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Measuring Trade Creation and Trade Diversion Effects of the ASEAN Free Trade Area: A Gravity Model Approach

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Abstract

The formation of trade agreements will result in trade creation when the importing country changes its import sourcing from non-members with higher costs to members with lower costs. On the other hand, if there is a shift in imports from non-member partners with lower costs to members with higher costs, the effect will be considered trade diversion. This paper estimates trade creation and trade diversion effects of the AFTA by using the stochastic frontier gravity model. ASEAN/AFTA members included in this study are Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. The study finds that the free trade agreement formed by ASEAN countries is welfare improving given that the trade creation and trade diversion effects are found to be positive and significant. The results are also robust when being tested in shorter time ranges and controlling for effects of other FTAs. This offers policy implications for countries to embrace regional cooperation and promote trade among any trading block members in a manner that does not raise trade barriers for other countries to divert trade from non-FTA trading partners.

Keywords: Trade Creation, Trade Diversion, the Stochastic Frontier Gravity Model, ASEAN, AFTA

1. Introduction

The Association of Southeast Asian Nations (ASEAN) is considered one the most vibrant and integrated regions in the world (Armstrong et al. 2008; Kalirajan & Singh 2008; Armstrong & Drysdale, 2011). Armstrong et al. (2008) found that ASEAN had the highest intraregional trade performance, followed by East Asia, then North America and Europe. Intraregional trade performance was found to be lowest in South Asia. The formation of trade agreements will result in trade creation when the importing country changes its import sourcing from non-members with higher costs to members with lower costs. On the contrary, if there is a shift in imports from non-member partners with lower costs to members with higher costs, the effect will be considered trade diversion (Viner, 1950). Therefore, the welfare implication of regional trade blocks will depend on whether the trade creation effect is greater or less than the trade diversion effect.

Pioneer empirical works measuring welfare implications of free trade areas (FTAs) show that the EU had increased intra-regional trade during the 1960s and 1970s (Bergstrand, 1985). Evidence of trade creation has also been found for trade agreements in Asia and in North America in subsequent studies by Frankel (1997), & Frankel and Wei (1998). Similarly, Armstrong et al. (2008) also find that ASEAN had the highest intraregional trade performance as compared to other regional blocks. Ukabe and Urata (2013) find positive and significant trade creation effects in ASEAN. They suggest that trade creation effects are smaller for newer ASEAN members than older members. The estimated coefficients are found to be positive and significant for a wide range of products for Indonesia, Malaysia, the Philippines, and Thailand while fewer products are reported to have trade creation impact for Cambodia, Myanmar, and Vietnam. In a study by Ekanayke et al. (2010) on Asian FTAs, the estimates of dummy variables for three out of the four trade agreements (ASEAN, Bangkok Agreement, and South Asia Association for Regional Cooperation) have positive signs and are statistically significant. However, the welfare effect for the Economic Cooperation Organization in Central Asia is found to be negative, which is unexpected. This paper evaluates welfare effects of the ASEAN free trade area (AFTA) and addresses two questions: 1) to what extent have ASEAN member countries managed to increase trade flows among themselves and whether their intra-regional trade patterns differ between the older and newer members; and 2) does AFTA formation lead to welfare-improving or not from the assessment based on frontier gravity model estimation?

The study proceeds as follows. Section 2 provides a background on AFTA evolution and trade patterns among members. Section 3 outlines the model specification while data and its sources are explained in section 4. This is followed by economic results and discussions in section 5. The conclusion is provided in section 6.

2. ASEAN Free Trade Area

The AFTA formulation began in 1993 when six older ASEAN members, namely Brunei, Indonesia, Malaysia, the Philippines, Singapore, and Thailand, agreed to establish a free trade area. The AFTA was then joined by Vietnam in 1995, Laos and Myanmar in 1997, and Cambodia in 1999. The ASEAN members have set out to establish the ASEAN Economic Community (AEC) to promote free flows of trade in goods and services aiming to create a competitive single market by 2015.

As regards implementation progress, more than 99 percent of the tariff lines in the inclusion list had been eliminated in the six original members by 2010. At the same time, around 95-99 percent of the tariff lines had been brought down to the 0-5 percent for the newer members (ASEAN Secretariat, 2010). In light of notable achievements in trade liberalization under AFTA, this paper tries to evaluate the impact of AFTA on trade among the ASEAN members. Specifically, the key question is to examine whether AFTA has promoted trade among member countries, as was expected before the establishment of the regional block.

ASEAN has successfully raised intra-regional trade flows in terms of imports and exports. Table 1 reports intra-ASEAN trade as measured by imports during 1990-2012. In 1990 before the AFTA has been established, intra-regional imports were recorded at 15 percent on average. The figure rose to 23 percent in 2012. A closer look reveals that intra-regional trade is found to be larger in smaller economies, with Laos having the highest share (70%)

over the 1990-2012 period, followed by Brunei Darussalam (51%) and Cambodia (47%). Over the same period, intra-regional imports ranged from 16 percent for Thailand to 24 percent for Singapore. This implies that trade for newer members with smaller economies tends to be relatively concentrated in the region as compared to older members. Overall, intra-regional trade has increased among older ASEAN members with the exception of Brunei Darussalam.

Table 1. Intra-ASEAN imports (per cent), 1990-2012

	1990	1995	2000	2005	2010	2011	2012	Average 1990-2012
Older members								
Brunei Darussalam	41.89	50.30	57.64	64.50	56.42	40.85	43.19	50.98
Indonesia	8.44	14.88	19.35	29.52	28.68	28.80	27.99	20.02
Malaysia	19.07	17.40	24.01	24.87	27.10	27.81	27.98	22.71
Philippines	10.57	10.57	15.55	18.71	28.04	23.67	22.87	16.51
Singapore	17.12	22.27	24.72	26.04	24.00	21.35	21.01	23.49
Thailand	13.07	11.50	16.66	18.29	16.60	16.25	16.30	15.33
Newer members								
Cambodia	43.27	75.97	38.92	31.02	34.36	56.73	58.53	46.68
Laos	60.91	56.08	77.71	76.85	73.16	72.87	70.57	70.05
Myanmar	26.04	43.63	45.30	50.87	43.58	40.52	37.04	43.46
Viet Nam	18.99	28.45	28.45	25.37	19.68	20.01	18.59	26.12
ASEAN	15.22	17.95	22.47	24.34	24.17	23.45	23.18	21.28

Source: Author's calculation through ADB Integration Indicators database.

In terms of exports, a similar picture can also be drawn as shown in Table 2. Smaller ASEAN members still take up a relatively higher share of intra-regional exports. During the 1990-2012 period, 46 percent of exports from Laos were destined to other ASEAN markets which were almost twice of the intra-regional exports made by Malaysia (27%). For larger economies, intra-ASEAN exports were highest in Singapore, averaging 28 percent, which reflects its trading hub location in the region and the world. The intra-regional exports were found to be lowest in the Philippines, only around 14 percent on average between 1990 and 2012.

Table 2. Intra-ASEAN exports (per cent), 1990-2012

	1990	1995	2000	2005	2010	2011	2012	Average 1990-2012
Older members								
Brunei Darussalam	20.93	22.20	23.16	25.30	10.53	12.63	12.95	20.23
Indonesia	9.95	14.24	17.52	18.47	21.13	20.69	22.01	17.17
Malaysia	29.45	27.55	26.56	26.08	25.37	24.59	26.80	26.57
Philippines	7.26	13.58	15.65	17.34	22.38	17.92	18.85	14.21
Singapore	22.32	30.32	27.34	31.34	30.15	30.98	31.54	28.44
Thailand	11.92	19.79	19.34	21.99	22.93	24.28	24.71	19.64
Newer members								
Cambodia	74.56	63.12	6.78	4.73	12.60	12.17	16.96	28.66
Laos	68.41	54.98	42.69	42.17	43.78	46.51	46.50	46.46
Myanmar	28.21	30.27	21.29	51.11	46.59	43.57	45.75	34.14
Viet Nam	13.81	19.79	18.09	17.70	14.83	14.62	15.63	18.12
ASEAN	18.94	24.41	22.98	25.33	25.03	25.02	25.92	23.43

Source: Author’s calculation through ADB Integration Indicators database.

3. Model specifications

A gravity model is a popular tool used to evaluate the implication of trade policies as an alternative to the general equilibrium model. Intuitively, bilateral trade flows are believed to be determined by the relative size and distance of the two trading partners (Armstrong, 2007). The bigger the two countries are, the more they are likely to trade with each other while the geographical distance reduces their trade level. In this connection, the simple form gravity model can be formulated as:

$$Trade = f(size, distance) \tag{1}$$

The early use of this model had been criticized as a theoretical. Economic foundations underpinning the gravity were later contributed by Anderson (1979), Bergtrand (1985), and Deardorff (1998). They provided a rigorous derivation for a reduced-form gravity equation from the general equilibrium models. Anderson (1979) used Armington preferences with the assumption of homogenous goods to derive a role for transport costs while Bergstrand (1985) further developed the model with the increasing returns to scale. The gravity model has now been widely used to evaluate the impacts of trade policies, including to measure the effects of trade creation and trade diversion.

There have been arbitrary choices of trade determinants and policy variables entered into gravity model estimation. Armstrong (2007) categorizes trade determinants as either natural or man-made. The natural determinants are geography, size, and language while those which are man-made affecting trade flows between countries include such policy variables as trade agreements, customs unions, and import restrictions. Kalirajan (2007) groups of factors affecting trade flow into 4 broad categories.

1) Natural factors such as demand, supply, and transport costs which are in turn determined by national output, population, and geographical distance. Other factors may include a common border, and language and political links;
2) Behind-the-border constraints in the exporting country such as institution and infrastructure rigidities which could inhibit exporting capacity;

3) Beyond-the-border constraints in the importing country which can be explicit such as tariffs and non-tariff measures as well as implicit such as institution and infrastructure rigidities; and
4) Mutual interest factors such as participation in trade agreements either at the bilateral, regional or multilateral levels which would promote more trade between the importing and exporting countries (Kalirajan, 2007).

Thus, the standard gravity model can be expressed as:

$$X_{ij} = f\left(Z, \beta\right) \exp\left(\varepsilon\right) \tag{2}$$

Where X_{ij} is export flow from country i to j, Z is explanatory variables, β is parameter(s) to be estimated, and is the error term.

The estimation of the standard gravity model in equation (2) by ordinary least squares (OLS) will result in biased and inconsistent estimators (Kalirajan, 2008). This is due to the fact that country-specific factors (institutions, and political and economic settings) cannot properly be captured in the model. Therefore, these omitted variables are correlated with included explanatory variables, eg geographical distance, and hence causes the variance from the regression to be biased upward. This will make the test of the signification of the OLS estimators to be inclusive (Kalirajan, 2008; Armstrong, 2007). Therefore, the use of stochastic gravity model is more appropriate. It basically aims to measure trade resistances beyond the explicit resistances that are not normally captured in the standard gravity model.

The error term can be decomposed to normally distribute statistical error term and a non-negative unobservable term. The latter in effect captures unobservable and resistances to trade in the stochastic gravity model as shown in equation (3).

$$X_{ij} = f\left(Z, \beta\right) \exp\left(v - u\right) \tag{3}$$

where v is normally distributed statistical error term. u is the unobservable term which is referred to as manmade resistance to trade including behind the border resistances (Armstrong, 2007) and barriers to international integration (Kalirajan, 2007).

Kalirajan (2008) points out two advantages in estimating the gravity model with the stochastic frontier method. First, this method avoids a loss of estimation efficiency and at the same time can be used to estimate the combined impacts of economic distance. Second, it also allows for the non-normal unobservable term to be partial out from the normally distributed error term.

This study uses the baseline specification as expressed in a linear logarithm formation as follows:

$$log(X_{ijt}) = \beta_0 + \beta_1 \log(GDP_{it}) + \beta_2 \log(GDP_{jt}) + \beta_3 \log\left(Pop_{it}\right) + \beta_4 \log\left(Pop_{jt}\right) + \beta_5 Dist_{ij} + \beta_6 Border_{ij} + \beta_7 Comp_{ijt} + \beta_8 Lang_{ij} + \beta_9 Tariff_{jt} + \beta_{10} AFTA\_both + \beta_{11} AFTA\_1 + v_{ijt} - u_{ijt} \quad (4)$$

Where X_{ijt} is exports from countries *i* to *j* at time *t.* In this study, imports data is used as imports are a more accurate reflection of trade flows than reported exports bilateral trade given importers have less incentive to under-report their transactions (Armstrong et al. 2008).

GDP_{it} and GDP_{jt} are the national output of country *i* and *j* at time *t,* measured by GDP at current prices.

Pop_{it} and Pop_{jt} are the populations of country *i* and *j* at time *t*.

$Dist_{ij}$ is the relative distance from country *i* to *j,* measured by the great circle distance between capital cities and relative to the square root of the sum of all distances for countries *i* and *j* between their trading partners.

$Border_{ij}$ is a dummy variable with the value of one if countries *i* and *j* share a common land border, zero otherwise.

$Comp_{ijt}$ is a complementarity index of countries *i* trading with *j* at time *t.*

$Lang_{ij}$ is an index on language similarity which takes a value of 0 if none of the population of country *i* speaks the same language as in country *j* and a value of 10,000 if all of the population in both countries speak the same language.

$Tariff_{jt}$ is average import tariff of country j at time t.

AFTA_both is a dummy variable which takes a value of 1 if both mporting and export countries are AFTA members, zero otherwise.

AFTA_1 is a dummy variable which takes a value of 1 if either importing or export countries is AFTA member, zero otherwise.

Dummy variables are used to capture trade creation or intra-FTA trade when both the exporting and importing countries are in the same regional grouping. Trade diversion or extra-regional trade is captured by FTA dummy if either one of the country pairs is from the same FTAs. The use of FTA dummies is considered a crude measurement of trade creation and diversion effects but this been used by a number of studies (Armstrong et al., 2008; Ekanayke et al., 2010).

The signs for GDP, border, trade complementarity, language similarity are expected to be positive. For GDP it means the bigger the economies are the more they will trade. Likewise, a higher degree of complementarity in trade explains higher trade. Language similarity is linked to increased trade flows. On the contrary, the signs for distance and tariff variables are expected to be negative. Distance is a proxy for transport costs which implies that any increase in the transport costs would result in a lower trade. The population is used to control for demand effects, which is expected to have a negative sign (sometimes it is positive). That is the larger its population, the more a country consumes the output being produced. The tariff imposed by the importing country is associated with a lower trade. The signs for trade creation and trade diversion variables can be either positive or negative.

4. Data

The model is estimated from bilateral trade flows between AFTA members and trading partners with the full sample of the top 65 trading countries for the period 1998 to 2006. The sample covers only 6 ASEAN members: Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam, whereby other countries (Brunei Darussalam, Cambodia, Laos, and Myanmar) are excluded because of data unavailability. List of countries used in this study is provided in Appendix 1.

Trade flow data is taken from the International Monetary Fund's Direction of Trade and the United Nations' Comtrade. Data on national output and population is from the World Development Indicators and Penn World Table 8. Relative distance and language similarity are taken from the databases of Chemical Ecology of Insects and CEPII geodesic distances.[1] Complementarity index is calculated based on Drysdale and Garnaut (1982).[2]

5. Results and discussions

This study estimates welfare effects of the ASEAN free trade area over the period 1998-2006. Before explaining the results, it is worthwhile discussing some model specification tests (Armstrong et al. 2008). The first test is on Gamma with the null hypothesis γ=0 (against the alternative γ>0). This is used to test whether a one-sided error specification is appropriate or not. Gamma is the proportion of total variation that is explained by variation in the non-negative disturbance and is given by $\gamma = \frac{\sigma_u^2}{\sigma_u^2 + \sigma_v^2}$

where σ_v^2 is the variance of v_{ij} and σ_u^2 is the variance of u_{ij}.

The second test is on Mu with the null hypothesis μ=0 (against the alternative μ≠0). If the null hypothesis is rejected, it implies a truncated normal distribution fits the non-negative error term better than a half-normal distribution.

The third test is on eta (η) with the null hypothesis η = 0 (against the alternative η ≠ 0) from equation (5).

$$u_{ijt} = \eta_{it} u_{jt} = \left\{ \exp\left[-\eta \left(t - T \right) \right] \right\} u_{ij} \tag{5}$$

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1 Accessible online at http://www.chemical-ecology.net/ and http://www.cepii.fr/anglaisgraph/bdd/distances.htm

2 Calculation from; $C_{ij} = \sum_k \left\{ \frac{X_i^k}{X_i} \cdot \frac{M_w}{M_i^k} \cdot \frac{M_j^k}{M_j} \right\}$ Where X is exports, M is imports while subscripts denote country (*i*, *j*, and the *world*) and superscript *k* is the commodity. The index calculation is at the three-digit level from the Australian National University's International Economic Databank for all combinations of countries and years.

This is used to test whether *u* is varying over time or not. If the value is positive then the behinds the border constraints decline exponentially to its minimum value at the last period *T*. In other words, the gap between potential and actual exports has been narrowing. If the value is negative, the potential-actual trade gap is implied to be increasing. See more discussions in Kalirajan and Singh (2008).

Table 3 reports the results from the stochastic frontier gravity model for the 1998-2006 periods. Column (i) shows the time-invariant model. The specification with time-varying decay has also been tried but it does not converge. Instead, an alternative model specification with year dummies is reported in column (ii). The year dummies capture specific year effects on exports but this does not mean to substitute the time-varying decay inefficiency model. The time-varying decay specification allows u_i to vary over time to reflect the rise or fall of efficiency while the year dummies model allows a change in the intercept.

Table 3. Baseline specification, 1998-2006

	Time-invariant *(i)*	**Year dummies** *(ii)*
Constant	-17.0018*** (0.4268)	-20.6446*** (0.5621)
Log(GDPi)	0.6993*** (0.0125)	0.8292*** (0.0144)
Log(GDPj)	0.7981*** (0.0121)	0.9068*** (0.0136)
Log(Popi)	0.1349*** (0.0165)	0.0580*** (0.0163)
Log(Popj)	-0.0237 (0.0164)	-0.0871*** (0.0161)
Distance	-3.0568*** (0.0998)	-2.9071*** (0.0940)

Table 3. Baseline specification, 1998-2006 (cont.)

	Time-invariant *(i)*	**Year dummies** *(ii)*
Border	1.1111*** (0.1406)	1.0544*** (0.1318)
Complementarity	0.0632*** (0.0198)	0.6057*** (0.0198)
Language similarity	0.0001*** (0.000)	0.0001*** (0.0000)
Tariff	-0.0001 (0.0000)	-0.0000 (0.0000)
AFTA_both	1.3693*** (0.2658)	1.5454*** (0.2492)
AFTA_1	0.7424*** (0.0600)	0.8347*** (0.0565)
Mu	4.4582*** (0.2610)	4.7936*** (0.3907)
Gamma	0.8434** (0.0038)	0.8236** (0.0041)
Sigma-squared	2.2122 (0.8434)	1.9813 (0.0424)
Log-likelihood	-36875.33	-36757
No of observations	33048	33048

Notes: Standard errors are in parentheses. ***, **, * denote significance at 1%, 5% and 10% level. Year dummy variable in column (ii) is found to be significant in each year but not reported here to save space.

Source: Author's estimation.

The results in Table 3 show that the stochastic frontier is preferred to the standard gravity model given that Gamma (γ) and Mu (μ) are found to be statically significant in the first and second columns. The estimated coefficients have expected signs and significant (mostly at the 1% significance level). The signs for GDP, border, trade complementarity, and language similarity is positive as expected. For GDP it means the bigger the economies are the more they will trade. Likewise, a higher degree of complementarity in trade explains higher bilateral trade. Language similarity is linked to increased trade flows (even with a relatively small value but it is still significant). On the contrary, the signs for population (of importing country *j*), distance and tariff are negative. The population is used to control for demand effect. Distance is considered as a proxy for costs of transport. A higher tariff imposed by importing country is associated with lower trade as expected.[3]

Our parameters of interest are the trade creation and trade diversion effects. The coefficients of variables *AFTA_both* and *AFTA_1* are found to positive and significant at the 1% level. The *AFTA_both* variable captures the intra-AFTA trade and is used to capture the trade creation effect. The value 1.3693 of the coefficient in the log-linear equation implies trade among AFTA members is enhanced around $\{\exp[1.3692]-1]\}$*100 = 293% compared to normal trade situation, *taking other things else constant*. Likewise, trade diversion or extra-AFTA trade is represented by *AFTA_1* variable. The positive sign on *AFTA_1* suggests that AFTA formation does not lead to trade diversion. In all cases, the intra-AFTA trade which captures trade creation effect is greater than extra-AFTA trade. The magnitude of the coefficients is slightly different between the results in columns (i) and (ii) but that does not alter our conclusion about welfare improving implication. The results drawn here are consistent with findings in other studies (Armstrong et al., 2008; Ekanayke et al., 2010; Ukabe & Urata, 2013). The trade enhancing effect is estimated as high as $\{\exp[1.346]-1]\}$*100 = 284% during the period of 2000-2009 in Ekanayke et al. (2010). Armstrong et al. (2008) find that ASEAN has the highest intraregional trade performance. It is followed by East Asia, then North America and Europe while the trade performance of South Asia is the lowest.

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[3] Note that the magnitude of a tariff is very small and insignificant in the full sample estimation but it becomes significant in subsequent estimations. Hence tariff variable is kept allowing for comparable results.

The results have also been tested for sensitivity over a shorter timeframe in three ranges: 1998-2000, 2001-2003 and 2004-2006. The estimates from the time-invariant model are provided in columns (i)-(iii) while the time-varying decay specification is in the last three columns.

Table 4. Results for sub-periods: 1998-2000, 2001-2003, 2004-2006

	Time-invariant			**Time-varying decay**		
	1998-2000 *(i)*	2001-2003 *(ii)*	2004-2006 *(iii)*	1998-2000 *(iv)*	2001-2003 *(v)*	2004-2006 *(vi)*
Constant	-21.90 (19.51)	-21.97*** (0.8513)	-24.45*** (0.7604)	-22.33*** (1.45)	-16.75* (9.02)	-22.36*** (5.10)
Log(GDPi)	1.0544*** (0.0153)	0.9499*** (0.0148)	1.0450*** (0.0159)	1.0545*** (0.0153)	0.9862*** (0.0149)	1.0981*** (0.0153)
Log(GDPj)	1.0001*** (0.155)	0.9699*** (0.0167)	0.9460*** (0.0161)	0.9994*** (0.0156)	1.0037*** (0.0168)	1.0087*** (0.0169)
Log(Popi)	-0.1134*** (0.0163)	-0.0537*** (0.0162)	-0.0939*** (0.0175)	-0.1133*** (0.0163)	-0.0748*** (0.0161)	-0.1249*** (0.0176)
Log(Popj)	-0.2062*** (0.0166)	-0.1746*** (0.0177)	-0.0936*** (0.0180)	-0.2055*** (0.0166)	-0.1958*** (0.0177)	-0.1368*** (0.0183)
Distance	-2.6215*** (0.0912)	-2.7881*** (0.0914)	-2.6783*** (0.0986)	-2.6205*** (0.0913)	-2.7570*** (0.0910)	-2.6310*** (0.0985)
Border	0.9847*** (0.1263)	1.0394*** (0.1247)	1.0706*** (0.1354)	0.9841*** (0.1263)	1.0266*** (0.1238)	1.0509*** (0.1351)
Complementarity	0.8118*** (0.0317)	0.8304*** (0.0304)	0.6292*** (0.0329)	0.8118*** (0.0317)	0.8116*** (0.0302)	0.5810*** (0.0329)
Language similarty	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0001*** (0.0000)
Tariff	-0.0001 (0.0001)	-0.0006*** (0.0002)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0006*** (0.0002)	-0.0003** (0.0001)
AFTA_both	1.6752*** (0.2414)	1.5518*** (0.2363)	1.7901*** (0.2562)	1.6754*** (0.2414)	1.6040*** (0.2348)	1.8855*** (0.2558)
AFTA_1	0.9497*** (0.0544)	0.9136*** (0.0544)	1.0092*** (0.0591)	0.9494*** (0.0544)	0.9432*** (0.0541)	1.0512*** (0.0591)
Mu	6.8045 (19.50)	4.7121*** (0.7572)	5.0387*** (0.6318)	6.3724*** (1.39)	11.0813 (9.02)	8.8686* (5.10)

Table 4. Results for sub-periods: 1998-2000, 2001-2003, 2004-2006 (cont.)

	Time-invariant			Time-varying decay		
	1998-2000 *(i)*	2001-2003 *(ii)*	2004-2006 *(iii)*	1998-2000 *(iv)*	2001-2003 *(v)*	2004-2006 *(vi)*
Eta				-0.0005 (0.0009)	-0.0063 (0.0052)	-0.0079* (0.0045)
Gamma	0.8682** (0.0036)	0.8570** (0.0041)	0.8789** (0.0034)	0.8683** (0.0036)	0.8583** (0.0041)	0.8819** (0.0034)
Sigma-squared	1.6540 (0.0358)	1.6489 (0.0368)	1.9157 (0.0428)	1.6553 (0.0359)	1.6439 (0.0384)	1.9344 (0.0452)
Log-likelihood	-12762	-13170	-13660	-12762	-13101	-13597
No of observations	10763	11029	11256	10763	11029	11256

Notes: Standard errors are in parentheses. ***, **, * denote significance at 1%, 5% and 10% level.

Source: Author's estimation.

We can compare the results from the time-invariant and time-varying decay models. In columns (iv)-(vi) of Table 4, *Eta* is found to be negative but insignificant for most cases (except for the period 2004-2006 which is significant only at the 10% level). The result suggests that the time-invariant specification is preferred to the time-varying decay model. This is may be explained by the fact the time span used is the estimation is relatively short, only 3 years for each period.

Now focusing on the time-invariant specification in column (i), (ii) and (iii), Gamma and Mu are reported to significant. This also reaffirms that the stochastic frontier model is preferred to the standard gravity model. For Gamma, it means 85.7% to 87.9% of (total) variance variation is explained by the variation of the non-negative disturbance. Mu is found to be positive and significant (except for 1998-2000), which implies a truncated normal distribution fits the non-negative error term better than a half-normal distribution.

Robustness tests have been performed by including FTA dummies for NAFTA, EU, ANDEAN and MERCOSUR in equation (4). The results are provided in Appendix 2. The robustness tests reveal that the time-invariant specification is preferred to the time-varying decay model. Again, Gamma is significantly different from zero and suggest between 85.5 percent (2001-2003) and 87.5 percent (2004-2006) of the total variation is coming from the non-negative term that captures the influence of unobservable constraints on trade. Mu is also found to be significant in most cases.

With the use of FTA dummies to control for trade flows of other trade blocks, the magnitudes of our coefficients of interest that capture trade creation and trade diversion do not differ much from those in the baseline specification. The results suggest that being a member of ANDEAN, MERCOSER and the EU is associated with higher trade within that group. However, the coefficient on intra-NAFTA which captures trade creation effect does not have a statistically significant effect on trade, which is an unexpected result.[4]

6. Conclusion

This paper estimates trade creation and trade diversion effects of the AFTA by using the stochastic frontier gravity model. ASEAN/AFTA members included in this study are Indonesia, Malaysia, the Philippines, Singapore, Thailand, and Vietnam. The study finds that the free trade agreement formed by ASEAN countries is welfare improving given that the trade creation and trade diversion effects are found to be positive and significant. The results are also robust when being tested in shorter time ranges and controlling for effects of other FTAs. This offers policy implications for countries to embrace regional cooperation and promote trade among any trading block members in a manner that does not raise trade barriers for other countries to divert trade from non-FTA trading partners.

In interpreting these findings, a few cautions should be highlighted given limitations faced in this study. Fist, the sample covers only 6 countries for which data is available. Thus, the results may not fully represent the precise estimates for all the ASEAN members. Second, this study uses average (applied) tariffs whereby trade within the AFTA has now mostly occurred at the preferential rates. This calls for further research to overcome these issues.

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4 Note that tariffs are significant for period 2001-2003 but not significant for 1998-2000 and 2004-2006. The individual coefficients of other FTA dummies are insignificant for some year intervals.

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Appendices

Appendix I

List of countries

1. Argentina	23. Hong Kong	45. Paraguay
2. Australia	24. Hungary	46. Peru
3. Austria	25. India	47. Philippines *
4. Belgium	26. Indonesia *	48. Poland
5. Bangladesh	27. Ireland	49. Portugal
6. Brazil	28. Israel	50. Russia
7. Bulgaria	29. Italy	51. Singapore *
8. Canada	30. Jamaica	52. Slovakia
9. Chile	31. Japan	53. South Africa
10. China	32. Jordan	54. Spain
11. Colombia	33. Korea, South	55. Sri Lanka
12. Costa Rica	34. Malaysia *	56. Sweden
13. Cyprus	35. Malta	57. Switzerland
14. Denmark	36. Mauritius	58. Taiwan
15. Ecuador	37. Mexico	59. Thailand *
16. Egypt	38. Netherlands	60. Turkey
17. Finland	39. New Zealand	61. United Kingdom
18. France	40. Nicaragua	62. United States
19. Germany	41. Nigeria	63. Uruguay
20. Ghana	42. Norway	64. Venezuela
21. Greece	43. Pakistan	65. Vietnam *
22. Honduras	44. Panama	

Note: * denotes AFTA members.

Appendix II

Robustness tests by controlling for additional FTA dummies

	1998-2000	2001-2003	2004-2006
	(i)	*(ii)*	*(iii)*
Constant	-22.2320 (22.93)	-22.1408*** (0.6985)	-25.6199*** (0.9471)
Log(GDPi)	1.0433*** (0.0166)	0.9209*** (0.0163)	1.0787*** (0.0170)
Log(GDPj)	0.9875*** (0.0166)	0.9512*** (0.0175)	0.9791*** (0.0170)
Log(Popi)	-0.0893*** (0.0166)	-0.0190 (0.0167)	-0.1042*** (0.0182)
Log(Popj)	-0.1814*** (0.0168)	-0.1503*** (0.0178)	-0.1043*** (0.0185)
Dist	-2.1489*** (0.0977)	-2.3975*** (0.0986)	-2.4534*** (0.1071)
Border	0.7660*** (0.1321)	0.7873*** (0.1316)	0.8471*** (0.1392)
Complimentarity	0.7950*** (0.0315)	0.8092*** (0.0302)	0.6176*** (0.0327)
Language similarity	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0001*** (0.0000)
Tariff	-0.0001 (0.000)	-0.0008*** (0.0001)	0.0000 (0.0001)
AFTA_both	1.7874*** (0.2371)	1.6957*** (0.2345)	1.8455*** (0.2529)
AFTA_1	0.8226*** (0.0546)	0.8480*** (0.0554)	0.9652*** (0.0592)
NAFTA_both	0.5673 (0.2371)	0.6132 (0.5057)	0.3143 (0.5458)

NAFTA_1	-0.3281*** (0.0759)	-0.1748** (0.0767)	-0.3615*** (0.0804)
EU_both	0.3924*** (0.1027)	0.4979*** (0.1028)	0.3762*** (0.0952)
EU_1	0.0009 (0.0471)	0.1468*** (0.0484)	-0.1977*** (0.0510)
ANDEAN_both	1.0944*** (0.3779)	1.1602*** (0.3693)	-0.1130 (0.0849)
ANDEAN_1	-0.6048*** (0.0637)	-0.5373*** (0.0646)	-0.2284*** (0.0268)
MERCOSUR_both	1.2097*** (0.2872)	1.3707*** (0.2884)	1.4263*** (0.3119)
MERCOSUR_1	-0.5017*** (0.0588)	-0.1822*** (0.0597)	0.0812 (0.0638)
Mu	6.7267 (22.93)	4.3833*** (0.5599)	5.1990*** (0.8319)
Gamma	0.8634 (0.0038)	0.8551 (0.0042)	0.8753 (0.0035)
Sigma-squared	1.5914 (0.0343)	1.6151 (0.0364)	1.8583 (0.0413)
No of observations	10763	11029	11256

Notes: ***, **, * denote significance at 1%, 5% and 10% level, respectively. Number in parentheses are standard errors.

Source: Author's estimation.

The estimations have been performed in both the time-invariant and time-varying decay inefficiency models. The estimated Eta from the time-varying decay specification is not significant at the 5% level (i.e. 0.58, 0.17 and 0.06 for sub-periods 1998-2000, 2001-2003 and 2004-2006, respectively) and hence the time-invariant estimation is preferred. The results for the time-varying decay specification are not reported here.