An Analysis of the Determinants of U.S. Imports Using a Gravity Model Approach

---

Major Research Paper

by Yuan Ma

(7410250)

Department of Economics of the University of Ottawa

in partial fulfillment of the requirements of the M.A. Degree

Supervisor: Professor Patrick Georges

Eco 6999

April 2015

Table of Contents

Abstract

As the primary export target of many countries, the trade pattern of U.S. has radically changed with globalization. The U.S. imports are not only influenced by cost of goods, but also determined by other factors such as culture, distance, and social network with other countries. This paper outlines key determinants of U.S. imports by using a gravity panel data model approach. This paper extends the basic gravity model using several variables in order to find more plausible determinants of U.S. imports. Pooled ordinary least squares, fixed effect and random effect approaches are estimated. Several model selection tests lead us to accept the results of random effect model as the most appropriate. The estimation results show that economic size of trading partners, geographical distance and trade openness of exporting countries have significant impact on U.S. imports. The results also demontrate that in recent years, U.S. has significantly increased its imports from SARRC members and East Asia with respect to other overseas countries.

1. Introduction and overview of U.S. merchandise import

As the world's largest market, U.S. has been the primary export target of many countries. According to the U.S. Bureau of Economic Analysis (2012), at the end of December 2012, total merchandise imports reached U.S. $2,299 billion, which is an increase in U.S. goods import by U.S. $63,462 billion with respect to the previous year. As shown in Figure 1, considerable growth in U.S. goods import trade occurred from 1993 to 2000, especially after the initiation of the North American Free Trade Agreement (NAFTA) in 1994. Over this horizon the average annual rate of growth in the U.S. dollar value of imports has been 10.8% which is much larger than the average annual rate of growth of U.S. GDP of 3.4%. Note, however, that imports slowed down from 2001 to 2003 most likely due to the enhanced security measures at the U.S. border as a result of the terrorist attacks of September 11, 2001 (9/11). However, import increased again from 2004, but a sharp reduction occurred in 2008 from U.S. $2,103 billion at the end of 2008 to U.S. $1,559 billion in 2009. The main reason for this fall in imports is the financial crisis of 2008. After that, a slow recovery began from the second half of 2009. Finally, in 2010 the total value of import reached U.S. $1,939 billion, still a lower level compared to the situation before the economic crisis.

In 2012, the industrial supplies including petroleum oil remained the top commodity by import value at 33% of total imports. Capital goods and consumer goods shares were respectively 24% and 22%. See Figure 2(a). Figure 2(b) also indicates the shares of these products in year 2000.

According to the U.S census bureau, in 2012, the top 5 U.S. goods suppliers are, respectively, China, Canada, Mexico, Japan and Germany. Collectively considered, these countries accounted for 53 percent of total U.S. imports value in 2012. In 2012 China was the largest source of U.S. imports with a value of $ 425 billion, which represents 19.7% of total merchandise import. As shown in Figure 3, the import values from Canada, Mexico, Japan and Germany are respectively U.S. $320, $275, $145 and $105 billion. It is worth noting that in recent years, U.S. has begun to import goods from an increasing number of developing countries. The most remarkable examples are China and India. The major determinants of U.S. imports are complicated. Besides considering the cost of imports, Head and Ries (1998) suggests that migrants create their future generations, and at least part of the effect relates to the fact that many of them still keep their taste for goods from home country. In other words, the country mix of immigrants to U.S. helps to predict the of U.S. trade patterns with the countries of origin (Helliwell, 2002).

The gravity model has been widely employed to describe and predict international trade flows between countries and the main purpose of this paper is to estimate an augmented gravity model in order to investigate primary determinants of U.S. goods imports. The rest of this paper is as follows. Section 2 summarizes major findings from the previous literature. Section 3 describes the data set and the panel data methodology used in this paper. Section 4 discusses basic estimation results. Section 5 provides some extensions. Finally, section 6 gives concluding comments.

2. Literature review

2.1 Basic theory

The gravity model is an empirical model that aims to capture the factors explaining trade flows between origin country *i* and its destination *j* (Anderson, 2011). The fundamental theory of this model is an analogy to Newton's gravity law where geographical distance would have a negative effect on trade flows between countries, while the "mass" or economic size of the countries would have a positive effect.

The typical gravity model for bilateral trade was first introduced by Tinbergen (1961) and Linneman (1966). They exploit distance between two countries as a proxy of transaction cost and use a country's market size for measuring potential demand and supply of trading countries. The basic theoretical gravity model for trade between country *i* and *j* is formulated as:

$$F_{ij} = G \times \frac{Y_i Y_j}{D_{ij}} \tag{1}$$

where F_{ij} denotes trade volume between countries *i* and *j*. Import, export and total trade are the most common dependent variables used in the gravity model. *G* is a constant term. Y_i and Y_j are the economic sizes of country *i* and *j*, and D_{ij} is the geographical distance between the two countries. As described by Hossain and Sharif (2009) the trade gravity model shows that the trade flows between two countries are proportional to the product of each country’s economic mass, generally measured by GDP, divided by the distance between the countries respective economic centers of gravity, generally their capitals.

For convenience during the estimation process, the gravity model is usually converted in a logarithmic form. Thus, the standard gravity model for bilateral trade becomes:

$$\log(\mathrm{M}_{\mathrm{ij}}) = c + \beta_1 \log(Y_i) + \beta_2 \log(Y_j) + \beta_3 \log(D_{ij}) + \beta_4 \log(A_{ij}) + \nu_{ij} \quad (2)$$

Besides the GDP (*Y)* and the distance (D) variables defined above, we will assume that M_{ij} is the flow of import into country *i* from country *j*. A_{ij} represents other factors that may have effects on trade, *c* is the constant term and ν_{ij} represents the error term.

An issue is whether bilateral trade volume should be expressed in nominal or real terms. Shepherd (2013) suggests that trade flows should be in nominal, not real terms because deflating exports using different country specific price indices, such as the CPI or the GDP deflator, would produce misleading results and would not adequately capture the observed multilateral resistance term (MRT). Here, multilateral resistance refers to all barriers which each country faces in its trade with all trading partners (including domestic and internal trade).

Distance is a typical independent variable in the trade gravity model. The reasons are summarized by Head (2003). First, many economists believe that distance is a standard proxy for transport cost. According to Dimitrios (2010) transportation cost is the main factor impeding trade flows between countries. Indeed, a country will suffer from larger transportation expenses when importing from a distant country. Furthermore, the time elapsed during shipment increases the risk of damage, loss or decomposition of organic materials while shipping, especially for perishable goods. Also, distance leads to a synchronization cost. For instance, if factories combine many inputs in the production process, they probably need to rent warehouse which raises expenses such as storage cost, technological obsolescence and fashion changes. Moreover, distance is correlated with transaction cost and communication cost. Increasing the cost of searching for trading opportunity may become central concerns.

In addition, Helliwill (2002) indicates that distance has the same significant impact on the probability of migration as its effects on trade flows. The effects of national borders[1] are even greater for migration than for trade in goods and services. He also points out that networks (or social capital) between countries are generally built by common trust, advocated by common institutions, and improved by frequent interactions. All of these decline with distance and as national borders are crossed.

Anderson and Yotov (2010) provide empirical evidence that the effect of distance on commodities trade is negative and significant at any level. There is significant variability in the effect of distance on trade across different merchandises. Distance is a more crucial factor to influence trade for low value commodities such as Petroleum and Coal, Paper and Paper Products, and Furniture, while less important for commodities such as Electrical Products and Hosiery and clothing. One obvious explanation for this could be transportation cost. They also find that trade flows are larger between contiguous provinces and states. This finding demonstrates the argument in Brown and Anderson (2002) that contiguous provinces and states will trade more with each other.

The appropriate proxy for market size is discussed in many studies. Some studies

[1] The effects of national borders is often used to describe the extent to which national boundaries influence trade patterns (Helliwell, 2002).

use gross domestic product per capita (GDP per capita) or gross national product per capita (GNP) instead of the level of GDP or GNP (e.g. Breuss and Egger 2004). Shepherd (2013) emphasizes that according to the properties of the gravity model, it would be ideal to include data on sectoral expenditure and output. However, this is usually impossible in an empirical study, especially when developing countries are included in the sample. Thus aggregate GDP remains the most appropriate proxy to describe the economic size of countries because it implicitly takes into account the size of population of each country; using population and per capita GDP as separate explanatory variable should be avoided.

2.2 Extended framework and survey of related empirical literature:

Most empirical studies include more control variables than those in equation (3) to build an augmented gravity model that analyzes trade flows between regions. Unlike fundamental variables in the standard gravity model, these specific factors have less theoretical justification.

Greene (2013) extends the traditional gravity model by adding factors such as physical land area, real exchange rate, population and population density. He points out that population is a proxy for a country's market size, potential domestic consumption capacity, and potential degree of economic diversification and expects population to have a positive and significant impact on trade between U.S. and its trading partners. However, the final estimation results from his study fail to demonstrate this argument, as both population and population density carry a negative coefficient and are statistically insignificant.

Also, several variables in his empirical study such as participating in a free trade agreement (FTA), whether an exporting country is coastal, and the existence of a common language between importers and exporters, are typically added in the model. Two countries that speak the same language may trade more because it facilitates transactions between buyers and sellers. Also it may reveal a common history or past colonial links (Head, 2003). Positive effects are expected from the binary variable FTA because FTAs provide a more liberalizing trading environment and eliminate some trading restrictions such as tariff and non-tariff barriers

Rose (2000) and Head (2003) add several dummy variables such as whether two countries share a common border or belong to a currency union. Rose (2000) emphasizes the effects of having the same currency among countries on trade flows. He concludes that countries using a common currency are trading three times more with each other than with other countries. Many researchers also emphasize the importance of "culture distance" between countries. They suggest that cultural differences may lead to general misunderstandings and inhibit communication and trade between countries. As suggested above, a variable such as the existence of a common language is often used to represent the culture distance. Thus it is assumed that countries that use the same language are typically closer culturally and usually trade more (Head, 2003).

Many studies add dummy variables to identify participation in economic organizations and trade agreements, for example, membership in an economic union such as EU, NAFTA and ASEAN (e.g. Rose and Wincoop, 2000; Glick and Rose, 2001; Bussière and Schnatz, 2008). According to Frankel and Rose (2000), memberships in a FTA might triple trade between members. However, Baier and Bergstrand (2007) suggest that recent studies do not provide clear evidence of a growing trade benefit from FTAs.

Helliwell (2002) points out that the actual goods flows between British Columbia and Ontario were more than twice than those between Ontario and California. After the Canada-United States Free Trade Agreement (FTA) was signed at 1989, there have been large increase in merchandise trade between two countries. Also these were significant decline in the effect of national borders between Canada and U.S. from seventeen in 1981 to about twelve in 1996. However, the border effect for services appear to be larger than those for merchandise trade and show less evidence of elimination by the FTA (Helliwell 1998).

Grant and Lambert (2008) also mention that FTAs exhibit varying degrees of regional integration. They emphasize that potential trade flows depend on the specific FTA and the length of its implementation period. For example, even if NAFTA was signed in 1994, it required two separate bilateral trade agreements with Mexico for the agriculture sector and a fifteen year phase-out period ending in 2008 (Grant and Lambert, 2008). Therefore, it may take a long time before observing an actual effect of a FTA on trade.

McCallum (1995) uses a basic gravity model with several dummy variables to study the impact of the Canada-U.S. border on regional trade patterns. He points out that Canada and U.S. is a particularly interesting case because these two countries are very similar in term of culture, language, and institutions. The statistical results from his study support his initial assumption that the effects of a continental free trade agreement could turn out to be relatively modest, or if not modest, at least gradual. On the other hand, the impact of reduced tariff on the rising trade share is already low and does not have a further or fall before it reaches zero because tariff rates pre-NAFTA were already low. He also concludes that the national borders between Canada and U.S. continue to matter and have important effect on continental trade patterns.

Grant and Andres (2010) use the traditional gravity model with a set of binary variables to investigate the magnitudes on trade resulting from stricter food safety measures in the U.S. fishery and seafood sectors. They estimate three different regression models (OLS and two fixed effects method) using cross-sectional data for four different time periods. Their results show that all fundamental variables of the gravity model are statistically significant in the three regression estimations. GDPs have a large positive effect on trade flows, whereas distance is negatively correlated to trade flows in fishery and seafood. Moreover, a common language is also an important factor boosting trade flows between countries. On the contrary, they found that there is no statistically significance of the binary variable FTA for fishery and seafood trade between U.S. and its suppliers.

Chi and Kliduff (2010) investigate possible factors influencing U.S. apparel imports. They employ a pooled OLS approach and add several specific factors such as GDP per capita, tariff rates and a set of trade agreements dummy variables in the augmented gravity model. Their empirical investigation demonstrate that U.S. GDP and trading partner's GDP are important factors explaining U.S. imports of clothing. Also, the estimation provides evidence that geographical distance significantly hinder bilateral trade. Moreover, they find that U.S. tends to trade more with English speaking countries. Finally they show that there was an increase in apparel import by U.S. from Mexico after Mexico became a member of NAFTA and from China after it entered the WTO in 2001.

Breytenbach and Jordon (2010) extend the basic gravity model in order to analyze the factors that determine export trade flows between South Africa and its main trading partners. Variables included in the model are, in particular, population, exchange rate, language and a dummy variable tracking whether a country is a European Union member or is from Africa. A fixed-effect model is estimated using panel data from 37 South Africa's major partners. A finding worth mentioning is that South Africa tends to trade more intensively with members of the Southern Africa Development Community (SADC). Also, SADC membership stimulates potential exports to the rest of world.

Rahman (2006) and Roy and Rayhan (2012) include a set of regional dummy variables, per capita GDPs, export to GDP ratio, and trade ratios as a proxy for the openness of a country, in an augmented gravity model to investigate determinants of Bangladesh import flows. Both studies use panel data to estimate pooled OLS, fixed effects and random effects models. Both studies expect and find that the trade ratio as a proxy for openness, has a positive impact on international trade. Besides, they conclude that although regional agreement such as SAARC[2] is statistically significant, it is negatively correlated to import flows of Bangladesh.

2.3 Econometric techniques

Most empirical studies usually construct an augmented gravity model based on three estimation approaches: either a fixed-effects or random-effects model or a pooled ordinary least square model (pooled OLS). Then authors select the most efficient method based on several selection tests. However, the way researchers use the estimation methods in their empirical investigation depends on the nature of the data. Some of the studies use time series to estimate a dynamic OLS model or the fixed-effect model (e.g. Martinez-Zarzoso and Nowak-Lehmann, 2002; Glick & Rose, 2001; Micco, et al, 2002). On the other hand, some studies use an OLS approach with cross-sectional data (Rose, 2000; Rose &Wincoop, 2000; Glick & Rose, 2001; Micco, et als, 2002).

Panel analysis is, however, the most often used technique in the empirical trade gravity literature. Kepaptsoglou et als. (2010) mention that the properties of bilateral trade flows naturally indicate three main dimensions: time, exporter countries and importer countries. Therefore, using cross sectional data on countries but excluding the crucial source of time variations, could lead to inconsistent estimation results. Koo and Karemera (1991) also suggest that panel data is more suitable than cross-sectional data in international trade analysis. A distinct advantage of panel data relative to cross-sectional analysis is that it provides observations on the same units (here,

[2] The South Asian Association for Regional Cooperation (SARRC) is an economic and geopolitical organization of eight South Asian countries.

countries) in several different time periods (Kennedy, 2008). Panel data can manage the heterogeneity problem across different countries and time periods because it captures relationships over variables in time and observing individual effects between trading partners (Kepaptsoglou et als. 2010)[3]. Panel data control the relevant relationships among variables over time and can monitor unobservable country-specific effects (Rahman, 2003). Moreover, Baltagi (2001) mentions that panel data lead to more informative data**,** more variability, less collinearity among the variables, more degrees of freedom and more efficiency**.**

An ordinary least square (OLS) method would be considered inefficient in some cases with cross-sectional or time series data (Park, 2011). To understand this it might be useful to briefly recap the traditional hypothesis of the OLS estimator. There are eight key assumptions of the OLS estimator: linearity, explanatory variables (X_t) has some variation, explanatory variables (X_t) is non-stochastic and fixed in repeated samples, the expected value of error term is zero, homoskedasticity, serial independence, normality of disturbance and no multicolinearity across independent variables (Asteriou and Hall, 2011). The linearity is the first assumption of the OLS estimator and assumes that the dependent variable can be expressed as a linear function of a set of explanatory variables plus a disturbance term.[4] In addition, explanatory variables must have some variation, which means that at least one observations of X_t has to be different from the others so that the sample variance is

[3] In econometric theory, the heterogeneity problem indicates differences across the individual units being studied. In our study, it refers to differences across countries *j*.
[4] The function can be expressed as: $Y_t = \alpha + \beta X_t + \mu_t$ Thus the regression model is linear in the unknown coefficients α and β**.**

not equal to 0. It is an important assumption because it shows how much the independent variable X varies over the particular sample. Non-stochastic independent variables means that X_t is not determined by chance which implies that X_t is uncorrelated with the disturbance term μ_t. Moreover, the expected value of the error term must be equal to zero ($E(\mu_t) = 0$). This assumption is necessary because we need it in order to interpret the key part of a regression model ($\alpha + \beta X_t$), as a "statistical average" relation (Asteriou and Hall, 2011). The assumption of homoskedaticicity means that the variance of the error term remains constant for all periods t ($Var(\mu_t) = \sigma^2$). The assumption of serial independence requires that error terms are independently distributed and not correlated with each others. This condition indicates that a disturbance in one period is not related to a disturbance in other periods. Normality of residuals requires that the disturbances follow a normal distribution. Finally, assumption of no linear relationships among independent variables means there is no direct linear relationships among then, that is there is no multicollinearity (Asteriou and Hall, 2011). Based on these assumptions an OLS equation is expressed as:

$$y_{ij} = (\alpha + \mu_i) + X_{it}\beta + \varepsilon \qquad (3)$$

where α is a constant term, μ_i refers to individual effects such as individual characteristics of a country j and is assumed equal to 0 in the OLS estimation, β is the unknown coefficient that must be estimated. y_{ij} is the dependent variable, X_{it} represents a set of independent variables, and ε_{it} is the disturbance term. Based on the eight assumptions above, the OLS estimator is the best linear unbiased estimator

(BLUE). However, if one of the assumptions is violated, the OLS estimator is no longer efficient. For example, the assumption of serial independence of the error term is frequently violated in practice (Asteriou and Hall, 2011). Also, the parameter μ_{i} which denotes individual effects such as geographic features or personal characteristics of a country *j* must be equal to zero for the OLS to be consistent and unbiased. On the contrary, in the case where individual effects exist, then they are not captured in the regression model and the heterogeneity of these features violate the assumptions of OLS. In this case OLS is biased and no longer efficient (Greene, 2008).

The fixed effects and random effects models are used to examine individual or time effects or both. According to Park (2011), a fixed effect model examines if the intercept varies across group or time period, whereas a random effect model explores differences in error variance components across individual or time period. Also, an essential differences between the fixed and random effect models are the role of dummy variables. Following the description by Asteriou and Hall (2011), in the fixed effects model the constant term is treated as group-specific. This indicates that the model has different constants for each group. The econometric equation for fixed effects is given by:

$$Y_{it} = a_i + X_{it}^{'}\beta + \mu_{it} \qquad (4)$$

This can be written in a matrix notation as:

$$Y = D\alpha + X\beta^{'} + u \qquad (5)$$

where D is the dummy variable and μ is the error term assumed independently and identically distributed. The fixed effects estimator is also called the least squares dummy variable (LSDV) estimator because it allows different constants for several groups, in other words, it includes a dummy variable for each groups. This is expressed as $D\alpha$ in equation (5), which indicates that a dummy variable (D) is a component of the intercept term and it allows us to take different group-specific estimates for each of the constants for each different section.

The random effects model is also called a variance components model. A property behind the random effect model is that the variation across each group of independent variables is assumed to be random and uncorrelated with other independent variables. The difference between random effects and fixed effects model is that in random effect model, we treat the constants for each section as not fixed, but random parameters. Thus, the constant term for each section becomes:

$$a_i = a + v_i \tag{6}$$

where v_i is a zero mean standard random variable (Asteriou and Hall, 2011). Hence, the random effects can be written as:

$$Y_{it} = (a + v_i) + X_{it}^{'}\beta + \mu_{it} \tag{7}$$

$$Y_{it} = a + X_{it}^{'}\beta + (\mu_{it} + v_i) \tag{8}$$

As a result, the difference between the two basic methods of panel data analysis is that the random model considers that each country differs in its error term. On the other hand, the fixed effects model assumes that each country differs in its constant term (Asteriou and Hall, 2011). The random effects model has two advantages over the fixed effects method. It has fewer parameters to estimate and it allows the use of dummy variables.

Besides, the fixed effects model is often estimated through a within fixed effect estimation method or least squares dummy variable regression (LSDV) or both (two-stage regression procedures). The differences between these two approaches are the definition of dummy variables. The within fixed-effect method would absorb time-invariant variables such as distance and binary variables. On the contrary, the LSDV approach works for estimating individual specific effects of a country *j*.

When a gravity model study considers different estimation approaches, several modeling selection tests are used to choose the most appropriate method. Breusch and Pagan (1980) first introduced the idea that random effects can be tested by the Lagrange multiplier (LM) test. A rejection of the null hypothesis provides statistical evidence in favor of a random effect model instead of a pooled OLS. Statistic evidence for fixed effects models is often tested by the use of a F test. Failing to reject the null hypothesis implies that the pooled OLS regression[5]model is more appropriate (Park, 2011). In addition, the Hausman test (Hausman, 1978) is commonly used by most economists to decide between the random effects and fixed effects models. The Hausman test is also referred to as an analysis of exogenity assumptions. It provides a formal statistical assessment of whether or not the unobserved individual effect is correlated with the conditioning regressors in the model (Amini et al. 2012). According to the null hypothesis of the Hausman test, there is no correlation between the individual specific effects and the regressors. A rejection of the null hypothesis

[5] Pooled OLS regression is carried out by combining time-series and cross-sectional data.

indicates that a fixed effects model is more efficient. Alternatively, failing to reject the null hypothesis provides support for a random effect model.

3. U.S. import determinants: Data and econometric methodology

3.1 Data

This paper investigates the determinants of U.S. merchandise imports by using data from 50 supplying countries. Selection of these countries is based on their trading relationship with U.S. and availability of data. In 2012, the trade volume that U.S. imported from these countries accounted for over 95% of overall U.S. goods imports. The dependent variable in our gravity model is U.S. merchandise imports. We use panel data from period 1993 to 2012. Merchandise trade data by country is provided by the United States Census Bureau[6], and is measured in U.S. current dollars (nominal value). The data for explanatory variables are obtained from various sources. Data on GDP for U.S. and the 50 exporting countries, export to GDP ratios, and trade to GDP ratios can be found at the World Development Indicators (WDI)[7]. Data on distance is measured in kilometers between Washington, DC, and the capital of its 50 trading partners. The data is obtained from the website: DistanceFromTo.[8]

In addition, we include seven dummy variables. Three of them take into account free trade agreements or customs unions, that have a long-term trade relationship with U.S. These are the Association of Southeast Asian Nations (ASEAN), the South Asian

[6] Data is available at United States Census Bureau: http://www.census.gov/foreign-trade/statistics/historical/

[7] World Development Indicators (WDI): http://data.worldbank.org/data-catalog/world-development-indicators

[8] DistanceFromTo: http://www.distancefromto.net/

Association for Regional Cooperation (SAARC) and the European Union (EU). In our data set, seven countries are members of the ASEAN: Cambodia, Indonesia, Malaysia, Philippine, Singapore, Thailand and Vietnam. Three countries (out of a total of seven) represents SAARC (India, Bangladesh and Pakistan). The EU, which consists of twenty-eight countries, is represented in our data set by thirteen of them (Belgium, Czech Republic, Denmark, Finland, France, Germany, Ireland, Italy, Netherlands, Poland, Spain, Sweden and United Kingdom). Besides, in recent years, U.S. has imported a considerable amount of merchandise from East Asia. A binary variable referred to as "East Asia" (including China, Japan, Hong Kong and South Korea) is added in the model, even if these countries as a whole do not form a common economic community. In addition, a dummy variable for the existence of a free trade agreement (FTA) between U.S. and other countries is included. In our sample, 10 countries signed a free trade agreement with U.S. These are Australia, Chile, Columbia, Costa Rica, Dominican Republic, Guatemala, Israel, Peru, Singapore and South Korea. We also add NAFTA which is a FTA between Canada, Mexico and the U.S. Finally, we also introduce a common language dummy, that is, countries that have English defined as first official language.[9] These English-speaking countries included in our sample are Australia, Canada, Nigeria, New Zealand, Singapore and United Kingdom.

3.2 Methodology

---

[9] Selections of countries where English is speaking as first official language is according to information provided by the CEPII at: http://www.cepii.fr/CEPII/en/bdd_modele/bdd.asp

In our analysis, as reviewed in the previous setion, we use panel data to examine the trade gravity model. As mentioned, cross-section data observed over several time periods and grouped into a panel data result in more useful information than cross-section data alone.

Also, we examine three prevailing estimation methods of panel data to investigate trade behavior between U.S. and its trading partners. These are the pooled ordinary least square (OLS), the fixed-effects and the random effects approaches. An important problem related to the fixed effect model needs to be mentioned. In general, the fixed effects model cannot estimate the time-invariant variables (e.g. dummy variables) because these variables are absorbed in the constant term. On the other hand, the least square dummy variable method (LSDV) is another way to examine the fixed effects and it is designed to estimate binary variables directly. However, some inevitable concerns arise when using the LSDV method, and it becomes problematic when there are many "units" or "individuals" in the panel data and, in our particular case, countries.[10] Baltagi (2001) indicates that when the number of time periods (T) is fixed and the number of "individual" is large, parameter estimates of regressors are consistent, however, the coefficients of individual effects, are not. In addition, another significant drawback of the LSDV method is that the variables could be perfectly collinear with binary variables (Breytenbach and Jordaan, 2010; Shepherd, 2013). This limitation implies that in the gravity model, it is impossible to estimate a fixed

[10] Panel data refers to a group of cross-sectional units, such as countries, or households, who are observed over time. Such units are considered as "individuals." (Hill, Griffiths, et al. 2008)

effect model that includes data that are constant across all importers or constant across all exporters, but, most policy data fall into this category (Shepherd, 2013). Many empirical studies point out that a possible way to estimate the fixed effects model is to construct a two-stage regression estimation (e.g. Greene, 2013; Breytenbach and Jordaan, 2010, Rahman, 2003). The two-stage regression suggests separating the fixed effect estimation into within fixed-effects and LSDV method in order to analyze all possible determinants of the trade gravity model. Therefore, the two-stage regression procedure is used in Section 4 as for the fixed effects model.

We extend the standard gravity model by adding several conditioning factors. Based on our review of the literature, our augmented trade gravity model is formulated as follows:

$$IM_{ijt} = \beta_0 + \beta_1 \ln GDP_{jt} + \beta_2 \ln GDP_{it} + \beta_5 \ln Dist_{ijt} + \beta_8 TRGDP_{jt} + \beta_9 TRGDP_{it}$$
$$+ \delta_1 D_{1ijt} + \delta_2 D_{2ijt} + \delta_3 D_{3ijt} + \delta_4 D_{4ijt} + \delta_5 D_{5ijt} + \delta_6 D_{6ijt} + \delta_7 \mathrm{D}_{7\mathrm{ijt}} + \mu_{ijt}$$

where the subscript *t* represent time, *i* represents the U.S. (the import country) and *j* represents the 50 exporting countries included in the panel dataset. Also,

IM_{ijt} = U.S. imports from country *j*; total value in U.S. dollar;

GDP_{it} = nominal GDP for country *i* (the U.S.); GDP_{jt} =nominal GDP of country *j*;

$Dist_{ijt}$ = distance between country *i* and country *j*;

$TRGDP_{jt}$ = merchandise trade ratio as a percentage of GDP of *j*;

$TRGDP_{it}$ = merchandise trade ratio as percentage of GDP of *i* (the U.S.);

D_{1ijt} = a dummy variable that includes country (*j*) if a member of ASEAN;

D_{2ijt} =a dummy variable that includes country (*j*) if a member of EU;

D_{3ijt} = a dummy variable that includes country (*j*) if a member of SAARC;

D_{4ijt} = a dummy variable that includes country (j) if located in East Asia (Japan, China, HK and South Korea);

D_{5ijt} = a dummy variable that includes country (j) if its official language is English;

D_{6ijt} =a dummy variable that includes country (j) if it has a free trade agreement with U.S., excepting for NAFTA countries (Canada and Mexico)

D_{7ijt} = a dummy variable that includes country (j) if a member of NAFTA;

Finally, μ_{ijt} is the error term and β_0 is a constant term.

We choose nominal GDP as the proxy for importers and exporters' economic size, although gross national product (GNP) or GDP per capita are also used in some studies. Empirical evidence discussed by previous researchers show that GDP is the most commonly measure of the economic size. A country that has a larger economic size has the capacity to trade more with others. Therefore, we predict a positive sign for GDP for all *j* as well as GDP for U.S. Also we expect a negative impact of geographical distance on U.S. goods import.

The trade-GDP ratio, also called trade openness ratio, is often used as a proxy for the degree of openness of a country and measures the importance for this country of international transactions relative to domestic transactions. This indicator is calculated for each country as the sum of exports and imports of goods and services relative to GDP. Frankel and Rose (2002) argue that countries that engage in more trade have much higher level of GDP per capita than countries that engage in less trade. Data for this ratio come from the WDI. We expect that a country with a higher degree of openness tends to trade more.

The several dummy variables in the model take into account the existence of several free trade areas of which the U.S. is either a member (e.g. NAFTA), or not (e.g. E.U., ASEAN etc.). Positive signs are expected for these regional binary variables when U.S. is included in the FTA. However, when the U.S. is not part of the agreement then the parameters estimate could be negative, reflecting trade creation effects between members of the FTA and trade diverting effects between the FTA and outside members including U.S. Also based on suggestions of many empirical studies, the dummy variable "common language" takes into account countries that have English as official language. We predict that this specific language factor is positively correlated to U.S. goods imports.

Besides, selection tests summarized in the literature review section, are used. The first consideration is the decision between fixed and pooled OLS or random effect and pooled OLS. The Breusch and Pagan Lagrange multiplier (BP-LM) test is applied to check whether the country-specific effect error variance components are zero. It is tested in order to select between random effects and pooled OLS (Park 2011). The result in our estimation shows a rejection of the null hypothesis. This indicates that the random effect model is preferred to the pooled regression model. Moreover, rejection of the null hypothesis of the F test shows that the fixed effect model is preferred to the pooled OLS. The second step in model selection is to choose between random effect and the fixed effect models. The Hausman test in our estimation shows that the random-effect model is more appropriate than the fixed-effect model because we cannot reject the null hypothesis that there is exogeneity in unobserved country-specific effects. Therefore, based on the above statistic tests, the random effect model is the most efficient estimation method in our study.

4. Basic estimation and results

Our estimation of the basic (non augmented) gravity model starts with the pooled OLS method. All estimation have been done with STATA software version 12. U.S. goods imports from its trading partners are regressed on gross domestic product (GDP) and geographical distance (Distance) for the period 1993 to 2012. Results are shown in Table 1. The R-square in Table 1 shows that the model explains 60 percent of the total variation of U.S. merchandise imports across the data set during the period considered. Also, as shown in Table 1, estimated parameters of GDPs for U.S. and its trading partners are positive and statistically significant. This result indicates that countries' economic sizes influence U.S. merchandise imports. A higher U.S. GDP will result in U.S. importing more goods from the rest of the world. Also, the significance of the exporters' GDP implies that a country with a larger economic size tends to export more goods to the U.S. Moreover, as expected, the distance coefficient is statistically significant and has a negative impact on U.S. goods import and is statistically significant. That is, U.S. tends to import less from more geographically distant countries.

The estimation results of the augmented gravity model are presented in Table 2. Three different approaches are estimated: pooled OLS, fixed effects, and random effects models. Most of the independent variables have the expected sign and are statistically significant. The second column of Table 2 shows the estimation results for the pooled OLS estimator. Column (4) and (5) show the estimation results of the two-stage regression of the fixed effects model. Column (4) illustrates the result of the within fixed effects method. The within fixed-effects is the first stage of the two-stage regression model, and it introduces heterogeneity. The result shows that all time-invariant variables (distance and dummy variables) are absorbed in the constant term. Column (5) presents estimation results by using a least square dummy variables (LSDV) approach. The LSDV estimator provides the country-specific fixed effects estimation, which is the second step of the two-stage regression procedure. Unlike the within fixed-effect method, it works for all time-invariant variables in the model. Finally, Column (3) illustrates the results of the method using a random effects estimator. The model introduces heterogeneity, but unlike the fixed-effects model it minimizes the loss of degree of freedom and presupposes a specific distribution (i.e, each country differs in its error term) (Jordann and Eita, 2007).

As mentioned earlier, on the basis of BP-LM test and F test, the fixed effects and random effects model are preferred to the pooled OLS model. The result of BP-LM test in our model is:

$$\chi^2(1) = 3395.8, P = 0.000$$

which shows a rejection of the null hypothesis of the BP-LM test that there is no heterogeneity across country *j*. The result of F test shows a rejection of the null hypothesis, which indicates that the fixed effects model is more appropriate than the pooled OLS model:

$$F(49, 943)=32.60, P=0.000$$

According to the Hausman test, the random effects model is finally accepted as the most appropriate model. The result of Hausman test shows that we cannot reject the null hypothesis, which means country *j's* heterogeneity is uncorrelated to each other, thus:

$$\chi^2(4) = 7.12 \quad P=0.130$$

Therefore, discussion will focus mainly on the estimation results obtained from the random-effects model. The primary advantage of the random effect over the fixed effect method is that it allows time-varying variables and time-invariant variables to correlate (Kenneth A. Bollen and Jennie E. Brand, 2011).

The R-square value in the random-effects model (Column 3) shows a within estimation value of 0.6, which indicates that the model explains 60 percent of the total variation in U.S. imports. The R-square is relatively small. However, recent studies pointed out that a low R-square is common for panel data (Herrmann and Mihaljek, 2010).

The estimated coefficients are typically significant and usually carry the expected sign. The positive and high statistical significance of GDPs provide evidence that a country's size plays a vital role for both importer (the U.S.) and exporters (country j). The results show that a one percent increase in U.S. GDP boosts domestic consumption and increases U.S. import by 0.93 percent. Similarly, one percent increase in the trading partners' GDP raises their exports to the U.S. by 0.74 percent. The estimated coefficient of GDPs are frequently found to be "close" to unity in the empirical literature (Head, 2003, and Shepherd, 2013) with values ranging anywhere between 0.7 and 1.1. Thus, our estimated coefficients for GDPs are staying at a reasonable range based on empirical evidence from previous studies.

The geographical distance parameter is highly statistically significant at 1 percent level and has a negative impact on U.S. goods import. This result confirms our initial assumption that greater geographical distance impedes bilateral trade flows between U.S. and its partners, as distance generates higher trade costs. The coefficient value indicates that when geographical distance between U.S. and any of its suppliers increase by 1 percent, U.S. imports is reduced by 1.1 percent.

The coefficient for the trade to GDP ratio for U.S. trading partners (trade ratio for country *j*), which is commonly used as a proxy for a country's openness, carries a positive sign and it is statistically significant at a 5 % level. This result indicates that countries more open to trade export more to the U.S. This is as expected and similar results are given in previous empirical studies (e.g. Rahman, 2006). However, the coefficient of U.S. trade-GDP ratio is negative and it is statistically significant at a 5% level. A possible reason could be that U.S. has experienced a decrease in its trade-GDP ratio, especially after the 9/11 terrorist attacks and, subsequently, after the 2008 financial crisis period (Figure 4). Thus U.S. GDP may have increased more than its trade volumes during these specific periods. Therefore, U.S. imports and the U.S. trade ratio may be negatively correlated during some periods.

The regional dummy East Asia has also a positive coefficient, and it is statistically significant at the 5 percent level. The coefficient value 0.88 implies that

U.S. imports with East Asia countries is 141 percent [(exp (0.88)-1)*100][11] higher than economic size and distance would typically suggest. Among these countries, China in particular, has emerged as the largest supplier to U.S. after its participation in WTO in December 2001. Figure 5 provides explicit information about total U.S. imports and U.S. import from five major trade partners for the period 1993 to 2012. Apparent from the graph is that imports from China has increased at a very high rate, especially after 2001. It is due not only because of the WTO membership, but also thanks to the significant economic and social progress of China over the past two decades. Some researchers believe that cheap labor costs have played a crucial role in China's trading success (Amponsah and Boadu, 2002). However, this opinion is questioned by an increasing number of studies, which point out that China has no price competitive advantage compared to competitors such as India, Vietnam and Indonesia. The fast-developing infrastructure (e.g. transportation system, financial system, information system, exporting system, etc.) and abundance of well-trained workers (e.g. a large portion of workers have polytechnic school and higher education degrees) have made China more competitive (Chi and Kilduff, 2006; Smook, 2005).

On the contrary, the coefficient of the regional dummy in the European Union is negative, and it is statistically significant at 5 percent level. This result shows that U.S. imports 60 percent [(exp(0.469)-1)*100] less from European Union member states than their sizes and distance suggest. Figure 6 shows the relative value of import by U.S. from EU, NAFTA and East Asia since 1993. The diagram indicates a slower

[11] The model is specified in logarithmic form, so the coefficient of all dummy variables have to be interpreted by taking the exponent (Greene, 2013).

growth in the U.S. imports from EU member states during the two decades from 1993 through 2012. On this account, the negative sign attached to the E.U. dummy variables may suggest that the European common market signed in 1992 has been somewhat trade diverting, that is, European countries trade more between themselves and less with the rest of the world, including the U.S. As well, during this time horizon until 2008 the Euro appreciated strongly with respect to the U.S. dollar, making European goods less competitive**.** Countries such as European countries with higher income tend to be service-oriented, while, low-income countries often trade more in merchandise. Therefore, this might also indicate that U.S. imports less goods but more service from European countries than Asian countries (which is not included in our data set). Unlike the European union case, the dummy variable for ASEAN countries is statistically insignificant.

In the augmented model, we also have a dummy variable tracking existing FTAs between U.S. and trade partners (FTA_{ij}) and a separate dummy variable for NAFTA, given the historic importance of this trade agreement. We observe a (0.542) an insignificant effect of NAFTA and an insignificant effect for other FTAs as well. In fact, the statistical significance of NAFTA on U.S. import has been discussed by several researchers. An empirical investigation by Chi and Kilduff (2010) shows that between 1995 and 2006 NAFTA has a significant impact on U.S. apparel imports. On the contrary, some studies suggest that NAFTA has a weak "trade-enhancing effect" on member states because high levels of trade had already been achieved before NAFTA's implementation (Soloaga and Winters, 2001). Finally. several FTAs signed with the U.S. such as those with Israel or Columbia may be more political in nature than trade oriented.

5. Extensions

It is possible that at different periods of time, explanatory variables may have distinct impacts on U.S. imports. For example, FTAs agreements may not have actual effects on U.S. imports when the agreements are signed, but only after a phase-in period. In order to investigate key determinants of U.S. imports more carefully, we add a time dummy in the augmented model. The time dummy divides the horizon into three periods. The first period includes years before the terrorist attacks of September 11 (1993-2000). The second period goes from 2001 up to the 2008 financial crisis (2001-2007). The third period is from 2008 to 2012.

Tables 3 and 4 present the regression results in the first and second periods. Similar results are found in these two estimations. Among all independent variables, U.S. trading partners' GDP, distance and trading partners' trade to GDP ratio are statistically significant at a 1% level. These results indicate that from 1993 to 2007, trading partners' economic size, degree of trade openness and geographical distance play crucial roles in determining U.S. imports. In addition, the regional dummy variables ASEAN, SARRC, East Asia and the dummy variable for common language are all statistically significant at 1% level and carry a positive sign. The regional dummy variable EU is also significant at a 1% level, but carries a negative sign. Although trade to GDP ratio for U.S. is statistically insignificant, it has a positive sign during these two periods.

Table 5 presents the estimation results after 2008 financial crisis (2008-2011). Similar to the first two periods, U.S. trading partners' GDP, distance and trading openness still have large impact on U.S. imports. However, the U.S. trade to GDP ratio carries a negative sign and is statistically significant at 5% level. One possible interpretation of this has been suggested before.

As a result, from both random effects estimation and time dummy analysis, we conclude that U.S. trading partners' economic size, geographical distance and degree of trade openness are important determinants of U.S. imports.

Although the estimation results from the random effects model do not show any statistical significant influence for the regional dummy SARRC, it is worth mentioning that the coefficient is positive and statistically significant at the 1 percent level when we add time dummies in the model (Tables 3, 4, 5). Perhaps the main reason explaining this is the rapidly increasing bilateral trade between U.S. and SARRC member countries (India, Pakistan and Bangladesh in our sample). Figure7 presents U.S. goods imports from India, which is one of the largest SARRC member states. It is apparent that starting from 1993, there was a continuous and rapid increase of imports by the U.S. from India. It can be seen in Figure7 that in 2000, total goods import value by U.S. from India was $ 10.7 million, however, this number increased to $ 40.5 million at the end of 2012 and the share of India in total U.S. imports has slightly increased over the time horizon especially in the latter years. Although countries from SARRC are not top exporters to the U.S., the sharp growth of merchandise imports by the U.S. from these countries draws attention. One of the main objectives of SARRC was to promote economic development. The SAPTA agreement[12] has played a crucial role in the economic development of SARRC countries. and its capacity to export to the world markets including the U.S. (Rajashree,1998). Moreover, cheap labor cost is one of the comparative advantages of SARRC countries, and during the period 1993-2011 Bangladesh, India and Sri Lanka specialized further in some categories of goods to the U.S. market (Chi and Kliduff, 2010).

Finally, with regards to the binary variable common language with time dummies, the estimated coefficient for countries speaking English has a positive and significant impact on U.S. imports. The estimation results show that during each sub periods U.S. imports 73.3% more from English-speaking countries relative to what they would typically do according to economic size and distance (Table3 4 5). Similar results are found in other empirical studies. See for example Iwanow and Kirkpatrick (2007), and also Grant and Andres (2010) in an application to seafood and fishery imports.

6. Conclusion

This paper analyzes determinants of U.S. imports from its 50 primary trading partners. It uses an augmented gravity model and, based on several tests, the random effects model has been selected.

[12] The agreement on SAPTA was signed on 11 April 1993. The purpose of the agreement is to promote and sustain mutual trade and economic cooperation within SARRC region.

Our estimation results confirm the well established facts that economic sizes of trade partners and geographical distance are statistically significant determinants of U.S. imports.

Also U.S. trading partners trade to GDP ratio has a positive impact on U.S. goods import. In other words, U.S. would trade more with countries that have a higher degree of trade openness. This result confirms the empirical finding suggested by Helliwell (2002) that countries which are main bases of international direct investment and international manufacturing capacity, usually prefer more open trading arrangements. However, the relationship between U.S. imports and U.S. trade to GDP ratio has changed over time from a positive to a negative relationship. In addition, we found a positive and statistically significant effect of the regional dummy variable SAARC. As Rajashree (1998) mentions, the member countries of SAARC oriented themselves more to international trade and have exported more to U.S. The SAPTA agreement between SAARC members also expanded foreign trade dramatically, especially for India. In addition, the estimation result shows that U.S. imports more goods from East Asia than distance and economic sizes suggest. This reinforces the fact that East Asian countries have become top exporters in the world markets and in particular in the U.S. market. On the contrary, the EU dummy is significantly negatively related to U.S. goods imports. In other words, E.U. appears to export less to the U.S. than its economic size and geographical distance suggest. Possible interpretations are that the 1992 European common market has been trade diverting and the strong appreciation of the euro with respect to the U.S. dollar since its launch in 2002.

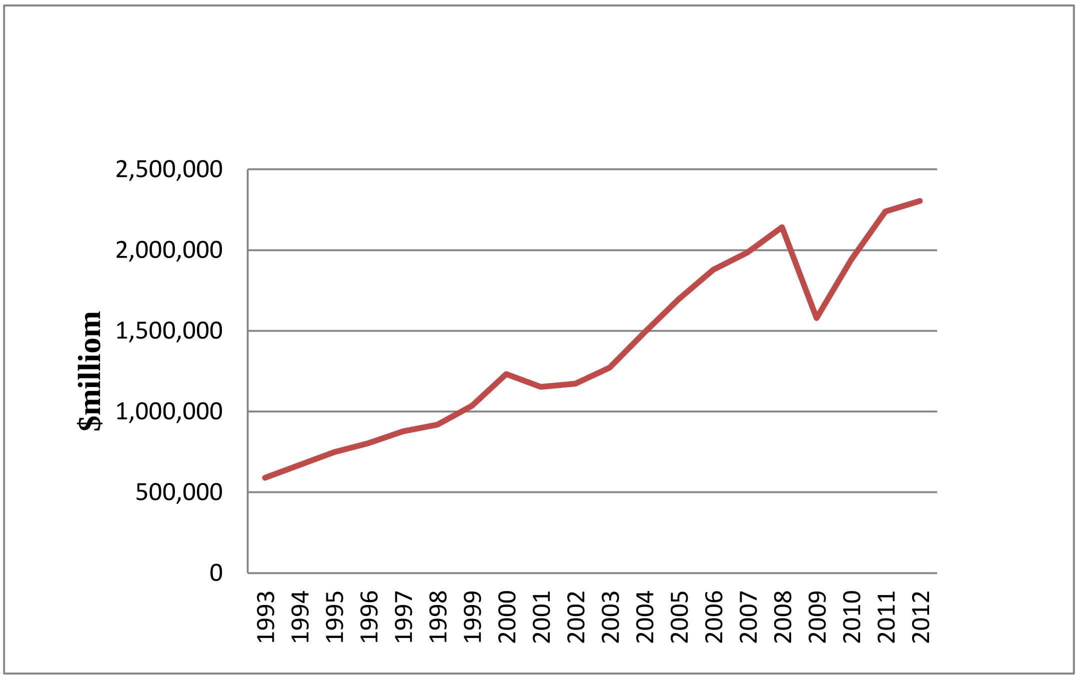
Moreover many evidence from previous empirical studies show that there are significant border effects for the industrial countries (i.e. members of the EU) and very much higher border effects for developing countries. Yet, developing countries have increase their share in total import from the U.S.(Helliwell, 2002)

Surprisingly, NAFTA does not seem to have influenced statistically trade between Mexico and Canada with the U.S. This is an unexpected result because other researchers such as Ting and Peter (2010) did find that NAFTA had a positive statistically significant impact. Helliwell (2002) mentions that the gravity model more or less proves that any closing of the income and openness gaps between rich and poor countries will indicate that an increasing fraction of trade and world GDP will take place outside North America. He suggests that Canadian trade with overseas countries will expand faster than Canadian trade with the U.S. over the next fifty years. In addition, after the 9/11 attack, heightened border security required by U.S. resulted in long delays in clearing both people and goods moving from Canada to U.S. One fact that needs to be researched further is whether the post 9/11 security measures partially or totally offset the beneficial effect of NAFTA.

Finally we found that English as an official language in the export countries is a factor contributing positively to U.S. imports. As suggested by Head (2003), the lack of a common language may inhibit communication while general misunderstanding impedes bilateral trade.

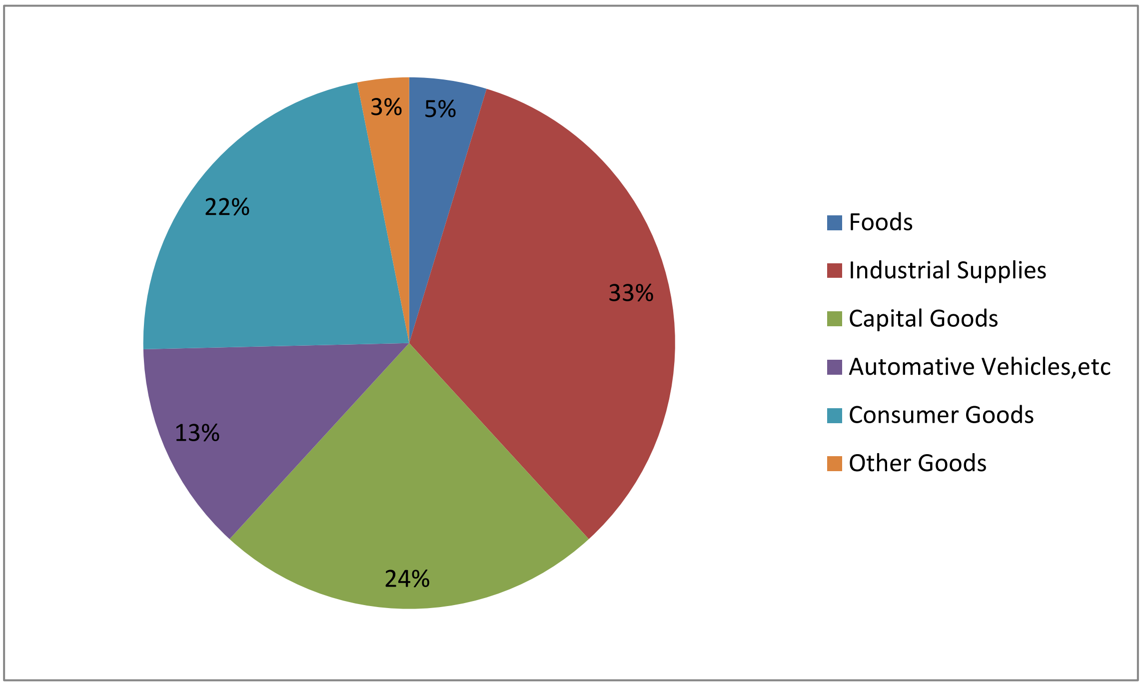
7.Appendix

Figure 1: U.S. Import in Goods-Balance of Payments (BOP) Basis. 1993-2012



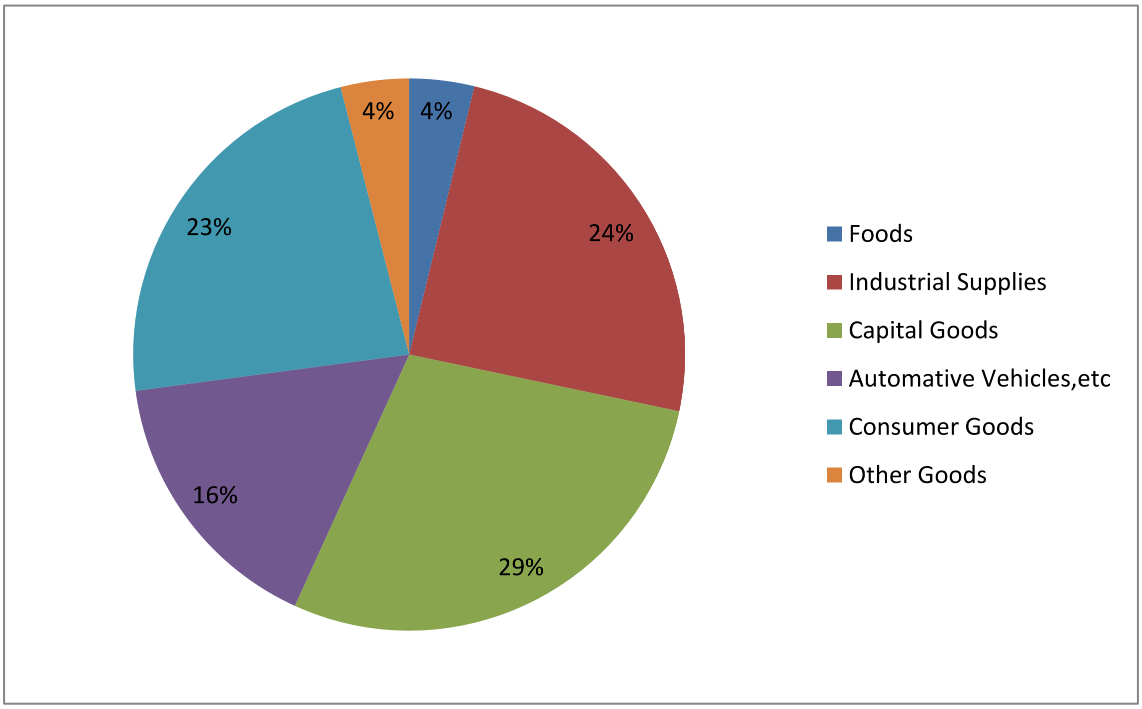
Source: United States Census Bureau

Figure 2(a): Percentage of Import Value for Top Five Goods Category in 2012



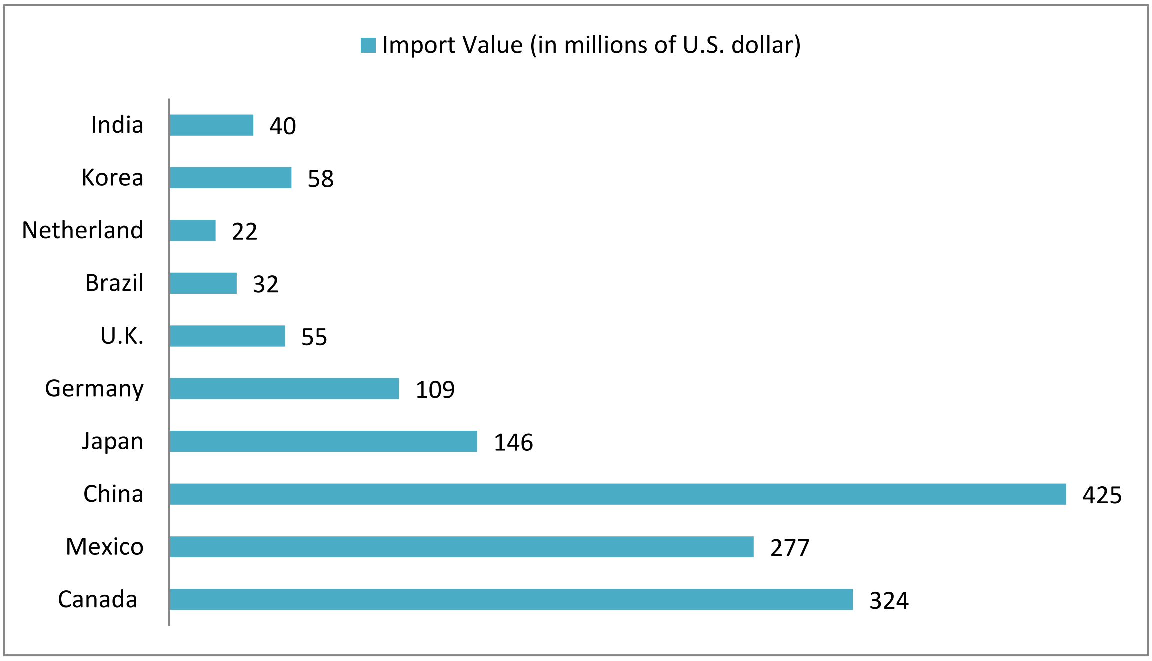
Source: United States Census Bureau

Figure 2(b): Percentage of Import Value for Top Five Goods Category in 2000



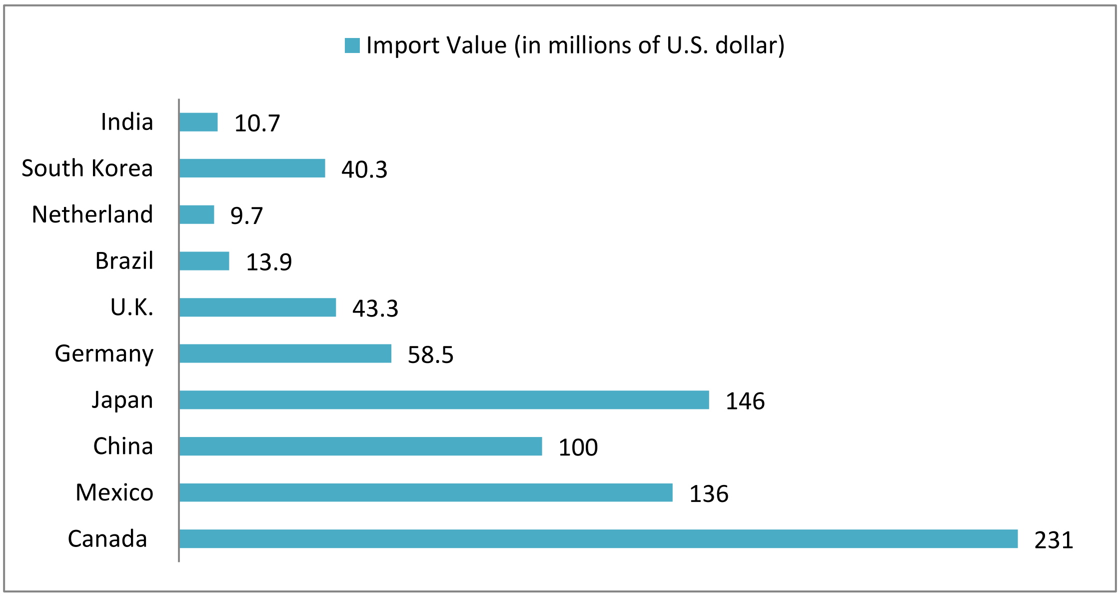
Source: United States Census Bureau

Figure 3 (a): Top 10 U.S. Import Partners in 2012



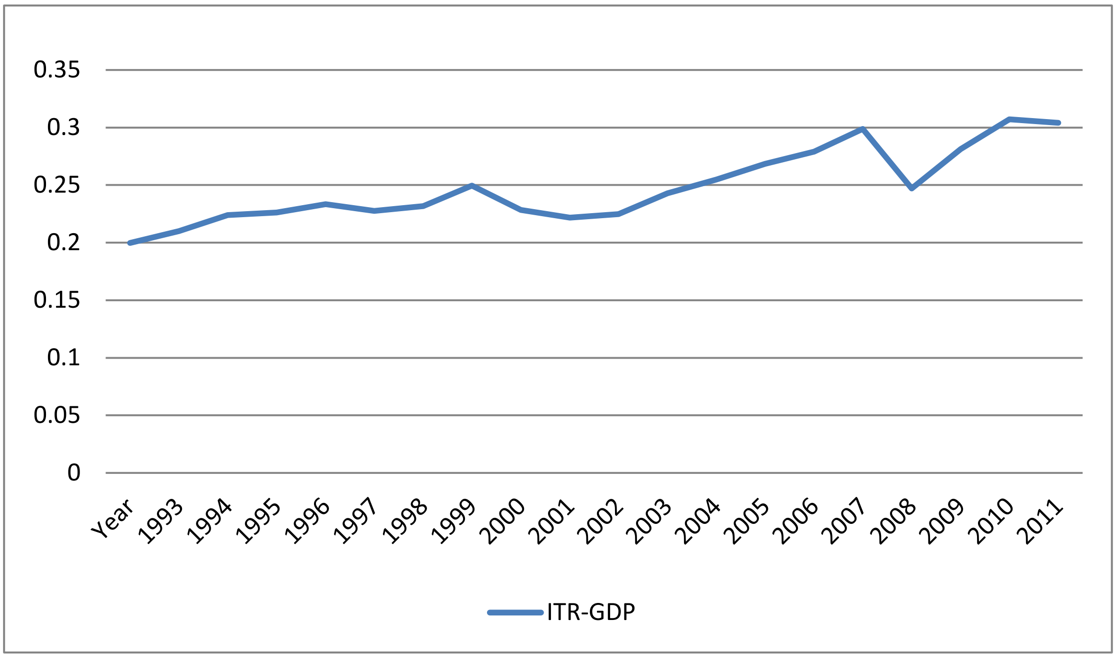
Source: United States Census Bureau

Figure 3(b): Top 10 U.S. Import Partners in 2000



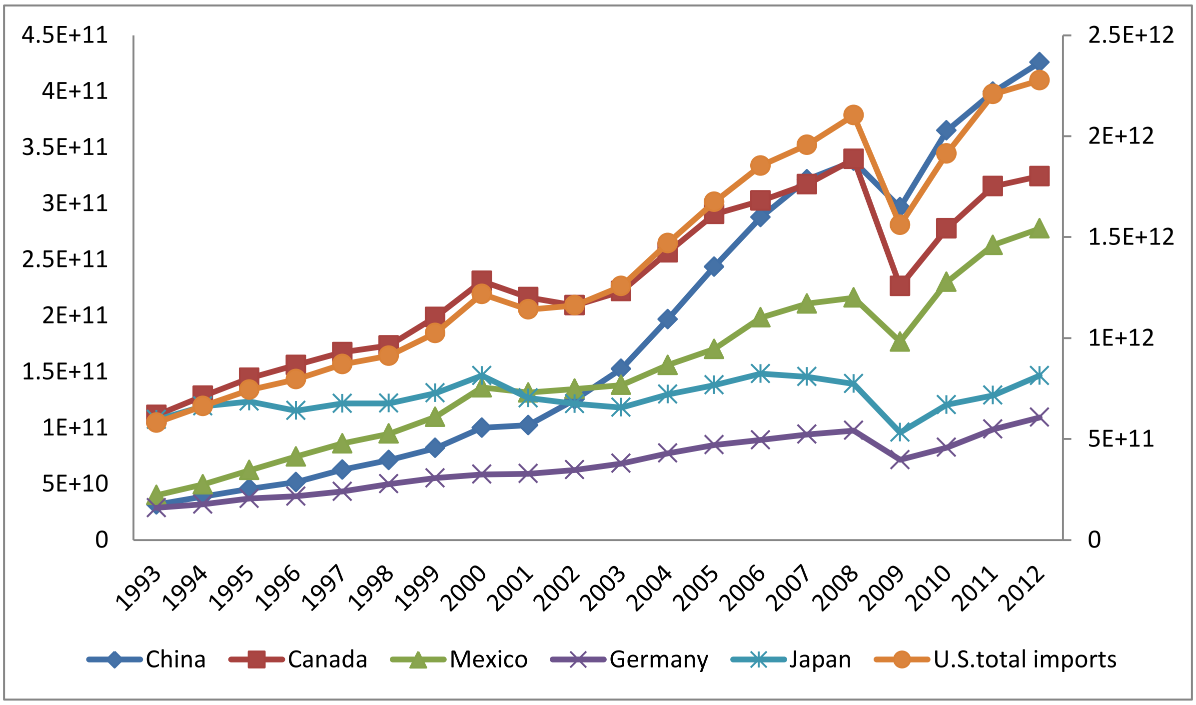
Source: United States Census Bureau

Figure 4: U.S. Trade to GDP Ratio 1993-2012



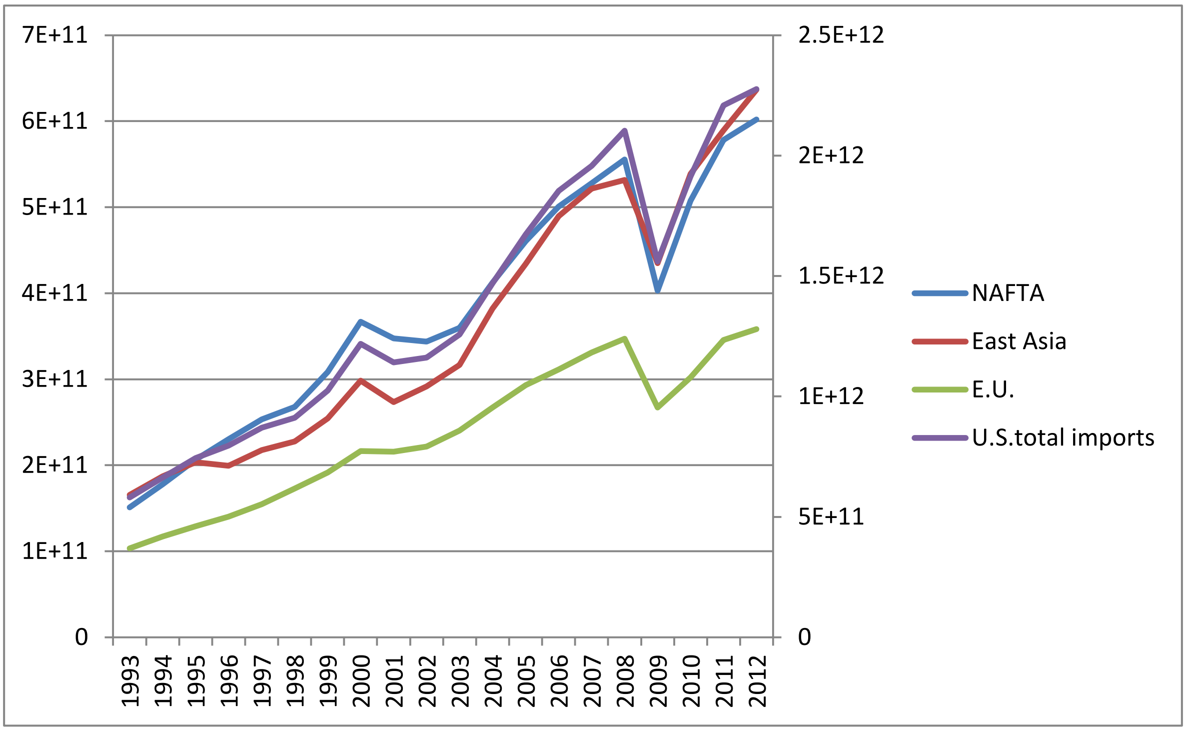
Source: The World Bank

Figure 5: U.S. Goods Import From 5 Major Trading Partners,1993-2012



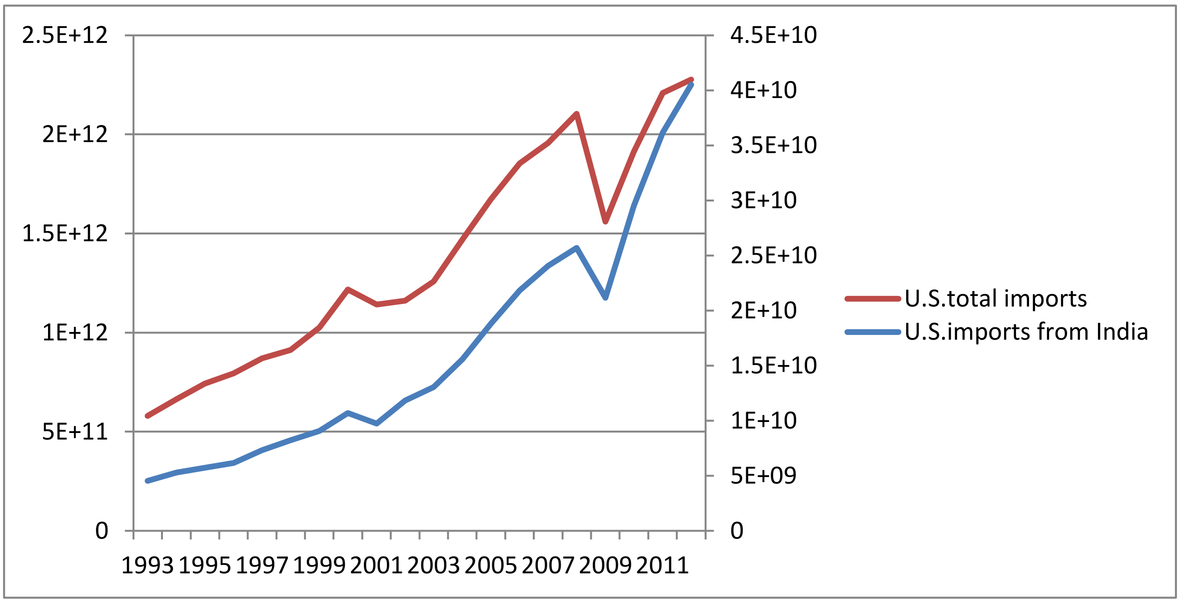
Source: United States Census Bureau

Figure 6: U.S. Goods Import From EU, NAFTA and East Asia, 1993-2012



Source: United States Census Bureau

Figure 7: U.S. Goods Import from India, 1993-2012



Source: United States Census Bureau

Table 1: Estimation results for the basic gravity model with pooled OLS

Independent Variables	Coefficient	t- Statistic
$Log(GDP_j)$	.688	10.59***
$Log(GDP_i)$	.816	4.13***
$Log(Distance_{ij})$	-.651	-2.71***
Constant	-13.757	-2.33***
R^2	0.609	
F-statistic	(3, 49) = 61.81	

*Note: ***indicates the coefficients are statistically significant at 1% significance level;*
*** indicates the coefficients are statistically significant at 5% significance level;*

Table 2: Gravity model estimation for U.S. goods import from 50 primary trading partners, 1993-2012

Independent Variables	Pooled OLS	Random effects model	Fixed Effects Within FEM	model LSDV
$Log(GDP_j)$	0.781(9.11)***	0.736(7.10)***	0.700(10.73)***	0.700(10.73)***
$Log(GDP_i)$	0.970(4.78)***	0.931(7.35)***	0.934(7.21)***	0.934(7.21)***
$Log(Distance_{ij})$	-1.184(-3.34)***	-1.104(-3.83)***	Omitted	-0.941(-4.32)***
$Trade\ Ratio_j$	0.300(1.42)	0.602(2.26)**	0.710(6.74)***	0.710(6.74)***
$TradeRatio_i$	-4.04(-3.11)**	-3.925(-3.27)**	-3.765(-3.68)***	-3.765(-3.68)***
$NAFTA_{ij}$	0.262(0.56)	0.542(0.88)	Omitted	Omitted
$ASEAN_{ij}$	1.051(2.82)**	0.688(1.19)	Omitted	-0.718(-2.57)**
EU_{ij}	-0.403(-1.48)	-0.469(-1.98)**	Omitted	-0.042(-0.15)
$EastAsia_{ij}$	1.024(2.56)**	0.878(2.22)**	Omitted	0.325(0.83)
$SAARC_{ij}$	0.495(1.61)	0.489(1.81)	Omitted	0.100(0.45)
$ComLang_{ij}$	0.550(1.56)	0.450(1.82)	Omitted	-0.204(-1.54)
FTA_{ij}	0.027(0.09)	-0.057(-0.28)	Omitted	0.240(0.57)
Constant	-15.520(-2.35)**	-14.077(-3.95)**	-23.120(-7.36)***	-14.300(-3.50)***
Within R^2		0.59	0.59	
Between R^2		0.79	0.55	
Overall R^2	0.76	0.75	0.56	0.91

*Note: ***indicates the coefficients are statistically significant at 1% significance level;*
*** indicates the coefficients are statistically significant at 5% significance level;*
The t-statistic is in the parentheses

Table 3: Gravity model estimation for U.S. goods import from 50 primary trading partners when adding time dummies, 1993-2001

Independent variables	Coefficient	t-Statistic
$Log(GDP_j)$	0.792	18.66***
$Log(GDP_i)$	-0.878	-1.71
$Log(Distance_{ij})$	-1.202	-11.09***
$Trade\ Ratio_j$	0.301	3.91***
$TradeRatio_i$	2.380	1.02
$ASEAN_{ij}$	1.064	9.08***
EU_{ij}	-0.417	-4.78***
$EastAsia_{ij}$	1.008	8.32***
$SAARC_{ij}$	0.505	5.71***
$ComLang_{ij}$	0.551	6.43***
FTA_{ij}	0.030	0.41
$NAFTA_{ij}$	0.215	1.06
Constant	38.550	2.59**
Overall R^2	0.771	

*Note: ***indicates the coefficients are statistically significant at 1% significance level;*

*** indicates the coefficients are statistically significant at 5% significance level;*

Table 4: Gravity model estimation for U.S. goods import from 50 primary trading partners when adding time dummies, 2001-2008

Independent variables	Coefficient	t-Statistic
$Log(GDP_j)$	0.784	18.58***
$Log(GDP_i)$	0.381	1.58
$Log(Distance_{ij})$	-1.190	-10.97***
$Trade\ Ratio_j$	0.297	3.78***
$TradeRatio_i$	0.884	0.41
$ASEAN_{ij}$	1.058	8.89***
EU_{ij}	-0.406	-4.64***
$EastAsia_{ij}$	1.022	8.41***
$SAARC_{ij}$	0.498	5.61***
$ComLang_{ij}$	0.551	6.46***
FTA_{ij}	0.029	0.40
$NAFTA_{ij}$	0.247	1.22
Constant	0.851	0.13
Overall R^2	0.767	

*Note: ***indicates the coefficients are statistically significant at 1% significance level;*
*** indicates the coefficients are statistically significant at 5% significance level;*

Table 5: Gravity model estimation for U.S. goods import from 50 primary trading partners when adding time dummies, 2008-2012

Independent variables	Coefficient	t-Statistic
$Log(GDP_j)$	0.786	18.68***
$Log(GDP_i)$	1.334	7.26***
$Log(Distance_{ij})$	-1.194	-11.04***
$Trade\,Ratio_j$	0.297	3.82***
$TradeRatio_i$	-6.404	-3.48**
$ASEAN_{ij}$	1.061	8.97***
EU_{ij}	-0.409	-4.69***
$EastAsia_{ij}$	1.018	8.42***
$SAARC_{ij}$	0.500	5.65***
$ComLang_{ij}$	0.551	6.46***
$NAFTA_{ij}$	0.238	1.18
FTA_{ij}	0.029	0.40
Constant	-25.867	-4.91***
Overall R^2	0.768	

*Note: ***indicates the coefficients are statistically significant at 1% significance level;*
*** indicates the coefficients are statistically significant at 5% significance level;*

References

Amini, Sharharm, M. S. Delgado, D. Henderson, and C. Parmeter. "Fixed vs Random: The Hausman Test Four Decades Later." July 30, 2012

Amponsah, W.A. and Boadu, V.O. “Crisis in the US textile and apparel industry: is it caused by trade agreements and Asian currency meltdown?”, working paper, International Trade Center, North Carolina A&T State University, Greensboro, NC.2002

Anderson, E. James."The Gravity Model." Annual Review of Economics, Annual Reviews, vol.3 (1), pages122-160,09. 2011

Anderson, E. James. and Yotov V.Yoto. " The Changing incidence of Geography." The American Economic Review, Vol 100, No.5: 2157-2186. 2010

Asteriou, Dimitrios and Hall, G. Stephen. "Applied Econometrics, 2nd ed." Palgrave macmillan.2011

Baier SL, H. Bergsrtand. "Do free trade agreements actually increase members' international trade?" 71(1): 72-95. J Int Econ 2007

Baltagi, Badi H."Econometric Analysis of Panel Data." Wiley, John & Sons. 2001

Bollen, Kenneth A.and E.Jennie E. Brand. “A General Panel Model with Random and Fixed Effects: A Structural Equations Approach." Social forces; a scientific medium of social study and interpretation 89.1 (2010): 1–34. PMC. Web. 18 Nov. 2014.

Breusch, T. S., and A. R. Pagan."The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics." Review of Economic Studies,47(1):239-253. 1980

Brown, W. M. and A.P. William."Spatial Markets and the Potential for Economic Integration Between Canadian and U.S. Region." Papers in Regional Science, 81(1): 99-120.2002

Chi, Ting. "An Empirical Investigation of the Determinants and Shifting Patterns of US Apparel Imports Using a Gravity Model Framework." Journal of Fashion Marketing and Management. 2010.

Chi, T. and P. Kilduff. “An assessment of trends in China’s comparative advantages in textile machinery, man-made fibers, textiles and apparel”, Journal of the Textile Institute,Vol. 97 No. 2, pp. 173-91.2006

Egger P. "Estimating regional trading bloc effects with panel data." 140(1): 151-66. Rev World Econ 2004

Egger P and M. Pfaffermayr. "The proper panel econometrics specification of the gravity equation: a three-way model with bilateral interaction effects." 28(3): 571-80. Empire Econ 2003

Frankel, Jeffrey and Rose, Andrew "Estimating the Effect of Currency Union on Trade and Output." NBER Working paper No.7857, Cambridge, National Bureau of Economic Research.2000

Glick, R. and K. A. Rose, (2001). "Does a currency union affect trade? The time series evidence." Retrieved January 6, 2013

Grant, Jason and Ander, Seven."Agriculture and Applied Economics Association."American Journal of Agriculture Economics 573-580. 2010

Grant, J. H., and D. M. Lambert."Do Regional Trade Agreements Increase Members' Agricultural Trade?" American Journal of Agricultural Economics 90(3): 65–82. 2008

Grant, J.H., and D.M. Lambert."Do Regional Trade Agreements Increase Members' Agricultural Trade?"American Journal of Agricultural Economics, 90(3): 765- 782. 2008

Greene, William."Export potential for U.S. Advanced Technology Goods to India Using Gravity Model Approach. Office of Economic Working Paper." U.S. International Trade Commission. 2013

Greene, William H."Econometric Analysis, 6th ed." Upper Saddle River, NJ: Prentice Hall. 2008

Hans, Linnemann." An Econometric Study of International Trade Flows."North-Holland, Amsterdam.1966

Hausman, J. A."Specification Tests in Econometrics." Econometrica , 46(6):1251-1271.1978

Head, Keith and John, Ries."Immigration and Trade Creation: Evidence from Canada." Canadian Journal of Economics 31(1)：47-62. 1998

Head, Keith." Gravity for Beginners." University of British Columbia. 2003

Helliwell, F.John."Globalization and Wellbeing" University of British Columbia

Press.2002

Helliwell F.John."How Much Do Natioanl Borders Matter?" Brookings Institution Press.1998

Hill R.Carter, Willian E. Griffiths and L. C. Guay. "Principles of Econometrics, 3rd ed." John Wiley and Sons, Inc. 2008

Hossain,Sharif M. "South Asian Free Trade Area:Implications for Bangladesh." MPRA paper No. 18517. 2009

Jordaan, A.C. and H. J. Eita."Export and Economic Growth in Namibia: A Granger Causality Analysis, South African Journal of Economics."75(3): 540-547. 2007

Jan, Tinbergen."Shaping the World Economy." The Twentieth Century Fund, New York. 1962

Kennedy, Peter."A Guide to Econometrics,6th ed." Malden, MA: Blackwell Publishing. 2008

Konstantinos Kepaptsoglou, Matthew G. Karlaftis and Dimitrios, Tsamboulas. "The Gravity Model Specification for Modeling International Trade Flows and Free Trade Agreement Effects: A 10-Year Review of Empirical Studies." The Openness Economics Journal, 2010, 3, 1-13.

Koo, W.W. and D. Karemera."Determinants of world wheat trade flows and policy analysis."Canadian Journal of Agricultural Economics, Vol. 39 No. 3, pp. 439-45. 1991

Krugman, Paul R. and O. Maurice. "International Economics: Theory and Policy. 8thed. Chapter2." Boston: Pearson Addison-Wesley. 2009

Martinez, Zarzoso. I and F. Nowak. "Augmented Gravity Model: An Empirical Application to Mercosur-European Union Trade Flows. Journal of Applied Economic, 6(2). 2002.

Matthieu Bussière, Jarko F. and S. Bernd."EU enlargement and Trade Integration: Lessons from a Gravity Model." Blackwell Publishing Ltd.2008

McCallum, John."National Borders Matter: Canada-U.S. Regional Trade Patterns." American Economic Review 85:615-23.1995

Micco. A, E. Stein, G. K. Midelfart and M. J. Viaene. "The Currency Union Effect on Trade: Early Evidence from EMU." Economic Policy, 18(37). 2003.

Mili, Roy and Md. Israt Rayhan. "Import Flows of Bangladesh: Gravity Model Approach under Panel Data Methodology." Dhaka University Journal of Science. Vol60 No.2.2012.

Park, Hun Myoung."Practical Guides To Panel Data Modeling: A Step-by-step Analysis Using Stata. Tutorial Working Paper." Graduate School of International Relations, International University of Japan. 2011

Rahman, Mohammad Mafizur."A panel data analysis of Bangladesh's trade: the gravity model approach." In: 5th Annual Conference of the European Trade Study Group (ETSG2003).2003

Rajashree, Kanungo. "SAARC Moving Towards SAFTA: Prospects of India's Regional Trade." Journal of Peace Studies Vol. 5, Issue 1, January-February.1998

Rajashree, Kanungo. "United States' Trade Relations with SAARC Countries." Journal of Peace Studies Vol. 5, Issue 4, September-October.1998

Rose, A. K."One money, one market: Estimating the effect of common currencies on trade." Economic Policy, 15(30), 7-46. 2000

Rose, A. K. and E.Wincoop."National money as a barrier to international trade: The real case for currency union." Retrieved January 6, 2013.

Shepherd, Ben."The Gravity Model of International Trade: A User Guide."ARTNET Gravity Modeling Initiative. 2013

Soloaga, I., and L. A. Winters."Regionalism in the Nineties: What Effect on Trade?" North American Journal of Economics and Finance 12: 1–29.2001