A Panel Data Analysis of Trade Creation and Trade Diversion Effects:

The case of ASEAN-China Free Trade Area

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Abstract

This study uses a theoretically justified gravity model of trade to examine the impact of the ASEAN-China Free Trade Agreement (ACFTA) on exports, focusing on trade creation and diversion effects. The model is tested on a sample of 31 countries over the period dating from 1995 to 2010 using aggregated and disaggregated export data for agricultural and manufactured goods and within manufactures for chemical products, as well as for machinery and transport equipment. In order to obtain unbiased estimates, multilateral resistance terms are included as regressors and the endogeneity bias of the FTA variables is addressed by controlling for the unobserved specific heterogeneity that is specific to each trade flow. A Multinomial PML is also applied to solve the zero trade issue and the presence of heteroskedasticity. The results indicate that ACFTA leads to substantial and significant trade creation. Using disaggregated data, the significant and positive relationship between exports and ACFTA is confirmed in the case of both agricultural and manufactured goods, as well as in the case of the most important manufacturing industries, namely, chemical products and machinery and transport equipment.

Keywords: Gravity Model, Panel Data, Trade Creation and Trade Diversion Effects, ACFTA,

Multinomial PML

JEL Classification: F14, F15

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1. Introduction

Since the early 1990s, significant progress has been made in regional integration in the most important economic areas in the world. According to a report by the WTO in 2011, more than 500 regional trade agreements are currently in force. As bilateral and regional trade liberalisation is becoming increasingly prominent, it is important to ascertain what implications this may have for world trade. In the last two decades, Asian economies have been involved in market integration of all sorts and have gained fame as the "world factory" as a result. Since the economic crisis in 1997, Asia has been moving towards closer region-wide economic integration, including the proliferation of bilateral free trade agreements and even monetary institutional cooperation with neighbouring countries. Accompanied by enhanced economic interaction between Northeast and Southeast Asian countries, economic cooperation and integration between the economies in the region has become more efficient. ASEAN and China are playing a key role in the evolving dynamics of East Asian regionalism through their various bilateral free trade agreements. Since 2002, China and ASEAN have signed a series of free trade agreements as part of an economic cooperation agreement[4] (hereafter referred to as ACFTA[5]), including the agreement on a dispute settlement mechanism, the agreement on trade

[4] The full name of the agreement is "Framework Agreement on Comprehensive Economic Cooperation between ASEAN and China".

[5] As regards the Free Trade Area, China calls it the China-ASEAN Free Trade Area (CAFTA); ASEAN calls it the ASEAN-China Free Trade Area (ACFTA). In order to avoid confusion with other agreements such as the Central American Free Trade Agreement (also CAFTA), the acronym "ACFTA" will be used in this paper.

in goods and the agreement on trade in services, as well as the agreement on investment.[6] The formation of ACFTA helps ASEAN members to access the prosperous Chinese market and fosters economic growth in ASEAN countries. As China's first attempt to take part in a regional economic cooperation agreement, ACFTA provides China with opportunities to obtain more raw materials to be used in production and helps Chinese enterprises to extend their foreign market in Southeast Asia. Generally, ACFTA can be seen as a fundamental step forward that strengthens trade activities and initiates economic cooperation among ASEAN member countries and China.

The objective of this paper is to evaluate the trade creation and diversion effects of the free trade agreements between ASEAN and China. Any assessment of the trade effects stemming from the formation of free trade agreements is always accompanied by the concepts of trade creation and trade diversion, which were first introduced by Viner (1950). Trade creation occurs when new trade arises between member countries due to the reduction in internal trade barriers. Trade diversion emerges when imports from a low-cost extra-bloc country are replaced by imports from a higher-cost member country because the intra-bloc country has preferential access to the market and does not have to pay tariffs. Trade creation leads to a shift in the origin of a product from an intra-bloc producer, whose resource costs are higher to another intra-bloc producer whose resource costs are lower. This results in an improvement in resource allocation and presumably has positive welfare effects. Conversely, trade diversion refers to a welfare loss caused by a shift in the origin of a product from an extra-bloc producer whose resource costs are lower to an intra-bloc producer whose resource costs are higher.

[6] The agreement on trade in goods and the dispute settlement mechanism of the framework agreement on comprehensive economic cooperation between ASEAN and China was signed in 2004. The agreement on trade in services between ASEAN and China was signed in 2007. Finally, the agreement on investment between ASEAN and China was signed in 2009.

Following the methodology proposed by the recent literature on this topic, we will first specify a gravity model of trade that includes multilateral resistance terms (MRTs), as proposed by Anderson and van Wincoop (2003), and we will obtain unbiased estimates by controlling not only for *country-and-time* effects, but also for *country-pair* fixed effects, as proposed by Baier and Bergstrand (2007). Next, as suggested by Head and Mayer (2013), a Multinomial PML is also applied to solve the zero trade issue and the presence of heteroskedasticity. The main contribution of the paper is twofold. First, this is to the best of our knowledge the first attempt to obtain ex-post unbiased estimates of trade creation and trade diversion effects in ACFTA taking into account the endogeneity bias of an FTA. Second, we will estimate the model not only using aggregated trade data, but also disaggregated data for four different sectors: agricultural goods, manufactured goods, chemical products and machinery products. The reason for doing so is to ascertain whether or not the trade effects in this region differ by commodity.

The rest of the paper is organised as follows. Section 2 describes the ASEAN-China Free Trade Agreement and addresses the most relevant related literature. Section 3 explains the theoretical foundations of the gravity model of trade. Section 4 presents the model specification and Section 5 describes the data and reports the empirical results. Finally, Section 6 concludes.

2. ASEAN-China Free Trade Agreement

2.1 ACFTA Background Information

In August 1967, Indonesia, Thailand, Singapore, the Philippines and Malaysia signed the "Bangkok Declaration". The main aim of this declaration was to announce the establishment of the Association of Southeast Asian Nations (ASEAN). The regional group has since been extended to ten country members and has made great progress in economic integration.[7] Indeed, the ASEAN Economic Community (AEC) is due to come into force by 2015. The ASEAN Free Trade Area (AFTA), which entered into force in January 1992, is a common external preferential tariff scheme to promote the free flow of goods within ASEAN and the foundation of the AEC. As a quick-growing economic organisation, ASEAN's total aggregate nominal GDP amounted to USD $ 1.8 trillion in 2010, ranking it the 9th largest economic bloc in the world and the 3rd largest in Asia.[8]

China has become one of the fastest growing economies in the world since it began the process of economic reform and liberalisation in the late 1970s. After recording an average annual growth rate of over nine percent for the last two decades, China's nominal GDP reached 7.3 trillion US Dollars in 2011. In the same year, China's export value grew to about 3 trillion US Dollars and it ranked first in terms of exports, overtaking Germany in the global community.[9] During this period of time, China also started to become actively involved in regional economic cooperation processes. Before the 1990s, China only had limited official bilateral relations with certain individual ASEAN members. This situation has been changing gradually since 1991 and trade between China and ASEAN has grown substantially since the mid-1990s. In 2002, China and ASEAN started negotiating a number of free trade agreements. In 2004, the so-called Early Harvest Program (EHP) was launched[10], which mainly focused on reducing

[7] Member countries today include Vietnam, Laos, Cambodia, Myanmar, Thailand, Malaysia, Singapore, Indonesia, the Philippines and Brunei.
[8] WTO (2012b).
[9] WTO (2012b).
[10] http://www.worldtradelaw.net/fta/agreements/aseanchinafta.pdf : "For trade in goods, the negotiations on the agreement for tariff reduction or elimination as set out in Article 3 of this Agreement shall commence in early 2003 and be concluded by 30 June 2004".

bilateral tariffs levied on agricultural goods, including live animals, meat and edible meat, fish, dairy products, vegetables and fruits. The agreement on goods was signed in November 2004 and entered into force in January 2005. According to the Asian Development Bank (ADB) 2010 report, bilateral trade between China and ASEAN increased more than tenfold between 1995 and 2008 from about USD $ 20 billion to USD $ 223 billion. China's trade growth rate has increased rapidly since 2001, when the country joined the WTO and two initial meetings were held to discuss the creation of the ASEAN-China Free Trade Area. More specifically, the yearly average growth rate in bilateral trade from 2001 to 2008 was about 30 percent. In 2011, ASEAN became China's third largest trading partner behind the USA and the EU.[11]

According to the agreements, China and ASEAN regarded the period between 2002 and 2009 as a transitory period before the completion of the ASEAN-China Free Trade Area. During that period, the tariffs charged on goods traded between China and ASEAN would be gradually reduced. For example, in the agreement on trade of goods, tariff reduction started in July 2005 and aimed to cut the duties to zero by 2010 on about four thousand types of goods for the six relatively developed ASEAN countries (i.e. Thailand, Malaysia, Singapore, Indonesia, the Philippines and Brunei), and to five percent by 2015 for the rest of ASEAN members (i.e. Vietnam, Laos, Cambodia and Myanmar).

2.2 Review of the Empirical Literature on the ACFTA

Following the increase observed in trade volumes between ASEAN and China, researchers have devoted more and more attention to the effects of ACFTA. More specifically, one interesting issue is whether the ACFTA poses a threat to or creates opportunities for both

[11] ADB (2012).

parties, namely China and ASEAN. On the one hand, regional trade among ACFTA members could receive a significant boost through removing tariffs and non-tariff barriers. On the other hand, one could speculate that ACFTA will intensify competition between China and ASEAN countries in exports to both advanced countries and the regional domestic market, given the similarity in their production and demand structures.

A number of researchers have recently studied the integration effects of the ACFTA from different perspectives and using various methodologies. Research results remain mixed nevertheless. Some studies have asserted positive effects of the integrative cooperation, admitting that there might be some negative influence in a certain period of time. A few authors focus on ex-ante effects. Among them, Chirathivat (2002) used a Computable General Equilibrium (CGE) model to examine the *ex ante* impact of the ACFTA on sectoral products, finding that the ACFTA would elevate China's rice, sugar and vegetable oil imports and fruit exports. He concluded that the ACFTA would lead to an increase in GDP growth both in China and ASEAN. Park et al. (2008) performed a CGE model to quantify the output gains and potential welfare gains of ACFTA. They found that ACFTA would lead to net trade creation, higher output and have positive welfare effects for the region. The results also showed that more advanced countries in ACFTA, such as Singapore and Malaysia, would benefit more than less developed countries, such as Cambodia, Laos, Myanmar and Vietnam. Also using a CGE approach, Estrada et al. (2011) explored the possibilities of trade liberalisation among ASEAN and another three large Asian economies, namely China, Japan and the Republic of Korea. They suggested that a large scale FTA founded by these four parties would create more trade opportunities and larger dynamic efficiency gains than the bilateral FTAs founded by each pair of them. Based on a Global Trade Analysis Project (GTAP) model Qiu et al. (2007) used disaggregated agricultural trade data to investigate the impacts of the ACFTA on China's agricultural trade. They confirmed that the ACFTA could enhance resource allocation efficiency in both China and ASEAN and could promote bilateral agricultural trade and economic growth on both sides. They revealed that China would significantly increase its exports of goods with a comparative advantage, such as vegetables, wheat and horticultural products under the ACFTA framework. Moreover, through an analysis of the price effects of the ACFTA, they pointed out that northern China could obtain more trade welfare gains than southern China.

Among the studies using partial equilibrium approaches, Ahearne et al. (2004) used aggregated and disaggregated data to examine trade relations between China and other new industrial economies (NIEs) in Asia. They found a complementary exporting linkage between ASEAN and China at aggregate level and indicate that a tariff reduction in the ACFTA could raise trading competitiveness in member countries. Roland-Holst and Weiss (2004) also used disaggregated trade data to identify the specific conditions influencing China-ASEAN export competition. The authors found that due to increasing Chinese competition in the short term, ASEAN significantly lost market share in the US and Japanese markets. Despite this fact, they state that there is still considerable complementary trade potential between China and ASEAN in the long term. They also made a further observation of the adjustment patterns within ASEAN countries to investigate how these countries could achieve such complementary trade potential. Their results indicate that ASEAN economies might still hold their market shares of higher value-added goods and China's economic emergence could be expected to absorb and increase regional demands in East Asia.

Two additional studies focused exclusively on agricultural products. The study by Rong and Yang (2006) concluded that the benefits from trade liberalisation agreements could not be confirmed. Ferrianta et al. (2012) specifically analysed the impact of the ACFTA on the maize economy of Indonesia and found that ACFTA constituted an external shock and had negative impacts on Indonesian maize self-sufficiency due to the implementation of an import prohibition policy which was in contradiction with a free trade agreement.

There are a few studies that are more closely related to our approach in terms of methodology. Zhou (2007) estimated a gravity model to explain bilateral trade effects in the region of China and ASEAN, paying particular attention to the potential endogeneity problem of a WTO dummy variable. He presented a two-stage estimation approach and found that WTO membership is endogenous for China and ASEAN. The results yielded a positive coefficient for the WTO dummy variable and indicated that being WTO members could positively affect bilateral trade between China and ASEAN. Hastiadi (2011) employed a Two-Stage Least Squares (2SLS) approach and a fixed effects model to prove the importance of regional economic cooperation in East Asia including China, Korea, Japan and ASEAN. He emphasised that, while there could be rival competition in the export market between China and ASEAN in the short term because of the similar comparative advantages and production structures of the countries involved, a long-term regional integration process could promote export growth for East Asia as whole. Also using a gravity approach, Robert (2004) examined the validity of the Linder Hypothesis in the ACFTA using data from 1996 to 2000. The Linder Hypothesis assumes that countries with similar demand patterns trade more with each other having assumed similar GDP per capita. So proving the Linder effect could indicate trade enhancement through the ACFTA. However, this effect could not be identified in this study, as the coefficient of the relevant variable, GDP per capita differences, was found to be statistically insignificant. In a more recent study, Robert and Rush (2012) also estimated a gravity model for non-oil resource imports and found that one of the main drivers of the increase in demand for resource imports has been the growth of China's domestic and export-oriented manufacturing production.

Finally, Sheng et al. (2012) estimated the impact of the FTA between ASEAN and China for total trade, estimating an extended gravity model for trade between 117 countries over the period 1980 to 2008. The authors mainly focus on the effects on total trade and on intra-industry trade and find that both types of trade have increased substantially due to the entry into force of the FTA, this is in part due to closer international production linkages and increasing trade in parts and components in the region.

3. The Gravity Model

In a generalized gravity model, trade between country *i* and country *j* is positively related to the size of the economies and negatively related to the distance, a proxy for transportation costs, between them. In addition a number of bilateral factors that foster or impede trade are usually included as explanatory variables. Hence, adding the time dimension it can be specified as:

$$X_{ijt} = \alpha Y_{it}^{\beta_1} Y_{jt}^{\beta_2} Pop_{it}^{\beta_3} Y_{jt}^{\beta_4} Dist_{ij}^{\beta_5} F_{kijt}^{\phi_k} \mu_{ijt} \qquad (1)$$

where X_{ij} is trade flows or exports from country *i* to *j* in year *t*. Y_{it} is *GDP* for country *i, year t* and Y_j is *GDP* for country *j, year t,* and *Pop* denotes the respective populations. $Dist_{ij}$ denotes geographical distance between the two countries, which is often measured using "great circle" calculations. Finally F_k denotes other bilateral factors such as FTAs, a common border or a common language that can foster trade.

As a most commonly used analytical framework, the gravity model has been applied in a large number of empirical studies. Among them, one of the key issues is to analyse the specific effects of trade policies by introducing dummy variables, namely FTA_{ijt}, to indicate the existence of a regional trade agreement between country i and j. This methodology can be extended to estimate trade creation and trade diversion and thus makes an important contribution to the regionalism debate.

3.1 Theoretical Developments of the Gravity Model

Based on a Constant Elasticity Substitution (CES) system, Anderson and van Wincoop (2003) used a Non-linear Least Squares (NLS) model considering the endogeneity of trade costs to refine the theoretical foundations of the gravity model and provide evidence of border effects in trade. They indicated that the costs of bilateral trade between two countries are affected not only by bilateral trade costs such as distance, being landlocked, a common border and language; but also by the relative weight of these trade costs in comparison to trading partners in the rest of the world (the so-called multilateral resistance terms).[12]

Anderson and Wincoop (2003) pointed out that multilateral resistance factors should be taken into account in empirical research in order to avoid a biased estimation of the model parameters.

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[12] Anderson and van Wincoop (2003) derived the gravity equation in a cross-sectional model as follows:

$$x_{ij} = \frac{y_i y_j}{y^W}\left(\frac{t_{ij}}{P_i P_j}\right)^{1-\sigma},$$

where x_{ij} refers to exports from country i to j, y_i and y_j are the nominal income of country i and j, $y^W \equiv \sum_j y_j$ denotes world nominal income, t_{ij} is the trade cost factor between country i and j, and σ is the elasticity of substitution between all goods. P_i and P_j measure the trade barriers of country i and j in exports and imports, i.e. outward and inward multilateral trade resistance.

In the same vein, Mátyás (1997, 1998) proposed that bilateral trade flows should be estimated as a three-way specification including time effects and exporter and importer fixed effects in order to avoid inconsistent modelling results caused by unobserved variation. A similar approach was also taken by Abraham and Hove (2005) in a gravity estimation of exports from Asia-Pacific countries. However, some researchers (Baier and Bergstrand, 2007) have found that conventional *time-invariant* fixed effects are insufficient to capture the unobservable factors in the gravity equation, such as *time-varying* multilateral resistance terms. Baier and Bergstrand (2007) followed the methodologies of Anderson and van Wincoop (2003) and extended the data series from cross-section to panel setting to enable the introduction of time-varying fixed effects. In order to eliminate the endogeneity bias stemming from FTA dummy variables (the so-called "gold medal error" identified by Baldwin and Taglioni (2006)), Baier and Bergstrand (2007) used *country-pair* fixed effects in addition to the abovementioned *time-varying* trade costs to obtain unbiased estimates. This analytical methodology will also be applied in this paper.

Related to our research interests in the ACFTA, the decisions made by China and ASEAN countries to sign free trade agreements could also depend on unobservable heterogeneities such as the existence of specific domestic regulations and other political motives related to bilateral trade. Hence, the reasons behind a country selecting into a preferential trade agreement are difficult to identify and often correlated with the level of trade. This raises the typical problem of endogeneity bias due to omitted variables in gravity equations. In the presence of endogeneity bias in cross-section data, Instrumental Variable (IV) approaches can generally be applied to solve the problem. However, Baier and Bergstrand (2007) pointed out that an instrumental variable approach is not sufficiently reliable to settle the endogeneity issue in the case of FTA dummy variables, as it is difficult to find a suitable instrumental variable for FTAs. Alternatively, Baldwin and Taglioni (2006) argued that applying *time-varying* country dummy variables can reduce the bias caused by incorrectly specifying or omitting multilateral trade resistance. Baier and Bergstrand (2007) suggested that unbiased estimates of average treatment effects of FTA can be obtained by introducing *country-and-time* effects and *country-pair* fixed effects simultaneously. Similarly, Martínez-Zarzoso et al. (2009) claimed that a simple method to measure unbiased estimates is to introduce individual country dummies in cross-sectional studies and bilateral fixed effects as well as *country-and-time* effects in panel data estimations to eliminate the endogeneity bias effectively.

3.2 Zero trade issue

A widely discussed issue in the recent gravity literature is how to handle zeros in the dependent variable, namely in bilateral exports between a given pair of countries. The main concern is that by transforming the original multiplicative model (Eq. 1) into a log-log model, zero (or missing data) trade flows are dropped out of the estimation. This method is only correct if the zeros (or missing data) are randomly distributed, but it will provide biased estimates if zero trade reflects a systematic pattern, related for example with large fixed costs of exporting. Several alternative methods have been proposed in the literature that retains the zero trade in the sample. The first one is to use the Pseudo Poisson maximum likelihood (PPML) estimation proposed by Santos Silva and Tenreyro (2006), the implicit assumption of which is that that zeros are the result of rounding errors and hence missing observations are wrongly recorded at zero. The PPML method estimates the gravity model in its original multiplicative form, permitting the inclusion of zeros, and also allowing for a more flexible distribution of the error term. However, zeros can also be the result of firms' decision not to export to a given destination, in particular when dealing with sectoral trade data. In this case Helpman et al (2008) suggest taking a Heckman approach, which involves two steps. First, a probit is estimated to evaluate the probability that exports are positive, and second, the gravity equation is estimated on the positive trade flows including two additional regressors: a correction for selection bias and a correction for firm heterogeneity. The main difficulty in this approach is to find an exclusion variable for the probit model (selection equation) that is exogenous to the trade value[13]. More recently, two alternative approaches have been proposed that seem to overcome the shortcomings of the previously used methods. Head and Mayer (2013) simulation results indicate that the two preferred methods to tackle the zero-trade problem are the Multinomial Poisson based on Eaton et al. (2012) and an EK-Tobit based on Eaton and Kortum (2001). Both methods have the advantage of not requiring exclusion restrictions, as is the case of the Helpman et al. (2008) method, and being easily estimated. The multinomial Poisson instead consists of estimating a Poisson model using the market share (X_{ij}/X_j) as the dependent variable and adding country-specific fixed effects as regressors. The EK-Tobit consists of replacing the zero trade flows (X_{ij}) with the minimum value of the dependent variable for a given origin (X_{ij}, min for all j) and the new variable is used

[13] Martínez-Zarzoso (2013) compares different estimations techniques that have been proposed in the economic literature to deal with issues concerning zero trade values and heteroskedastic residuals. Using simulations to compare PPML, GPML, NLS and FGLS estimators, she finds that although the PPML estimator is less affected by heteroskedasticity than others are, its performance is similar, in terms of bias and standard errors, to the FGLS estimator performance, in particular for small samples. GPML presents however the lowest bias and standard errors in the simulations without zero values. The results of the empirical estimations, using three different samples containing real data, indicate that the choice of estimator has to be made for each specific dataset. There is not a general "best" estimator and it is highly recommended to follow a model selection approach using a number of tests to select the more appropriate estimator for any application.

as the dependent variable in a Tobit-type regression (intreg in Stata). The selection of the appropriate estimator depends on the process generating the error term. Under the assumption of a Poisson-type error term it would be better to use Multinomial PML but under log-normality, EK-Tobit is preferred. The solution we took in this paper is to assume that all missing values are zeros and then use a MaMu (Manning and Mullay, 2001) test to check for the process generating the error term[14]. Since we could not reject the assumption of a Poisson-type error term in our data, we estimated the gravity model using the multinomial PML as suggested by Head and Mayer (2013) in this case. Alternative estimates are used in the robustness analysis.

3.3 Interdependence of FTAs

Pair of countries involvement in a new FTA may depend on the RTAs that each of the countries already have with third countries. The importance of this third-countries' effect has been stated by Egger and Larch (2008), Baier et al. (2011) and Baldwin and Jaimovich (2012). The main argument is related to the determinants of RTA formation between countries and the main aim of these papers is to predict the likelihood of a pair of countries forming RTAs. A possibility when considering the endogeneity of the RTA variable in the gravity model of trade is to use the predicted likelihood as an instrument for the RTA variable; however, this has been regarded as problematic by Baier and Bergstrand (2004) mainly because it is difficult to find appropriate exclusion variables that only explain the probability of forming an RTA, but not the amount of trade. Hence, in the context of this paper, we deal with the issue of endogeneity by using panel data techniques.

[14] See Martínez-Zarzoso (2013), page 321, eq. (13).

4. Modelling Trade Effects in the ACFTA

4.1 An Augmented Gravity Equation

We follow the Vinerian specification of integration effects with an extension of three different sets of FTA dummy variables representing trade creation and diversion effects in terms of export and import, as proposed by Endoh (1999), Soloaga and Winters (2001), Carrère (2006), Magee (2008) and Martínez-Zarzoso et al. (2009), so that we can test whether the creation of an ASEAN-China Free Trade Area has facilitated international trade among the member countries at the expense of non-member countries. The inclusion of FTA dummy variables in a gravity equation can be problematic because the dummies capture a range of contemporaneous dyadic fixed effects. Meanwhile, country-specific heterogeneity is ignored if all the countries in a certain FTA are treated as a homogenous group. In order to overcome this problem, we apply the panel data fixed effects model to control for all the time-invariant factors that vary bilaterally. We aim to obtain unbiased estimates for the ACFTA dummy variables, namely trade creation effects within the trade-bloc (FTA_1_{ijt}), trade creation/diversion effects in term of export/import between intra-bloc countries and extra-bloc countries (FTA_2_{ijt}) (FTA_3_{ijt}), using a panel data approach that controls for all country-and-time and time-invariant country-pair unobserved heterogeneity. Taking logs from equation (1) the baseline augmented gravity model is given by

$$\ln X_{ijt} = \alpha_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln Pop_{it} + \beta_4 \ln Pop_{jt} + \beta_5 \ln Dist_{ij} + \beta_6 Lang_{ij} + \beta_7 Adj_{ij} + \phi_1 FTA\_1_{ijt} + \phi_2 FTA\_2_{ijt} + \phi_3 FTA\_3_{ijt} + u_{ijt}$$

(2)

where *ln* denotes variables in natural logs. The dependent variable, X_{ijt} indicates bilateral exports from exporter *i* to importer *j* in period *t* at current US\$. GDP_{it} and GDP_{jt} are the level of nominal gross domestic product in country *i* and *j* in period *t*. As a proxy for economy size of the observed country, *GDP* denotes the consumption and demand levels of a country and is likely to have a positive relationship with trade flows. Pop_{it} and Pop_{jt} are the populations of country *i* and *j* in period *t*. The impact of population on bilateral trade is ambiguous. Population would tend to negatively correlate with trade flows, as larger populations imply larger domestic markets, richer resource endowment and more diversified outputs, as well as less dependence on international specialisation. However, Brada and Méndez (1985) pointed out that the coefficient of population can also be positive, because a larger population in an importing country enables imported goods to compete better with domestic goods and compensates 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 wider range of goods. $Dist_{ij}$ measures the great-circle distance between the capital cities (or economic centres) of country *i* and *j*. As the geographical distance is used to proxy for transportation and communication costs, as well as required delivery time, its sign should be negative. Two binary variables namely sharing a common border (Adj_{ij}) and speaking the same language ($Lang_{ij}$) are also included as regressors. Finally, u_{ijt} is assumed to be a log-normally distributed error term.

FTA_1_{ijt}, FTA_2_{ijt} and FTA_3_{ijt} are binary variables that measure the specific trade effects in the ASEAN-China Free Trade Area. FTA_1_{ijt} takes a value of 1 after 2003[15] if both countries *i* and *j* in year *t* belong to the ACFTA and zero otherwise. A positive and statistically significant

[15] Although the China-ASEAN trade agreement on goods entered into force the 1rst of January of 2005, the EHP started in 2004 and we assume that there could have been anticipation effects (before entry into force). Additionally, due to China entrance also the rest of ASEAN countries traded more among themselves, mainly exchanging parts and components due to the increasing demand for China.

coefficient of FTA_1_{ijt} represents trade creation effects and indicates that intra-regional trade has been promoted more by the free trade agreement and is higher than normal trade levels.

FTA_2_{ijt} takes a value of one if exporter i belongs to the ACFTA in year t and destination country j does not and zero otherwise. A positive and statistically significant coefficient of FTA_2_{ijt} is defined as a trade creation effect in term of exports and indicates that regional integration leads to a switch of export activities from ACFTA member countries to non-ACFTA member countries. Conversely, a negative and statistically significant coefficient of FTA_2_{ijt} indicates a decrease in exports from member countries to non-member countries and is defined as an export diversion effect.

FTA_3_{ijt} takes a value of one if exporter i is a non-ACFTA member in year t and destination country j belongs to the ACFTA and zero otherwise. A positive and statistically significant coefficient of FTA_3_{ijt} is defined as a trade creation effect in terms of imports and indicates expanded imports from non-member countries to member countries. Conversely, a significantly negative ϕ_3 indicates a trade diversion effect in terms of imports.

Here, an additional explanation of trade creation and trade diversion effects is considered necessary. Firstly, the "export diversion effects" and "import diversion effects" mentioned above are different from the definitions proposed by Viner (1950). The term "export trade diversion" was first described by Endoh (1999) and "import trade diversion" was defined by Balassa (1967). According to Carrère (2006) and Martínez-Zarzoso et al. (2009), one observation alone of intra-bloc trade (ϕ_1) is insufficient to confirm whether or not there is net trade creation in a free trade area because, for example, an increase in intra-bloc exports ($\phi_1>0$) may be accompanied by a reduction in imports from extra-bloc countries ($\phi_3<0$). These trade creation and diversion effects may offset each other. Hence, besides the coefficient of FTA_1_{ijt}, we still need to examine the magnitudes and directions of trade among member and non-member countries (i.e. ϕ_2, ϕ_3,). Let us assume $\phi_1>0$ and $\phi_2>0$ which denotes that trade creation is accompanied by an increase in exports from intra-bloc countries to extra-bloc countries. This can be described as pure trade creation in the ACFTA. However, a positive ϕ_1 accompanied by a negative ϕ_2 denotes a combination of trade creation effects and export diversion effects. Here, if $\phi_1>\phi_2$, we can conclude, despite trade creation effects being offset to a certain extent by export diversion effects, trade creation still prevails. Conversely, the case of $\phi_1<\phi_2$ indicates a dominant export diversion effect representing a welfare loss on behalf of member countries. Such possible trade effects under an FTA (Soloaga and Winters, 2001) were specifically explained by Martínez-Zarzoso et al. (2009, pp8) and are presented below in Table (1) as a summary.

Table 1. The Possible Outcomes of Trade Effects in an FTA

4.2 Analytical Specifications

In order to capture all the unobserved *time-invariant* and *time-varying* heterogeneity among trading partners, the following model specifications are intended to obtain unbiased and consistent estimates.

First, we estimate equation (2) using a pooled OLS technique and exclude time and individual country dummy variables from the model. This conventional OLS estimation merely pools all the available data together, but does not consider the differentiation between the individual trading pairs. Although the coefficients of pooled OLS can be biased and inconsistent due to ignoring multilateral resistance terms and heterogeneity related to time and country-specific effects, we still run this original model as a benchmark for other specifications.

Although there is flexibility when it comes to applying econometric techniques in a gravity model, a fixed effects model has been selected in the majority of empirical studies. Kepaptsoglou et al. (2010) summarised the related empirical literature published over the last ten years and concludes that the fixed effects model tends to provide better results than the random effects model and has been preferred in most studies. We also select and apply a fixed effects model in our estimations[16]. Hence, our second specification is a model with dyadic fixed effects. Additionally, time fixed effects are also included to control for macroeconomic effects, such as global economic booms and recessions. Note that the demean process in the fixed effects model comes at the cost of not being able to estimate the impact of *time-invariant* bilateral determinants, such as distance, adjacency, common border or other economical, political and cultural factors. Therefore, $Dist_{ij}$, $Lang_{ij}$ and Adj_{ij} in equation (2) will be eliminated from the estimation because they are fixed over time. The model is specified as

$$\begin{aligned} \ln X_{ijt} &= \alpha_0 + \beta_1 \ln Y_{it} + \beta_2 \ln Y_{jt} + \beta_3 \ln Pop_{it} + \beta_4 \ln Pop_{jt} + \phi_1 FTA\_1_{ijt} \\ &+ \phi_2 FTA\_2_{ijt} + \phi_3 FTA\_3_{ijt} + \delta_t + \pi_{ij} + u_{ijt} \end{aligned} \quad (3)$$

According to Anderson and van Wincoop (2003), the standard gravity model could be misspecified when ignoring multilateral resistance and remoteness terms in the model. In order to estimate our model appropriately, it is essential to model not only bilateral trade resistance through country-pair fixed effects, but also multilateral trade resistance, i.e. the trade barriers that each country faces when dealing with all its trading partners. One widely used approach in the literature to tackle multilateral resistance terms is to use country-specific

[16] We run a Hausman test to check whether the time-invariant unobserved heterogeneity is orthogonal to the time-varying part of the error term and the null hypothesis was rejected, hence invalidating a random effects specification.

effects (Baldwin and Taglioni (2006)). Country dummy variables capture all the time-invariant individual effects of exporters and importers that are omitted from the rest of the model specifications, such as preferences, institutional differences, etc. However, the inclusion of country fixed effects and time effects only partly avoids the omitted variable bias identified by Anderson and van Wincoop (2003). As claimed by several authors, in order to correctly account for multilateral resistance, the exporter and importer effect that proxy for multilateral resistance should be time-varying. Following the methodologies proposed by Baier and Bergstrand (2007), the panel data specification allows us to control for both *time-varying* multilateral resistance terms and to avoid the endogeneity bias of the gravity equation by introducing *country-and-time* effects while maintaining the *country-pair* fixed effects. The gravity equation is given by

$$\ln X_{ijt} = \beta_0 + \phi_1 FTA\_1_{ijt} + \phi_2 FTA\_2_{ijt} + \phi_3 FTA\_3_{ijt} + \pi_{ij} + \xi_{it} + \psi_{jt} + u_{ijt} \quad (4)$$

As each country trades with many countries in the world and the prices for its exports change yearly and depend on the conditions in all other trading partners, multilateral resistance terms should be specific to each country and each year. As mentioned by Magee (2008, p353), *time-varying* factors affecting trade cannot only be described by traditional gravity equation components like GDP, GDP per capita or population. There are still other variables that are difficult or unlikely to be observed and measured, such as infrastructure, factor endowments, multilateral trade liberalisation or openness and other *country-and-time* specific factors. Baier and Bergstrand (2007, pp78) also claimed that this unobserved heterogeneity could highly correlate with the decision of two countries to form an FTA and lead to the endogeneity bias we discussed in Section *3*. In this sense, the aspects of *time-varying* heterogeneity across countries have to be taken into consideration in the estimation. In our fourth model, we simultaneously introduce *country-and-time* fixed effects (by generating a full set of *exporter-and-time* and *importer-and-time* dummy variables) and *country-pair* fixed effects to correct the bias induced by unobserved *time-varying* multilateral resistance terms. Doing so minimises omitted variable bias and "purifies" the actual impacts of the free trade agreement on bilateral trade flows.

As countries with close political, cultural and historical relationships are likely to trade more with each other than normal and these *country-pair* factors may have a significant impact on the level of bilateral trade between these two countries, but not with third countries, researchers have attempted to incorporate as many relevant dummy variables as possible in the model to represent these bilateral ties so as to obtain an unbiased estimation. However, as so many unobservable dyadic factors remain, the choice of specific *country-pair* fixed variables is always an intractable problem in empirical studies. One effective alternative to solve the problem is to generate a full range of *country-pair* dummy variables to capture bilateral factors that are specific to country pairs but constant over time, so that all sources of time-invariant *country-pair* variability in exports can be included in the model. Finally, we estimate the model in its original multiplicative form to tackle the problems of zero trade and heteroscedaticity in the error term. As mentioned in Section 3, we follow the most recent developments in the gravity model literature and estimate a Multinomial PML as described in Head and Mayer (2013) and as explained in Section 3 above. To select between procedures we have used a MaMu test, the results of which are presented in Table A.3 in the Appendix and support the use of the PML error structure.

5. Data, Main Results and Discussion

5.1 Data

We use a panel data set of 31 countries including China, ASEAN-10 countries and China's top 20 trading partners in 2010 (see Table A.2) covering a 16-year period dating from 1995 to 2010 at aggregated and disaggregated level with a maximum of 14,880 observations (31×30×16). All export values are taken from the UNCTAD database and are based on the Standard International Trade Classification (SITC) under Revision 3 and expressed in nominal values to avoid measurement error (Balwind and Taglioni, 2006). We also perform analyses of four sub-categories separately, including agricultural goods (SITC 0, 1, 2 and 4 excluding 27 and 28, i.e. primary products minus fuels and mining products), manufactured goods (SITC 5 to 8 excluding 667 and 68) and two sub-categories of manufactured goods: chemical products (SITC 5) and machinery and transport equipment (SITC 7). The distinction between agricultural and manufacturing goods is relevant because different provisions apply for agricultural goods (EHP) and for manufacturing goods (Agreement on trade in goods, Normal Track). Since the agreements involve different tariff-reduction schedules over time[17], they can have distinctive effects on trade flows. Within the manufacturing sector, the two sub-categories have been selected in view of its importance. In particular, the share of chemical products exported (imported) from China to ASEAN over the period 1995-2010 is around 15 percent (20 percent) and the share of machinery and transport equipment is around 55 percent (60 percent).

GDP data in nominal values and population in number of inhabitants are obtained from the

[17] The EHP accelerates the implementation of the FTA for agricultural goods with HS Chapters 1-8 subjet to tariff elimination. Under the Normal Track provision tariff will be gradually reduced and eliminated by 2010 for most countries.

World Bank Development Indicators data series. The data on geographical and cultural proximity, such as distance, adjacency and common language, come from the CEPII database. The FTA variables have been created using the information concerning the announcement, signature and entering into force of the agreements between China and ASEAN. We hence consider that as the agreement was announced in advance and the initial framework agreement was signed on 4 November 2002, there could have been anticipation effects. Hence, FTA_1 takes the value 1 starting in 2003 if two countries belong to ACFTA. The FTA_1 dummies include not only the country pair of China and ASEAN countries but also the country pairs of ASEAN countries. For example, the FTA_1 dummy for China and Malaysia takes the value of zero from 1995 to 2002 and takes the value of one from 2003 to 2010. And the FTA_1 dummy for Indonesia and Singapore also takes the value of zero from 1995 to 2002 and the value of one afterwards.

5.2 Main Results and Discussion

We employ the panel data models described above to estimate the trade creation and trade diversion effects of the ACFTA agreement. The main results are presented in Table (2). Compared with cross-sectional data, panel data can be applied to distinguish the specific effects across countries and capture the characteristics of integration effects on trade over time. In Column (1), our estimation follows Equation (2) under the pooled OLS technique including the main proxies for trade costs (*Dist, Lang, Adj*), but without any country-pair or time dummies. The coefficients of FTA_1_{ijt}, FTA_2_{ijt} and FTA_3_{ijt} are likely biased due to ignoring time-invariant unobserved heterogeneity and multilateral resistance terms.

A model with time and dyadic random effects is presented in Column (2). The coefficients of

Pop_{it} and Pop_{jt} become insignificant and the impact of *FTA*s on trade changes drastically and is not statistically significant. In Column (3) we present a model with dyadic and time fixed effects. The demean process in this fixed effects approach comes at the cost of not being able to estimate the impacts of *time-invariant* determinants, such as distance, adjacency, common border or other economical, political and cultural factors. Compared with the model in Column (2), the coefficients of *FTA*s are not very different from the RE estimates but gain statistical significance. The different results registered by these models indicate that the estimated effects of *FTA*s on trade flows depend considerably on how researchers control for the unobserved country heterogeneity and, therefore, imply that estimations for unbiased results are highly reliant on correct model specifications.

Table 2. Panel data gravity estimations for total trade

Finally, the results considering *time-varying* multilateral resistance terms and *country-pair* fixed effects are shown in Column (4). As mentioned in *Section 3*, as the dummy variables FTA_1_{ijt}, FTA_2_{ijt} and FTA_3_{ijt} vary in three dimensions (*i*, *j* and *t*), the best way to control for everything else is to include two types of dummy variables as suggested by Baier and Bergstrand (2007) and Benedectis (2011), i.e., *exporter-and-year* and *importer-and-year* effects on the one hand, and *country-pair* effects on the other hand. By doing so, we control for all determinants that vary in those dimensions with *it* and *jt* (such as GDP and population in country *i* and *j*) and also the *time-invariant* dyadic effects between two countries (such as distance, common language and border). The results, presented in Column (4), provide unbiased estimates for FTA_1_{ijt}, FTA_2_{ijt} and FTA_3_{ijt}. The coefficients of FTA_1_{ijt}, FTA_2_{ijt} and FTA_3_{ijt} in Column (4) are positive and statistically significant and are also higher in magnitude than in columns (2) and (3). The positive coefficient of FTA_1_{ijt} indicates that the ACFTA has caused an intra-regional trade creation effect and increases the welfare of member countries. The average treatment effect is 118.6% {=[exp(0.782)-1]×100} higher than expected from normal levels of trade. The dummy of FTA_2_{ijt}, which represents exports from ACFTA member countries to non-member countries, displays a significantly positive coefficient, which indicates a welfare gain effect also for the countries outside the trade bloc (positive export diversion effect or export expansion). Concerning the import diversion effects, the coefficient of FTA_3_{ijt} is also positive and significant at the ten-percent level. It reveals an upward trend in exports from non-member countries to ACFTA member countries (import expansion). As $\phi_1>0$, $\phi_2>0$ and $\phi_3>0$, a pure trade creation effect in terms of exports and imports is identified in our model.

In order to provide further insight to explain the impacts of the ACFTA on intra- and extra-regional exports in various types of products, we also estimate the gravity model given by equation (4) for four different products. The theoretically justified specification suggested by Baier and Bergstrand (2007) that controls for *country-and-time* effects (*it*, *jt*) and *country-pair* fixed effects (*ij*) is used. The main results are presented in Table (3).

Table 3. Panel data gravity estimations using disaggregated trade with *country-and-time* and *country-pair* fixed effects

According to the results for agricultural goods in Column (1), two *FTA* dummies are positively related to exports, FTA_1 and FTA_3, whereas the estimated coefficient for FTA_1_{ijt} is statistically significant only at the 10 percent level, the estimated coefficient for FTA_3_{ijt} is statistically significant at 1 percent. This result partially verifies the optimistic prospects from some other researcher such as Park et al. (2008) and Gradziuk (2010) who believed that the bilateral trade for agricultural goods between China and ASEAN will be promoted by the free trade agreement. The results for manufactured goods are reported in Column (2). The positive and significant coefficients estimated for FTA_1_{ijt} and FTA_3_{ijt} indicate on the one hand, that the trade agreements between ASEAN and China increase exports of manufactured goods among the member countries, and on the other hand, also promote imports of manufactured goods to member countries from non-member countries. The positive signs of the coefficient of FTA_1_{ijt} (ϕ_1) and the coefficient of FTA_3_{ijt} (ϕ_3) (ϕ_1>0 and ϕ_3>0) reveals a pure trade creation effect in terms of imports and indicates that the ASEAN-China free trade area has become a major export market for manufactured products. Column (3) reveals the relationship between *FTA* and exports of chemical products. The coefficients of FTA_1_{ijt} (ϕ_1) and FTA_2_{ijt} (ϕ_2) are positive and statistically significant at the one percent and five percent level, respectively. ϕ_1>0 and ϕ_2>0 report a pure trade creation effect in terms of exports for chemical products. Column (4) also shows positive trade creation and export diversion effects for machinery and transport equipment, but the coefficients are imprecisely estimated and not statistically significant at conventional levels, perhaps because in this case some non-tariff barriers remain in place.

Next, we present the results obtained by applying the Multinomial PML method originally proposed by Eaton et al. (2012) and supported by Head and Mayer (2013), as this method performs better in simulations than the PPML proposed by Santos Silva and Tenreyro (2006, 2010). The Multinomial PML has been estimated using the *poisson* command in Stata to estimate a model in which the dependent variable is a market share variable X_{ij}/X_j and country-specific fixed effects are added as regressors. This method incorporates zero trade flows and gives less importance to large levels of trade, reducing heteroskedasticity. The results obtained are presented in Table 4. First. we observe that similar to Table 3, trade creation effects are positive and significant, but somewhat smaller in magnitude. Second, import trade diversion effects are negative and significant in all regressions, apart from agricultural goods; however the magnitudes are small and are outweighed by positive trade creation effects in all cases.

Table 4. Panel data gravity estimations using disaggregated trade with *country* fixed effects. Multinomial PML

Since the estimates using this procedure are more conservative and the method overcomes some of the shortcomings of the linear estimation, we use them to present the net trade creation effects in Table 5.

Table 5. Summary of Trade Creation Effects

The first three columns show the estimated coefficients of the FTA variables used to calculate the net trade creation effect and the last column indicates the net trade creation in percentage terms. In terms of total exports a 117 percent increase is associated to the agreement, this effect is greater for manufactured goods (130 percent increase in exports) than for agricultural goods (22 percent increase in exports). Within the manufacturing sector, the increase in exports due to the FTA is estimated to be 130 percent for chemical products, whereas the increase in machinery and transport equipment is only 36 percent. In comparison with the linear model with dyadic fixed effects and multilateral resistance, these numbers are smaller. Using the results in Table 3, the estimated net exports' increase is 205 percent for total trade and 41 percent for agricultural goods.

5.3 Robustness

In this section we perform two robustness checks. First, although we have chosen the

Multinomial PML as a way to solve the zero trade problem and to use a more flexible error term structure, for comparative purposes we also present the results obtained by using the Santos Silva and Tenreyro PPML approach in Table A.4. The FTA's estimates are almost always positive and significant and always higher in magnitude in comparison to the Multinomial PML approach used in Table 4.

Second, the EK-Tobit, proposed by Eaton and Kortum (2001) and supported in simulations performed by Head and Mayer (2013) is also used. The procedure assumes that there is a minimum level of trade that falls below the observed minimum of trade for a given exporter, say X_{ij}, if "ideal" trade falls below this level we will observe $X_{ij}=0$. Under this assumption the model can be estimated by replacing all zeros in X_{ij} with the bottom-coded $\ln X_{ij}$ as the dependent variable in a Tobit model that allows for a user-specific lower limit for the dependent variable. As shown in Table A.5, the method yields net trade creation effects in all regressions, supporting our main results.

6. Conclusions

This paper analyses the impact of free trade agreements between ASEAN and China on export flows focusing on their trade creation and trade diversion effects. We used aggregated and disaggregated data for four different categories of goods (including agricultural products, manufactured products, chemical products and machinery and transport equipment) traded by 31 countries and covering the period dating from 1995 to 2010. We considered the endogeneity bias problem stemming from omitted variables and dealt with it by controlling for *time-varying* multilateral resistance terms and *country-pair* fixed effects to obtain unbiased and consistent estimates. We also used a method to tackle the issues of zero trade and heteroscedasticity in the error term.

According to the estimated results using aggregate and disaggregated data, the trade agreements between ASEAN and China yield an overall positive trade effect. The positive and significant estimated results for the aggregate data confirmed that reducing and removing tariff barriers in ACFTA promotes total trade volume not only among intra-bloc member countries, but also between intra-bloc and extra-bloc countries. When the ACFTA effect is estimated for different products, there are significant trade creation effects in terms of exports of manufactured goods and chemical products, although the trade creation effects for agricultural goods, as well as machinery and transport equipment, are small.

Based on our findings, the actual trade policy between China and ASEAN should be maintained, as it favours not only ACFTA's intra-regional trade growth and development, but also benefits extra-bloc countries. However, from the perspective of international production chains, China and most ASEAN countries are still hovering in the low segment of international trade. Even if the ACFTA bloc has great economic and trade potential, its implementation is still at an initial stage compared to other well-developed regional trade agreements. On the one hand, the reduction and elimination of tariffs for sensitive goods, such as agricultural products, is still restricted in ACFTA. On the other hand, the progress in other areas, such as the reduction of non-tariff barriers, free trade in services, foreign direct investment, labour mobility and environmental standards, has been slow. In order to achieve a deeper economic integration in the region, ACFTA should not only focus on tariff barriers, but also on improving production efficiency, product competitiveness and structures of trade complementarities. Meanwhile, trade facilitation should get more attention, such as coordination of products standards and simplification of customs clearance procedures. In future research, we believe it is necessary to take into consideration more disaggregated data for specific commodities. Moreover, from the perspective of similarities and differences in trade structures and integration impacts, a comparative study between ACFTA and other FTAs using disaggregated trade data could also be a relevant research topic.

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Table 1. The Possible Outcomes of Trade Effects in an FTA

	Export Effects		Import Effects	
	$\phi_2>0$	$\phi_2<0$	$\phi_3>0$	$\phi_3<0$
$\phi_1>0$	Pure TC(X)	TC+XD ($\phi_1>\phi_2$) or XD ($\phi_1<\phi_2$)	Pure TC(M)	TC+MD ($\phi_1>\phi_3$) or MD ($\phi_1<\phi_3$)
$\phi_1<0$	XE	XD+XC	ME	MD+MC

Note: ϕ_1 is the coefficient of *FTA_1* which denotes exports among member countries. ϕ_2 is the coefficient of *FTA_2* which denotes exports from member countries to non-member countries. ϕ_3 is the coefficient of *FTA_3* which denotes exports from non-member countries to member countries. TC(X) and TC(M) denote trade creation in terms of exports and trade creation in terms of imports, respectively. XD and MD denote export diversion and import diversion, respectively. XE and ME denote expansion of extra-bloc exports and expansion of extra-bloc imports, respectively. XC and MC denote contraction of intra-bloc exports and contraction of intra-bloc imports, respectively.

Table 2. Panel data gravity estimations for total trade

	(1)	(2)	(3)	(4)
	Pooled OLS	*t*,(*ij*, RE)	*t*, *ij*, FE	*it*, *jt*, *ij*, FE
ln_Y_{it}	1.048***	0.885***	0.673***	
	(101.58)	(27.48)	(13.30)	
ln_Y_{jt}	0.963***	0.932***	1.007***	
	(90.16)	(26.31)	(14.34)	
ln_Pop_{it}	-0.021	0.001	0.139	
	(-1.46)	(0.22)	(0.25)	
ln_Pop_{jt}	-0.159***	-0.005	-0.402	
	(-12.80)	(-0.67)	(-0.77)	
ln_$Dist_{ij}$	-1.043***	-1.096***		
	(-55.28)	(-15.18)		
$Lang_{ij}$	0.555***	0.413*		
	(9.04)	(1.77)		
Adj_{ij}	1.006***	1.153***		
	(26.42)	(7.89)		
FTA_1_{ijt} (ϕ_1)	0.429***	0.084	0.086	0.782***
	(5.57)	(0.86)	(0.83)	(3.25)
FTA_2_{ijt} (ϕ_2)	0.288***	0.082	0.114*	0.456***
	(5.13)	(1.28)	(1.65)	(3.25)
FTA_3_{ijt}(ϕ_3)	-0.439***	-0.087	-0.072	0.334*
	(-9.23)	(-1.59)	(-1.18)	(1.65)
Constant	-1.574***	-9.899***	-5.408	12.297***
	(-6.84)	(-15.18)	(-0.68)	(67.49)
N	14395	14395	14395	14449
R^2	0.731	0.725	0.404	0.527
R^2 adjusted	0.730	0.724	0.403	0.495
RMSE	1.670	0.665	0.633	0.585
LL	-2.8e+04	-1.4e+04	-1.4e+04	-1.2e+04
Hausman Test		53.04		
(probability)		(0.0006)		
Type of FE:				
π_{ij}	*No*	*Yes*	*Yes*	*Yes*
τ_t	*No*	*Yes*	*Yes*	*No*
ξ_{it}, ψ_{jt}	*No*	*No*	*No*	*Yes*

Note: Robust and clustered standard errors used to compute t-values, *p<0.1, **p<0.05, ***p<0.01. *t*-values are reported below each coefficient. Estimation uses White's heteroskedasticity-consistent covariance matrix estimator. RE denotes random effects. FE: fixed effects. τ_t: time effects. ξ_{it}, ψ_{jt}: country time-varying fixed effects. π_{ij}: time invariant country-pair fixed effects. Hausman test result indicates rejection of the null hypothesis of uncorrelated time-invariant unobserved heterogeneity with the regressors, only FE is consistent.

Table 3. Panel data gravity estimations using disaggregated trade with *country-and-time* and *country-pair* fixed effects

	(1) Agricultural Goods	(2) Manufactured Goods	(3) Chemical Products	(4) Machinery and Transport Equipment
FTA_1_{ijt} (ϕ_1)	0.342	1.182***	0.624***	0.652*
	(1.64)	(3.57)	(2.79)	(1.58)
FTA_2_{ijt} (ϕ_2)	-0.330	0.291	0.464**	0.718
	(-1.47)	(1.05)	(2.29)	(1.52)
FTA_3_{ijt} (ϕ_3)	0.891***	0.719***	0.147	-0.213
	(5.34)	(3.87)	(1.01)	(-1.11)
N	14059	13835	14340	13348
R^2	0.407	0.489	0.551	0.479
R^2 adjusted	0.336	0.453	0.521	0.440
RMSE	0.695	0.707	0.593	0.703
Ll	-1.4e+04	-14364.711	-12375.554	-13769.192

Note: Robust and clustered standard errors used to compute t-values, *p<0.1, **p<0.05, ***p<0.01. *t*-values are reported below each coefficient. Estimation uses White's heteroskedasticity-consistent covariance matrix estimator. Same sets of FE as in column (4) of Table 2.

Table 4. Panel data gravity estimations using disaggregated trade with *country* fixed effects. Multinomial PML

	(1) Agricultural Goods	(2) Manufactured Goods	(3) Chemical Products	(4) Machinery and Transport Equipment	(5) Total Trade
FTA_1	0.195***	0.496***	0.450***	0.377***	0.372***
	(2.78)	(6.62)	(6.54)	(4.99)	(5.82)
FTA_2	0.026	0.537***	0.522***	0.201***	0.404***
	(0.54)	(10.25)	(11.48)	(2.83)	(9.38)
FTA_3	-0.078	-0.202***	-0.183***	-0.271***	-0.179***
	(-1.63)	(-4.71)	(-4.35)	(-6.10)	(-4.37)
N	14880	14880	14880	14880	14880
ll	-1.5e+03	-1.5e+03	-1.5e+03	-1.5e+03	-1.5e+03

t statistics in parentheses. * p<.1, ** p<0.05, *** p<0.01. Estimation uses White's heteroskedasticity-consistent covariance matrix estimator. Multinomial PML Eaton et al 2012 applying the poisson command to the market share variable Xni/Xn, along with country-specific fixed effects.

Table 5. Summary of Trade Creation Effects

Trade Flow	ϕ_1	ϕ_2	ϕ_3	Net effect	Net TC %
Total Trade	0.372***	0.404***	-0.179***	TC+XC+MD=0.776	117
Agricultural goods	0.195***	0.0260	-0.077	TC= 0.195	22
Manufactured Goods	0.496***	0.537***	-0.202***	TC+XC+MD=0.831	130
Chemical Products	0.450***	0.522***	-0.183***	TC+XC+MD=0.789	120
Machinery and Transport Equipment	0.377***	0.201***	-0.271***	TC+XC+MD=0.307	36

Note: Only the coefficients that are statistically significant have been used to calculate the net effect. Calculations made using the results in Table 4.

Appendix A

Table A.1 Summary Statistics

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
Total export	14449	6054472	1.84e+07	0.066	3.54e+08
Agricultural goods	14118	510454	1633605	0	2.87e+07
Manufactured goods	13835	2754742	9160494	0	1.49e+08
Chemical products	14342	4696583	1.47e+07	0	2.74e+08
Machinery and transport equipment	13348	689919.5	2098600	0	3.50e+07
GDP	14850	1133451	2163265	1226.162	1.48e+07
Population	14880	137861.2	282753.3	294.962	1318194
Distance	14880	7793.103	4904.956	173	19276

Table A.2 List of countries

Member Countries of ACFTA	Top 20 Trade Partners of China in 2010
Brunei Cambodia China Indonesia Laos Myanmar Malaysia Philippine Singapore Thailand Viet Nam	Australia Belgium Brazil Canada France Germany Hong Kong SAR India Italy Japan Mexico Netherlands Panama, Republic of China (Taiwan) Republic of Korea Russian Federation Spain Turkey United Kingdom United States

Table A.3. MaMu test for the implicit error structure in Multinomial PML and FE

TEST LOG-LOG	**Coeff.**	**95% Confidence Interval**	
λ_1	1.013	1.052	1.167
Prob. test λ_1=1	0.0002		
Prob. test λ_1=2	0.0000		
Nobs	14449		

Note: The equation estimated is $\ln(y_{it} - \hat{y}_{it})^2 = \ln(\lambda_0) + \lambda_1 \ln \hat{y}_{it} + \varepsilon_{it}$ with robust standard errors. No rejection of H_0: λ_1=2, based on a robust covariance estimator, would be in support of the log-linear model, whereas no rejection of H_0: λ_1=1, will support the Poisson error structure.

Table A.4. PPML estimation results

VARIABLES	(1) Agricultural Goods	(2) Manufactured Goods	(3) Chemical Products	(4) Machinery and Transport Equipment	(5) Total Trade
FTA_1	0.566***	0.647***	0.652***	0.541***	0.618***
	(0.121)	(0.184)	(0.182)	(0.0978)	(0.136)
FTA_2	0.179*	0.806*	0.680**	0.541***	0.551**
	(0.0979)	(0.420)	(0.277)	(0.106)	(0.249)
FTA_3	0.479***	0.483***	0.409***	0.225	0.412***
	(0.183)	(0.106)	(0.0763)	(0.142)	(0.0694)
Observations	14,064	14,672	14,784	14,544	14,784
Number of id	879	917	924	909	924

Robust Standard errors in parentheses. Regressions include time and bilateral country pair fixed effects.
*** p<0.01, ** p<0.05, * p<0.1.

Table A.5 E-K Tobit estimation results

VARIABLES	(1) Agricultural Goods	(2) Manufactured Goods	(3) Chemical Products	(4) Machinery and Transport Equipment	(5) Total Trade
FTA_1	0.144***	0.348***	0.343***	0.358***	0.357***
	(0.0441)	(0.0601)	(0.0475)	(0.0594)	(0.0459)
FTA_2	-0.213***	0.0390	0.236***	-0.124**	0.192***
	(0.0458)	(0.0489)	(0.0348)	(0.0580)	(0.0331)
FTA_3	0.152***	-0.0887***	-0.0125	-0.0353	0.0423
	(0.0331)	(0.0325)	(0.0298)	(0.0314)	(0.0275)
Observations	14,880	14,880	14,878	14,880	14,880

Robust standard errors in parentheses. Regressions include time and bilateral country pair fixed effects.
*** p<0.01, ** p<0.05, * p<0.1.