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THE IMPACT OF COMPETITIVENESS ON TRADE EFFICIENCY: THE ASIAN EXPERIENCE BY USING THE STOCHASTIC FRONTIER GRAVITY MODEL

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Abstract

The purpose of this study is to examine the bilateral machinery and transport equipment trade efficiency of selected fourteen Asian countries by applying stochastic frontier gravity model. These selected countries have the top machinery and transport equipment trade (both export and import) volumes in Asia. The model we use includes variables such as income, market size of trading partners, distance, common culture, common border, common language and global economic crisis similar to earlier studies using the stochastic frontier gravity models. Our work, however, includes an extra variable called normalized revealed comparative advantage (NRCA) index additionally. The NRCA index is comparable across commodity, country and time. Thus, the NRCA index is calculated and then included in our stochastic frontier gravity model to see the impact of competitiveness (here measured by the NRCA index) on the efficiency of trade.

Keywords: Gravity Model, Stochastic Frontier Analysis, Efficiency, Trade, Normalized Revealed Comparative Advantage Index, Asia

JEL Classifications: F10, F14, C43, C13

1. Introduction

Machinery and transport equipment (MTE) sector's trade plays a major role in the world's sectoral trade. The sector consists of power-generating machinery and equipment, machinery specialized for particular industries, metal working machineries, general industrial machinery and equipment, office and automatic data-processing machines, telecommunications and sound-recording, electrical machinery, road vehicles and other transport equipment depends on the SITC (Standard of International Trade Classification). According to 2015 data, MTE sector's export consists almost 40% of world's export market.

Asian countries are leading the world's MTE trade. According to 2015 data, 5 countries from Asia-wide entered the list of top ten countries in MTE exports. The 14 countries in this study have been the leader countries of Asia's MTE export for last 10 years. In this study we examine the intra-regional MTE trade among these countries. Our main question in this study is: How does competitiveness on MTE goods effect the MTE exports efficiency? We emphasize two main concepts to answer this question. The first one is stochastic frontier gravity model that indicate efficiency, and the second one is normalized revealed comparative advantage (NRCA) index that represents competitiveness.

Competitiveness is an important concept for explaining the sources of trade. The theory of competitiveness is basically based upon the Ricardian comparative advantages. In empirical trade area, comparative advantages can be measured by "revealed comparative advantage" (RCA) indices. In this study, we use a version of RCA Index that named the NRCA Index. The NRCA Index is comparable across commodity, country and time. Thus, the NRCA index in this work is calculated in the Yu *et al.* (2009) fashion and then included in our stochastic frontier gravity model to see the impact of competitiveness (here measured by the NRCA index) on the efficiency of trade. The main aim of this article is to examine the competitiveness (by calculating the NRCA index) effect on trade efficiency by using the stochastic frontier gravity model and produce the bilateral trade efficiency scores of countries. In this context, the remainder of this paper is organized as follows. The next section outlines the theory of the stochastic frontier gravity model and the structure of NRCA Index respectively. The third section reviews the literature and the fourth one includes the model and the data set. Section 5, shows empirical results. And the last section concludes the paper.

2. Theoretical Foundation

In this section, we introduce two main theoretical concepts of the study. First one is the Stochastic Frontier Gravity Model that analyzes the bilateral trade with efficiency concept. Second one is Normalized Revealed Comparative Advantage Index that is a method for calculating the competitiveness among countries.

2.1. The Stochastic Frontier Gravity Model

From Tinbergen (1963) and Poyhonen (1963) to the day-, the gravity model has turned out to be eminent tool in quantitative trade researches. The model has been implemented to flows of different types such as foreign direct investment, migration and more particularly to international trade flows. Due to gravity models, exports between countries are clarified by their economic sizes (Gross Domestic Product (GDP) or Gross National Product (GNP)), populations, distances between them, and a number of dummies associating several types of institutional features common to specific flows (Martinez-Zarzoso, 2003).

The basic natural log-linear gravity model used in bilateral trade analysis is shown below:

$$\ln Trade_{ij} = \beta_0 + \beta_1 lnGDP_i + \beta_2 lnGDP_j + \beta_3 \ln(Dist_{ij}) + \mu_{ij} \quad (1)$$

where, $Trade_{ij}$ shows the trade flows between countries, β_0 is the country-pair fixed effects covering all unobservable factors affecting bilateral trade, GDP_i is exporter and GDP_j is importer gross domestic products, $Dist_{ij}$ is the distance between capitals or economic centers, and μ_{ij} is the error term. β_0, β_1, β_2 and β_3 are coefficients to be estimated (Greene, 2013).

However, researchers often used the gravity model to examine the effects of other variables on foreign trade. Depending on the field of research, researchers expanded their models by including such variables as the volume of trade, physical space, exchange rates, population density, tariffs and non-tariff trade barriers, market access, public economic integration, trade openness, common culture, language and border etc.

İn this study bilateral machinery and transport equipment trade efficiency of selected fourteen Asian countries is estimated. In the light of Kalirajan (2008) model, this study utilizes stochastic frontier technique for the estimation of the gravity model.

As indicated by Kalirajan (2008); stochastic frontier gravity equation can be represented as follows;

$$X_{ij} = f(Z_i;\beta) + \varepsilon_{it} \quad (2)$$
$$\varepsilon_{it} = v_{it} - u_{it}$$
$$u_{it} = G(t)u_i$$
$$v_{it} \sim N(0, \sigma_v^2)$$
$$u_{it} \sim N^+(\mu, \sigma_u^2)$$

where; X_{ij} refers to the export of the country i to country j and Z_i's refers to the determinants of potential trade. The error term is separated into two parts ($v_{it} - u_{it}$) .The v_{it} component is the random error term, which makes the frontier stochastic; where the u_{it} component refers to inefficiency.

Stochastic frontier gravity model is usually estimated by "maximum likelihood" method. When the model expressed with logarithmic terms, the ratio of the actual to potential gives the efficiency level (exp ($-u_i$));

$$\exp(-u_i) = \frac{X_{ij}}{f(Z_i;\beta)+\exp(v_i)} \quad (3)$$

(exp ($-u_i$)) is a value between 0 and 1. If the value is equal to 0, this means that the observed trade volume is equal to potential trade volume and there is no inefficiency. If this value is greater than 0 but is less than or equal to 1, this indicates the presence of inefficiency ($0<(\exp(-u_i))\leq 1$).

2.2. The Normalized Revealed Comparative Advantage (NRCA) Index

Comparative advantage, namely Ricardian theory contains a statement as two countries which make bilateral trade are interdependent and can reciprocally benefit from each other. The two countries can carry out exchange transactions in accordance with their comparative advantage. Ricardian theory indicates that countries with a stronger comparative advantage in a specific good, will tend to focus its production factors on producing and increasing the amount of production and afterwards exporting to countries that have weaker comparative advantage for that good. Conversely, the country will tend to decrease or in fact not to produce goods that have weaker comparative advantage and afterwards will tend to import such good from countries that have stronger comparative advantage (Fakhrudin and Hastiadi, 2016). Furthermore, the difference in production endowment have an influence on international trade (Heckscher, 1919; Ohlin, 1933). Based on Heckscher - Ohlin theory, Edward and Schoer (2002) proposed that exports are made by countries with rich production endowment factor as they have weaker opportunity cost compared to other countries. For this reason, differences in production endowment and opportunity cost are the core of comparative advantages, in addition to distinctions in technological improvement (Fakhrudin and Hastiadi, 2016).

Within the framework of the above statements, it is clear that comparative advantage shows export performance pattern. Thus, if we want to examine countries export performance pattern, we should calculate the comparative advantages. In the economic literature, there are many indices have been presented to calculate comparative advantages.

Balassa's Revealed Comparative Advantage(BRCA) is the earliest one (Balassa,1965). Many of empirical studies use BRCA Index only to detect the relative ranking of the comparative advantages of a country for different goods, although usually it remains problematic in its relative order (Fakhrudin and Hastiadi, 2016).

As a result, some RCA fractions have been built up to accomplish the disabilities of the BRCA index. Some of these indices are; logarithmic form of the BRCA (Vollrath, 1991), Symmetrical Revealed Comparative Advantage (SRCA) (Laursen, 1998), Weighted Revealed Comparative Advantage (WRA) (Proudman and Redding, 1998), Additive Revealed Comparative Advantage (ARCA) (Hoen and Oosterhaven, 2006). These indices developed some sights of the

BRCA index, but they could not be used for comparison between spaces (either goods or state and region) and time (Fakhrudin and Hastiadi, 2016). For a list and use of some of these indices see as Simsek *et al.* (2007).

Because of the insufficiencies of the BRCA index and some other RCA indices, Yu *et al.* (2009) have proposed BRCA index into a Normalized Revealed Comparative Advantage (NRCA). The NRCA index has properties that can demonstrate the rank and comparable in comparative advantage across goods, countries, and time spans. Thus, the NRCA index can show a country's trade pattern. It reflects enabling identification of which types of goods have potential in a market and at a certain time. The NRCA index value for each good from each country as a whole is zero or neutral. This is in line with the idea that no country has a comparative advantage for all goods (Fakhrudin and Hastiadi, 2016).

The derivation mechanism from the BRCA index to the NRCA index is shown below;

$$BRCA_J^i = \left(E_j^i/E_j\right)/(E^i/E) \tag{4}$$

where E_j^i indicates country i's export of good j; E_j indicates export of good j by all countries; E^i indicates country i's export of all goods and E indicates export of all goods by all countries (Yu *et. al.*, 2009).

A value of $BRCA_J^i$ above 1 shows that country i has comparative advantage in this good, as country i's market share in good j's export market is larger than its market share in the world export market. A value of $BRCA_J^i$ below 1 means that country i has comparative disadvantage in good j; and a value of $BRCA_J^i$ equals to 1 means that country i has "neutral" comparative advantage in good j (Yu *et. al.*, 2009).

According to equation 4, we can verify that 1 and 0 are the comparative- advantage-neutral point for the BRCA Index. Under the case of comparative- advantage- neutral, country i's export of good j is $\widehat{E_j^i}$ and equals to E^iE_j/E. Country i's exact export of good j in the real world, E_j^i, would normally differ from $\widehat{E_j^i}$ and the difference can be stated as;

$$\Delta E_j^i \equiv E_j^i - \widehat{E_j^i} = E_j^i - (E^iE_j)/E \tag{5}$$

Dividing ΔE_j^i to the world export value, E, reveals the NRCA index as follows;

$$NRCA_J^i \equiv \Delta E_j^i/E = E_j^i/E - E_jE^i/EE \tag{6}$$

The NRCA index measures the rate of drift of country's real export from its comparative-advantage-neutral level in terms of its relative scale with respect to the world export market and so provides a suitable sign of the underlying comparative advantage (Yu *et. al.*, 2009).

For cross-country comparison regarding a specific good, the odds between the NRCA indexes of country 1 and 2 is;

$$\Delta NRCA_j^{1-2} \equiv NRCA_j^1 - NRCA_j^2 = \frac{E_j}{E}\left[\left(\frac{E_j^1}{E_j} - \frac{E_1}{E}\right) - \left(\frac{E_j^2}{E_j} - \frac{E_2}{E}\right)\right] \tag{7}$$

From equation 7, cross-country comparison of NRCA scores substantially compares the relative performance of these two countries in a good. $\Delta NRCA_j^{1-2} > 0$ (or $\Delta NRCA_j^{1-2} < 0$) means that country 1's relative export performance in good j with respect to its average export performance (calculated by $\frac{E_j^1}{E_j} - \frac{E_1}{E}$) is stronger (or weaker) than country 2's relative export performance in good j (calculated by $\frac{E_j^2}{E_j} - \frac{E_2}{E}$) and consequently country 1 has stronger (or weaker) comparative advantage than country 2 in good j (Yu *et. al.*, 2009).

In our study we calculate the $\Delta NRCA_J^{1-2}$ scores for each bilateral trade line in panel model. Than we add dummy variable depending on the scores of $\Delta NRCA_J^{1-2}$ (1 for stronger and 0 for weaker score).

3. Literature

In this section, we present the studies investigating the efficiency of bilateral trade in the framework of gravity model using stochastic frontier analysis. Kang and Frattianni (2006), Kalirajan and Singh (2008), Armstrong *et al.* (2008), Armstrong and Drysdale (2009), Salim *et al.* (2011), Khan and Kalirajan (2011), Danquah *et al*. (2013), Koh (2013), Sanya *et al.* (2013), Roberto and Edgardo (2014), Ravishankar and Stack (2014), Bhattacharya and Das (2014), Miankhel *et al.* (2014), Ahsan and Chu (2014), Drysdale and Armstrong (2014), Effendi (2014), Sayavong (2015), Viorica(2015), Waheed and Abbas (2015), Miankhel (2015), Armstrong (2015), Nguyen and Kalirajan (2016), Nasir and Kalirajan (2016), Tamini *et al.* (2016), Kalirajan and Liu (2016), Liaquat *et. al.* (2016), Kumar and Prabhakar (2017), Nguyen and Doan (2017), Assefa (2017), Lei (2017) are the studies that investigating the efficiency of bilateral trade in the framework of gravity model using stochastic frontier analysis. None of these studies investigate the effect of competitiveness by using comparative advantage indices. Our work is different from other studies in the literature on the ground that it is the first study implementing the stochastic gravity model to examine the bilateral machinery and transport equipment trade efficiency under competitiveness. For catching up the competitiveness concept we use the NRCA index and add as an extra independent variable to the model.

4. Empirical Model and Data

We determine the gravity model equation as follows;

$$lnExport_{12}^{t} = \alpha_0 + \alpha_1 DIST_{12} + \alpha_2 lnGDP_1^t + \alpha_3 lnGDP_2^t + \alpha_4 lnPOP_1^t + \alpha_4 lnPOP_2^t + \alpha_6 CONTIG + \alpha_7 COMLANG + \alpha_8 COMCOL + \alpha_9 NRCADUM_{12}^t + \alpha_{10} DUM + \alpha_{11} TA + exp(v_{12}^t) + \exp(-u_{12}^t) \quad (8)$$

A panel data set is structured in the framework of bilateral machinery and transport equipment trade of selected Asian economies for the years 2006-2015. Ln $Export_{12}^t$ is machinery and transport equipment export between country 1 to 2 for t year and obtained from World Integrated Trade Solutions in World Bank and United Nations Comtrade databases. lnGDP_1^t and $lnGDP_2^t$ are respectively country 1 and 2's gross domestic products for t year and are obtained from World Bank. $DIST_{12}$ is distance between countries and obtained from CEPII (Centre de recherche français dans le domaine de l'économie internationale). lnPOP_1^t and lnPOP_2^t are respectively country 1 and 2's populations for t year and are obtained from World Bank. CONTİG, COMLANG and COMCOL are respectively common border, common official language and common colonizer after 1945 and obtained from CEPII. $NRCADUM_{12}^t$ is a competitiveness dummy as we mentioned. DUM is the dummy variable for global financial crisis occurred between 2008-2012 and generated by the authors giving 1 from 2008 to 2015. TA is free trade agreement or economic union dummy for countries and obtained from Economic Integration Agreement Database. The descriptive statistics of the variables presented in this study are given in Table 1.

Table 1. The descriptive statistics of the variables

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
Ln $Export_{12}^{t}$	1,820	13.7761	2.2346	5.3453	19.3262
$DIST_{12}$	1,820	4,362,555	2877236	1156.67	9907011
$lnGDP_1^t$	1,820	27.2688	1.1955	24.9185	30.0347
$lnGDP_2^t$	1,820	27.2688	1.1955	24.9185	30.0347
$lnPOP_1^t$	1,820	18.1770	1.5538	15.2974	21.0389
$lnPOP_2^t$	1,820	18.1770	1.5538	15.2974	21.0389
CONTİG	1,820	0.0769	0.2665	0	1
COMLANG	1,820	0.1648	0.3711	0	1
COMCOL	1,820	0.0659	0.2482	0	1
$NRCADUM_{12}^{t}$	1,820	0.5	0.5001	0	1
DUM	1,820	0.8	0.4001	0	1
TA	1,820	0.4428	0.4968	0	1

Source: Author's own

5. Empirical Findings

The empirical part of this paper consists of two components. First, maximum likelihood based regression estimates of stochastic frontier are presented. Secondly, country specific trade efficiency scores are obtained using Battase and Coelli (1988) formula.

5.1. Estimation Results of the Stochastic Frontier Gravity Model

Before the stochastic frontier model we run OLS (ordinary least squares) regression. We check the error term skewness from the OLS regression, and find that the errors are skewed to the left thus model has inefficiency, the model is suitable for stochastic frontier regression.

Thus, table 2 gives the maximum likelihood estimation results of the stochastic frontier gravity model for bilateral machinery and transport equipment trade of selected Asian economies for 2006-2015 period. Based on the results all variables are statistically significant.

Table 2. Estimation Results of the Stochastic Frontier Gravity Model

Variables	Stochastic Frontier Gravity Equation
Constant	-16.3437 (-12.74)*
$DIST_{12}$	-1.38e-07 (-9.01)*
$lnGDP_1^t$	0.8433 (19.18)*
$lnGDP_2^t$	0.8374 (19.82)*
$lnPOP_1^t$	-0.4086 (-12.39)*
$lnPOP_2^t$	-0.3849 (-12.18)*
CONTİG	1.0745 (7.24)*
COMLANG	0.5638 (4.58)*
COMCOL	0.7569 (4.07)*
$NRCADUM_{12}^{t}$	0.8669 (9.05)*
DUM	-0.4175 (-4.27)*
TA	1.4187 (15.14)*
$\sigma^2(u)$	1.9876 (13.33)*
$\sigma^2(v)$	0.1357 (1.17)
γ	2.5242 (11.55) *
Log-Likelihood	-3504.1837

Notes: Values in parentheses are z scores. * significance at 1%. $\gamma = \sigma^2(u)/\sigma^2(v)$. $\sigma^2(v)$ is the variance of the random error term. $\sigma^2(u)$ is the variance of the efficiency

Source: Author's own

The theoretical rationale for the idea that bilateral trade depends on the GDP's comes from the works of Helpman and Krugman (1985). The countries with the largest GDP's are engaged in more trade. The coefficients for the GDPs in the regression are therefore expected to have a positive effect in both exporting and importing countries (i.e. $\alpha_2 \geq 0$ and $\alpha_3 \geq 0$ to confirm that the bigger the economy, the higher the trade becomes) (Sumani, 2015). Accordingly, we estimate a significant and positive coefficient for the GDP's of countries.

The greater the distance between the two countries, the more transport costs tend to rise, and consequently reducing the volume of trade (Sumani, 2015). The distance variable is significant and negative in accordance with the theory.

The impact of population of a country on bilateral trade can be positive or negative depending on whether the absorption effect is bigger than the economies of scale effect, which is equally related to the population. Greene (2013) indicated that countries with bigger populations have larger and more varied production, are more self-contained, and tend to trade less than countries with smaller populations. Yang and Martinez-Zarzoso (2013) added that, population would tend to negatively correlate with trade flows as larger populations mention bigger domestic markets, generous resource endowment and more different outputs, as well as less dependence on international specialization. Additionally, they pointed out that the coefficient of population can also be positive, because a larger population in an importing country allows of imported goods to compete better with domestic goods and balances exporters for the cost of sales activities abroad. This indicates economies of scale and promotes the country to trade more with foreign partners in a broad range of goods (Sumani, 2015). In our case we found statistically significant and negative effect that support the idea of larger populations have bigger domestic markets, generous resource endowment and more different outputs, as well as less dependence on international specialization. Because in our data set we have big countries such as China, India, Indonesia, Russia, Japan, Philippines, Vietnam, Turkey, Thailand and Korea. The total population of these 10 countries almost equal to 60% of World population.

Countries with common borders are likely to have more trade than countries without common borders. Crossing a border involves not only fees but also other transaction costs, implying that countries that do not have a common border may be exposed to higher cost of trading with each other, as they have to ship goods through third countries or ports. (Sumani, 2015). Accordingly, we estimate a significant and positive coefficient for the common border or contiguity (CONTIG).

If trading partners share a common official language, transaction costs of trading is expected to be reduced, because speaking the same language helps simplify and accelerate trade negotiations (Sumani, 2015). Thus, we found a positive and significant coefficient as we expected for common official language (COMLANG). Additionally, common colonizer (COMCOL) variable is a significant and positive coefficient as we expected. Significant dummy variable for the crisis (DUM) implies that the global financial crisis has affected the trade negatively.

Finally, we estimate statistically significant and positive NRCA coefficient. This means NRCA index positively affect the export of country-pairs for a specific good (in this case bilateral machinery and transport equipment good), its effect on export is even larger than traditional gravity variables effect on export. In our model, NRCA's impact on export is more than GDP, population, common language and common colonizer's impact.

5.2. Trade Efficiency Scores

Trade efficiency scores were obtained using the results of our Stochastic Frontier Gravity model. Estimated efficiency scores on bilateral machinery and transport equipment trade of selected fourteen Asian countries for the years 2006-2015 are presented in Appendix. Battese and Coelli(1988) formula is used in the estimation of Country-specific efficiency scores. Accordingly, efficiency is estimated to be 34.32 percent on average, 0.01 percent minimum and 77.6 percent maximum.

China has dominated the scores which have export efficiency above 50 percent consistent in 10 years with 5 countries. These are Australia, Hong Kong, Japan, Korea and Turkey. Also, Hong Kong, Japan and Korea have export efficiency above 50 percent with China.

Additionally, Singapore has export efficiency above 50 percent consistent in 10 years with 3 countries (China, Hong Kong, Indonesia), Korea has one other than China (Hong Kong), Hong Kong has one other than China (Thailand), Indonesia has one (Singapore), Japan has one other than China (Hong Kong), Malaysia has one (Hong Kong), Philippines has one (Hong Kong), Thailand has two (Hong Kong and Vietnam), Vietnam has one (Thailand).

Australia's export efficiency scores with India, Japan, Russia, Singapore, Thailand and Turkey has been estimated below 10 percent consistent in 10 years. Also, Russia, India and Turkey have export efficiency below 10 percent with Australia. Philippines's export to Russia, Russia's export to Philippines, Russia's export to Thailand, are the other export flows that have an export efficiency scores below 10 percent consistent in 10 years.

6. Conclusion

This paper analyzes 14 Asian countries' MTE exports efficiency by a set of variables. Regression results are then presented and trade efficiency scores are estimated for the 2006-2015. Efficiency is estimated to be 34.32 percent on average, 0.01 percent minimum and 77.6 percent maximum.

Asian countries' export performances are significantly affected by distance, GDP, population, contiguity, common official language, common colonizer, NRCA and free trade agreements. The regression results also indicate that export flows are affected by global financial crisis. Following the results of regression, a few ideas are suggested:

- Positive and significant results of GDPs show that growth-oriented policies can help reaching export potential in coming years.
- Population results are negative and significant so that these countries have less dependence on international specialization.
- Contiguity and common colonizer variables have positive and significant results. But these are unalterable factors so we don't make any suggestions. Another unalterable factor is distance and negatively correlated with exports.
- Significant and negative dummy variable for the global financial crisis in 2008 implies that Asian countries' MTE trade is negatively affected by the crisis. Consequently, countries have to implement monetary policies for protecting trade from negative externalities posed by the global financial system.
- The sign for common official language is positive and significant that means same language is an important factor for countries. Countries can develop their foreign language teaching policies for diminishing transaction costs.
- Free trade agreement is significant, positive and have the biggest coefficient. Therefore, countries can increase and develop their trade agreements.
- Finally, dummy for the NRCA Index is positive and significant. Countries could improve their production technology to obtain stronger comparative advantages. Improvement in production technology depends on increasing in research and development expenditures and human capital.

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APPENDIX. YEAR BASED TRADE EFFICIENCY SCORES OF BILATERAL FLOWS

Country 1	Country 2	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
AUS	CHN	33.97	32.79	32.68	32.56	31.79	30.34	25.99	22.32	22.18	21.86
AUS	HKG	13.59	15.00	21.91	21.51	22.22	22.20	18.51	18.54	21.05	19.54
AUS	IDN	33.92	31.60	37.14	36.18	14.09	13.52	11.95	9.98	9.59	10.01
AUS	IND	7.85	6.96	9.18	7.43	6.16	5.82	4.68	3.55	3.50	3.58
AUS	JPN	6.23	5.75	6.61	5.59	5.74	5.24	4.80	5.41	5.82	6.42
AUS	KOR	24.48	23.83	28.95	18.32	20.50	21.30	19.47	19.04	15.01	11.76
AUS	MYS	21.58	22.29	24.05	29.84	10.35	9.93	8.44	8.66	8.88	9.47
AUS	PHL	10.95	9.89	15.48	13.76	4.16	4.17	4.85	3.87	4.08	4.44
AUS	RUS	0.74	0.67	1.07	1.53	0.81	0.82	0.60	0.53	0.54	0.48
AUS	SGP	7.81	7.84	10.54	11.92	8.80	8.68	7.80	8.09	8.85	8.51
AUS	THA	5.14	4.73	5.70	4.79	4.77	4.25	4.84	3.72	4.39	4.51
AUS	TUR	1.18	1.25	1.51	1.09	1.69	1.08	1.03	1.14	0.80	1.37
AUS	VNM	8.41	9.70	14.82	16.28	3.07	2.36	2.20	2.08	2.79	3.66
CHN	AUS	58.39	58.50	60.18	60.32	60.26	58.79	57.47	56.03	56.21	56.62
CHN	HKG	52.69	51.59	54.41	52.35	53.68	52.71	52.70	53.50	50.57	50.06
CHN	IDN	47.16	46.79	53.91	50.14	49.07	57.39	55.19	53.69	53.45	54.60
CHN	IND	55.36	57.22	62.55	61.40	59.96	50.64	51.21	50.73	48.78	46.95
CHN	JPN	66.84	66.24	67.99	57.86	58.48	57.22	56.89	57.94	57.97	57.37
CHN	KOR	68.61	68.41	72.46	71.90	71.25	70.37	70.68	70.28	69.71	69.88
CHN	MYS	46.20	44.72	47.09	46.36	43.34	39.59	40.00	40.76	39.40	40.48
CHN	PHL	46.22	44.31	47.80	45.38	44.46	41.28	40.49	39.86	41.64	42.59
CHN	RUS	42.37	45.42	50.01	41.69	46.27	45.22	45.41	43.88	44.22	42.18
CHN	SGP	48.08	45.60	49.82	48.31	44.55	41.44	40.26	38.57	37.84	40.14
CHN	THA	47.15	43.95	48.58	46.42	46.42	46.79	48.20	46.09	45.76	47.75
CHN	TUR	55.33	54.98	58.63	58.20	58.06	58.24	57.44	57.60	57.28	58.03
CHN	VNM	32.02	37.14	42.67	41.73	42.53	41.24	39.96	43.89	46.08	45.18
HKG	AUS	30.27	30.02	35.79	35.79	33.07	30.57	29.76	29.35	28.42	31.72
HKG	CHN	61.30	59.84	62.29	61.27	61.73	60.22	59.64	59.00	58.22	57.25
HKG	IDN	41.69	44.05	51.30	51.97	51.52	49.02	45.66	43.47	44.68	45.76
HKG	IND	25.93	25.96	37.09	39.63	42.57	42.84	42.49	42.65	42.89	45.95
HKG	JPN	54.66	53.87	57.66	56.26	56.97	55.95	56.20	56.59	56.98	57.15
HKG	KOR	58.12	55.98	59.99	59.51	59.82	59.47	47.92	58.88	47.16	44.66
HKG	MYS	36.30	34.88	40.06	36.37	37.55	36.05	34.93	32.18	33.23	34.59
HKG	PHL	49.55	47.85	51.41	48.56	47.42	47.49	47.86	45.78	45.78	46.90
HKG	RUS	21.26	22.41	29.71	29.11	37.90	35.41	38.82	40.15	40.23	41.16
HKG	SGP	50.49	34.74	42.01	37.90	37.20	35.42	34.31	33.46	32.80	32.84
HKG	THA	52.88	52.20	56.98	54.56	55.77	57.20	56.15	55.55	56.89	56.02
HKG	TUR	30.94	26.71	32.55	35.89	34.04	35.42	33.98	33.19	38.58	39.40
HKG	VNM	45.98	51.60	57.80	58.00	59.40	60.30	60.80	60.55	61.67	62.64
IDN	AUS	29.77	28.36	24.95	29.25	9.00	11.83	8.13	8.45	12.02	6.97
IDN	CHN	30.13	27.85	28.98	30.88	22.03	19.61	16.81	15.00	13.29	12.98
IDN	HKG	51.68	47.30	51.47	51.42	50.57	51.18	50.44	44.68	39.49	40.81
IDN	IND	31.41	30.19	37.71	36.09	16.76	14.78	16.21	13.42	15.28	12.14
IDN	JPN	52.30	52.07	56.34	52.03	29.65	27.98	28.90	30.80	31.88	32.13
IDN	KOR	34.90	12.21	18.48	20.99	19.50	19.20	18.45	17.69	16.35	16.57
IDN	MYS	26.63	21.24	27.63	25.46	21.17	19.52	20.16	20.60	17.40	19.65
IDN	PHL	40.43	39.52	46.12	50.17	49.21	46.52	46.04	45.82	47.74	46.98
IDN	RUS	16.42	7.67	8.88	12.21	12.09	9.64	7.89	13.09	17.65	23.49
IDN	SGP	66.04	63.87	66.56	65.01	62.84	60.45	60.46	59.91	58.67	57.14
IDN	THA	43.71	41.87	47.81	44.93	47.80	48.07	48.32	47.15	45.96	45.85
IDN	TUR	37.61	28.42	28.87	28.95	20.87	17.83	22.33	27.32	24.94	30.10
IDN	VNM	46.03	44.36	49.46	42.79	42.43	40.22	38.11	38.87	37.56	39.84
IND	AUS	3.74	5.05	8.82	8.27	8.94	6.55	6.82	7.01	6.51	5.43
IND	CHN	22.04	20.22	23.06	30.00	23.08	25.40	23.14	27.91	26.68	20.18
IND	HKG	9.26	7.89	15.58	27.24	23.03	25.47	19.59	18.38	16.24	13.88

APPENDIX CONTINUED

Country 1	Country 2	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
IND	IDN	39.43	41.20	56.51	64.04	42.01	40.20	45.74	39.71	39.11	33.80
IND	JPN	9.38	8.93	12.61	13.48	9.22	13.93	14.06	18.99	18.22	24.92
IND	KOR	23.27	21.80	37.20	30.92	8.90	8.83	9.27	10.33	9.42	9.81
IND	MYS	25.22	21.27	30.74	55.91	24.21	12.64	15.49	16.32	17.07	24.59
IND	PHL	32.06	32.11	45.19	47.00	22.29	23.98	24.23	31.32	27.26	28.52
IND	RUS	11.39	10.92	17.35	18.31	28.33	25.05	26.15	25.49	25.12	23.82
IND	SGP	19.45	15.54	34.44	31.76	24.24	35.12	26.45	28.54	22.30	19.04
IND	THA	40.26	39.09	48.58	54.81	31.29	32.44	35.63	34.10	31.51	30.11
IND	TUR	35.82	34.06	44.25	38.61	44.37	50.52	48.99	54.90	57.44	57.32
IND	VNM	43.26	45.18	47.55	59.58	50.27	34.78	26.89	30.32	38.62	41.51
JPN	AUS	45.92	46.01	49.79	46.61	47.43	44.53	45.27	44.10	43.57	44.02
JPN	CHN	61.77	61.16	63.26	68.20	69.34	68.27	66.22	65.46	65.20	64.25
JPN	HKG	55.56	55.65	58.79	56.30	57.73	54.85	53.88	53.60	53.98	53.92
JPN	IDN	51.21	52.64	58.71	54.36	38.94	36.98	38.84	37.66	36.13	33.21
JPN	IND	29.75	31.82	40.83	34.54	36.79	38.45	36.84	34.01	32.64	32.47
JPN	KOR	42.34	41.72	48.55	45.22	46.06	44.35	42.38	42.65	40.82	41.45
JPN	MYS	56.61	56.54	58.88	57.19	38.61	35.77	35.83	34.10	33.53	34.64
JPN	PHL	56.93	55.43	57.40	55.05	37.25	34.78	35.18	32.78	33.21	34.20
JPN	RUS	47.06	49.88	56.53	35.14	45.76	47.19	47.17	46.64	45.72	42.71
JPN	SGP	53.97	52.61	57.50	53.93	34.00	31.49	28.11	27.49	28.52	29.46
JPN	THA	61.44	60.91	48.23	45.35	47.97	47.03	49.33	47.41	45.73	45.40
JPN	TUR	34.93	34.84	39.76	29.25	35.37	35.56	29.87	32.42	32.01	34.85
JPN	VNM	51.27	54.45	58.81	55.82	36.89	35.60	36.80	37.11	39.75	42.85
KOR	AUS	41.30	39.01	42.47	46.63	47.02	45.44	43.57	40.21	39.54	43.82
KOR	CHN	76.86	76.23	77.60	77.46	77.59	76.84	76.47	76.68	76.29	76.25
KOR	HKG	58.64	56.47	61.05	62.77	63.40	64.13	70.56	62.18	68.05	69.48
KOR	IDN	43.11	22.99	33.02	30.41	26.73	25.12	28.66	27.58	24.41	21.28
KOR	IND	55.31	52.23	61.62	59.98	42.98	41.23	39.19	36.28	36.07	36.91
KOR	JPN	42.94	43.57	49.41	47.12	46.21	47.02	47.32	46.55	45.89	45.67
KOR	MYS	56.65	34.79	37.26	33.50	32.60	28.45	29.63	28.73	25.75	26.82
KOR	PHL	56.09	32.84	39.21	40.24	41.36	38.74	38.55	39.51	40.26	40.39
KOR	RUS	48.09	52.54	58.25	50.17	54.58	54.64	54.73	53.86	52.58	45.34
KOR	SGP	37.32	37.99	46.56	46.60	43.38	43.66	42.99	41.44	40.06	36.21
KOR	THA	46.25	21.84	30.10	28.86	28.83	28.15	28.93	26.48	25.30	24.09
KOR	TUR	46.32	46.48	51.08	48.26	49.05	51.66	49.39	48.88	47.63	47.75
KOR	VNM	52.06	34.56	42.42	46.33	47.44	51.52	54.11	57.45	56.53	60.29
MYS	AUS	49.04	47.63	50.13	53.19	29.63	22.71	20.44	19.90	20.35	21.16
MYS	CHN	53.10	52.69	47.39	57.78	56.32	53.49	51.49	49.77	48.85	47.72
MYS	HKG	60.68	58.64	55.55	63.11	62.80	60.91	59.72	59.81	60.60	59.31
MYS	IDN	16.30	15.19	18.42	18.67	14.87	15.17	15.75	15.51	14.00	14.42
MYS	IND	37.28	37.58	41.08	38.16	19.43	21.62	21.35	15.92	13.87	15.25
MYS	JPN	60.40	59.49	59.99	61.60	44.31	42.00	39.81	41.23	42.12	43.89
MYS	KOR	55.21	32.79	32.15	39.30	38.70	38.55	34.79	32.65	30.77	35.60
MYS	PHL	41.58	38.64	44.63	35.08	37.31	36.85	46.80	44.75	44.03	46.09
MYS	RUS	20.34	26.93	34.59	24.82	23.01	22.84	21.52	19.45	25.17	28.71
MYS	SGP	42.11	37.27	35.89	39.49	36.69	32.38	30.99	31.56	30.93	32.99
MYS	THA	34.63	31.57	46.45	35.49	33.18	29.73	44.24	44.10	43.90	44.91
MYS	TUR	32.29	30.71	26.83	29.40	26.33	24.25	24.04	25.19	17.42	17.35
MYS	VNM	38.44	30.30	31.87	32.40	39.87	35.14	36.63	37.17	35.10	37.39
PHL	AUS	14.90	10.85	13.24	13.77	4.23	3.63	3.46	3.73	5.80	3.55
PHL	CHN	61.24	59.06	60.14	50.42	50.32	47.65	50.16	47.45	46.21	45.61
PHL	HKG	66.41	68.18	68.88	66.13	65.27	60.75	64.98	64.00	65.49	66.08
PHL	IDN	20.82	21.62	26.72	19.37	15.27	14.65	15.63	15.63	20.10	14.77
PHL	IND	16.85	27.69	23.73	24.20	14.66	10.77	12.35	9.56	7.52	7.97
PHL	JPN	64.47	62.02	64.15	62.30	40.40	38.73	40.60	43.95	47.48	48.23

APPENDIX CONTINUED

Country 1	Country 2	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
PHL	KOR	55.55	35.83	43.95	44.05	39.70	28.52	34.31	33.66	28.48	32.86
PHL	MYS	63.30	59.74	47.15	55.69	32.63	29.17	25.65	24.29	25.60	28.64
PHL	RUS	0.36	0.75	0.62	3.70	0.48	1.21	1.93	1.30	0.94	2.33
PHL	SGP	52.55	47.73	46.58	49.99	37.55	40.44	50.77	45.73	46.17	45.66
PHL	THA	42.84	37.46	41.66	38.65	50.45	47.59	55.04	50.00	52.19	41.31
PHL	TUR	17.27	17.08	12.71	7.40	12.06	8.84	8.91	5.24	4.97	5.90
PHL	VNM	18.31	16.85	20.73	19.85	19.57	24.07	25.73	23.55	17.85	29.39
RUS	AUS	0.28	0.28	0.47	1.04	0.54	0.34	0.39	0.11	0.11	0.27
RUS	CHN	31.99	25.08	23.10	28.32	23.46	15.05	17.38	19.18	21.17	26.82
RUS	HKG	7.33	7.18	10.52	12.66	9.83	9.08	7.85	10.84	9.65	11.39
RUS	IDN	3.49	1.54	9.24	11.65	4.39	1.84	1.67	33.50	7.69	2.43
RUS	IND	56.17	48.21	57.57	60.12	51.53	48.39	51.74	49.77	48.46	49.27
RUS	JPN	1.68	1.98	5.17	7.01	11.50	9.64	10.93	10.18	4.43	21.61
RUS	KOR	11.94	7.42	9.81	13.10	30.77	10.42	11.08	5.15	11.87	18.95
RUS	MYS	21.52	8.19	5.42	12.09	13.55	12.20	5.17	8.49	11.75	14.39
RUS	PHL	1.07	0.72	0.91	0.51	0.65	0.37	7.60	0.68	0.20	0.27
RUS	SGP	17.70	19.03	13.94	12.72	8.00	16.53	6.03	15.95	2.99	31.75
RUS	THA	0.83	0.26	0.81	0.23	2.23	1.10	5.33	1.75	1.07	7.04
RUS	TUR	4.62	6.19	10.94	9.57	8.53	3.86	5.50	6.95	10.73	11.83
RUS	VNM	35.18	38.06	37.63	32.80	48.47	48.40	51.87	45.66	38.25	48.08
SGP	AUS	18.37	17.28	20.04	19.16	17.73	14.79	14.55	13.26	14.50	16.48
SGP	CHN	59.00	55.67	57.72	54.02	53.79	50.70	50.00	50.47	50.55	50.27
SGP	HKG	55.51	63.58	66.89	67.05	67.81	66.55	66.30	66.02	65.85	65.38
SGP	IDN	67.69	66.15	68.90	66.74	64.35	63.50	63.34	62.07	60.67	60.06
SGP	IND	27.34	26.16	33.99	29.87	28.43	24.68	22.03	20.78	19.53	20.05
SGP	JPN	59.56	57.80	61.98	58.74	41.44	39.53	38.65	41.18	41.03	41.27
SGP	KOR	48.92	48.67	56.00	57.67	55.01	52.67	51.93	50.92	49.77	49.53
SGP	MYS	35.17	31.34	33.78	32.04	30.30	26.09	24.30	23.35	21.81	23.06
SGP	PHL	38.92	39.11	44.93	39.37	39.16	35.74	33.12	31.73	32.03	31.83
SGP	RUS	28.02	24.43	23.33	18.52	20.62	14.46	15.43	16.40	17.58	19.78
SGP	THA	49.76	46.31	51.14	48.72	47.75	45.59	46.62	45.13	43.91	43.91
SGP	TUR	21.11	16.84	20.44	20.65	15.21	16.90	25.72	20.02	18.75	19.21
SGP	VNM	44.43	44.22	49.21	50.19	45.27	46.23	45.93	49.08	50.56	51.66
THA	AUS	21.89	23.00	27.66	27.41	27.93	22.44	24.20	25.51	25.78	28.50
THA	CHN	56.67	56.76	59.48	58.38	57.06	53.67	51.33	45.97	45.10	45.40
THA	HKG	67.99	67.38	69.96	69.14	70.46	70.19	69.87	69.66	69.69	68.89
THA	IDN	41.28	43.83	51.81	46.57	48.01	48.48	50.16	48.29	46.96	43.48
THA	IND	51.64	50.59	57.36	57.42	37.77	35.89	37.20	36.20	37.00	37.33
THA	JPN	64.35	63.99	51.27	47.99	48.79	47.83	46.98	47.78	49.04	49.38
THA	KOR	51.42	29.91	36.79	39.79	35.92	31.62	33.65	30.87	31.23	31.73
THA	MYS	44.91	43.65	35.54	48.11	47.94	46.83	31.89	31.72	32.18	31.60
THA	PHL	59.87	57.29	59.85	60.05	50.69	47.45	47.37	47.42	49.79	61.47
THA	RUS	19.69	22.80	38.03	22.56	33.41	34.70	34.92	32.54	32.77	28.87
THA	SGP	56.54	55.83	57.25	55.33	52.54	50.72	49.22	48.58	49.92	49.28
THA	TUR	35.95	33.86	42.04	34.54	37.18	40.18	38.80	41.11	40.33	41.18
THA	VNM	59.34	59.71	64.03	64.21	63.62	63.99	60.93	62.27	62.21	63.87
TUR	AUS	2.33	2.46	3.44	2.94	2.98	2.63	2.61	3.08	3.58	3.70
TUR	CHN	18.34	14.66	20.22	15.78	14.61	14.99	13.35	10.50	11.23	13.27
TUR	HKG	11.31	5.00	6.44	19.18	10.44	14.23	11.81	16.29	14.06	13.11
TUR	IDN	5.09	10.77	12.62	12.11	6.05	8.23	9.03	9.70	9.27	12.53
TUR	IND	12.19	10.37	18.38	17.51	17.70	17.82	17.32	16.03	13.08	14.20
TUR	JPN	2.17	5.11	4.54	4.28	4.85	3.06	2.75	8.72	4.66	6.21
TUR	KOR	11.64	5.94	11.52	14.90	12.51	15.75	9.85	10.95	12.44	19.11
TUR	MYS	9.08	10.29	12.65	16.60	10.62	18.38	14.57	19.31	17.95	22.97
TUR	PHL	21.84	6.03	9.68	9.93	8.64	9.38	9.43	9.67	11.35	14.64

APPENDIX CONTINUED

Country 1	Country 2	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
TUR	RUS	27.42	25.57	34.94	21.96	25.30	28.13	27.63	28.80	25.95	20.64
TUR	SGP	11.31	9.02	18.74	11.99	18.15	22.78	10.34	11.27	18.81	21.73
TUR	THA	17.38	12.92	18.88	15.68	12.47	15.65	19.56	15.62	20.32	20.29
TUR	VNM	13.76	9.84	15.40	18.35	13.41	7.85	16.73	15.47	20.82	24.68
VNM	AUS	21.78	12.67	12.31	14.65	5.18	7.88	8.94	11.15	11.53	13.99
VNM	CHN	9.97	11.01	18.08	17.83	25.28	26.33	30.81	31.77	32.63	33.66
VNM	HKG	41.55	44.19	54.89	53.85	57.81	60.87	62.79	64.56	66.12	69.62
VNM	IDN	9.26	8.46	14.11	19.82	25.92	26.31	29.60	37.99	40.65	40.30
VNM	IND	12.54	19.30	29.13	41.12	31.70	37.55	38.56	44.38	41.84	38.98
VNM	JPN	57.73	58.57	62.01	59.96	44.62	43.47	44.15	45.50	46.81	47.66
VNM	KOR	28.64	14.22	21.87	20.94	24.65	31.67	38.81	41.43	40.33	51.37
VNM	MYS	15.74	18.60	28.64	23.43	25.70	33.87	51.45	54.90	45.42	48.05
VNM	PHL	48.40	48.45	49.27	48.79	50.26	50.48	49.73	48.82	48.91	47.89
VNM	RUS	2.16	2.79	3.53	4.30	43.57	49.72	52.71	53.29	51.34	54.20
VNM	SGP	24.53	27.22	35.36	38.56	38.42	42.81	43.06	44.47	43.14	44.71
VNM	THA	62.97	61.54	63.85	62.01	59.71	60.59	64.19	65.51	65.33	65.48
VNM	TUR	29.63	25.88	29.03	32.12	49.28	51.77	44.82	53.16	58.24	58.69

Note: AUS: Australia, CHN: China, HKG: Hong Kong, IDN: Indonesia, IND: India, JPN: Japan, KOR: Korea, MYS: Malaysia, PHL: Philippines, RUS: Russia, SGP: Singapore, THA: Thailand, TUR: Turkey, VNM: Vietnam. The logic of reading trade efficiency scores: for example**;** Turkey's Export to Russia in 2014 has an efficiency score of 25.95%. Observed MTE export is 1.523.879.000 dollars. Potential MTE Export is (100*(Observed MTE Export))/25.95. So it is 5.872.391.000 dollars.

Source: Author's own