Differentiated Agri-Food Product Trade and the Linder Effect

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Abstract

Using a generalized gravity equation, this study tests for the Linder effect in differentiated agri-food product trade, i.e. as the demand structures of two countries become more similar, their trade intensity increases. Two proxies of demand structure, the Balassa index and the absolute value of the difference in per capita GDPs of trading partners, are used to capture the Linder effect. In addition, two measures of bilateral trade, the Grubel and Lloyed index, and the value of bilateral trade are used as the dependent variable. The study investigates the role of the Linder effect in explaining the trade of 37 differentiated agri-food and beverage products categorized into eight product groups: cereals; fresh fish; frozen fish; vegetables; fresh fruit; processed fruit; tea and coffee; and alcoholic beverages. The data covers trade across 52 developed and developing countries from 1990 to 2000. The type of proxy used for the Linder effect and the way in which bilateral trade is measured influence the outcome of the statistical tests for the Linder effect. The Linder effect for cereals, frozen fish, vegetables, processed fruits, and tea and coffee, using the value of trade as the dependent variable, is often accepted but it is generally rejected when the GL index is used as the measure of trade intensity. In brief, the results do not provide strong support for the Linder effect in the trade of differentiated agri-food products.

Key Words: Agri-food, Generalized Gravity Equation, Grubel and Lloyed index, Linder Effect, trade

Introduction

The motivation behind positive trade theory is to better understand the factors that determine the direction and composition of trade. In his *Essay on Trade and Transformation*, Linder (1961, p. 94) developed several hypotheses regarding the structure and pattern of trade, with his most famous observation being "the more similar the demand structures of two countries, the more intensive[i], potentially, is the trade between these two countries." Empirically the similarity of "demand structures" of trading partners is not easily measured and it is generally proxied by the similarity in the income levels of the trading partners. As the per capita incomes of two trading partners become more equal it is expected that trade will expand and this is referred to as "the Linder effect" and it is the focus of this study. The Linder effect is included in the models of Thursby and Thursby (1987) and others via a variable generated by taking the absolute value of the difference between the per capita incomes of trading partners and more recently by the Balassa and Bauwens (1987) inequality index[ii], referred to as the Balassa index in this article. We use both of these measures of the Linder effect to investigate its role in agri-food trade.

Linder (1961 p. 107-8), also argued that "the distance factor may . . . mean that entrepreneurs are not even aware of the market opportunities in some distant country . . . irrespective of the scope for potential trade. . . . The distance factor should be expected to upset the pattern of actual trade completely". He then argued that it is not only distance but also "cultural and political affinities or aversions" (Linder 1961, p. 108) that could potentially distort trade, while "similar language and cultural backgrounds could be expected to increase the intensity of trade" (Linder 1961, p. 108). In response to Linder's observations, proximity factors (distance, landlocked countries, island countries), political affinities (preferential trade agreements), and cultural factors (similar language, common colonizer) are commonly included in recent models that attempt to explain trade flows.

In order to explain intra-industry trade, Linder used product differentiation, monopolistic competition, income and its distribution, proximity, and socio-cultural factors. Krugman (1979) and Helpman and Krugman (1985) elegantly combined these factors under the paradigm of the "new trade theory." These models assume that product differentiation requires economies of scale in production such that each country produces a restricted range of goods but global welfare increases because international trade makes these varieties available for global consumption. Internal economies also give large firms a cost advantage over small firms due to their downward sloping average cost curve that leads to monopolistic competition. These factors suggest that the new trade theory is the proper theoretical framework to use in explaining intra-industry trade and the consideration of proximity, cultural and political factors in the analysis points to the gravity equation as the proper empirical tool. However, in order to test for the Linder effect the generalized gravity equation is better suited to the task because it justifies the introduction of the average per capita incomes (PCI) of trading partners in explaining bilateral trade flows. As noted above, the similarity of demand structures is often measured as the difference in the PCIs of trading partners. Fillat-Castejón and Serrano-sanz (2004) criticized this approach as being "oversimplified" but also acknowledged that such a test captures an "essential aspect" of the Linder hypothesis.

Empirical studies have typically employed gravity-type equations to test for the Linder effect (Bergstrand 1989; Hoftyzer 1984; Krugman 1980; Linnemann and van Beers 1988; McPherson, Redfearn & Tieslau 2001; Qureshi, French and Sailors 1980). The results of these studies are mixed viź-a-viź the Linder effect and suffer from at least three limitations. First, they use highly aggregated data; for example, Thursby and Thursby (1987) and McPherson et al.

(2001) use the annual value of trade for all commodities; Bergstrand (1990) uses two-digit SITC data; and Chow, Kellman, and Shachmurove (1999) use aggregate three-digit SITC data. These aggregations ignore product differentiation by combining both homogenous and differentiated products. Second, none of these studies test for the Linder effect in agri-food trade, although some studies focused on agri-food include variables like the inequality of GDPs of trading partners to explain intra-industry trade (Hirschberg, Sheldon and Dayton 1994). Intra-industry trade of differentiated agri-food products, is a widely accepted phenomenon and provides the justification for testing for the Linder effect.

In the next section we review Bergstrand's generalized gravity model and note its limitations. The model is based on the assumptions of scale economies, monopolistic competition, and product differentiation. This is followed by a discussion of the data, estimation procedures and the results.

The Model

While the theoretical foundations for the gravity equation are no longer an issue, many researchers have extended the standard gravity equation to include the per capita incomes of bilateral trading partners without providing any theoretical justification. Bergstrand (1989) provides the theoretical foundation for including the per capita incomes of trading partners in a generalized gravity equation, and it is adopted in this study. Bergstrand (1989) adopted the assumptions of product differentiation, increasing returns to scale, and monopolistic competition that Linder (1961) argued for and compared to Anderson's (1979) gravity equation it accounts for the cost of distributing each country's output to national and foreign markets.

Bergstrand (1989) starts with a representative consumer that maximizes a "nested" Cobb-Douglas-CES-Stone-Geary utility function over differentiated (X_{fdljit}) and homogenous (X_{hdljit})

products subject to a budget constraint where X_{fdljit} (X_{hdljit}) is the amount of the differentiated (homogenous) agri-food product of industry *f* (*h*) of firm d_f (d_h) in country *j* demanded by consumer *l* in country *i* in time period *t*.

$$U_i^l = \left[\left\{\sum_{f=1}^{F}\sum_{d=1}^{D_f} X_{fdljit}^{\rho_f}\right\}^{1/\rho_f}\right]^{\mu} \times \left[\left\{\sum_{h=1}^{H}\sum_{d=1}^{D_h} X_{hdjlit}^{\rho_h} - \bar{X}_{ht}\right\}^{1/\rho_h}\right]^{1-\mu} \tag{1}$$

$$-\infty < \rho_f, \rho_h < 1; 0 < \mu < 1$$

where $\bar{X}_h$ is the minimum consumption requirement for the homogenous product. Suppressing *l* and *t*, income of the individual is represented as y_j such that $y_j = \left[\left[\sum_{i=1}^{I}\sum_{d=1}^{D}\left(P_{X_fji} \cdot \tau_{X_fji}\right)\right] X_{fdji} + \left[\sum_{i=1}^{I}\sum_{d=1}^{D}\left(P_{X_hji} \cdot \tau_{X_hji}\right)\right] X_{hdji}\right]$ is the per capita income of the consumer, P_{X_fji} (P_{X_hji}) is the price of differentiated (homogenous) product X_f (X_h) produced in country *i* exported to country *j*, and τ_{X_fji} (τ_{X_hji}) is the associated transaction cost of the trade. Maximizing utility subject to the budget constraint and aggregating across identical consumers generates market demand (Equation (2)) for differentiated agri-food product.

$$X_{fji} = \mu\left(Y_j - \bar{X}_h\left(\sum_{d=1}^{D}\sum_{i=1}^{I}\left(P_{X_hji} \cdot \tau_{X_hji}\right)^{1-\psi}\right)^{1-\psi} L_j\right)\left(P_{X_fji} \cdot \tau_{X_fji}\right)^{-\sigma}$$
$$\times\left(\sum_{d=1}^{D}\sum_{i=1}^{I}\left(P_{X_fji} \cdot \tau_{X_fji}\right)^{1-\sigma}\right)^{-1} \tag{2}$$

where $\sigma = {}^{1}/_{1-\rho_f}$, $\psi = {}^{1}/_{1-\rho_h}$, Y_j is country *j*'s gross domestic product (GDP), and L_j is the population of country *j*. Hence, the market demand for imports is a function of the aggregate income of the importing country, the prices of products, and the transaction costs associated with trade.

On the supply side, Bergstrand (1989) assumed a representative firm in the exporting country maximizes profit using linear technology. The linear cost function is assumed to allow for decreasing average costs and incorporates the assumption of increasing returns to scale and monopolistic competition. Each variety competes with all other varieties, and hence the firm is better off by choosing to produce a variety that is not being produced by others, to avoid sharing the demand for its variety. Let $L_{X_f di}$ ($K_{X_f di}$) be firm *d*'s labor (capital) demand in country *i*'s industry f to produce X_f; α_{LdX_f} (α_{KdX_f}) is firm *d*'s fixed labor (capital) requirement, and β_{LdX_f} (β_{KdX_f}) is the marginal product of labour (capital). Then the production relationship is given by the following two equations:

$$L_{X_f di} = \alpha_{LdX_f} + \beta_{LdX_f} \cdot X_{di} \tag{3}$$

$$K_{X_f di} = \alpha_{KdX_f} + \beta_{KdX_f} \cdot X_{di} \tag{4}$$

where X_{di} is the quantity of differentiated product X_f. The linear production technology implies a linear cost function:

$$\begin{aligned} C(X_{fji}, W_i, R_i) &= W_i L_{X_f di} + R_i K_{X_f di} \\ &= W_i \alpha_{LdX_f} + R_i \alpha_{KdX_f} + \beta_{LdX_f} W_i X_{di} + \beta_{KdX_f} R_i X_{di}. \end{aligned} \tag{5}$$

Each firm's output is assumed to be distributed across the domestic market and foreign markets according to a constant elasticity of transformation (CET) function. Bergstrand (1989) calls it a "two-stage process." In the first stage, each firm produces a differentiated product under decreasing cost, and in the second stage distributes it to foreign and home markets under increasing cost. The function allows the data to determine the degree of "transformability," or "substitutability," of output among markets. Suppose that C_{dij} is the transfer cost per unit of output, including resources lost in shipping the output. Then the CET function is

$$X_{fdi} = \left[\sum_{j=1}^{J} \left(C_{fdji} X_{fdji}\right)^{\theta_f}\right]^{\frac{1}{\theta_f}} \tag{6}$$

where $X_{fdi}$is output supplied to country j by the representative firm in country i and $\theta_f$is the elasticity of transformation of production. Assuming that all firms are identical and resources are fully employed, then profit maximization for a representative firm yields the marginal cost function for exports (Equation (7)).

$$X_{fji} = \mu^{\frac{\gamma}{\gamma+\sigma}} \left(D_{X_f i}\right)^{\frac{-\sigma}{(\gamma+\sigma)}} (K_i^*)^{\frac{\sigma}{(\gamma+\sigma)}} \left[\frac{\left(\beta_{LX_h}\right)}{\beta_{KX_f}\beta_{LX_h}-\beta_{LX_f}\beta_{KX_h}} - \frac{\beta_{LX_h}\left(K_i^* / L_i^*\right)^{-1}}{\beta_{KX_f}\beta_{LX_h}-\beta_{LX_f}\beta_{KX_h}} \right]^{\frac{\sigma}{(\gamma+\sigma)}}$$

$$\times \left(Y_j\right)^{\frac{\sigma}{(\gamma+\sigma)}} \left(1-\left(y_j^*\right)^{-1}\right)^{\frac{\sigma}{(\gamma+\sigma)}} \left(C_{fji}\right)^{\frac{-(1+\gamma)\sigma}{(\sigma+\gamma)}} \left(\tau_{X_f ji}\right)^{\frac{-\gamma\sigma}{(\gamma+\sigma)}} \tag{7}$$

$$\times \left(\sum_{j=1}^{J} \left(D_{X_f i}\right)\left(P_{X_f ji} \cdot \tau_{X_f ji}\right)^{1-\sigma}\right)^{\frac{-\gamma}{(\gamma+\sigma)}} \left(\sum_{j=1}^{J} \left(\frac{P_{X_f ji}}{C_{fji}}\right)^{1+\gamma}\right)^{\frac{-\gamma\sigma}{(\gamma+1)(\gamma+\sigma)}} \left(D_{X_f i}\right)^{\frac{-\gamma}{(\gamma+\sigma)}}$$

Where $\gamma = \frac{1}{1-\theta_f}$, $D_{X_f i}\left(D_{X_\mathrm{h} i}\right)$ represents the number of firms producing differentiated products, $L_i^* = L_i - D_{X_f i}\alpha_{LX_f}$, and $K_i^* = K_i - D_{X_f i}\alpha_{KX_f}$ are the net stock of labor and capital. The industry trade flow is determined by the product of $P_{X_f ji}$ and $X_{X_f ji}$ summed over firms, that is, $P_{X_f ji}X_{X_f ji} = PX_{X_f ji} = \sum_{d=1}^{D} P_{X_f ji}X_{X_f ji}$, and is also expressed as

$$PX_{X_f ji} = \mu^{\frac{\gamma+1}{\gamma+\sigma}} \left[\frac{(K_i^*)^{\frac{\sigma-1}{(\gamma+\sigma)}}}{\left(\sum_j^J \left(\frac{P_{X_f ji}}{C_{fji}}\right)^{1+\gamma}\right)^{\frac{\gamma}{(\gamma+1)}}} \right] \left[\left(\left(1-\left(y_j^*\right)^{-1}\right)\right)^{\frac{\gamma+1}{(\gamma+\sigma)}} \right]$$

$$\times \left[\frac{\left(\beta_{LX_h}\right)}{\beta_{KX_f}\beta_{LX_h}-\beta_{LX_f}\beta_{KX_h}} - \frac{\beta_{KX_h}}{\beta_{KX_f}\beta_{LX_h}-\beta_{LX_f}\beta_{KX_h}} \left(K_i^* / L_i^*\right)^{-1} \right]^{\frac{\sigma-1}{(\gamma+\sigma)}} \tag{8}$$

$$\times \left[\frac{\left(Y_j\right)^{\frac{\gamma+1}{(\gamma+\sigma)}}}{\left(\sum_{j=1}^{J}\left(P_{X_f ji} \cdot \tau_{X_f ji}\right)^{1-\sigma}\right)^{\frac{-(1+\gamma)}{(\gamma+\sigma)}}} \right] \left[\left(C_{fji}\right)^{\frac{-(\sigma-1)(1+\gamma)}{(\sigma+\gamma)}} \left(\frac{C_{fji}}{\tau_{X_f ji}}\right)^{\frac{\sigma(1+\gamma)}{(\gamma+\sigma)}} \right]$$

Equation (8) is the industry-specific generalized gravity equation, which is similar to Equation (12) of Bergstrand (1989). The dependent variable in Equation (8) is $PX_{X_{f}ji}$ that is the value of trade of differentiated product X_f exported by country i to j. However, the Linder hypothesis relates trade intensity with similarity of preferences of trading partners, and the value of imports may not represent trade intensity. Bergstrand (1990) showed that the Grubal and Lloyd (GL) index, a measure of trade intensity, can replace the value of trade without affecting the specification of Equation (8). We use both measures of the dependent variable, i.e. the GL index and total value of trade in the empirical analysis. In addition, we have adjusted the GL index for the sectoral trade imbalance in light of the criticism of the unadjusted GL index raised by Aquino (1978).

It is important to understand how the terms in the theoretical model (Equation (8)) are measured in the empirical model. The importer's GDP and per capita GDP explicitly enter Equation (8) as Y_j and y_j^*. The expression $\frac{(K_i^*)^{\frac{\sigma-1}{(\gamma+\sigma)}}}{\left(\sum_j^J\left(\frac{P_{X_{f}ji}}{C_{fji}}\right)^{1+\gamma}\right)^{\frac{\gamma}{(\gamma+1)}}}$ is the exporter's national output expressed in terms of units of capital, i.e. the real capital stock of the exporting country. This variable is proxied by the exporter's real GDP. Similarly, K_i^*/L_i^* in Equation (8) represents the exporter's per capita capital which is proxied by the per capita GDP of the exporting country. All of these variables (GDPs and per capita GDPs) are measured in US dollars. The term $\frac{(\beta_{LX_h})}{\beta_{KX_f}\beta_{LX_h}-\beta_{LX_f}\beta_{KX_h}} - \frac{\beta_{LX_h}}{\beta_{KX_f}\beta_{LX_h}-\beta_{LX_f}\beta_{KX_h}}$ determines whether a commodity is capital or labour intensive and hence determines the sign on the exporting country's per capita income. Bergstrand (1990) argues that since the exporter's per capita income is a proxy for the exporter's per capita capital, the sign of the exporter's per capita income variable determines if the product is produced in a capital- or labor-intensive industry. When $\beta_{KX_f}\beta_{LX_h} - \beta_{LX_f}\beta_{KX_h} > 0$, X_f is considered capital intensive in production, and in this case the sign of the per capita income variable of the exporting county will be positive, and vice versa.

In Equation 8, the term $\left(\sum_{j=1}^{J}\left(P_{X_f ji} \cdot \tau_{X_f ji}\right)^{1-\sigma}\right)^{\frac{-(1+\gamma)}{(\gamma+\sigma)}}$ is the transaction-cost-adjusted price index that is commodity, importing and exporting country and time specific. Since prices are not observable commodity, importing and exporting country, and time specific fixed effects are added to the estimable equation to account for the missing prices.[iii] The fixed effects also account for other potential sources of variation that are difficult to quantify, such as industrial policies, managerial know-how; industry-specific border-related hindrances; difficult to measure product quality characteristics; and technical and non-technical barriers to trade. These factors may systematically vary across observations, and hence it is important to control for this variation.

It is assumed that trade-related transaction cost ($\tau_{X_f ji}$) is determined by distance, trade partners sharing a common border, landlocked countries, island countries, preferential trade agreements, protocols on trade among developing countries, countries sharing a common language, trade partners colonized by the same colonizer, and bilateral trade partners who colonized each other. The variable distance measures the distance between the two largest or capital cities of the trading partners. The variable representing landlocked and island countries equals zero, one or two when none, one or both trading partners are landlocked or an island. The remainder of the transaction cost variables are binary, that is, equal to one when the phenomenon exists and zero otherwise, e.g. the common border variable equals one when two countries share a border and zero when they don't.

Finally, Equation (8) is augmented with the Gini variables of the importing and exporting countries as proxies for income inequality. Their inclusion is warranted because: 1) the more unequal income distribution within a country, potentially the greater the share of expenditure on differentiated products; 2) Linder suggests that within country income distribution helps to determine the pattern of trade; and 3) the relationship of agri-food intra-industry trade and income and income distribution provides an opportunity to look for evidence of the Linder effect without imposing a specific form on demand (Francois and Kaplan 1996). The recent trade literature has highlighted the issue of income inequality and it may be that two countries with the same average income level have different demand structures if the distribution of income varies between the countries. Finally, two binary variables representing the level of development of the trading partners are added to Equation (8). The developed (developing) country variable equals one when both trading partners are developed (developing) countries and zero otherwise. These variables will show if the development status of trading partners is an important determinant of trade.

Estimation Methods

A variety of estimation techniques in combination with different model specifications are used to test for the Linder effect and these are summarized in Table 1.

Table 1: Combinations of the Measure of the Dependent Variable, the Linder Effect Specification and the Estimation Technique

Dependent variable measured as:	Linder effect measured as:	
	GDP difference	Balassa index
GL index	Estimation technique: 1. OLS, linear including zero values of the GL index 2. OLS, log-linear excluding zero values of the GL index 3. Tobit, linear	Estimation technique: 1. OLS, linear including zero values of the GL index 2. OLS, log-linear excluding zero values of the GL index 3. Tobit, linear
Value of trade	Estimation technique: 1. OLS, log-linear, all observations	Estimation technique: 1. OLS, log-linear, all observations

When the GL index is used to measure the Linder effect it falls between zero and one, and hence a variety of econometric techniques, including limited dependent variable estimation, can be employed to estimate the model. However, there is no consensus among economists over the particular choice of a functional form and estimation procedure that accounts for the structure of this dependent variable. Bergstrand (1989) used a logit model but this transformation is undefined for IIT index values of zero and one. Since these values carry important economic information, they cannot be ignored in the analysis.[iv] A probit model is the next obvious choice, but it is not used, as the values of IIT are not concentrated at the limits of zero and one. Balassa and Bauwens (1987) use a Tobit model censoring the GL index at both zero and one. One disadvantage of the Tobit procedure is that it uses the same stochastic process to determine both the probability of the value of the GL index and the distribution of observations of IIT, which may not be the same. Numerous studies have used ordinary least squares (OLS) but with a linear functional form it could predict values falling outside the range of zero and one, while the log-linear functional form requires ignoring zeros in the analysis. Ordinary least squares and Tobit estimation are used in this study. A linear functional form is adopted when using OLS and Tobit estimation with the GL index as the measure of trade intensity. The log-linear functional form is used when the total value of trade is the dependent variable, i.e. the measure of trade intensity.

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 categorized SITC codes into eight differentiated agri-food product groups: cereals; fresh fish; frozen fish; vegetables; fresh fruit; processed fruit; tea and coffee; and alcoholic beverages.[v]

Countries that account for at least one percent of world trade are included in the sample and this resulted in the selection of 52 countries of diverse development levels.[vi] Gross domestic product (GDP), per capita GDP and GDP deflators come from the World Bank's World Development Indicators while 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 (World Bank 2007). The dummy variable representing multilateral trade agreements is developed from the Tuck Trade Agreement database (CIB 2007). The data required for the other gravity variables in the trade model are compiled from Glick and Rose (2002).

Empirical Results

The results of testing for the Linder effect, using different specifications of the model, are presented in Tables 2 to 7 for each of the eight product groups. The parameters, when using Tobit estimation, do not have the interpretation as derivatives of the independent variable with respect to the regressors. With Tobit estimation, the derivative of the expected value of the dependent variable with respect to the regressor is the estimated coefficient times the value of the cumulative density function (CDF) for the normal distribution evaluated at the particular value of the regressor (usually the mean) (Maddala 1983). The marginal effects in the form of elasticities, at means, are calculated for both the Tobit and the OLS estimates to make them comparable.

All of the estimated models are significant using the F-test. Importing and exporting country and year fixed effects were added to the estimated models to control for a variety of industry and country-level determinants that could potentially affect trade but were not included in the models. Anderson and van Wincoop (2003) criticized this approach due to the omission of multilateral resistance (MR) terms, or terms representing the index of prices in Equation (8). Anderson and van Wincoop (2003) suggest that due to omission of these terms, it is not possible to conduct counterfactual experiments. Consequently, if counterfactual experimentation is the objective of the study, then it cannot be used to calculate the appropriate general equilibrium comparative statics. However, the use of country fixed effects provides unbiased bilateral trade estimates (Bergstrand et al. 2007). Although, Anderson and van Wincoop (2003) suggest estimating a structural set of non-linear price equations under the assumption of symmetric bilateral trade costs using a non-linear estimation procedure, which then generates multilateral price terms before and after any counterfactual experiment. While this approach provides unbiased estimates and general equilibrium comparative statics, it does so under the symmetric bilateral trade cost assumption (Bergstrand et al. 2007). Empirically, importing and exporting country specific fixed effects are often used to account for the price terms in a gravity equation and this is the approach we have adopted. Our results show that exporting, importing, and commodity fixed effects are statistically significant for models estimated using both least squares and Tobit procedures.

The Linder Effect

Before discussing the role of the Linder effect in explaining agri-food trade, let's briefly discuss the other variables in the model. The sign of the exporter's per capita income variable determines if the product is produced in a capital or labor intensive industry. When, the sign of the per capita income variable of the exporting county is positive, the industry is considered capital intensive in production, and vice versa. Focusing only on the statistically significant coefficients for the exporting countries per capita GDP, tables 5 and 7 show that fresh fish and cereals have negative signs indicating that these industries are labor intensive. There are no statistically significant positive signs indicating capital intensive industries.

Distance is consistently negative and statistically significant in 43 of 48 possible cases. In most of cases, the least squares coefficient estimates for distance are lower than those obtained with Tobit estimation. Linders and de Groot (2006) also report smaller estimates using least squares. The common border dummy is consistently positive while, the coefficients for preferential trade agreements (PTAs) have the expected sign in 40 out of 48 cases. The four cases where the coefficient for PTAs have an unexpected and significant negative sign is for alcoholic beverages, a product subject to a wide variety of trade restrictions even within PTAs. Common language, common colonizer, and trading partners having ever colonized each other had positive and statistically significant effects in most of the cases but occasionally have unexpected signs. Such unexpected signs are more common in studies using disaggregated trade data. With aggregated data the sign of the trade cost variables, whether policy or gravity oriented, are not allowed to vary across products. As more disaggregated data is used, the more variation there is in the signs, magnitude and significance of these variables. Hallak's (2006) analysis for less aggregated data also resulted in a significant number of unexpected signs on gravity (common border) and policy (PTAs) related variables.

This brings us to the main question that this study raises: whether the Linder effect holds for agri-food products? For the effect to hold, the Linder variable in the regression equations should have a negative sign and be statistically significant. Overall, out of the 48 tests, the Linder effect is negative and statistically significant in only 13 cases. However, all of the products have a significant Linder effect with at least one of the specifications noted in table 1. But, irrespective of the measure used for the Linder effect and estimation procedure, the positive effect of income similarity on trade is overwhelmingly rejected using the GL index as the measure of trade intensity (31 cases out of 32, tables 2-5). Conversely, when the value of trade is the dependent variable and the Linder effect is measured using the Balassa's inequality index it has a positive and significant effect for five out of eight products. Similar results are obtained when the absolute difference in per capita GDPs of the trading partners is used as the proxy for the Linder effect. It is important to note that the product for which the Linder effect was found using the GL index (fresh fruit) disappeared when the total value of trade was used as the dependent variable. Hence, the significance of the Linder effect is sensitive to the type of measure of trade intensity, the proxy used for the measurement of the Linder effect, the specification of the model, and the estimation procedure.

Conclusions

We tested for the Linder effect in differentiated agri-food product trade after accounting for many of the factors Linder (1961) identified in his *Essay on Trade and Transformation*. We employed Bergstrand's generalized gravity model derived using the assumptions of product differentiation, increasing returns to scale, and monopolistic competition. Per capita income differences of trading partners and the Balassa inequality index were used to proxy for the Linder effect, while trade intensity was measured as either the adjusted GL index or the total value of trade. Estimation was carried out using ordinary least squares and Tobit procedures.

The Linder effect is usually examined using aggregate data for industrial products. However, there is no reason it should not apply to differentiated agri-food products trade. However, the empirical results did not provide strong support for the Linder effect. While the outcome of the tests for the Linder effect were influenced by measure of trade intensity employed, the Linder effect for cereals, frozen fish, vegetables, processed fruits, and tea and coffee, using the value of trade as the dependent variable, were statistically significant. The role of the Linder effect in explaining agri-food trade was statistically insignificant when the GL index is used as a measure of the trade intensity. In brief, the results do not provide strong support for the Linder effect in the trade of differentiated agri-food products.

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Table 2: Estimation Results for the Linder Effect Using Absolute Difference in per Capita Incomes of Trading Partners and GL Index Using OLS[A]

Variable	Fish Fresh	Fish Frozen	Cereals	Vegetables	Fresh Fruit	Processed Fruit	Tea, Coffee and Mate	Alcohol
Distance	-0.036*	-0.005	-0.057**	-0.045*	-0.036*	-0.047*	-0.091***	-0.065**
	(0.019)	(0.023)	(0.020)	(0.023)	(0.019)	(0.025)	(0.024)	(0.024)
Gini - Importing Country	0.005	0.040	0.029	0.071	0.005	-0.133	0.098	0.142*
	(0.083)	(0.098)	(0.092)	(0.093)	(0.083)	(0.092)	(0.089)	(0.082)
Gini - Exporting Country	-0.087	0.104	0.111	0.010	-0.087	0.045	-0.007	-0.045
	(0.087)	(0.098)	(0.090)	(0.093)	(0.087)	(0.090)	(0.091)	(0.082)
Common Border	0.012**	0.017***	0.006	0.003	0.012**	0.014***	0.005	0.015***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
GDP Importing Country	0.078	0.037	-0.022	-0.002	0.078	0.057	0.056	-0.061
	(0.049)	(0.056)	(0.050)	(0.050)	(0.049)	(0.051)	(0.056)	(0.049)
GDP Exporting Country	-0.001	0.015	-0.033	-0.010	-0.001	-0.063	0.014	-0.022
	(0.049)	(0.059)	(0.053)	(0.050)	(0.049)	(0.048)	(0.050)	(0.047)
Linder Effect	-0.036	-0.025	0.006	0.011	-0.036	0.022	-0.036	-0.017
	(0.031)	(0.032)	(0.034)	(0.040)	(0.031)	(0.039)	(0.037)	(0.034)
Land Locked	0.052**	-0.027**	-0.123**	0.057	0.052**	-0.014	-0.137**	-0.328***
	(0.022)	(0.013)	(0.058)	(0.053)	(0.022)	(0.054)	(0.050)	(0.079)
Island	0.130**	0.086*	-0.099	0.012	0.130**	0.059	0.004	-0.200***
	(0.059)	(0.045)	(0.064)	(0.049)	(0.059)	(0.063)	(0.057)	(0.061)
Common Colonizer	0.000***	0.000**	0.000	0.001	0.000***	0.002	-0.004**	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)
Colony	0.000	-0.003	0.006*	0.007*	0.000	-0.006*	0.001	0.011**
	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
PTA	0.002	0.006**	-0.002	0.004*	0.002	0.008**	0.001	-0.008**
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)	(0.003)	(0.004)	(0.003)
Common Language	-0.010	-0.004	0.016**	0.005	-0.010	0.005	-0.007	-0.004
	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)	(0.007)	(0.007)	(0.007)
Protocol on trade among	0.001	-0.001	-0.001	-0.003*	0.001	0.003**	0.002	-0.002
devel. countries	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Trading Partners:	0.070	-0.290**	-0.122	0.274	0.070	-0.087	-0.013	-0.086
Developed Countries	(0.259)	(0.123)	(0.149)	(0.226)	(0.259)	(0.180)	(0.189)	(0.208)
Trading Partners:	-0.024	0.040*	0.049	-0.094	-0.024	0.045	0.003	0.031
Developing Countries	(0.052)	(0.021)	(0.034)	(0.081)	(0.052)	(0.070)	(0.070)	(0.057)
Fixed Effects (F-Test)								
Commodity	762.1***	370.2***	110.2***	2.7***	1,399.8***	215.6***	836.5***	118.1***
Importing Country	4.1***	4.8***	2.7***	2.7***	3.7***	5.4***	26.6***	9.8***
Exporting Country	3.5***	11.9***	4.6***	505.8***	4.9***	5.7***	6.7***	5.2***
Year	0.4	1.0	2.9***	0.4	0.4	0.3	1.0	0.8
Summary Statistics								
#Observations	5,167	5,576	3,477	17,600	6,937	17,175	9,702	8,493
F-Statistics	12.0***	8.6***	3.0***	16.6***	48.3***	10.2***	29.0***	9.0***
R-squared	0.23	0.16	0.10	0.11	0.47	0.07	0.27	0.12

[A] Standard errors are robust.

*, ** and *** denote variables significant at 10, 5 and 1% respectively.

Table 3: Estimation Results for the Linder Effect Using Absolute Difference in Per Capita Incomes of Trading Partners and GL Index Using Tobit[A]

Variable	Fish Fresh	Fish Frozen	Cereals	Vegetables	Fresh Fruit	Processed Fruit	Tea, Coffee and Mate	Alcohol
Distance	-0.105***	-0.094**	-0.079***	-1.083***	-0.108	-1.271**	-0.516***	-0.220***
	(0.029)	(0.037)	(0.025)	(0.175)	(0.078)	(0.509)	(0.101)	(0.029)
Gini - Importing	0.011	0.003	0.021	0.408	0.069	-0.934**	0.501	0.253***
Country	(0.120)	(0.157)	(0.114)	(0.602)	(0.323)	(0.401)	(0.344)	(0.012)
Gini - Exporting	-0.122	0.162	0.121	0.402	0.060	0.494***	0.011	-0.032**
Country	(0.127)	(0.158)	(0.111)	(0.586)	(0.336)	(0.137)	(0.357)	(0.016)
Common Border	0.023***	0.030***	0.011**	0.146***	0.124***	0.153**	0.072***	0.031***
	(0.005)	(0.006)	(0.005)	(0.025)	(0.022)	(0.055)	(0.014)	(0.002)
GDP Importing	0.098	0.036	-0.024	-0.036	0.217	0.363**	0.247	-0.081***
Country	(0.069)	(0.084)	(0.058)	(0.280)	(0.183)	(0.128)	(0.192)	(0.010)
GDP Exporting	0.022	0.026	-0.041	-0.132	0.258	-0.302**	-0.020	-0.026***
Country	(0.068)	(0.090)	(0.062)	(0.289)	(0.224)	(0.124)	(0.178)	(0.006)
Linder Effect	-0.065	-0.039	0.006	0.342	-0.395**	0.143***	-0.107	-0.014
	(0.045)	(0.051)	(0.042)	(0.244)	(0.126)	(0.024)	(0.138)	(0.010)
Land Locked	-0.013	-0.055**	-0.211**	-0.771**	-0.137	0.001	0.253	-2.423***
	(0.020)	(0.019)	(0.076)	(0.357)	(0.103)	(0.008)	(0.280)	(0.235)
Island	-0.031	0.048	-0.080**	-0.974*	0.056	5.277**	1.273	-1.347***
	(0.058)	(0.065)	(0.033)	(0.533)	(0.096)	(1.982)	(0.360)	(0.131)
Common Colonizer	0.000***	0.000***	0.000	0.011	0.014*	0.020**	-0.017**	0.000***
	(0.000)	(0.000)	(0.001)	(0.008)	(0.008)	(0.007)	(0.006)	(0.000)
Colony	0.002	0.000	0.007*	0.092***	0.019	0.000	-0.002	0.020***
	(0.005)	(0.007)	(0.004)	(0.023)	(0.014)	(0.004)	(0.014)	(0.001)
PTA	0.005	0.010**	-0.002	0.030**	0.033**	0.029**	0.026**	-0.014***
	(0.004)	(0.004)	(0.003)	(0.012)	(0.014)	(0.010)	(0.013)	(0.002)
Common Language	-0.009	-0.007	0.020**	0.089*	-0.021	0.158**	0.016	0.001
	(0.011)	(0.013)	(0.009)	(0.048)	(0.030)	(0.052)	(0.025)	(0.002)
Protocol on trade	0.001	-0.002	-0.002	-0.020	0.002	0.026**	0.006	-0.004***
among devel. countries	(0.002)	(0.003)	(0.002)	(0.013)	(0.008)	(0.009)	(0.008)	(0.001)
Trading Partners:	-0.637***	-0.545**	-0.263	-0.365	-0.325	1.167**	4.140***	-3.632***
Developed Countries	(0.095)	(0.178)	(0.173)	(0.759)	(0.507)	(0.429)	(1.118)	(0.354)
Trading Partners:	0.111***	0.076**	0.092**	0.298	0.087	-0.363**	-1.528***	1.015***
Developing Countries	(0.022)	(0.031)	(0.042)	(0.285)	(0.154)	(0.143)	(0.421)	(0.097)
Fixed Effects (F-Test)								
Commodity	700.3***	393.5***	111.1***	464.0***	1,558.0***	3,226.1***	865.4***	8,054.0***
Importing Country	3.7***	6.1***	3.3***	5.8***	6.5***	39,526.8***	5.5***	300,000.0***
Exporting Country	3.7***	10.5***	3.1***	4.0***	3.8***	120,000.0***	3.6***	280,000.0***
Year	0.5	1.4	2.6***	0.6	0.6	366.3***	2.1***	442.6***
Summary Statistics								
#Observations	5,167	5,576	3,477	17,600	6,937	17,175	9,702	8,493
F-Statistics	1,505.9***	1,069.0***	404.1***	450.0***	4,219.8***	44,900.0***	3,408.9***	1,335.4***
R-squared	0.03	0.02	0.01	0.02	0.09	0.02	0.05	0.02

[A] Standard errors are robust.

*, ** and *** denote variables significant at 10, 5 and 1% respectively.

Table 4: Estimation Results For the Linder Effect Using Balassa Inequality Index and GL Index Using OLS[A]

Variable	Fish Fresh	Fish Frozen	Cereals	Vegetables	Fresh Fruit	Processed Fruit	Tea, Coffee and Mate	Alcohol
Distance	-0.034*	-0.003	-0.057**	-0.045*	0.023	-0.048**	-0.089***	-0.064**
	(0.019)	(0.023)	(0.020)	(0.023)	(0.022)	(0.025)	(0.024)	(0.024)
Gini - Importing Country	0.015	0.046	0.030	0.074	0.019	-0.134	0.094	0.139*
	(0.083)	(0.098)	(0.092)	(0.093)	(0.090)	(0.092)	(0.089)	(0.082)
Gini - Exporting Country	-0.087	0.112	0.108	0.015	-0.027	0.048	-0.014	-0.046
	(0.087)	(0.099)	(0.090)	(0.093)	(0.094)	(0.090)	(0.091)	(0.082)
Common Border	0.012**	0.017***	0.006	0.003	0.014**	0.014***	0.005	0.015***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.004)	(0.004)	(0.004)
GDP Importing Country	-0.021	-0.031	-0.047	-0.021	0.015	0.007	0.098	-0.041
	(0.061)	(0.071)	(0.062)	(0.061)	(0.067)	(0.063)	(0.065)	(0.060)
GDP Exporting Country	-0.007	-0.015	-0.005	-0.031	0.008	-0.020	0.026	-0.026
	(0.061)	(0.074)	(0.065)	(0.062)	(0.075)	(0.060)	(0.061)	(0.058)
Log PC GDP Importing	0.304**	0.202	0.093	0.064	0.058	0.185	-0.158	-0.077
Country	(0.132)	(0.148)	(0.123)	(0.125)	(0.142)	(0.129)	(0.121)	(0.120)
Log PC GDP Exporting	-0.023	0.063	-0.098	0.071	-0.039	-0.150	-0.053	0.004
Country	(0.136)	(0.142)	(0.132)	(0.129)	(0.155)	(0.135)	(0.128)	(0.119)
Linder Effect	-0.032	0.013	0.024	0.032	-0.033	0.025	-0.048	-0.011
	(0.031)	(0.033)	(0.035)	(0.039)	(0.030)	(0.039)	(0.035)	(0.039)
Land Locked	0.012	-0.044**	-0.006	0.055	-0.038	-0.029	0.052	-0.159**
	(0.011)	(0.015)	(0.066)	(0.053)	(0.035)	(0.041)	(0.084)	(0.057)
Island	0.167***	0.037	0.044	0.010	-0.032	0.054	-0.047	-0.033
	(0.036)	(0.049)	(0.121)	(0.049)	(0.022)	(0.064)	(0.068)	(0.057)
Common Colonizer	0.000***	0.000**	0.000	0.001	0.004*	0.002	-0.004**	0.000
	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
Colony	0.001	-0.002	0.006*	0.007*	0.003	-0.006*	0.001	0.011***
	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
PTA	0.002	0.006**	-0.002	0.004*	0.005	0.008**	0.002	-0.008**
	(0.003)	(0.003)	(0.003)	(0.002)	(0.005)	(0.003)	(0.004)	(0.003)
Common Language	-0.010	-0.003	0.016**	0.005	0.001	0.005	-0.006	-0.004
	(0.008)	(0.008)	(0.008)	(0.007)	(0.009)	(0.007)	(0.007)	(0.007)
Protocol on trade among	0.001	-0.001	-0.001	-0.003*	0.000	0.003**	0.002	-0.002
devel. countries	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Trading Partners:	-0.202*	-0.364**	0.221	-0.157	-0.094	-0.079	0.487*	0.399***
Developed Countries	(0.122)	(0.146)	(0.226)	(0.171)	(0.165)	(0.120)	(0.271)	(0.119)
Trading Partners:	0.029	0.063**	-0.026	0.071	0.049	0.045	-0.193*	-0.102***
Developing Countries	(0.024)	(-0.024)	(0.053)	(0.061)	(0.050)	(0.047)	(0.102)	(0.030)
Fixed Effects (F-Test)								
Commodity	2.96***	4.37***	4.7***	2.47***	4.14***	2.98***	6.12***	4.6***
Importing Country	4.32***	11.21***	2.56***	2.65***	3.65***	5.24***	23.89***	9.37***
Exporting Country	0.41*	1.19***	2.89***	0.4	0.4	0.3	1.0	0.8
Year	764.0***	370.44***	110.06***	506.1***	1397.28***	215.1***	834.64***	302.25***
Summary Statistics								
#Observations	5167	5576	3477	17600	6937	17175	9702	8493
F-Statistics	11.8***	8.6***	3***	16.34***	47.52***	10.09***	28.57***	8.87***
R-squared	0.23	0.16	0.1	0.11	0.47	0.07	0.28	0.12

[A] Standard errors are robust.

*, ** and *** denote variables significant at 10, 5 and 1% respectively.

Table 5: Estimation Results for the Linder Effect Using Balassa Inequality Index and GL Index Using Tobit[A]

Variable	Fish Fresh	Fish Frozen	Cereals	Vegetables	Fresh Fruit	Processed Fruit	Tea, Coffee and Mate	Alcohol
Distance	-0.101***	-0.091**	-0.079***	-1.094***	-0.090	-1.28***	-0.508***	-0.220***
	(0.016)	(0.037)	(0.024)	(0.175)	(0.077)	(0.192)	(0.101)	(0.032)
Gini - Importing Country	0.023**	0.012	0.023	0.430	0.053	-0.942*	0.488	0.250***
	(0.009)	(0.157)	(0.114)	(0.602)	(0.324)	(0.570)	(0.344)	(0.015)
Gini - Exporting Country	-0.121***	0.174	0.119	0.440	0.063	0.517	-0.009	-0.033**
	(0.023)	(0.159)	(0.111)	(0.587)	(0.336)	(0.557)	(0.357)	(0.017)
Common Border	0.024***	0.030***	0.011**	0.146***	0.123***	0.153***	0.071***	0.031***
	(0.002)	(0.006)	(0.005)	(0.025)	(0.022)	(0.024)	(0.014)	(0.003)
GDP Importing Country	-0.032***	-0.063	-0.052	-0.073	0.068	0.101	0.303	-0.066***
	(0.006)	(0.109)	(0.073)	(0.353)	(0.228)	(0.344)	(0.225)	(0.011)
GDP Exporting Country	0.007***	-0.017	-0.009	-0.213	0.193	-0.003	-0.020	-0.028***
	(0.002)	(0.114)	(0.077)	(0.366)	(0.279)	(0.334)	(0.216)	(0.006)
Log PC GDP Importing	0.382***	0.290	0.100	0.352	0.201	1.045	-0.243	-0.058***
Country	(0.029)	(0.233)	(0.148)	(0.780)	(0.488)	(0.780)	(0.439)	(0.015)
Log PC GDP Exporting	-0.022**	0.092	-0.116	0.469	-0.214	-1.032	-0.048	0.001
Country	(0.010)	(0.224)	(0.160)	(0.783)	(0.509)	(0.783)	(0.441)	(0.009)
Linder Effect	-0.046***	0.017	0.038	0.334	-0.171	0.127	-0.194	-0.018***
	(0.009)	(0.057)	(0.044)	(0.261)	(0.110)	(0.257)	(0.146)	(0.009)
Land Locked	0.159***	-0.053**	-0.215**	0.384	-0.140	-0.248	0.268	-1.269***
	(0.015)	(0.023)	(0.077)	(0.343)	(0.115)	(0.270)	(0.281)	(0.143)
Island	1.018***	0.049	-0.225**	0.585	0.044	0.463	-0.105	-0.024***
	(0.097)	(0.075)	(0.107)	(0.409)	(0.102)	(0.490)	(0.237)	(0.005)
Common Colonizer	0.000***	0.000**	0.000	0.012	0.014***	0.020**	-0.018**	0.000**
	(0.000)	(0.000)	(0.001)	(0.008)	(0.008)	(0.009)	(0.006)	(0.000)
Colony	0.002**	0.002	0.007*	0.091***	0.022	-0.001	-0.003	0.020***
	(0.001)	(0.007)	(0.004)	(0.023)	(0.014)	(0.021)	(0.014)	(0.002)
PTA	0.005***	0.010**	-0.002	0.028**	0.037***	0.028*	0.028**	-0.014***
	(0.001)	(0.004)	(0.003)	(0.012)	(0.014)	(0.017)	(0.013)	(0.002)
Common Language	-0.009**	-0.006	0.020**	0.085*	-0.012	0.156***	0.018	0.001
	(0.003)	(0.013)	(0.009)	(0.048)	(0.030)	(0.047)	(0.025)	(0.002)
Protocol on trade among	0.001***	-0.003	-0.002	-0.019	0.002	0.026**	0.007	-0.004***
devel. countries	(0.000)	(0.003)	(0.002)	(0.013)	(0.008)	(0.012)	(0.008)	(0.001)
Trading Partners:	1.176***	-0.400*	0.454	-0.498	-0.177	0.540	-1.140*	3.735***
Developed Countries	(0.108)	(0.227)	(0.373)	(1.032)	(0.549)	(0.802)	(0.595)	(0.413)
Trading Partners:	-0.258***	0.066*	-0.068	0.362	0.097	-0.111	0.420*	-1.013***
Developing Countries	(0.026)	(0.037)	(0.088)	(0.364)	(0.165)	(0.315)	(0.220)	(0.114)
Fixed Effects (F-Test)								
Commodity	62583.4***	4.36***	3.34***	5.23***	5.86***	5.39***	5.39***	170000***
Importing Country	45339.3***	4.27***	2.34***	3.97***	3.63***	3.9***	3.14***	140000***
Exporting Country	152.6***	1.5	3.1***	0.6	0.6	1.1	2.04**	424.22***
Year	30816.4***	393.82***	111.0***	463.88***	1556.57***	221.81***	863.6***	7774.18***
Summary Statistics								
#Observations	5167	5576	3477	17600	6937	17175	9702	8493
F-Statistics	406.02***	1069***	404.1***	28.17***	153.44***	1335.5***	41.06***	
R-squared	0.03	0.022	0.01	0.02	0.09	0.02	0.05	0.02

[A] Standard errors are robust.

*, ** and *** denote variables significant at 10, 5 and 1% respectively.

Table 6: Estimation Results for the Linder Effect Using Absolute Difference in Per Capita Incomes of Trading Partners and Total Value of Trade Using OLS[B]

Variable	Fish Fresh	Fish Frozen	Cereals	Vegetables	Fresh Fruit	Processed Fruit	Tea, Coffee and Mate	Alcohol
Distance	-1.422***	-1.031***	-1.148***	-1.121***	-0.654***	-0.825***	-0.602***	-0.628***
	(0.053)	(0.047)	(0.052)	(0.029)	(0.051	(0.026)	(0.039)	(0.034)
Gini - Importing	0.133	-0.108	-0.143	-0.042	-0.102	0.044	-0.071	-0.133
Country	(0.223)	(0.216)	(0.254)	(0.124)	(0.210)	(0.118)	(0.181)	(0.157)
Gini - Exporting	-0.063	0.291	-0.169	-0.021	0.026	-0.025	-0.104	0.021
Country	(0.243)	(0.218)	(0.230)	(0.126)	(0.214)	(0.121)	(0.181)	(0.158)
Common Border	0.443***	0.692***	0.868***	0.633***	1.052***	0.849***	0.872***	0.583***
	(0.107)	(0.094)	(0.101)	(0.064)	(0.099)	(0.063)	(0.089)	(0.086)
GDP Importing	2.056	-4.378***	1.545	0.154	1.424	0.922	0.174	0.669
Country	(1.380)	(1.298)	(1.455)	(0.635)	(1.196)	(0.627)	(0.948)	(0.937)
GDP Exporting	-1.502	-0.54	-1.873	0.955	-1.421	0.495	-0.445	1.86**
Country	(1.378)	(1.291)	(1.376)	(0.600)	(1.255)	(0.62)	(0.990)	(0.940)
Linder Effect	0.009	-0.053***	-0.075**	0.018	0	-0.046**	-0.069**	0.03
	(0.031)	(0.029)	(0.033)	(0.020)	(0.033)	(0.019)	(0.027)	(0.025)
Land Locked	7.379	-23.202***	1.254	-1.479	-9.236	2.284	5.048	10.288**
	(4.815)	(6.399)	(4.654)	(3.899)	(6.122)	(3.349)	(3.284)	(5.045)
Island	2.436	-19.282***	4.255	-0.457	-3.971	1.551	5.654	6.104
	(1.643)	(5.536)	(2.812)	(1.923)	(5.937)	(1.491)	(4.697)	(4.099)
Common	-2.201***	10.586***	0.746	1.757***	1.603***	1.737***	0.437	0.885**
Colonizer	(0.662)	(0.707)	(0.516)	(0.254)	(0.484)	(0.271)	(0.325)	(0.427)
Colony	1.124***	0.92***	0.584***	0.741***	0.704***	0.249***	0.684***	0.576***
	(0.119)	(0.119)	(0.123)	(0.070)	(0.129)	(0.065)	(0.108)	(0.097)
PTA	0.79***	0.751***	0.664***	0.778***	0.799***	0.604***	0.661***	0.329***
	(0.116)	(0.101)	(0.105)	(0.070)	(0.098)	(0.061)	(0.092)	(0.089)
Common	-0.41***	0.364***	0.509***	-0.156**	-0.204**	0.314***	-0.182**	0.283***
Language	(0.103)	(0.092)	(0.091)	(0.051)	(0.095)	(0.047)	(0.077)	(0.070)
Protocol on trade	-0.49	-0.074	-0.457	-0.779***	0.429*	0.543***	0.294	0.08
among devel.	(0.438)	(0.29)	(0.404)	(0.145)	(0.244)	(0.132)	(0.212)	(0.197)
Trading Partners:	2.407	21.356***	2.456	-1.675	-9.43	-0.484***	1.514	1.554***
Developed	(1.764)	(6.463)	(2.546)	(2.336)	(7.222)	(0.112)	(3.694)	(0.158)
Trading Partners:	-3.758**	-22.987***	-2.406	1.436	9.404	A	-1.826	A
Developing	(1.781)	(6.446)	(2.545)	(2.334)	(7.235)		(3.684)	
Fixed Effects (F-Test)								
Commodity	21.9***	19***	10.4***	35.8***	21.2***	33.6***	16.9***	25.6***
Importing Country	22.8***	21.1***	7.4***	31.9***	24.5***	30.6***	22.6***	31.7***
Exporting Country	0.9	1.7*	2.8**	1.8**	0.6	1.2	2.0**	1.2
Year	66.1***	28.8***	90.8***	69.3***	64.7***	13.3***	38.4	427.3***
Summary Statistics								
#Observations	5167	5576	3477	17600	6937	17175	9702	8493
F-Statistics	43.4***	32.2***	34.8***	105***	45.0***	112.8***	44.3***	92.8***
R-squared	0.52	0.42	0.56	0.44	0.46	0.46	0.38	0.58

[A] Variable dropped due to co-linearity

[B] Standard errors are robust.

*, ** and *** denote variables significant at 10, 5 and 1% respectively.

Table 7: Estimation Results for the Linder Effect Using Balassa Inequality Index and Total Value of Trade Using OLS[A]

Variable	Fish Fresh	Fish Frozen	Cereals	Vegetables	Fresh Fruit	Processed Fruit	Tea, Coffee and Mate	Alcohol
Distance	-1.359***	-0.999***	-1.050***	-0.953***	-0.787***	-0.715***	-0.563***	-0.569***
	(0.057)	(0.049)	(0.053)	(0.031)	(0.063)	(0.030)	(0.045)	(0.034)
Gini - Importing	0.299	-0.169	0.063	0.033	-0.342	0.102	0.181	-0.257
Country	(0.229)	(0.220)	(0.258)	(0.142)	(0.236)	(0.138)	(0.198)	(0.162)
Gini - Exporting	-0.175	0.449**	-0.188	-0.036	-0.007	-0.102	-0.304	-0.008
Country	(0.241)	(0.218)	(0.234)	(0.140)	(0.246)	(0.139)	(0.206)	(0.169)
Common Border	0.381***	0.547***	0.914***	0.654***	0.891***	0.942***	0.983***	0.502***
	(0.109)	(0.098)	(0.099)	(0.065)	(0.112)	(0.064)	(0.091)	(0.086)
GDP Importing	-0.388	-3.384**	1.067	0.424	0.700	-0.541	-0.144	-0.137
Country	(1.409)	(1.326)	(1.549)	(0.759)	(1.500)	(0.739)	(1.137)	(1.013)
GDP Exporting	0.314	-1.631	-2.095	1.137	-0.008	-0.073	-1.672	1.228
Country	(1.434)	(1.376)	(1.487)	(0.705)	(1.547)	(0.733)	(1.133)	(1.003)
Log PC GDP	0.629	4.325**	-0.787	0.198	-0.083	0.953	0.288	0.554
Importing Country	(1.475)	(1.407)	(1.615)	(0.798)	(1.569)	(0.781)	(1.189)	(1.061)
Log PC GDP	-0.266	2.241	3.166**	-0.610	0.415	0.415	1.841	-0.767
Exporting Country	(1.507)	(1.434)	(1.548)	(0.740)	(1.631)	(0.778)	(1.189)	(1.052)
Linder Effect	-0.010	-0.024	-0.048**	-0.020*	0.044**	-0.042***	-0.027*	0.011
	(0.017)	(0.015)	(0.017)	(0.011)	(0.019)	(0.011)	(0.015)	(0.013)
Land Locked	-2.029	-3.727	-1.666	1.469	0.209	1.902	7.746**	2.375**
	(4.112)	(3.634)	(4.071)	(2.511)	(4.289)	(1.584)	(3.728)	(0.920)
Island	-1.516	-0.913	-3.661	2.533	1.128	2.598*	6.655	1.517
	(5.993)	(4.030)	(2.237)	(3.648)	(2.513)	(1.488)	(5.568)	(1.581)
Common Colonizer	-2.865***	10.486***	0.516	1.644***	2.140***	1.854***	-0.329	0.297
	(0.855)	(0.755)	(0.618)	(0.357)	(0.557)	(0.397)	(0.456)	(0.349)
Colony	0.986***	0.910***	0.444***	0.812***	0.657***	0.293***	0.612***	0.643***
	(0.123)	(0.129)	(0.132)	(0.077)	(0.148)	(0.074)	(0.115)	(0.101)
PTA	0.832***	0.605***	0.724***	0.703***	0.905***	0.550***	0.486***	0.343***
	(0.112)	(0.100)	(0.106)	(0.070)	(0.110)	(0.062)	(0.089)	(0.084)
Common Language	-0.415***	0.320***	0.561***	-0.251***	-0.363**	0.159**	-0.344***	0.051
	(0.107)	(0.099)	(0.094)	(0.059)	(0.116)	(0.055)	(0.085)	(0.073)
Protocol on trade	-1.120**	0.153	-0.274	-0.971***	-0.253	0.646***	-0.261	-0.004
among devel.	(0.428)	(0.334)	(0.415)	(0.192)	(0.305)	(0.170)	(0.257)	(0.220)
Trading Partners:	1.313	-6.916*	-3.696*	0.138	0.501	0.347	6.945	3.795
Developed Countries	(3.922)	(3.555)	(1.915)	(3.387)	(2.088)	(1.580)	(5.372)	(2.326)
Trading Partners:	-3.265	4.887	3.666*	-0.557	-0.256	-1.009	-6.997	-2.002
Developing Countries	(3.950)	(3.574)	(1.939)	(3.382)	(2.098)	(1.575)	(5.372)	(2.319)
Fixed Effects (F-Test)								
Importing Country	22.3***	25.6***	14.4***	21.4***	15.4***	31.8***	12.3***	25.9***
Exporting Country	34.2***	25.5***	7.2***	23.7***	17.8***	25.1***	20.2***	26.1***
Year	1.4	1.3	2.3***	1.1	1.0	1.7*	1.9**	1.2
Commodity	96.3***	81.9***	15.9***	63.1***	92.0***	14.4***	60.5***	69.6***
Summary Statistics								
#Observations	3,999	4,155	2,944	10,210	3,994	9,963	5,676	6,272
F-Statistics	32.8***	23.9***	29.7***	70.4***	28.5***	76.5***	28.2***	78.0***
R-squared	0.51	0.42	0.56	0.48	0.49	0.50	0.40	0.61

[A] Standard errors are robust.
*, ** and *** denote variables significant at 10, 5 and 1% respectively.

[i] Linder (1961) defined trade intensity in terms of the value of trade.

[ii] The Balassa inequality index (IE) is measured as

$IE = 1 + [wln(w) + (1 - w)ln(1 - w)]/ln2$, where $w = \frac{I_i}{(I_j + I_i)}$, i and j are the trading partners and I represents their per capita income, and ln is the natural logarithm. Balassa and Bauwens (1987) argue that the measure is not affected by a change in the units of measurement and as is the absolute difference between per capita incomes.

[iii] The subscript representing time (t) is suppressed at the beginning of the consumer-maximization problem and is not present in the price terms.

[iv] A GL index value of zero indicates complete intra-industry trade while one indicates complete inter-industry trade.

[v] Fish fresh includes products having SITC codes 0341 and 0350; frozen fish 0342, 0343, 0360, 0371 and 0372; cereals 0481, 0483, 0484 and 0488; 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; tea and coffee 0711, 0712, 0730, 0741 and 0742; and alcoholic beverages 1121, 1123 and 1124.

[vi] 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).