Cultural Barriers and Agricultural Trade in the Western Hemisphere

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Abstract

This study analyzes the impacts of cultural distance on bilateral trade flows in the Western Hemisphere using a Fixed Effects Vector Decomposition (FEVD). Four cultural dimensions of Hofstede are used to capture cultural distance. The results found that the effects of each dimension vary considerably with three of four dimensions (UAI, PDI, and MFI) have a negative impact and one dimension (ICI) has a positive effect. The magnitude of ICI is large enough to offset the negative effects of the other three dimensions resulting in a net positive effect of cultural distance, suggesting that culturally-dissimilar countries trade more than less.

Key Words: agricultural trade, cultural distance, gravity model

Introduction

Gravity models have been widely used to describe bilateral trade patterns, where countries are expected to trade much less with distant partners. Empirical studies have shown that geographic distance, a variable typically used to proxy transport costs, has significant impacts on trade flows (*e.g.* Bergstrand, 1985, 1989; McCallum, 1995; Cheng and Wall, 2005). Disdier and Head (2008) conducted a comprehensive and quantitative analysis of the magnitude of the distance effects on trade flows and found that the estimated negative impacts of distance on trade are still large and has not shown a clear tendency to decline over time. However, it is argued that there are additional costs involved in trading besides transport costs. Deardorff (2004) states that transport costs alone do not fully explain the trade patterns between countries and that the current amount of global trade is far below the level that would prevail if transport costs were the only costs of trading (Deardorff, 2004).

Other dimensions being considered could include cultural differences. Previous research have attempted to take into account such cultural aspects by including dummy variables indicating whether the trading partners share a common language, religion, and colonial pasts. However, it is argued that these dummy variables only measure cultural familiarity that only requires acquaintance between cultures and, therefore, do not indicate cultural similarity that captures the extent of differences in norms and values (Möhlmann *et al*, 2009; Linders *et al*, 2005). Including variables that capture cultural similarity in the model may help better understand bilateral trade flows beyond traditional measures as modeled in the standard gravity model.

In this study, bilateral trade flows in the Western Hemisphere are analyzed using an extended gravity model where variables capturing cultural similarity are included. We adopt cultural dimensions developed by Hofstede (1980, 2001) to measure cultural differences. Previous work normally used a cultural index developed by Kogut and Singh (1988)[1]. Our measures of cultural distance differ from previous studies in that instead of using directly a measure developed by Kogut and Singh (1988), we include each of the four dimensions of culture in the model. This specification is also motivated by Reimann et al (2008) that state that each dimension has different values and impacts where uncertainty avoidance is argued to be the most cultural value dimension in the service sector. A more detailed concept of Hofstede's cultural framework is discussed in the following section.

Cultural Dimensions and International Trade

Hofstede (2001) analyzed survey data obtained from IBM employees in marketing and service positions in more than 50 countries. He identified four dimensions of national culture: Uncertainty Avoidance Index (UAI), Power Distance Index (PDI), Individualism and Collectivism Index (ICI), and Masculity and Feminity Index (MFI). Each index has a score that varies from zero to 100.

[1] Kogut and Singh (1988) developed an index representing cultural distance between two countries. The index is based on four cultural dimensions developed by Hofstede (2001) and is constructed by taking a weighted average of the squared difference in each dimension.

Hofstede describes that UAI focuses on the level of tolerance for uncertainty and ambiguity and PDI stresses the degree of equality or inequality between people within a society. A high level of UAI indicates the country has a low tolerance for uncertainty and ambiguity and a high level of PDI shows that inequalities of power and wealth have been allowed to grow within the society. ICI focuses on the degree the society reinforces individual or collective achievement and interpersonal relationships. A High Individualism ranking indicates that individuality and individual rights are paramount within the society. The United States and Germany are examples of countries that can be seen as individualistic with ICI scores of 91 and 89, respectively. MFI focuses on the degree the society reinforces, or does not reinforce, the traditional masculine work role model of male achievement, control, and power. A high masculinity ranking indicates the country experiences a high degree of gender differentiation where males dominate a significant portion of the society and power structure, with females being controlled by male domination. A Low Masculinity ranking indicates the country has a low level of differentiation and discrimination between genders. In these cultures, females are treated equally to males in all aspects of the society

Kogut and Singh (1988) developed an index using the four dimensions of Hofstede’s framework to measure cultural distance between countries. This index has been used in international business research and it has recently has been used in international trade to analyze the impacts of cultural barriers on trade flows. Similar to previous studies, this study adopts Hofstede’s framework. Unlike previous work that used Kogut and Singh index, this study includes the four dimensions directly in the model to measure specific elements of culture that may affect trade flows differently from each other. This specification is motivated by Reimann et al (2008) that state that each dimension has different values and impacts where uncertainty avoidance is argued to be the most cultural value dimension in the service sector. The importance of analyzing individual dimensions of culture is also demonstrated by Huang that empirically tested the association between familiarity and distance and found that high uncertainty aversion countries (represented by UAI) trade disproportionately less with distant partners than gravity models predict.

In this study, UAI, PDI, ICI, and MFI are measured as the absolute difference between two trading partners and, therefore, indicate an index of cultural distance between two trading partners. Möhlmann *et al* (2009) stated that cultural distance can have either negative or positive impacts on trade flows. A large cultural distance is generally recognized to raise the costs of international trade, as large cultural differences make it difficult to understand, control, and predict the behavior of others (Linders *et al*, 2005). This will ultimately impede the realization of business deals, suggesting that large cultural differences reduce the amount of trade between trading partners. On the other hand, the horizontal foreign direct investment (FDI) may suggest that cultural distance can lead to positive trade flows between trading partners if high cultural differences lower the attractiveness of serving markets with FDI and may lead to substitution by trade flows (Möhlmann *et al,* 2009).

Empirical Models, Estimation Procedures, and Data

Empirical Models

The gravity model has traditionally been estimated using cross-sectional data. However, this approach has been criticized because it generates biased results as it ignores heterogeneity across individuals or deals inadequately with omitted variables (Baldwin, 1994; Matyas, 1997). To mitigate the problems, researchers lean towards panel data analysis which provides an attractive way of dealing with unobserved heterogeneity as well as functional misspecifications. Following Matyas (1997), the general form of the panel data gravity model can be written as

(1) $$\ln EXP_{ijt} = \alpha_i + \gamma_j + \lambda_t + \mathbf{x}_{ijt}^{'}\boldsymbol{\beta} + u_{ijt}$$

where:

EXP_{ijt} is the volume of trade (exports) from country *i* to country *j* at time *t* and $\mathbf{x}_{ijt}^{'}$ is a $k\,x1$ row vector of explanatory variables. α_i, γ_j, and λ_t are, respectively, exporter, importer, and time effects; and u_{ijt} is a typical white noise disturbance term.

In empirical work, a number of explanatory variables are included in the row vector $\mathbf{x}_{ijt}^{'}$ including gross domestic product (GDP), population, geographic distance, and time invariant variables such as language commonality, border measures, and trade blocks. Following Helpman (1987) (see also Baltagi et al., 2003) we include three explanatory variables related to both gross domestic product and population: the sum of bilateral trading partner GDP as a measure of bilateral overall country size ($LGDP_{ijt}$), an index that measures relative country size ($LGDPI_{ijt}$), and the absolute difference in relative factor endowments between the two trading partners ($LGDPP_{ijt}$).

Geographical distance between trading partners ($LDIS_{ij}$) is included in the model to represent a proxy of trade costs. $LDIS_{ij}$ is expected to have negative impacts on trade flows. We also include language commonality and religion to represent cultural familiarity and MERCOSUR and NAFTA as trade agreement variables. All of these four variables are expected to have positive signs. To measure distance proximity, we also include a variable to reflect common borders between trading partners. Countries that share border are expected to trade more. As discussed previously, we include variables capturing cultural similarity or cultural distance. These include the four dimensions of Hofstede's cultural framework as discussed in the previous section. These variables are measured in absolute deviation between two trading partners.

Including all variables, our empirical model can be written as

$$\begin{aligned} \ln EXP_{ijt} &= \alpha_i + \gamma_j + \lambda_t + \beta_1 LGDP_{ijt} + \beta_2 LGDPI_{ijt} + \beta_3 LGDPP_{ijt} \\ &+ \beta_4 LDIS + \beta_5 UAI_i + \beta_6 PDI_j + \beta_7 ICI_i + \beta_8 MFI_j \\ &+ \beta_9 LANGUAGE + \beta_{10} RELIGION + \beta_{11} BORDER \\ &+ \beta_{12} NAFTA + \beta_{13} MERCOSUR + YEARLYDUMMY + u_{ijt} \end{aligned} \tag{2}$$

Where

$$LGDP_{ijt} = Ln(GDP_{it} + GDP_{jt}),$$

$$LGDPI_{ijt} = Ln\left[1 - \left(\frac{GDP_{it}}{GDP_{it} + GDP_{jt}}\right)^2 - \left(\frac{GDP_{jt}}{GDP_{it} + GDP_{jt}}\right)^2\right],$$

$$LGDPP_{ijt} = \left| Ln\left(\frac{GDP_{it}}{N_{it}}\right) - Ln\left(\frac{GDP_{jt}}{N_{jt}}\right)\right|.$$

$LDIS_{ij}$ is geographic distance between two countries (trading partners) in log values. UAI, PDI, ICI, and MFI are four dimensions of culture as defined previously and measured in absolute difference between two trading partners. LANUAGE is language commonality that takes a value of one if two trading partners share common language and zero otherwise. RELIGION is a variable for major religion that takes a value of one if two trading partners have the same major of religion and zero otherwise. NAFTA and MERCOSUR are dummy variables for North American Trade Agreement and Central American Trade Agreement, respectively. Border takes a value of one if two trading partners share common border and zero otherwise. Included in the model are annual dummy variables.

Estimation Procedures

Different estimators have been proposed to estimate (1) or (2). A widely used approach is fixed effects model. This approach has been successful in dealing with heterogeneity issues. However, it does not work for time invariant variables such as distance, language commonality, and common borders. A second best alternative is to use a random effects estimator, which has an advantage over the fixed effects estimator in that it allows the recovery of the parameter estimates of any time invariant explanatory variables which would otherwise be removed in the fixed effects transformation. A possible drawback is that the random effects model requires that unobserved heterogeneity obey some probability constraints (Green; Baltagi; Woodridge). For example, random effects impose strict exogeneity of and orthogonality between explanatory variables and the disturbance terms.

The Hausman-Taylor (HT) estimator has also been widely recommended for panel data with time invariant variables and correlated unit effects (Wooldridge, 2002; Hsiao, 2003) and has gained popularity in panel data analysis (Egger and Pfaffermayr, 2004). It has been shown that this procedure provides consistent solution to the potentially severe problem of correlation between unit effects and time invariant variables. The drawback is that HT can only work well if the instruments are uncorrelated with the errors and the unit effects and highly correlated with the endogenous regressors.

Plumper and Troeger (2007) propose an approach to deal with panel data with time invariant and rarely changing variables through decomposing the unit fixed effects (FE) into an unexplained part and a part explained by the time invariant or the rarely changing variables (p.2). The procedure, called fixed effects vector decomposition (FEVD), involves three steps: estimating the unit FE by running a FE estimate of the baseline model, splitting the unit effects into an explained and an unexplained part by regressing the unit effects on the time invariant explanatory variables of the original model, and performing a pooled OLS estimation of the baseline model by including all explanatory time variant, time invariant, the rarely changing variables, and the unexplained part of the FE vector. Because of the nature of the data where many time invariant variables are involved, this study adopts the FEVD approach. We believe that the FEVD procedure is appropriate and gives robust results.

Data

Countries in the Western Hemisphere included in the analysis are determined based on the availability of the data, particularly those related with cultural index measures. A total of 15 countries are included in the model. This study utilizes annual bilateral trade data (US dollar) from 1995 to 2006 obtained from United Nations Comtrade database for agricultural products SITC 1 digit classification). We include three product categories: (1) food and live animals, (2) beverages and tobacco, and (3) animal, vegetable oil, fats and waxes. Gross domestic product (GDP) and population are obtained from International Financial Statistics of IMF. GDP is in billion US dollars and population is in millions. Distance is in miles and is calculated between the capitol Cities using the World Atlas. The four dimensions of culture are obtained from Hofstede (2001) and given in appendix 1.

Estimation Results and Discussions

Standard Gravity Model

Table 1 shows the regression results for the standard gravity equation. As shown, the overall bilateral country size (LGDP) and index of relative country size (LGDPI) have significant and positive effects on the amount of trade between trading partners. The estimated coefficients of the relative factor endowment (LGDPP) are negative, suggesting that the relative factor endowment has negative effects on trade flows. The negative signs of LGDPP can partly be explained by the fact that LGDPP is weighted using population. Cheng and Wall (2005) state that the coefficients of population of exporting and importing countries should not be necessarily consistent in the gravity equation. Therefore, we may expect that the coefficients of LGDPP are not as unequivocal. Baltagi *et al* also found inconsistent signs of relative factor endowments. Most of the yearly dummy variables (not shown) are statistically significant at 5% or 1% levels of significance.

Table 1. Regression Results: Standard Gravity Model

Variable	Parameter Estimates	Standard Errors
INTERCEPT	17.834***	0.3411
LGDP	0.9825***	0.0316
LGDPI	0.4109***	0.0281
LGDPP	-0.4794***	0.0301
LDIST	-0.7251***	0.0404
NAFTA	1.3677***	0.1547
MERCOSUR	0.4458***	0.1403
BORDER	1.0451***	0.0793
LANGUAGE	-0.9247***	0.0704
RELIGION	-0.1480**	0.0728
Yearly Dummy	yes	
Observations	2328	
R^2	0.871	

Notes: *** , ** , and * are significant at the 1%, 5%, and 10% levels, respectively.

The coefficient of geographic distance (LDIST) which is usually referred to as the elasticity of trade volume with respect to distance has a negative effect and indicates strong explanatory power with a magnitude of -0.725. Therefore, trade flows between two trading partners will be less as the distance increases. The common border variable is positive and significant suggesting that adjacent countries trade substantially more than non-contiguous countries. The variables of trade agreements (NAFTA and MERCOSUR) have positive signs indicating that trade agreements raise bilateral trade among country members. Two variables reflecting cultural familiarity (LANGUAGE and RELIGION) have negative signs and are statistically significant. The negative signs of these variables are not as expected but we suspect that the standard gravity model may suffer from omitted variable bias particularly with respect to cultural distance.

Gravity Model with Cultural Dimensions

Table 2 contains the estimated results for the gravity equation accounting for the four cultural dimensions. As shown, the estimated parameters for the bilateral overall country size (LGDP), index of relative country size (LGDPI), and the relative factor endowment (LGDPP) do not change in terms of both the magnitudes and statistical inferences. Most of the yearly dummy variables remain statistically significant. However, substantial changes occurred in the rest of the variables included in the model.

The magnitude of the elasticity of trade volume with respect to geographic distance (LDIST) increased from -0.725 to -0.834. This shows that excluding cultural dimensions from the model underestimated the trade cost associated with distance. The estimated coefficients of trade agreements (NAFTA and MERCOSUR) and adjacency (BORDER) are less than those in the standard model. Surprising results are shown in the estimated coefficients of variables capturing cultural familiarity. As can be seen in Table 2, the coefficients of LANGUAGE and RELIGION changed substantially not only in terms of magnitudes but also direction once we control for cultural dimensions. This intuitively shows that both cultural familiarity and cultural distance are two different concepts which are related to each other. Therefore, excluding either type of cultural variables will lead to omitted variable bias as previously suspected.

Table 2. Regression Results: Cultural Dimension

Variable	Parameter Estimates	Standard Errors
INTERCEPT	16.915***	0.3689
LGDP	0.9825***	0.0341
LGDPI	0.4109***	0.0312
LGDPP	-0.4794***	0.0303
LDIST	-0.8337***	0.0411
UAI	-0.0119***	0.0024
PDI	-0.0095***	0.0018
ICI	0.0397***	0.0019
MFI	-0.0016	0.0019
NAFTA	1.3708***	0.1587
MERCOSUR	1.1459***	0.1459
BORDER	1.1417***	0.0809
LANGUAGE	0.1138	0.0833
RELIGION	0.3777***	0.0733
Yearly Dummy	yes	
Observations	2328	
R^2	0.871	

Notes: *** , ** , and * are significant at the 1%, 5%, and 10% levels, respectively.

With regard to the variables of interest, we found that the three dimensions of culture: UAI, PDI, and ICI are statistically significant at the 1% level, but it is not for MFI. These three variables have negative signs, suggesting that a larger distance of each of these cultural dimensions reduces the amount of trade between trading partners. This is consistent with the findings given in Huang (2007). ICI, on the other hand, has positive sign suggesting the amount of trade increases as the distance of ICI between two trading partners gets larger.

In terms of magnitudes, the effects of each cultural dimension on trade flows vary considerably. Since a negative sign indicates the existence of cultural barriers, UAI is found to be of the most cultural value in affecting trade flows. As shown in Table 2, Impacts of PDI and MFI are substantially less than UAI, and statistically insignificant for MFI. This confirms the finding reported by Reimann et. al (2008). As noted previously, ICI has positive impacts on trade flows with relatively higher magnitudes compared with the other three dimensions. The magnitude parameter estimate of ICI is virtually large enough to offset the negative impacts of the other three dimensions of culture. We suspect that the net impacts of cultural distance would be positive. Because of this perspective, we re-estimated the model by combining the four dimensions of culture (Labeled as MAD) and the results are given in Table 3.

As shown in Table 3, the coefficient of MAD (the sum of absolute deviations of the four cultural dimensions) has a positive sign and is statistically significant, but the magnitude is quite small (0.008). Following Linders et al (2005) and (Möhlmann *et al*, 2009), substitution between trade and FDI provides a possible explanation. The costs of trade may increase with cultural distance, but at the same time the costs of production in the host-country increase faster. Ultimately, firms prefer to trade rather than undertake host-country production. Furthermore, the results in Table 3 also show that the estimated parameters of LANGUAGE and RELIGION changed substantially; reconfirming that cultural familiarity and cultural similarity are related and that excluding either one of these will lead to omitted variable bias.

Table 3. Regression Results: Cultural Dimensions Combined

Variable	Parameter Estimates	Standard Errors
INTERCEPT	14.7517***	0.2515
LGDP	0.9825***	0.0323
LGDPI	0.4109***	0.0306
LGDPP	-0.4794***	0.0303
LDIST	-0.6709***	0.0405
MAD	0.0078***	0.0007
NAFTA	1.3712***	0.1562
MERCOSUR	0.6939***	0.1421
BORDER	1.3041***	0.0807
LANGUAGE	-0.4836***	0.0768
RELIGION	0.0489	0.0735
Yearly Dummy	yes	
Observations	2328	
R^2	0.8582	

Notes: Estimates: Parameter estimates; StdE: estimated standard errors; RE: Random Effects Model; HT: Hausman-Taylor; FEVD: Fixed Effects Vector Decomposition. MAD is the sum of absolute differences of the four cultural dimensions.
*** and ** are significant at the 1% and 5% levels, respectively.

Conclusions

This study analyzes bilateral trade flows of agricultural products in the Western Hemisphere using an extended gravity model that includes variables capturing cultural distance developed by Hofstede (2001). The model was estimated using a Fixed Effects Vector Decomposition (FEVD) procedure developed by Plumpter and Kroeger (2007). The method provides reliable estimates and the results indicate that controlling for cultural distance reduces omitted variable bias.

The results indicate that geographical distance is negative and significantly affects trade flows. The effects of each dimension of cultural distance vary considerably. Three of four dimensions (UAI, PDI, and MFI) have a negative signs with UAI having the most impact. ICI is found to have a positive effect with its magnitude substantially large enough to offset the negative effects of the other three dimensions. Re-estimated equations that combine all four cultural dimensions show that the net effect of cultural distance has a positive impact on trade flows. We suspect that the substitution effect between FDI and trade dominates so that the net effect is positive.

Appendix 1. List of Countries Included in the Analysis and Cultural Index Data

Country	UAI	PDI	ICI	MFI
Argentina	86	49	46	56
Brasil	76	69	38	49
Canadá	48	39	80	52
Chile	86	63	23	28
Colombia	80	67	13	64
Costa Rica	86	35	15	21
Ecuador	67	78	8	63
El Salvador	94	66	19	40
Guatemala	101	95	6	37
México	82	81	30	69
Panama	86	95	11	44
Peru	87	64	16	42
Uruguay	100	61	36	38
United Sates	46	40	91	62
Venezuela	76	81	12	73

Source: Hofstede (2001), Exhibit A5.1 p.500

Appendix 2. Fixed Effects Decomposition Procedure (FEVD)

Let the data generating process (DGP) be

$$\text{(A1)} \quad y_{it} = \alpha + \sum_{k=1}^{K} \beta_k x_{kit} + \sum_{m=1}^{M} \gamma_m z_{mi} + u_i + \varepsilon_{it} \, ,$$

where the x and z represent vectors of time varying and time invariant variables, respectively, u_i denotes the unit specific effects, ε_{it} is the error term, α is the intercept, and γ and β are parameters to be estimated. The first step of the FEVD approach is to estimate the standard fixed effects model. Averaging (A1), we obtain:

$$\text{(A2)} \quad \bar{y}_i = \alpha + \sum_{k=1}^{K} \beta_k \bar{x}_{ki} + \sum_{m=1}^{M} \gamma_m z_{mi} + \bar{e}_i + u_i \, ,$$

where

$$\bar{y}_i = \frac{1}{T}\sum_{t=1}^{T} y_{it} \, , \; \bar{x}_i = \frac{1}{T}\sum_{t=1}^{T} x_{it} \, , \; \bar{e}_i = \frac{1}{T}\sum_{t=1}^{T} e_{it} \, .$$

Here, e represents the residual of the estimated model. Subtracting (A2) from (A1) removes the individual effects u_i and the time-invariant variables z, shown as follows:

$$\text{(A3)} \quad \ddot{y}_{it} = \beta_k \sum_{k=1}^{K} \ddot{x}_{kit} + \ddot{e}_{it}$$

Where $\ddot{y}_{it} = y_{it} - \bar{y}_i$, $\ddot{x}_{kit} = x_{kit} - \bar{x}_{ki}$, and $\ddot{e}_{it} = e_{it} - \bar{e}_i$.

Model (A3) is used to obtain the unit effects $\hat{u}_i$. Note that $\hat{u}_i$ includes all time invariant variables, the constant term, and the mean effects of the time varying variables. Therefore,

$$\text{(A4)} \quad \hat{u}_i = \bar{y}_i - \sum_{k=1}^{K} \beta_k^{FE} \bar{x}_{ki} - \bar{e}_i \, ,$$

Where β_k^{FE} is the pooled OLS estimate of (A3).

Step 2 of the FEVD is to regress $\hat{u}_i$ on z to obtain the unexplained part, we call it h_i. That is

(A5) $$\hat{u}_i = \sum_{m=1}^{M} \gamma_m z_{mi} + h_i \ .$$

The last step is to estimate (A1) without the unit effects but including the unexplained part h_i using pooled OLS. This model is written as

(A6) $$y_{it} = \alpha + \sum_{k=1}^{K} \beta_k x_{kit} + \sum_{m=1}^{M} \gamma_m z_{mi} + \delta h_i + \varepsilon_{it} \ ,$$

where $h_i = \hat{u}_i - \sum_{m=1}^{M} \gamma_m z_{mi}$. Plumper and Kroeger show that the coefficient of δ is always one if we do not account for dynamics and less than one if we account for dynamics. However, it remains asymptotically one regardless of the dynamics aspect. A more detailed procedure can be found in Plumper and Kroeger (2007).

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