Trade Performance and Potential of the Philippines: An Application of Stochastic Frontier Gravity Model

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ABSTRACT

This study was conducted to investigate the issue of what Philippine merchandise trade flows would be if countries operated at the frontier of the gravity model. The study sought to estimate the coefficients of the gravity model. The estimated coefficients were used to estimate merchandise export potentials and technical efficiency of each country in the sample and these were also aggregated to measure impact of country groups, RTAs and inter-regional trading agreements.

Result of the study shows that technical efficiency for all sample countries is relatively large with standard deviation from the mean of 35.02% suggesting that the frontier is not so distant. The most efficient countries in the sample which recorded more than 90% efficiency were Canada, Australia, New Zealand, USA, Singapore, Denmark, Hongkong, Sweden and UK. In terms of country groups, RTA and Inter-regional trading agreements, APEC recorded as the most efficient trade agreement of the Philippines. The Philippines was also able to established strong link among countries in East Asia, members of AFTA. ASEAN and EU posed export potential. In a country level, China and members of the ASEAN such as Vietnam, Indonesia, Thailand, Cambodia and Malaysia posed the highest export potential for merchandise exports.

The significant determinants of these potentials are the expanding market of developing economies and lower trade cost. Then dominance of APEC countries in trade efficiency was verified by the result of the trade inefficiency effect model. Factors reducing technical inefficiencies were membership to APEC, reduction of corruption, and freer business environment. Membership to ASEAN and WTO turns out insignificant in reducing trade inefficiencies of the Philippine exports to member countries.

Keywords: Merchandise exports, Gravity, Stochastic, export potential

INTRODUCTION

Trade is the exchange of goods and services across regions and national borders was considered important in improving welfare of people even before the birth of economics as organized science in 1776. The mercantilist philosophy maintained that

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the way for a nation to be rich and powerful was to export more than to import. The Philippines is one of the world's oldest open economies, which traded goods even prior to its discovery by the western world. For more than a century however, it experienced widening gap between exports and imports which causes trade deficit. This means that the country is not trading at its potential, which maybe due to its institutional and infrastructures rigidities or the rigidities of its trading partner which will be explored in this study.

Transactions of the Philippines with the rest of the world are recorded in the Balance of Payment (BOP) which shows country's external economic position. The BOP is composed of current, capital and financial account. Figure 1 shows a positive BOP position of the Philippines since 2004 which reflects a positve extenal position. This means that financial inflow to the Philippines is greater than outflow to the rest of the world.

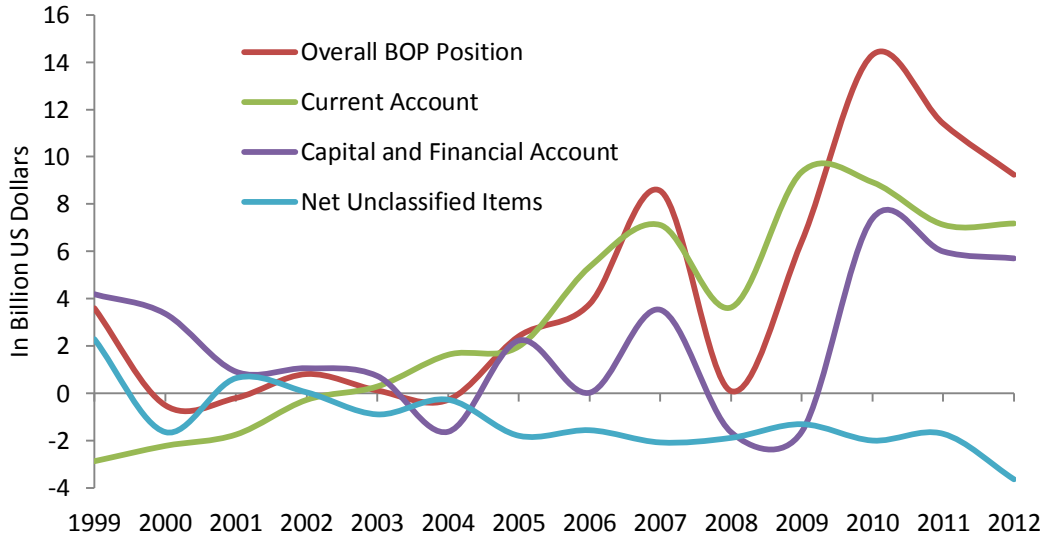

Figure 1. Balance of payment (BOP), Philippines, 1999-2012.
Source of Data: Philippine Institute of Development Studies
http://econdb.pids.gov.ph/tablelists/table/153

Current account as one of the components of the BOP shows the flows of goods and services, income and current transfers. It was observed that the Philippines have been operating a current account surplus since 2003 (pushing the BOP), despite a large trade deficit as reflected in Figure 2. Current account surplus stimulates domestic production and income while the deficit dampens domestic production and income. This surplus in the current account is accounted to current transfers and strong remittances inflows of Overseas Filipino Workers (OFW) which are represented as income. Moreover, trade of goods and services pulls current account surplus. This pulling of current account due to trade of goods and services is called trade deficit.

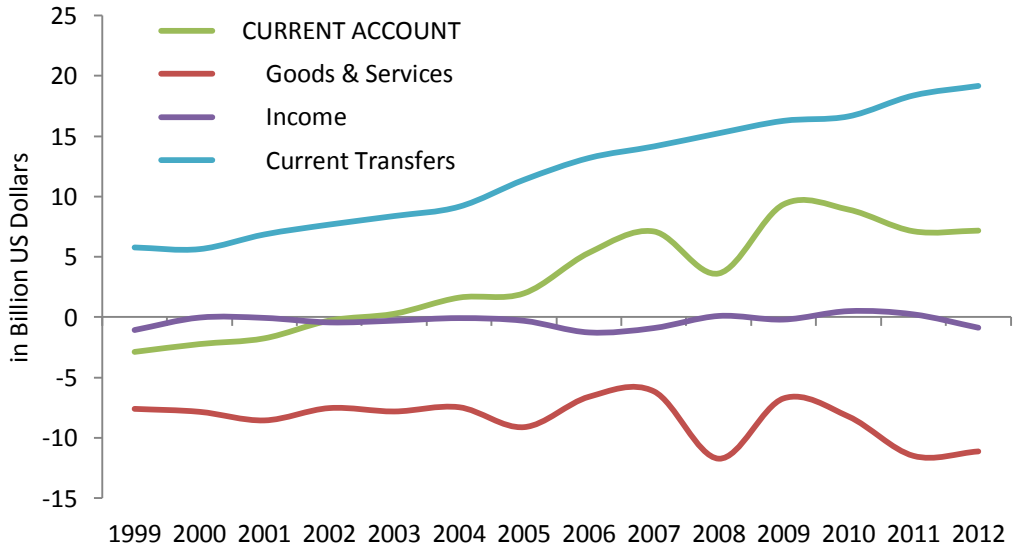

Figure 2. Current account balance, Philippines, 1999-2012.
Source of Data: Philippine Institute of Development Studies
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Trade deficit is an economic measure of a negative balance of trade in which a country's import exceeds its export (Figure 3) which was observed in the Philippines for

decades. Figure 4 show that huge trade deficit was accounted to large deficit on traded goods. A trade deficit represents an outflow of domestic currency to foreign markets. Furthermore, it causes the strengthening of foreign currency against the home currency which results in expensive importation of goods and services as compared to exportation home-produced goods and services. These are the impacts of devalued home currency (peso) and if significantly large can cause BOP deficit.

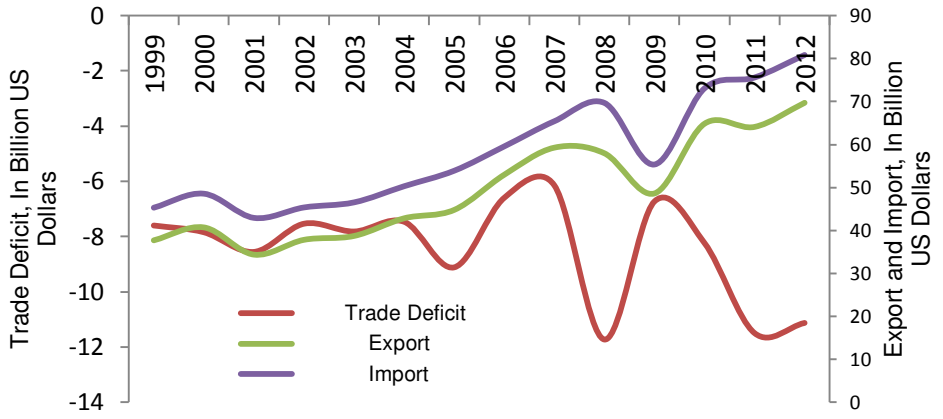

Figure 3. Trade Deficit (export - import), 1999-2012.
Source of Data: Philippine Institute of Development Studies
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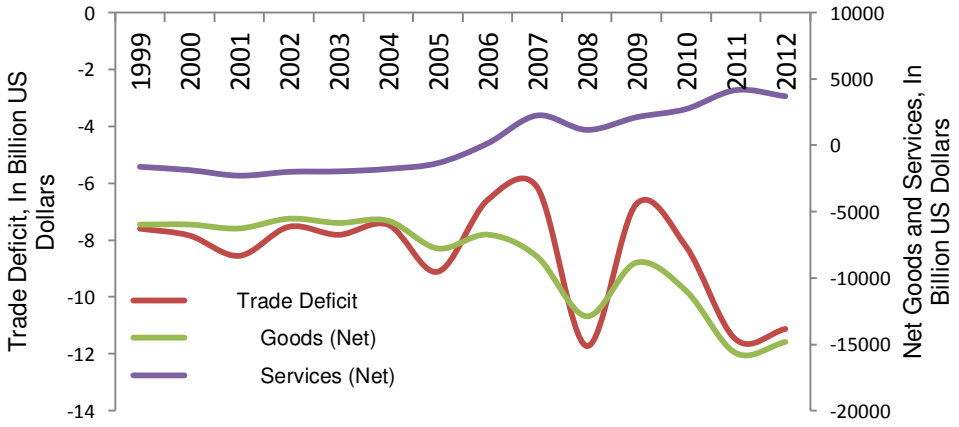

Figure 4. Trade Deficit (goods + services), 1999-2012.
Source of Data: Philippine Institute of Development Studies
http://econdb.pids.gov.ph/tablelists/table/153

The characteristics of exports and global trade are radically changing as the world recovers from the recent global financial crisis and the natural disasters in Japan. Moreover, the unfolding political events in the Middle East and North Africa (MENA) will contributed to volatile market conditions. The key features are the speedy growth of emerging economies with large consumer populations and the sluggish single-digit growth of developed markets. This will result in the re-balancing of consumption, export market size and supply chain configurations in relation to pre-crises periods (PEDP, 2011-2013).

These changes in global export environment pose opportunities for the Philippines to grow exports of merchandise and services. This leads the Philippines to target a forty percent (+40%) increase in export by 2013 and to exceed Philippine exports by one hundred twenty billion U.S dollars (US$ 120B) by 2016 as targeted in the Philippine Export Development Plan (PEDP). The 2016 target is more than twice compared to the 2012 Philippine export value of US$ 57.5B (BSP Database). It was stated in the PEDP that this target will be achieved through core strategies as follows: (a) develop Key Export Sectors that have high potential for growth, (b) maximize benefits of Free Trade Agreements (FTA) and (c.) target high-growth emerging markets. Achievement of this target requires understanding of the factors that prevent the Philippines to reach its export potential. These factors could be explored to achieve the target of PEDP.

Conventional trade study uses Gravity Model to explain trade flows between two countries as directly proportional to the product of each country's 'economic mass' that can be measured by their Gross Domestic Product (GDP) and inversely proportional to

the distance between the countries (Anderson, 1979). This model was derived from different theories but was criticized because of weak theoretical foundations. This is rectified the recent work to the point where Frankel, Stein and Wei (1997) claimed that the gravity model has "gone from an embarrassing poverty of theoretical foundation to an embarrassment of riches" as cited by Armstrong (1997). This model was very successful in analyzing trade flows. However, this cannot provide estimates of trade potential if estimated using the Ordinary Least Square (OLS) regression analysis as the commonly used method in estimating conventional gravity models.

Earlier studies have estimated the difference between observed values and the estimated predicted values by using the gravity equation through OLS estimates as potential trade (Baldwin, 1994 and Nilsson, 2000) between a pair of countries. The OLS estimation procedure produces estimates that represent the centered values of the data set. However, potential trade refers to free trade with no restrictions to trade. Thus, for policy purposes, it is rational to define potential trade as a maximum possible trade that can occur between any two countries, which has liberalized trade restrictions the most, given the determinants of trade. This means that the estimation of the potential trade requires a procedure that represents the upper limits of the data and not the centered values of the data (Kalirajan, 2007). To address this, the concept of stochastic production frontier analysis which deals with the upper bound of the data set to measure the maximum possible output is utilized (Drysdale et al., 2000).

This thesis is an attempt to investigate the trade patterns and constraints of the merchandise exports of the Philippines using the gravity stochastic frontier model. It seeks to analyze factors affecting trade of merchandise export. It also aims to come up

with technical efficiency estimates for each of the trading partner. Further, the study attempt to assess if multilateral agreements of the Philippines increase the volume of Philippine trade. The factors considered in this study are “beyond the border” constraints and natural constraints to trade. This will also estimate export potential and compare it with actual export performance to see whether there are still some opportunities to ensure the surplus of the current account of the balance of payments by increasing the volume of exported goods. Estimation of the model will follow the proposed method of Drysdale et al., (2003) and Kalirajan and Finley (2005). The study includes comprehensive measures of “beyond the border” constraints which are product of recently established country specific indices which are not included in the studies in the literatures.

Knowing the trade potential and factors affecting it could narrow down trade deficit especially in merchandise export. Narrowing the trade deficit is an advantage of the country as it will be reflected in a trade surplus of current account balance. The surplus of the current account of BOP is a full factor for the Philippines to achieve an investment grade sovereign rating which boost capital inflows and positive factor for the Philippines Economic fundamentals like appreciation of Philippines peso against US dollars.

Understanding the rigidities that affect export flows could help policy maker’s efforts to minimize or at least mitigate the effects of existing restrictive measures of trade growth, i.e., engaging in bilateral and multilateral agreements and processes. Therefore the objective of every country is to try to achieve its full trade potential through the engagement process or even through unilateral reforms. It is of significant

importance that each country may know its full potential with other countries or other regions in order to get the engagement process started. Enhancement of this trade flows will enhance welfare of people.

OBJECTIVES OF THE STUDY

This study aims to analyze the export flows between the Philippines from 2008 to 2012 based on 90 trading partners of merchandise exports. Specifically, the study aims:

1. to estimate the potential trade between the Philippines and its trading partners;
2. to estimate the technical efficiency of Philippine merchandise exports to each trading partners; and,
3. to determine the constraints to Philippine trade.

THE GRAVITY MODEL

The Gravity Model is based on the law of universal gravitation in physics developed by Isaac Newton in 1687 which described the gravitational force between two masses in relation to the distance that lies between them (Newton, 1687), that is

$$F_{ij} = G\frac{M_i M_j}{d_{ij}^2} \qquad (1)$$

The gravitational force F_{ij} is proportional to the product of the two masses M_i and M_j and inversely proportional to the square of the distance d_{ij} that keeps the two masses apart from each other. The gravitational constant G is an empirical determined value.

This relationship is applicable to any context where the modeling of flows or movements is demanded (Starck, 2012).

The gravity equation was first applied to international trade flows by Timbergen in 1962. He assumed the relationship as in equation 3.

$$X_{ij} = A\frac{Y_i^{\alpha}Y_j^{\beta}}{D_{ij}^{\gamma}} \qquad (2)$$

There is a direct proportionality between the explanatory variables and the variable to be explained is not necessary implied. The exponents α, β and γ can therefore take values different from 1. These are elasticity of the exporting country's GDP (α), the elasticity of the importing country's GDP (β) and the elasticity of distance (γ). Where, α=β=1 and γ=2, in equation 3, will correspond to the universal gravitation equation of Isaac Newton. By taking the natural logarithm of equation 3 and by adding the error term ε_{ij} a linear relationship is obtained. This is traditionally estimated using the Ordinary Least Squares (OLS) regression analysis; the coefficients can be interpreted as elasticities.

$$\log(X_{ij}) = \log A + \alpha \log(Y_i) + \beta \log(Y_j) - \gamma \log(D_{ij}) + \varepsilon_{ij} \quad (3)$$

Anderson (1979) was one of the first economists who developed a sound theoretical foundation of the gravity model that brought gravity model into mainstream economics. The development of the Anderson's theoretical foundation of gravity model was gradual. His work became the basic theoretical framework for a gravity model of trade flows with the basic assumptions of homothetic preferences for trade goods across countries and using the constant elasticity of substitution (CES) preferences.

Anderson yielded the specification of aggregated trade flows as Anderson's final gravity equation

$$X_{ij} = \frac{Y_i \Phi_i}{\sum_j Y_j \Phi_j \frac{1}{f(d_{ij})}} \cdot \frac{\Phi_j Y_j}{f(d_{ij})} = \frac{Y_i \Phi_i \Phi_j Y_j}{f(d_{ij})} \left[\sum_j Y_j \Phi_j \frac{1}{f(d_{ij})} \right]^{-1} \quad (4)$$

Adding the error term ε_{ij}, equation 17 can be rewritten as

$$X_{ij} = \frac{Y_i \Phi_i \Phi_j Y_j}{\sum_j Y_j \Phi_j} \frac{1}{f(d_{ij})} \quad \left[\sum_j \frac{Y_j \Phi_j}{\sum_j \Phi_j Y_j} \frac{1}{f(d_{ij})} \right]^{-1} \varepsilon_{ij} \quad (5)$$

where,

X_{ij} = Exports of country i to country j

Y_i= Income in country i

d_{ij} = Distance between country i and country j

Φ_i = The share of expenditure on all traded goods and services in total expenditure of country $\Phi_i = F(Y_i N_i)$, where N_i is the population in country i

Inherent Bias of the Gravity Model

According to Anderson (1979), the log linear of equation 18 resembles the standard gravity equation in equation 4, with an important difference. This difference is the bracket term in equation 18 which is:

$$\left[\sum_j \frac{Y_j \Phi_j}{\sum_j \Phi_j Y_j} \frac{1}{f(d_{ij})} \right]^{-1}$$

This is missing in the generally used empirical specification of the gravity model presented in equation 4. Anderson (1979) described this term as "the flow from i to j depends on economic distance from i to j relative to a trade weighted average of

economic distance from i to j to all points in the system. Measuring the correct specification of the relative economic distance term is difficult because researchers do not know all the factors affecting this term. The economic distance can be affected by many factors, including institutional, regulatory, cultural and political, which are difficult to measure completely. These factors are referred to as 'behind the border' constraints of the importing countries or constraints to export.

Omission of this term in the empirical work of gravity model leads to the biasness of the estimation. This is because the term in the square brackets (economic distance term) of equation 18 affects the log-normal distribution of the error term. Therefore, the expected value of the error term is no longer zero ($E(Uij) \neq 0$) and the normality assumption of OLS is violated. This omission leads to heteroskedastic error terms and the log-linearization of the empirical model in the presence of heteroskedasticity leads to inconsistent estimates because the expected value of the logarithm of a random variable depends on higher-order moments of its distribution (Silva and Tenreyro, 2003 as cited in Miankhel et al., 2009). Therefore, the OLS estimation on such gravity equations will be biased.

Aside from the violation of the OLS normality assumption, the estimation of these conventional gravity models through OLS provides the values at the mean of the observation or sample countries. This is problematic in determining trade potential which requires identifying the upper bound. To address these problems, the concept of stochastic production frontier analysis was incorporated to the gravity model. In this case, export potential is conceptually similar to a firm producing at the *frontier*.

STOCHASTIC FRONTIER GRAVITY MODEL

The Gravity Stochastic Frontier Model is the Integration of Gravity Model and Stochastic Frontier Production Function Model which was formally introduced by Kalirajan (2000) to address the inherent bias of the conventional gravity model of trade and to estimate potential trade flows.

With a stochastic frontier approach, the gravity equation can be written as:

$$lnX_{ijt} = lnf(Y_{ijt};\beta)exp^{(v_{ijt}-u_{ijt})} \qquad (6)$$

where the term X_{ijt} represents the actual exports from country i to country j. The term $f(Y_{ijt};\beta)$ is a function of the determinants of potential trade (Y_{ijt}) and β is a vector of unknown parameters. The single sided error term, u_{ijt} is the economic distance bias referred by Anderson (1979), which is due to the influence of the "behind the border measures" of the importing country. This bias creates the difference between actual and potential trade between two countries. u_{ijt} takes value between 0 and 1 and it is usually assumed to follow a truncated (at 0) normal distribution, $N(\mu, \sigma_u^2)$. When u_{ijt} takes the value 0, this indicates that the bias or country-specific "behind the border constraints" are not important and the actual exports and potential exports are the same, assuming there are no statistical errors. When u_{ijt} take the value other than 0 (but less than or equal to 1), this indicates that the bias or country-specific "behind the border" constraints are important and they constrain the actual exports from reaching potential exports. The double-sided error term v_{ijt}, which is usually assumed to be $N(0, \sigma_v^2)$, captures the influence on trade flows of other left out variables, including measurement error that are randomly distributed across observations in the sample.

Export potential is conceptually similar to a firm producing at the frontier. When a firm is producing at the frontier, it has achieved economic efficiency which is composed of technical and allocative efficiency (Kalirajan and Shand, 1999). It is then argued that when a country achieves its trade potential or is trading at the frontier, the country is trading in the most efficient manner. Export potential is defined as the export achieved when there is least resistance (least inefficiencies) to trade given the current trade, transport and institutional practices (Drysdale et. al., 2000; Kalirajan, 2000; Armstrong, 2007). In other words, export potential is explained as the maximum possible value of exports that could hypothetically be attained using the most open (most efficient) trade policies observed. Following from this argument, we can define export performance (the achieved export efficiency of the economy) as the ratio of actual to potential exports as shown in equation 7.

$$TEX_{ijt} = \frac{f(Y_{ijt};\beta)\exp(v_{ijt} - u_{ijt})}{f(T;\beta)\exp(v_{ijt})} = \exp(-u_{ijt}) \qquad (7)$$

The advantages of the suggested method of estimation of the gravity model are as follows: Firstly, it does not suffer from loss of estimation efficiency. Secondly, it corrects for the economic distance bias term, which is creating heteroskedasticity and non-normality, isolating it from the statistical error term. This isolation property will enable us to examine how effective are the importing countries “behind the border constraints” as major trade constraints. Thirdly, the suggested approach provides potential trade estimates that are closer to frictionless trade estimates. This is because the approach represents the upper limits of the data, which come from, those economies that have liberalized their trade restrictions the most (Miankhel, et al., 2009).

Finally, the suggested method bears strong theoretical and trade policy implications towards finding ways of minimizing unilateral impacts to volume of trade.

CONCEPTUAL FRAMEWORK OF THE STUDY

The flow of the study and variables are presented in Figure 8. The study will utilize secondary data from various sources to estimate the Gravity Stochastic Frontier and determine the export potential of the Philippines to trading partners.

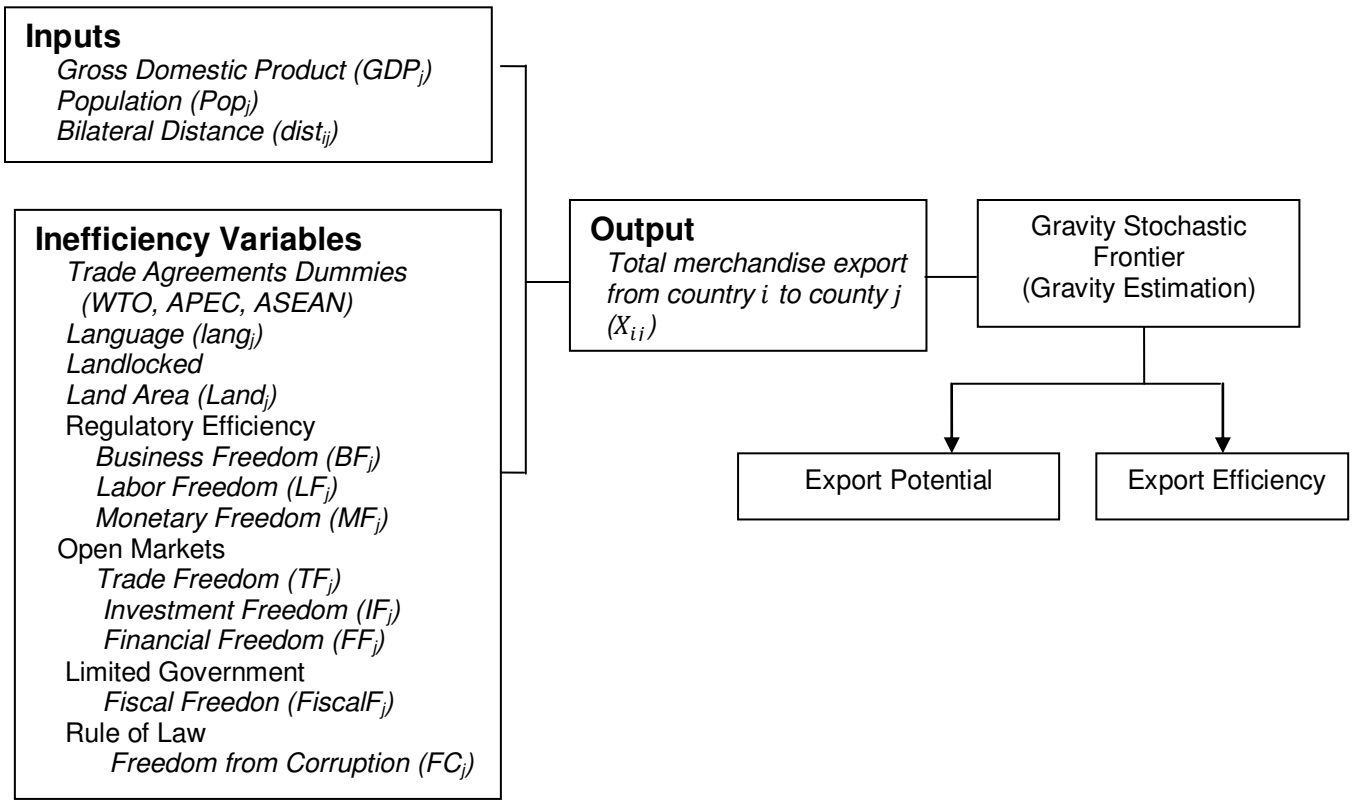

Figure 8. Estimation process of gravity stochastic frontier.

The Gravity Stochastic Frontier will utilize GDP, population, bilateral distance, relative factor endowment and similarity index between country i to j. Since the study will employ the gravity stochastic frontier model which is similar to estimation of firm level technical efficiency and production potential. Various inefficiency variables like trade agreements between Philippines and partner country, commonality of language,

landlocked, and partner country specific measures was explored. The country specific inefficiency variable includes regulatory efficiency, open markets, limited government intervention and rule of law. This was used to estimate export potential and efficiency.

DATA SOURCES

This study will utilize panel data consisting of 90 bilateral trading partners of the Philippines on merchandise exports from 2008 to 2012. The list of countries included in this study is shown in Table 1 which was chosen based on their relative importance to Philippine merchandise exports.

Table 1. Trade partners of Philippine merchandise exports to be included in the study.

AFRICA (10)	*Iran*	*United Arab Emirates*	*Malta*	*Panama*
South Africa	*Israel*	*Viet Nam*	*Montenegro*	*USA*
Egypt	*Japan*	*Yemen*	*Netherlands*	**SOUTH AMERICA (8)**
Tunisia	*Jordan*	**EUROPE (30)**	*Norway*	*Argentina*
Ghana	*North Korea*	*Austria*	*Poland*	*Brazil*
Kenya	*South Korea*	*Belgium*	*Portugal*	*Chile*
Morocco	*Kuwait*	*Bulgaria*	*Romania*	*Colombia*
Madagascar	*Lebanon*	*Cyprus*	*Slovak Republic*	*Ecuador*
Algeria	*Malaysia*	*Czech Republic*	*Slovenia*	*Peru*
Guinea	*Myanmar*	*Denmark*	*Spain*	*Uruguay*
Zimbabwe	*Oman*	*Estonia*	*Sweden*	*Venezuela*
ASIA (31)	*Pakistan*	*Finland*	*Switzerland*	**OCEANIA (5)**
Bahrain	*Qatar*	*France*	*UK and N. Ireland*	*Australia*
Bangladesh	*Russia*	*Germany*	*Ukraine*	*Macau*
Brunei	*Saudi Arabia*	*Greece*	**NORTH AMERICA (7)**	*Micronesia*
Cambodia	*Singapore*	*Hungary*	*Canada*	*New Zealand*
China	*Sri Lanka*	*Ireland*	*Costa Rica*	*Papua New Guinea*
Hong Kong	*Taiwan*	*Italy*	*Dominican Republic*	
India	*Thailand*	*Lithuania*	*Guatemala*	
Indonesia	*Turkey*	*Luxembourg*	*Mexico*	

Note: Classification is based from http://www.worldatlas.com/cntycont.htm#.Ugv73aCHMag

The aggregate data on merchandise export was taken from the Department of Trade and Industry (DTI). Data on Gross Domestic product as proxy to income and population as proxy for market size was taken from the World Bank. Data on bilateral distance measured in kilometers, landlocked, language and land area was secured from

the *Centre d'Etudes Prospectives et d'Informations Internationales (CEPII)* which was developed by Mayer and Zignago (2005). "Behind the Border" variables including freedom from corruption (FC), fiscal freedom (FiscalF), business freedom (BF), labor freedom (LF), monetary freedom (MF), trade freedom (TF) investment freedom (IF) and financial freedom (FF) was taken from the Heritage Foundation. List of APEC member countries was taken from apec.org while ASEAN member countries was taken from asean.org. World Trade Organization list of members was taken from wto.org.

EMPIRICAL APPLICATION

Adopting the methodology proposed by Drysdale et.al. (2000) and Kalirajan and Finley (2005), the stochastic frontier approach of the gravity model in equation 6, imposing the variables proposed in this study can be rewritten as:

$$\ln X_{ijt} = \beta_0 + \beta_1 lnGDP_{jt} + \beta_2 lnPop_{jt} + \beta_3 lndist_{ijt} + -u_{ijt} + v_{ijt} \qquad (8)$$

where:

X_{ijt}- is the total value of exports from Philippines (i) to partner country (j) at time t.

GDP_j- Gross Domestic Product of country j at time t as proxy for income.

Pop_j- population of country j as proxy for market size.

$dist_{ij}$- is the geographical distance between the capital cities of country i and j measured in kilometers.

u_{ijt} - Single sided error for the combined effects of inherent economic distance bias or 'behind the border' constraints, which is specific to the exporting country with respect to the particular importing country,

creating the difference between actual and potential bilateral trade. u_{ijt} is assumed to have an iid nonnegative half normal distribution that is $u_{ijt} \sim iid\ N(0, \sigma_u^2)$

v_{ijt} – Double sided error term that captures the impact of inadvertently omitted variables and measurement errors that are randomly distributed across observations in the sample. v_{ijt} is assumed to follow an iid normal distribution with mean zero and constant variance that is $v_{ijt} \sim iid\ N(0, \sigma_v^2)$.

The disturbance term can be specified as: $\varepsilon_{ijt} = v_{ijt} - u_{ijt}$

The inefficiency effect model, are specified in equation 9 captures significant factors that contribute to Philippine merchandise export inefficiency.

$$u_{ijt} = \delta_0 + \delta_1 APEC + \delta_2 ASEAN + \delta_3 WTO + \delta_4 Lang_j + \delta_5 Landlocked + \delta_6 Area_j + \delta_7 TF_j + \delta_8 BF_j + \delta_9 IF_j + \delta_{10} FC_j + \delta_{11} FiscalF_j + \delta_{12} LF_j + \delta_{13} MC_j + \delta_{14} FF_j + w_{ijt} \quad (9)$$

where:

$APEC$ - is a dummy variable that takes the value of 1 if country j is a member of Asia Pacific Economic Cooperation and 0, otherwise.

$ASEAN$ - is a dummy variable that takes the value of 1 if country j is a member of Association of Southeast Nation and 0, otherwise.

WTO- is a dummy variable that takes the value of 1 if country j is a member of World Trade Organization and 0, otherwise.

$Lang_j$- is a dummy variable, 1 if country js' language is English and 0 otherwise.

$Landlocked$- is a dummy variable, 1 if the country j is landlocked and 0 otherwise.

$Area_j$- Country j's area measured in km^2.

TF_j- Trade Freedom index of country j, which is a composite measure of the absence of tariff and non tariff barriers in partner country j which includes quantity, price, regulatory, investment, customs restrictions and direct government intervention. The TF score of each partner country j is a number between 0 and 100. The higher the score implies lesser barriers of trade.

BF_j- is Business Freedom index developed by The Heritage Foundation, is an overall indicator of the efficiency of government regulations of business. The BF score of each partner country j is a number between 0 and 100 with 100 as the freest business environment.

IF_j- Investment Freedom Index of partner country j determines how free the flow of investment capital is. The higher the score, the freer is the investment into and out of specific activities, both internally and across the country's border. The IF score of each partner country j is a number between 0 and 100 with 100 as the freest in terms of investment.

FC_j-Freedom from corruption index of country j developed by Transparency International's Corruption Perception Index (CPI). The FC score of each partner country j is a number between 0 and 100, the higher the score indicates little corruption.

$FiscalF_j$- is Fiscal Freedom index of country j, is a measure of the tax burden imposed by the government, it includes direct taxes on individuals and corporate incomes. The index lies between 0 to 100, the higher the index means the higher tax burden.

LF_j- Labor Freedom index of country j, measures various aspect labor market's legal and regulatory framework including minimum wages, laws inhibiting layoffs, severance of requirements and measurable

regulatory restraints on hiring and hours worked. The index lies between 0 to 100, the higher the index means freer labor.

MF_j- Monetary Freedom index of country j, combines a measure of price stability with an assessment of price controls. Both inflation and price controls distort market activity. Price stability without microeconomic intervention is the ideal state for the free market. The index lies between 0 to 100, the higher the index means country j has a stable currency and market determined prices.

FF_j –Financial Freedom index of country j, is a measure of banking efficiency as well as a measure of independence from government control and interference in the financial sector. The index lies between 0 to 100, the higher the index means higher financial freedom.

ESTIMATION

The estimation of equations 8 and 9 was done simultaneously. The Estimation involves panel data which do not require the assumption that the one-sided error-term, u_{ijt} and the other independent variable in the gravity equation are independent. The estimation of the u_t is carried out with the assumption that it is time-varying over the period of time. Frontier 4.1 software of Tim Coelli (2004) was used.

RESULTS

Stochastic and OLS Estimates of the Gravity Model

The trade gravity model in equation 8 and the trade inefficiency model in equation 9 were estimated simultaneously following the usual stochastic frontier production function using frontier 4.1.

Table 2. Maximum likelihood estimates of the stochastic frontier gravity equation for Philippine trade among trading partners, 2009-2012.

Betas (factors of trade contributing to TE)				
Variable	**Coefficient**	**Std. err**	**t-ratio**	**p-value**
Constant	20.7600***	1.1298	18.375	0.0000
GDP	0.051290^{ns}	4.8450	1.059	0.2906
Population	0.6808***	6.0887	11.182	0.0000
Bilateral Distance	-1.5183***	0.1522	9.970	0.0000
Deltas (factors of technical inefficiency)				
Variable	**Coefficient**	**Std. err**	**t-ratio**	**p-value**
Constant	5.5557***	1.0017	5.5459	0.0000
APEC	-1.5817***	0.4483	3.5284	0.0005
ASEAN	0.2606^{ns}	0.5616	0.4641	0.6429
WTO	-0.4193^{ns}	0.5506	0.7615	0.4470
Language	-0.1857^{ns}	0.3491	0.5321	0.5951
Landlocked	0.7540**	0.3881	1.9426	0.0530
Land Area	0.0000^{ns}	0.5490	0.4384	0.6614
Freedom from Corruption	-0.0576***	0.0761	5.5620	0.0000
Fiscal Freedom	0.0105^{ns}	0.0127	0.8297	0.4074
Business Freedom	-0.0139*	0.0079	1.7607	0.0793
Labor Freedom	-0.0068^{ns}	0.0105	0.6458	0.5189
Monetary Freedom	0.0340*	0.0196	1.7362	0.0836
Trade Freedom	-0.0202^{ns}	0.0175	1.1540	0.2494
Investment Freedom	-0.0049^{ns}	0.0115	0.4245	0.6715
Financial Freedom	-0.0002^{ns}	0.0098	1.5430	0.1239
Sigma-squared (σ^2)	1.5271***	0.17	8.91	0.0000
gamma (γ)	0.0695^{ns}	0.30	0.23	0.8153
log likelihood function	-496.49			
LR test of one sided error	267.54			

^{ns} not significant at 10% level, * significant at10% level,
** significant 5% level, *** significant at 1% level
Note: The dependent variable of the stochastic regression is $\ln X_{ijt}$ (exports from i to j at time t). The total number of observation is 304.

Results of the stochastic frontier gravity model are presented in Table 2. It shows that merchandise export flows from the Philippines to its trading partners are significantly affected by population and bilateral distance. Population is proxy to market

size of the importing country. Result shows a positive relationship between Philippine export and market size, that is, on the average, a percent increase in the population or market size of the importing country, increases value of export by 0.68%. Result of the bilateral distance shows negative effect to export value. The farther the distance between the Philippines and its trading partner decreases the trade between them. That is, a percent increase in bilateral distance, decreases export flows by 1.52%. This result verified the existence of the gravitational effect on trade. Thus, we can say, that even in the modern days, with modern transport technology, distance still matters in trade flows among countries.

This distance variable is also a proxy to transport cost and other cost of trade like communication cost, and transaction cost, among others. Thus the greater the distance implies higher cost, thereby reducing export of the Philippines to partner country. The GDP variable as proxy to income of the importing country turns out insignificant. Thus, it implies that income change in the importing country has no impact on export from the Philippines.

The results of equation 9, on factors affecting technical inefficiency were also presented in Table 2. The model includes APEC, ASEAN and WTO to capture the impact of regional trade agreements entered by the Philippines and government of trading partners. The result shows that the Philippines membership to APEC decreases technical inefficiency of the Philippine export flow to trading partners. Membership to ASEAN and WTO turns insignificant in reducing trade inefficiency of the Philippines.

The study also included trading partner's specific characteristics such as language, if the country is landlocked and total land area. Among these characteristics,

landlocked only turns out significant. If the country is landlocked, it increases technical inefficiency. This could be attributed to high cost of transportation in the absence of seaports. Language and land area has no effect on technical inefficiency.

This study disaggregated the components of economic freedom to capture the impact of country specific indicators covering from macroeconomic stability, the role of the government and corporate sector in business, price stability, legal system and policies regarding investment and international trade. Result of the estimation shows that freedom from corruption and business freedom are significantly decreases trade inefficiency, while monetary freedom do the opposite. The impact of freedom from corruption and business freedom in the importing county to Philippine export reduces the gap between the actual and potential export flows. Monetary freedom that captures price control in the importing country distorts this flow.

The estimate of the sigma-square (σ^2) is highly significant which a measure of the mean total variation over the four (4) year time periods in the model. This can be interpreted that the potential export of the Philippines in within this period have been changing (not remained constant). This variation can be attributed to the Philippine specific variables (home country) and partner countries specific variables (beyond the border) such as variables included in the inefficiency effect model. However, the estimated gamma (γ) turns out insignificant. This could mean that the variations shown in σ^2 are not due to beyond the border variables.

Export Performance

Estimated Technical efficiencies were presented in Tables 5 to 11. Table 5 shows the technical efficiency of Philippine merchandise export to member countries in

the ASEAN. Results show that TE is consistently very high with Singapore, while the rest of the member countries were below the mean TE.

Table 5. Technical efficiency (in percent) of Philippine merchandise exports to ASEAN member countries.

Country	2009	2010	2011	2012
INDONESIA	5.81	3.21	7.79	7.28
MALAYSIA	36.34	17.82	20.02	26.84
SINGAPORE	94.49	94.31	94.79	94.99
THAILAND	18.06	12.15	24.49	40.39
VIET NAM	8.54	7.19	5.15	14.65
Mean	32.65	26.94	30.45	36.83

Table 6 shows the TE of countries in the East Asian (EA) Region. It reveals that TE is high and far above the mean TE. Philippine export is relatively efficient with Hongkong, followed by Japan, South Korea and Taiwan. Chinas' TE is below the mean TE, this suggest that there is an immense opportunity for enhancing trade from the Philippines to China. Based from the mean, TE of the Philippines to members of EA region is increasing within the period of the study.

Trade performances of Philippine export to the members of Europian Union (EU) were presented in Table 7. Relative to the members of EU, the Philippines TE with Denmark, UK, Sweden, Belgium, Finland, Germany and Netherlands are high.

Table 6. Technical efficiency (in percent) of Philippine merchandise exports to East Asian (EA) countries.

Country	2009	2010	2011	2012
CHINA	20.72	11.84	16.87	20.43
HONG KONG	24.62	81.68	86.11	91.75
JAPAN	84.67	56.58	62.56	79.96
S. KOREA	62.42	67.51	82.16	71.06
TAIWAN	80.13	69.84	78.81	70.36
Mean	**54.51**	**57.49**	**65.30**	**66.71**

Table 7. Technical efficiency (in percent) of Philippine merchandise exports to EU member countries.

Country	2009	2010	2011	2012
AUSTRIA	30.66	70.08	44.19	67.16
BELGIUM	66.78	85.11	78.54	86.46
CROATIA	5.27	10.20	7.74	3.40
CYPRUS	12.42	26.96	21.47	14.67
DENMARK	90.04	94.64	94.07	94.55
FINLAND	77.87	89.62	91.83	87.25
FRANCE	59.72	58.02	52.53	60.58
GERMANY	63.67	85.28	82.80	76.39
GREECE	7.71	13.46	7.05	5.62
HUNGARY	6.69	13.62	12.71	8.73
ITALY	14.68	23.67	13.50	11.31
LITHUANIA	9.55	13.98	18.80	9.61
LUXEMBOURG	24.28	52.87	51.65	39.11
NETHERLANDS	87.21	91.11	91.90	89.60
POLAND	7.38	7.95	12.28	16.00
PORTUGAL	22.31	31.88	25.21	18.95
SLOVAK REPUBLIC	3.27	6.62	4.44	3.79
SLOVENIA	21.09	43.51	36.46	12.15
SPAIN	37.15	45.80	36.07	43.69
SWEDEN	84.56	93.96	94.07	91.10
UK	86.95	89.78	90.89	90.80
Mean	**39.01**	**49.91**	**46.11**	**44.33**

Table 8 shows the TE of the Philippines to members of the North American Free Trade Area (NAFTA). The members of NAFTA registered a very high TE except for Mexico. Canada in 2010 registered 100% efficiency of trade, which means that, Philippine merchandise export to Canada meet the potential, given the factors considered in the gravity equation. While, TE with USA almost remain constant within the period examined.

Table 8. Technical efficiency (in percent) of Philippine merchandise exports to NAFTA member countries.

Country	2009	2010	2011	2012
CANADA	94.56	100.00	96.48	95.62
MEXICO	25.47	22.68	35.59	17.98
USA	93.02	95.46	95.54	95.13
Mean	**71.01**	**72.71**	**75.87**	**69.58**

The two countries that composed the European Free Trade Area (EFTA) both registered high TE with 85% for Norway and 77% for Switzerland in 2012.

Table 9. Technical efficiency (in percent) of Philippine merchandise exports to EFTA member countries.

Country	2009	2010	2011	2012
NORWAY	74.99	88.38	90.50	84.50
SWITZERLAND	44.94	80.02	71.08	77.17
Mean	**59.97**	**84.20**	**80.79**	**80.83**

Technical efficiency among APEC member countries are shown in Table 10. Results show that Philippine merchandise exports TEs were high with APEC member countries. Specifically, with major partner economies like Australia, Canada, Chile, Hongkong, Japan, New Zealand, Singapore, Taiwan and USA. Results show that there are still huge market potentials for Philippine merchandise exports among the APEC countries.

Table 10. Technical efficiency (in percent) of Philippine merchandise exports to APEC member countries.

Country	2009	2010	2011	2012
AUSTRALIA	94.76	95.7	96	95.6
CANADA	94.56	100	96.48	95.62
CHILE	91.91	82.4	88.23	78.18
CHINA	20.72	11.84	16.87	20.43

Country	2009	2010	2011	2012
HONG KONG	24.62	81.68	86.11	91.75
INDONESIA	5.81	3.21	7.79	7.28
JAPAN	84.67	56.58	62.56	79.96
S. KOREA	62.42	67.51	82.16	71.06
MALAYSIA	36.34	17.82	20.02	26.84
MEXICO	25.47	22.68	35.59	17.98
NEW ZEALAND	95.53	95.77	96.4	95.37
PAPUA NEW GUINEA	11.91	8.98	10.4	11.51
PERU	10.33	4.71	7.75	8.33
RUSSIA	8.53	8.69	13.87	14.6
SINGAPORE	94.49	94.31	94.79	94.99
TAIWAN	80.13	69.84	78.81	70.36
THAILAND	18.06	12.15	24.49	40.39
USA	93.02	95.46	95.54	95.13
VIET NAM	8.54	7.19	5.15	14.65
Mean	**50.62**	**49.29**	**53.63**	**54.21**

The technical efficiencies were summarized in Table 11. It shows that TEs in ASEAN member countries is low. This would simply imply that the Philippines did not able to maximize the benefits of RTA like lesser barrier to trade and the factors considered in this study like distance and market size. Among the countries considered in the study, countries in the ASEAN are closer to the Philippines, thus, imply lower cost of trade. This study cannot make direct recommendation on either this potential is driven by factors like substitutability or complementarily of traded goods. But as far as the variables in this study are concern, the Philippines can explore the potential determined by the market size and lesser transport cost in the ASEAN.

The Philippines was able to establish better trade in the countries in the East Asian region with above 50% export performance. This is also true with the countries in NAFTA. The Philippines was able to establish strong trade link between USA and

Canada. The countries in the EU also posed potential for merchandise export that could be explored by the Philippines.

Table 11. Mean technical efficiency (in percent) of Philippine merchandise exports, by trading groups, 2009-2012.

Trading Groups	No. of Countries	2009	2010	2011	2012
ASEAN	5	32.65	26.94	30.45	36.83
EA	5	54.51	57.49	65.30	66.71
EU	21	39.01	49.91	46.11	44.33
NAFTA	3	71.01	72.71	75.87	69.58
WTO	70	28.70	31.52	31.70	30.75
Non-WTO	6	28.85	31.18	31.75	30.20
APEC	19	54.21	53.63	49.29	50.62
Non-APEC	57	22.93	24.39	25.60	21.40
Overall Mean		28.85	31.18	31.75	30.20

In terms of inter-regional trading agreements, on the average, Export performance is high in APEC countries compared to Non-APEC countries, however Philippine export performance with WTO and Non-WTO countries almost did not differ.

In general, the efficiency measure are generally low, suggesting large deviations of actual observed trade flows from the potential trade flows estimated by the gravity equation. The next section will discussed trade potential if countries in the sample operated at the frontier of the trade gravity model.

Export Potential

Export potential is defined as the trade that could have been achieved at optimum trade frontier with open and frictionless trade possible given the current level of trade, transport and institutional technologies or it is the maximum level of trade given

current level of determinants of trade as well as the least level of restrictions within the economic system (Miankhel, et al., 2009). The potential export in this study was computed using the estimated coefficients of the gravity model and imposed the mean actual observed data of the four year periods. The results are shown in Table 12.

Table 12 shows the trade gap as the difference between the potential export generated by the gravity model and actual observed export. Among the 76 countries in the sample, China recorded the highest potential of around 34.6 Billion US dollars. These potential was driven by a very huge market in china for merchandise export of the Philippines that should be explored. This is followed by India, and members of the ASEAN like Vietnam, Indonesia, Thailand, Cambodia and Malaysia.

Table 12. Philippines export gap of merchandise exports, US Dollars, 2009-2012.

Country	Actual Export	Potential Export	Trade Gap
CHINA, PEOPLE'S REP. OF	6,159,105,793.00	40,859,002,860.99	34,699,897,067.99
INDIA	326,846,937.00	15,916,508,005.88	15,589,661,068.88
VIET NAM	593,443,265.00	14,644,134,918.77	14,050,691,653.77
INDONESIA	839,666,572.00	13,378,925,833.47	12,539,259,261.47
BANGLADESH	26,357,602.00	6,047,304,099.05	6,020,946,497.05
THAILAND	2,445,956,284.00	7,319,845,763.51	4,873,889,479.51
CAMBODIA	16,372,403.00	2,531,715,356.83	2,515,342,953.83
MALAYSIA	1,018,099,385.00	2,937,115,206.11	1,919,015,821.11
RUSSIAN FEDERATION	66,487,427.00	1,554,247,392.75	1,487,759,965.75
S. KOREA	2,862,007,873.00	4,324,343,937.73	1,462,336,064.73
NEPAL	1,182,441.00	1,358,187,900.67	1,357,005,459.67
NIGERIA	5,772,933.00	1,219,597,400.10	1,213,824,467.10
IRAN, ISLAMIC REP. OF	34,166,077.00	1,150,837,662.80	1,116,671,585.80
EGYPT ARAB REPUBLIC	16,982,261.00	1,002,764,697.82	985,782,436.82
SRI LANKA	18,214,061.00	880,330,338.87	862,116,277.87
UKRAINE	5,759,258.00	661,345,562.46	655,586,304.46
MACAU SAR	28,538,998.00	664,684,117.86	636,145,119.86
PAPUA NEW GUINEA	25,069,286.00	596,432,057.35	571,362,771.35
KENYA	6,057,486.00	504,677,497.54	498,620,011.54
POLAND	45,639,069.00	535,794,886.00	490,155,817.00

Country	Actual Export	Potential Export	Trade Gap
SAUDI ARABIA	85,823,351.00	538,337,427.28	452,514,076.28
YEMEN	6,347,279.00	434,341,128.26	427,993,849.26
ALGERIA	2,615,905.00	419,557,049.51	416,941,144.51
ITALY	218,662,793.00	634,037,237.66	415,374,444.66
SPAIN	116,168,852.00	496,897,860.49	380,729,008.49
MADAGASCAR	3,142,540.00	377,659,667.38	374,517,127.38
SOUTH AFRICA	110,299,752.00	471,356,327.22	361,056,575.22
BRAZIL	148,154,450.00	507,026,217.16	358,871,767.16
MEXICO	225,163,266.00	581,938,406.52	356,775,140.52
AUSTRALIA	387,265,898.00	633,315,445.88	246,049,547.88
FRANCE	359,657,372.00	560,510,254.29	200,852,882.29
COLOMBIA	19,624,912.00	210,590,409.67	190,965,497.67
ARGENTINA	50,073,902.00	237,122,083.87	187,048,181.87
TUNISIA	11,556,547.00	194,636,059.57	183,079,512.57
JORDAN	8,024,480.00	183,751,554.31	175,727,074.31
GREECE	31,812,859.00	204,385,327.27	172,572,468.27
OMAN	3,692,382.00	165,837,019.86	162,144,637.86
ISRAEL	72,763,408.00	203,405,586.52	130,642,178.52
DENMARK	36,096,452.00	160,675,382.38	124,578,930.38
GUATEMALA	2,649,524.00	126,677,078.48	124,027,554.48
LEBANON	3,552,244.00	127,436,268.09	123,884,024.09
SLOVAK REPUBLIC	4,793,692.00	127,233,119.96	122,439,427.96
ECUADOR	3,284,615.00	124,809,940.10	121,525,325.10
KUWAIT	37,165,839.00	154,365,926.67	117,200,087.67
CROATIA	1,171,253.00	112,758,682.02	111,587,429.02
PORTUGAL	16,230,002.00	122,703,602.36	106,473,600.36
NEW ZEALAND	49,088,058.00	153,504,537.99	104,416,479.99
CHILE	29,548,595.00	131,113,551.23	101,564,956.23
NORWAY	12,602,773.00	112,914,918.63	100,312,145.63
PERU	17,275,048.00	116,790,382.59	99,515,334.59
SWEDEN	78,284,877.00	175,151,209.15	96,866,332.15
LITHUANIA	4,132,169.00	98,310,199.14	94,178,030.14
DOMINICAN REPUBLIC	3,822,682.00	96,934,362.82	93,111,680.82
UNITED ARAB EMIRATES	220,217,148.00	301,359,611.52	81,142,463.52
AUSTRIA	98,165,622.00	179,165,382.47	80,999,760.47
BAHRAIN	5,014,616.00	77,906,244.40	72,891,628.40
SLOVENIA	2,105,277.00	67,503,905.52	65,398,628.52
HUNGARY	143,204,350.00	205,104,532.23	61,900,182.23
FINLAND	115,569,788.00	175,343,347.64	59,773,559.64
CYPRUS	1,908,149.00	48,852,192.73	46,944,043.73
PANAMA	10,934,253.00	47,320,921.50	36,386,668.50

Country	Actual Export	Potential Export	Trade Gap
MICRONESIA	3,848,035.00	36,819,652.37	32,971,617.37
COSTA RICA	23,171,356.00	52,663,436.24	29,492,080.24
URUGUAY	14,010,278.00	37,482,508.12	23,472,230.12
LUXEMBOURG	5,321,586.00	25,698,935.04	20,377,349.04
UK GREAT BRITAIN	656,580,025.00	620,003,764.13	(36,576,260.87)
BELGIUM	302,081,069.00	198,089,574.85	(103,991,494.15)
CANADA	508,184,921.00	309,619,289.99	(198,565,631.01)
SWITZERLAND	381,036,264.00	144,571,618.21	(236,464,645.79)
HONG KONG SAR	4,776,082,101.00	4,385,235,273.00	(390,846,828.00)
GERMANY	1,956,563,141.00	937,948,598.74	(1,018,614,542.26)
NETHERLANDS	1,550,982,113.00	242,416,942.53	(1,308,565,170.47)
TAIWAN	1,915,311,138.00	72,530,986.80	(1,842,780,151.20)
JAPAN	9,881,269,130.00	6,848,787,440.01	(3,032,481,689.99)
SINGAPORE	4,863,929,036.00	1,143,650,780.07	(3,720,278,255.93)
USA	7,395,500,297.00	1,300,666,773.82	(6,094,833,523.18)

Note: Export potential was computed using equation 23. Trade gap was computed as the difference between actual and potential exports.

Several countries in the sample recorded a negative trade gap, these countries are major trading partners of the Philippines. A negative trade gap means that potential export predicted by the gravity model is less than the actual observed export. This might due to other factors that facilitated this trade that were not included in the model. These countries were USA, Singapore, Japan, Taiwan, Netherlands, Germany, Hongkong, Switzerland, Canada, Belgium and UK. These countries recorded high technical efficiencies relative to all sample countries.

The estimated export potential using the OLS shows that 46% of the sample countries were below the mean export potential while 54 were about the mean. The comparison of the estimates using stochastic frontier, OLS and the actual export is presented in Appendix 1.

SUMMARY AND CONCLUSION

This study investigated the issue of what Philippine merchandise trade flows would be if countries operated at the frontier of the gravity model. The study sought to estimate the coefficients of the gravity model at the frontier using stochastic frontier and from mean using ordinary least squares. The estimated coefficients were used to estimate merchandise export potentials. This export potential was used to estimate technical efficiency of each country in the sample and these were also aggregated to measure impact of country groups, RTAs and inter-regional trading agreements. The study also identified factors affecting technical inefficiency using the stochastic frontiers and technical efficiency using the pooled regression.

The computed technical efficiency for all sample countries is relatively large with standard deviation from the mean of 35.02% suggesting that the frontier is not so distant. The most efficient countries in the sample which recorded more than 90% efficiency were Canada (95.6%), Australia (95.6%), New Zealand (95.4%), USA (95.1%), Singapore (95.0%), Denmark (94.5%), Hongkong (91.7%), Sweden (91.0%) and UK (90.8%). In terms of country groups, RTA and Inter-regional trading agreements, APEC recorded as the most efficient trade agreement of the Philippines. The Philippines was also able to established strong link among countries in East Asia, members of AFTA. ASEAN and EU posed export potential or opportunities for the Philippines to expand export flows. In a country level, China and members of the ASEAN such as Vietnam, Indonesia, Thailand, Cambodia and Malaysia posed the highest export potential for merchandise exports.

The significant determinants of these potentials are the expanding market of developing economies and lower trade cost. Then dominance of APEC countries in trade efficiency was verified by the result of the trade inefficiency effect model. Factors reducing technical inefficiencies were membership to APEC, reduction of corruption, and freer business environment. Membership to ASEAN and WTO turns out insignificant in reducing trade inefficiencies between the Philippine exports to member countries.

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Appendix 1. Estimated export potential by OLS and Stochastic Frontier by country.