The Role of the Imports for Re-Exports Program in Determining Canadian Demand for Imported Cheese: Implications for U.S. Exports

Andrew Muhammad
Department of Agricultural Economics
Mississippi State University
PO Box 5187
Mississippi State, MS 39762
Phone: (662) 325-0200
Fax: (662) 325-8777
E-mail: muhammad@agecon.msstate.edu

Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Dallas, TX, February 2-6, 2008

The Role of the Imports for Re-Exports Program in Determining Canadian Demand for Imported Cheese: Implications for U.S. Exports

Andrew Muhammad, Mississippi State University

Abstract

Given the importance of the Imports for Re-exports Program in (IREP) in Canada, this study assessed the impact of per-unit export returns on Canadian demand for imported cheese. If Canadian importers increase utilization of IREP, U.S. exports to Canada will remain unchanged while imports from the EU will increase.

Key words Canada, cheese, import demand, IREP, Rotterdam model

JEL Classification: Q17, Q18, F13

1. Introduction

Canada maintains substantial trade barriers where imports have been strictly controlled to protect high internal prices. Although Canada replaced import quotas with tariff rate quotas (TRQ) under the 1994 Uruguay Round agreement, access quantities are small and triple-digit above access tariff rates make importing quite prohibitive (Romain and Sumner 2001; IDFA 2007). The TRQ quota limit for cheese is currently set at 20.4 million kilograms (kg) and above access tariff rates are as high as 245.5% (Canada Border Service Agency 2007). Notwithstanding, cheese imports have been significantly higher than the TRQ quota limit. From 2000 to 2006, above access imports have averaged 4.9 million kg annually (UNCOMTRADE 2007).

A significant percent of above access imports go through the Imports for Re-export Program (IREP). IREP imports receive tariff-free access as long they are re-exported within six months of the date of entry (Foreign Affairs and International Trade Canada 2005). Dairy products imported through the IREP are primarily used as ingredients in further processing where whole milk powders, butter fats and oils, and fluid milk account for the majority of imports through this program (38%, 24%, and 15%

respectively). Cheese on the other hand is often re-exported with little additional processing and accounts for 7% of total IREP imports (Agriculture and Agri-Food Canada 2007).

Patterson (2006) noted the direct relationship between total cheese imports and IREP imports in recent years. The importance of the IREP to import demand raises the question, how has the re-export market impacted the demand for imported cheese in Canada? The primary goal of this study is to assess the impact of the IREP on import demand. This is accomplished by estimating the derived demand for imported cheese in Canada and assessing the impact of re-export price on total cheese imports and imports from specific countries. Past import demand studies have typically used demand models derived from consumer theory such as the AIDS model (Deaton and Muellbauer 1980) and Rotterdam model (Theil 1980). Given the intermediate nature of agricultural imports, import demand is modeled as input demand in this study. By allowing imports to be treated as inputs and by specifying an unconditional input demand function (that is aggregate imports as a function of output and re-export prices) this paper makes it possible to relate the re-export price to total demand for cheese imports, but more interestingly, to the demand for cheese from specific markets. It is through the intermediate product assumption and the procedure used in this paper that it is possible to address the effects of the re-export market on the demand for imported cheese from a specific country.

In this paper a production version of the Rotterdam model is used to estimate import demand (differential production model) (Theil 1980; Laitinen 1980). The model is derived from a two-step profit maximization procedure and results in a structural system of import demand equations (total and source-specific). The system of equations allows for simultaneous determination of total import expenditures and source-specific imports. Specific objectives of this study are as follows: (1) Canadian demand for imported cheese differentiated by country of origin is estimated. Instead of assuming that total expenditures are exogenous (which is common practice in most papers) we test for expenditure endogeneity using the Durbin, Wu and Hausman test. Given that total expenditures were found to be endogenous, total and source-specific import demand was estimated using the full information maximum likelihood procedure. (2) Empirical estimates are used to derive sensitivity measures of import demand with respect to changes in import prices, domestic prices, re-export prices and the price of resources used by importers such as labor and energy. Of particular importance is the impact of re-export prices on imports of U.S. cheese.

2. Theoretical and Empirical Model

Consumer approaches to import demand have been used quite extensively in empirical analysis. Empirical models have included (but are not limited to) the Armington (1969) model, AIDS model (Deaton and Muellbauer 1980) and Rotterdam model (Theil 1980). While these models have found great use in the demand analysis literature, their use in estimating import demand are at times misapplied because traded products are often intermediate in nature (Davis and Jensen 1994; Washington and Kilmer 2002). In consumer applications, production related variables such as resource prices and output prices are for the most part not considered although they may significantly determine import demand. Most goods entering international trade require further processing before final demand delivery, and when products are not physically altered, activities such as handling, insurance, transportation, storing, repackaging, and retailing still occur, resulting in a significant amount of domestic value added before final demand delivery (Kohli 2001, 1978; Sanyal and Jones 1982; Burgess 1974).

The differential production model is used to estimate total and source-differentiated import demand. See Laitinen (1980) and Theil (1980) for theoretical derivation. See Washington and Kilmer (2002), Muhammad (2007), and Muhammad, Jones, and Hahn (2007) for empirical applications. We assume that firms import cheese in a two step procedure where total expenditures on cheese imports are explained by economic factors derived from profit maximizing behavior. The allocation of total expenditures across import suppliers are explained by the level of total expenditures and individual import prices (Brenton, 1989). Follow Armington (1969), it is assumed that cheese imports are differentiated by country of origin where U.S. cheese, French cheese, Italian cheese, etc. are considered to be individual products. Assume that firms import cheese from *n* countries using *m* resources. The resale of imported cheese can be specified by the following supply specification (Theil 1980 p. 38):

(1) $$d(\log Q) = \frac{\psi}{\gamma - \psi}\left[d(\log p) - \sum_{j=1}^{n} \theta_j d(\log w_j) - \sum_{k=1}^{m} \theta_k d(\log w_k) \right].$$

Q represents total output (total imports in this context), *p* is the output price (resell price), w_j is the price of imported good *j* ($j \in$ exporting countries) and w_k is the price of the domestic resource *k* ($k \in$ labor and energy). ψ is a positive scalar and may be regarded as a measure of the curvature of the logarithmic cost function, and γ is the elasticity of total cost with respect to output. $\theta_{j(k)}$ is the marginal share of the *j*th(*k*th) input in total cost, $\left(\theta_{j(k)} = \partial(w_{j(k)} x_{j(k)}) / \partial C\right)$. $x_{j(k)}$ is the quantity of input *j*(*k*) and *C* is total cost.

Assuming that domestic resources and individual imports are weakly dependent, the derived demand for cheese from country *i* is specified as[1]

(2) $$f_i d(\log x_i) = \gamma \theta_i d(\log Q) - \psi \sum_{j=1}^{n} (\theta_{ij} - \theta_i \theta_j) d(\log w_j).$$

where f_i is the share of the *i*th import in total import cost $\left(w_i x_i \big/ \sum_{i \in n} w_i x_i\right)$. $\mathbf{\Theta}_{n \times n} = \left[\theta_{ij}\right]$ is a symmetric positive definite matrix where $\mathbf{\Theta} = \frac{1}{\psi}\mathbf{F}(\mathbf{F} - \gamma \mathbf{H})^{-1}\mathbf{F}$. $\mathbf{F}_{n \times n}$ is a diagonal matrix with import factor shares (f_i) along the diagonal and **H** is a Hessian matrix of the firm's implicit production function, where the elements of **H** are the second partials with respect to inputs $\partial h^2 \big/ \partial \mathbf{x} \partial \mathbf{x}'$. $\sum_{j=1}^{n} \theta_{ij} = \theta_i$ and $\sum_{i=1}^{n} \sum_{j=1}^{n} \theta_{ij} = 1$.

Summing Equation (2) over *i* we get the following relationship

(3) $$d(\log X) = \gamma d(\log Q).$$

---

[1] The weak dependence between domestic resources and imports implies that changes in the price of resources such as labor do not directly affect individual cheese imports; rather labor prices affect individual imports indirectly, by determining total import expenditures. Given this assumption resources prices needn't be included in Equation (2).

$d(\log X)$ is the Divisia volume input (import) index where $d(\log X) = \sum_{i=1}^{n} f_i d(\log x_i)$ and is measure of real import expenditures.[2] Multiplying Equation (1) by γ and substituting $d(\log X)$ for $\gamma d(\log Q)$ yields the total import decision where total import expenditures are represented by the Divisia volume input index. Substituting $d(\log X)$ for $\gamma d(\log Q)$ in Equation (2) results in the import allocation decision. The total import decision and the import allocation decision are respectively specified as

$$d\log(X) = \varphi\, d\log(p) + \sum_{j=1}^{n} \pi_j\, d\log(w_j) + \sum_{k=1}^{m} \pi_k\, d\log(w_k) \tag{4}$$

$$f_i d(\log x_i) = \theta_i d(\log X) + \sum_{j=1}^{m} \pi_{ij}\, d(\log w_j)\,. \tag{5}$$

$\varphi = \gamma\psi/(\gamma-\psi)$, $\pi_j = -\theta_j\left[\gamma\psi/(\gamma-\psi)\right]$ $\pi_k = -\theta_k\left[\gamma\psi/(\gamma-\psi)\right]$ and $\pi_{ij} = -\psi(\theta_{ij} - \theta_i\theta_j)$.

Finite versions of Equations (4) and (5) are used for analysis. Letting *t* denote time, we express the total import decision in finite log changes as

$$\begin{aligned} DX_t &= \varphi_0 + \varphi_1\, Dp_{Dt} + \varphi_2\, Dp_{Xt} + \varphi_D\, d_{WTO} + \varphi_t\, t \\ &\quad + \pi_L\, Dw_{Lt} + \pi_E\, Dw_{Et} + \sum_{j=1}^{n} \pi_j\, Dw_{jt} + \varepsilon_t \end{aligned}. \tag{6}$$

DX_t is the finite version of the Divisia volume index, where $DX_t = \sum_{i=1}^{n} \bar{f}_{it}\, Dx_{it}$, $\bar{f}_{it} = (f_{it} + f_{it-1})/2$, and for any variable *y*, $Dy_t = \log(y_t / y_{t-1})$. Equation (6) states that total import expenditures are a function of domestic retail prices (p_D), export prices (p_X), a WTO dummy variable (d_{WTO}), a time trend (*t*), wages (w_L), energy prices (w_E) and individual import prices (w_j). Both domestic prices and export prices are included in the total import decision because imports are resold domestically as well as re-exported. d_{WTO} is equal to 1 for all years after 1994 and 0 otherwise, and is included in Equation (6) to account for the impact of the 1995 WTO agreement on total imports. Labor and energy prices are

[2] This relationship is due to $\sum_{i=1}^{n}\theta_i = 1$ and $\sum_{i=1}^{n}\sum_{j=1}^{n}(\theta_{ij} - \theta_i\theta_j)\, d(\log w_j) = 0$ (Theil 1980 p. 35).

included in Equation (6) to account for the impact of resource prices on import demand. Inputs not included in the model are accounted for by the constant term (φ_0) and trend variable (*t*). $\varphi_0, \varphi_1, \varphi_2, \varphi_D, \varphi_t, \pi_L, \pi_E$ and π_j are parameters to be estimated. ε_t is a random disturbance term.[3]

A finite version of the import allocation decision, Equation (5), is as follows:

$$\bar{f}_{it} Dx_{it} = \theta_i DX_t + \sum_{j=1}^{n} \pi_{ij} Dw_{jt} + u_{it} \quad (7)$$

θ_i is the marginal import share and π_{ij} is the conditional price effect. Both are assumed constant and are parameters to be estimated. u_{it} is a random disturbance term. Equation (7) states that cheese imports from country *i* (weighted by factor share) is a function of total import expenditures (represented by the Divisia volume index) and individual import prices. The import allocation model requires that the following parameter restrictions be met in order to conform to theoretical considerations: $\sum_j \pi_{ij} = 0$ (homogeneity), $\pi_{ij} = \pi_{ji}$ (symmetry), and the matrix of conditional price effects $\left(\mathbf{\Pi} = \left[\pi_{ij}\right]\right)$ is negative semidefinite. Homogeneity and symmetry are imposed on estimates and statistically tested. The negative semidefinite property is verified by inspection.

From Equation 7, we get the typical elasticities found in many import demand studies: the conditional own/cross-price elasticity $\eta^c_{xw} = \pi_{ij} / \bar{f}_i$ and the Divisia index (conditional expenditure) elasticity $\eta_{xX} = \theta_i / \bar{f}_i$. The benefit of a production approach is that in addition to the conditional price and expenditure elasticities, the responsive of imports to domestic and resource prices can be derived. Additionally, the total effect of prices on import demand (unconditional price effects) can be determined.

[3] If it were possible to model the actual output market, and if the quantity of labor, energy, and other resource use by this industry were known, equation (6) would be estimated jointly with output supply and resource demand equations. Two studies that modeled the output market for an imported agricultural good are Davis and Jensen (1994), and Koo, Mao, and Sakurai (2001). Davis and Jensen estimated import demand for source differentiated lumber in Japan and considered furniture production and construction as outputs. Koo, Mao, and Sakurai estimated import demand for source differentiated wheat in Japan and considered milled wheat flour varieties as outputs.

Unconditional price effects are more appropriate for analyzing the impact trade policies because the complete effect of prices on demand is account for in these estimates (Davis and Jensen 1994).

Substituting the right-hand side of Equation (6) for the Divisia index term in Equation (7), we get the unconditional elasticities of import demand with respect to the following: domestic retail prices, export prices, wages and energy prices. These are calculated respectively as

(8) $$\eta_{xp_D} = \frac{Dx_i}{Dp_D} = \frac{\theta_i}{\bar{f}_i}\varphi_1$$

(9) $$\eta_{xp_X} = \frac{Dx_i}{Dp_X} = \frac{\theta_i}{\bar{f}_i}\varphi_2$$

(10) $$\eta_{xw_L} = \frac{Dx_i}{Dw_L} = \frac{\theta_i}{\bar{f}_i}\pi_L \, .$$

(11) $$\eta_{xw_E} = \frac{Dx_i}{Dw_E} = \frac{\theta_i}{\bar{f}_i}\pi_E \, .$$

Equations (8)-(11) determine the impact of percentage changes in domestic prices, export prices, wages and energy prices on imports from country *i*. From the above substitution we also get the unconditional own-price/cross-price elasticity

(12) $$\eta_{xw} = \frac{d\log(x_i)}{d\log(w_j)} = \left[\theta_i \pi_j + \pi_{ij}\right] / \bar{f}_i \, .$$

Equation (12) measures the impact of a change in the *j*th price on the quantity imported from country *i*.

3. Results and Discussion

The United Nations Commodity Trade Statistic Division (UNCOMTRADE) provided the data used in this study. The exporting countries were: the U.S., Denmark, France, Italy, other EU (aggregation of remaining EU countries), and the rest of the world (ROW).[4] Cheese quantities were in kilograms and values were in $US. Values included cost, insurance and freight (CIF). Annual data were used for

---

[4] ROW imports are primarily from Switzerland, and to a lesser extent Argentina. A small percent of ROW imports are from Australia and New Zealand.

estimation and the time period for the data was 1962 through 2006. Per-unit import values were used as proxies for import prices ($US/kg) and per-unit export values were used as proxies for export prices. Cheese exports were on a FOB (Free on Board) basis. The cheese CPI was used to account for changes in domestic prices and was provided by Agriculture and Agri-Foods Canada. A wage index for the wholesale trade sector and energy price index were used to account for the impact of labor and energy cost on import demand. The wage index was provided by the Bureau of Labor Statistics and the energy price index was provided by Statistics Canada. Descriptive statistics on model variables are presented in Table 2.[5]

Equations (6) and (7) were estimated jointly using the full information maximum likelihood (FIML) procedure in TSP (5.0) where the Divisia index (DX) and individual imports $(\bar{f}_{it} Dx_{it})$ were simultaneously determined. Given the difficulties in modeling higher stages in consumer demand applications, total import expenditures (DX) are typically assumed exogenous and analysis is usually limited to estimating the import allocation system. Using rational random behavior theory, Theil (1980) shows that if the parameters in Equations (6) and (7) are constant and the errors normally distributed, then $\text{cov}(\varepsilon_t, u_{it}) = 0$. This suggests that the total import decision is independent of the allocation decision and that Equations (6) and (7) could be estimated separately. Instead of assuming that this is the case, we test for expenditure endogeneity using the Durbin, Wu and Hausman (DWH) test (Davison and MacKinnon 2004 p. 341; Dhar, Chavas, and Gould, 2003). The DWH test is based on the difference between parameter estimates with and without controlling for expenditure endogeneity. The DWH test statistic can be specified as

$$(13) \qquad \text{DWH} = \left(\boldsymbol{\theta}_{LS} - \boldsymbol{\theta}_{FIML}\right)' \left[\text{Var}(\boldsymbol{\theta}_{LS}) - \text{Var}(\boldsymbol{\theta}_{FIML})\right]^{-1} \left(\boldsymbol{\theta}_{LS} - \boldsymbol{\theta}_{FIML}\right) \sim \chi^2_j .$$

$\boldsymbol{\theta}_{LS}$ is a vector of least squares estimates where expenditures are assumed exogenous. $\boldsymbol{\theta}_{FIML}$ is a vector of FIML estimates with expenditures assumed endogenous. Under the null hypothesis of no endogeneity,

[5] Import data were fairly consistent throughout the data period with no missing observations. This is verified by the min/max values in Table 2.

Equation (12) is distributed χ^2_j, where *j* is the number of potentially endogenous variables. For sufficiently large values of DWU, the null is rejected and endogeneity holds.

The DWU test statistic (28.87) was greater than the $\chi^2_{(5)}$ critical value (11.07) indicting that total import expenditures are endogenous. Consequently, Equations (6) and (7) are not independent and least squares estimation would have produced bias estimates. Likelihood ratio (LR) tests were used to test for the economic properties of homogeneity and symmetry. The LR test statistic for homogeneity was 6.95, which was less than the $\chi^2_{(6)}$ critical value 12.59, indicating a failure to reject homogeneity. The LR test statistic for symmetry was 15.89, also less than the $\chi^2_{(15)}$ critical value 25.00, indicating a failure to reject symmetry. All results that follow are the FIML estimates with homogeneity and symmetry imposed. Theory also suggests that the matrix of conditional price effects be negative semi-definite. This property is confirmed when all eigenvalues of the price coefficient matrix are less than or equal to zero. As verified by inspection, all eigenvalues were nonpositive.

Estimates of the total import decision are presented in Table 3. Domestic prices and export prices had a significant and positive impact on the Divisia index as expected. The impact of domestic prices (0.490) was larger than the impact of export prices (0.143). The WTO affect on the Divisia index was positive and significant (0.048) indicating that WTO policy had a positive impact on total cheese imports. Consistent with theory, wages and energy prices had a significant negative impact on the Divisia index (-0.471 and -0.229 respectively) indicating that higher labor and energy costs decreases total import expenditures. Each import price should negatively impact total cheese imports. This was the case for Denmark, France, Italy and the EU; however no import price was significant.

Estimates of the import allocation system are presented in Table 4. The marginal import share estimates (θ_i) indicate that the Divisia index or total import expenditures had a significant and positive effect on imports from ROW (0.320), the EU (0.237), Denmark (0.199) and France (0.180). Imports from the U.S. and Italy were statistically invariant to changes in the Divisia index. Consistent with theory, all conditional own-price effects (π_{ii}) were negative and significant at the 0.01 level. Own-price effects for the U.S., Denmark, France, Italy, other EU, and ROW were -0.204, -0.187, -0.123, -0.147, - 0.173, and -0.203 respectively (diagonal elements, Table 4). Conditional cross-price estimates indicated competitive relationships between the U.S. and Italy (0.047), U.S. and other EU (0.060), and U.S. and ROW (0.073). A competitive relationship also existed between Denmark and France (0.051), Denmark and ROW (0.062), France and Italy (0.029), France and ROW (0.047) and Italy and Other EU (0.058). Given the insignificant impact of import prices on total imports, the conditional and unconditional cross-price effect should be statistically equivalent.

We limit the following discussion to the unconditional elasticities presented in Tables 5. Conditional elasticities and unconditional cross-price elasticities can be provided upon request. Given that imports from the US and Italy were statistically invariant to changes in the Divisia index, the responsiveness of imports from these countries to domestic and import prices, and resource prices were insignificant. For Denmark, France, Other EU and ROW the impact of domestic and export prices were all significant 0.05 level. Imports from Denmark were the most responsive to export prices (0.207). Next were France (0.185), other EU (0.179) and ROW (0.179). Overall, individual imports were two to three times more responsive to changes in domestic prices than export prices which suggest that the domestic market has a greater effect on imports than the re-export market. Imports were also two times more responsive to changes in wages than energy prices. The wage elasticities were also relatively more significant, particularly for France and other EU.

The relationship between the re-export market and cheese imports from different countries is implied from the export price elasticities. The insignificant estimate for the U.S. indicates that imports of U.S. cheese were invariant to changes in export prices. A possible explanation is that a significant percent of cheese re-exported from Canada goes to the U.S. It is highly unlikely that the U.S. would be importing its' own cheese. In 2006, cheese re-exports (not necessarily IREP cheese) were valued at $5.35 million. The U.S. was the primary market for cheese re-exports accounting for 78%. If cheese re-exports are primarily for the U.S., then it is unlikely that IREP expansion will significant impact Canadian imports of U.S. cheese.

The unconditional own-price elasticities indicated that the demand for U.S. and Denmark cheeses was the most elastic (-1.597 and -1.469 respectively). The demand for cheese from France and other EU was relatively less elastic (-1.110 and -1.022 respectively), and the demand for cheese from Italy was inelastic, but close to unit elastic (-0.943). ROW cheese was the most inelastic (-0.645). Future trade negotiations will more than likely lead to lower above access tariff rates in the future. The unconditional own-price elasticities give an indication of the impact of tariff reductions on individual imports. Given a proportional reduction in import prices, U.S. cheese exports to Canada will increase by the greatest percent, and given that demand was elastic, expenditures on U.S. cheese should also increase as well (Table 5).

4. Summary and Conclusion

Given the direct relationship between total cheese imports and IREP imports in Canada, this study investigated the impact of export prices on total and source specific import demand for cheese in Canada. A production version of the Rotterdam model was used to estimate import demand that permitted simultaneous estimation of total import expenditures and import demand from each country. Unlike past consumer-based studies where analysis was limited to conditional expenditure and price effects, the model used in this study allowed for determining the effect of domestic prices, export prices, wages and energy prices on the total import demand and source-specific imports. Theil (1980) suggests that the parameterization of the differential import allocation model results in exogenous import expenditures. While most studies accept this as fact, this was not the case total cheese imports in Canada. A Durbin, Wu and Hausman test rejected the null of no expenditure endogeneity. Consequently, total and source-specific imports were simultaneously estimated using the full information maximum likelihood procedure.

The primary goal of this study was to assess the impact of the IREP imports on Canadian demand for U.S. cheese. The elasticity estimate of the responsiveness of imports of U.S. cheese to changes in export prices was not statistically significant suggesting that the returns to re-exporting in Canada did not significantly impact imports of U.S. cheese. However, results indicated a significant and positive relationship between export prices and imports from Denmark, France, other EU countries, and ROW. Therefore if Canadian processor and importers increase utilization of the IREP, U.S. exports to Canada will likely remain unchanged while imports from the EU and the rest of the world will significantly increase.

References

Agriculture ands Agri-Food Canada. Dairy Section. *Canadian Dairy Trade Bulletin: 2006*. Ottawa, Ontario: 2007 http://dairyinfo.gc.ca/pdf/bulletin2006.pdf (accessed August 20, 2007).

---. *Canadian Dairy Industry Profile*. Ottawa, Ontario: 2005 http://www.infolait.gc.ca/pdf/dairyprofile.pdf (accessed August 20, 2007).

Armington, Paul S. "A Theory of Demand for Products Distinguished by Place of Production." *International Monetary Fund Staff Papers* 16(1) (1969):159-178.

Benton, Paul A. "The Allocation Approach to Trade Modelling: Some Tests of Separability between Imports and Domestic Production and between Different Imported Commodity Groups." *Weltwirtschaftliches Archiv* 125(2) (1989):230-251

Canada Border Service Agency. *Departmental Consolidation of the Customs Tariff 2007- Live Animals; Animal Products*. Ottawa, Ontario: 2007 http://www.cbsa-asfc.gc.ca/trade-commerce/tariff-tarif/tariff2007/01-99/tblmod-1-e.html (accessed July 10, 2007).

Burgess, David F. 1974. "Production Theory and the Derived Demand for Imports." *Journal of International Economics* 4(2) (1974):103-17.

Davis, George C., and Kim L. Jensen. "Two-Stage Utility Maximization and Import Demand Systems Revisited: Limitations and an Alternative." *Journal of Agricultural and Resource Economics* 19(2) (1994):409-24.

Davidson, Russell and James G. MacKinnon. *Econometrics Theory and Methods*. New York, New York: Oxford University Press, 2004.

Deaton, Angus and John Muellbauer. "An Almost Ideal Demand System." *The American Economic Review* 70(3) (1980):312-326.

Dhar, Tirtha, Jean-Paul Chavas, and Brian W. Gould. "An Empirical Assessment of Endogeneity Issues in Demand Analysis for Differentiated Products." *American Journal of Agricultural Economics* 85(3) (2003):605-617.

Foreign Affairs and International Trade Canada. *Export and Import Permits Act*. Serial No. 663. Ottawa, Ontario: 2005 http://www.international.gc.ca/eicb/notices/ser663-en.asp (accessed August 10, 2007).

International Dairy Foods Association (IDFA). *What Are Some of Our Obstacles?* Washington D.C.:2007 http://www.idfa.org/intl/obstacle.cfm (accessed March 14, 2007).

Kohli, Ulrich R. "A Gross National Product Function and the Derived Demand for Imports and Supply of Exports." *Canadian Journal of Economics* 11(2) (1978):167-82.

---. "Sanyal and Jones on Trade in Middle Products." *Journal of International Trade and Economic Development* 10(1) (2001):39-63.

Koo, Won W., Weining Mao and Takeshi Sakurai. “Wheat Demand in Japanese Flour Milling Industry: A Production Theory Approach.” *Agricultural Economics* 24(2) (2001):167-78.

Laitinen, Kenneth. *The Theory of the Multiproduct Firm*. New York, New York: North-Holland Publishing Company, 1980

Muhammad, Andrew. “The impact of increasing non-agricultural market access on EU Demand for imported fish: implications for Lake Victoria chilled fillet exports.” *European Review of Agricultural Economics* 34(4) (December 2007).

Muhammad, Andrew, Keithly G. Jones, and William F. Hahn. “The Impact of Domestic and Import Prices on U.S. lamb Imports: A Production System Approach.” *Agricultural and Resource Economics Review* 36(2) (October 2007): 293-303.

The Office of the United States Trade Representative. *Canadian Dairy Exports U.S. & Canada Reach Agreement on Dairy Exports to U.S.* By Richard Mills and Ricardo Reyes. Washington D.C.:2003 http://www.ustr.gov/Document_Library/Press_Releases/2003/May/US_Canada_Reach_Agreement_on_Dairy_Exports_to_UShtml.html (accessed August 20, 2007).

Romain, Robert F. and Daniel A. Sumner. “Dairy Economic and Policy Issues between Canada and the United States.” *Canadian Journal of Agricultural Economics* 49(3) (2001):479–492.

Sanyal, Kalyan K. and Ronald W. Jones. “The Theory of Trade in Middle Products.” *American Economic Review* 72(1) (1982):16-31.

Theil, H. *The System-Wide Approach to Microeconomics*. Chicago, Illinois: The University of Chicago Press, 1980.

United States Department of Agriculture. Foreign Agricultural Service. *Canada Dairy and Products Annual Report 2006*. By Darlene Dessureault. GAIN Report Number: CA6054. Washington D.C.:2006.

---. *Canada Dairy and Products Annual 2005*. By Christina Patterson. GAIN Report Number: CA5073. Washington D.C.:2006.

Washington, Andrew A. and Richard L. Kilmer. “The Production Theory Approach to Import Demand Analysis: A Comparison of the Rotterdam Model and the Differential Production Approach.” *Journal of Agricultural and Applied Economics* 34(3) 2002:431-443.

United Nations. United Nations Commodity Trade Statistics Database (UNCOMTRADE). 2007. http://unstats.un.org/unsd/comtrade/default.aspx (accessed 12 December 2006).

Table 1. Canadian Cheese Imports (kg): Total, Above Access, and IREP

Year	Total Cheese Imports	Above Access Imports	IREP Imports	IREP % of Total Imports	IREP % of Above Access
2001	26,635,049	6,223,183	2,254,617	8.46	36.23
2002	25,613,355	5,201,489	3,968,478	15.49	76.30
2003	24,872,998	4,461,132	3,943,502	15.85	88.40
2004	24,562,777	4,150,911	2,983,484	12.15	71.88
2005	25,263,463	4,851,597	4,139,735	16.39	85.33
2006	24,859,372	4,447,506	4,089,589	16.45	91.95

Sources: United Nations Commodity Trade Statistics, Agriculture and Agri-Food Canada, and USDA, Foreign Agricultural Service

Table 2. Descriptive Statistics for Model Variables: 1962-2006

Import Cost Share (%)	Mean	Standard Deviation	Minimum	Maximum
U.S.	12.25	3.83	6.28	23.09
Denmark	13.83	4.22	7.09	21.13
France	14.06	5.28	6.52	25.30
Italy	15.38	4.86	7.48	25.85
Other EU	18.90	3.22	13.38	25.15
ROW	25.58	5.23	18.07	36.01
Import Price ($/kg)				
U.S.	3.59	1.39	1.25	5.72
Denmark	3.63	2.13	0.87	8.76
France	4.36	2.24	1.32	9.06
Italy	4.47	2.10	1.10	8.42
Other EU	3.28	1.91	0.88	7.66
ROW	3.03	1.55	1.04	7.41
Import Quantity (1,000 kg)				
U.S.	2,439	1,798	723	8,834
Denmark	2,632	889	1,378	4,030
France	2,414	1,440	351	5,303
Italy	2,296	1,029	965	4,257
Other EU	4,130	1,285	1,056	6,271
ROW	5,781	2,003	1,326	8,820
Total Import Variables				
Total Imports (1000 kg)	19,692	5,672	6,633	29,417
Export Prices ($/kg)	2.80	1.39	0.67	5.79
Cheese price index	58.37	33.62	13.63	118.60
Wage index	68.47	29.86	24.60	104.00
Energy price index	54.69	36.44	11.20	132.80

Table 3. Full Information Maximum Likelihood Estimates of Total Cheese Imports (Equation 6)

Parameters	Estimate	Import Price Parameters	Estimate
φ_0 constant	0.090 (.024)***	π_1 U.S.	0.101(.090)
φ_1 domestic price	0.490 (.210)**	π_2 Denmark	-0.075(.122)
φ_2 export price	0.143 (.051)***	π_3 France	-0.183(.147)
φ_D WTO	0.048 (.018)***	π_4 Italy	-0.125(.083)
φ_t trend	-0.003 (.001)***	π_5 Other EU	-0.091(.093)
π_L labor	-0.471 (.230)**	π_6 ROW	0.185(.132)
π_E energy	-0.229 (.114)**		

Equation R^2 = .33
DW = 2.15

Asymptotic standard errors are in parentheses.
*** Significance level = 0.01; ** Significance level = 0.05; * Significance level = 0.10

Table 4. Full Information Maximum Likelihood Estimates of Import Allocation System (Equation 7)

Exporting Country	Marginal Import Shares, θ_i	Price Coefficients, π_{ij} U.S.	Denmark	France	Italy	Other EU	ROW	
U.S.	0.091 (0.074)	-0.204*** (0.037)	0.039* (0.024)	-0.016 (0.019)	0.047* (0.026)	0.060** (.028)	0.073*** (.026)	R^2 = .53 DW=2.20
Denmark	0.199*** (0.058)		-0.187*** (0.042)	0.051* (0.028)	0.011 (0.022)	0.024 (0.026)	0.062* (0.035)	R^2 = .44 DW=2.52
France	0.180*** (0.044)			-0.123*** (0.035)	0.029* (0.017)	0.012 (0.021)	0.047* (0.028)	R^2 = .50 DW=1.91
Italy	-0.028 (0.076)				-0.147*** (0.033)	0.058** (0.025)	0.003 (0.022)	R^2 = .32 DW=1.87
Other EU	0.237*** (0.068)		Symmetry			-0.173*** (0.034)	0.019 (0.022)	R^2 = .49 DW=1.96
ROW	0.320*** (0.057)						-0.203*** (0.045)	R^2 = .66 DW=1.34

Asymptotic standard errors are in parentheses.
*** Significance level = 0.01; ** Significance level = 0.05; * Significance level = 0.10;

Table 5. Unconditional Elasticities of Derived Demand

Exporting Country	Domestic Price	Export Price	Wages	Energy Price	Own-Price
U.S.	0.364 (0.366)	0.107 (0.099)	-0.350 (0.379)	-0.170 (0.162)	-1.597*** (0.343)
Denmark	0.707** (0.359)	0.207** (0.087)	-0.679* (0.382)	-0.330** (0.162)	-1.459*** (0.370)
France	0.631** (0.273)	0.185*** (0.056)	-0.606** (0.268)	-0.294* (0.167)	-1.110*** (0.179)
Italy	-0.089 (0.257)	-0.026 (0.073)	0.085 (0.246)	0.041 (0.119)	-0.943*** (0.199)
Other EU	0.610** (0.275)	0.179** (0.079)	-0.586** (0.274)	-0.285* (0.164)	-1.022*** (0.208)
ROW	0.611** (0.282)	0.179*** (0.070)	-0.587* (0.310)	-0.285* (0.148)	-0.645** (0.304)

Asymptotic standard errors are in parentheses.
*** Significance level = 0.01; ** Significance level = 0.05;
* Significance level = 0.10;