Agricultural Tariff Rate Quotas: Impacts on Market Access

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Introduction

The 1994 Uruguay Round Agreement on Agriculture (URAA) set new rules for trade in agricultural products and initiated a modest reduction in protection (Anania et.al.). However, agriculture is still facing significant trade restrictions and there is much to be done to future liberalize trade in this industry. The current (Doha) round of the WTO was launched in 2001, and so far has made little or no progress in moving towards freer trade in agriculture. The massive subsidies and trade barriers in OECD countries undercut the fledgling agricultural sectors in developing countries and helps keep poor countries poor. For example, the 2002 US Farm Bill increased, rather than decreased, agricultural subsidies in the United States. This is all very discouraging.

One of the major accomplishments of the URAA was the replacement of quantitative restrictions and other non-tariff barriers (NTBs) with tariffs – the so called tariffication. To prevent "dirty" tariffication (i.e., the conversion of NTBs to extremely high tariffs) and to improve market access, tariff rate quotas (TRQs) were introduced as part of the URAA. TRQs were set up in order to establish minimum market access opportunities where there had previously been no significant imports, or to maintain access opportunities where tariffication would otherwise have reduced market access. But have these TRQs moved the globe closer to or further from freer trade in agricultural products?

TRQs are two-tiered tariffs, with a limited volume of imports (i.e., the quota) imported at a lower tariff rate, and with all additional "above-quota" imports subject to a higher tariff (Skully). A TRQ displays both tariff-like and quota-like characteristics.

Under TRQs, the import quantity is not limited and over-quota imports are permitted as long as the importer is willing to pay the higher tariff.

The introduction of TRQs as a result of the URAA, ensures one thing – that agricultural trade policies continue to be very complex. TRQs have a number of undesirable features (Anderson). For instance, they generate quota rents, legitimize a role for state trading agencies, and introduce an opportunity for importers to blatantly discriminate among exporting countries. Hence, from the theoretical point of view, it is unclear if the introduction of TRQs truly improves economic welfare.

In practice, TRQs have been broadly adopted in agricultural trade since the URAA. The number of TRQs has been rising and 1,475 TRQs were reported to the World Trade Organization (WTO) by forty-three members in 2002. For example, U.S. dairy, peanuts, and beef NTBs were converted to TRQs. Japan introduced TRQs for rice imports, and the European Union (EU) did the same for dairy products.

Did the implementation of TRQs really improve market access as promised? We try to address this question in this paper. Based on summary statistics, the performance of agricultural TRQs seems unsatisfactory. The average yearly TRQ fill rate, a ratio of actual annual imports to the notified import quantities, was only slightly higher than 60% from 1995 to 2000. In addition, there was a slight declining trend in TRQ fill rates over this five year period. The average fill rates of OECD TRQs fell from 67% in 1995 to 57% in 1999 (OECD, 2001). These relatively low average fill rates reveal that agricultural TRQs are under-utilized by a significant margin.

Several proposals for further liberalizing agricultural TRQs have been brought to the WTO in the Doha round, but unsurprisingly no consensus has been reached. The

debate on liberalizing TRQs continues. The most effective way to further reform agricultural TRQs is to change those factors that reduce TRQ fill rates the most. Therefore, a better understanding of the effects of TRQs on market access is needed.

Trade theory provides several possible explanations for the poor performance of TRQs. First, the domestic demand for imports may be insufficient to fill the quota. Second, the in-quota and over-quota tariffs may simply be too high and therefore block imports. Third, TRQ administrative methods could easily undermine market access. TRQ administration is a rationing problem and allocates import rights, influencing both absolute import volume and trade shares. Some administrative methods can increase transactions costs and lead to lower fill rates.

A set of invited papers published in the April 2000 issue (Vol. 29, No. 1) of *Agricultural and Resource Economics Review* described the implementation of agricultural TRQs in the EU, the United States, Canada, Japan, Korea, and developing countries. Some of these papers identified factors impeding market access under TRQs and singled out ideas for further reform of TRQs. For example, in the Philippines, a reduction of the above-quota tariff on pork would lead to larger imports of this commodity (Abbott and Paarlberg). Maximum trade liberalization benefits in developing countries would most likely come from tariff reductions rather than from quota expansion (Abbott and Morse). Alternatively, in the EU increasing quota volumes would likely result in greater welfare gains than would tariff reductions (Bureau and Tangermann).

We believe that there is a lack of knowledge on the impacts of TRQ implementation practices on market access. Previous studies either theoretically analyzed the potential reasons why TRQs have failed to fully reach their stated goals, or they

conducted individual case studies that are primarily country and commodity specific. No comprehensive empirical study, except Monnich (2003), has attempted to untangle an explanation of fill rates. However, Monnich only examined TRQs in the EU that account for less than 7% of total agricultural TRQs. Moreover, we believe there were problems with her model specification. In order to fill a gap in the literature, we conduct a systematic study of the implementation of agricultural TRQs. Our analysis is conducted at a disaggregate level and we include in our dataset all TRQs that were notified to the WTO during the 1995-2000-time period. The effects of TRQ administration on market access are addressed. We identify factors that impede market access and our results have implications for ways to reform agricultural TRQs.

The following section provides our analytical framework. The implementation of the URAA TRQs is briefly described, then the empirical model is developed, which is followed by a discussion of results and conclusions.

The Analytical Framework

A TRQ scheme contains three trade instruments, including an in-quota tariff (T_1), a specified quota (Q_0), and an over-quota tariff (T_2). Hence, a TRQ regime combines tariffs and a quota, which make it quite complex.

Both tariffs and quotas limit imports and create wedges between world and domestic prices. However, the mechanisms through which these two policies influence imports differ. Figure 1 and Figure 2 show how these two policies function. Here, we assume that the importing country is small. In the case of free trade, the excess supply curve (ES) facing the importing country is a horizontal line at the world price (P_w). The equilibrium is determined by the intersection of the excess demand curve (ED) and the

excess supply curve. The domestic price is the same as the world price and imports equal M_0.

If an import tariff is imposed (Figure 1), the excess supply curve is shifted upward by the amount of tariff, and become ES'. The domestic price (P_d) is determined at the point where ED intersects ES' and is higher than the world price by the tariff level t. Moreover, imports decrease from M_0 to M_t and the government collects the tariff revenue.

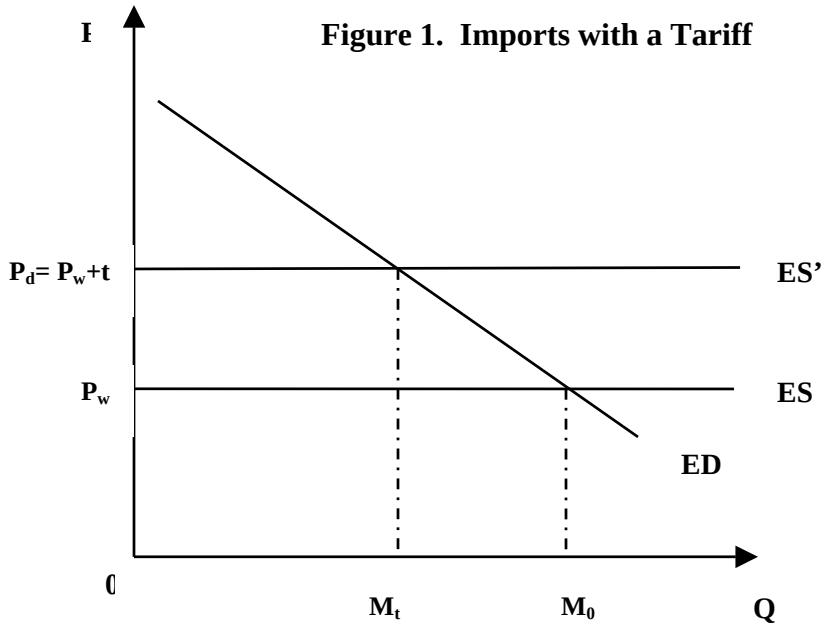


Figure 1. Imports with a Tariff

If instead, an import quota is used to restrict trade (see Figure 2), then any import volume exceeding the quota is not allowed and thus the ES curve is no longer continuous. Instead, the ES' is kinked with a vertical portion at the quota level (Q_0). Quota rents (P_d - P_w per unit) are generated from this instrument and these rents are not necessarily obtained by the government. Who gets the quota rents? Well that depends on how the import rights are allocated by the government.

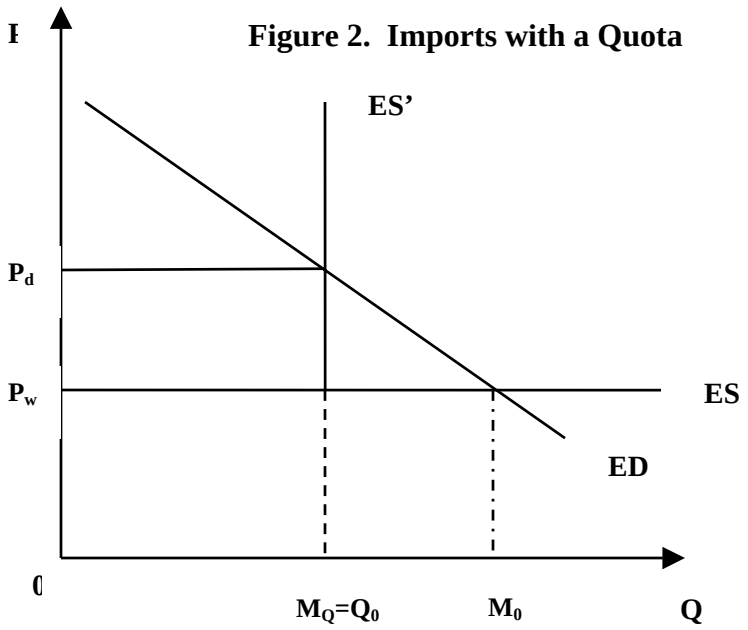
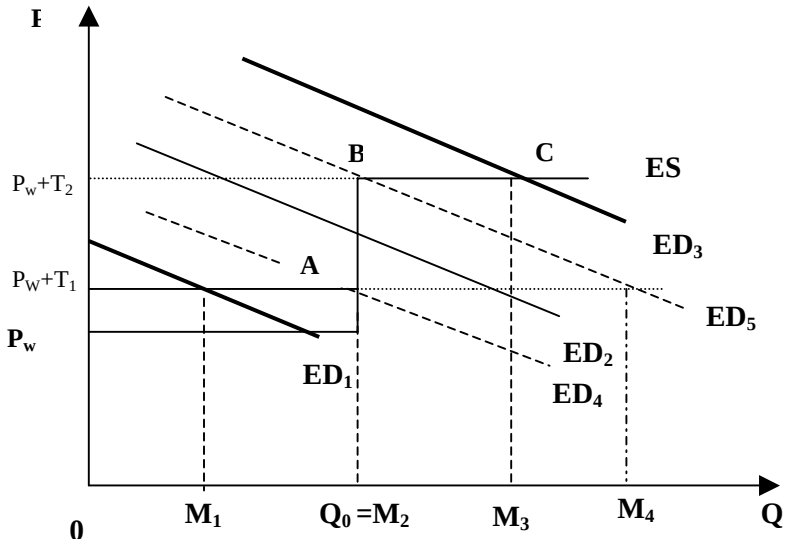


Figure 2. Imports with a Quota

A TRQ displays both tariff-like and quota-like characteristics. Figure 3 shows how a TRQ works. For imports within quota, importers face the price P_w+T_1 and for imports over quota the price is P_w+T_2. Hence, the excess supply (ES) curve is a step function $(P_W+T_1)ABC$. Imports under TRQs are determined by the excess demand (ED) in the home country and excess supply $(P_w+T_1)ABC$. In theory, a TRQ regime is less restrictive than a standard quota since imports over the quota level are allowed at a higher tariff rate. However, in principal, a TRQ becomes a traditional quota if the over-quota tariff rate is prohibitive under normal market conditions. Which policy element is effective under a TRQ depends on the relative positions of the excess demand and supply curves.

When the domestic demand for imports is relatively small, for example ED_1 in Figure 3, the 1st-tier tariff, T_1, becomes effective and the quota is redundant. Imports equal M_1 and the domestic price is P_w+T_1. In this case, the TRQ behaves as a tariff-only regime.

Figure 3. Imports under TRQs



If domestic demand for imports is higher, say at level ED_2 in Figure 3, then the quota becomes binding. Imports equal the quota amount, M_2. The tariff-inclusive price of imports is P_w+T_1, but the domestic price is higher and is set where ED_2 intersects the vertical line rising above M_2. Therefore, quota rent is generated. In this case, the TRQ serves as a quota with the import price inflated by the in-quota tariff.

If the domestic demand for imports is strong, say at ED_3, then imports over the quota quantity may occur and the 2nd-tier tariff becomes the effective instrument. Imports now equal M_3 and the domestic price is P_w+T_2. The difference between P_w+T_2 and P_w+T_1 becomes the size of the unit quota rent for the volume of product imported up to the point where the quota is filled (i.e., M_2) and charged a lower in-quota tariff rate T_2.

A simple descriptive statistic, the TRQ fill rate, is often constructed to assess the performance of TRQs relative to market access goals. The fill rate is defined as the actual import volume over the scheduled quota volume (i.e., Q_0 in Figure 3). It is determined by both actual imports and notified import quantities.

In the pure-tariff situation, fill rates range from 0 to less than 1, i.e., [0, 1). In this case, the TRQ is said to be under-filled with a fill rate (M_1/Q_0) less than 1, and a portion of the quota is not utilized. A zero fill rate indicates domestic demand is very low and domestic market conditions do not permit imports at the current in-quota tariff level. If the TRQ becomes a pure quota, i.e., the excess demand curve falls between ED_4 and ED_5 in Figure 3, then the quota fill rate will be 1 as the quota is completely filled. If the second tier tariff becomes effective, then the fill rate (M_3/Q_0) is greater than 1, and the TRQ is overfilled. The WTO does not require that TRQs be filled, and under-fill does not necessarily imply economic inefficiency, because under-fill may be due to insufficient domestic demand or exogenous market conditions.

As long as arbitrage is profitable, imports will occur under TRQs. Obviously, the world price (P_w), the two tariff levels (T_1 and T_2), and the quota level (Q_0) influence the volume of final imports and the fill rate. Moreover, other factors that directly affect excess demand and excess supply also affect the import volume and fill rate.

Administrative methods can influence TRQ fill rates. Although TRQs are not considered quantitative restrictions, they clearly contain a quota element. Hence, allocating import quota is necessary under a TRQ regime and some form of administrative method is needed. Therefore, TRQ administration fundamentally is a rationing problem, determining how import rights are distributed. Some administrative methods can increase transactions and import costs, and lead to low import volumes and low fill rates. Therefore, TRQ administrative methods have been a focus of discussion since the URAA.

The administration of TRQs involves different costs (Anderson). The first is the cost of rent seeking. If government intervention and regulation creates economic rent, firms and individuals will use resources to compete for a share of the rents. Rent seeking costs are wasted in the sense that these resources are not used in a productive fashion (Vousden). Rent seeking can take many different forms, like lobbying government officials, bribery, or overinvestment in physical plant to qualify for import licenses.

Second, administrative costs may be high. The government can intentionally make the quota application process complex. Third, the administrators can influence import costs such as transportation. For instance, it is possible for the government to allocate quotas in a size that is not commercially feasible.

Finally, administrative methods may allocate TRQs to high cost foreign producers and thereafter cause inefficiency. These suppliers would not be competitive under normal commercial conditions, but they are chosen for political reasons. For example, Japan's rice TRQs are allocated in a non-commercial fashion.

All of the above costs can be depicted in Figure 3 as an upward shift of ES or a leftward shift of ED. The magnitude of the shift of these curves determines how much imports are reduced and how the fill rate is affected. If the transactions costs are really high, it could even change the binding instrument. For instance, if ED_3 in Figure 3 shifts to ED_1, the quota will no longer be effective, and the 1^{st}-tier tariff will instead become binding. As a result, the quota will become under-filled.

Ten principle TRQ administrative methods have been identified by the WTO: applied tariffs (AT), license on demand (LD), first-come first-served (FC), historical importers (HI), auctions (AU), state trading (ST), producer groups (PG), mixed allocation

(MX), other (OT), and non-specified (NS). These alternative administrative methods can be theoretically ranked in terms of the inherent risk of biasing trade and underfilling the quota and they can be classified into three categories (Skully).

The first group, the "market allocation method", including auctions and applied tariffs, is inherently superior. The second group, "quasi-market methods", includes FC, license on demand, and historical allocation. These methods add random elements to the market allocation process. As a result, less efficient foreign suppliers have opportunities to gain a share of the market with these methods. The uncertainty and transactions costs introduced by these allocation methods can inhibit imports and increase the probability of underfill. The third group is termed "discretionary" and includes STEs and producer group methods. These methods could introduce market power and significantly distort trade. Hence, they are the least efficient. Some methods may be more preferable than others, and our empirical analysis will help measure how these methods affect market access opportunities.

Additional conditions attached to TRQs also potentially bias trade and affect fill rates (WTO, 2001). These include domestic purchase requirements (DPR), limits on TRQ shares per allocation (LA), export certificates (EC), past trading performance (PT), and a combination of the above conditions. These additional conditions impact the eligibility of entities that can participate in the market and often give rise to economic inefficiency.

Overview of TRQs

Following the URAA, 33 WTO members established a total of 1,259 agricultural TRQs. Eight years later, by 2002, the total number of agricultural TRQs increased to 1,425 and the number of countries employing TRQs increased to 43.

Although the WTO requires member countries to report details regarding the implementation of TRQs, not all countries fully comply. For example, Poland only notified 17 TRQs out of the 109 scheduled, and Costa Rica reported 8 out of its 27 TRQs. Additional reasons why TRQs go unnotified are because they are not open during the entire year or some TRQs are aggregated with others. For instance, the US does not report those TRQs reserved for Mexico under NAFTA. Our study includes TRQs employed by 28 countries who were members of the WTO prior to 1995.[1]

The number of TRQs in each member country differs significantly. Some countries use TRQs intensively. For example, Norway registers the highest number of TRQs with 232, accounting for 18% of the total number of agricultural TRQs. Poland comes in as second with 109 scheduled TRQs. In contrast, Australia, Brazil, and Indonesia only schedule and notify 2 TRQs each per year.

Agricultural TRQs are typically subject to high tariff protection (Table 1). The average in-quota tariff for the TRQs covered in this study was about 90.5% from 1995 to 2000. The standard deviation of the in-quota tariff was very high, about 359%, indicating a huge variation among countries. For instance, New Zealand did not apply any tariffs to its TRQs. The in-quota tariffs for Australia, Canada, and United States were relatively low, typically below 10%. On the other hand, Norway's average in-quota tariff reached 314% and Morocco's specified in-quota tariffs were 117%, on average.

The over-quota tariffs were substantially higher than in-quota tariffs, with an average tariff of 160%, and a standard deviation of 459%. Thirteen out of twenty-eight

[1] There are five additional countries with scheduled TRQs from 1995, but they are not included in this study. El Salvador and Nicaragua did not notify any TRQs to the WTO because these two countries did not open quotas for any of the scheduled products. Malaysia, Mexico and Romania only notified a few of their scheduled TRQs in some years. Hence, these three countries were also dropped from this study. All members who joined the WTO after 1995 are excluded from this study.

Table 1: Average In- and Over-quota Tariffs of TRQs (1995-2000)

Country	*In-Quota Tariff (%)*		*Over-Quota Tariff (%)*	
	Mean	**Sd**	**Mean**	**Sd**
Australia	1.03	1.09	15.14	15.98
Barbados	32.30	12.10	32.30	12.10
Brazil	11.50	1.57	11.50	1.57
Canada	9.43	6.11	214.63	122.17
Colombia	73.41	64.80	92.80	89.47
Costa Rica	55.00	0.00	152.11	71.39
Czech Republic	29.17	17.81	70.09	36.28
European Commission	12.83	24.39	106.63	92.70
Guatemala	18.48	11.21	55.01	70.80
Hungary	26.22	14.75	60.66	23.95
Iceland	17.40	20.38	57.77	139.33
Indonesia	57.08	36.34	151.58	89.86
Israel	90.92	77.52	119.32	62.42
Japan	18.61	11.61	414.44	559.55
Korea	20.05	16.95	311.76	256.89
Morocco	117.09	46.54	190.50	86.09
New Zealand	0.00	0.00	0.00	0.00
Norway	314.24	723.40	329.69	722.06
Philippines	34.73	14.02	65.26	34.00
Poland	39.50	22.86	129.13	72.14
Slovak Republic	29.38	17.13	71.37	36.49
Slovenia	29.09	26.31	93.15	67.17
South Africa	11.65	9.28	55.72	81.01
Switzerland	42.79	75.84	350.05	1562.60
Thailand	28.29	11.97	105.79	65.99
Tunisia	26.26	9.46	131.19	63.79
United States	8.00	5.60	71.11	52.46
Venezuela	17.61	6.53	21.96	23.03
Average	90.52	358.85	159.98	458.83

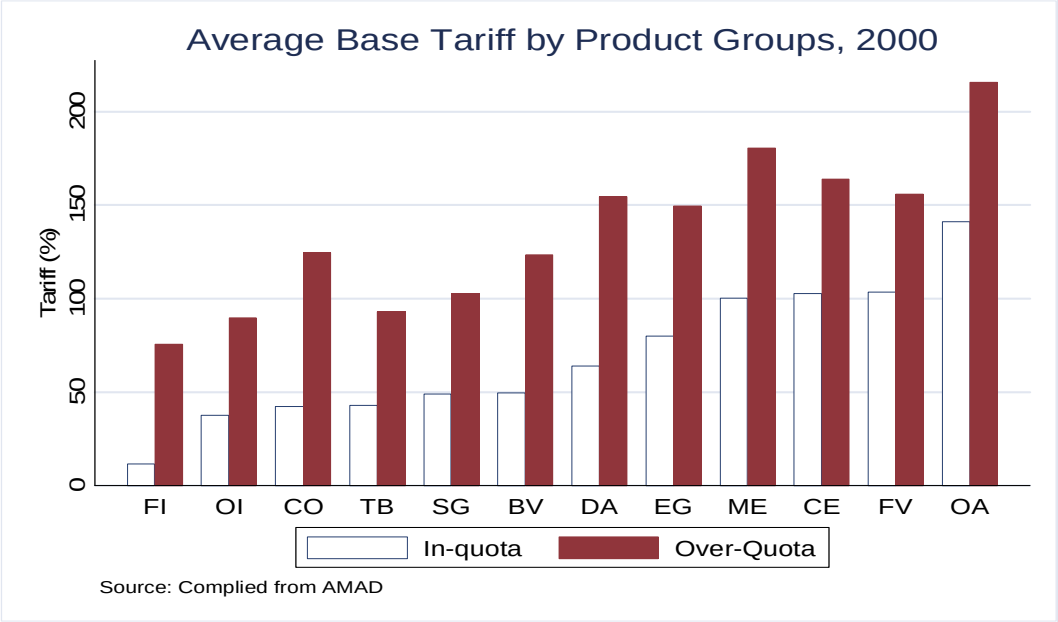
Source: Compiled from AMAD.

countries charged over-quota tariffs that exceeded 100% during the 1995-2000-time period. For example, the average over-quota tariff in Japan was 414%.

In some countries, the over-quota tariff was only slightly higher than the in-quota tariff. However, in other cases the over-quota tariff was much higher than the in-quota tariff. For example, the average in-quota tariff in Canada was only 9.4%, while the over-quota imports were subject to an average tariff rate of 214.6%. In Japan, the average over-quota tariff was 22 times the average in-quota tariff, with the in-quota and over-quota tariffs at 18.6% and 414.4%, respectively.

Tariff protection afforded by TRQs is quite diverse across product groups (Figure 4). Agricultural fibers are least protected by TRQs, with the average in-quota tariff of 8.4%. The in-quota tariff rates for tobacco, oilseed products, sugar, coffee, tea and spices are all below 50%. On the other hand, "other" agricultural products, fruits and vegetables, meat, and cereal crops all enjoy a protection level of more than 100%, even for in-quota imports. Tobacco has the lowest over-quota tariff with the tariff level of 56%. Meat products and other agricultural products have the highest over-quota average tariff of more than 200%.

Figure 4. Average In- and Over-Quota Tariffs



Note: BV=Beverages, CE=Cereals, CO=Coffee, tea, spices, & their products, DA=Fairy products, EG=Eggs and products, FI = Agricultural fibers, FV=Fruit & vegetables, ME=Meat products, OA=other agricultural products, OI=Oilseeds products, TB = Tobacco, SG=Sugar & products.

Among the ten principal administrative methods, applied tariffs (AT) is the most heavily employed and accounts for almost 50% of all TRQs (Table 2). Limited demand (LD) serves as the second most popular method, accounting for about a quarter of the

TRQs. Producer group (PG) and "other" methods (OT) are seldom used, with only 8 TRQs regulated by PG in 1995 and 6 TRQs regulated by OT in 2000.

Table 2: Distribution of Administrative Methods: Number of TRQs

Administration	*1995*	*1996*	*1997*	*1998*	*1999*	*2000*
AT	498	477	483	477	457	448
AU	38	35	36	34	34	26
FC	85	97	97	97	92	90
HI	60	78	83	86	81	95
LD	246	268	272	272	274	258
MX	50	52	54	55	53	52
OT	10	11	5	5	4	6
PG	8	8	7	7	7	9
ST	22	22	20	19	19	19
Total	1,017	1,048	1,057	1,052	1,021	1,003

Source: Compiled from AMAD.
Note: AT = Applied tariffs, AU = Auctioning, FC = First come, first served, HI = Historical importers, LD = Licenses on demand, MX = Mixed allocation methods, OT = Other, PG=Producer groups, ST = Imports by state trading enterprises.

During the 1995-2000 time period, the TRQ administrative methods have hardly changed. The use of applied tariffs decreased slightly from 1995 to 2000, dropping from 498 TRQs in 1995 to 448 TRQs in 2000. In contrast, the use of historical allocation (HI) methods increased from 60 to 95, from 1995 to 2000.

Some countries employ only one or two administrative methods. For example, all TRQs in Barbados are administered by AT. On the other hand, several countries regulate TRQs by a variety of methods. For instance, Canada uses 7 different methods to regulate its 21 TRQs.

All TRQs in Barbados, Brazil, Guatemala, New Zealand, Tunisia, and Venezuela are implemented by AT. The majority of TRQs in Iceland and in Norway are also regulated by AT. Costa Rica employs an auction system to administer its TRQs, while the Czech Republic and Morocco report all of their TRQs under the FC category. On the other hand, the TRQs in Hungary, Slovak Republic and Slovenia are dominated by the

LD method. If we turn to the two giants in international agricultural trade, LD and HI account for about 84% of total EU TRQs, while 65% of the US TRQs are administered by FC.

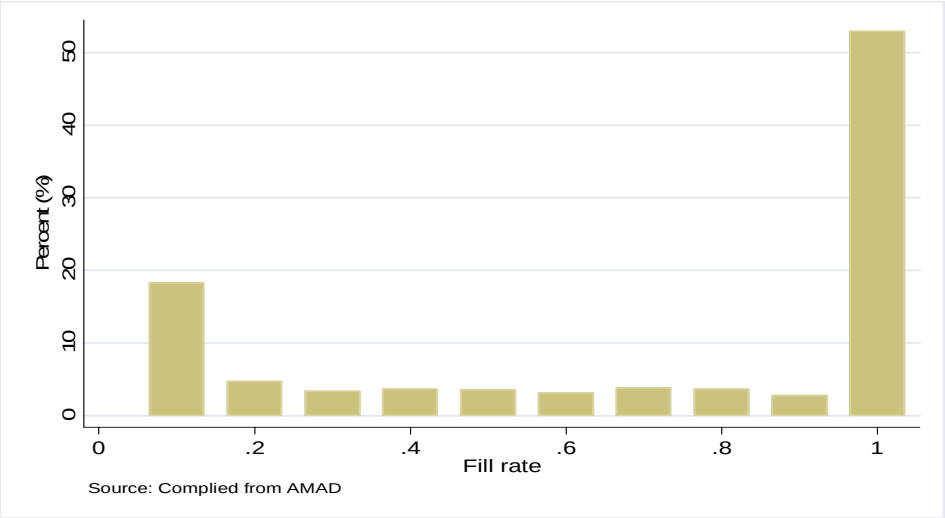
Four additional administrative methods and the combination of them are identified by the WTO. These additional requirements are applied to about 23% of the total TRQs. Among these four methods, "limits on tariff quota shares per allocation" is most intensively used, accounting for about one-half of the TRQs with additional requirements. Domestic purchase requirements and past trading performance requirements, respectively, account for another 20% of TRQs.

Only sixteen countries report the use of "additional conditions" in addition to the principal administrative methods. The additional requirements are mostly employed with the LD method. About 70% of the TRQs administered by LD requires additional methods, while other principal methods, including AT, FC, HI, OT, and PG, do not involve additional methods.

The average TRQ fill rate fell below 70% in each year from 1995 to 2000.[2] Figure 5 shows the distribution of fill rates in 1995. About 53% of the TRQs had fill rates that were higher than 0.9 and the fill rates associated with about 18% of the TRQs were below 0.1. The relatively low average fill rate, together with a large number of unfilled TRQs reveals that agricultural TRQs are under-utilized by a significant margin. This suggests that the URAA TRQ regime may not lead to the expected market access improvements.

[2] In order to provide consistency across countries, fill rates higher than 1 are censored to 1 in the following discussion.

Figure 5. Distribution of TRQ Fill Rate (1995)



The fill rates of each administrative method show different patterns (Table 3). Although economically efficient, the fill rate for AU is the lowest among all methods. However, the fill rates for this method steadily increased over our sample period from 27% to 44%, which suggests improved efficiency over time. With the second largest

Table 3. TRQ Fill Rates across Principal Administrative Methods

Regulation	1995	1996	1997	1998	1999	2000
AT	0.71	0.66	0.67	0.71	0.69	0.69
AU	0.27	0.30	0.34	0.40	0.40	0.44
FC	0.56	0.63	0.58	0.63	0.63	0.63
HI	0.91	0.73	0.73	0.68	0.69	0.70
LD	0.61	0.57	0.56	0.53	0.51	0.52
MX	0.72	0.78	0.70	0.70	0.70	0.68
NS		0.00				
OT	0.56	0.61	0.93	0.91	0.99	0.95
PG	0.74	0.53	0.85	0.78	0.69	0.75
ST	0.81	0.83	0.90	0.91	0.73	0.80
Average	0.67	0.64	0.63	0.65	0.63	0.64

Source: Compiled from AMAD.
Note: AT = Applied tariffs, AU = Auctioning, FC = First come, first served, HI = Historical importers, LD = Licenses on demand, MX = Mixed allocation methods, OT = Other, PG=Producer groups, ST = Imports by state trading enterprises.

number of TRQs, LD also had fill rates lower than the average. Moreover, the fill rate for this method decreased slightly. On the other hand, PG and ST showed relatively high fill rates.

The TRQ fill rates with PT and LA methods were significantly lower than the average fill rates (Table 4). On the other hand, the fill rates with DPR additional requirement were dramatically higher than the average fill rate.

Table 4. TRQ Fill Rates across Additional Administrative Methods

Additional Methods	1995	1996	1997	1998	1999	2000
DPR	0.87	0.84	0.82	0.78	0.80	0.78
DPR+LA					1.00	1.00
PT	0.64	0.58	0.53	0.52	0.46	0.56
LA	0.50	0.50	0.44	0.46	0.43	0.45
EC	0.77	0.75	0.77	0.73	0.66	0.71
EC+PT		0.50	1.00	1.00	1.00	0.87
Average	0.67	0.64	0.63	0.65	0.63	0.64

Source: Compiled from AMAD.
Note: DPR = Domestic purchase requirement, EC = Exports certificates, LA = Limits on shares per allocation, PT = Past trading performance.

The Empirical Model

In this section, we specify an empirical model to assess the effects of TRQ implementation on market access and we measure those factors that affect TRQ fill rates. As noted previously, TRQ fill rate is the ratio of actual imports to the scheduled quota quantity. The notified quantities for a country are negotiated and predetermined before the implementation of TRQs. The only random component in the fill rate is actual imports. Hence, we start by modeling import behavior, i.e., focusing on a country's excess demand for imports.

If domestic prices deviate from the world price, arbitrage opportunities should exist and result in imports/exports. Hence, import demand, *Y*, is modeled as a function of

the domestic price, P_d, and the world price, P_w, and a vector of other exogenous demand shifters, X.

$$Y = f(P_d, P_w, X) \tag{1}$$

Three sets of variables are included in the other exogenous demand shifters, X. The first set of variables contains each country's income and population. Three policy instruments, the 1st-tier tariff and 2nd-tier tariff, and quota volume, are the second set of demand shifters. The last set of demand shifters includes both principal and additional administration methods.

Let's define Y_{ijt}* as the hypothetical imports of commodity i in country j in year t and the other variables as in Table 5. Equation (1) can be rewritten as:

$$\begin{aligned} Y_{ijt}^{*} &= X'\beta + e \\ &= \beta_0 + \beta_1 Pd_{ijt} + \beta_2 Pw_{it} + \beta_3 AT_{ijt} + \beta_4 FC_{ijt} + \beta_5 LD_{ijt} + \beta_6 AU_{ijt} + \beta_7 HI_{ijt} + \beta_8 ST_{ijt} \\ &\quad + \beta_9 PG_{ijt} + \beta_{10} OT_{ijt} + \beta_{11} MX_{ijt} + \beta_{12} DPR_{ijt} + \beta_{13} LA_{ijt} + \beta_{14} EC_{ijt} + \beta_{15} PT_{ijt} \\ &\quad + \beta_{16} Pop_{jt} + \beta_{17} Inc_{jt} + \beta_{18}\tau_{1ijt} + \beta_{19}\tau_{2ijt} + \beta_{20} Q_{ijt} + e_{ijt} \end{aligned} \tag{2}$$

There are several potential problems with the above specification (2). First of all, endogeneity problems arise. Because prices and import quantities are simultaneously determined, it is quite possible that some factors embodied in the error term are also related to price variables and this would lead to biased estimation results. Assuming the international market is perfectly competitive and every importing country is small, the world price can be treated as an exogenous variable. However, the domestic price is likely serially correlated with the error term. In order to deal with this problem, we use a one-period lagged production as the proxy for domestic price. Therefore, we can obtain a reduced-form model in which net imports is estimated directly as a function of world price, lagged domestic supply, current trade policies, and regulation methods.

Table 5: Regressors in the Import Equation

Regressors	
Principle Administration Methods	In the form of dummy variables
AT	Applied tariffs
FC	First-come, first-served
LD	Licenses on demand
AU	Auctioning
HI	Historical importers
ST	Imports by state trading enterprises
PG	Producer groups/associations
OT	Other
MX	Mixed allocation methods
Additional Conditions	In the form of dummy variables
DPR	Domestic purchase requirements
LA	Limits on tariff quota shares
EC	Export certificates
PT	Past trading performance
Policy Instruments	
τ_1	1^{st} – tier tariffs
τ_2	2^{nd} – tier tariffs
Q	Quota quantity
Other Regressors	
P_d	Domestic price, in terms of domestic currency
P_w	World reference price, in domestic currency
Inc	Income
Pop	Population level
c	Individual-specific effects
e	Random error term
Plag	One-time period lagged production

Another possible specification problem with equation (2) is perfect multicollinearity. The principal administrative method enters the specification as a dummy variable. If all principal methods are included in the model, as in equation (2), then we fall into the dummy variable trap. To avoid perfect multicollinearity, we drop the "applied tariffs method" dummy. This administrative method does not impose

quantitative restrictions on imports and acts like a pure tariff and requires the least administrative effort. Therefore, this method is considered the most efficient way to administrative TRQs. Choosing this dummy as the benchmark also facilitates the interpretation of the results. The "additional administrative methods" also enter the specification in the form of dummy variables. However, these variables do not cause a multicollinearity problem since more than one-half of TRQs are not subject to additional requirements.

In addition, unobserved individual heterogeneity and measurement errors may cause another type of endogeneity problem. Errors of measurement are, without doubt, important in microeconomic data and the bias due to omitted heterogeneity may be important. When a panel data set is available, these problems could be controlled by including individual specific effects in the model (Matyas and Sevestre, 1992). Therefore, we add a set of individual specific effects in equation (2).

Taking into account the above problems, we specify a new demand function. Because the variable we are most interested in is the TRQ fill rate, we define the TRQ fill rate, y_{ijt}^{*}, as:

$$y_{ijt}^{*} = \frac{Y_{ijt}^{*}}{Q_0}$$

Dividing both sides of equation (2) by the predetermined quota quantity, we have the following specification of TRQ fill rates, in which the quota quantity drops off from right hand side,

$$
\begin{aligned}
y^{*}_{ijt} &= X'\beta + c + e \\
&= \beta_0 + \beta_1 Plag_{ijt} + \beta_2\, Pw_{jit} + \beta_3 AT_{ijt} + \beta_4 FC_{ijt} + \beta_5 LD_{ijt} + \beta_6 AU_{ijt} + \beta_7 HI_{ijt} + \beta_8 ST_{ijt} \\
&\quad + \beta_9 PG_{ijt} + \beta_{10} OT_{ijt} + \beta_{11} MX_{ijt} + \beta_{12} DPR_{ijt} + \beta_{13} LA_{ijt} + \beta_{14} EC_{ijt} + \beta_{15} PT_{ijt} \\
&\quad + \beta_{16} Pop_{jt} + \beta_{17} Inc_{jt} + \beta_{18}\tau_{1ijt} + \beta_{19}\tau_{2ijt} + c_{ij} + e_{ijt}
\end{aligned}
\tag{3}
$$

However, the above model fails to capture a distinguishing feature of the TRQ trade regime. In the analytical framework, we see that the dependent variable, the TRQ fill rate, is left-censored at 0 because no imports occur for some TRQs during some years. In the empirical analysis, the dependent variable is also right censored. First, the quota is binding for some TRQs with fill rates of 1. In addition, several countries only report imports under TRQs up to the quota level and over-quota imports are not reported. In order to be consistent, fill rates greater than 1 are censored to 1. Hence, TRQs are right-censored at 1. A linear specification such as equation (3) is then inappropriate. In order to account for this characteristic, we specify a double-censored Tobit model, as suggested by Maddala (1983).

Given the censored nature of the data, the TRQ fill rate, y_{ijt}^{*}, is a latent variable and is partially observed. What we can observe is a censored variable, y_{ijt}. For simplification, all of the subscripts of y_{ijt}^{*} and y_{ijt} are omitted in the following text. The observed fill rate can be defined as,

$$
y = \begin{cases} 0 & if\ y^{*} \le 0 \\ y^{*} & if\ 0 < y^{*} < 1 \\ 1 & if\ 1 \le y^{*} \end{cases}
\tag{4}
$$

The censored nature of the dependent variables causes us to further consider how individual-specific variables should be included in the model. In general, individual-specific variables can enter the model as either fixed effects or random effects. However, parametric estimators of limited dependent variable models with fixed effects from panel

data are inconsistent. This problem is most acute when the time dimension of the panel is low. Honore (1992) developed a nonparametric method, to obtain consistent estimates of a fixed-effect Tobit model in a short panel, the so called trimmed least absolute deviations and trimmed least squares estimators. However, this method cannot estimate variables that lack variation over time because the first differencing technique cancels out such variables. In most cases, principal and additional administrative methods do not change over time after they are first introduced. Therefore, this method cannot be applied to estimate the fill rate model. As a result, the individual specific variables, c_{ij}, enter the model as random effects and we make the following assumption,

$$c_{ij} \sim N(0, \sigma_c^2)$$

Estimation and Results

Our dataset covers the first six-year period of TRQ implementation, i.e., 1995 to 2000, and every TRQ notified to the WTO is included.[3] The data on market access and TRQ trade regimes were mainly derived from the Agricultural Market Access Database (AMAD), updated on July 5, 2004. The AMAD is a cooperative effort among Agriculture and Agri-Food Canada, the EU Commission-Agriculture Director-General, FAO, OECD, the World Bank (WB), UNCTAD, and the United States Department of Agriculture-Economic Research Service (ERS). The information on TRQs, including scheduled quota quantity, notified quantity imported under TRQs, relevant in-quota and out-of-quota tariffs, and applied tariffs were mainly complied from this database. In the case of

[3] The study covers the 1995-2000-time period mainly because of data availability. The implementation of TRQs after 2000 has not changed much for developed countries because no consensus has been reached about reforms of TRQs in the Doha round. Moreover, the implementation of TRQs in developing country has not changed much, either. Based on the available small sample data, the fill rates of TRQs were even lower in 2001 and 2002. The administrative methods remain much the same for most TRQs.

missing data, the original country's notification files to the WTO were used to obtain relevant information.

Data on the principal and additional TRQ administration methods were obtained from a Background Paper by the WTO Secretariat, Tariff Quota Administration Methods and Tariff Quota Fill (TN/AG/S/6, 22 March 2002). Other data, including population and national income were obtained from the 2004 World Development Indicators published by the World Bank.

Two models, a pooled Tobit model and a random-effect Tobit model were estimated. The likelihood ratio test rejects the pooled Tobit model, and in favor of the random effects Tobit model. In order to fit the random effects Tobit model, the Gauss-Hermite quadrature is used to compute the likelihood function. The regression results are presented in Table 6.

An examination of the random effects Tobit model result indicates that the world price negatively affects quota fill rates. This makes sense because higher world prices reduce import revenue and result in a lower volume of imports. The one-period lagged production in the random effects Tobit model turns out to be positive, which seems counterintuitive. However, the impact of domestic production on market access is very marginal and the estimate is not statistically different from zero. This marginal effect may be caused by the weak linkage between the domestic and international market since other factors may play a stronger role in determining imports. It may also be a result of the aggregate production data. The production data from FAO sometimes is less disaggregate than trade data. Population growth increases the aggregate demand for agricultural

products and encourages more imports. The income level is statistically insignificant and does not affect imports much.

Table 6. Regression Results for Fill Rate Models

Regressors	***Pooled Tobit***		***Random Effects Tobit***	
	Coefficient	**t-value**	**Coefficient**	**t-value**
P_w	0.003	0.31	-0.021**	-3.46
Plag	0.000	0.42	0.000	0.64
GDP Per Capita	-0.001	-0.64	-0.001	-0.35
Pop	0.001**	5.15	0.001**	7.72
τ_1	-0.096**	-6.11	-0.054**	-3.47
τ_2	0.000**	4.92	0.000**	3.67
AU	-1.018**	-13.57	-0.717**	-9.45
FC	-0.457**	-9.27	-0.488**	-8.02
HI	-0.419**	-8.33	-0.383**	-7.84
LD	-0.725**	-15.33	-0.592**	-11.07
MX	-0.536**	-9.00	-0.354**	-5.18
OT	-0.045	-0.28	-0.399*	-2.46
PG	-0.409*	-2.85	-0.123	-1.35
ST	-0.269*	-2.89	-0.559**	-5.63
DPR	0.767**	10.66	0.543**	7.05
PT	-0.108	-1.73	-0.128*	-2.04
LA	-0.008	-0.16	-0.145*	-2.55
EC	0.261*	2.96	-0.225**	-2.75
Constant	1.211**	40.95	1.141**	32.97
σ_c	-	-	0.694	34.43
Log-Likelihood	-4150.086		-2841.644	
Observations	4581		4581	

*Note: * significant at 5%; ** significant at 1%*

The estimate of the 1st-tier tariff is negative at the 1% significance level. This type of protection reduces market access. On the other hand, the estimated coefficient for the 2nd-tier tariff is very small and not much different from zero. This result suggests that the 2nd-tier tariffs did not have much influence on quota fill rates during the study period, despite the high protection level offered by these tariffs. Therefore, negotiations focusing on general reductions of the over-quota tariff will not necessarily improve market access.

Considering the principal administrative methods, our regression results show that administration plays an important role in the performance of TRQs. All estimated coefficients are negative. Except for the producer group method, all coefficients for the administrative methods are statistically significant, indicating that all of these methods are inferior to the applied tariff method and they negatively impact imports.

Our results show that the applied tariffs (AT) method is superior to other methods in the sense that it has the least negative effect on imports. Under this method, imports are allowed in unlimited quantities at the in-quota tariff rate, or below. No shares are allocated to importers under this method. Hence, TRQs managed by the AT method are not real TRQs since there is no quantitative restriction. TRQs administered by this method are equivalent to simple tariffs.

Theoretically efficient, auctioned import licenses lead to surprisingly low quota fill rates and we find that they have the most negative effect on market access. It is possible that the countries applying this method have introduced some additional distortions in the auction system. Skully (2001) found that this method outperforms other methods only when the market is sufficiently liquid, i.e., when the market has a large volume of trade and is competitive.

First come, first served, license on demand, and historical importer methods allocate imports rights in different ways. However, they have similar estimated impacts on market access. In the FC method, the physical importation of the good determines the applicable tariff. This method places a premium on time. If the importer is caught as the one importing over quota, the importers have to either pay a higher tariff level, store the product outside the border, or trans-ship the product to another country. This method also

biases trade distribution because it gives an advantage to exporters who are geographically closer to the importers. All these reasons can lead to low market access for this method.

In the licenses on demand (LC) method, licenses are issued among all applicants based on quantities requested in most cases. If the total volume of license requests exceeds the available quantity, then requests are reduced pro rata. This pro rata reduction brings inefficiencies and leads to potential quota underfill. First of all, importers have the incentive to exaggerate their quota requests, anticipating a reduction in the total licensed quantity. Furthermore, the overall reduction may lead to fragmented market shares so that importers then choose not to import small quantities. Hence, some quotas may not be filled.

If the historical importers method is used, importers' shares are allocated to exporters principally based on past import performance. This method makes the existing exporters' planning easier. However, it results in static trade shares. Once the quota is allocated to an exporter, the license tends to be valid for several years. The importing country has the power to control trade in the sense that they can choose the reference year to decide who obtains licenses. A historical importer may not even be a current supplier due to cost considerations. If these high-cost countries are granted a license, then quota under-fill is possible.

Imports controlled by state trading entities (ST) is the least transparent way to administrate TRQs, because the state trader has the right to make import-sourcing decisions that may have nothing to do with commercial considerations. However, our regression results show that the degree to which these factors impede imports is

moderate. This result may be due to the fact that most of TRQs under this method are politically sensitive so that governments have an incentive to fill the quota.

Although all principal administrative methods have negative impacts on TRQ fill rate, the magnitudes of the estimated coefficients differ. We tentatively rank the effects of each method on the fill rate, according to the size of the estimated coefficients. Surprisingly, the empirical ranking is different from the theoretical ranking. The two discretionary methods, PG & ST are not the methods that reduce fill rates the most. In contrast, PG has the least impact on fill rates other than AT, and ST has a medium influence on fill rates. On the other hand, auctioning (AU), the best method in theory, results in the lowest fill rates among all principal methods.

Table 7. Rank of the Impacts on Fill Rates across Administrative Methods

Impacts on Fill Rates	**Theoretical Ranking**		**Empirical Results**
Low	Market allocation Method	AT AU	AT PG HI
Medium	Quasi-market methods	FC LD HI	FC ST LD
High	Discretionary Methods	PG ST	AU

Note: 1. AT = Applied tariffs, AU = Auctioning, FC = First come, first served, HI = Historical importers, LD = Licenses on demand, PG=Producer groups, ST = Imports by state trading enterprises.

2. MX(= Mixed allocation method) and OT(= Other) are not ranked because they combine several methods and therefore are difficult to rank them theoretically.

It is not surprising that the three additional administrative requirements, limits on TRQ shares per allocation (LA), export certificates (EC), and past trading performance (PT), are negatively related to quota fill rates. However, our results indicate that the DPR condition increases imports, which is a bit puzzling. This additional condition requires

the purchase or absorption of domestic production of the product in order to be eligible for a share of the import quota. This requirement obviously increases the costs for some importing firms. However, firms are more likely to commit to import once they obtain their quota share because they are involved in the domestic business, and this results in higher fill rates.

Conclusion

We have conducted a comprehensive study of the impacts of agricultural TRQs on market access. A two-limit random effects Tobit model was specified to examine factors that affect TRQ fill rates. The empirical results provide insights as to how to further liberalize TRQs and improve market access for agricultural products.

We find that the in-quota tariffs have provided strong protection. Further reducing in-quota tariffs will be much more effective in improving market access, compared to reducing the over-quota tariffs. However, this does not imply that the over-quota tariffs should be left untouched. It simply means that in the presence of the current in-quota tariffs and quota levels; the over-quota tariffs are not very relevant.

Moreover, we have found that the choice of TRQ administrative method is very important because all administrative methods, including principal and additional methods, have the potential to reduce market access. We find that the empirical ranking of the fill rate impacts of alternative administrative methods deviates from the theoretical ranking. The applied tariff method is found to be superior to other methods, which emphasizes the importance of increasing the transparency of administrative methods. Trade negotiations devoted to making TRQ administration simpler and more transparent will surely improve market access. The sooner the transitional TRQ regime is phased out

and is replaced by a tariff-only regime, the greater the market access in the world agricultural trade.

References:

Abbott, P. C., and B. A. Morse. “Tariff Rate Quota Implementation and Administration by Developing Countries” *Agricultural and Resource Economics Review* 29/1(April 2000) 115-124.

Abbott, P. C., and P. L. Paarlberg. “Tariff Rate Quotas: Structural and Stability Impacts in Growing Markets” *Agricultural Economics* 19(1998) 257-267.

Anania, G., M.E. Bohman, C.A. Carter, and A.F. McCalla (eds). "Agricultural policy reform and the WTO: where are we heading?" Cheltenham, UK ; Northampton, MA : Edward Elgar, 2004.

Anderson, K. “Agriculture, Developing Countries and the WTO’s Millennium Round.” paper presented at the World Bank and WTO Conference on Agriculture and the New Trade Agenda in the WTO 2000 Negotiations, Geneva, October 1-2, 1999.

Bureau, J.C., and S. Tangermann. “Tariff Rate Quotas in the EU” *Agricultural and Resource Economics Review* 29/1 (April 2000) 70-80.

Honore, B. “Trimmed LAD and Least Squares Estimation of Truncated and Censored Regression Models with Fixed Effects” *Econometrica*, Vol. 60 (May, 1992), 533-65.

Maddala, G. S. *Limited Dependent and Qualitative Variables in Econometrics*. Cambridge University Press, 1983.

Matyas, L., and P. Sevestre. *The Econometrics of Panel Data*. Kluwer Academic Publishers, 1992.

Monnich, C. “Tariff Rate Quotas: Does Administration Matter?” paper presented at the International Conference on Agricultural Policy Reforem and the WTO: Where Are We Heading?, Capri, Italy, June 23-26, 2003.

OECD, “Towards More Liberal Agricultural Trade” http://www.oecd.org/publications/Pol_brief, Paris OECD, 2001.

OECD, Agriculture and Trade Liberalisation : Extending the Uruguay Round Agreement Paris OECD, 2002.

Podbury, T. and I. Roberts, “ WTO Agricultural Negotiations: Important Market Access Issues”, ABARE Research Report 99.3, Canberra, 1999.

Skully, D. "Economics of Tariff-Rate Quota Administration: Economic Analysis of TRQ Administrative Methods" http://www.ers.usda.gov/publications/tb1893/tb1893d.pdf, Economic Research Service/USDA, 2001.

Vousden. N. *The Economics of Trade Protection*. Cambridge University Press, 1990.

WTO, "Tariff Quota Administration Methods and Tariff Quota Fill "Background Paper by the Secretariat, G/AG/NG/S/8, May 2000.

WTO, "Tariff Quota Administration Methods and Tariff Quota Fill, Revision" Background Paper by the Secretariat, G/AG/NG/S/8/Rev. 1, May 2001.