the assumption in this study is that quota rents accrue to importing countries. Thus, increases in quota rents partially or completely offset the reduction of import tariff revenues due to the zero in-quota tariff level.

The changes in trade policies due to CAFTA are estimated to marginally affect the U.S. rice production sector, with changes in rice production, producer prices, and aggregate domestic demand all smaller than 1 percent.

The impact on the Central American rice production sector is also expected to be small for the first three scenarios. Rice production marginally decreases despite the increase in producer prices. The significant reduction in the derived demand for rice by the Central American food sector, which now faces direct competition from the U.S. food sector, more than offsets the price stimulus on rice production.

Table 5. Impact of the general equilibrium simulations of the different scenarios on important sectoral variables.

	Scenarios				
Paddy rice	**Year 1**	**Year 5**	**Year 10**	**Year 15**	**Year 20**
Total volume of US exports	-1.0%	-1.1%	-1.0%	0.0%	1.1%
to CAFTA	-10.7%	-11.2%	-9.2%	4.6%	19.0%
to Rest of the World	2.4%	2.4%	1.9%	-1.6%	-5.2%
Total value of US exports (f.o.b.)	-1.4%	-1.4%	-1.2%	0.2%	1.8%
to CAFTA	-11.1%	-11.6%	-9.5%	4.8%	19.6%
to Rest of the World	2.0%	2.1%	1.6%	-1.4%	-4.5%
Value of quota rent	---	8.3%	9.5%	1.1%	-7.0%
U.S.					
Rice production	-0.2%	-0.2%	-0.2%	0.1%	0.4%
Producer price for rice	-0.3%	-0.3%	-0.3%	0.2%	0.7%
Aggregate domestic demand	0.1%	0.1%	0.1%	0.2%	0.2%
Central America					
Rice production	-0.4%	-0.4%	-1.0%	-5.3%	-9.7%
Producer price for rice	3.7%	3.6%	2.4%	-4.8%	-9.6%
Volume of intra-regional trade	127.3%	127.5%	118.5%	64.4%	24.3%
Value of intra-regional trade	130.9%	131.1%	120.8%	59.6%	14.7%
Aggregate domestic (regional) demand	-3.3%	-3.5%	-3.6%	-3.9%	-4.0%
	Scenarios				
Milled rice	**Year 1**	**Year 5**	**Year 10**	**Year 15**	**Year 20**
Total volume of US exports	1.0%	1.9%	2.4%	4.7%	5.1%
to CAFTA	57.2%	99.2%	119.3%	226.1%	244.2%
to Rest of the World	-0.2%	-0.2%	-0.2%	-0.2%	-0.2%
Total value of US exports (f.o.b.)	1.0%	1.9%	2.4%	4.7%	5.1%
to CAFTA	57.2%	99.2%	119.3%	226.1%	244.3%
to Rest of the World	-0.2%	-0.2%	-0.2%	-0.2%	-0.1%
Value of quota rent	6.7%	6.0%	5.4%	1.1%	0.0%
U.S.					
Milling output	0.2%	0.4%	0.5%	1.0%	1.1%
Market price for milled rice	0.0%	0.0%	0.0%	0.0%	0.1%
Aggregate domestic demand	0.0%	0.0%	0.0%	0.0%	0.0%
Central America					
Milling output	-2.1%	-3.5%	-4.1%	-7.0%	-7.2%
Market price for milled rice	2.5%	2.5%	2.3%	1.2%	0.4%
Volume of intra-regional trade	-23.5%	-35.8%	-40.6%	-58.9%	-61.1%
Value of intra-regional trade	-21.0%	-33.3%	-38.3%	-57.7%	-60.7%
Aggregate domestic (regional) demand	-1.8%	-1.8%	-1.7%	-1.4%	-1.3%

The highly significant percentage increase in paddy trade among Central American countries means little in absolute terms, given the very small value of paddy rice traded regionally at the baseline. Rice production in Central America is expected to decrease significantly after year 15 as a result of increasing TRQ volumes and decreasing over-quota tariffs. With free trade, production is estimated to decrease by 9.7 percent mainly as a result of the decrease in the derived demand for domestic rice by the food sector.

The results for milled rice show small increases in US milled rice exports, both in terms of volume and value, since year 1, achieving a 5.1 percent increase after the TRQ has been removed (year 20). Regarding trade flows to CAFTA specifically, however, the increases are expected to be large enough to make the TRQ on milled rice binding, and therefore generating quota rents as shown in the table above. With full trade liberalization, US milled rice exports to CAFTA are expected to grow 244.2 percent from the baseline volume and value.

Regarding the impact on the US rice-milling sector, it is estimated that total output will marginally increase to 0.2 percent by year 1 up to 1.1 percent with free trade. This increase is fully attributed to increases in exports; no changes in domestic demand for milled rice are expected.

The Central American milling industry is expected to decrease its output by 2.1 percent in year 1 up to 7.2 percent with free trade, driven mainly by a decrease in derived demand from the food sector, and final demand (direct consumption) for domestically-milled rice. As for paddy rice, the decrease in the derived demand for milled rice from the food sector results from a decrease in the food sector’s output, which, in turn, results from the direct competition with the US food sector under CAFTA. The decrease in the final consumption of Central American milled rice is a consequence of the substitution by cheaper US milled rice.

The general equilibrium analysis allows us to identify changes in the markets for factors of production that the partial equilibrium analysis does not. It is important to remember here that land and natural resources were assumed to be sluggish factors, whereas capital and labor were assumed to be mobile across different sectors. Land is only used in agriculture, whereas the other resources are used across most sectors in the economy. This implies that differential prices would be found for the sluggish factors, whereas only one market price would be determined for mobile factors. The land rent price in the U.S. rice sector is expected to increase by approximately 7 percent, whereas the price of capital and labor is expected to marginally increase by 0.02 percent. As can be seen, the gains in value perceived by the rice production sector get mostly capitalized into the value of the fixed factor of production.

Limitations

The definition of the partial equilibrium model, mainly the price linkages between paddy, brown and milled rice, does not allow for an appropriate analysis of TRQs. It is important to modify this model to be able to properly simulate scenarios where TRQs schedules are relevant, so that results for intermediate stages can be analyzed. Another important limitation of this study is the difference in theoretical assumptions, mainly regarding supply and demand functional forms. Thus, comparisons of results are severely limited, and findings have to be seen as complements, stressing the estimated benefits for the U.S. rice industry in the long run under both modeling scenarios.

Conclusions

The market conditions proposed by CAFTA are likely to positively impact the U.S. rice sector. Despite the differences in the impact of the agreement, both analytical approaches, namely, partial and general equilibrium modeling, yield results in the same direction. The small difference in the results from both approaches suggests a low income and cross-sectoral effects between the U.S. rice sector and other segments of the economy[3]. U.S. rice production is likely to expand to meet an increasing international demand for this commodity. The U.S. rice milling industry should also expect benefits from CAFTA, expanding by 1 percent in the general equilibrium model and up to 8 percent in the partial equilibrium framework. The more significant the export substitution effects among milling degrees, the more promising the future market scenario for the U.S. milling industry. It is also expected that the Central American rice industry would operate in a much more competitive environment as a result of CAFTA. High import tariffs have protected a relatively, economically inefficient production sector. The end result of CAFTA can be a significant reduction in production and processing as these sectors are faced with direct competition from the more competitive U.S. rice industry.

Partial and general equilibrium approaches complement each other in the analysis of policy scenarios like CAFTA. The suggested approach would be to obtain and compare partial and general equilibrium results, and based on the nature of the results, determine the relevance of income and cross-sectoral effects. Partial equilibrium models allow the researcher to introduce more details, e.g. rice types and milling degrees in this study, which would likely make a general equilibrium model overwhelmingly large. More detailed models

[3] These comments are based on results obtained using a partial equilibrium closure in GTAP. For more detail on this partial equilibrium analysis, contact the authors.

are likely to improve the analysis on the impact of a policy change. As an example, findings from GTAP would not provide any insight regarding distribution of benefits beyond the country level. The partial equilibrium findings suggest a promising market future for the rice industry in the Mississippi delta, where long-grain rice is produced, and roughly no changes for the Californian rice industry, where medium and short rice varieties are grown.

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Table A 1. Absolute and percentage changes in important sectoral variables as a result of CAFTA.

	Changes in production			Changes in producer prices			Changes in producer surplus		
	baseline	free trade	% change	baseline	free trade	% change	baseline	free trade	% change
Costa Rica	245,037	230,149	-6.1%	215	160	-25.9%	46,588,760	33,344,540	-28.4%
El Salvador	27,718	26,575	-4.1%	230	163	-29.2%	5,934,820	4,111,407	-30.7%
Dominican Rep	537,453	518,668	-3.5%	185	159	-13.7%	86,599,590	73,224,510	-15.4%
Guatemala	45,687	43,329	-5.2%	222	163	-26.5%	9,163,075	6,539,753	-28.6%
Honduras	8,823	8,121	-8.0%	198	151	-23.6%	1,454,214	1,057,650	-27.3%
Nicaragua	272,247	236,628	-13.1%	237	163	-31.5%	51,141,090	32,160,570	-37.1%
Total	1,136,965	1,063,470	-6.5%	207	160	-22.4%	200,881,549	150,438,430	-25.1%
U.S.	9,200,900	9,245,813	0.5%	98	99	1.7%	752,160,600	763,843,500	1.6%

	changes in consumption			changes in wholesale prices			changes in consumer surplus		
	baseline	free trade	% change	baseline	free trade	% change	baseline	free trade	% change
Costa Rica	245,169	255,157	4.1%	386	301	-22.2%	257,886,300	279,326,800	8.3%
El Salvador	88,550	95,746	8.1%	411	308	-25.1%	56,268,870	65,785,310	16.9%
Dominican Rep	357,834	376,775	5.3%	340	302	-11.4%	131,634,600	145,938,600	10.9%
Guatemala	73,368	76,593	4.4%	398	308	-22.8%	75,636,030	82,430,830	9.0%
Honduras	95,438	102,841	7.8%	373	299	-19.9%	45,676,500	53,037,720	16.1%
Nicaragua	253,222	278,852	10.1%	421	307	-27.2%	143,473,500	173,986,700	21.3%
Total	1,113,581	1,185,964	6.5%	381	303	-20.5%	710,575,800	800,505,960	12.7%
U.S.	3,889,294	3,881,924	-0.2%	211	212	0.9%	1,324,442,100	1,319,443,800	-0.4%

	changes in milling activity			Changes in Government revenues		
	baseline	free trade	% change	baseline	free trade	% change
Costa Rica	376,950	230,149	-38.9%	7,367,332	0	-100.0%
El Salvador	136,148	26,575	-80.5%	7,137,142	0	-100.0%
Dominican Rep	550,175	518,668	-5.7%	306,417	0	-100.0%
Guatemala	112,804	43,329	-61.6%	3,865,952	0	-100.0%
Honduras	151,392	8,121	-94.6%	5,651,832	0	-100.0%
Nicaragua	389,333	236,628	-39.2%	8,618,309	0	-100.0%
Total	1,716,802	1,063,470	-38.1%	32,946,984	0	-100.0%
U.S.	5,439,567	5,879,344	8.1%			