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THE IMPACT OF PREFERENTIAL TRADE AGREEMENTS ON SOUTH ASIAN EXPORT FLOWS: Using Matching Econometrics

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Abstract

This study investigates the effects of preferential trade agreements (PTAs) on export performance of four South Asian countries: Bangladesh, India, Pakistan and Sri Lanka. The study also examines the long-term PTAs' average treatment effect (ATE) on South Asian export flows with their trade partners (intra and extra) around the world. The study provides a methodological comparison of parametric and non-parametric matching - Propensity Score Matching (PSM) technique. It is evident from the findings of the study that PSM provides more plausible estimates of PTAs. The empirical findings also reveal that PTA increases the South Asian export flows by 129 per cent. Moreover, the intra-regional and extra-regional export increases by 124 per cent and 93 per cent respectively over the period of 1980-2012. The overall findings suggest that PTA formation significantly increases intra and extra regional export flows of South Asian countries. Finally, the study recommends that the government and policymakers should execute more such agreements to boost trade among the regional countries.

Keywords: Preferential Trade Agreements, Export, Propensity Score Matching, Average Treatment Effects, South Asia.
JEL Classification: F1, F140, F100, F150.

I. Introduction

International trade plays a vital role in the development of an economy. Economic integration such as preferential trade agreement (PTA), free trade agreement (FTA) leads to economies of scale, greater specialization for domestic producers and attracts more foreign direct investment (FDI) [Robinson and Theirfelder (1999)]. Under preferential trade agreement (PTA), countries enjoy preferential rights or lower tariffs for particular commodities. WTO report (2011) reveals that most of the bilateral preferences were formed between developing countries, specifically in Asian countries [Krishna, et al. (2011)]. Most of the South Asian countries signed the PTAs with their

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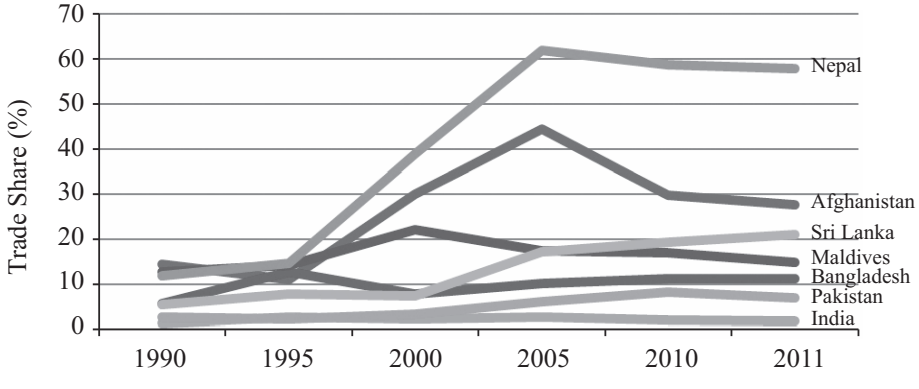
extra-regional trade partners such as European countries like Japan and the United States, to enhance trade flows. This is why the intra-regional trade share of South Asia in the world's trade remained lower than their extra-regional trade share. It is also evident from the ADB[1] and IMF data that South Asian intra-regional export flows increased from US$. 0.95 billion in 1990 to US$. 15.88 billion in 2010. Moreover, it also shows a significant increase in extra-regional export flows, i.e., from US$. 27.36 billion to US$. 271.53 billion, over the period.

Though, many studies have examined the impact of trade agreements on South Asian trade flows using gravity model approach, but this study investigates the effects of PTAs on South Asian export flows using the semi-parametric matching technique, i.e., Propensity Score Matching (PSM) proposed by [Rosenbaum and Rubin (1983), (1984), (1985)] to control the problem of self-selection in observational studies. In trade, several empirical studies employed PSM to attain more stable estimates of trade flows [Baier and Bergstrand (2009) and Bergstrand, et al. (2011)].

Figure 1 depicts the intra-regional trade share of South Asian countries' in the total trade of the region over the period of 1990 to 2011. As discussed above, Asian countries trade more outside the region than with their regional partners. From the figure, it can be depicted that most of the South Asian countries' intra-regional trade share lies between 0 to 20 per cent, in other words, around 80 to 100 per cent trade is outside the region. Further, it is obvious from the figure that except for Nepal, the intra-regional trade share has been increasing since the existence of SAARC in 1995 and reached almost 60 per cent.



Source: Author's illustration based on ARIC, ADB.
Note: Trade share is the percentage of total trade of the country with all the partners to total trade of the region.

FIGURE 1

SAARC Intra-Regional Trade Share (%)

[1] Asia Regional Integration Centre, http://aric.adb.org/integrationindicators.

This study aims to find the effects of PTAs on South Asian export flows with its regional and extra-regional trading partners around the world, using propensity score matching. This study provides a deeper understanding of effects of various trade agreements between SAARC economies and their trading partners. There is no study has examined the impact of intra and extra regional average treatment effects of PTAs on South Asian export flows using Propensity Score Matching Technique (PSMT). This study to examine the effects of PTAs, this study employs a parametric gravity model, i.e., Pooled OLS, fixed and random effects and country pair fixed effects. Second, adopts an alternative approach, i.e., semi-parametric propensity score matching technique to control the problem of endogeneity, occurred due to self-selection of trade agreements (PTA, FTA etc).

The study is organized as follows: the next section provides a review of the relevant literature. The methodological framework is presented in Section III. Section IV presents the model specification and sources of data used in the study. The empirical results are discussed in Section V, and finally, Section VI concludes the study and provides relevant policy implications.

II. Review of Literature

Numerous studies have examined the impact of PTAs formation on trade flows using the gravity model. However, very few studies have explored the impact of PTAs using a matching technique in order to control the selection bias problem of trade. Baier and Bergstrand (2007) examined the effect of bilateral PTAs of 96 member countries' trade flows for the period of 1960 to 2000 using gravity model. The study found that bilateral trade between member countries has almost doubled after 10 years of the agreements. Magee (2008) analyzed the impact of PTAs on bilateral trade flows of 133 member countries and found that the trade creating effects of PTAs increased bilateral trade by 89 per cent of member countries. Ghosh and Yamarik (2004) examined the effects of PTAs on trade flows for 186 countries using gravity model over the period of 1970 to 1995. The study found both the trade creating and trade diverting effects of PTAs on trade flows and increased the intra-regional trade by 39 per cent; while it was also experienced that as a result of the PTA formation, non-members' trade reduced by 6 per cent over the period.

Lee and Shin (2006) analyzed the regional PTAs effects on bilateral trade flows using gravity mode for 175 countries over 1948 to 1999 periods. Their study finds that PTAs results in both trade creation and trade diversion. Moreover, the intra-region at trade effects are trade creating; i.e., 51.6 per cent while 6.5 per cent is trade diversion (trade with non-member). Frankel, et al. (1995) examined the impact of PTAs on 63 countries' trade flows, including the EAEC, APEC, EC, EFTA, NAFTA, MERCUSOR and ANDEAN over the period of 1965 to 1990. The study found that trade is creating effects of intra-regional PTAs within a continent but not in the case of EFTA and NAFTA trading blocs.

Egger (2004) assessed the intra, as well as cross-regional effects of the regional agreements particularly for EU, EEA and NAFTA; and found the evidence of trade creation effects of intra-regional agreements. Akhter and Ghani (2010) examined the effects of FTAs intra SAARC and the other South Asian regional trading partners using the GLS method. The results showed that traditional gravity estimates were statistically significant. Whereas, estimates of intra-SAFTA provide negative effects of FTA, which showed that SAFTA diverts trade with a member, as well as with non-member countries. However, there is trade creating effects of FTA among Pakistan, India and Sri Lanka, the major South Asian partners.

Khoso, et al. (2011) investigated the impact of SAFTA, particularly on Pakistan and the other South Asian countries' trade flows and their results indicate that the implementation of SAFTA has increased the net exports of Pakistan. Leu (2011) explored the trade diversification effects of PTAs of intra-southeast Asian countries (AFTA) and with extra-regional trading partners, such as China and Japan, through ASEAN-China (ACFTA) and ASEAN-Japan (AJCEP) agreements. The study revealed that the ASEAN's extra-regional trade showed trade creating effects of PTAs within ASEAN. Further, the integration witnessed the trade creating effects of intra-ASEAN (AFTA) and extra-region (ACFTA and AJCEP). Dahi and Damir (2013) examined the PTAs formation for 28 developing countries' export flows with their 241 importing partners particularly in manufactured goods for the period of 1978 to 2005. The study revealed that PTA formation increased the export flows among the southern region of the developing countries. On average, the signing of agreement increased the intra-south export flows by 15 to 61 per cent, over a year. However, PTAs decreased the South-North export flows by 48 per cent. Moinuddin (2013) analyzed the effects of SAFTA on trade flows. The findings of the study showed that trade creation effects of intra-regional integration were very low within SAFTA than with the extra-regional trading partners.

Bergstrand, et al. (2011) examined the ex-post treatment effects of EU with their trade partners on trade flows by using both the parametric and nonparametric estimation methods and found the statistically significant results of FTA on trade flows. The empirical results of parametric estimation (OLS) showed that the effects of common membership with EU were 166 per cent and the nonparametric estimation (matching technique) was 157 per cent. Egger, et al. (2006) investigated the effects of PTAs on trade flows by adopting the propensity score matching technique. The findings of the study indicated that undermatching, estimates were much stable in various model specifications as compared to the parametric technique. Further, the results show that PTAs increased bilateral trade by 15 per cent to 25 per cent of member countries. Foster, et al. (2010) found that the effects of PTA were traded creating along with extensive margin. Furthermore, they found that extensive margin effects PTA in larger exporters and larger bilateral country pairs. Hur and Park (2009) used the nonparametric matching approach to estimate the effects of the free trade agreement on economic growth. Their empirical results revealed an insignificant effect of FTA on economic growth.

III. Methodological Framework: Propensity Score Matching (PSM)

The limitation of gravity model is addressed by several empirical studies [Rose (2004), Feenstra (2004) and Baier and Bergstrand (2009)]. Similarly, Anderson and Wincoop (2003) addressed the omission of "MRT" (Multilateral Resistance Terms) or remoteness indexes and the problem of missing time invariant MRT controlled by using the country fixed effects [Feenstra (2004)]. Moreover, selection into a PTA is non-random, which could bias OLS estimates [Baier and Bergstrand (2004), Persson (2001)]. Matching provides more stable and plausible average treatment effect (ATE) of PTA without any functional relationship that avoids potential misspecification and allows arbitrary heterogeneity. It forms treatment and control groups by selecting observable (random selection) covariates and comparing observations from the same distribution. Therefore, it provides plausible estimates of treatment effects and therefore deals with the problem of endogeneity or self-selection.

Generally, the treatment variable is a binary (1, 0) variable (individual is treated or not treated). Therefore, there are two potential outcomes for each individual, with treatment (Y_1) and without treatment (Y_0). The treatment effect (causal) is the difference between these two outcomes, i.e.

$$TE = Y_1 - Y_0 \tag{1}$$

Moreover, in matching potential outcomes, the difference between them is randomly assigned from the population. An individual effect of being treated and untreated is not observable in an experiment. Therefore, researchers find average treatment effects (ATE). Most of the studies focus on two measures of treatment effects.

$$ATE = E(Y_1) - E(Y_0) \tag{2}$$

The ATE is the expected effect of treatment "P" for a randomly assigned individual from the population. However, there is another treatment effect called the average treatment effect on treated (ATT).

$$ATT = E(Y_1 | P = 1) - E(Y_0 | P = 1) \tag{3}$$

It can be assumed that P is a treatment (dummy) variable. Where, Y_1 and Y_0 denotes individual with treatment (P=1) or without treatment (P = 0).

The ATT is the expected outcome of randomly drawn individuals from the population who have undergone treatment. The reason to construct the ATT to deal with the problem of 'self selection'. The ATT is the difference between the outcome of treatment groups who were treated and who were not treated.

In the above Equation (3) the second term is called counterfactual outcome (Y_0), for those being treated but was not observed.

In observational studies, the assignment to treatment is not random, so the treatment effect cannot be identified. Therefore, to estimate the treatment effect, matching adopts two identifying assumptions to solve the selection bias problem.

1. Matching Assumptions

a) Unconfoundedness or Conditional Independence

Conditional on X, P and (Y_0, Y_1) are independent. In other words, individuals with the same characteristics X, then P and Y_0, Y_1 are independent.

The assumption of CIA states as:

$$Y_0, Y_1 \perp P$$

The above assumption shows that the outcome $E(Y_0|P = 1)$ will be replaced by the outcome $E(Y_0|P = 0)$.

$$Y_{(1,0)} = \begin{cases} Y_1 \text{ if } P = 1 \\ Y_0 \text{ if } P = 0 \end{cases}$$

$$= Y_0 + (Y_1 - Y_0)\, P \tag{4}$$

The above Equation (4) is valuable because $(Y_1 - Y_0)$ is the causal effect of treatment for a single person. As a rule, there is liable to be a dissemination of both Y_1 and Y_0 in the population, so the treatment effect could be distinctive for diverse individuals. As it is not possible that both the potential outcomes are for one individual therefore, a treatment effect is estimated as the difference between the average effects of individuals who were and were not treated. The comparison of average by treatment gives potential outcomes. The comparison of average effect conditional on treatment status is formally linked to the average causal effect by the following equation:

$$\underbrace{E[Y_1 \mid P = 1] - E[Y_0 \mid P = 0]}_{ATE}$$

$$= \underbrace{E[Y_1 - \mid P = 1] - E[Y_0 \mid P = 1]}_{ATT} + \underbrace{E[Y_0 \mid P = 1] - E[Y_0 \mid P = 0]}_{Selection\ Bias} \tag{5}$$

In the above Equation (5) the term on the left hand side is the observed difference in the average treatment effects (ATE). The first term on the right side is an average treatment effect on treated (ATT), which is the difference in the average outcome of treated individuals [E (Y_1 | P = 1)] and the counterfactual mean for treated, i.e., [E (Y_0 | P = 1)]. The second term is the difference in the average outcome of individuals from treatment and comparison groups in the absence of the treatment called selection bias. The difference between ATE and ATT is called self-selection bias. The true ATT can be estimated if this self-selection bias becomes equal to zero.

b) Overlap or Common Support Condition

The overlap assumption ensures that the given covariates X, the probability of being treated and untreated might be greater. To avoid this overlap, covariates X probability should satisfy this condition.

$$0 < \text{Prob}\,(P = 1 \mid X) < 1$$

The probability of a treated group must lie between 0 and 1 and be obtained through the probit model. In other words, there are both treated and untreated observations for each covariate *x*. Thus, having a large data set, this assumption is not violated. Moreover, the condition of strong ignorability holds if both the un-confoundedness and overlap assumptions are valid, as depicted in Figure B-1 (Appendix) [Rosenbaum and Rubin (1983)].

For propensity score a model based on the binary choice probit model is considered.

$$\text{Prob}\,(P = 1 \mid X) = \text{Prob}\,(X)$$

where, P(X) represents the propensity score. A propensity score P (X) is chosen at random and two individuals having the same propensity score. One of them is treated and the other is not. The average treatment effect conditional on propensity score is as:

$$E\,(Y \mid P = 1, P\,(X)) - (E\,(Y \mid P = 0, \text{Prob}\,(X)) = E\,(Y_1 - Y_0 \mid P\,(X)) \qquad (6)$$

These propensity scores are estimated via logit or probit model. This study employs the most commonly used matching strategy, i.e., NN matching suggested by Abadie and Imbens (2011) and Baier and Bergstrand (2009).

2. Nearest Neighbor (NN) Matching

The most widely used method of matching is NN matching, where treated units and matched control units have closest propensity scores. As all the treated units are

matched with the control units, thus their differences are obtained. The average of these differences provides ATT. Such matching can be applied with or without replacement. NN matching without replacement matches only once whereas, matching with replacement (one nearest neighbor) minimizes bias but increases the variance. On the other hand, matching with more nearest neighbors increases bias but reduces the variance.

In NN matching, the treated unit *i* is matched with non-treated unit *j* as follows:

$$|p_i - p_j| = \min_{k \in \{D=0\}} \{|p_i - p_j|\} \tag{7}$$

where, p_i and p_j denote the propensity scores of the ith and jth unit, respectively. The NN Matching estimator is written as:

$$ATT^{NN} = \frac{1}{N^T} \sum_{i:wi=1} [Y_i^{obs} - \sum_{j \in C_{(i)}^M} W_{ij} Y_{ij}^{obs}]$$

$$= \frac{1}{N^T} \sum_{i:wi=1} Y_i^{obs} - \frac{1}{N^T} \sum_{j \in C_{(i)}^M} W_j Y_{ij}^{obs}$$

where,

N^T denotes the no. of observations in the treated group
$W_{ij} = 1/N^c$ if *j* is a control unit of *i* and zero otherwise and $W_j = \sum_i W_{ij}$
$C_{(i)}^M$ denotes the set of first M matches for unit *i*

IV. Model Specification and Data Sources

1. Model Specification

To assess the effects of preferential trade agreements (PTAs) on export flows of South Asian countries with its trading partners, this study finds at its first stage, the average treatment effects (ATE) of South Asian countries with its trading partners, using OLS regression analysis. Several studies reveal that the traditional gravity equation is miss-specified due to the confounding of variables (omission of the non-linear term). This can be controlled by adding a multilateral price resistance term [Anderson and Wincoop (2003)]. The unbiased estimates of the traditional gravity equation can be obtained using OLS fixed effect model to account for the multilateral resistance terms [Feenstra (2004), Biar and Bergstrand (2009)].

In the second stage of analysis, this study acquires average treatment effects on treated (ATT) using Propensity Score Matching technique. Matching is a non-parametric technique, which avoids potential misspecification of E [Y (0) | X] and allows for arbitrary heterogeneity in causal effects E [Y (1) – Y (0) | X] [Grilli and Rampichini (2011)].

The gravity model is specified as:

$$\ln (EXP_{ij})_t = \alpha_{ij} + \beta_1 \ln(GDP_i)_t + \beta_2 \ln (GDP_j)_t + \beta_3 \ln(Dist_{ij}) + \beta_4 LANG_{ij} + \beta_5 COLONY_{ij} + \beta_6 PTA_1 + \beta_7 PTA_2 + \beta_8 PTA_3 + \varepsilon_{ij}$$

where, *i* denotes the exporting countries and *j* denotes the importing countries. The subscript '*t*' is the time period of 1980 to 2012 (each variable is defined in Table A-1, Appendix).

2. Data Sources

The data used for the study consists of four exporting (South Asian) countries (Bangladesh, India, Pakistan and Sri Lanka) and 195 importing partner countries for the period of 1980 to 2012. The information for the core gravity variables is gathered from the CEPII database which provides a compiled gravity data set for almost all countries around the world for the period of 1948 to 2006. The remaining series from 2007-2012 has been constructed using a variety of sources.

Bilateral export flows are taken from the United Nations Commodity Trade database (UN COMTRADE) and the United Nations Conference on Trade and Development (UNCTAD). The GDPs of exporting and importing countries are taken from the World Development Indicators [WDI (2014)] over the period of 2007 to 2012. Geographical bilateral distance (in kilometers) has been compiled using the CEPII database website (dist_cepii.xls) for longitudes and latitudes of economic centers to calculate the great circle distances. The other country specific geographical variables like a common language, common colonies and common borders. The dummies for these geographical variables have also been compiled from the CEPII website.

The dummy variables for preferential trade agreement (PTA) have been computed from the WTO PTA database for trade agreements. The study has constructed three PTA dummies. The dummy variable PTA_1 represents the South Asian countries (four countries used in the study) preferential trade agreements with their trading partners around the world; whereas PTA_2 represents the intra-regional preferential trade agreements, i.e. exporting and importing countries are South Asian countries. The third PTA dummy, i.e., PTA_3 represents the extra-regional PTAs.

V. Empirical Results

1. Estimates of Parametric Model

Table 1 reports the estimates of PTAs using parametric techniques (pool OLS, fixed effect, and random effect) over the period of 1980 to 2012. The traditional gravity estimates [log (GDP_i), log (GDP_j) and log (distance)] are expected and the-

oretically justified. The positive and statistically significant coefficient of exporter and importer GDPs shows that exports (or imports) of reporter (partner) country increase with the size of the economy by 1.43 per cent (one per cent). The sign of the coefficients of bilateral distance, common colony and adjacency are consistent and are in line with previous studies [Krugman and Obsfeld (2006), Baier and Bergstrand (2009) and Anderson (2011)].

The coefficient of bilateral distance indicates that if South Asian countries' export to far distant trading partners decreases by 0.33 per cent, it is consistent with the theory of gravity model. Furthermore, other variables, such as common colony and adjacency (common borders) are found to be positive and statistically significant. The coefficient value of common colony [$(e^{1.18}-1) = 2.25$] indicate that South Asian partners with common colony increase bilateral exports by more than double (225 per cent) over the period; whereas, the coefficient of adjacency shows that countries sharing common borders increase their exports by almost four times. The coefficient of language [$(e^{-0.25}-1) = -0.22$] contradicts the theory, which is statistically significant but negative and shows that bilateral exports of those South Asian countries who share a common language with their trading partners decrease by 22 per cent over the period. The coefficient of PTA_1 dummy captures the South Asian

TABLE 1

Parametric Estimates of PTAs

Variable	Pool OLS		Fixed Effects		Random Effect		LSDV	
	Coeffi.	t-value	Coeffi.	t-value	Coeffi.	z-value	Coeffi.	t-value
PTA_1	1.08*	7.66	-2.19*	-2.59	1.17*	3.53	-2.22*	-1.26
Intra-region PTA_2	-0.09	-0.33	-1.84*	-2.46	-1.53	-1.82	0.56	0.25
Extra-region PTA_3	1.46*	8.94	-1.89	-1.63	1.39*	3.82	-0.03	-0.02
Log of GDP_i	1.43*	41.85	-150.18	-1.86	-131.71	-1.81	1.96*	15.93
Log of GDP_j	1.08*	54.34	-208.16	-2.79	-206.33	-2.85	0.00	-0.03
Log of $Dist_{ij}$	-0.33*	4.38	-	-	-0.57	-2.68	-0.79*	-2.65
ADJ_{ij}	1.76*	4.33	-	-	1.72	1.62	0.37	0.61
Com. $Lang_{ij}$	-0.25*	1.80	-	-	-0.03	-1.10	-0.26	-1.51
Com. $Colony_{ij}$	1.18*	10.46	-	-	1.09	3.76	15.14*	18.99
Constant	-14.41*	16.97	-13.09	-8.97	-8.71	-4.20	-9.10	-3.31
No. of Observations	22812		22812		22812		22812	
R^2	0.20		0.04		0.20		0.34	

Source: Authors' estimation based on UNCTAD, CEPII and WTO.
Note: * denotes significant at 1% level.

export creation effects of PTA. The positive and statistically significant coefficient of PTA_1 dummy reflects that the member countries experienced increase in exports by [$(e^{1.08} -1) = 1.94$ or 194 per cent] which unearths that South Asian countries' bilateral exports with their PTA members around the world are almost double; whereas the coefficient of intra-regional PTA dummy is negative, statistically insignificant and implausible bias estimates of ATE. On the other hand, the extra-regional PTA dummy coefficient seems to be positive and highly statistically significant having value [$(e^{1.46} -1) = 3.30$ or 330 per cent]. These estimates are consistent with the empirical studies [Krishna, et al. (2011) and Moinuddin (2013)], highlights that South Asian countries' export is more with extra-regional countries' than the intra-regional countries.

Further, Table 1 reports the estimates of the gravity model using fixed effect and random effect estimation methods. Under the fixed effect and random effect models, estimates are relatively weak as compared to the country pair fixed effects model. The coefficients of importer and exporter GDPs reflect a negative coefficient but statistically significant. The coefficients of PTA dummies (PTA_1, PTA_2 and PTA_3) are also turned negative and statistically significant (except the extra-regional PTA_3). These estimates of regional PTA dummies are consistent with the study of Moinuddin (2013). In order to take into account the time invariant variables of gravity model, the paper uses the random effects model. Unlike the fixed effects model variation across individuals is assumed to be random in random effects model and does not correlate with the predictor or regressors used in the model. Therefore, it allows time-invariant variables in gravity model. If variables which influence predictor in the model are not identified, then random effects model causes omitted variable bias. Hausman's post estimation test reveals the fixed effects model as the preferred one.

Moreover, the country pair fixed effects (least square dummy variable - LSDV) helps in understanding the fixed effects across countries and time, which control the unobserved heterogeneity which exists across country pairs in the gravity model. Additionally, fixed effects model control for all time-invariant variables (like distance, common language, common colony, common borders, etc) therefore, the omission of unobservable time-invariant 'MRT' can be controlled by using country pair fixed effects. The Table 1 provides consistent estimates of the gravity equation with the exception of importer's GDP (negative statistically insignificant). The coefficient of bilateral distance is as expected, i.e., negative and statistically significant. The comparison of LSDV and fixed/random effects gives plausible estimates of ATE of PTA dummies. As it is evident, relatively small and positive (though statistically insignificant) coefficient of intra-regional PTA dummy is used in the LSDV model. However, the estimates of ATE for other PTA dummies (PTA_1 and extra-region PTA_3) also reflect relatively smaller but negative and statistically insignificant. Table 2 summarizes the above discussed parametric estimates of PTA (i.e., ATE).

TABLE 2

Comparison of Parametric ATE of PTAs

Variable	Coefficient	t/Z- Stat
Pool OLS		
PTA_1	1.08*	7.66
Intra-Region PTA_2	-0.09	-0.33
Extra-Region PTA_3	1.46*	8.94
Fixed Effect		
PTA_1	-2.19*	-2.59
Intra-Region PTA_2	-1.84*	-2.46
Extra-Region PTA_3	-1.89	-1.63
Random Effect		
PTA_1	1.17*	3.53
Intra-Region PTA_2	-2.65	-6.72
Extra-Region PTA_3	1.39*	3.82
LSDV		
PTA_1	-2.22*	-1.26
Intra-Region PTA_2	0.56	0.25
Extra-Region PTA_3	-0.03	-0.02

Source: Authors' estimation based on UNCTAD, CEPII and WTO.
Note: *denotes significant at 1% level.

2. Estimates of Propensity Score Matching (PSM)

The average treatment effects on treated (ATT) using PSM consists of two steps. In the first step, the Probit Model provides propensity scores for both the treated and control groups. These probabilities are used to construct a randomly selected control group and then find the average treatment effect of PTAs on export flows.

The estimates of the probit model for all PTA dummy variables are given in Table 3. The probit model estimates cannot be interpreted directly; it indicates the change in z-score by one-unit change in each predictor. However, almost all the probit model coefficients are consistent and statistically significant. The likelihood of chi-square value fits the model statistically.

Table 4 presents the average treatment effects of PTAs before and after the matching. The positive and statistically significant coefficient of ATE before matching (unmatched ATE) shows [$(e^{3.91} -1) = 48.4$] an upward bias of almost 48 times greater than

TABLE 3

Estimates of Probit Model

Variable	PTA Dummy		Extra-Regional PTA Dummy		Intra-Region PTA	
	Coefficient	Z-value	Coefficient	Z-value	Coefficient	Z-value
Constant	2.71*	12.15	-5.6**	-20.03	26.06*	27.54
Log of GDP_i	36.52*	1.74	52.01*	2.02	-37.63	0.71
Log of GDP_j	-62.67*	-3.43	-74.56*	-3.43	-55.01	1.09
Log of $(GDP_i)^2$	-18.31*	-1.74	-26.07**	-2.02	18.77	1.71
Log of $(GDP_j)^2$	31.50*	3.45	37.55*	3.45	27.42	1.09
Log of Distance	-0.67*	-30.69	0.025	1.01	-3.12*	30.3
Common Borders	0.80*	10.82	-1.12*	-6.88	0.46*	3.61
Common Language	0.28*	6.66	0.60*	10.79	-0.36**	2.47
Common Colony	-0.55*	-15.98	-1.55*	-17.55	1.21*	16.61
No. of Observations	22812		22812		22569	
Pseudo R^2	0.33		0.47		0.64	
Chi-Square	6805.18		8265*		4048*	

Source: Authors' estimation based on UNCTAD, CEPII and WTO.
Note: * denotes significant at 1% level and ** at 10%.

the positive and statistically significant coefficient of ATT having value [($e^{0.83}$ -1) = 1.3/129 per cent]. It is also evident from [Baier and Bergstrand (2002), (2007) and (2009)] and Magee (2003) who suggested that trade agreements like PTAs should be treated as the endogenous determinant of trade. Ignoring endogenous selection of PTAs in parametric estimation of PTAs resulted in a negative impact on exports [Egger, et al. (2011)]. After controlling the endogeneity, using the non-parametric PSM technique,

TABLE 4

Estimates of PTA Dummy

Treat	Group	Treated	Controls	Difference	S.E.	T-stat
PTA	Unmatched	12.21	8.3	3.91	0.13	29.13
	Matched ATT	12.21	11.38	0.83	0.25	3.25
Extra-Regional PTA	Unmatched ATE	12.95	8.37	4.57	0.15	30.48
	Matched ATT	12.95	12.14	0.81	0.44	1.84
Intra- Regional PTA	Unmatched	11.44	8.91	2.52	0.29	8.54
	Matched ATT	11.44	10.78	0.66	0.57	1.15

Source: Authors' estimation based on UNCTAD, CEPII and WTO.

the study found (unbiased) positive and statistically significant coefficient of PTA. It shows that preferential trade agreements increase bilateral exports of South Asian countries by 3 times as compared to 48 times without matching.

However, the lower value of ATT is credible because the positive and significant value of ATT reflects an increase in exports for randomly selected pairs of countries. Furthermore, technically the lower value of ATT reveals that ATE is a weighted average of ATT (average treatment effect on treated) and ATU (average treatment effect on untreated). Conclusively, the higher ATE reflects the higher effects of ATU. Further, the table shows that after treating PTA endogenous rather than exogenous, the coefficient of extra-regional PTA dummy variable is found to be positive and statistically significant, i.e., $[(e^{0.81} - 1) = 1.24$ or 124 per cent]. This shows that the region has experienced an increase in exports outside the region by 1.2 times over the long period of 1980 to 2012, while the intra-regional export flows are economically positive but relatively slow (though statistically insignificant) value of $[(e^{0.66} - 1) = 0.93$ or 93 per cent] which reflects export creating effects of PTAs within the region. Finally, matching quality measures such as standardized percentage bias, average percentage bias [Tables A-2 and A-3 in Appendix) show a reduction in bias. Similarly, Figures B-2 and B-3 (in Appendix B) depict a reduction in bias graphically. Conclusively, all the measures reveal that matching through PSM (NN) is an efficient method to construct a similar control group (counterfactual) to estimate the ATT of PTA.

Conclusively, though the fixed effects and country-time fixed effects also control the issue of endogeniety PTA coefficients were found to be negative and insignificant caused by measurement error in the gravity model. Matching technique coped with the issue of endogeniety occurred in parametric PTA and export causation analysis as stated above. The ex-post treatment effects of PTAs on its export flows are positive and statistically significant over the sample period. Moreover, these estimates show that the region exports more with extra regional partners (outside the region). Though practicing regional preferences since the early 1990s, the regional countries are still facing high non-tariff barriers (technical barriers to trade-TBT) within the region. Unlike other regions of the world, the South Asian region is facing a share of 86.3 per cent of SPS-TBT from the total NTBs within the region [Rahman, et al. (2011)]. Therefore, these countries should reduce the NTBs to increase their intra-regional export flows.

VI. Conclusions and Policy Implications

From the historical perspective, SAARC's export performance in terms of share to world export is negligible and was continuously dealing till the late 1990s. The merchandise exports of SAARC region are less than one per cent to the world export if India is excluded. The region shares to world exports gradually decreased to 0.8 per cent in 1990, whereas it was 3.7 per cent in 1950; and then, steadily it rose to reach to 2.04 per cent level in 2014. Many studies examined the effect of PTAs on South Asian

trade flows using various parametric approaches. However, this study explores the effects of PTAs both on intra and extra regional export flows using both the parametric (panel analysis) and the non-parametric (PSM) techniques to attain more reliable estimates. After controlling the heterogeneity and self-selection bias in the gravity model. This study provides more plausible treatment effects of PTAs using semi-parametric Propensity Score Matching which allows arbitrary heterogeneity. The empirical findings of this study suggest that PTA increases South Asian export flows by 129 per cent over the sample period. Moreover, the intra-regional and extra-regional exports increased by 124 per cent and 93 per cent respectively. However, the ATEs estimated from the parametric gravity model provide relatively the implausible average treatment effects of PTAs for both the intra and extra-regional South Asian PTAs. Additionally, the country pair fixed effects gravity model was used to control the unobserved heterogeneity of omitted variable which provided the relatively credible estimates for both the intra-regional and extra-regional PTAs. Furthermore, it is also evident from the findings that South Asian intra-regional exports are relatively lower than the extra-regional export flows.

Political conflicts between the two major South Asian countries, i.e., India and Pakistan, have pressurized the countries to continue imposing high non-tariff barriers (NTBs) on each other's trade potential. Therefore, these conflicts lowered the South Asian intra-regional export flows. It is suggested that the South Asian countries should reduce the NTBs particularly to boost intra-regional export flows. Similarly, the findings also recommend that PTAs formation with their extra regional trade partners can enhance the export performance of SAARC countries. The conclusion can be drawn from the findings of this study that governments and policymakers of the region should execute more such agreements to boost; particularly, the intra-regional export flows and also ensured that domestic producers are better-off from the trade agreements.

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APPENDIX-A

TABLE A-1

Variables and Definitions

Variables	Definition of Gravity Variables
Log of Exports	Bilateral export flows from country i to j in time t.
Log of GDP_i	Log of Gross Domestic Product of country i in time t.
Log of GDP_j	Log of Gross Domestic Product of country j in time t.
Log of $(GDP_i)^2$	Log of square of Gross Domestic Product of country i in time t.
Log of $(GDP_j)^2$	Log of square of Gross Domestic Product of country j in time t.
Log of Distance	Log of geographical distance between country i and j.
Common $Lang_{ij}$	Dummy variable equal to 1 if countries i and j speak common language, 0 otherwise.
Common Colony	Dummy variable equal to 1 if countries i and j same colonies of the same colonizer, 0 otherwise.
Adjacency	Dummy variable equal to 1 if countries i and j share common border, 0 otherwise.
Overall PTA_1	Dummy variable equal to 1 if partner countries form PTA with reporter countries around the world, 0 otherwise.
Extra-region PTA_2	Dummy variable equal to 1 if partner country form PTA with external partners, 0 otherwise.
Intra-region PTA_3	Dummy variable equal to 1 if both countries are PTA members as well as South Asian, 0 otherwise.

Source: Authors' illustration.

TABLE A-2

Standardized Percentage Bias t-test for PTA

Variable	Unmatched/ Matched	Mean		% Reduction		t-test
		Treated	Control	%bias	|bias|	t
Log of GDP_i	U	11.02	11.05	-2.2	-52.0	-1.26
	M	11.03	11.08	-3.3		-1.51
Log of GDP_j	U	11.71	8.78	130	95.6	75.66*
	M	11.71	11.58	5.7		2.74**
Log of $(GDP_i)^2$	U	22.04	22.10	-2.2	-52.0	-1.26
	M	22.06	22.16	-3.3		-1.51
Log of $(GDP_j)^2$	U	23.42	17.55	130	95.6	75.66*
	M	23.42	23.16	5.7		2.74**
Log of Distance	U	0.07	0.01	33.8	69.1	29.34*
	M	0.07	0.06	8.1		2.84*
Adjacency	U	0.07	0.01	33.8	76.0	29.34*
	M	0.07	0.06	8.1		2.84**
Com. Language	U	0.10	0.17	-19.2	54.9	-10.47*
	M	0.11	0.10	8.6		4.46*
Com. colony	U	0.12	0.32	-48.9	88.8	-25.71*
	M	0.13	0.15	-5.5		-2.8**

Source: Authors' estimation based on UNCTAD, CEPII and WTO.
Note: * indicates level of significance at 1%, ** at 5%.

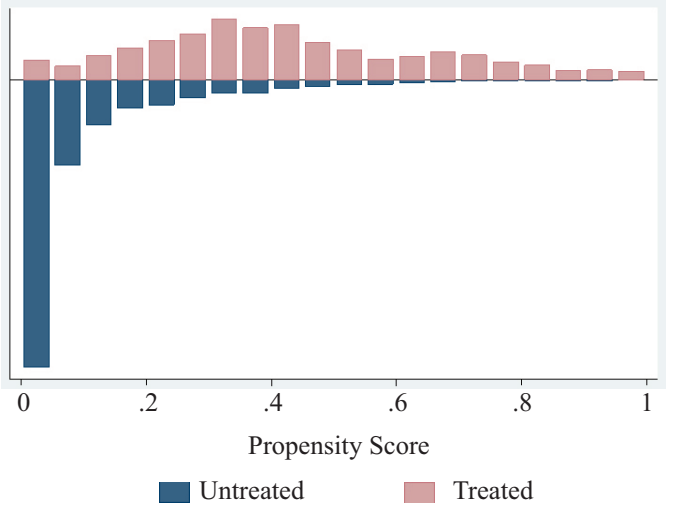
TABLE A-3

Average Percentage Bias for PTA1 Dummy

Group	Pseudo R^2	LR Chi-Square	Mean Absolute Bias
Unmatched	0.33	6805.18*	52.0
Matched	0.01	104.79*	7.1

Source: Authors' estimation based on UNCTAD, CEPII and WTO.
Note: * indicates level of significance at 1%, ** at 5%.

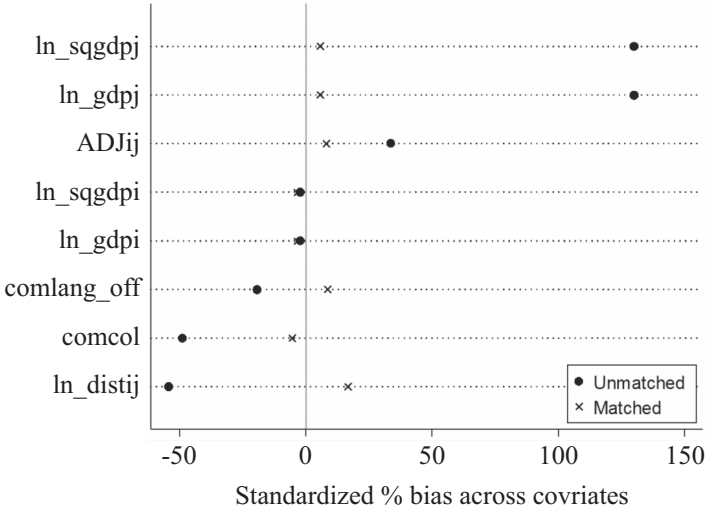
APPENDIX-B



Source: Authors' illustration based on UNCTAD, CEPII and WTO.

FIGURE B-1

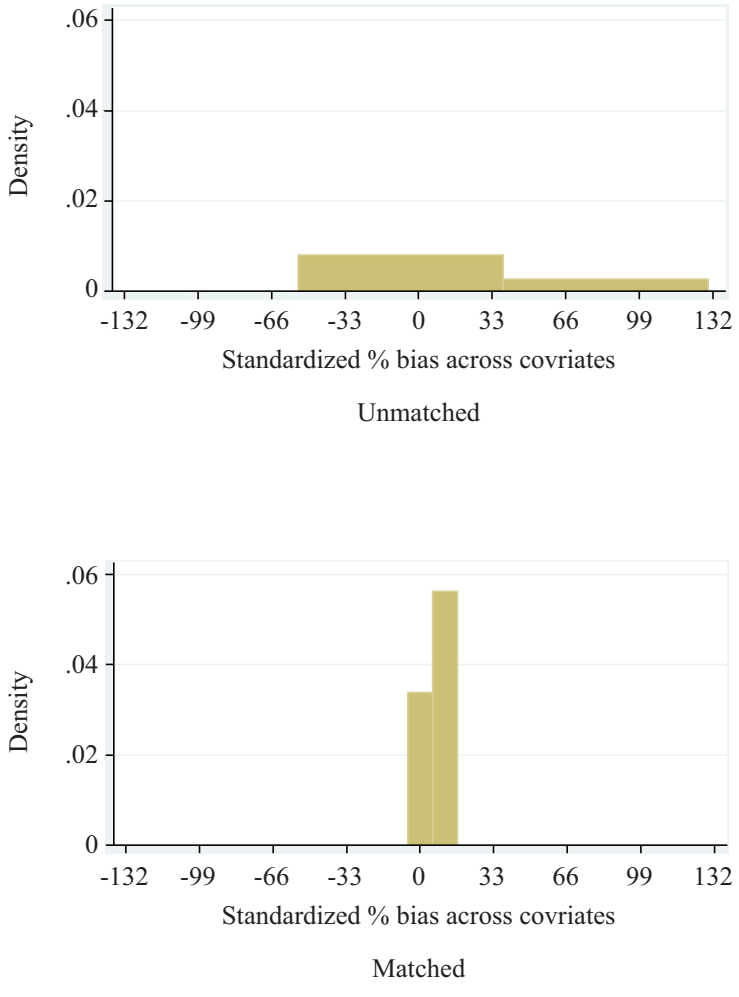
Overlapping of Treated Untreated Groups



Source: Authors' illustration based on UNCTAD, CEPII and WTO.

FIGURE B-2

Scatter Diagram of Differences in Matched/Unmatched Groups



Source: Authors' illustration based on UNCTAD, CEPII and WTO.

FIGURE B-3

Standardized Bias Differences in Unmatched/Matched Groups