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The Role of Income and Non-homothetic Preferences in Trading Differentiated Food and Beverages

The Case of Canada, the United States, and Selected EU Countries

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Abstract

This study investigates the role of income in determining the agrifood exports of selected EU countries, Canada, and the United States (U.S.) by estimating per capita bilateral trade flows for 10 commodity groups across 52 countries for the period 1990–2000. About 43 percent of the total observations of bilateral trade-flows for the selected regions and commodities are zero. Therefore, the fixed-effects Heckman two-step estimation procedure is used to account for the zero observations instead of ignoring or truncating the zeros. A number of hypotheses are tested to highlight the role of income in determining agrifood exports of differentiated agrifood products.

The results show that the three regions (selected EU countries, Canada, United States) face statistically significant, positive and relatively elastic expenditure elasticities from the developing countries as compared to developed countries. Middle income developing countries, among developing countries, are the growth market of the future as growth in their expenditure on agrifood imports outpaces growth in their per capita income. However, all U.S. agrifood exports face statistically significant expenditure elasticities as compared to only a few for Canadian and EU commodities. The study also finds that Canadian exports face homothetic preferences, U.S. exports face homothetic preferences for more than one-half of the commodities, and the selected EU countries' exports face non-homothetic preferences for nine commodity groups. The study concludes that income plays an important role in agrifood trade; however, further investigation is needed to help us understand the forces that determine the divergent results.

Introduction

Over the past 40 years, Canada, the United States, and the European Union (EU) have had diverse domestic and trade policy regimes, but it can be argued that the ultimate goal of all three governments has been to stabilize and raise the average level of prices and incomes received by farmers. As we move into the future, developed countries will be looking to developing countries as increasingly important trading partners because of the latter's rapidly rising real incomes. This raises the question of whether developed countries face different trade prospects as a result of differences in their current and historical domestic and trade policy interventions. Developing countries import one-half of the agricultural products exported by developed countries and export 61 percent of their agricultural products to developed countries. In addition , the last two decades have been a period of rapid economic growth for developing countries compared to that of developed countries and this can potentially increase their expenditures on agricultural products. However, it is unclear whether agrifood exports originating from various countries face similar or different growth prospects from developing countries.

This study uses demand-side factors, or more specifically per capita income, to investigate the emerging role of developing countries in differentiated agrifood product trade. The study develops an import demand model to explore the trade performance of the United States, Canada, and selected EU[1] member nations in trading differentiated agrifood products with bilateral trading partners that include both developing and developed countries. However, in order to bring out differences among the developing countries, they are grouped into low, lower-

[1] Throughout this document, EU refers to the 11 countries of Denmark, Finland, France, Germany Ireland, Italy, the Netherlands, Portugal, Spain, Sweden and the United Kingdom.

middle, and upper-middle-income countries using the World Bank's classification[2]. The study investigates the role of income in agrifood exports originating from the EU, Canada, and the United States by testing a number of specific hypotheses, namely (1) income has no effect on the trade of differentiated agrifood commodities; (2) the expenditure elasticities for developing countries' imports of differentiated agrifood commodities from Canada, the United States, and the EU are zero; (3) Canadian, U.S., and EU exports of differentiated agrifood products are driven by non-homothetic preferences; and (4) the expenditure elasticities of agrifood products for Canada, the United States, and the EU are the same across the development spectrum. The results of these tests will help to understand whether agrifood products originating from the three regions are considered the same across the development spectrum.

The article is organized into six sections. A discussion of the theoretical and empirical model follows in the second section. The third section contains a description of the data used in the empirical analysis. The fourth section presents the problem of dealing with zero trade flows in trade modeling and how this study handles the issue. The empirical model used to test the hypotheses is presented in the fourth section. The empirical results are explained in the fifth section, followed by conclusions in the sixth section.

The Consumer Problem

Demand in each country i is generated by a representative consumer with a two-tier utility function. The upper-tier utility function is weakly separable in subutility indices defined over differentiated goods X_f where $f = 1,\ldots, F$ and for each homogenous product X_h where $h = F+1,\ldots, H$, such that

[2] The groups are divided according to GNI per capita: low income, $905 or less; lower middle income, $906 - $3,595; upper middle income, $3,596 - $11,115; and high income, $11,116 or more.

$$U^k = U\left(u_1^i, \ldots u_f^i \ldots, u_F^i, u_{F+1}^i, \ldots, u_h^i, \ldots, u_H^i\right) \qquad \text{Equation (1)}$$

The subutility index u_h^i is a general function of the quantity consumed of product *h* while the subutility index u_f^i is assumed to have a constant elasticity of substitution (CES) utility function as used by Dixit and Stiglitz (1977) to allow for substitution between differentiated products.

$$U_f^i = \left(\sum_{n=1}^{N} X_n^{\rho_f}\right)^{1/\rho_f} \qquad \text{Equation (2)}$$

where U_f^i is defined over varieties $n \in N_f$ in sector[3] *f* in country *i*, and $0 < \rho_f < 1$, to preserve concavity. The CES approximation of consumer preferences also captures product differentiation. Further, the representative consumer in country *i* allocates expenditure $E_f^i = \sum_{f=1}^{F} P_f^i X_f^i$ in the second stage of budgeting and maximizes the CES approximation of preferences subject to this expenditure, generating demand functions

$$X_n^i P_n^i = \frac{\left(P_n\right)^{\frac{\rho_f}{1-\rho_f}}}{\sum_{n=1}^{N}\left(P_n^i\right)^{\frac{\rho_f}{1-\rho_f}}} \bar{I}_i \left(\bar{I}_i, \theta_i\right) \qquad \text{Equation (3)}$$

where X_n^i represents the demand for variety *n* in sector *f* of country *i*, and P_f^i represents the price of each variety. Since data on the expenditures made on any sector *f* in country *i* is not available, in the empirical analysis, E_f^i is represented by average per capita income ($\bar{I}^i$), its income distribution (θ_i). The income distribution is represented by the Gini coefficient.

[3] Each Sector represents a broad commodity sector that consists of the constituent commodities; e.g., the meat sector has five differentiated commodities.

Bilateral Trade Flows

Let $\frac{1}{1-\rho_f} \equiv \sigma_f$ be the elasticity of substitution between any two products within a sector faced by a consumer in country *i*. It is assumed that importing country *i* consumes N_f^i different varieties in sector *f*, all of the same quality, and that they sell at the same price. Given this, the value of the bilateral trade flow of country *i*'s imports from country *j* in sector *f* (imp_{if}^j) is

$$imp_{if}^j = N_{jf} \frac{\left(P_{jf} \cdot \tau_{if}^k\right)^{1-\sigma_f}}{\sum_{f=1}^{F}\left(P_{jf} \cdot \tau_{if}^j\right)^{1-\sigma_f}} \bar{I}_i\left(\bar{I}_i, \theta_i\right). \qquad \text{Equation (4)}$$

Since the price of a commodity in sector *f* in importing country *i* is affected by transaction costs, the import prices (P_{if}^j) are replaced by $P_{jf} \cdot \tau_{if}^j$ using the equality between the import price and the product of the export price and trade costs.

Trade costs (τ_{if}^j) are broadly influenced by three groups of variables: (1) variables that affect transportation costs, such as distance (dist), trade partners sharing a common border (DCB), landlocked countries (Landl), and island countries (Island); (2) factors affecting the tariff structure between trade partners, such as preferential trade agreements (DPTA); and (3) other socioeconomic variables that affect trade costs, such as countries sharing a common language (DComlang) and bilateral trade partners colonizing each other (DColony). This relationship is based on the insights from previous studies (Hallak 2004 and 2006; Glick and Rose 2002; Rose 2004) that have used gravity equations similar to Equation (5).

$$\ln \tau_{if}^i = \beta_1 \ln dist_i^j + \beta_2 DCB_i^j + \beta_3 Landl_i + \beta_4 Island_i + \beta_5 DPTA_i^j + \beta_6 DComlang_i^j + \beta_7 DColony_i^j + \nu_i^j \qquad \text{Equation (5)}$$

Taking the logarithm of both sides of Equation (4) and substituting for transaction cost (τ_{if}^{j}), the following equation for the value of imports is obtained.

$$\begin{aligned}\ln imp_{if}^{j} &= \ln(N_{jf}) + (1-\sigma_f)\ln P_{jf} - (1-\sigma_f)\ln\sum_{f=1}^{F} P_{if} + (1-\sigma_f)\beta_1 \ln dist_i^{j} + \\ &(1-\sigma_f)\beta_2 DCB_i^{j} + (1-\sigma_f)\beta_3 Landl_i + (1-\sigma_f)\beta_4 Island_i + (1-\sigma_f)\beta_5 DPTA_i^{j} + \\ &(1-\sigma_f)\beta_6 DComlang_i^{j} + (1-\sigma_f)\beta_7 DColony_i^{j} + \alpha_1 \ln \bar{I}_i + \alpha_2 \ln\theta_i + \varepsilon_{if}^{j}\end{aligned} \quad \text{Equation (6)}$$

In equation (6), $\ln(N_{jf})$ and P_{jf} are specific to the exporting country and in a general model would be captured by exporter fixed effects; however, since the study only considers exports of single countries or regions, these fixed effects are not required. The importing country fixed effects $(\gamma_0 D_i)$ captures the missing importing country specific variable $\sum_{f=1}^{F} P_{if}$, where D_i is a dummy variable representing the importing country. Country-specific fixed effects allow for unobserved or misspecified factors that simultaneously explain trade volumes between two countries. Therefore, fixed effects provide a solution to unobserved heterogeneity, and this is the reason why importing-country-specific fixed effects are included in the empirical model. Hallak (2004, 2006), Mátyás (1997), Egger (2002), and many others use these fixed effects to control for missing prices. Letting $(1-\sigma_f)\beta_1 = \gamma_1$, $(1-\sigma_f)\beta_2 = \gamma_2$, $(1-\sigma_f)\beta_3 = \gamma_3$, $(1-\sigma_f)\beta_4 = \gamma_4$, $(1-\sigma_f)\beta_5 = \gamma_5$, $(1-\sigma_f)\beta_6 = \gamma_6$ and $(1-\sigma_f)\beta_7 = \gamma_7$, and noting that $\varepsilon_{if}^{j} = (1-\sigma_f)V_{if}^{j}$. Equation (6) can be rewritten as

$$\begin{aligned}\ln imp_{jx_f}^{k} &= \gamma_0 D_i + \gamma_1 \ln dist_i^{j} + \gamma_2 DCB_i^{j} + \gamma_3 Landl_i + \gamma_4 Island_i + \gamma_5 DPTA_i^{j} + \\ &\gamma_6 DComlang_i^{j} + \gamma_7 DColony_i^{j} + \alpha_1 \ln \bar{I}_i + \alpha_2 \ln\theta_i + \varepsilon_{if}^{j}\end{aligned} \quad \text{Equation (7)}$$

Equation (7) is further modified in the fourth section of this article to account for our choice of estimation procedure. The equation is estimated with only the EU, Canada, and the United States as exporters.

Data

The trade data come from the World Trade Analyzer (WTA) of Statistics Canada, covering trade flows from 1990 to 2000 for most countries of the world. The data is organized by the Standard International Trade Classification (SITC), revision 3, at the four-digit level. Statistics Canada uses United Nations bilateral trade data to develop the WTA. The data is unique in two ways: (1) imports and exports between any two pairs of countries are matched; and (2) imports are disaggregated to the four-digit SITC level. We arranged commodities into 10 groups of differentiated agrifood commodities of meat, dairy products, fresh fish, frozen fish, cereals, fresh fruits, processed fruits, vegetables, tea and coffee and alcoholic beverages[4].

Countries that account for at least 1 percent of world trade are included in the sample. This is done to: (1) select a group of countries that account for a large share of the world's trade of the selected commodities; and (2) select countries in a way that reduces the number of zero trade flows in the data. Hence the selection process for countries within income groups is biased toward countries with a relatively larger share of world imports. We categorized these countries into lower income (LI), lower middle income (LMI), upper middle income (UMI) and high income (HI) using World's Bank per capita gross national product thresholds[5].

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[4] Meat includes commodities having SITC codes 0111, 0112, 0113, 0121 and 0149; dairy 0223, 0230, 0240 and 0980; fish fresh 0341 and 0350; frozen fish 0342, 0343, 0360, 0371 and 0372; cereals 0481, 0483, 0484 and 0488; beverages 1121, 1123 and 1124; fresh fruits 0571, 0572, 0574, 0575 and 0579; processed fruits 0577, 0583, 0585, 0586, 0589 and 1110; vegetables 0541, 0542, 0544, 0545, 0546, 0561 and 0565; and tea and coffee 0711, 0712, 0730, 0741, 0742.

[5] Lower income countries include (Bangladesh, Ethiopia, India, Madagascar, Pakistan and Tanzania), Lower Middle Income countries include (Bolivia, Brazil, China, Colombia, Dominican Republic, Ecuador, Egypt, El Salvador, Guatemala, Indonesia, Jamaica, Jordan, Paraguay, Peru, Philippines, Romania, Sri Lanka and Thailand), Upper Middle income countries include (Argentina, Chile, Costa Rica, Hungary, Malaysia, Mexico, Panama, Poland, South Africa, Turkey, Uruguay and Venezuela) and High income countries include (Canada, Denmark, Finland, Germany, France, Ireland, Italy, Japan, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom and the United States).

Gross domestic product (GDP) and per capita GDP data come from the World Bank's World Development Indicators. Also, since GDP data for all of the selected countries are in U.S. dollars, the U.S. GDP deflator is used to get GDP estimates in real terms. Income inequality data come from the UN-WIDER data set. Estimates of the distance between capitals and border sharing are obtained from the World Bank's website (Worldbank 2007). The dummy variable representing multilateral trade agreements is developed from the Tuck Trade Agreement (CIB 2007). The data required for the other gravity variables in the trade model are compiled from Glick and Rose (2002).

The Problem of Zero Trade and Appropriate Estimation Procedures

About 43 percent of the total observations of bilateral trade-flows from 1990–2000, across the three exporters are zero. This problem has led researchers to either use more aggregate data or to drop the zero observations. However, dropping zeros can lead to nonrandom selection bias that can cause specification error and biased estimates in econometric analysis (Heckman 1979)[6].

Previous studies have dealt with zeros in three ways: (1) ignore zeros and estimate the using ordinary least squares (Bikker 1987; MacCallum 1995; Frankel 1997 and Dalgin et al. 2006); (2) replace zeros with small positive numbers (Linneman 1966; MacCallum 1995; Raballand 2003); and estimate the regression equation as a Tobit model and censor these observations at the left tail (Rose 2000).

[6] Hillberry (2002) shows how selection bias can lead to biased estimates. He uses the same data set as MacCallum (1995) and shows that the finding of MacCallum—that the volume of trade among Canadian provinces exceeds the provinces' trade with U.S. states by a factor of more than 20.9—is reduced to a factor of 5.7 when zero observations are included in the investigation. This huge decrease from 20.9 to 5.7 illustrates the importance of selection bias caused by ignoring zeros in empirical analysis.

In selecting an estimation procedure, it is important to know the reasons behind the existence of zeros in the bilateral trade data[7]. A major reason for zero bilateral trade flows is either low or no trade of a commodity between a pair of countries during the year. Using the UN data it is not possible to ascertain whether trade is zero, close to zero and rounded off to zero, or missing and therefore represented by a zero. Dow and Norton (2003) explain the difference between actual and potential zeros (outcomes) and the subsequent effect on the choice of estimation procedure. The actual outcome of zero is a fully observed variable and represents a corner solution. Dow and Norton (2003) argue that in this case, there is a selection problem and a two-part model (2PM) is the one to implement. In contrast, if the zeros represent missing or no data, then Dow and Norton (2003) recommend the latent variable approach of Heckman (1979). In this case, the non-zero outcomes are assumed to be the true observations, but the zero values indicate observations for which the actual data is missing. Unfortunately, it is impossible to know if a zero in the trade data is an "actual" or "potential" zero and as a consequence the Heckit estimation procedure is used in this study (Linders and De Groot 2006; Bikker and De Vos 1992).

The Heckit procedure consists of sample selection and outcome equations. The sample selection equation follows a selection rule where imports between bilateral trade partners are observed when the trade flow is greater than zero, while the outcome equation investigates the relationship of interest when the outcome is observable, i.e., when imports are greater than zero. Let the general form of the equation that determines sample selection be

$$t_{ijk}^{*} = z'\gamma_i + u_i \qquad \text{Equation (8)}$$

and let the outcome equation be

[7] Helpman et al. (2007) explain the theoretical reasons for the existence of zeros in trade data based on firm theory.

$$\mathrm{T_{ijk}} = \mathrm{X_i'}\beta + \varepsilon_i \qquad \text{Equation (9)}$$

where *i* indexes the importing country, *j* indexes the exporting country, and *k* indexes the commodity. We use t^*_{ijk} to represent a binary variable that takes the value of one if the bilateral trade flow between *i* and *j* is greater than zero and the value of zero when there is no or zero trade reported. Hence, t^*_{ijk} is not observed but the bilateral trade flow between trading partners is observed. Hence $t_{ijk} = 1$ if $t^*_{ijk} > 0$ and $t_{ijk} = 0$ if $t^*_{ijk} \le 0$. Variables *z* and *X* represent a matrix of the variables that enter the selection and outcome equations, while γ and β are their respective vector of parameters to be estimated. The specification of these equations is discussed in the next section.

It is assumed that $(u_i, \varepsilon_i) \sim \text{bivariate}(0,0,\sigma_u,\sigma_\varepsilon,\rho)$. It is important to mention that standard regression techniques assume that ρ=0 and hence yield biased results. $\mathrm{T_{ijk}}$ is the value of the bilateral trade flow of the commodity in real dollars and is observed for a random sample when $t^*_{ijk} > 0$. In this case, Greene (2003) shows that

$$\begin{aligned} E\left[T_{ijk} \middle| t_{ijk} \text{ is observed}\right] &= E\left[T_{ijk} \middle| t_{ijk} > 0\right] \\ &= E\left[T_{ijk} \middle| u_i > -z'\gamma_i\right] \\ &= X_i'\beta + E\left[\varepsilon_i \middle| u_i > -z'\gamma_i\right] \\ &= X_i'\beta + \rho\sigma_\varepsilon\lambda_i(\alpha_u) \\ &= X_i'\beta + \beta_\lambda\lambda_i(\alpha_u) \end{aligned} \qquad \text{Equation (10)}$$

where $\alpha_u = \frac{z'\gamma_i}{\sigma_u}$, $\beta_\lambda = \rho\sigma_\varepsilon$, and $\lambda_i(\alpha_u)$ is the inverse Mills ratio (IMR) and is given by the following relationship:

$$\lambda(\alpha_u) = \frac{\phi(\alpha_u)}{1-\Phi(\alpha_u)} = \frac{\phi(-\alpha_u)}{\Phi(\alpha_u)} = \frac{\phi\left(\frac{z'\gamma_i}{\sigma_u}\right)}{\Phi\left(\frac{z'\gamma_i}{\sigma_u}\right)} \qquad \text{Equation (11)}$$

where ϕ is the standard normal density function and Φ is the cumulative standard normal distribution.

The Heckit procedure uses a probit model to estimate the selection equation, equation (8), and the vector of parameters γ using the maximum likelihood method, and then uses the estimates of γ (i.e., $\hat{\gamma}$) to calculate the IMR for each observation. The estimated IMR, $\hat{\lambda}$, is used as a variable in the outcome equation to consistently estimate the parameters of the outcome equation (i.e., β). The non-inclusion of $\hat{\lambda}$ in the outcome equation is the familiar omitted-variable case and results in inconsistent estimates of $\hat{\beta}$ (Greene 2003; Hoffmann and Kassouf 2005). When a variable enters both the selection and outcome equations, this common variable (in X_i and z_i), along with other variables, determines $\hat{\lambda}$. Hence, the marginal effects of the common variables in the selection and outcome equations need to be corrected (Saha et al. 1997; Sigleman and Zeng 1999; Hoffmann and Kassouf 2005). Most of the empirical literature that adopts the Heckit model ignores this fact, including Helpman et al. (2007), Linders and De Groot (2006), and Bikker and De Vos (1992).

Several authors including Saha et al. (1997), Greene (2003) and Hoffmann and Kassouf (2005) report the method for determining the corrected marginal effects for the variables that are common to both the selection and outcome equations. Saha et al. (1997), Sigleman and Zeng (1999), and Greene (2003) derived the corrected conditional marginal effects for continuous variables, while Hoffmann and Kassouf (2005) not only derived these but also calculated the unconditional marginal effects for both the continuous and binary variables common to the selection and outcome equations. The correction procedure for continuous variables, irrespective of whether the zeros are considered actual or potential, is:

$$\begin{aligned}\frac{\partial E\left[T_{ijk}\middle|t^*_{ijk}>0\right]}{\partial X_{ki}} &= \beta_k + \beta_\lambda\left[\frac{-\alpha_u\phi(\alpha_u)}{(1-\Phi(\alpha_u))}+\frac{(\phi(\alpha_u))^2}{(1-\Phi(\alpha_u))^2}\right]\cdot\left(\frac{-\gamma_k}{\sigma_u}\right)\\ &= \beta_k + \beta_\lambda\left[-\alpha_u\lambda_i(\alpha_u)+(\lambda_i(\alpha_u))^2\right]\cdot\left(\frac{-\gamma_k}{\sigma_u}\right) \qquad \text{Equation (12)}\\ &= \beta_k - \frac{\gamma_k}{\sigma_u}\beta_\lambda\lambda_i(\alpha_u)\left[\lambda_i(\alpha_u)-\alpha_u\right]\end{aligned}$$

where $\phi'(\alpha_u)=-\alpha_u\phi(\alpha_u)$. Greene (2003) substituted $\delta_i=\lambda_i(\alpha_u)\left[\lambda_i(\alpha_u)-\alpha_u\right]$ to get equation (13).

$$\frac{\partial E\left[T_{ijk}\middle|t^*_{ijk}>0\right]}{\partial X_{ki}} = \beta_k - \frac{\gamma_k}{\sigma_u}\beta_\lambda\delta_i \qquad \text{Equation (13)}$$

The expression $\frac{\gamma_k}{\sigma_u}\beta_\lambda\delta_i$ is the correction factor required to get the corrected marginal effect for the common continuous variables.

Hoffmann and Kassouf (2005) consider the case of common binary variables for both the actual and potential cases of zero. We assume in this study that the zeros are actual. In this case, let $\bar{z}_1$ be the binary explanatory variable that is common to both the selection and outcome equations and has two levels: zero ($\bar{z}_{10}$) and one ($\bar{z}_{11}$). The change in $\hat{\lambda}$ when $\bar{z}_1$ moves from 1 to 0 is

$$\Delta\lambda = \frac{\phi\left(\frac{z_{11}\gamma_i}{\sigma_u}\right)}{\Phi\left(\frac{z_{11}\gamma_i}{\sigma_u}\right)} - \frac{\phi\left(\frac{z_{10}\gamma_i}{\sigma_u}\right)}{\Phi\left(\frac{z_{10}\gamma_i}{\sigma_u}\right)} \qquad \text{Equation (14)}$$

Then, according to Equation (10) for the binary variable case, the corrected marginal effect for the conditional case is given by

$$\frac{\partial E\left[T_{ijk} \middle| t^*_{ijk} > 0\right]}{\partial X_{ki}} = \beta_k + \beta_\lambda \Delta\lambda \qquad \text{Equation (15)}$$

The extended version of equation (8) (i.e., selection equation) that also accounts for the commodity and country classification is

$$\begin{aligned} t^*_{ijkt} = {} & \psi_i + \psi_t + \gamma_1 \ln dist_{ij} + \gamma_2 DCB_{ij} + \gamma_3 Landl_{ij} + \gamma_4 Island_{ij} + \gamma_5 DPTA_{ij} + \gamma_6 DComlang_{ij} \\ & + \gamma_7 DColony_{ij} + \gamma_8 \ln\theta_{it} + \gamma_9 D^i_{LMI} + \gamma_{10} D^i_{UMI} + \gamma_{11} D^i_{HI} + \gamma_{12} GDP_{it} + \varepsilon_{iikt} \end{aligned} \qquad \text{Equation (16)}$$

where t^*_{ijkt} represents a binary variable that takes the value of 1 if the bilateral trade flow of commodity *k* between importing country *i* and exporting country *j* is greater than zero and takes the value of 0 when there is no or zero trade, ψ_i represent importing-country specific fixed effects, ψ_t represent time specific fixed effects and GDP_{it} is GDP of importing country and other variables are defined earlier.

The sample selection model, equation (16), corresponds to a decision-making process where given a commodity sector, an importing country first chooses exporters and then decides on the volume of imports to take from each. Hence, equation (16) models the probability of an importing country selecting an exporting country to supply a particular commodity. A number of factors, including the type of commodity, transaction costs, the level of economic development of the importing country, the price of the commodity, and so on, influence this decision. Transaction costs are further determined by the tariff structure between trading partners, existence of a common border, and distance. Hence, the selection decision is made after a comparison of the costs and benefits of a bilateral transaction.

Once a trading partner is selected, a decision about the level of imports needs to be made to complete the exchange. The outcome equation models the quantity of imports in value terms. Again, this value is influenced by a number of factors, such as transaction costs, level of economic development of the importing country, and the price of the commodity.

$$\ln imp_{ijkt} = \psi_i + \psi_t + \psi_k + \gamma_1 \ln dist_{ij} + \gamma_2 DCB_{ij} + \gamma_3 Landl_{ij} + \gamma_4 Island_{ij} + \gamma_5 DPTA_{ij} + \gamma_6 DComlang_{ij} + \gamma_7 DColony_{ij} + \gamma_8 \ln \bar{I}^i_{LIt} + \gamma_9 \ln \bar{I}^i_{LMIt} + \gamma_{10} \ln \bar{I}^i_{UMIt} + \gamma_{11} \ln \bar{I}^i_{HIt} + \gamma_{12} \ln \theta_{it} + \varepsilon_{iikt} \qquad \text{Equation (17)}$$

The outcome equation is specified in double-log form and imp_{ijkt} is observed when $t^*_{ijkt} > 0$. Equation (17) is similar to equation (7) with the exception that it is augmented with year-specific fixed effects (ψ_t) and commodity specific fixed effects (ψ_k). Also, the per capita income variable is split into $\bar{I}^i_{LI}, \bar{I}^i_{LMI}, \bar{I}^i_{UMI}$ and $\bar{I}_{HI}$, representing per capita income for lower, lower-middle, upper-middle, and higher-income countries, respectively. These variables are the product of per capita income and a dummy variable representing the level of economic development and are created to make hypothesis testing easy. Equation (17) is estimated for EU, Canada, and the United States, and for exports of their differentiated agrifood products. The selection and outcome equations are estimated using the Heckman two-step procedure.

The Heckit model requires sufficient variation to identify the parameters of the selection and outcome equations, requiring identification of separate variables that affect the IMR from those that determine the outcome equation. However, in practice this is seldom possible, because in most cases the variables that determine the selection equation also determine the outcome equation. This might lead to multicolinearity between variables in the outcome equation and IMR, causing parameter instability. Dow and Norton (2003) and Maddala (1983) suggest using an exclusion restriction in such a case. However, Maddala (1983) shows that the problem will not exist if: 1) either the rho (ρ) between the errors terms of the selection and outcome equations is equal to zero; 2) or at least one variable in X is not included in z. Comparing the selection and outcome equations (Equations 16 and 17) shows that more than one uncommon variable is included in the selection and outcome equations; gross domestic product, per capita income, dummies for lower-middle, upper-middle, and high-income countries are included only in the selection equation while commodity-specific fixed effects are only included in the outcome equation..

Finally, the Heckit model can be estimated either simultaneously or as two separate equations. Stata 9.0 provides both of these estimation procedures, with the option of truncating ρ between −1 and 1 so that the variance-covariance matrix is positive definite and useable for hypothesis testing. However, the two-step procedure, i.e., separate estimation of the selection and outcome equations, is generally more stable and allows for estimates of ρ less then −1 or greater than 1 and therefore is adopted in this study.

Results and Discussion

Tables 1–3 provide the estimated results of the model for exports of differentiated agrifood products by the EU (table 1), Canada (table 2), and the United States (table 3). The outcome equation had the largest number of observations for the United States, followed by the EU and Canada. The highest number of observations that were censored was for meat in the United

States. Wald tests of the hypothesis that all of the coefficients in the regression model (except the constant) are zero, were consistently rejected at the 99 percent level of significance for all commodities and regions. The importing-country, year and commodity specific fixed effects are kept in the models to account for missing prices and to control for other omitted country-specific factors. These fixed effects are tested with the null hypothesis that their joint effects are zero. Importing-country and commodity fixed effects are statistically significant for all commodities across all the regions, while the fixed effects representing years are significant in one-third of the cases.

Results in table 1 show that IMR is statistically significant for all EU exported commodities except dairy. On the other hand, it is statistically significant only for the US exports of alcoholic beverages and cereals and Canadian exports of cereals, dairy products, frozen fish and processed fruits. These results imply that ignoring zero trade flows will produce biased estimates just as any omitted variable would. Hence, the use of OLS in this case would produce biased results (Heckman, 1979). It is relevant to mention that rho has been truncated in only 6 out of 30 cases, indicating the absence of serious misspecification problems (Maddala, 1983).

Trade Costs

In the theoretical model it is postulated that trade costs (transaction costs) are influenced by distance, preferential trade agreements between bilateral trade partners, countries being landlocked or islands, common language and borders, and whether trade partners ever colonized each other. Theoretically, the distance variable is expected to have a negative sign because an increase in the distance between trading partners is expected to decrease imports. Similarly, countries with a common border, common language, and preferential trade agreements (PTA) are expected to trade more, and hence dummies representing these variables are expected to have positive signs. However, these variables may take signs other than what is expected in empirical analysis (Hallak 2004, 2006). In our case, one third of the estimates for distance are positive, three statistically significant. We tested the hypothesis that the joint effect of the variables determining trade costs is zero. The results show that the hypothesis of zero trade costs is consistently rejected across all of the regions and commodities, with the exception of Canadian and U.S. meat exports (table 4). Hence, irrespective of the individual significance of variables that determine trade-related transaction costs, their joint effect is statistically significant.

Role of Income

The role of income in trading ten differentiated agrifood products by Canada, the United States and the EU is explored by testing specific hypotheses about the role of per capita income across the development spectrum. For this purpose, development-dependent dummy variables were created and multiplied by the logarithm of per capita income to create low, lower-middle, upper-middle, and high-income variables. Since the model is estimated in log-log form, the coefficients of these variables are expenditure elasticities, and the role of income is highlighted by testing hypotheses regarding these expenditure elasticities. The variables representing the interaction of per capita income and the level of economic development also provide for variation in the expenditure elasticities across the development spectrum, which otherwise would be constrained to be the same given the functional form.

We first test the hypothesis that the joint effect of all the expenditure elasticities is zero—in other words, that agrifood exports originating from the EU, Canada, and the United States during 1990−2000 are not influenced by the per capita income of the importing countries. The results of this and other statistical tests are compiled in table 4 and show that the hypothesis is rejected for 8 out of 10 commodity groups in the EU, 4 out of 10 times for Canada, and 9 out of

10 times for the United States. Further, the hypothesis of no income effect is consistently accepted for alcoholic beverages and meat in Canada and the EU and U.S. exports of tea, coffee and mate.

It is also relevant to examine whether the results of the above test change when only the expenditure elasticities of developing countries are considered. In other words, is the joint effect of the expenditure elasticities of developing countries zero? For the United States, the results of this test differ from those above for meat and tea, coffee and mate. The test that the joint influence of per capita income is equal to zero is rejected for meat when all countries from the development spectrum are considered, but it is accepted for developing countries only; while the reverse is true for US exports of tea. Similarly, the test that the joint influence of income is equal to zero is statistically rejected for EU exports of fresh fruits to all countries, but it is accepted for developing countries. Also, the test of the joint effect of the expenditure elasticities of developing countries equaling zero is rejected for Canadian cereals, but is accepted when developed and developing countries are considered together. Hence, the status of economic development of the importing country does matter for a few commodities. While the above mentioned joint tests of expenditure elasticities highlight the role of income, it is also relevant to look at their individual significance across commodities and regions. Characterizing the individual expenditure elasticities is a challenge, but certain themes do emerge for developing countries. In constructing these themes we have focused only on elasticities that are statistically significant. One-third of the 30 expenditure elasticities for high income countries are statistically significant, four each for the U.S. and Canada and 2 for the EU (tables 1–3). In Canada, the significant coefficients show exports of cereals, dairy products, fresh fish and processed fruits all have expenditure elasticities close to 2; in the U.S. alcoholic beverages, fresh fruits, vegetables and meat have expenditure elasticities ranging from -3.18 to 1.72; and in the EU exports of fresh fish and fresh fruits, have expenditure elasticities of 1.20 and -1.33, respectively. It is important to mention that the expenditure elasticities for Canadian exports in developed countries are all positive and elastic, showing that developed countries growth in expenditure on Canadian exports outpaces the growth in their per capita income. Also, Canadian exports of fresh fruits have a positive and highly elastic expenditure elasticity while it is negative and slightly elastic for the EU. Hence, similar commodities face different preferences depending on the country of origin.

Of the 30 expenditure elasticities estimated for low-income countries, only six are statistically significant: fresh fruits (-1.66) and frozen fish (1.77) for EU, dairy products (2.02), fresh fish (9.39) and processed fruits (5.35) for Canada and fresh fruits (1.93) for the US. It seems plausible that the low-income countries are importing essentially bulk agricultural commodities, and their incomes have not yet reached the level where differentiated agrifood products figure prominently in their trade.

Among lower-middle-income countries, slightly more than one-half of the expenditure elasticities are statistically significant. Eight of these are for products exported by the United States and four for Canadian exports, and in all cases the expenditure elasticities are positive and elastic. This contrasts with the results for the EU where four expenditure elasticities are statistically significant but two of these (processed fruits and tea, coffee and mates) are negative, implying that as incomes of the importing countries rise, their expenditures on imports from the EU decrease.

Turning to the upper-middle-income group, there are 18 significant expenditure elasticities of which 15 positive, among the 30 estimated. The upper-middle-income group's growth in exports from the United States outpaces income growth for all the commodities except meat i.e. 9 of the 10 expenditure elasticities are positive and elastic ranging from 1.3 to 3.2. For Canada 4 out of 10 expenditure elasticities are statistically significant. Again, the estimated expenditure elasticities are positive and greater than one (alcoholic beverages (2.17), frozen fish (1.24), processed fruits (3.27) and tea, coffee and mate (4.44)). Four out of 10 expenditure elasticities are positive and statistically significant for EU exports ranging from 0.74 to 1.31.The negative expenditure elasticity for US meat exports could be due to the bovine spongiform encephalopathy (BSE) that originated in the United Kingdom during the 1980s (Sarker and Sampath 2007). Burton and Young (1996) and Lloyed et al. (2006) also report decreases in consumption of beef and other red meats within due to BSE.

Comparing the results across the commodities shows that fruit and their products (i.e. fresh and processed fish), fish (fresh and frozen) and alcoholic beverages typically have significant expenditure elasticities. For alcoholic beverages and fish, the elasticities are positive when statistically significant irrespective of the exporter. On the other hand, EU processed fruits exports have negative and inelastic expenditure elasticity while US fresh fruit exports have positive, statistically significant and elastic expenditure elasticities in both the developed and developing countries. Sarker and Sam path (2007) also report negative expenditure elasticities for fruit exports from the EU. However, their estimates of expenditure elasticities are low compared to the estimates in this study and this may be due to three reasons: (1) their expenditure elasticities represent the average affect of all the countries and are not disaggregated according to the development level of the importing country; (2) the commodities they consider are a subset of what are included in this study; and (3) they distinguish between trade within and outside the EU while this study does not make any such distinction. Hence, their results concerning the direction of trade are similar to ours, but the magnitude of the effect is different.

A few generalizations are in order: (1) expenditure elasticities are positive and in most case growth in exports outpaces growth in income, whenever these are statistically significant; (2) importers distinguish imports from the three regions as all US exports face elastic expenditure elasticities as compared to Canadian and EU exports; (3) In terms of middle- and upper-income countries being the growth markets of the future, this hypothesis is supported by our results especially for the United States.

Are Preferences Homothetic?

Trade theories explaining the supply-side determinants of trade generally ignore demand-side forces, assuming at the outset that preferences are identical and homothetic across countries in order to make the analysis more tractable. However, recent developments in trade theory confirm that relative factor endowments are not the only cause of trade (Krugman 1999). Still, the question of whether preferences are homothetic is interesting from a theoretical perspective.

In this section we present results of the tests of homotheticity. Homotheticity is examined by testing that expenditure elasticities are equal to one. The results of testing for homotheticity in the commodity-specific models, estimated using the Heckit two-step procedure, are shown in table 5. These results indicate that the hypothesis of homotheticity is consistently rejected for the EU countries, is rejected for more than one-half of the commodities for the United States, and is more consistently accepted for Canada. The table further shows that the outcome of the test of homotheticity differs across the commodities and regions e.g. it is rejected for EU exports of alcoholic beverages, tea, coffee and mate but is accepted for Canadian and the U.S. exports of these commodities. Similarly, it is more consistently rejected for processed fruits and accepted for fresh and frozen fish across the three regions.

Conclusion

World Bank estimates show that economic growth in developed countries has been slowing down since the 1970s, while growth in developing countries has been more rapid. This increase in the growth of developing economies is expected to increase their expenditures on the consumption of agricultural products. However, we don't know the expected impacts of these growth rates for different agrifood products exported from the EU, Canada, and the United States. This study investigated the role of income in agrifood trade by estimating per capita bilateral trade flows of ten commodity groups from 1990 to 2000, for the EU, Canada, and the United States, using a fixed-effects two-step Heckman estimation procedure using a double-log functional form. The role of income was investigated by testing a number of postulates regarding expenditure elasticities of low, lower-middle, upper-middle, and high-income countries.

While it is difficult to characterize the individual expenditure elasticities, the study showed that most of the statistically significant expenditure elasticities of both developed and developing countries faced by the three exporting regions are positive and relatively elastic. Expenditure elasticities of middle income countries are more likely to be statistically significant, positive and elastic hence their expenditure growth on imports from the three regions outpaces their income. Further, the proposition that middle-income countries are the growth markets of the future is supported strongly for the United States and less so far Canada and the EU. The study also shows that the expenditure elasticities are jointly statistically significant for most commodities in the case of the EU, and U.S. commodities, and for four Canadian commodities.

We also found that Canadian exports face homothetic preferences, U.S. exports face homothetic preferences for more than one-half of the commodities, and EU exports face non-homothetic preferences for nine out of 10 commodity groups.

The study concludes that income plays an important role in agrifood trade; however, growth of importing countries income may have different ramifications for agrifood products originating from individual exporting countries. While almost all the U.S. exports rose with increases in per capita income of importing countries, the EU exports both increased and decreased, and only four commodity groups of Canadian exports were affected. While we conclude that growth of importing countries has different ramifications for the three regions, further investigation is needed to help us understand the forces that determine these divergent results.

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Table 1: Regression Results for Selected EU Countries' Agrifood Products and Beverages Export Values (2000 Real dollars) using Heckman Two-Step Selection Method

	Alcohalic beverages		Cereals		Dairy products		Fresh Fish		Frozen fish		Fresh fruits		Processed fruits		Meat		Tea, coffee & mate		Vegetables	
Explanatory variables	Estimate	Sig.[1]	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.
Common Border	1.220	***	0.331	***	0.630	***	-0.003		0.159	*	1.729	***	1.058	***	0.642	**	0.261		1.074	***
	(0.146)[B]		(0.094)		(0.092)		(0.108)		(0.088)		(0.134)		(0.084)		(0.215)		(0.231)		(0.083)	
Log of Distance	-1.335	***	-2.096	***	-1.715	***	-2.007	***	-1.326	***	-0.070		-1.458	***	0.424	**	-2.031	***	-0.861	***
	(0.108)		(0.068)		(0.066)		(0.109)		(0.072)		(0.104)		(0.071)		(0.136)		(0.185)		(0.057)	
ln(PCI)*Lower Income Countries Dummy	-0.236		0.036		0.732		0.833		1.768	**	-1.660	*	-0.323		0.667		-0.988		0.277	
	(0.42)		(0.397)		(0.353)		(0.909)		(0.677)		(1.004)		(0.318)		(0.718)		(0.853)		(0.443)	
ln(PCI)*Lower Middle Income Countries Dummy	0.441	*	0.394		0.221		1.845	***	0.488		-0.281		-0.636	**	-0.625		-1.629	**	-0.197	
	(0.262)		(0.269)		(0.23)		(0.507)		(0.332)		(0.52)		(0.221)		(0.501)		(0.568)		(0.27)	
ln(PCI)*Upper Middle Income Countries Dummy	0.258		0.741	***	0.860	***	0.531		1.307	***	-0.444		0.158		0.150		-0.551		0.915	***
	(0.246)		(0.236)		(0.21)		(0.414)		(0.253)		(0.379)		(0.186)		(0.367)		(0.493)		(0.221)	
ln(PCI)*High Income Countries Dummy	0.342		0.273		0.424		1.201	***	0.211		-1.328	***	-0.248		-0.110		-0.671		-0.278	
	(0.369)		(0.282)		(0.28)		(0.333)		(0.269)		(0.389)		(0.226)		(0.551)		(0.607)		(0.243)	
Log of Gini	-0.021		0.035		-0.014		-0.093		0.104		-0.513		-0.236		-0.026		-0.175		-0.094	
	(0.213)		(0.154)		(0.141)		(0.223)		(0.164)		(0.337)		(0.16)		(0.352)		(0.457)		(0.156)	
PTA	1.530	***	1.846	***	1.790	***	0.362	***	0.184	**	1.453	***	1.986	***	0.059		1.593	***	1.739	***
	(0.14)		(0.094)		(0.107)		(0.107)		(0.093)		(0.132)		(0.083)		(0.191)		(0.237)		(0.08)	
Island	1.163		3.406	***	2.498	**	3.272	**	2.568	**	-6.240	***	-0.651		-1.125		0.344		1.887	***
	(1.108)		(0.367)		(0.793)		(1.081)		(1.045)		(1.836)		(0.765)		(1.797)		(3.744)		(0.356)	
Land Locked	-1.033		1.283		-0.017		-0.008		2.147	**	-8.129	***	2.042	*	0.450		-4.552	*	1.193	
	(1.071)		(0.826)		(0.743)		(1.649)		(0.944)		(1.84)		(0.74)		(1.148)		(2.343)		(0.806)	
Colony	0.769	***	0.204	**	0.061		0.719	***	0.902	***	1.737	***	0.664	***	0.885	***	0.895	***	1.048	***
	(0.116)		(0.085)		(0.081)		(0.117)		(0.088)		(0.166)		(0.078)		(0.181)		(0.225)		(0.083)	
Common Language	0.097		0.255	***	0.254	***	0.334	***	0.206	**	-1.690	***	-0.163	**	-0.770	***	-0.128		-0.661	***
	(0.096)		(0.072)		(0.0630		(0.097)		(0.072)		(0.148)		(0.067)		(0.154)		(0.194)		(0.073)	
Inverse Mill's Ratio	-2.515	***	-0.563	***	0.075		0.435	**	0.665	***	0.665	***	-2.713	***	-1.944	***	-1.861		-4.801	***
	(0.116)		(0.124)		(0.211)		(0.21)		(0.186)		(0.186)		(0.158)		(0.074)		(1.159)		(0.283)	
Fixed Effects																				
Importing Country (χ Test)	38.7	***	3218.1	***	2403.5	***	39.3	***	39	***	1428.5	***	544.9	***	1679.4	***	544.9	***	3150.8	***
Year (χ Test)	1.7	*	9.1		22.13	**	1.38		0.9		8.5		26.6	**	7.3		26.6	**	36.1	***
Commodity (χ Test)	312.6	***	1349.7	***	2467.6	***	480.8	***	235.2	***	550.4	***	939.2	***	18.7	***	939.2	***	1517.2	***
Selection Hazards																				
Rho	-1.000		-0.302		0.042		0.255		0.385		-0.976		-0.961		-0.672		-1.000		-0.642	
Sigma	2.515		1.866		1.775		1.710		1.729		2.778		2.022		2.769		4.801		2.089	
Summary Statistics of Outcome Equation																				
Censored Observations (Number)	3740		5509		6161		3800		5878		5707		6137		7280		6137		9689	
Uncensored Observations (Number)	10713		11055		11546		4983		8605		6641		9125		4582		9125		14263	
Wald ((χ Test))	5540.6	***	10295.6	***	11702.9	***	5510.3	***	6677.2	***	4271.8	***	3170.8	***	3191.0	***	3170.8	***	11067.3	***
Summary Statistics of Selection Equation																				
LR (χ Test)	3879.8	***	4625.4	***	3463.3	***	4316.4	***	5618.2	***	5327.7	***	3401.7	***	853.1	***	3401.7	***	8102.3	***
Pseudo R-Square	0.23		0.22		0.15		0.36		0.29		0.31		0.17		0.05		0.17		0.25	

[A]*, ** and *** respectively show statistical significance at 90, 95 and 99 percent levels.

[B] Figures in parantheses are standard errors

[C] Dropped due to collinearity.

Table 2: Regression Results for Canadian Agrifood Products and Beverages Exports Values (2000 Real dollars) using Heckman Two-Step Selection Method

	Alcoholic beverages		Cereals		Dairy products		Fresh fish		Frozen fish		Fresh fruits		Processed fruits		Meat		Tea, coffee & mate		Vegetables	
Explanatory variables	Estimate	Sig.[A]	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.
Log of Distance	-3.564		-0.953		4.024	**	-2.601		-2.669		-7.304		-2.116		7.082		-5.152	**	-2.234	
	(2.333)[B]		(1.932)		(1.767)		(2.643)		(2.054)		(4.786)		(1.612)		(8.411)		(2.384)		(2.208)	
ln(PCI)*Lower Income Countries Dummy	3.105		1.332		2.022	*	9.387	*	1.745		2.195		5.350	**	33.827		4.101		0.841	
	(17.995)		(1.313)		(1.153)		(5.054)		(1.365)		(2.2)		(2.313)		(28.082)		(11.892)		(1.396)	
ln(PCI)*Lower Middle Income Countries Dummy	2.466	*	0.040		0.121		2.883	*	3.216	***	3.209		3.254	**	-4.334		0.095		0.193	
	(1.428)		(0.926)		(0.728)		(1.655)		(0.859)		(1.995)		(1.202)		(3.486)		(1.807)		(1.208)	
ln(PCI)*Upper Middle Income Countries Dummy	2.169	**	-0.704		2.838		1.439		1.244	*	0.338		3.267	***	-0.139		4.444	***	0.812	
	(1.016)		(0.652)		(0.659)		(1.952)		(0.66)		(2.294)		(1.054)		(2.91)		(1.443)		(0.904)	
ln(PCI)*High Income Countries Dummy	0.916		1.936	**	1.973	**	1.977	*	0.606		-0.568		1.956	**	0.834		0.876		0.243	
	(0.937)		(0.945)		(0.875)		(1.157)		(0.899)		(1.891)		(0.979)		(4.614)		(1.255)		(1.067)	
Log of Gini	-0.473		0.079		0.257		0.079		-0.020		0.743		-0.572		0.284		1.113		-0.418	
	(0.443)		(0.523)		(0.548)		(0.706)		(0.55)		(0.69)		(0.561)		(2.556)		(0.688)		(0.44)	
PTA	C		C		0.994	**	C		0.684		C		-0.216		C		-0.801		C	
					(0.496)				(0.617)				(0.693)				(1.194)			
Island	-1.887		9.732	**	-2.085		4.985		9.963		8.148		-1.705		-19.449		-6.241	*	1.285	
	(3.748)		(3.39)		(6.403)		(5.932)		(6.874)		(8.933)		(6.414)		(32.573)		(3.778)		(6.287)	
Land Locked	3.087		-6.209		4.975		0.693		-2.735		C		-5.189		-8.814		7.372	**	1.836	
	(3.05)		(4.448)		(3.053)		(5.747)		(2.948)				(4.51)		(20.826)		(2.668)		(2.607)	
Colony	2.722		-5.511		-3.040		0.000		6.877	*	13.052	*	0.420		-11.433		5.494		-0.288	
	(3.815)		(3.506)		(3.034)		(0)		(4.165)		(7.022)		(2.976)		(15.367)		(4.631)		(3.124)	
Common Language	1.400		-7.785	**	5.948	**	-0.384		3.541		-4.469		-1.363		-1.060		11.181	**	1.469	
	(3.576)		(3.237)		(2.711)		(5.377)		(2.8)		(4.91)		(3.196)		(12.566)		(4.036)		(2.69)	
Inverse Mill's Ratio	0.414		-1.320		1.796	**	-0.730		2.007	*	-0.886		1.858	**	6.784		1.097		-1.766	
	(1.716)		(0.246)		(0.716)		(1.747)		(1.079)		(2.468)		(0.878)		(12.793)		(1.245)		(1.335)	
Fixed Effects																				
Importing Country (χ Test)	263.2	***	348.7	***	289.9	***	321	***	390.1	***	115.5	***	144.2	***	49.5	**	125.9	***	443.4	***
Year (χ Test)	6.4		9.1		9.8		6.2		22.2	**	8.1		7		0.9		11.6	***	7.7	
Commodity (χ Test)	348.6	***	130.9	***	332.4	***	495.7	***	34.8	***	268.3	***	45.9	***	4.9		295.1	***	801.4	***
Selection Hazards																				
Rho	0.379		-0.806		1.000		-0.476		1.000		-0.638		0.973		1.000		0.791		-0.877	
Sigma	1.094		1.638		1.796		1.535		2.007		1.388		1.909		6.784		1.386		2.014	
Summary Statistics of Outcome Equation																				
Censored Observations (Number)	433		988		773		582		746		642		1384		810		883		1286	
Uncensored Observations (Number)	436		739		712		430		882		337		794		455		316		1497	
Wald (χ Test)	2336.9	***	6655.1	***	6759.9	***	1767.9	***	1742.2	***	721.9	***	3221.9	***	398.1	***	1355.3	***	7846.3	***
Summary Statistics of Selection Equation																				
LR (χ Test)	324.6	***	790.1	***	270.8	***	477.9	***	911.2	***	268.7	***	738.3	***	324.6	***	410.7	***	521.7	***
Pseudo R-Square	0.27		0.34		0.13		0.35		0.41		0.21		0.26		0.20		0.30		0.14	

[A]*, ** and *** respectively show statistical significance at 90, 95 and 99 percent levels.

[B] Figures in parantheses are standard errors

[C] Dropped due to collinearity. Results of common border dummy is not included in the table because it consistently dropped due to collinearity from the estimated models.

Table 3: Regression Results for U.S. Agrifood Products and Beverages Exports Values (2000 Real dollars) using Heckman Two-Step Selection Method

	Alcoholic beverages		Cereals		Dairy products		Fresh fish		Frozen fish		Fresh fruits		Processed fruits		Meat		Tea, coffee & mate		Vegetables	
Explanatory variables	Estimate	Sig.[A]	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.	Estimate	Sig.
Common Border	[C]		1.289	**	2.655	***	1.278	***	1.240	***	-0.237		[C]		-0.848		[C]		1.075	**
			(0.491)		(0.483)		(0.368)		(0.403)		(0.418)				(0.834)				(0.484)	
Log of Distance	0.674	***	1.384		1.638		1.438		-3.352		1.612	***	-3.916	***	0.787		-3.035	**	1.614	
	(0.148)[B]		(20.126)		(4.65)		(84.871)		(81.628)		(0.237)		(1.003)		(0.557)		(1.297)		(4.053)	
ln(PCI)*Lower Income Countries Dummy	-0.212		1.067		-0.867		0.300		-0.077		1.932	**	-0.118		2.014		0.280		0.472	
	(0.73)		(1.011)		(0.844)		(1.05)		(0.948)		(0.803)		(0.607)		(1.605)		(0.951)		(0.601)	
ln(PCI)*Lower Middle Income Countries Dummy	1.562	***	2.689	***	1.112	*	3.034	***	0.849		3.287	***	1.922	***	-1.234		1.335	*	1.601	***
	(0.401)		(0.591)		(0.584)		(0.586)		(0.563)		(0.5380		(0.348)		(0.946)		(0.696)		(0.389)	
ln(PCI)*Upper Middle Income Countries Dummy	1.312	***	3.156	***	1.487	***	1.443	**	1.996	***	2.511	***	2.350	***	-1.457	*	1.355	**	2.458	***
	(0.357)		(0.575)		(0.461)		(0.487)		(0.469)		(0.493)		(0.311)		(0.888)		(0.584)		(0.316)	
ln(PCI)*High Income Countries Dummy	1.724	**	0.902		0.478		0.854		0.213		1.073	*	0.305		-3.179	**	0.322		0.845	*
	(0.582)		(0.896)		(0.811)		(0.658)		(0.713)		(0.612)		(0.497)		(1.328)		(0.752)		(0.492)	
Log of Gini	-0.046		0.101		-0.181		0.088		-0.127		0.192		-0.150		0.001		-0.081		-0.097	
	(0.264)		(0.401)		(0.283)		(0.328)		(0.329)		(0.29)		(0.224)		(0.611)		(0.306)		(0.215)	
PTA	0.778	**	[C]		-0.415		[C]		[C]		0.348		0.942	**	[C]		1.531	***	[C]	
	(0.316)				(0.397)						(0.307)		(0.304)				(0.391)			
Island	-3.786		-4.850		0.704		2.204		-0.056		2.411		-1.100		8.849		-0.181		2.516	
	(3.475)		(192.553)		(5.137)		(42.597)		(126.698)		(23.889)		(1.942)		(7.726)		(2.469)		(3.696)	
Land Locked	-2.708	*	5.103		-1.371		-3.796		0.721		-3.870		4.382		4.486		-0.829		4.115	
	(1.584)		(188.221)		(43.364)		(871.207)		(346.074)		(15.664)		(2.711)		(11.698)		(1.597)		(37.428)	
Colony	-8.228		-6.230	***	-2.334		0.660		5.238	*	7.282	*	6.211	**	13.806	*	4.545	*	-5.900	
	(6.612)		(0.725)		(7.503)		(7.282)		(2.835)		(3.967)		(1.988)		(7.411)		(2.529)		(4.087)	
Common Language	5.847	*	11.896	**	0.537		0.842		4.483	**	-3.729		3.620	**	-4.957		1.293		4.712	**
	(3.425)		(4.956)		(2.914)		(3.767)		(1.952)		(2.738)		(1.379)		(4.8)		(2.071)		(2.082)	
Inverse Mill's Ratio	1.129	**	2.189	**	-0.173		0.986		-0.567		-0.049		0.819		-1.194		0.729		-0.191	
	(0.479)		(0.741)		(0.956)		(0.779)		(0.707)		(0.896)		(0.611)		(2.932)		(1.097)		(0.84)	
Fixed Effects																				
Importing Country (χ Test)	955.7	***	594.6	***	526.2	***	441.5	***	397	***	909.4	***	794.9	***	518.3	***	416.3	***	1160.7	***
Year (χ Test)	18.6	**	6.5		9.8		14		14.5		9.58		29.9	***	5.4		16.4	*	4.1	
Commodity (χ Test)	150.4	***	268.4	***	3151.5	***	1083.7	***	517.2	***	717.3	***	1545.9	***	22.7	***	1079.2	***	178.5	***
Selection Hazards																				
Rho	0.914		1.000		-0.131		0.779		-0.383		1.489		0.582		-0.641		0.525		-0.142	
Sigma	1.236		2.189		1.322		1.266		1.481		-0.049		1.408		1.863		1.388		1.342	
Summary Statistics of Outcome Equation																				
Censored Observations (Number)	10713		5509		6161		3800		5878		5707		8881		7280		6137		9689	
Uncensored Observations (Number)	5540.6		11055		11546		4983		8605		6641		13466		4582		9125		14263	
Wald ((χ Test))	5540.6	***	10295.6	***	11702.9	***	5510.3	***	6677.2	***	4271.8	***	12550.3	***	3191.0	***	3170.8	***	11067.3	***
Summary Statistics of Selection Equation																				
LR (χ Test)	712	***	749.2	***	476.8	***	665.8	***	1002.7	***	789.5	***	1051.4	***	266.6	***	463.7	***	686.4	***
Pseudo R-Square	0.53		0.36		0.18		0.37		0.41		0.27		0.33		0.11		0.15		0.17	

[A]*, ** and *** respectively show statistical significance at 90, 95 and 99 percent levels.

[B] Figures in parantheses are standard errors

[C] Dropped due to collinearity.

Table 4: Test of the joint hypotheses regarding the role of income and transaction cost for EU, Canada, and the United States (χ test)

	Alcohalic beverages		Cereals		Dairy Products		Fresh Fish		Frozen Fish		Fresh Fruits		Processed Fruits		Meat		Tea, coffee & Mate		Vegetables	
	χ Test	Sig.[1]	χ Test	Sig.	χ Test	Sig.	χ Test	Sig.	χ Test	Sig.	χ Test	Sig.	χ Test	Sig.	χ Test	Sig.	χ Test	Sig.	χ Test	Sig.
EU																				
The joint effect of trade cost is zero	203.5	***	1354.7	***	1030.3	***	679.1	***	619.3	***	165.3	***	663.7	***	33.8	***	33.5	***	634.8	***
Elasticities are jointly equal to zero	4.5		11.4	**	20.4	***	25.5	***	33.2	***	13.8	**	12.3	**	2.8		9.1	*	21.4	**
Elasticities of developing countries are jointly zero	4.0		10.9	**	20.8	***	14.8	**	33.2	***	3.8		11.6	**	2.8		8.8	**	19.3	**
Elasticities are same across the development spectrum	2.2		3.2		5.3		4.6		12.8	**	5.2		10.4	**	2.8		3.2		19.1	**
Canada																				
The joint effect of trade cost is zero	59.5	***	100.9	***	24.7	***	58.7	***	15.8	**	12.8	**	52.3	***	3.4		111.4	***	8.4	*
Elasticities are jointly equal to zero	5.2		7.0		26.8	***	6.5		14.3	**	7.7		11.6	**	4.1		12.3	**	1.8	
Elasticities of developing countries are jointly zero	5.2		7.2	*	24.6	***	5.3		14.3	**	6.0		11.6	**	3.9		12.3	**	0.8	
Elasticities are same across the development spectrum	1.6		6.8	*	14.5	**	3.1		7.0	*	7.1	*	3.3		3.9		9.2	**	1.0	
United States																				
The joint effect of trade cost is zero	90.6	***	140.8	***	98.2	***	128.9	***	130.6	***	85.5	***	219.3	***	6.1		171.7	***	124.5	***
Elasticities are jointly equal to zero	31.5	***	41.1	***	15.3	**	29.7	***	18.5	***	47.8	***	72.5	***	9.8	**	6.8		65.5	***
Elasticities of developing countries are jointly zero	24.2	***	41.1	***	15.3	**	29.7	***	18.5	**	47.8	***	72.5	***	5.3		6.3	*	65.0	***
Elasticities are same across the development spectrum	5.5		6.9	**	8.0	**	12.4	**	7.5	**	9.2	**	22.1	***	6.8	**	3.1		14.2	**

Table 5: Are preferences homothetic?

Agrifood product & development level	EU		Canada		United States	
	χ Test	Sig.	χ Test	Sig.	χ Test	Sig.
Alcahalic Beverages						
Low income	8.66	**	0.01		2.76	*
Lower-middle income	4.54	**	1.05		1.96	
Upper-middle income	9.09	**	1.32		0.76	
High income	3.19	*	0.01		1.54	
Cereals						
Low income	5.9	**	0.06		0	
Lower-middle income	5.09	**	1.07		8.18	**
Upper-middle income	1.21		6.84	**	14.06	***
High income	6.62	**	0.98		0.01	
Dairy Products						
Low income	0.58		0.79		4.9	**
Lower-middle income	11.44	***	1.46		0.04	
Upper-middle income	0.45		7.77	**	1.11	
High income	4.24	**	1.24		0.41	
Fresh Fish						
Low income	0.03		2.75	*	0.44	
Lower-middle income	2.78	*	1.29		12.06	**
Upper-middle income	1.29		0.05		0.83	
High income	0.36		0.71		0.05	
Frozen Fish						
Low income	1.29		0.3		1.29	
Lower-middle income	2.38		6.65	**	0.07	
Upper-middle income	1.48		0.14		4.51	**
High income	8.58	**	0.19		1.22	
Fresh Fruits						
Low income	7.01	**	0.29		1.35	
Lower-middle income	6.07	**	1.23		18.09	***
Upper-middle income	14.54	***	0.08		9.4	**
High income	35.79	***	0.69		0.01	
Processed Fruits						
Low income	17.37	***	3.54	**	3.4	*
Lower-middle income	54.96	***	3.52	*	7.04	**
Upper-middle income	20.58	***	4.62	**	18.78	***
High income	30.54	***	0.95		1.96	
Meat						
Low income	0.21		1.37		0.4	
Lower-middle income	10.51	**	2.34		5.58	**
Upper-middle income	5.38	**	0.15		7.66	**
High income	4.06	**	0		9.9	**
Tea						
Low income	5.43	**	0.07		0.57	
Lower-middle income	21.41	***	0.25		0.23	
Upper-middle income	9.91	**	5.7	**	0.37	
High income	7.58	**	0.01		0.81	
Vegetables						
Low income	2.66		0.01		0.77	
Lower-middle income	19.72	***	0.45		2.39	
Upper-middle income	0.15		0.04		21.24	***
High income	27.63	***	0.5		0.1	

Note: *, ** and *** respectively show statistical significance at 90, 95 and 99 percent levels.