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Abstract

The two most populous countries have embarked upon an extensive array of preferential trading agreements (PTAs). This paper examines the impacts of eleven PTAs on China's and India's trade creation and trade diversion using an augmented gravity model incorporating zero trade flows. Results suggest that PTAs were net trade creating for China's exports and imports; the same PTAs were net trade diverting for India's exports and insignificant for her imports. For both countries, most ASEAN+6 PTAs had created intra- and extra-bloc trade. The partial scope Asia-Pacific Trade Agreement generated the strongest net export creation effect.

Keywords: Trade creation; Trade diversion; Distance; Trade agreements

JEL Classification: F11, F13, F14, F15

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1. Introduction

The continued stalemate of WTO multilateral trade negotiations has been accompanied by aggressive explorations into the second-best option of bilateral/regional trade liberalization through Preferential Trade Agreements (PTAs). PTAs are discriminatory by nature as they allow preferential treatment only between member countries while leaving member countries to follow their own trade policies against non-members. This trend has been particularly pronounced in Asia since the Asian financial crisis in 1997, which incited the 2001 bilateral PTA between Singapore and New Zealand. Since then, this trend has proliferated rapidly to include members of the Association of Southeast Asian Nations (ASEAN[1]) as well as Australia, China, India, Japan, New Zealand and South Korea, also known as the ASEAN+6, and is likely to continue to develop and expand in the near future.[2]

ASEAN+6's primarily objective has been Asian economic integration, with PTAs seen as promoting market-driven integration through comprehensive liberalization and facilitation of trade in goods, services and investments. Policymakers in Asia believe that well designed and implemented free trade agreements (FTAs) have the potential to deepen trade and investment linkages both bilaterally and regionally among these economies. Several studies argue that the current proliferation of regionalism is driven by competitive liberalization and a tariff complementary effect, where each country utilizes one PTA to reduce (or prevent) trade diversion from other PTAs (Bagwell and Staiger, 1997; Baier *et al*., 2011).

There exists a reasonable body of empirical literature attempting to analyse the impact of PTAs in the Asia-Pacific region, but very few of them focus on the ASEAN+6 economic grouping. This is a surprising omission as ASEAN+6 includes two of the world's major emerging and most populous economies – China and India – that are negotiating towards the creation of the Regional Comprehensive Economic Partnership (RCEP).[3] A majority of these empirical studies have approached this issue from either a general equilibrium or a gravity model approach, with Sen *et al*., (2013) being a recent example. However, most applications of the gravity model to the ASEAN+6 area have been estimated without adequate attention to the potential abundance of zero trade values in the dependant variables, which has the potential to create inconsistent results in the traditional log-linear OLS approach (Burger *et al*., 2009; Kohl, 2012).

This paper makes an important contribution to the existing literature by focusing attention on the effects of PTAs on trade creation and trade diversion for China and India. It assesses the effects of eleven distinct PTAs on trade creation and trade diversion for China and India individually over the 1984-2009 period using an augmented gravity model. This paper contributes to the existing literatures on Asian economic integration and applications of the gravity model in a number of ways. First, this paper models ASEAN+6 economic integration by considering all trading partners of India and China including those with zero

1 ASEAN+6 was formed in 2005 and is presently attempting to create one of the world's largest PTA by starting negotiations towards creation of a Regional Comprehensive Economic Partnership (RCEP) in November 2012.

2 According to Kawai and Wignaraja (2009), there were 54 trade agreements concluded within these countries and 78 more in the negotiation stage or under discussion.

3 The RCEP would be the world's largest PTA yet. See http://www.asiaone.com/News/AsiaOne%2BNews/Asia/Story /A1Story20121022-378928.html

trade flows. This is unusual as most empirical studies only include data for trading partners who have positive trade values (e.g. Baier and Bergstrand, 2007; Vicard, 2011; Sen *et al*., 2013). Magee (2008) did consider zero trade flows in his study of trade creation and trade diversion of PTAs but restricts the sample to WTO members only over the 1980-1998 period. Second, this paper presents estimates generated through Poisson pseudo maximum likelihood (PPML) and negative binomial (NB) methods to explicitly integrate into the analysis zero trade flow data. We also present estimates using the zero-inflated negative binomial (ZINB) method that has hitherto not been attempted in the India-China context or the broader context of Asian economic integration. Apart from Kohl (2012), who applied NB and ZINB methods to revisit the role of WTO in creating trade, Magee (2008) is the only other existing study that presents estimates of trade creation and trade diversion effects of regional trade agreements using bilateral trade flows. Third, this paper presents estimates of the intra- and extra-bloc effects of eleven distinct PTAs, including seven regional PTAs, on China's and India's bilateral exports and imports. In particular, the inclusion of the Asia-Pacific Trade Agreement (APTA) PTA is an important contribution of this study as this is the only regional PTA in Asia that currently implements tariff concessions on selected goods between India and China.

The remainder of this paper is organized as follows. The next section presents a review of the trends in PTA proliferation among Asian countries over the study period, 1984-2009. Section 3 reviews the empirical literature on the use of the gravity model for measuring trade creating and trade diverting effects of PTAs. Section 4 describes the econometric approach and the data. Results and policy implications are discussed in Section 5, followed by conclusions in Section 6.

2. Trends in PTA proliferation among the ASEAN+6

This paper focuses on the PTAs that came into agreement over the 1985-2009 period. A full set of the PTAs that are of immediate relevance for this article is presented in Table 1.[4] The Asia-Pacific Trade Agreement (APTA), formerly known as the Bangkok Agreement, has been in force since 1976 is one of the oldest PTAs, although China acceded to APTA in 2001. India and South Korea were founding members of this partial scope agreement on a few goods. Hamanaka (2012) identified APTA as the potential regional PTA, and argued that since APTA is based on the Enabling Clause, it also allows concessions under the agreement to suit the requirements of individual developing countries that wish to accede to it, thereby avoiding complex multiple rules of origin under different bilateral PTAs.

{Insert table 1 here}

It can be observed that 79 percent of the PTAs have been bilateral. Among bilateral PTAs, the Australia-New Zealand Closer Economic Relations (CER) PTA is the oldest having been in force since 1983. There was a proliferation of bilateral PTAs following New Zealand and Singapore's ANZSCEP agreement in 2001. Some countries have two or more PTAs with the same trading partner, where one PTA is bilateral and the other is regional in scope. Most ASEAN+6 bilateral PTAs came into force post-2003 and some are still evolving in terms of their impact on bilateral trade and investment as their coverage is being extended from goods only to include services and investment.

[4] Our empirical analysis considers 31 regional and bilateral PTAs, see notes on Table 1.

Lee and Park (2005) observed that the rapid rise of new regionalism across East Asia was not simply an attempt to enhance market-driven integration but was also a reaction to the creation of other regional blocs (such as NAFTA and the EU) due to the domino effect of the fear of being left out (Baldwin, 1993). As a regional bloc, ASEAN has been an attractive PTA partner, with China, Korea, Japan, and more recently India, Australia and New Zealand enforcing their regional PTAs with the ten-member Southeast Asian countries. On a bilateral basis, while Singapore has been the leader in entering into PTAs, other members of ASEAN+6 are catching up fast. Cross-regional PTAs are increasingly evident too, such as the US-Singapore FTA. While the EU did not have a bilateral or regional PTA partner in the ASEAN+6 countries until 2006, she has since embraced PTAs fairly rapidly and currently has a working FTAs with Korea and Singapore and is in bilateral negotiations with India and other ASEAN+6 members.

The above summary of the evolution of PTAs illustrates that the process of bilateral and regional trade liberalization in ASEAN+6 is evolving rapidly and becoming increasingly complex as PTAs expand both intra- and extra-regional trade. It is crucial therefore to comprehend how the effects of PTAs on trade creation (altering intra-bloc trade post-PTA) and/or trade diversion (altering extra bloc-trade post-PTA) vary across the ASEAN+6 member countries when all its trading partners (including former ones) are considered. It is also essential to analyse these patterns with the explicit consideration of pairs of countries that do not trade, which has not yet been sufficiently addressed in the India-China or ASEAN+6 contexts and is usually ignored. This is vital if we are going to have a true and unbiased picture of the effects of PTAs on trade.

3. Background literature

When analyzing the impact of PTAs as overall trade creating or trade-diverting, understanding the magnitude of these effects and why it varies across different countries is critical (Krueger, 1999; Adams *et al*., 2003; Soloaga and Winters, 2001). A majority of existing studies have examined the impacts of PTAs on bilateral trade flows using a gravity model and by measuring the extent that PTAs affect trade creation[5] or trade diversion[6] with the results being mixed and effected by the size of the sample, time period, gravity equation specification and the particular PTAs considered (Polak, 1996; Eventt and Keller, 2002). Lee and Park (2005) argue that if a PTA has stronger trade diverting than trade creating effects then it could become a stumbling block for global free trade. However, the evidence is supporting their relative strengths is mixed with some studies finding that PTAs expand intra-bloc trade while contracting output and trade in non-member countries.

This empirical literature has typically employed two separate approaches. First, a general equilibrium model of trade that generates simulations, which typically reveals positive welfare effects of PTAs on members measured in terms of real GDP (or equivalent variation) and a net trade creation effect with possibilities for trade diversion with non-members.[7] These results are often sensitive to the model's underlying assumptions and the

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5 i.e. due to elimination in distortions between the relative prices of member and non-member goods
6 i.e. due to the introduction of distortions between the relative prices of member and non-member goods
7 See Robinson and Thierfelder (1999), Panagariya and Dutta-Gupta (2001) and Lloyd and Maclaren (2003). In the context of East Asia, see Scollay and Gilbert (2001) and Urata and Kiyota (2003).

method of estimation. Further, this indicative approach emphasizes the potential trade creation and diversion effects that may not be actually realized due to slow implementation or compliance costs.

Second, a gravity model of bilateral trade that is based on the idea that trade between two countries is a function of economic mass and distance. This model was first analysed by Tinbergen (1962) and Poyhonen (1963) for estimating bilateral trade flows between some European countries. Studies such as Anderson (1979), Bergstrand (1985), Sanso *et al*. (1993), Matyas (1997, 1998) and Anderson and van Wincoop (2003) have improved upon its theoretical foundations and these models have been recently applied in the Asian context by Sharma and Chua (2000), Lee and Park (2005) and Pusterla (2007). The standard gravity model's explanatory variables, such as economic size and common language or currency, are expected to have a positive effect on bilateral trade, while greater distances between countries are expected to yield a negative effect.

Aitken (1973) was the first study to include a dummy variable to estimate the effect of a PTA, which takes a value of one if the two trading countries are members of the same agreement and zero otherwise. A positive coefficient on this variable indicates that the PTA tends to generate more trade among its members and is trade creating. A number of more recent studies built upon this literature (Bayoumi and Eichengreen, 1997; Frankel, 1997; Frankel and Wei, 1998) by augmenting the model to include another dummy variable to represent extra-bloc trade, which takes the value of one for bilateral trade between a PTA member and a non-member country; the coefficient on this extra-bloc trade variable indicates the size of the trade diverting effects of the PTA. These studies have largely observed that PTAs tend to increase trade between members and the rest of the world, and thereby foster greater trade worldwide. However, Dee and Gali (2003) control for some unobservable factors and find that 12 of the 18 recent PTAs have diverted more trade to non-members than they have created among members, and this is particularly apparent when the analysis is extended beyond the trade in goods.

The formation of PTAs can have different effects on different country pairs with many suggesting that asymmetries are related to the relative levels of development of PTA partners, as measured by their per capita income. In particular, differences in per capita income may represent differences in tastes (Linder, 1961) or differences in capital-labour ratios (Helpman and Krugman, 1985), and similar arguments are employed when considering the products of per capita incomes. Globerman (1992) argued however that the formation of PTAs between country pairs with dissimilar per capita incomes, especially in the context of developing countries, generates powerful stimuli toward the rationalisation of production owing to increasing industrial concentration and unexploited economies of scale.

Empirical literature on the gravity model specification and estimation issues continues to be refined. While Polak (1996) suggested caution in the use of absolute bilateral distances due to the introduction of misspecifications in the model, Dhar and Panagariya (1999) added that the use of total trade as a dependent variable in a pooled data across countries can also be problematic. Vicard (2011) further extended the measurement of the PTA effect by interacting several calibrations of PTA characteristics with member country characteristics and observed that the size and distribution of GDP between PTA members are important determinants of whether a regional trade agreement increases bilateral trade. Vicard observed that bilateral trade through RTAs are likely to expand much more when two countries are large and symmetric and other RTA members are small and asymmetric, thereby suggesting that the presence of a third large country will reduce bilateral trade creation as it is likely to mitigate the competitive advantage granted by tariff reduction. Notably, even this study also did not address the treatment of zero trade flows in the estimation process.

It is not unusual for two countries to trade very little or not at all in certain years, thereby resulting in zero or near zero trade flows. While some studies tend to ignore these zero trade flows, omission can lead to misspecification (see Eichengreen and Irwin, 1995, and Felbermyer and Kohler, 2004) and the standard approach of estimating gravity models using log-linear OLS regression techniques is inappropriate if the dependant variable's value is zero.

Kohl (2012) suggested five ways to deal with zero trade flows in the estimation process. First, drop all observations with zero trade flows. This is at a cost of ignoring a large amount of trade data and information. Second, increase all zeros by a small constant. However, when zero values are not randomly distributed then biased results are probably.

Third, employ a Tobit procedure. Santos Silva and Tenreyoro (2006) argue that this method is based on strong and unrealistic homoscedasticity and normality assumptions, which are therefore likely to yield biased results compared with OLS. Fourth, Santos Silva and Tenreyro (2006) demonstrated that heteroskedasticity is present in both the traditional gravity equations of Tinbergen (1962) and Anderson and van Wincoop (2003) and showed that Poisson Maximum Likelihood (PML) estimation methods yield more robust estimates than the OLS approach. Further, Santos Silva and Tenreyro (2006) argued that application of OLS methods will generate results that greatly exaggerate the roles of colonial ties and geographical proximity in a log-linearized gravity model. Siliverstovs and Schumacher (2009) and Herz and Wagner (2011) corroborated the finding that non-linear multiplicative Poisson specifications of the gravity model performed better than traditional OLS estimates of a log-linear gravity equation. However, a drawback of standard Poisson models is the assumption of equi-dispersion, which requires that the conditional mean and conditional variance are equal, may not hold in cases of excessive zeros in trade data.

Fifth, use a negative binomial or zero-inflated binomial estimation approach. Burger *et al*. (2009) observed that the zero-inflated negative binomial (ZINB) approach is superior to the standard Poisson model that encounters problems with data over-dispersion. Although the Poisson model does account for observed heterogeneity, it does not correct for unobserved heterogeneity originating from omitted variables and hence generates inefficient results (Greene, 1994). Trade data dependent variable is often over-dispersed as the conditional variance is often higher than the conditional mean, and so a negative binomial regression model is most frequently used as a modification of the Poisson regression model. The ZINB model considers two different kinds of zero-valued trade flows: i) countries that never trade and ii) countries that do not trade now but potentially could in the near future. Burger *et al*. (2009) argued that ZINB models allow for the possibility of detaching the trade probability from the trade volume.[8]

[8] Cameron and Trivedi (2009) show that the Poisson quasi-MLE is capable of providing consistent estimates even in the case of over-dispersion provided that the conditional mean function is correctly specified.

This paper follows the work of Burger *et al*. (2009) by applying the ZINB estimator and comparing the results with other more standard methods. Kohl's (2012) applications of ZINB models revealed a trade creating effect for WTO members that was far greater than suggested by Rose (2004).

4. Empirical Specification and Data

4.1 Data

The present study analyses the determinants of pair wise real trade flows (exports and imports in constant 2000 US dollars) for India and China with all other countries over the 1984-2009 period.[9] We commence our analysis from 1984 because this is the first year that Chinese data were available and ends in 2009 when the Chinese Economic Stimulus Plan came into operation. All trade data are sourced from the United Nations Commodity Trade Database (COMTRADE). Although this database provides the most comprehensive and internationally comparable bilateral trade data available, it does have limitations. Yeats (2011) showed that the reporting system used for the compilation of COMTRADE statistics suffers from misstating dutiable import values and does not always correctly identify the goods facing trade restrictions.[10] This could be particularly problematic for countries that undertake a considerable amount of trans-shipment, such as Singapore and Hong Kong which both play a vital role in facilitating trade involving India, China and the other ASEAN+6 members. We acknowledge this potential problem and that it could affect the reliability of our results, but we continue to use this dataset as it is undoubtedly the best currently available dataset for the analysis of bilateral trade data across developed and developing countries and is widely used for gravity model estimations.

Our real income measure is the real value of GDP (in constant 2000 US dollars) with observations drawn from the World Bank's World Development Indicators (WDI). Bilateral distance, common border and common language variables are extracted from Mayer and Zignago's (2011) distance database. The total number of observations constitutes an unbalanced panel of 9,581 observations, with 4,790 in the India section and 4,791 in the Chinese section. Notably, a number of these observations include China and India's trade with "Former" trading partners that later either unified into a single country (e.g. Germany, Vietnam, Yemen, Panama) or broke up into smaller newer trading nations (e.g. Yugoslavia, Czechoslovakia, Soviet Union or USSR post-1991). Nearly 11 percent or 1,050 observations are recorded as "zero" when real exports are calculated, while about 22 percent or 2,131 observations are recorded as "zero" when real imports are calculated, justifying the importance of adopting an estimation approach that takes into the bias created by excessive amounts of zeros in trade flows.

Merged into the above panel data set are a set of 22 PTA dummy variables. These consist of 11 pairs of trade creating (TC) and trade diverting (TD) dummies. The TC

9 Cheong *et al*. (2012) argue that employing bilateral imports as the dependent variable avoids bias induced from the averaging of trade flows

10 According to Yeats (2011), the general trade compilation procedure used by COMTRADE may greatly amplify valuation bias. This is due to the fact that the UN's records tabulate information on products entering a country's geographic territory but may fail to record relevant information on the nature and value of the goods actually clearing customs. This problem occurs when imports experience significant transformation in foreign trade zones and then clear customs under a different HTS codes than that recorded in COMTRADE. Thus, general trade statistics could bias the results of analyses relating to tariffs and other trade barriers.

dummies take a value equal to one if a pair of countries are trading partners within a PTA in a particular year, and is equal to zero otherwise. The TD dummies take a value equal to one if only one of a pair of countries is a PTA member in a particular year, and equal to zero otherwise. The 11 sets of TC and TD dummies correspond to trade creation and trade diversion effects of memberships in eight major PTAs involving China, India and their major trading partners, viz. APTA, AFTA, ACFTA, CECA, SAFTA, USSFTA, AUSFTA, CER, NAFTA, EU and MERCOSUR, as shown in table 1. All PTA dummies are specified according to their year of enforcement (and not signing), as enforcement may not immediately occur after signing. Seven of these are regional PTAs, while the remaining four are bilateral PTAs. Bilateral PTAs enforced post-2006 are not considered for separate analysis of trade creation and trade diversion effects as a gestation period of three years is considered too short to appropriately estimate a post-PTA effect in this model.

4.2 Econometric approach

A number of considerations strongly influence our econometric approach. First, our two dependent variables, the real values of exports and imports, are bounded from below at zero. To deal with the problem of over-dispersion and the possibility of excess zeros in the dependent variable we estimate the models using three separate regression approaches: Poisson, negative binomials (NB) and ZINB.

A useful feature of NB and ZINB models is that they include an over-dispersion parameter, α. If $\alpha = 0$, the conditional mean is equal to the conditional variance and a standard Poisson model is the most appropriate fit. However, if $\alpha > 0$, there is evidence of over-dispersion in the data and the NB is preferred to Poisson. The likelihood ratio tests for $\alpha=0$ helps decide whether NB is a better fit than the Poisson model: if it is statistically significant then it suggests that our response variable is over-dispersed and is not sufficiently described by the Poisson distribution.

As analysed by Kohl (2012), NB estimation is appropriate to model over-dispersed data, but it may predict fewer zeros for a given mean value of trade than the actual number of observed zeros in the data. This is particularly the case if there is an excessive number of zeros in the dependent variable, in which case a ZINB variant of the model is preferable. In a ZINB variant the first part of the model is a binary function that is typically estimated with a logit regression, and the second part of the model is a count function that estimated using a Poisson or NB regression.[11] We incorporate exposure using time and apply inflation in the ZINB using data on the trading partner country's population. We use the Vuong test to allow us to infer whether the ZINB model is preferred to the NB model.

All three of these estimators typically require count data, and for consistency we round our raw data (which is in constant 2000 US dollars) to no decimal places, although Woodridge (2002) suggests that the Poisson estimator can present useful results when the data are non-negative continuous observations. We apply random effects to capture trading partner country-specific time-invariant effects with the literature suggesting that if it is left unaccounted for then PTA coefficients will tend to be biased upward because they are likely to capture trade creation that is not specifically PTA-related (Cheng and Wall 2005; Cheong *et al*., 2012). The basic gravity model for estimation is:

[11] See Kohl (2012) and Cameron and Trivedi (2009) for further details on the ZINB specification.

$$T_{ijt} = \alpha_1 + \beta_1 HGDP_{it} + \beta_2 PGDP_{it} + \beta_3 D_{ij} + \beta_4 Border_{ij} + \beta_5 Lang_{ij} + \beta_6 All\_C_{ijt} + \beta_7 All\_D_{ijt} + \varepsilon_{ijt}$$
(1)

where T_{ijt} refers to the count of trade flows (either exports or imports) from country *i* to country *j* at time *t*, H_{it} is the home country's GDP at time *t*, P_{jt} is the partner country's GDP at time *t*, D_{ij} is the distance between countries *i* and *j*, and *Border* and *Lang* are dummy variables that capture whether the two countries share a common border or common language respectively.

Apart from these standard variables in the gravity model, we augment the model by adding two dummy variables capturing the trade creation (intra-bloc) and trade-diversion (extra-bloc) effects for all trading partners of India and China. *All_C* is a trade creation dummy variable that takes a value 1 if both countries *i* and *j* are a member of any of the PTAs at time *t*, and takes the value zero otherwise. *All_D* refers to the trade diversion dummy variable and it takes a value of one if either countries *i* or *j*, but not both, are a member of any of the PTAs at time *t*, and the value zero otherwise.

The above model does not provide further insight into trade creation or diversion attributable to specific bilateral or regional PTAs, so we further augment the model in the next stage of the estimation process to incorporate the separate effects of the eleven distinct PTAs: APTA, AFTA, ACFTA, CECA, SAFTA, USSFTA, AUSFTA, CER, NAFTA, EU and MERCOSUR. As an example $APTA\_C_{ijt}$ measures the effect of being a member of APTA and takes the value one if the j^{th} country is a member to APTA with country *i* at time *t*, and zero otherwise. Similarly, $APTA\_D_{ijt}$ measures the effect of either country not being a member of APTA and takes a value 1 if either country *i* or *j* is a member to APTA at time *t*, and zero otherwise. Thus, India is a current member in APTA, CECA and SAFTA, while China is a current member in APTA and the ACFTA, so $APTA\_C_{ijt}$ gets a value 1 when country *i* and *j* are India and China, but $APTA\_D_{ijt}$ gets the value 0 for the same pair at the same time period.

5. Results and policy implications

Estimates of these six set of regressions appear in the first six columns of data in all regression tables below. Tables 2 and 3 present the results for India's exports and imports while tables 4 and 5 present the same for China. For convenience of interpretation, all results are reported in terms of incidence rate ratios (IRRs) where the IRR estimate is the rate ratio for a one unit increase in the independent variables on the dependent variable, hold constant the other variables in the model. An IRR greater than one indicates that an increase in the independent variable increases the rate of count of the dependent variable, while an IRR less than one suggests a possible decrease in the rate of count of the independent variable.

{Insert tables 2 – 5 here}

Comparison of the results across the different estimation methods reveals that the LR test for α=0 is invariably significant, suggesting that the Poisson results are inferior compared to the NB models. Further, the Vuong test statistics are all positive and significant, suggesting that the NB approach is inferior to the ZINB approach. This provides statistical evidence to corroborate Burger *et al*. (2009) and Kohl (2012) who argue that the presence of zero trade flows cannot be ignored when estimating a gravity model. The results indicate that better estimates of the gravity model can be achieved through estimation of ZINB models when investigation focuses on a regional context.

Tables 2 and 4 present results for India's and China's exports, respectively. The IRR estimates of the effect of home country GDP tends to be greater than one, but the effect of a one unit increase in home country GDP on the exports is stronger for China compared to India. Although the effect of an increase in the partner country GDP on exports is consistently greater than one for both countries, it is consistently greater for India than for China. Similar results are identified for China's imports relative to India's imports shown in tables 3 and 5.

The distance decay effect is measurably stronger for exports for India than for China in the Poisson and ZINB models, with the reverse occurring in the NB model. Similar results are presented for imports using the ZINB model.

The Poisson results suggest that a common border enhances exports, but these results are not wholly consistent with contradictory results estimated using the NB method for China and for the second three sets of results for India. If the ZINB estimates are superior to the Poisson results for India, then this suggests that greater export value is achieved through trade with countries further afield, such as in the EU, NAFTA or with Australasia. The corresponding results for imports also highlight inconsistent results across the three estimators, but as a general rule it appears that China benefits more from exporting with her neighbours than does India, and this is especially evident in the ZINB model.

Having a common language appears to be a particularly strong effect on China's exports, with column (6) suggesting that Chinese exports are likely to increase by nearly 10-fold due to the presence of a common language with India receiving smaller 1.8-fold increase, but this may be correlated with border (or trans-shipment) effects as only Hong Kong, Macau, Taiwan and Singapore officially share a common language with China. Similar results are obtained for China's imports in the ZINB model, with the largest estimate suggesting that imports are likely to increase by a factor of 5.4 due to the presence of a common language. India's imports do not seem to be affected by the presence of a common language, with many of her corresponding coefficients being statistically insignificant.

Preferential trading agreements

As the focus of this study is on the trade agreements of India and China, it would be astute to focus the majority of our results description on the estimated effects of PTAs on export or import counts and whether these have created or diverted trade among non-members. The most interesting results are observed for the aggregate effects of PTAs on India's and China's exports. Comparing Tables 2 and 4, the results of the ZINB model presented in columns 5 for *All-C* and *All-D* suggests that Chinese exports were more likely to be net trade creating while India's exports were more likely to be net trade diverting. The estimate of India's *All-D* suggests that exports decreased 4.2-fold (=1/0.236) which is greater than 2.4-fold (=1/0.416) decrease in India's exports suggested by *All-C*. These estimates therefore suggest that PTAs have enhanced China's exports overall and have decreased India's exports overall through both trade creation and trade diversion channels.

The corresponding effects on imports of PTAs are also particularly interesting. Comparing Tables 3 and 5, the results of the ZINB model presented in columns 5 for *All-C* and *All-D* suggests that Chinese imports were more likely to be net trade creating while India's exports were more likely to have no statistically significant effect, and the coefficient estimate here suggests that the economic effect might be net trade diverting. The estimate of China's *All-D* suggests that her imports increased by 1.7-fold which is greater than the 1.4-fold increase in her imports indicated by *All-D*. Taken together, these estimates suggest that PTAs have enhanced Chinese imports through net trade creating while India's imports were unlikely to have been affected.

We now progress to focus on each PTA individually and assess whether China's and India's export and import counts have benefited through created or diverted trade. We approach these trade agreement issues in turn and for simplicity summarise the exports and imports results in Tables 6 and 7 respectively, where "+" signifies a statistically significant IRR value greater than one due to trade creation or diversion and where "X" signifies an associated drop in trade due to IRRs being statistically significant but with values less than one. To indicate the relative magnitudes of these effects, which are simply reflections of the results in tables 2 – 5, we insert one "+" (or "x") if the IRR magnitude is between 1 and 1.5 (0.667 and 1); two "+"s (or "x"s) if the IRR magnitude is between 1.5 and 2 (0.5 and 0.667); three "+"s (or "x"s) if the IRR magnitude is greater than 2 (less than 0.5).

{Insert tables 6 and 7 here}

Trade creation effects

It is expected that the efficiency gains through trade creation can be enhanced from establishing PTAs with the largest possible grouping of countries that have a higher share of pre-PTA trade and a non-uniform pre-PTA tariff structure. China and India have been members of APTA post-2001, China has been a member of the ACFTA involving AFTA members, while India has been a member of the bilateral CECA with Singapore since 2005, and the regional agreement SAFTA involving its South Asian neighbours since 2006. Hence, trade creation effects are likely to be present only among these PTAs.

APTA is found to generate significant benefits for China's exports. The *APTA-C* IRR for China's exports was 2.225, which was greater than corresponding export *APTA-D* IRR (1.655), suggesting that China experienced a net trade creation in its exports due to APTA membership. On the import side, the *APTA-C* IRR (1.058) is less than the *APTA-D* IRR (1.556), suggesting that there was net trade diversion for Chinese imports.

APTA is found to generate significant net trade creation effects for India's exports too, which indicates that efficiency gains have been reaped through this PTA. This can be confirmed further from inspection of the regression results wherein *APTA-C* IRR for India's exports is 1.474 which is greater than and more statistically significant than the (1/0.949=) 1.054 decline in the rate of export count due to *APTA-D*. Further inspection of the regression results corresponding to her net imports reveals significant net diversion. Given that APTA is a partial scope PTA on only a few albeit strategically important goods covering less than 20-

25% of total value of bilateral trade among their members,[12] the above results suggests potential for stronger trade creation through APTA for both India and China if they were to extend the coverage of APTA to all goods traded.[13] APTIAD (2013) notes an increase in imports on APTA concession items at HS 6-digit level, with China being the largest exporter to India on these items between 2005-2011 that resulted in China-India bilateral exports increasing its intra-APTA exports share from 78 to 84 percent.

ACFTA membership is observed to have also generated a significant trade increases for both of China's exports and imports, which roughly equal each other; on her export side her *ACFTA-C* IRR (2.637) is about the same as her *ACFTA-D* IRR value (2.734) and on her import side her *ACFTA-C* IRR (2.036) is about the same as her *ACFTA-D* IRR value (1.959). No statistically significant effects of ACFTA were identified for India. Moreover, membership of CECA or SAFTA did not bring any significant trade creation benefits for either China or India, which may not be surprising given that only five years of post-PTA trade data have been analysed in this dataset. However, membership of CECA and SAFTA did have strong trade diversion effects on both China and India during this time period.

Trade diversion effects

It was noted above that trade creation in the form of exports were stimulated by APTA non-membership. APTA also had fairly strong trade diversion effects on both China's and India's imports and also on China's exports. The net effects of APTA on both India and China are trade creating exports and trade diverting imports, suggesting that non-membership was particularly beneficial to these two countries. In the case of AFTA, positive extra-bloc trade effects are observed for China's exports, while for India these are observed to be insignificant, suggesting no evidence of trade diversion for India's exports or imports due to AFTA. This implies that creation of AFTA as an extra-bloc for India and China did not significantly reduce their bilateral trade with AFTA members, i.e. the ten-member ASEAN countries of Southeast Asia.

China was a member of ACFTA and this seems to have had significant effects on her trading patterns. Although the total amount of trade has been enhanced significantly, there appears to be no strong patterns indicating whether it was net trade creating or net trade diverting. The enforcement of the ACFTA seems to have had no significant effects on India's exports or imports albeit as a non-member. In contrast, the enforcement of the SAFTA seems to have had significant effects on India trade diversion, in which it is net trade diverting in terms of both its exports and imports. China, as a non-member, seems to have been adversely affected by this PTA, with trade diversion reducing both her exports and imports by a rate of (1/0.433=) 2.31 and (1/0.049=) 20.41 respectively. Although these asymmetries are

[12] APTIAD (2013) observes that there has been a progressive increase in the number of items included in the tariff concession by APTA from 1721 to 9992 over the three rounds of tariff negotiations between 1990-2007.

[13] Management processes under regional agreements have helped to reduce the negotiation costs significantly, thereby enhancing overall efficiency gains (Laird, 1999; Summers, 1991). APTA has so far adhered to a simple, common Rules of Origin with minimum local value content requirement of 45 percent f.o.b. (35 percent for LDCs). Further, a set of operational procedures for the certification and verification of the origin of goods was adopted in October 2007 that, for the first time among developing countries in the region, may have also contributed to the strong net trade creation on the export side (see www.unescap.org/tid/apta/factsheet08.pdf).

significant, it should be qualified that these results are based on only 4-5 years of post-PTA trade data and therefore should be treated tentatively.

There appears to be also a trade diversion effect of CECA that increased India's exports to and imports from non-CECA members and also China's imports from non-CECA members, although the latter is only significant at the 10 percent level. An important caveat here is that there is a data valuation bias as Singapore's total exports to India and China include a significant proportion of re-exports (estimated to be about 40% or more of its total exports) that are originating from other Southeast Asian countries and are only transhipped through Singapore to India and China.

Since neither India nor China are members of the remaining five PTAs (NAFTA, EU, MERCOSUR, CER, USSFTA and AUSUSFTA), it is also interesting to analyze whether these regional or bilateral PTAs have generated any significant trade diversion effects. It is often argued that large regional PTAs, such as NAFTA and EU, could reduce India or China's exports to and imports from the member countries of these PTAs. Our results suggest that NAFTA, EU and MERCOSUR did reduce China's import counts by a factor of (1/0.362=) 2.76, (1/0.434=) 2.3 and (1/0.618=) 1.62 respectively. Further, MERCOSUR also reduced India's imports count by a factor of (1/0.611=) 1.64. On the export side, the NAFTA, MERCOSUR and EU appear to have increased India's exports due to trade diversion, by a factor of 1.59, 1.42 and 1.25 respectively; NATFA also appears to have increased China's exports due to trade diversion by a factor of 1.89, suggesting that the PTA of NAFTA was particularly beneficial to India's and China's exports these trading blocs' non-members and also reduced their imports, thereby inadvertently improving China's and India's balance of payments.

CER also increased China's and India's imports due to trade diversion by factors of 1.95 and 2.56 respectively. However, the USSFTA and AUSUSFTA PTAs seem to have no significant effect on India or China's exports or imports.

A couple of caveats are to be noted while obtaining these results. First, the model does not capture the effect of all PTAs and their interactions. For example, the effect of Singapore's PTA with US on its CECA agreement with India is not explicitly captured here, nor is the effect of Mexico's PTAs with Japan and Korea and its effect on their trade with China. Second, ASEAN+6 members continue to enter into negotiations of new PTAs which might influence these results in the near future.[14] For example, the ASEAN-India FTA and the ASEAN-Australia-New Zealand FTA are two important regional PTAs that are likely to interact with the existing complex web of ASEAN+6 PTAs and therefore influence current levels of trade creation and diversion. Further research could address these issues.

Sensitivity tests and endogeneity

Baier and Bergstrand (2007) argued that countries select endogenously into FTAs, making the PTA dummy variable possibly correlated with the level of trade and therefore potentially endogenous in a gravity model. Given that the focus of our attention was on the relative effects of eleven PTAs on China's and India's trade over time, obtaining instrumental

[14] The Trans Pacific Partnership (TPP) agreement that involves twelve Asia-Pacific economies (Brunei, Canada, Chile, Japan, New Zealand, Singapore, Australia, Malaysia, Peru, the United States and Vietnam) is likely to strongly influence trade, which is expected to conclude before 2015.

variable was problematic if not impossible to find and justify for each PTA and country individually.[15] We also appreciate Baier and Bergstrand's (2002, 2004b) and Magee's (2003) observations that traditional estimates of the effect of PTAs on bilateral trade flows may have been underestimated by as much as 75 to 85 percent, albeit in an estimation approach that did not take heed of zero or near zero trade flows.

Baier and Bergstrand (2007) further emphasised that excluding the GDP variables from a gravity model might reduce any potential endogeneity bias created by simultaneity. This is because GDP is a function of net exports and net imports and is potentially endogenous to bilateral trade flows (Frankel and Romer, 1999). To investigate the potential effect of simultaneity in our results, we re-estimate all previous ZINB models containing the PTA dummy variables but this time we exclude the GDP variables; results of these sensitivity analyses are presented in the final columns, marked ZINB (S), throughout tables 2-5.

These new results corroborate the earlier findings on the effects of distance, common borders and common languages on exports and imports for both China and India; the only exception is the statistical insignificance of the border effect on China's exports, but this is in line with the results presented generated through the Poisson estimation approach.

The estimated effects of the five PTAs on for which China and/or India are members suggest that the positive effects presented earlier were consistently underestimated using the standard gravity approach. Part of the reason for this is that the *GDP partner* variable in particular would have been capturing some of the scale effects in the export and import data, which now is partly captured using the PTA dummies. For instance, the trade diversion effect of NAFTA on India's exports has increased from a factor 1.59 to a factor of 27.8. It is particularly noticeable that the magnitudes of the coefficients corresponding to trade blocs that China and India are non-members are now particularly large (e.g. NAFTA, EU, MERCOSUR), and this change is likely to be related to the economic size of the member countries of these trading blocs.

5. Concluding remarks

This paper has focused on the contributory effects of different Preferential trading agreements on the export and import trading volumes of India and China over the 1984-2009 period using the gravity model. The analysis in this paper deviates from the traditional log-linear approach of gravity model estimation and takes account of available information on all trading partners, which allows the possibility of zero trade flows as a dependent variable and confirms that the zero-inflated negative binomial regression approach fits the data the best.

Results for the zero-inflated negative binomial regression confirms that Chinese exports and imports were more likely to be net trade creating in presence of PTAs while India's exports were more likely to be net trade diverting in the presence of the same PTAs, with imports having an insignificant effect. Thus, PTAs may be trade creating or diverting and there is no general thumb rule. For China and India, many PTAs seems to have created both intra- and extra-bloc trade, with the partial scope APTA being observed to be the only

[15] Egger *et al*. (2011) offer a method to estimate the trade effects of endogenous PTA in cross-sectional models, but these effects are unlikely to be constant in models over time.

significant export creating PTA for India while APTA and ACFTA are both found to be export creating for China.

These findings for India are consistent with Srinivasan and Archana's (2009) analysis which concludes that the rapid global spread of bilateral PTAs and RTAs towards which India is moving rapidly is largely deleterious or insignificant from India's perspective in terms of its impacts on trade flows. Corroborating these findings, Jha (2013) confirms that only one out of the 15 PTAs implemented by India has achieved a utilization rate of 11% over 2006-2008, although this is potentially due to skewed preferences.[16] It is also observed that India's imports were likely to suffer trade diversion due to MERCOSUR only, while China's imports were likely to suffer trade diversion due to the creation of NAFTA, EU and MERCOSUR.

However, this is only a partial picture of the Asian trade evolution, and future research needs to include the trade effects on all ASEAN+6 members in order to capture a thorough analysis of the complex interactive effects of the evolving economic integration process in Asia. The ongoing negotiations of mega-trade deals such as the RCEP involving all ASEAN+6 members and possible implementation of the TPP is expected to further obscure these interactions in the process of Asian economic integration.

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[16] Our results suggest that Indian policymakers need to provide adequate attention to the effective implementation of its PTAs, otherwise they run the risk of becoming paper agreements with no net positive gain.

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Table 1: List of PTAs considered in the paper

	Name of PTA and Acronym	**Members**	**Initiated**
AFTA	ASEAN Free Trade Area	Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, Thailand (1993), Vietnam (1995) Lao PDR and Myanmar (1997) and Cambodia (1999)	1993
APTA	Asia-Pacific Trade Agreement, formerly Bangkok agreement	Bangladesh, India, Korea, Lao PDR and Sri Lanka (1976) and China (2001)	1976
SAFTA	South Asian Free Trade Area	Afghanistan, Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka and Maldives	2006
ACFTA	ASEAN-China FTA	ASEAN members and China	2005
CER	Closer Economic Relations	Australia and New Zealand	1983
USSFTA	United States - Singapore Free Trade Agreement	US and Singapore	2004
AUSUSFTA	Australia-US FTA	Australia and US	2005
CECA	India - Singapore Comprehensive Economic Cooperation Agreement	Singapore and India	2005
EU	European Union	Belgium, France, Germany, Italy, Luxembourg and Netherlands (1957), UK, Ireland and Denmark (1973), Greece (1981), Spain and Portugal (1986), Austria, Sweden and Finland (1995), Cyprus, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Malta, Poland, Slovakia, Slovenia (2004), and Romania and Bulgaria (2007).	1957
NAFTA	NAFTA	USA, Canada and Mexico	1994
MERCOSUR	MERCOSUR	Argentina, Brazil, Uruguay and Paraguay (1991), Venezuela (2012)	1991

An intra-bloc and extra-bloc PTA dummy is applied to each of these PTAs separately. However, the econometric approach first considers a total of 31 regional and bilateral PTAs implemented over the time period. Therefore, in addition to the above, the following PTAs were also considered for the *All_C* and *All_D* dummy variables: South Pacific Regional Trade and Economic Cooperation Agreement, Trans-Pacific Strategic Economic Partnership Agreement, Agreement between New Zealand & Singapore on a Closer Economic Partnership, Agreement between Japan & the Republic of Singapore for New-Age Economic Partnership, Singapore - Australia FTA, Thailand - Australia Free Trade Agreement, Thailand-New Zealand Closer Economic Partnership, Korea - Singapore FTA, Malaysia-Japan Economic Partnership Agreement, EFTA-Singapore, China –Chile FTA, China- Hong Kong FTA, China- Macao FTA, China - Thailand FTA, Japan-Mexico FTA, Korea-Chile FTA, Singapore-Panama FTA, Singapore-Jordan FTA, Singapore-Peru FTA and Singapore-Chile, FTA.

Source: ADB (2011).

Table 2: IRR Estimates of gravity models for India's exports

	Poisson	Poisson	Neg. binomial	Neg. binomial	ZINB	ZINB	ZINB (S)
ln GDP home	1.115 (0.002)***	0.643 (0.001)***	4.246 (0.119)***	2.064 (0.069)***	2.978 (0.133)***	1.025 (0.046)	–
ln GDP partner	5.563 (0.014)***	4.076 (0.008)***	1.152 (0.011)***	1.171 (0.010)***	2.164 (0.018)***	2.047 (0.019)***	–
ln Distance	0.551 (0.095)*	0.375 (0.106)***	1.161 (0.048)***	0.903 (0.031)***	0.229 (0.010)***	0.191 (0.008)***	0.241 (0.015)***
Border	1.845 (1.890)	1.368 (1.176)	1.655 (0.222)***	0.492 (0.060)***	0.474 (0.070)***	0.391 (0.052)***	0.396 (0.071)***
Language	2.122 (0.757)**	2.073 (0.603)**	0.566 (0.028)***	0.895 (0.036)***	1.904 (0.084)***	1.867 (0.078)***	2.746 (0.190)***
All – C	1.295 (0.010)***	–	1.553 (0.306)**	–	0.416 (0.141)***	–	–
All – D	0.813 (0.006)***	–	0.939 (0.183)	–	0.236 (0.081)***	–	–
APTA – C	–	1.497 (0.006)***	–	2.965 (0.378)***	–	1.474 (0.220)***	3.399 (0.804)***
APTA – D	–	0.958 (0.001)***	–	0.806 (0.040)***	–	0.949 (0.068)	0.858 (0.077)*
CECA – C	–	1.541 (0.007)***	–	1.711 (0.564)	–	2.631 (2.476)	0.626 (0.892)
CECA – D	–	1.707 (0.002)***	–	1.360 (0.068)***	–	1.859 (0.213)***	1.263 (0.206)
SAFTA – C	–	1.000 (0.003)	–	1.138 (0.142)	–	1.186 (0.376)	0.699 (0.344)
SAFTA – D	–	1.252 (0.002)***	–	1.087 (0.051)*	–	1.353 (0.161)**	1.446 (0.257)**
ACFTA – C	–	–	–	–	–	–	–
ACFTA – D	–	1.028 (0.002)***	–	1.120 (0.095)	–	0.749 (0.190)	3.083 (1.157)***
AFTA – C	–	–	–	–	–	–	–
AFTA – D	–	0.931 (0.003)***	–	1.920 (0.175)***	–	0.969 (0.142)	1.641 (0.330)**
AUSUSFTA – C	–	–	–	–	–	–	–
AUSUSFTA – D	–	0.597 (0.002)***	–	0.569 (0.133)*	–	0.504 (0.278)	1.471 (1.203)
CER – C	–	–	–	–	–	–	–
CER – D	–	0.628 (0.003)***	–	1.315 (0.203)*	–	1.335 (0.278)	2.422 (0.760)***
EU – C	–	–	–	–	–	–	–
EU – D	–	1.222 (0.003)***	–	1.769 (0.093)***	–	1.246 (0.095)***	7.383 (0.753)***
MERCOSUR – C	–	–	–	–	–	–	–
MERCOSUR – D	–	7.595 (0.079)***	–	2.649 (0.294)***	–	1.417 (0.242)**	4.779 (1.248)***
NAFTA – C	–	–	–	–	–	–	–
NAFTA – D	–	1.212 (0.002)***	–	1.567 (0.193)***	–	1.588 (0.357)**	27.825 (9.247)***
USSFTA – C	–	–	–	–	–	–	–
USSFTA – D	–	1.255 (0.003)***	–	1.095 (0.287)	–	2.591 (1.689)	2.868 (2.776)
Intercept	0.000 (0.000)***	0.004 (0.010)**	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.011 (0.014)***	117072 (66403)***
Trading country pop	–	–	–	–	2.9e-09 (0.000)***	3.34e-09 (0.000)***	5.2e-09 (0.000)***
Intercept	–	–	–	–	-2.683 (0.075)***	-2.659 (0.074)***	-4.881 (0.295)***
Observations	4790	4790	4790	4790	4734	4734	4734
Zeros	–	–	–	–	617	617	617
Vuong	–	–	–	–	10.08***	10.96***	6.4***
alpha	4.175 (0.335)	2.963 (0.241)	–	–	1.691 (0.040)	2.018 (0.043)	4.722 (0.076)
LR test alpha=0	1.0e+7***	1.1e+7***	–	–	7.9e+6***	9.4e+06***	3.5e+07***
LR test vs. pooled	–	–	7827***	8477***	–	–	–
Log Likelihood	-872796	-1443840	-28626	-39149	-30722	-41585	-44183

Notes: ***, ** and * refer to variables found to be statistically significant at 1%, 5% and 10% respectively. Standard errors are in parentheses. All estimates are generated with partner country random effects. Exposure obtained with time. Logit inflation in ZINB is achieved using trading country's population.

Table 3: IRR Estimates of gravity models for India's imports

	Poisson	Poisson	Neg. binomial	Neg. binomial	ZINB	ZINB	ZINB(S)
ln GDP home	1.255 (0.002)***	0.562 (0.000)***	2.907 (0.107)***	1.959 (0.074)***	1.908 (0.124)***	0.884 (0.072)	–
ln GDP partner	4.014 (0.009)***	3.490 (0.006)***	1.353 (0.014)***	1.323 (0.013)***	2.196 (0.029)***	2.233 (0.032)***	–
Distance	2.520 (0.716)***	1.273 (0.347)	0.762 (0.031)***	0.644 (0.023)***	0.375 (0.027)***	0.311 (0.022)***	0.399 (0.034)***
Border	17.902 (17.147)***	8.956 (8.059)**	1.288 (0.175)*	0.702 (0.084)***	0.447 (0.105)***	0.408 (0.087)***	0.512 (0.119)***
Language	0.814 (0.276)	0.973 (0.300)	0.858 (0.044)***	0.958 (0.043)	0.920 (0.066)	1.018 (0.068)	1.629 (0.154)***
All – C	1.525 (0.017)***	–	2.027 (0.560)**	–	0.449 (0.257)	–	–
All – D	0.873 (0.009)***	–	1.017 (0.279)	–	0.413 (0.242)	–	–
APTA – C	–	3.599 (0.014)***	–	2.652 (0.341)***	–	0.718 (0.180)	3.277 (1.007)***
APTA – D	–	1.338 (0.002)***	–	0.925 (0.057)	–	1.312 (0.156)**	0.897 (0.109)
CECA – C	–	0.966 (0.004)***	–	0.940 (0.399)	–	2.026 (3.053)	0.333 (0.637)
CECA – D	–	1.624 (0.002)***	–	1.182 (0.078)**	–	1.716 (0.320)***	0.877 (0.193)
SAFTA – C	–	1.359 (0.008)***	–	1.557 (0.213)***	–	1.505 (0.788)	0.370 (0.246)
SAFTA – D	–	2.080 (0.003)***	–	1.496 (0.094)***	–	2.142 (0.412)***	2.825 (0.676)***
ACFTA – C	–	–	–	–	–	–	–
ACFTA – D	–	1.008 (0.002)***	–	1.509 (0.170)***	–	1.074 (0.437)	3.874 (1.972)***
AFTA – C	–	–	–	–	–	–	–
AFTA – D	–	0.909 (0.002)***	–	1.231 (0.133)*	–	1.119 (0.255)	2.009 (0.536)***
AUSUSFTA – C	–	–	–	–	–	–	–
AUSUSFTA – D	–	0.807 (0.002)***	–	0.738 (0.140)	–	0.726 (0.630)	2.190 (2.401)
CER – C	–	–	–	–	–	–	–
CER – D	–	1.348 (0.005)***	–	4.123 (0.706)**	–	2.563 (0.877)***	5.203 (2.197)***
EU – C	–	–	–	–	–	–	–
EU – D	–	0.929 (0.002)***	–	1.418 (0.084)***	–	1.000 (0.123)	6.505 (0.889)***
MERCOSUR – C	–	–	–	–	–	–	–
MERCOSUR – D	–	0.765 (0.003)***	–	1.447 (0.186)***	–	0.611 (0.175)*	2.983 (1.043)***
NAFTA – C	–	–	–	–	–	–	–
NAFTA – D	–	0.536 (0.001)***	–	0.762 (0.112)*	–	0.612 (0.227)	11.244 (5.031)***
USSFTA – C	–	–	–	–	–	–	–
USSFTA – D	–	1.194 (0.003)***	–	1.003 (0.300)	–	1.966 (1.996)	2.423 (3.144)
Intercept	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.0000 (0.000)***	0.000 (0.000)***	0.001 (0.002)***	2047 (1531)***
Trading pop	–	–	–	–	4.52e-9 (0.000)***	4.23e-9 (0.000)***	4.3e-9 (0.000)***
Intercept	–	–	–	–	-4.601 (0.417)***	-3.826 (0.299)***	-4.969 (0.480)***
Observations	4790	4790	4790	4790	4734	4734	4734
Zeros	–	–	–	–	1228	1228	1228
Vuong	–	–	–	–	3.84***	4.64***	3.81***
alpha	4.050 (0.329)	3.473 (0.283)	–	–	4.843 (0.104)	5.402 (0.118)	8.519 (0.152)
LR test alpha=0	1.5e+7***	1.4e+7***	–	–	1.6e+7***	1.6e+7***	4.6e+7***
LR test vs. pooled	–	–	4967.78***	5542***	–	–	–
Log Likelihood	-2666417	-3344398	-25825	-33518	-28194	-36382	-37856

See notes on table 2.

Table 4: IRR Estimates of gravity models for China's exports

	Poisson	Poisson	Neg. binomial	Neg. binomial	ZINB	ZINB	ZINB(S)
ln GDP home	2.836 (0.000)***	1.539 (0.000)***	4.424 (0.157)***	3.156 (0.154)***	2.373 (0.093)***	1.314 (0.062)***	–
ln GDP partner	3.141 (0.000)***	1.913 (0.000)***	1.114 (0.011)***	1.066 (0.012)***	2.001 (0.016)***	2.004 (0.018)***	–
Distance	0.923 (0.304)	0.673 (0.156)*	0.469 (0.030)***	0.490 (0.034)***	0.574 (0.027)***	0.635 (0.032)***	0.198 (0.010)***
Border	2.348 (1.383)	1.987 (0.911)	0.626 (0.072)***	0.675 (0.079)***	1.488 (0.139)***	1.675 (0.157)***	0.969 (0.117)
Language	1.986 (1.827)	8.210 (6.434)***	1.957 (0.379)***	2.153 (0.415)***	9.282 (1.258)***	9.762 (1.303)***	6.464 (1.250)***
All – C	0.657 (0.000)***	–	1.242 (0.092)**	–	1.421 (0.203)**	–	–
All – D	0.834 (0.000)***	–	1.193 (0.045)**	–	1.223 (0.078)***	–	–
APTA – C	–	3.121 (0.000)***	–	1.598 (0.192)***	–	2.225 (0.517)***	1.716 (0.544)*
APTA – D	–	1.406 (0.000)***	–	1.228 (0.046)***	–	1.655 (0.106)***	1.679 (0.119)***
CECA – C	–	–	–	–	–	–	–
CECA – D	–	0.788 (0.000)***	–	1.279 (0.227)	–	0.734 (0.335)	4.987 (3.318)**
SAFTA – C	–	–	–	–	–	–	–
SAFTA – D	–	1.618 (0.000)***	–	1.084 (0.114)	–	0.433 (0.122)***	0.460 (0.190)*
ACFTA – C	–	1.675 (0.0001)***	–	3.370 (0.432)***	–	2.637 (0.521)***	3.136 (0.856)***
ACFTA – D	–	1.571 (0.000)***	–	1.376 (0.048)***	–	2.734 (0.179)***	2.940 (0.254)***
AFTA – C	–	–	–	–	–	–	–
AFTA – D	–	0.888 (0.000)***	–	2.474 (0.292)***	–	1.331 (0.175)**	1.195 (0.220)
AUSUSFTA – C	–	–	–	–	–	–	–
AUSUSFTA – D	–	0.978 (0.000)***	–	1.052 (0.061)	–	1.299 (0.593)	2.572 (1.630)
CER – C	–	–	–	–	–	–	–
CER – D	–	1.878 (1.970)	–	1.358 (0.221)***	–	1.307 (0.230)	5.298 (1.320)***
EU – C	–	–	–	–	–	–	–
EU – D	–	1.804 (0.000)***	–	2.598 (0.162)***	–	1.084 (0.079)	6.638 (0.608)***
MERCOSUR – C	–	–	–	–	–	–	–
MERCOSUR – D	–	2.023 (0.000)***	–	3.416 (0.534)***	–	0.845 (0.124)	6.706 (1.364)***
NAFTA – C	–	–	–	–	–	–	–
NAFTA – D	–	2.122 (0.000)***	–	3.157 (0.589)***	–	1.880 (0.371)***	84.245 (23.201)***
USSFTA – C	–	–	–	–	–	–	–
USSFTA – D	–	1.158 (0.000)***	–	0.787 (0.121)	–	1.042 (0.469)	1.173 (0.710)
Intercept	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	2.3e+9 (1.08e+9)***
Trading pop	–	–	–	–	3.14e-9 (0.000)***	3.14e-09 (0.000)***	3.2e-09 (0.000)***
Intercept	–	–	–	–	-2.493 (0.055)***	-2.492 (0.055)***	-2.554 (0.059)***
Observations	4791	4791	4791	4791	4735	4735	4735
Zeros	–	–	–	–	433	433	433
Vuong	–	–	–	–	32.89***	33.71***	26.44***
alpha	2.962 (0.244)	2.175 (0.185)	–	–	1.525 (0.028)	1.434 (0.026)	2.967 (0.055)
LR test alpha=0	3.4e+10***	2.9e+10***	–	–	2.8e+10***	2.3e+10***	1.3e+11***
LR test vs. pooled	–	–	6781***	6920***	–	–	–
Log Likelihood	-5.777e+09	-4.486e+09	-51989	-51722	-66976	-66796	-68985

See notes on table 2.

Table 5: IRR Estimates of gravity models for China's imports

	Poisson	Poisson	Neg. binomial	Neg. binomial	ZINB	ZINB	ZINB(S)
ln GDP home	1.534 (0.000)***	1.922 (0.000)***	2.046 (0.064)***	1.612 (0.062)***	2.106 (0.111)***	1.529 (0.107)***	–
ln GDP partner	6.641 (0.000)***	5.334 (0.000)***	1.383 (0.012)***	1.344 (0.013)***	2.520 (0.037)***	2.678 (0.043)***	–
Distance	0.962 (0.466)	0.982 (0.447)	1.237 (0.043)***	1.304 (0.049)***	0.650 (0.040)***	0.658 (0.046)***	0.231 (0.014)***
Border	3.907 (4.057)	3.905 (3.836)	2.214 (0.207)***	2.476 (0.239)***	1.582 (0.213)***	1.700 (0.249)***	0.947 (0.146)
Language	0.248 (0.269)	0.627 (0.662)	1.510 (0.251)**	2.236 (0.347)***	5.465 (0.984)***	4.387 (0.799)***	2.629 (0.681)***
All – C	0.929 (0.000)***	–	1.907 (0.201)***	–	1.698 (0.332)***	–	–
All – D	1.034 (0.000)***	–	1.649 (0.070)***	–	1.383 (0.113)***	–	–
APTA – C	–	1.562 (0.000)***	–	2.858 (0.427)***	–	1.058 (0.344)	1.584 (0.654)
APTA – D	–	1.011 (0.000)***	–	1.473 (0.063)***	–	1.556 (0.144)***	1.225 (0.118)**
CECA – C	–	–	–	–	–	–	–
CECA – D	–	0.657 (0.000)***	–	1.956 (0.374)***	–	2.957 (1.901)*	16.485 (15.885)***
SAFTA – C	–	–	–	–	–	–	–
SAFTA – D	–	1.241 (0.000)***	–	0.873 (0.121)	–	0.049 (0.020)***	0.068 (0.038)***
ACFTA – C	–	1.142 (0.000)***	–	3.937 (0.549)***	–	2.036 (0.555)***	4.519 (1.669)***
ACFTA – D	–	1.080 (0.000)***	–	1.293 (0.053)***	–	1.959 (0.180)***	2.732 (0.314)***
AFTA – C	–	–	–	–	–	–	–
AFTA – D	–	0.639 (0.000)***	–	2.303 (0.264)***	–	1.334 (0.254)	1.803 (0.471)**
AUSUSFTA – C	–	–	–	–	–	–	–
AUSUSFTA – D	–	1.154 (0.000)***	–	1.598 (0.141)***	–	0.857 (0.559)	2.651 (2.205)
CER – C	–	–	–	–	–	–	–
CER – D	–	1.482 (0.159)	–	1.734 (0.347)***	–	1.953 (0.473)***	7.216 (2.429)***
EU – C	–	–	–	–	–	–	–
EU – D	–	1.034 (0.000)***	–	3.653 (0.247)***	–	0.434 (0.045)***	4.391 (0.540)***
MERCOSUR – C	–	–	–	–	–	–	–
MERCOSUR – D	–	1.056 (0.000)***	–	1.891 (0.266)***	–	0.618 (0.127)**	9.090 (2.487)***
NAFTA – C	–	–	–	–	–	–	–
NAFTA – D	–	0.639 (0.000)***	–	1.617 (0.250)***	–	0.362 (0.099)***	30.525 (11.126)***
USSFTA – C	–	–	–	–	–	–	–
USSFTA – D	–	0.839 (0.000)***	–	0.469 (0.092)***	–	0.502 (0.309)	1.056 (0.823)
Intercept	0.000 (0.000)***	0.000 (0.000)***	0.000(0.000)***	0.000 (0.000)***	0.000 (0.000)***	0.000 (0.000)***	8.8e+8 (4.9e+8)***
Trading pop	–	–	–	–	1.24e-09 (0.000)***	6.32e-10 (0.000)***	1.4e-9 (2.3e-10)***
Intercept	–	–	–	–	-1.581 (0.042)***	-0.408 (0.027)***	-1.780 (0.054)***
Observations	4791	4791	4791	4791	4735	4735	4735
Zeros	–	–	–	–	903	903	903
Vuong	–	–	–	–	9.58***	1.29*	10.01***
alpha	4.366 (0.347)	4.096 (0.327)	–	–	2.909 (0.063)	2.760 (0.058)	5.341 (0.132)
LR test alpha=0	2.8e+10***	2.3e+10 ***	–	–	3.7e+10***	2.9e+10***	1.2e+11***
LR test vs. pooled	–	–	4540***	4870***	–	–	–
Log Likelihood	-8.078e+9	-1.019e+10	-57422	-57188	-58716	-58116.23	-60198

See notes on table 2.

Table 6: Summary of the effects of PTAs on China's trade

		APTA	CECA	SAFTA	ACFTA	AFTA	AUSUSFTA	CER	EU	MERCOSUR	NAFTA	USSFTA
Trade creation	*Exports*	+++			+++							
	Imports				+++							
Trade diversion	*Exports*	++		×××	+++	+					++	
	Imports	++	+++	×××	++			++	×××	××	×××	

Source: Authors' estimates

Table 7: Summary of the effects of PTAs on India's trade

		APTA	CECA	SAFTA	ACFTA	AFTA	AUSUSFTA	CER	EU	MERCOSUR	NAFTA	USSFTA
Trade creation	*Exports*	+										
	Imports											
Trade diversion	*Exports*		++	+					+	+	++	
	Imports	+	++	+++				+++		××		

Source: Authors' estimates

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