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SAFTA and AFTA: a comparative welfare analysis of two regional trade agreements

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Abstract

The gravity model is one of the most successful empirical models in economics to evaluate the effects of several factors on international trade or bilateral trade flows. Many factors that are related to trade barriers can influence the bilateral trade between two countries. Regional trade agreements (RTAs) are important factors, which can pave the path of bilateral trades. In this paper, I use GEPPML estimator of Anderson et al. (Estimating general equilibrium trade policy effects: GE PPML. CESifo Working Papers-5592, 2015) to evaluate the counterfactual welfare effect of SAFTA and AFTA on member countries as well as on the non-member countries. After accounting for potential endogeneity of RTAs, removal of AFTA causes 3.08% real GDP loss for member countries, removal of SAFTA causes 6.36% real GDP loss for member countries, and joint agreement of SAFTA and AFTA brings 0.71 real GDP gains for member countries. In all scenarios, trade diversion effect is not remarkable.

1 Background

Regional trade agreements (RTAs) have been proliferating since the mid-90 s. As of May 2016, some 629 notifications of RTAs (including goods, services, and accessions separately) have been received by the WTO (World Trade Organization). Of these, 423 are in force. These WTO figures correspond to 458 physical RTAs (including goods, services, and accessions together), of which 270 are currently in force (WTO website). In the meantime, the share of world trade occurring within RTAs has been growing steadily, overreaching 30% even when intra-EU trade is excluded (Bureau et al. 2015).

It is more likely that RTAs can affect the order of international trade flows as they are signed to pave the way for trade between member countries, but their actual impact on trade flows remains controversial. Estimates in studies are highly variable, demonstrating a lack of robustness (Cipollina and Salvatici 2010; Ghosh and Yamarik 2004; Head and Mayer 2014). Several studies talked about trade diversion, i.e., when two countries gain from their bilateral trade agreement, third country will be affected negatively due to losing market share in member countries. For example, some authors find that RTAs generate large trade flows between members, albeit often at the expense of third countries (e.g., Caliendo and Parro 2015; Egger and Larch 2011; Egger and Wamser 2013; Fugazza and Nicita 2013; Grant and Lambert 2008). The impact of RTAs on trade flows tends to be lower than often expected due to large number of goods subject to low duties (Carpenter and Lendle 2011).

On the other hand, many recent studies (e.g., Felbermayr et al. 2015; Larch and Yotov 2016) found that trade creation effect can be significantly higher than the trade diversion effect and even trade diversion effect can be controlled through taking some potential steps for third countries when two countries sign a trade agreement. Larch and Yotov (2016) argued that the trade creation and trade diversion effects are first- and second-order GE effects, respectively; hence, trade creation effect is higher than trade diversion effect. In my paper, I use two regional trade agreements to show that the welfare effect of RTAs is higher than the risk they have.

The role of WTO (World Trade Organization) in economic integration has been questioned since it came into force. Several studies (e.g., Rose 2004; Subramanian and Wei 2007) found that the WTO promotes trade strongly but unevenly. The WTO provides asymmetric treatment effects to different trade flows. More developed countries are gaining more; on the other hand, less developed countries are on the losing side. Taking this limitation of WTOs into account, and in a bid to pave the path of trade among member countries, SAARC (South Asian Association for Regional Cooperation) member (Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka) countries formed their own RTA (SAFTA—South Asian Free Trade Area) in 2006 and ASEAN (Association of Southeast Asian Nation) member (Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore and Thailand, Cambodia, Laos, Myanmar, and Viet Nam) countries established AFTA (ASEAN Free Trade Area) in 1992 to boost trade among the member countries of these two Asian associations.[1]

SAPTA (SAARC Preferential Trade Agreement) was the first step to transition to a TLP (Trade Liberalization Program) among SAARC member countries. By recognizing that it is necessary to progress beyond a Preferential Trading Arrangement to move toward higher levels of trade and economic cooperation in the region by removing barriers (tariff, para-tariff, and non-tariff measures) to cross-border flow of good, in 1995, the Sixteenth session of the Council of Ministers (New Delhi, December 18–19, 1995) agreed on the need to strive for the realization of SAFTA. The SAFTA Agreement was signed on January 6, 2004, during Twelfth SAARC Summit held in Islamabad, Pakistan. The agreement entered into force on January 1, 2006, and the Trade Liberalization Program commenced from July 1, 2006.

There are very few studies which use empirical approach to evaluate the welfare effects of SAFTA. Sengupta and Banik (1997), Srinivasan and Canonero (1995) predict that SAFTA will have significant welfare effect on other member countries but very small impact on India. This prediction supports my GE equilibrium counterfactual welfare effect of SAFTA. Kemal (2004) conclude that the SAFTA has the possibility of providing long-run benefits at the expense of short-term costs and there exist great potential for free trade among the SAARC member countries. Using natural trading partner hypothesis, Pitigala (2005) argued that SAFTA can influence the trade flows among member countries positively. Hirantha (2003) use gravity model with panel trade data from 1996 to 2002 for SAPTA to find out the ex-ante welfare effect of SAFTA. For SAPTA, he found that SAPTA has significant trade creation effect on member countries; on the

[1] As Myanmar is not included in the 2012 observed data, I will avoid Myanmar in the counterfactual analysis.

other hand, trade diversion effect is negligible. Hence, this supports the proposition that further trade integration (SAPTA toward SAFTA) may bring significant welfare gains for member countries. Raihan (2012) argued that there is trade creation effect among member countries but infrastructure development could do more than trade liberalization.

The ASEAN heads of the government and state decided to sign a trade agreement (ASEAN Free Trade Area—AFTA) in 1992 to increase the ASEAN region's competitive advantage as a production base geared toward the world market. AFTA was formed in 1993 by Brunei Darussalam, Indonesia, Malaysia, the Philippines, Singapore, and Thailand, and in the second half of the 1990s it expanded to incorporate Vietnam, Laos, Myanmar, and Cambodia. The main step was the liberalization of trade among member countries through the elimination of tariff and non-tariff barriers. In addition, economic integration of ASEAN gives consumers wider choice and better quality consumer products. The trade liberalization under AFTA is a Common Effective Preferential Tariff scheme, which has been in force since January 1993. The Common Effective Preferential Tariff (CEPT) Agreement for AFTA requires that tariff rates levied on a wide range of products traded within the region are reduced to 0–5% (ASEAN website). The tariff reduction consisted of a schedule, to be implemented progressively until 2008. Quantitative restrictions and other non-tariff barriers are to be eliminated.

Using gravity model, Okabe and Urata (2013) find that AFTA has a significant and positive effect on the member countries through tariff elimination for a wide range of products. David (2008) finds significant positive welfare effect of AFTA among member countries using gravity model with PQML (Poisson quasi-maximum likelihood) estimator. On the other hand, the welfare effect Baldwin (2006) finds is very low.

Previously, it seems, no study finds out the general equilibrium comparative (including partial effect, conditional GE effect, and full GE effect) analysis of SAFTA and AFTA, which is one of the most important features of structural gravity model to find out the potential effect of RTAs. As well as, this paper is the first, which find out potential ex-ante welfare effect of joint SAFTA and AFTA as still, discussion on forming several RTAs among the member countries of these two RTAs are on the table, e.g., BIMSTEC[2] (Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation). Accounting for endogeneity of partial RTA estimate and using GEPPML estimator of Anderson et al. (2015), I find that the trade creation effect of SAFTA and AFTA among member countries is positive and significant; on the other hand, the trade diversion effect on non-members is negligible. The joint agreement of SAFTA and AFTA will bring more welfare for small economy countries of these two regional trade agreements.

2 Some challenges to the identification strategy

Assuming RTAs as exogenous, from the introduction of gravity equation until 90 s, several studies try to measure the effects of regional trade agreements (e.g., free trade agreement and customs union) on the bilateral trade flows or welfare gains. Most of them either found very little positive effect or negative effect on trade. Trefler (1993)

[2] BIMSTEC member countries (Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka, and Thailand) formed Trade Negotiation Committee (TNC) in September 2004 to establish the BIMSTEC Free Trade Area. But, still it is an ongoing process.

addressed systematically the simultaneous determination of US multilateral imports and US multilateral non-tariff barriers in a cross-industry analysis. Trefler found that, after accounting for the endogeneity of trade policies, the effect of policies on US imports increased tenfold. Hence, the study on bilateral international trade flows and bilateral RTAs is subject to the same critique that RTAs are not exogenous.

A regressor is endogenous when it is correlated with error term. Endogeneity of an explanatory variable leads to the inconsistent estimate of coefficients. As illustrated in (Wooldridge 2002), potential sources of endogeneity are measurement error, omitted variable bias, and reverse causality, i.e., simultaneity bias. Baier and Bergstrand (2002) are the first who addressed the endogeneity of RTA dummies systematically. They have argued that RTA coefficients have been underestimated due to ignoring the endogeneity of RTA variable and also showed the theoretical evidence that measurement error, omitted variable bias, and simultaneity bias altogether can be responsible for endogenous RTA variable.

A regressor of a regression model can be endogenous due to its correlation with error term, which arises from measurement errors. For example, missing observations in the bilateral trade flows that are wrongly recorded as zero (i.e., measurement errors) may also lead to inconsistent estimator of regressors as this measurement error is more likely to be correlated with small countries (small economy of a country), i.e., the measurement error will depend on the covariates (Santos Silva and Tenreyro 2006).

Some unobservable policy-related barriers that are omitted from the gravity model but correlated with RTA variable and also with decision to trade can be mixed with error term and can be resulted in inconsistent result. A country decides to sign a regional trade agreement on the basis of economic welfare of consumers, political consideration, or both. Initially, it was assumed that regional trade agreement is to reduce or remove tariff barrier to ease the bilateral trade. But RTAs can directly affect the tariff and other policy-related barriers and they may also change the private incentive to reduce the other kinds of trade costs, e.g., by improving harbor facilities (Felbermayr et al. 2015).

In addition, RTAs don't only reduce the tariffs and identifiable non-tariff barriers; they also reduce the cost of overcoming geographical or cultural distance. Unobserved non-tariff barriers lower the trade between two countries. Two countries are more likely to form a RTA since there is a large potential of the welfare gain from bilateral trade agreement and the RTA also broadens liberalization beyond tariff or identifiable non-tariff barriers. Hence, unobservable policy or non-policy-related barriers can be positively correlated with the probability of forming an RTA; hence, those omitted variables can produce inconsistent result by mixing with error term (Baier and Bergstrand 2007).

Another source of concern is the potential reverse causality of RTAs to bilateral trade, i.e., whether a system of simultaneous equations is treating bilateral trade and RTAs as endogenous. For example, when a typical gravity equation with explanatory variables (GDPs, distance, adjacent, language) predicts bilateral trade between any two countries (say, the USA and China) less than the observed trade between them, i.e., trading more than their "natural level" as predicted in gravity equation. This may create political pressures to avoid trade liberalization or possibly raise trade barriers. This may cause a negative simultaneity bias in the RTA coefficient estimate. On the other hand, the governments of two countries might be induced to form an RTA, because there might

potentially be less "trade diversion"[3] due to their extensive trading relationship, suggesting a positive simultaneity bias (Baier and Bergstrand 2007).

To account for endogeneity and NTMs, I follow the top-down approach used by Felbermayr et al. (2015) to evaluate the potential welfare effect of TTIP using 2012 data. They use past estimate of RTAs (from Egger et al. 2011, which accounts for potential endogeneity of RTAs) in the baseline trade cost function. Felbermayr et al. (2015) argue that the approach they use doesn't underestimate or overestimate the effect of RTAs. I also use 2012 data and constrain RTA coefficient (from Egger et al. 2011) in the partial estimate of trade cost function to analyze the conditional and full endowment GE effect of the SAFTA and AFTA; hence, I can argue that my approach doesn't under- or overestimate the effects of my targeted RTAs.[4]

The targeted RTAs are SAFTA and AFTA. As SAFTA and AFTA have been in operation already among the member countries of that Asian region, my counterfactual RTA will be the absence of these two regional trade agreements using gravity model, i.e., what would have happened to the bilateral trade or GDP of the respective countries and the bilateral trade or GDP of the rest countries of the world in the absence of SAFTA and AFTA. Other potential counterfactual analysis is to find out the (ex-ante) welfare effect of a joint agreement between SAFTA and AFTA.

In this paper, I use real GDP as a measure of welfare effect of RTAs on the member and non-member countries. Interested researchers can take other potential measures into consideration such as real GDP per capita and GDP growth to evaluate the welfare effect of an RTA. For example, Felbermayr et al. (2015) find that TTIP increases real GDP per capita by 3.9% in the EU and 4.9% in the USA using same observed data (2012).

The rest of the paper is organized as follows: In the third section of my paper, I discuss several studies, which study the effects of regional trade agreements using traditional and structural gravity equation since 1962. Fourth section includes the discussion about data. Fifth section discusses the identification strategy of my analysis. In the sixth section, I discuss the results of ex-post and ex-ante welfare analysis of two Asian regional trade agreements and possible join agreement of these two trade agreements, respectively. In the seventh section, I do a comparative discussion on my three counterfactual analyses. In the last section, I draw the conclusion of my result.

3 Study review

Trade agreements—to ease or remove the tariff or non-tariff barrier to international bilateral trade—have been in operation since 1947 (when GATT—General Agreements of Tariff and Trade—was signed by 23 nations) in the name of international trade organization or in the name of regional trade agreements. For the past 50 years, the gravity equation has been applied to evaluate the effects of trade cost variables including regional trade agreements. Ravenstein (1889) was the first to introduce the application of Newton's Law of Gravitation to economics by using gravity equation to study the immigration. Tinbergen (1962), who first applied the gravity equation to trade flows,

[3] Extensive trade between two countries can indirectly affect other partner of these two countries due to preference erosion.

[4] Interested readers can have a look in the Felbermayr et al. (2015) for the detail explanation and validity of the top-down approach.

found mix effect of the RTA coefficients in the bilateral trade flows. For example, Tinbergen found significant effect of the British Commonwealth membership in trade flows but an insignificant of Benelux RTA. Abrams (1980), Aitken (1973), and Brada and Mendez (1985) found the EC (European Community) to have an economically and statistically significant effect on trade flows among members, whereas Bergstrand (1985), Frankel et al. (1995) found insignificant effects. So far, those studies assumed RTA variable as exogenous and overall all studies found either little or no effect of RTAs. Frankel (1997) argued that if four years (1970, 1980, 1990, and 1992) data are pooled together, the effect of European Community is 16%. Accounting for endogeneity and using instrumental variable approach (for instance, remoteness of partners of a respective RTA as an instrument), they found that the effect of RTAs on trade is quadrupled. They found systematically, the effect of RTAs on trade flows has been underestimated by 75%. On average, when ignoring the endogeneity, RTAs increase the trade flows by about 23%. On the other hand, accounting for endogeneity of RTAs increase the trade flows by about 92%.

Magee (2003) used panel data and found the effects of RTA is 45% when using OLS, by contrast, the effect ranging from 300 to 800% when they account for endogeneity of RTA variable. However, these estimates do not account for fixed country effects in both the outcome equation for trade values and the RTA equation.

Baier and Bergstrand (2004) were the first to calculate the determinants of RTAs using econometric model based upon a general equilibrium model of world trade with two factors of production, two monopolistically competitive product markets, and explicit intercontinental and intra-continental transportation costs among multiple countries on multiple continents.

Baier and Bergstrand (2007) argued that standard cross-sectional techniques using instrumental variables and control functions do not provide stable ATE (average treatment effect) of RTAs. When they use panel data approach constructing panel data (for every five years) from 1960 to 2000 of the bilateral trade flows, bilateral trade agreements, and standard gravity equation covariates among 92 potential partners approach, the unbiased ATEs of RTAs ranging from 0.61 to 0.76, which is five to six times more when ignoring endogeneity. For instance, an RTA increase the trade between two members by about 100% (i.e., $e^{0.685} = 1.98$) after 10 years. Using same specification like Baier and Bergstrand (2007), Anderson and Yotov (2011) found similar result (but they use a Poisson quasi-maximum likelihood (PQML) estimator).

Extending the methodology established in Baier and Bergstrand (2007), Hummels and Klenow (2005), Baier and Bergstrand (2009) provided the first evidence using gravity equations of both the intensive and extensive (goods) margins being affected by regional trade agreements employing a panel data set with a large number of country pairs, product categories, and RTAs from 1962 to 2000. They found the long-run effect of RTAs on bilateral trade flows is about 100%; however, the effect differs substantially across trade agreements.

Egger et al. (2011) used structural gravity model to evaluate the role of regional trade agreements which is consistent with general equilibrium. Using two-part Poisson maximum likelihood estimation, which accounts for the potential endogeneity as well as zero trade flows, they found an average treatment effect of RTAs on bilateral trade flows of 236%.

Table 1 Summary statistics

	Mean	SD	Min	Max
Trade flow (mn, USD)	545.44	5862.42	0.00	444,407.20
Rta, dummy (0,1)	0.17	0.38	0.00	1.00
Distance, LnDIST	8.76	0.82	0.63	9.89
Contiguity, dummy (0,1)	0.02	0.13	0.00	1.00
Common language, dummy (0,1)	0.15	0.35	0.00	1.00
Common colony, dummy (0,1)	0.10	0.30	0.00	1.00
R^2	0.89			

Total numbers of countries are 173 and observations are 29,756. RTA dummy takes 1 if two countries are related by a trade agreement

4 Data

Although it is a good idea to use panel data to observe the welfare changes over time, this is tiresome using panel data for a large cross section of countries due to data-constraints and computational difficulties prompting from the high number of fixed effects. Hence, like Felbermayr et al. (2015) I use same cross-sectional data where trade data come from UN Comtrade and refer to the year 2012. All other variables come from CEPII.[5] The data contain all RTAs (notified to the WTO) that are active since 2012 and earlier. In total, data covers about 300 agreements. Table 1[6] represents the summary statistics. Total numbers of bilateral trade flows are 29,756, and 17% of them are affected by RTA. The mean value of bilateral trade flow is 545 million US dollars. Standard deviation shows the high variation in bilateral trade flows of the world. The base model can explain the variation in observed bilateral trade flows by 89%.

In the baseline gravity equation, trade cost variables are distance, colony, contiguity, and RTA. Distance is bilateral weighted distance between export and import countries, contiguity is a dummy variable whether two countries have same border or not, and RTA is also a dummy variable, i.e., whether two bilateral trade partners have any regional trade agreement.

5 Methods

This section discusses the three-step estimation procedure from Anderson et al. (2015) to estimate general equilibrium effects of trade policy using PPML estimator, which is the pivotal approach of my paper to estimate the welfare effect of two regional trade agreements- SAFTA and AFTA.

Step 1: Baseline gravity and GE The first structural gravity equation is derived by Anderson (1979) under the assumptions (Armington 1969) of identical constant elasticity of substitution preferences across countries for national varieties by place of origin:

$$X_{ij} = \left(\frac{t_{ij}}{\pi_{iP_j}}\right)^{1-\sigma} Y_i E_j \tag{1}$$

[5] http://www.cepii.fr/CEPII/en/welcome.asp.

[6] Other calculation tables are provided in "Appendix."

where

$$\prod_{i}^{1-\sigma} = \sum_{j} \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} E_j \tag{2}$$

and

$$P_j^{1-\sigma} = \sum_{i} \left(\frac{t_{ij}}{\pi_i}\right)^{1-\sigma} Y_i \tag{3}$$

where X_{ij} is the bilateral trade flows between two countries, E_j is the expenditure at destination j from all origins and Y_i denotes the sales at destination prices from i to all destinations. t_{ij} is the bilateral trade cost on shipping goods from country i to j, and σ is the elasticity of substitution across verities of goods. Following the suggestions of Feenstra (2004) and Santos Silva and Tenreyro (2006), many studies use the following version of gravity model including exporter importer fixed effects to estimate the structural gravity model using PPML estimator:

$$X_{ij} = \exp\left(t_{ij}\beta + \pi_i + \chi_j\right) + \varepsilon_{ij} \tag{4}$$

where t_{ij} is the vector of trade cost variables (distance, language, colony, and so on), β is the vector of coefficients, π_i is an exporter fixed effect that accounts for outward multilateral resistances (OMR) and outputs, χ_j is the importer fixed effects that account for inward multilateral resistance (IMR) term and expenditure, and ε_{ij} is the disturbance or error term. Trade cost vector t_{ij} can be denoted as

$$t_{ij} = \exp\left(\beta_1 \log \mathrm{DIST}_{ij} + \beta_2 \mathrm{BORD}_{ij} + \beta_3 \mathrm{COMLANG}_{ij} + \cdots + \delta\ \mathrm{RTA}_{ij}\right) \tag{5}$$

So, we can use several trade cost variables through this bilateral trade cost function. I proxy bilateral trade cost (t_{ij}) by bilateral distance between countries, border, common language, and regional trade agreement. One can use more proxies for bilateral trade cost, if those proxies have effect on trade. The dummy variables are same border and common language between exporting and importing countries, i.e., whether country i and j share the same border or not and whether they have common language or not.

Anderson and Yotov (2008) argued that the OMR could be seen as a case in which each province i shipped its product to a single world market facing supply side incidence of trade costs of π_i and the IMR, while each province j bought its goods from a single world market facing demand side incidence of χ_j. Several studies (e.g., Anderson and van Wincoop 2003 and Anderson et al. 2015) refer to the CES price indices of the demand and supply system as multilateral resistances variables as they depend on all bilateral resistances. A rise in trade barriers with all trading partners will raise the index. Empirically the estimation of MRT is unobservable. Several studies (e.g., Anderson et al. 2015; Mélitz 2007; Rose and van Wincoop 2001) used an approach to proxy the multilateral terms by country-specific fixed effects. The multilateral trade resistance terms are therefore replaced by a vector of N country-specific indicator variables and π_i and χ_j, i.e., exporter and importer fixed effects, each taking the value of 1 for trade flows between i and j and zero otherwise.

Following Anderson et al. (2015) as well as recommendation from Santos Silva and Tenreyro (2006), I use PPML estimator to estimate the baseline gravity estimates when I constrain RTA coefficient form Egger et al. (2011) in my benchmark scenario.

To solve Eqs. (2) and (3) for multilateral resistances, as multilateral resistance is a conditional general equilibrium idea and note also that solutions for Π_i and P_j are up to scalar, if $\{\Pi_i^0, P_j^0\}$ is a solution then so is $\lambda\{\Pi_i^0, P_j^0/\lambda\}$. To avoid perfect co-linearity, I drop one importer fixed effect and constant. They normalized this importer fixed effect to obtain unique solution of Eqs. (2) and (3). The corresponding multilateral resistance to the dropped importer fixed effect is $\widehat{P_0} = 1$ and although theoretically the importer fixed effect $\widehat{\chi_0} = E_0$, as it is dropped $\widehat{\chi_0} = 0$. This way, we can recover the OMRs and IMRs from the fixed effects as follows:

$$\widehat{\prod_i^{1-\sigma}} = E_0 Y_i \exp\left(\widehat{-\pi_i}\right) \tag{6}$$

$$\widehat{P_j^{1-\sigma}} = E_j/E_0 \exp\left(\widehat{-\chi_j}\right) \tag{7}$$

In my baseline analysis, the other approach is to construct baseline GE (general equilibrium) indexes using the estimates of the fixed effects from baseline gravity equation with data on outputs and expenditures to construct the multilateral resistances on the basis of (6) and (7), where, by construction, $Y_i = \sum_j X_{ij}$ and $E_j = \sum_i X_{ij}$.

Step 2: Conditional Gravity and GE Indexes This step allows the changes in IMRs and OMRs keeping the changes in outputs and expenditures unchanged. This step is to find out the changes in welfare due to changes in trade policy when everything else remains same and this is the intuition behind to call it conditional approach. We can use conditional gravity approach to measure the counterfactual effect of trade policy variable, as, for example, RTA variable can be amended to banish an existing agreement or to add a new one. In my evaluation, I want to measure the counterfactual effect of SAFTA and AFTA. Already the SAFTA and AFTA exist in the baseline RTA variable of the 2012 data. So, my counterfactual approach is to measure the welfare effect of the SAFTA and AFTA if they don't exist. Other counterfactual analysis will be the effect of the joint agreement of SAFTA and AFTA. In this case, I just include new counterfactual RTA variable instead of baseline RTA in trade cost function of Eq. (4) and create new exporter and importer fixed effects keeping output and expenditure same. I use PPML approach to estimate the coefficients.

$$X_{ij} = \exp\left(t_{ij}^c + \pi_i^c + \chi_j^c\right) + \varepsilon_{ij}^c \tag{8}$$

where, t_{ij}^c is the trade cost vector of counterfactual trade policy covariates. The other approach of conditional scenario is using the new estimated fixed effects from the counterfactual analysis of gravity estimation with the original data on outputs and expenditure to construct the "conditional" GE estimates of the multilateral resistances and any other GE indexes of interest. The obtained GE indexes from this estimation, we can compare with the baseline GE indexes, i.e., the percentage change in welfare in the counterfactual scenario (e.g., when SAFTA does not exist) compared to baseline (e.g., when

SAFTA is in the scene). This way, we can observe the changes in real GDP, export or import and multilateral resistances, i.e., IMRs and OMRs. The percentage changes in welfare in the "conditional" GE scenario relative to GDP:

$$\widehat{W_i} = \frac{Y_i^c/\widehat{P_i^c}}{Y_i/\widehat{P_i}} = \widehat{P_i}/\widehat{P_i^c} \tag{9}$$

Output is kept exogenous in "conditional" scenario, i.e., $Y_i^c = Y_i$.

Step 3: Full Endowment Gravity and GE Indexes This step allows the changes in IMRs and OMRs as well as changes in outputs and expenditures. Full endowment economy, where trade imbalance ratios $\Phi_i = E_i/Y_i$ (E_i is expenditure and Y_i is output or income in country i), is assumed to stay constant in the counterfactual for each country i. Full endowment gravity takes the changes in expenditure and income of countries with the changes in multilateral resistances into account. The changes in output, expenditure, and the multilateral resistances, however, are controlled for by the fixed effects in gravity estimations and cannot be accounted for explicitly. Therefore, following Anderson et al. (2015), I use the structural gravity Eq. (1) to translate the changes in output and expenditure, triggered by the changes in factory-gate prices, into changes in trade flows:

$$X_{ij}^c = \frac{\left(t_{ij}^{1-\sigma}\right)^c}{t_{ij}^{1-\sigma}} \frac{Y_i^c E_i^c}{Y_i E_i} \frac{\Pi_i^{1-\sigma} P_j^{1-\sigma}}{(\Pi_i^{1-\sigma})^c (P_j^{1-\sigma})^c} X_{ij} \tag{10}$$

Equation (10) accounts that a change in the factory-gate price will lead to changes in trade via changes in output and OMRs on the exporter side and changes in expenditure and IMRs on the importer side. Note also that the changes in trade implied by Eq. (10) are not the full endowment GE changes. The reason is that this only reflects the conditional OMR changes, which do not take into account the response of output and expenditures.

Repeat Step 2 with the new values for trade. The idea is that, using the new values of trade, the PPML estimator will translate the initial response of factory-gate prices into changes in the gravity fixed effects, which (in combination with the changes in trade) can be used to obtain additional responses in the MR terms. Repeat Step 3 to obtain a new set of factory-gate prices and new values of trade, income, and expenditures. Then re-estimate the model. Iterate until convergence, i.e., until the change in each of the factory-gate prices is close to zero.

The full endowment GE indexes are constructed using new set of factory-gate prices, new trade values, new expenditure, and output to estimate the counterfactual real GDP and MR terms. The percentage changes in these counterfactual indexes compared to the baseline GE indexes measure the effect of my respective trade policy.

6 Results

6.1 Estimation of baseline gravity and indexes

Anderson et al. (2015) prefer PPML estimator to estimate the baseline trade costs elasticities "β" to evaluate the conditional and full GE effect of the removal of international borders, which is constrained in the conditional and full general equilibrium stages.

Table 2 Estimated values of trade cost functions

Independent Var	Baseline	OLS	HM	Benchmark
RTA	0.30 (0.07)	0.55 (0.05)	0.36 –	1.21 –
Distance	−0.73 (0.04)	−1.56 (0.03)	−0.71 (0.03)	−0.50 (0.03)
Border	0.35 (0.07)	0.63 (0.12)	0.34 (0.07)	0.20 (0.08)
Language	0.22 (0.07)	0.73 (0.06)	0.22 (0.07)	0.19 (0.08)
Colony	0.45 (0.15)	1.05 (0.07)	0.47 (0.15)	0.71 (0.17)

Number of countries $C = 173$ and number of observations $N = 29{,}756$. Baseline is the estimation of trade cost matrix with PPML in the preliminary step. OLS is the estimation of trade cost matrix with log-linear estimation in the preliminary step. In the rest two columns, I constrain estimated value of RTA coefficient from Head and Mayer (2014) and Egger et al. (2011) when estimating the partial effect of trade cost function using 2012 data. Values in round brackets are standard error. All partial estimates I have estimated are highly significant at 1% level of significance

However, they also argue that any estimator can be used to estimate the baseline trade cost elasticities "β" even it can be taken from the studies, which routinely estimated the gravity equation. In the baseline specification,[7] Like Anderson et al. (2015), I also use PPML estimator to estimate the baseline trade cost coefficients. This paper calculates the general equilibrium impact of two specific RTAs.

In order to consider potential endogeneity, I borrow an estimated RTA coefficient from Egger et al. (2011), which is accountable for the potential endogeneity and as well as suitable option (top-down approach)[8] to make RTAs accountable for NTMs (non-tariff measures). This specification is the benchmark of my analysis. In the benchmark scenario, the trade cost coefficients other than RTAs are estimated using observed 2012 data when constraining RTA for potential endogeneity. This procedure ensures that I fit the model to the 2012 baseline data while accounting for the potential endogeneity of RTAs. Also In addition, to check robustness, I also constrain the estimated RTA coefficients from Head and Mayer (2014) in the preliminary step of the baseline gravity estimation.

Table 2 shows the estimated trade cost coefficients that are used in the preliminary step to evaluate conditional and full GE effect of trade policy variable. The first column shows the partial estimation of trade cost function of 2012 observed data using PPML. The estimated RTA coefficient 0.30 (exp $[0.30] - 1 = 0.35$) refers that regional trade agreement increases the bilateral trade between two countries by around 35%. The second column shows the partial estimate of trade cost coefficients of 2012 data using OLS.[9] The partial estimate of RTA is 0.55. The constrained RTA coefficient of column 4 is 1.21 (from Egger et al. 2011 accounted for potential simultaneous endogeneity) and refers 236% impact of RTAs on bilateral trade flows. Average estimated RTA coefficient using 2012 data is very small compared with Egger et al. (2011) even smaller than the estimated RTA coefficient (0.36) of HM (2014).

[7] All trade cost coefficients are estimated using 2012 observed data.

[8] The top-down approach does not need to specify by how much NTM cost will be reduced but only relies on past observed effect of RTAs.

[9] Following standard study of gravity estimation, I would like to rely on PPML estimator. Hence, in the result section, to evaluate conditional and full GE indexes, I use all specifications of Table 2 except OLS.

According to Anderson et al. (2015), baseline trade cost coefficients can even be borrowed from other studies as is routinely done in the study but Step 1 should be repeated with external parameters imposed as constraints in the PPML estimation.[10]

0.36 is the estimated coefficient of RTAs of the meta-analysis of structural gravity model from Head and Mayer (2014). This is the reason to use the top-down approach like Felbermayr et al. (2015) to estimate the conditional and full GE effect of AFTA and SAFTA. I constrain the all estimated coefficients from baseline gravity in the conditional and full general equilibrium steps with counterfactual trade policy variable, i.e., changes are made to RTA variable and multilateral resistance terms.

6.2 Conditional and full GE effect of AFTA

The conditional gravity regression model after removing AFTA from RTA variable can be written as:

$$\begin{aligned} X_{ij} = \exp\big(&- 0.50 \ln \mathrm{DIST}_{ij} + 0.20\,\mathrm{CONTG}_{ij} + 0.19\,\mathrm{LANG}_{ij} \\ &+ 0.71\,\mathrm{COMCOL} + 1.21\,\mathrm{RTA\_c\_AFTA} + \pi_i^c + \chi_j^c\big) + \varepsilon_{ij}^c \end{aligned} \tag{11}$$

So in conditional, all estimates are constrained to baseline estimates and changes are made to respective trade policy variable and multilateral resistance terms. One important thing to be mentioned here is, to obtain conditional GE indexes, expenditures and outputs have to be remained constant in this step.

In Table 3, I include neighboring countries of AFTA to see the trade diversion effect of AFTA on its neighboring countries (e.g., Bangladesh, India, and Pakistan) and as well as some bigger economy countries, which are distant countries (e.g., France, Germany, USA, and UK) from Asian region to observe the trade diversion effect of AFTA. The removal of AFTA from RTA variable has a significant negative impact on member countries' real GDP.

From the scenario of my benchmark index, if AFTA was not in the scene, it would cause 1.74% loss in real GDP of the AFTA member countries. The estimated lower RTA coefficients from HM and Egger show lower negative effect of the removal of AFTA on the member countries.

The top three losers are Cambodia, Malaysia, and Brunei Darussalam due to the removal of AFTA from RTA variable. Brunei Darussalam would loss 2.36 (462 mn USD) percent, which is the highest percentage loss among member countries. In all three specifications, all AFTA member countries would lose significant amount of real GDP when AFTA was not in the scene.

Trade diversion effect due to AFTA is not very systematic for bigger economy and distant countries like Germany, UK, and USA. For example, USA itself is a bigger market and also it has bigger market in Europe; hence, AFTA among Southeast Asian countries would not affect USA economy systematically. But, neighboring countries of AFTA

[10] As a alternative way of evaluating benchmark indexes, following Anderson et al. (2015), I borrowed all the baseline trade cost estimates from Felbermayr et al. (2015) as they use same data and identification strategy, i.e., constrain RTA coefficient from Egger et al. (2011), and I show the result in the appendix section as alternative way of evaluating the benchmark indexes of my paper. There is no significant difference in result in comparison to main identification strategy of my paper when I borrowed all baseline trade cost coefficient from Felbermayr et al. (2015) rather than constraining only RTA coefficient (main identification strategy) from Egger et al. (2011).

Table 3 Conditional GE of AFTA, measures from the changes in real GDP. *Source* Authors' calculations

Country	Baseline	HM	Benchmark
Brunei Darussalam	−1.13	−1.33	−2.36
Cambodia	−1.18	−1.38	−2.48
Indonesia	−0.51	−0.60	−1.04
Lao PDR	−0.92	−1.08	−2.02
Malaysia	−1.26	−1.46	−2.18
Philippines	−0.47	−0.55	−1.02
Singapore	−0.80	−0.97	−1.99
Thailand	−0.58	−0.68	−1.22
Vietnam	−0.66	−0.76	−1.31
AFTA average	−0.84	−0.98	−1.74
Bangladesh	0.02	0.03	0.06
Bhutan	0.01	0.00	0.00
China	0.01	0.02	0.08
Canada	−0.01	−0.01	0.00
France	−0.01	−0.01	0.00
Germany	−0.01	−0.01	0.00
India	0.02	0.02	0.07
Japan	0.00	0.00	0.06
Maldives	0.02	0.02	0.02
Nepal	0.00	0.00	0.00
Pakistan	0.00	0.01	0.03
Sri Lanka	0.04	0.04	0.08
UK	−0.01	−0.01	0.00
USA	0.00	−0.01	0.00
Third country average	0.00	0.00	0.01
World average	−0.04	−0.05	−0.08

All zeros in this table are not zero, rather very small, due to taking numbers till 2 decimal points

face systematic trade diversion effect due to AFTA. For example, Bangladesh, China, and India gain when AFTA is removed from RTA variable. The effect is not very big due to having individual trade agreement between some non-AFTA Asian countries and some AFTA member countries. For example, Lao PDR and Malaysia have RTA with Bangladesh, India, and Sri Lanka. Hypothetically, if AFTA didn't exist third countries would gain due to trade diversion. But the trade diversion effect is negligible when SAFTA is removed. In the benchmark, AFTA has a negligible positive impact on the welfare of the third countries. On average, world losses 0.08[11] percent, which is higher compared with other two specifications.

Following Eq. (11), we can evaluate the full endowment effect of AFTA by opening the option of the changes in outputs and expenditures with multilateral resistances. Table 4

[11] The average welfare gains of the world, the member countries, and the non-member countries are not based on their total real GDP; rather, it is average of all countries' real GDP gains (in percentage point) of the respective group in all calculation's tables. For example, AFTA member countries would loss 1.39% of their real GDP if the calculation is based on the total real GDP (293195.4 mn USD) of them. But to get the average treatment of an RTA on the member and non-member countries as countries' baseline real GDPs are different and I emphasize on every member's welfare gain, I take average of percentage losses of 9 AFTA member countries. Hence in conditional, the average real GDP loss of AFTA member countries is 1.74% after the removal of AFTA.

Table 4 Full GE effect of AFTA, measures from the changes in real GDP. *Source* Authors' calculations

Country	Baseline	HM	Benchmark
Brunei Darussalam	−2.03	−2.37	−4.18
Cambodia	−2.10	−2.46	−4.40
Indonesia	−0.93	−1.09	−1.85
Lao PDR	−1.65	−1.93	−3.57
Malaysia	−2.25	−2.61	−3.86
Philippines	−0.83	−0.98	−1.80
Singapore	−1.49	−1.79	−3.55
Thailand	−1.04	−1.23	−2.16
Vietnam	−1.16	−1.36	−2.31
AFTA average	−1.50	−1.76	−3.08
Bangladesh	0.05	0.06	0.09
Bhutan	0.03	0.03	0.01
China	0.04	0.05	0.11
Canada	0.00	0.00	0.00
France	0.00	−0.01	0.00
Germany	0.00	0.01	0.00
India	0.05	0.06	0.11
Japan	0.02	0.03	0.09
Maldives	0.05	0.05	0.03
Nepal	0.00	0.03	0.01
Pakistan	0.00	0.03	0.06
Sri Lanka	0.07	0.08	0.12
UK	0.01	0.01	0.00
USA	0.01	0.01	0.00
Third country average	0.02	0.02	0.02
World average	−0.06	−0.07	−0.14

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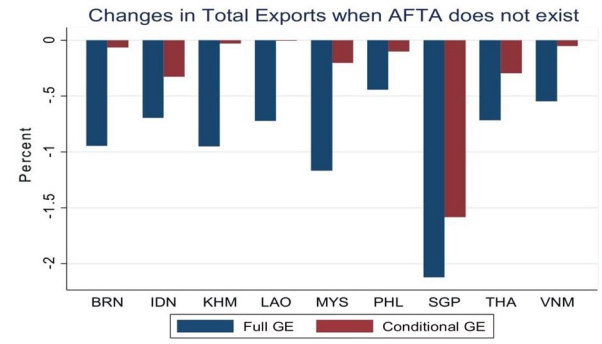
represents the full endowment general equilibrium impact of AFTA if AFTA doesn't exist in the Southeast Asian region. The effect in case of full endowment is higher compared with conditional GE. In the benchmark scenario, on average, AFTA member countries would loss 3.08% real GDP if AFTA was not in the scene. Estimated RTA coefficient using 2012 observed data and other one from HM produce lower welfare losses.

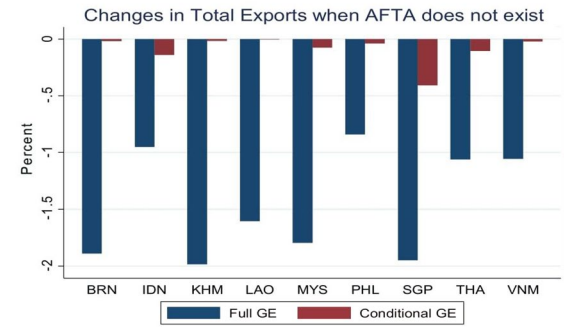
In the benchmark scenario, on average, third countries gain 0.02% and world losses 0.14%. The trade diversion effect is higher on third countries compared with conditional GE scenario.

Figure 1 represents the conditional and full GE impact of the removal of AFTA from RTA variable on the member countries in the baseline scenario. The figure represents that AFTA member countries would lose significant amount of export if AFTA was not signed. The amount of losses is the highest for Singapore in both form of general equilibrium effect and the amount of losses is around 2.5 and 1.5%. Other member countries lost export in small extent in the conditional GE, but the amount of losses is also significantly higher in the full GE scenario.

Figure 2 represents the conditional and full GE impact of the removal of AFTA from RTA variable on the member countries when estimated RTA coefficient is accounted for simultaneous endogeneity. In this scenario, Singapore losses around 1.9 and 0.5% export



Baseline



Benchmark

Figs. 1 and 2 Conditional and full GE impact of AFTA on member countries' export (baseline and benchmark)

in the conditional and full GE, respectively. The losses of other countries are significantly lower in the conditional GE in comparison to full GE. If we compare both figures, the magnitude of losses is higher, when I use external estimated RTA coefficient, compared with baseline scenario. Hence, the RTA coefficient, accounts for endogeneity, is producing more welfare effects of RTAs.

6.3 Conditional and full GE effect of SAFTA

The conditional gravity regression model (e.g., benchmark) after removing SAFTA from RTA variable can be written as:

$$X_{ij} = \exp\big(-0.50\ \ln \mathrm{DIST}_{ij} + 0.20\ \mathrm{CONTG}_{ij} + 0.19\ \mathrm{LANG}_{ij} + 0.71\ \mathrm{COMCOL} + 1.21\ \mathrm{RTA\_c\_SAFTA} + \pi_i^c + \chi_j^c\big) + \varepsilon_{ij}^c \tag{12}$$

Table 5 represents the conditional GE impact of the removal of SAFTA from RTA variable. The conditional GE effect of SAFTA on the member countries is really high. From the benchmark scenario, on average, SAFTA member countries would loss 3.63 percentage point of real GDP if SAFTA was not in the scene before 2012. The amount of losses would be 1.08 and 1.30 when I constrain RTA coefficient from HM in the baseline estimation.

The conditional GE effect of SAFTA on the world is around −0.15% and on the third country is around zero in the benchmark specification. The magnitude of the average

Table 5 Conditional GE effect of SAFTA, measures from the changes in real GDP. *Source* Authors' calculations

Country	Baseline	HM	Benchmark
Bangladesh	−1.49	−1.79	−4.29
Bhutan	−1.00	−1.21	−3.54
India	−0.26	−0.32	−0.84
Maldives	−1.10	−1.36	−5.22
Nepal	−1.16	−1.39	−3.86
Pakistan	−1.51	−1.81	−4.24
Sri Lanka	−1.03	−1.24	−3.41
SAFTA average	−1.08	−1.30	−3.63
Brunei Darussalam	0.00	0.01	0.02
Cambodia	0.00	0.00	−0.01
Canada	−0.01	−0.02	−0.03
China	0.00	0.00	0.06
France	−0.01	−0.02	−0.03
Germany	−0.01	−0.02	−0.03
Indonesia	0.00	0.00	0.01
Japan	−0.01	−0.01	−0.03
Lao PDR	0.00	0.00	0.00
Malaysia	0.01	0.01	0.07
Philippines	0.00	0.00	0.00
Singapore	0.00	0.01	0.08
Thailand	0.01	0.01	0.02
UK	−0.01	−0.01	−0.02
USA	−0.01	−0.01	−0.02
Third country average	0.00	−0.01	0.00
World average	−0.05	−0.06	−0.15

All zeros in this table are not zero, rather very small, due to taking numbers till 2 decimal points

negative effect in the conditional scenario on the world is not negligible. Hypothetically, third country would gain from the removal of SAFTA but it's around zero in the benchmark specifications. Effect on third country is also not consistent with hypothetical context in the rest two specifications. This might be, in the SAFTA, most of the country's economy is very small even they don't have a lot of trades with other countries, are away from them or with the bigger economy country (e.g., Germany, UK, and USA). This scenario might be ignoring the trade diversion effect of SAFTA when SAFTA exists or removes. Even most of the SAFTA member countries have also individual trade agreement with other Asian countries. Because of that even trade diversion effect from SAFTA on its neighboring countries is not very severe in the conditional GE.

Individually, almost all of the SAFTA member countries are gaining higher welfare except India. Bangladesh, Bhutan, Maldives, Nepal, Pakistan, and Sri Lanka would lose their real GDP by around 4.29, 3.54, 5.22, 3.86, 4.24, and 3.41%, respectively, if SAFTA was not in action. Although Bangladesh loses the highest monetary value 4937 million USD, the highest loser is Maldives in percentage measure as I rank welfare gains on the basis of percentage gain on baseline real GDP of the respective country. The negative welfare effect of the removal of AFTA on India is still not negligible, which is around one percent. In case of India, it might be, more central states or countries enjoy lower trade cost with other countries even before the creation of

Table 6 Full GE effect of SAFTA, measures from the changes in real GDP. *Source* Authors' calculations

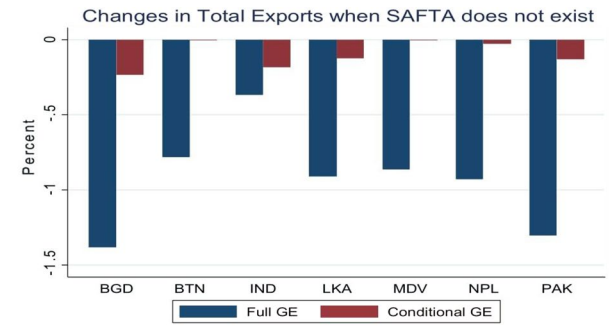
Country	Baseline	HM	Benchmark
Bangladesh	−2.66	−3.17	−7.51
Bhutan	−1.78	−2.14	−6.21
India	−0.46	−0.56	−1.44
Maldives	−1.96	−2.41	−9.14
Nepal	−2.05	−2.46	−6.78
Pakistan	−2.69	−3.20	−7.42
Sri Lanka	−1.82	−2.19	−5.98
SAFTA average	−1.92	−2.30	−6.36
Brunei Darussalam	0.03	0.04	0.08
Cambodia	0.02	0.03	0.04
Canada	0.00	0.00	0.00
China	0.02	0.03	0.14
France	0.00	0.00	0.01
Germany	0.00	0.00	0.01
Indonesia	0.02	0.03	0.06
Japan	0.01	0.01	0.01
Lao PDR	0.03	0.03	0.05
Malaysia	0.04	0.05	0.14
Philippines	0.02	0.03	0.05
Singapore	0.03	0.04	0.16
Thailand	0.03	0.04	0.08
UK	0.01	0.01	0.01
USA	0.01	0.01	0.01
Third country average	0.02	0.02	0.04
World average	−0.06	−0.07	−0.21

All zeros in this table are not zero, rather very small, due to taking numbers till 2 decimal points

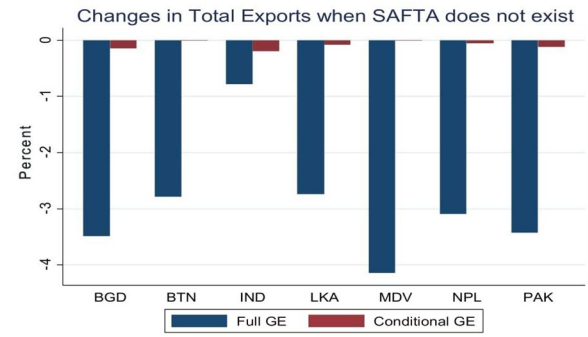
trade agreement (Felbermayr et al. 2015). Economically, India is one of the central countries of the Asia. Even it has individual or group trade agreements with almost all other countries of the Asia; hence, removal of the SAFTA would not bother Indian economy like other member countries of the SAFTA.

Table 6 represents the full GE effects of the removal of SAFTA on the welfare of the member countries and the third countries. The "full endowment" GE impact of SAFTA among member countries is largely negative. Except India, all other member countries would loss almost around 6–10% of their real GDP if the SAFTA was removed. The negative welfare effect of the removal of the SAFTA on SAFTA member countries is almost three times more in my benchmark specification compared with first two columns.

Also, the negative welfare effect in the full GE scenario is almost double compared with conditional GE. On average, world would loss 0.21% of the real GDP if SAFTA was not in the scene. The trade diversion effect of SAFTA is visible in the "full endowment" scenario. On average, third country would gain 0.04% if SAFTA was not signed but still very small. The reason behind that I have explained before. The higher value of my benchmark index shows the validity of the benchmark specification. Like conditional scenario, the trade diversion effects for neighboring countries also not significantly consistent with hypothetical scenario. Cambodia, China, Indonesia, Malaysia, and Singapore would gain very small percentage of welfare index if SAFTA was removed.



Baseline



Benchmark

Figs. 3 and 4 Conditional and full GE impact of SAFTA on member countries' export (baseline and benchmark)

The overall scenario from both counterfactual strategies, the creation of SAFTA brings more welfare compared with the risk of trade diversion effect. One may say trade diversion effect on the third countries is almost negligible. Figures 3 and 4 show the conditional and full GE effects of the removal of SAFTA on the export of its member countries.

Form both figures, we can observe that in the conditional scenario, the negative effect of the removal of the SAFTA on the export of its member countries is very small. On the other hand, in the full endowment scenario where we consider changes in expenditures and outputs, the export of almost all member countries decrease largely except India in the specifications (Baseline and Benchmark). In the baseline specification, except India, all other members would lose their export by around 1 or more than 1%. In the benchmark scenario, the magnitude of losses is even higher, which is around or more than 3% for all other member except India. The magnitude of the losses of India is even not that smaller, which about 1% is. This scenario also supports the validity of my benchmark index, i.e., it recovers the underestimation of partial estimate of RTAs using 2012 observed data.

6.4 Conditional and full GE effect of the joint SAFTA and AFTA

The conditional gravity regression model (e.g., benchmark) after the joint agreement of SAFTA and AFTA from RTA variable can be written as:

$$X_{ij} = \exp\big(-0.50\ \ln \mathrm{DIST}_{ij} + 0.20\ \mathrm{CONTG}_{ij} + 0.19\ \mathrm{LANG}_{ij} + 0.71\ \mathrm{COMCOL} + 1.21\ \mathrm{RTA\_c\_SAFTA\_AFTA} + \pi_i^c + \chi_j^c\big) + \varepsilon_{ij}^c \tag{13}$$

Table 7 Conditional GE effect of SAFTA + AFTA, measures from the changes in real GDP
Source **Authors' calculations**

Country	Baseline	HM	Benchmark
Bangladesh	0.01	0.01	0.02
Bhutan	0.47	0.57	1.76
Brunei Darussalam	0.09	0.11	0.31
Cambodia	0.08	0.09	0.23
India	0.00	0.00	0.00
Indonesia	0.00	0.00	0.02
Lao PDR	0.03	0.04	0.11
Maldives	0.58	0.70	2.08
Malaysia	0.00	0.00	0.02
Nepal	0.43	0.52	1.65
Pakistan	0.01	0.01	0.02
Philippines	0.00	0.00	0.01
Singapore	0.00	0.00	0.01
Sri Lanka	0.01	0.01	0.02
Thailand	0.01	0.01	0.02
Vietnam	0.00	0.01	0.02
AFTA + SAFTA average	0.11	0.13	0.39
Canada	0.00	0.00	0.00
China	0.00	0.00	0.00
France	0.00	0.00	0.00
Germany	0.00	0.00	0.00
Japan	0.00	0.00	0.00
UK	0.00	0.00	0.00
USA	0.00	0.00	0.00
Third country average	0.00	0.00	0.00
World average	0.01	0.01	0.04

All zeros in this table are not zero, rather very small, due to taking numbers till 2 decimal points

Table 7 represents the conditional GE impact of the joint agreement of SAFTA and AFTA. The positive welfare effect of the joint SAFTA and AFTA is almost invisible among member countries except Bhutan, Cambodia, Maldives, and Nepal. Welfare gains of Bhutan, Brunei Darussalam, Cambodia, Maldives, and Nepal are 1.76, 0.31, 0.23, 2.08, and 1.65%, respectively. The average effect of the joint SAFTA and AFTA on member countries is around 0.39 percentage point in the benchmark specification. In the other two specifications, the welfare effect even lower than the magnitude in the benchmark specification. On average, the joint agreement of SAFTA and AFTA would increase the real GDP of the world by around 0.04%, which is almost negligible. The impact on the third countries economy is almost zero in all three specifications.

The potential reason of the joint SAFTA and AFTA not to have a significant welfare effect can be interpreted in different ways. Firstly, SAFTA and AFTA already exist, and hence, the member of these two trade agreements gains nothing from the members within SAFTA and AFTA after the joint agreement of SAFTA and AFTA. For example, Bangladesh and India will gain nothing due to the joint agreement of SAFTA and AFTA rather they only gain from SAFTA. Secondly, most of the SAFTA member countries have their individual trade agreement with most of the AFTA member countries. This is the reason, Bhutan, Maldives, and Nepal are gaining from the joint agreement of SAFTA and AFTA,

Table 8 Full GE effect of SAFTA + AFTA, measures from the changes in real GDP *Source* Authors' calculations

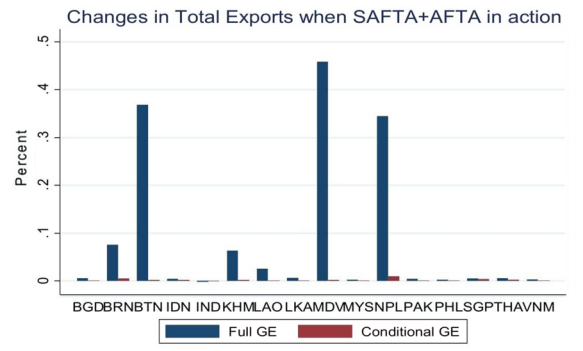
Country	Baseline	HM	Benchmark
Bangladesh	0.01	0.02	0.04
Bhutan	0.84	1.02	3.17
Brunei Darussalam	0.16	0.20	0.56
Cambodia	0.14	0.17	0.42
India	0.00	0.00	− 0.01
Indonesia	0.00	0.01	0.03
Lao PDR	0.06	0.07	0.20
Maldives	1.04	1.26	3.76
Malaysia	0.01	0.01	0.03
Nepal	0.77	0.93	2.98
Pakistan	0.01	0.01	0.03
Philippines	0.01	0.01	0.02
Singapore	0.00	0.01	0.02
Sri Lanka	0.01	0.02	0.04
Thailand	0.01	0.01	0.03
Vietnam	0.01	0.01	0.03
AFTA + SAFTA average	0.19	0.23	0.71
Canada	0.00	0.00	0.00
China	0.00	0.00	0.00
France	0.00	0.00	0.00
Germany	0.00	0.00	0.00
Japan	0.00	0.00	0.00
UK	0.00	0.00	0.00
USA	0.00	0.00	0.00
Third country average	0.00	0.00	0.00
World average	0.02	0.02	0.06

All zeros in this table are not zero, rather very small, due to taking numbers till 2 decimal points

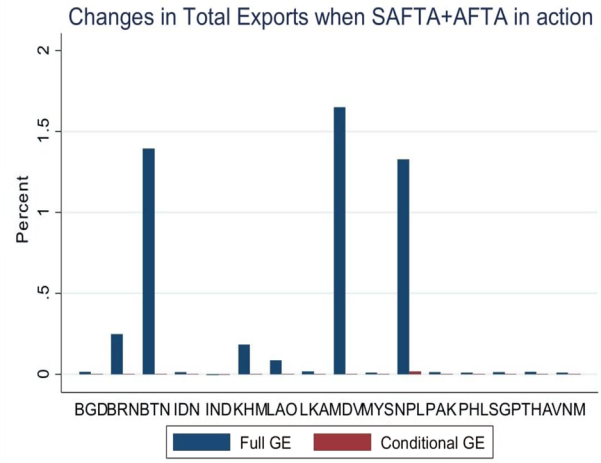
i.e., they don't have trade agreement with most of the members of AFTA. Hence, the joint agreement of SAFTA and AFTA could bring welfare for these countries. Thirdly, the trade diversion effect on the world and the third country is almost negligible, because the trade diversion effect individually from SAFTA and AFTA is already very small. Hence, the joint agreement of SAFTA and AFTA would not change anything to the third countries.

Something is very interesting in case of India; it losses very small percentage (around zero) in the benchmark specification, which supports the validity of my benchmark specification though the amount is very small. Actually, this small percentage of negative effect is coming from trade diversion, i.e., India has already individual or group trade agreement with all AFTA member countries and it is also a member of SAFTA. Hence, India can be a loser due to the joint agreement of the SAFTA and AFTA, i.e., to some extent it would lose a portion of its market in these two Asian regions.

Table 8 represents the full GE impact of the joint SAFTA and AFTA on the welfare of the member countries as well as on the third countries. The full GE impact of the joint SAFTA and AFTA also brings noticeable positive welfare effect for Bhutan, Cambodia, Maldives, and Nepal but in larger extent compared with conditional GE scenario. The effect for the other member countries remains almost same like



Baseline



Benchmark

Figs. 5 and 6 Conditional and full GE impact of the joint SAFTA and AFTA on member countries' export (baseline and benchmark)

conditional GE scenario. On average, SAFTA and AFTA member countries gain 0.71%, which is almost three times higher than other two specifications, the world would gain 0.06% and the trade diversion effect is almost negligible. The scenario for India remains same as conditional in the full GE scenario.

Figures 5 and 6 represent the percentage changes in the export of SAFTA and AFTA member countries due to the joint agreement of the SAFTA and AFTA to see what actually causes the changes in the real GDP of the member countries even in the real GDP of the rest countries of the world. The percentage change of the export in the conditional and full scenario is not noticeably higher for the other member countries except Bhutan, Cambodia, Maldives, and Nepal. The gain in export is higher in the benchmark scenario as well as in the full GE scenario compared with conditional GE scenario as well as compared with other two specifications. The joint agreement of the SAFTA and AFTA could affect the export of Bhutan, Cambodia, Maldives, and Nepal, which would increase the real GDP of these four countries. The export changes in the other member countries are almost negligible; this is the main force behind the negligible effects of the joint agreement of the SAFTA and AFTA on the other member countries.

Table 9 Regional trade agreements of South and Southeast Asian Countries. *Source* Website of ADB (Asian Development Bank)

Country	Number of RTAs
Bangladesh	6
Bhutan	3
Brunei Darussalam	11
Cambodia	8
India	28
Indonesia	17
Lao PDR	10
Maldives	2
Malaysia	22
Nepal	3
Pakistan	18
Philippines	11
Singapore	33
Sri Lanka	8
Thailand	22
Vietnam	16

7 Comparative discussions

The welfare effects of three regional trade agreements are not only heterogeneous among trade agreements but also heterogeneous within the member countries of an agreement. The welfare losses from the removal of SAFTA are higher on the member countries in comparison to two others RTA. In case of the joint agreement of SAFTA and AFTA, the welfare effect is lower. The intuition is explained before. When a member country of SAFTA and a member country (e.g., Brunei Darussalam and Nepal) of AFTA didn't have trade agreement with each other before, they will gain significant amount of GDP if SAFTA and AFTA come in force together. This result actually certifies the welfare effect of RTAs.

The welfare effect of AFTA among its member countries is smaller than the welfare effect of SAFTA. This result can be explained by Table 9.[12] Table 9 represents the number of RTAs belonged to all members of the SAFTA and AFTA. On average, SAFTA member countries have 9.71 regional trade agreements. On the other hand, on average, AFTA member countries have 16.67 regional trade agreements, which is more than 60% of SAFTA member countries. The highest number of RTAs belongs to an AFTA member, which are 33 for Singapore whereas India has the highest (28 RTAs) among SAFTA members. Thus, AFTA member countries would lose less in comparison to SAFTA member countries after removal of these two RTAs, as they have more options to trade than SAFTA.

On the other side of the spectrum, less developed as well as smaller countries gain more than developed and bigger countries. Small country with a small economy, like Bangladesh, Bhutan, Nepal, and Brunei Darussalam, would lose more in comparison to bigger country with a bigger economy after removal of respective trade agreements. Though the economy size of Singapore is much higher in comparison to other members, it would lose more, as the size of the country is smaller, i.e., smaller countries need more

[12] Data available at: https://aric.adb.org/fta-country.

option to trade. The intuition behind that is bigger countries have their own natural market to trade (Arkolakis et al. 2012).

The magnitude of the effect of SAFTA and AFTA is always higher in full GE in comparison to conditional GE, because in full GE, we open the channel of changes in output and expenditure, which is endogenous to the factory-gate prices. Hence, higher prices producers gain more in the full GE scenario. Although hypothetically it is acknowledged that trade creation brings trade diversion, i.e., when two countries sign a trade agreement, previous partner of this two countries will lose their market in member countries, According to standard study of gravity model (e.g., Larch and Yotov 2016), the trade diversion effect is smaller than trade creation effect. Because of the effect of an RTA on third countries comes from the changes in multilateral resistance terms between member and non-member countries, which are the second-order general equilibrium effect. The trade diversion or creation effect on non-member countries in my paper is a supporting result of this statement.

8 Conclusion

Regional trade agreement (RTA) is a fascinating word in the field of international trade. The number of RTAs has tremendously increased over time. SAFTA and AFTA were signed to pave the way for bilateral trade among member countries of the South Asian and Southeast Asian regions due to stalemate of the World Trade Organization on trade flow of small economy countries. I use GEPPML estimator of Anderson et al. (2015) to evaluate the counterfactual welfare effect of SAFTA and AFTA on member countries as well as on the non-member countries.

There is always possibility that RTAs can be endogenous by its nature. Unobservable policy or non-policy-related barriers in the regression model may always be correlated with RTAs and can lead to inconsistent result of the estimated coefficient. I use top-down approach to account for endogeneity of RTAs following Felbermayr et al. (2015). The result is significantly higher when I account for endogeneity of RTAs in comparison to the one without controlling for the endogeneity.

In conditional, AFTA member countries will loss 1.74% of their real GDP if AFTA is removed. The average world real GDP loss is 0.08% and third country average is negligible. In full GE, AFTA member countries will loss 3.08% and average world real GDP loss will be 0.14 if AFTA is removed.

The real GDP changes in "full endowment GE" and in "conditional GE" are approximately −6.36% and −3.63%, if SAFTA does not exist among South Asian countries; on the other hand, the world averages are −0.21 and −0.15%. The trade diversion effect, i.e., trade creation effect on non-member countries after the removal of SAFTA, is negligible.

The joint agreement of SAFTA and AFTA will bring significant welfare for Bhutan, Brunei Darussalam, and Nepal, but the magnitude of welfare is not noticeable for other member countries as most of them are already in a trade agreement with each other. Trade diversion effect for non-member countries is negligible. In this scenario, India may suffer from trade diversion effect as it has already trade agreement with all members of AFTA. India may lose a portion of its market share in AFTA region.

All the scenarios are providing that SAFTA and AFTA are bringing significant amount of welfare gains for the member countries. The significant amount of real GDP losses in member countries after removal of SAFTA and AFTA prove this statement. Policy makers are always worried about trade diversion effect of an RTA, which is invisible in case of SAFTA and AFTA as no non-member country gains noticeable amount of real GDP after removal of these two RTAs. Further economic integration (e.g., BIMSTEC Free Trade Area) between member countries of these two RTAs may not bring significant welfare gains for the member countries as we have seen that the ex-ante welfare effect of joint agreement between SAFTA and AFTA is not strong enough except for some small countries.

Now, at the end of the paper, it is time to talk about some limitations of my research. I use cross-sectional data (observed data 2012); hence, one cannot compare the welfare gains over time. I don't evaluate counterfactual welfare effect of SAFTA and AFTA, neither across sectors, nor across different skill groups.

Additional files

Additional file 1. Original geppml based data 2012.

Additional file 2. Original geppml based data 2012 for constraining RTA from Egger et al. (2011).

Additional file 3. Original geppml based data 2012 for constraining RTA from Egger et al. (2011) and Head and Mayer (2014).

Additional file 4. Result for AFTA constraining RTA (Head and Mayer (2014) tables 3, 4).

Additional file 5. Result for AFTA constraining RTA (Egger et al. (2011) tables 3, 4, figure 2).

Additional file 6. Result for AFTA from main model estimation (Tables 3, 4, Figure 1).

Additional file 7. Table A1 alternative method to measure welfare effect of AFTA.

Additional file 8. Partial estimate constraining RTA (Head and Mayer (2014) table 2).

Additional file 9. Partial estimate of main model Table 2.

Additional file 10. Partial estimate constraining RTA (Egger et al. (2011) table 2).

Additional file 11. Result for SAFTA constraining RTA (Head and Mayer (2014) tables 5, 6).

Additional file 12. Result for SAFTA constraining RTA (Egger et al. (2011) tables 5, 6, figure 4).

Additional file 13. Result for SAFTA from main model estimation Tables 5, 6, Figure 3.

Additional file 14. Result for SAFTA+AFTA constraining RTA (Egger et al. (2011) tables 7, 8, figure 6).

Additional file 15. Result for SAFTA+AFTA constraining RTA (Head and Mayer (2014) tables 7, 8).

Additional file 16. Table A3 alternative method to measure welfare effect of SAFTA+AFTA.

Additional file 17. Result for SAFTA+AFTA from main model estimation Tables 7, 8, Figure 5.

Additional file 18. Table A2 alternative method to measure welfare effect of SAFTA.

Additional file 19. Partial estimate using OLS and other estimation methods Table 2.

Additional file 20. Original geppml based data 2002

Additional file 21. Log file.

Additional file 22. Original data 2012.

Authors' contributions

I am the sole author of this manuscript; I confirm that the manuscript is my original work and the manuscript has not received prior publication and is not under consideration for publication elsewhere. The author read and approved the final manuscript.

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Competing interests
I confirm that I have no competing interests.

Availability of data and materials
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Appendix

See Tables 10, 11, 12.

Table 10 Alternative approach to evaluate counterfactual effect of AFTA

Country	Conditional	Full
Brunei Darussalam	−2.37	−4.20
Cambodia	−2.50	−4.43
Indonesia	−1.05	−1.86
Lao PDR	−2.03	−3.59
Malaysia	−2.20	−3.89
Philippines	−1.03	−1.81
Singapore	−2.01	−3.58
Thailand	−1.23	−2.18
Vietnam	−1.32	−2.33
AFTA average	−1.74	−3.10
Third country average	0.01	0.02
World average	−0.08	−0.14

One may consider it (or avoid it as this not the main identification strategy of my paper) only as an alternative approach to evaluate benchmark indexes when I constrain all the trade cost coefficients from Felbermayr et al. (2015) in the baseline step of GEPPML estimator. The results of first and second columns are almost similar to the third column of Table 3 and third column of Table 4, respectively

Table 11 Alternative approach to evaluate counterfactual effect of SAFTA

Country	Conditional	Full
Bangladesh	−4.30	−7.54
Bhutan	−3.56	−6.25
India	−0.84	−1.45
Maldives	−5.25	−9.12
Nepal	−3.89	−6.83
Pakistan	−4.26	−6.95
Sri Lanka	−3.43	−6.02
SAFTA average	−3.65	−6.39
Third country average	0.00	0.04
World average	−0.15	−0.22

One may consider (or avoid it as this not the main identification strategy of my paper) it only as an alternative approach to evaluate benchmark indexes when I constrain all the trade cost coefficients from Felbermayr et al. (2015) in the baseline step of GEPPML estimator. The results of first and second columns are almost similar to the third column of Table 5 and third column of Table 6, respectively

Table 12 Alternative approach to evaluate counterfactual effect of SAFTA + AFTA

Country	Conditional	Full
Bangladesh	0.02	0.04
Bhutan	1.76	3.18
Brunei Darussalam	0.31	0.56
Cambodia	0.28	0.42
India	0.00	−0.01
Indonesia	0.02	0.03
Lao PDR	0.11	0.20
Maldives	2.09	3.77
Malaysia	0.02	0.03
Nepal	1.66	2.99
Pakistan	0.02	0.03
Philippines	0.01	0.02
Singapore	0.01	0.02
Sri Lanka	0.02	0.04
Thailand	0.02	0.03
Vietnam	0.02	0.03
AFTA + SAFTA average	0.39	0.71
Third Country average	0.00	0.00
World average	0.04	0.07

One may consider it (or avoid it as this not the main identification strategy of my paper) only as an alternative approach to evaluate benchmark indexes when I constrain all the trade cost coefficients from Felbermayr et al. (2015) in the baseline step of GEPPML estimator. The results of first and second columns are almost similar to the third column of Table 7 and third column of Table 8, respectively

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References

Abrams RK (1980) "International trade flows under flexible exchange rates", federal reserve bank of Kansas City. Econ Rev 65(3):3–10
Aitken ND (1973) The effect of the EEC and EFTA on European trade: a temporal cross-section analysis. Am Econ Rev 63(5):881–892
Anderson JE (1979) A theoretical foundation for the gravity equation. Am Econ Rev 69(1):106–116
Anderson JE, van Wincoop E (2003) Gravity with gravitas: a solution to the border puzzle. Am Econ Rev 93(1):170–192
Anderson JE, Yotov YV (2008) The changing incidence of geography. Am Econ Rev 100(5):2157–2186
Anderson JE, Yotov YV (2011) Terms of trade and global efficiency effects of free trade agreements, 1990–2002, NBER Working Paper No. 17003
Anderson JE, Larch M, Yotov YV (2015) Estimating general equilibrium trade policy effects: GE PPML, CESifo Working Papers-5592
Arkolakis C, Costinot A, Rodríguez-Clare A (2012) New trade models, same old gains? Am Econ Rev 102(1):94–130
Armington PS (1969) A theory of demand for products distinguished by place of production. IMF Staff Papers 16(1):159–178
Baier SL, Bergstrand JH (2002) On the endogeneity of international trade flows and free trade agreements, Unpublished. http://www.nd.edu/~jbergstr/Working_Papers/EndogeneityAug2002.pdf. Accessed 13 June 2016
Baier SL, Bergstrand JH (2004) Economic determinants of free trade agreements. J Int Econ 64(1):29–63
Baier SL, Bergstrand JH (2007) Do free trade agreements actually increase members' international trade? J Int Econ 71(1):72–95
Baier SL, Bergstrand JH (2009) Estimating the effects of free trade agreements on international trade flows using matching econometrics. J Int Econ 77(1):63–76
Baldwin R (2006) Managing the noodle bowl: the fragility of east Asian regionalism, CEPR Discussion Paper No. 5561
Bergstrand JH (1985) The gravity equation in international trade: some microeconomic foundations and empirical evidence. Rev Econ Stat 67(3):474–481

Brada JC, Mendez JA (1985) Economic integration among developed, developing and centrally planned economies: a comparative analysis. Rev Econ Stat 67(4):549–556
Bureau JC, Guimbard H, Jean S (2015) What has been left to multilateralism to negotiate on?, CEPII Working Paper
Caliendo L, Parro F (2015) Estimates of the trade and welfare effects of NAFTA. Rev Econ Stud 82(1):1–44
Carpenter T, Lendle A (2011) "How preferential is world trade?", Centre for Trade and economic integration, CTEI-2010-32, The Graduate Institute, Geneva
Cipollina M, Salvatici L (2010) Reciprocal trade agreements in gravity models: a meta analysis. Rev Int Econ 18(1):63–80
David C (2008) The effects of AFTA: a disaggregated analysis. SAIS Bologna Center, Italy
Egger P, Larch M (2011) An assessment of the Europe agreements: effects on bilateral trade, GDP, and welfare. Eur Econ Rev 55(2):263–279
Egger P, Wamser G (2013) Multiple faces of preferential market access: their causes and consequences. Econ Policy 28(73):143–187
Egger P, Larch M, Staub K, Winkelmann R (2011) The trade effects of endogenous preferential trade agreements. Am Econ J Econ Policy 3(3):113–143
Feenstra RC (2004) Advanced international trade: theory and evidence. Princeton University Press, Princeton
Felbermayr G, Heid B, Larch M, Yalcin E (2015) Macroeconomic potential of transatlantic free trade: a high-resolution perspective for Europe and the world. Econ Policy 30(83):491–537
Frankel J (1997) Regional trading blocs. Institute for International Economics, Washington, DC
Frankel JA, Stein E, Wei SJ (1995) Trading blocs and the Americas: the natural, the unnatural, and the super-natural. J Dev Econ 47(1):61–95
Fugazza M, Nicita A (2013) The direct and relative effects of preferential market access. J Int Econ 89(2):357–368
Ghosh S, Yamarik S (2004) Are regional trading arrangements trade creating?: an application of extreme bounds analysis. J Int Econ 63(2):369–395
Grant JH, Lambert DM (2008) do regional trade agreements increase members' agricultural trade? Am J Agr Econ 90(3):765–782
Head K, Mayer T (2014) "Gravity Equations: Workhorse, Toolkit, and Cookbook", Chapter 3 in the Handbook of International Economics Vol. 4, eds. Gita Gopinath, Elhanan Helpman, and Kenneth S. Rogo, Elsevier Ltd., Oxford
Hirantha SW (2003) From SAPTA to SAFTA: gravity analysis of South Asian free trade, Mimeo, Department of Economics, Nagoya University, Japan
Hummels D, Klenow PJ (2005) The variety and quality of a nation's exports. Am Econ Rev 95(3):704–723
Kemal AR (2004) Exploring Pakistan's regional economic cooperation potential. Pak Dev Rev 43(4):313–334
Larch M, Yotov YV (2016) General equilibrium trade policy analysis with structural gravity, CESifo Working Paper, No. 6020
Magee CS (2003) Endogenous preferential trade agreements: an empirical analysis. Contrib Econ Anal Policy 2(1):1166
Mélitz J (2007) North, south and distance in the gravity model. Eur Econ Rev 51(4):971–991
Okabe M, Urata S (2013) The impact of AFTA on intra-AFTA trade, Economic Research Institute for ASEAN and East Asia (ERIA) Discussion Paper
Pitigala N (2005) What does regional trade in South Asia reveal about future trade integration? Some Empirical Evidence, World Bank Policy Research, working paper 3497
Raihan S (2012) SAFTA and the South Asian countries: quantitative assessments of potential implications, Munich Personal RePEc Archive (MPRA) Paper
Ravenstein EG (1889) The laws of migration: part 2. J R Stat Soc 52(2):241–305
Rose AK (2004) Do we really know that the WTO increases trade? Am Econ Rev 94(1):98–114
Rose A, van Wincoop E (2001) National money as a barrier to international trade: the real case for currency union. Am Econ Rev 91(2):386–390
Santos Silva JMC, Tenreyro S (2006) The log of gravity. Rev Econ Stat 88(4):641–658
Sengupta N, Banik A (1997) Regional trade and investment: case of SAARC. Econ Political Wkly 32:2930–2931
Srinivasan TN, Canonero G (1995) Preferential trading arrangements in south Asia: theory, empirics and policy. Yale University, New Haven. Unpublished manuscript
Subramanian A, Wei SJ (2007) The WTO promotes trade strongly but unevenly. J Int Econ 72(1):151–175
Tinbergen J (1962) Shaping the world economy. The Twentieth Century Fund, New York
Trefler D (1993) Trade liberalization and the theory of endogenous protection: an econometric study of U.S. import policy. J Political Econ 101(1):138–160
Wooldridge JM (2002) Econometric analysis of cross-section and panel data. MIT Press, Cambridge