Special Issue on
Public Enterprise Performance Benchmarking
Public Enterprise
Volume 22, Issue 1, pp. 35-55, 2016
https://doi.org/pehyj.2016.2201.03

International Center for Promotion of Enterprises
ICPE

Measurement of Trade Costs, its Determinants and Trade Growth Accounting for India with its Asian Trading Partners

Sarbjit Singh, Rahul Arora, and Somesh K. Mathur
Indian Institute of Technology Kanpur (IITK), Kanpur, India

Received July 2015; Revised January 2016; Accepted February 2016

Abstract

Gravity model of international trade established a fact that international trade of an economy is highly affected by the trade costs incurred locally and across borders. These costs are the difference between production cost of a traded commodity and its price paid by the ultimate buyers. The present study calculates the trade costs of Indian economy with its Asian trading partners. The study is developed in three stages: It measures the trade costs for India with its trading partners from the Asian region; it also estimates the determinants of trade costs by using the data on the available trade cost proxies; and thereafter, it decomposes the growth of Indian trade into the contribution of growth in income, the contribution of the decline in bilateral trade costs, and the contribution of the decline in multilateral resistance. It is found that the trade costs of India with all its Asian partners have declined throughout the whole study period (1995-2013). The decline in Indian trade costs was the highest in West Asia followed by Southeast Asia, East Asia, South Asia, and Central Asia. The variables, used as determinants of trade costs, namely: contiguity, distance, tariffs, non-tariff barriers, exchange rate, and port infrastructure, behaved according to the theoretical expectations. Furthermore, the decomposition of the growth of Indian trade with Asian partners revealed that the decline in the relative bilateral trade costs was the driving force of growth of Indian trade with all the Asian regions.

Keywords: Trade costs, Novy, India, Asia

Reference to this paper should be made as follows: Singh, S., Arora, R., and Mathur, S. K. (2016). Measurement of Trade Costs, its Determinants and Trade Growth Accounting for India with its Asian Trading Partners. *Public Enterprise*, *22*(1), 35-55. DOI: 10.21571/pehyj.2016.2201.03

S. Singh et al. (2016)
Public Enterprise
Volume 22, Issue 1, pp. 35-55, 2016
https://doi.org/pehyj.2016.2201.03

International Center for Promotion of Enterprises
ICPE

Introduction

The gravity model of international trade established a fact that international trade of an economy is highly affected by the trade costs incurred locally and across the borders. These costs are the difference between production cost of a traded commodity and its price paid by the ultimate buyers. To measure this price gap, between the supply price of a commodity and its final price, data on each and every variable that accumulates the price of a traded commodity from source to the ultimate destination is needed. But the paucity of data on directly observable variables – policy, geographical and environmental – forces to search for the other alternative measures of trade costs. These other alternative measures of trade costs are known as indirect measures of trade costs and surmise trade costs from trade flows by using the gravity model.

The presence of the gravity model in the international trade was first manifested by Tinbergen (1962). His gravity Equation imitates the Newton's gravity Equation and describes that international trade between two trading nations is directly linked with their economic sizes and inversely related with the distance between them, acting as a proxy for the trade costs. However, Tinbergen (1962) omitted many other trade affecting variables like tariff barriers, non-tariff barriers, contract enforcement costs, infrastructure costs, and distribution costs, among others. Thus, it triggered a debate among the economists to find out an appropriate gravity model of international trade which accounts for all of these omitted variables.

Anderson (1979) derived the gravity Equation from the systems' of expenditure Equations and provided a theoretical base to the gravity model of international trade. But McCallum (1995) again estimated the naive gravity Equation for the bilateral trade between the provinecs of Canada and states of America with distance and borderas proxies for the trade costs. He found that trade between two provinces have been more than 20 times larger than the trade between a state and a province. But Anderson and Wincoop (2003) challenged the estimated results of his study and proved that McCallum (1995) had used the wrong proxies to reflect the international trade costs. They emphasized that not only the bilateral trade barriers but multilateral trade barriers also affect the international trade and called these barriers as the multilateral resistance term, the resistance from the other trading partners.

Later on, Novy (2011) used the final gravity model of international trade by Anderson and Wincoop (2003) and after making some modifications into it, he derived a micro-founded measure for the international trade costs. His measure directly calculated the international trade costs from the observable international trade data. This bilateral measure of trade costs is comprehensive because it takes into consideration all kinds of costs involved in trading goods bilaterally relative to those involved in trading goods intranationally (Duval & Utoktham, 2011a).

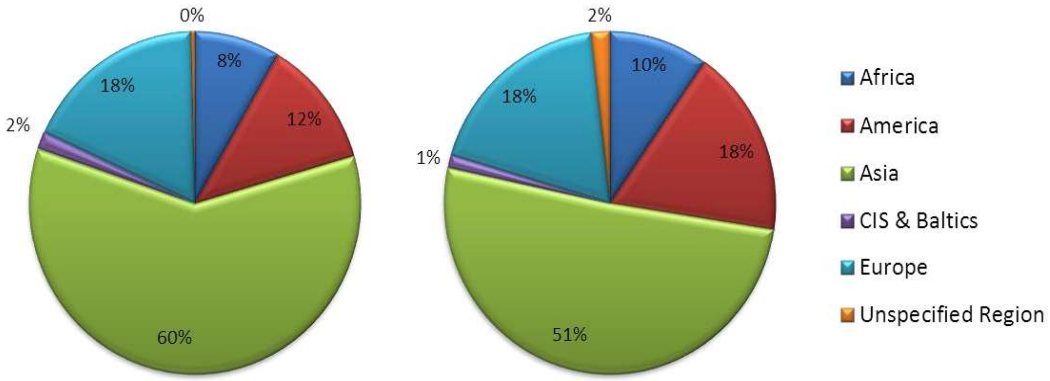
The present study uses Novy's (2011) measure to calculate the trade costs of India with its trading partners from the Asian region. Then, to check the level of connectedness of this trade cost measure with the available proxies of trade costs, the study attempts to find out the determinants of these calculated bilateral trade costs for thirty one Asian economies, comprising India and its thirty partners, by using the data on the available proxies of trade costs. Furthermore, by applying Novy's (2011) trade growth decomposition , the study decomposes the growth of Indian trade into: contribution of growth in income; the contribution of the decline in bilateral trade costs; and the contribution of the decline in multilateral resistance. To present the aforementioned analysis in a sequential form, the present study is divided into seven sections, including the present introductory one. Section 2 puts some light on the place of Asian partners in the international trade of India. Section 3 discusses the database and methodology used. In the fourth section, the study calculates the trade costs for India with its Asian trading partners. The fifth section estimates the determinants of bilateral trade costs of Asia. The decomposition of growth of Indian bilateral trade with Asia is developed in sixth section and, finally, the last section includes the study conclusions.

S. Singhet al. (2016)
Public Enterprise
Volume 22, Issue 1, pp. 35-55, 2016
https://doi.org/pehyj.2016.2201.03

International Center for Promotion of Enterprises
ICPE

Position of Asia in Indian Trade

Asia, the largest continent among the all seven continents of the world, is holding number one position in the category of region-wise trade (exports and imports) of India. It is apparently clear that in India's total imports (Figure 1, left panel), Asian countries have the maximum share (60%) followed by Europe (18%), America (12%), Africa (8%), CIS[1] and the Baltics (2%) and Unspecified Region (0.5%). On the exports side (Figure 1, right panel), about 51 percent share of India's total exports has gone to Asian countries followed by Europe (18%), America (18%), Africa (10%), Unspecified Region (2%) and CIS and the Baltics (1.23%).



Note. Compiled from Export-Import Data Bank (Ministry of Commerce and Industry, India).

Figure 1. Region-wise share of India's imports and exports (2013-2014).

Within the Asian region, GCC countries have maximum (38.64%) share in Asia's total exports to India (India's imports from Asian countries) followed by East Asia (32.01%), ASEAN members (15.74%), Other West Asian countries (12.40%), South Asian countries (0.94%) and Central Asian countries (0.27%). In the case of total exports to Asian countries, India's maximum exports have been to six GCC countries (31.47%), followed by East Asia (26.73%), ASEAN members (21.59%), South Asian countries (11.35%), other West Asian countries (8.51%) and least with Central Asian countries (0.35%).

Methodology and Database

Methodology

Obstfeld and Rogoff (2000) categorized measurement of trade costs as one of the major six puzzles in international macroeconomics. As discussed earlier, there is a lack of data on direct measures, thus, the present study uses an indirect measure of trade costs derived by Novy (2011). Novy assumed Anderson and Wincoop's (2003) final

[1]As per the data information provided by the Ministry of Commerce and Industry, CIS countries also includes all Central Asian countries and it has 0.16%and 0.17% share in total imports and exports of India respectively in 2013-14; therefore, it does not affect the total figure while explaining the required fact.

gravity model[2] as the starting point for the derivation of trade costs' measure, but ended up with totally different and more realistic findings. His measure of trade costs possesses some merits over the Anderson and Wincoop's trade cost function: it does not assume bilateral trade costs to be symmetric; trade costs do not depend only on the two variables distance and border; and also, these vary over time.
Anderson and Wincoop's (2003) framework:

$$x_{ij} = \frac{y_i y_j}{y^w}\left(\frac{t_{ij}}{\pi_i p_j}\right)^{1-\sigma} \quad (1)$$

$${\pi_i}^{1-\sigma} = \sum_j p_j^{1-\sigma}\theta_j t_{ij}^{1-\sigma}\ \forall_i \quad (2)$$

$${p_j}^{1-\sigma} = \sum_i \pi_i^{1-\sigma}\theta_i t_{ij}^{1-\sigma}\ \forall_j \quad (3)$$

where, x_{ij} is the level of trade of country *i* to country *j*; y_i, y_j and y^w are the GDPs of country *i*, *j* and world respectively; t_{ij} is the level of trade costs; π_i is the outward multilateral resistance and p_j is the inward multilateral resistance; and $\sigma > 1$ is the elasticity of substitution across the goods. In second and third Equations,θ_j and θ_i represents the income shares of country *i* and *j* in the world income, i.e., $\theta_j = \frac{y_j}{y^w}$ and $\theta_i = \frac{y_i}{y^w}$.

Equation (1) can be used to find an expression for country *i*'s intranational trade:

$$x_{ii} = \frac{y_i y_i}{y^w}\left(\frac{t_{ii}}{\pi_i p_i}\right)^{1-\sigma} \quad (4)$$

where t_{ii} represents intranational (domestic) trade costs. Expressing Equation (4) in terms of the product of outward and inward multilateral resistance as:

$$\pi_i p_i = \left(\frac{x_{ii}/y_i}{y_i/y^w}\right)^{\frac{1}{(\sigma-1)}} t_{ii} \quad (5)$$

The gravity Equation (1) includes the product of multilateral resistance terms (inward and outward) of both the trading partners *i* and *j*. But Equation (5) provides a solution for $\pi_i p_i$, which is only for i^{th} country. So to obtain a gravity Equation that contains both inward and outward resistance terms (for both *i* and *j* countries), it is wise to multiply the Equation (1) with the trade flows in the opposite direction x_{ji}.

$$x_{ij}x_{ji} = \left(\frac{y_i y_j}{y^w}\right)^2\left(\frac{t_{ij}t_{ji}}{\pi_i p_i \pi_j p_j}\right)^{1-\sigma} \quad (6)$$

By substituting the values of $\pi_i p_i$ and $\pi_j p_j$ (see Appendix A), Novy (2011) derived the following measure:

$$\tau_{ij} = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{\frac{1}{2}} - 1 = \left(\frac{x_{ii}x_{jj}}{x_{ij}x_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1 \quad (7)$$

In the above measure, τ_{ij} represents the tariff equivalents of trade costs, x_{ii} and $x_{jj}$are the intranational trade flows of country *i* and *j* respectively. $x_{ij}$is the bilateral trade flow from country *i* to *j* and x_{ji} represents the bilateral trade flows from country *j* to *i*. σ is the elasticity of substitution across goods. Thus, trade costs (τ_{ij}) depend upon the ratio

[2]See Equation (13) of Anderson and Wincoop (2003), p. 175.

of intranational trade ($x_{ii}x_{jj}$) to international trade ($x_{ij}x_{ji}$). If this ratio declines, it means that bilateral trade flows in relation to domestic trade flows rises, which depicts the low level of trade costs between two trading partners and viceversa.

The above measure of trade costs is derived by using the demand side framework of Anderson and Wincoop (2003). But this is not the only gravity model available in the literature. There are other gravity models which have been derived from the producer's side. These models are of Eaton and Kortum (2002), Chaney (2008) and Melitz and Ottaviano (2008). Therefore, there is a need to verify the authenticity of trade costs' measure given in Equation (7). Novy (2011) proved that the measures of trade costs derived from the above-mentioned supply side models are isomorphic with the trade costs measure derived from the demand side model of Anderson and Wincoop (2003).

Database

Domestic trade of county *i* (x_{ii}) is the total income minus total exports, $x_{ii} = y_i - x_i$. Total exports x_i are defined as the sum of all exports from country *i*, $x_i \equiv \sum_{j \neq i} x_{ij}$. As trade data are only for the merchandise goods, total GDP cannot be used to represent y_i, because it takes into account the data on all goods and services produced in a particular year. Therefore, the study took the sum of the GDP only from agricultural and manufacturing sectors to form y_i. The data on the GDP of agriculture and manufacturing, and trade (exports and imports) was taken from the World Development Indicators (WDI) and the World Integrated Trade Solutions (WITS), respectively. The study has assumed σ = 8, which is the middle range of 5 to 10, found by Anderson and Wincoop (2004)[3]. The study has also developed the sensitivity analysis by using the three different values of σ as 5, 8 and 10 respectively, but the trend line has depicted more or less the same behavior (see Appendix B). The study takes into account thirty trading partners of India within Asia and the rest was not included because of the limited data availability. The selected trading partners of India are categorized into five groups/regions: East Asia, West Asia, South Asia, Southeast Asia and Central Asia. The information about the number of countries and the names included in each group is given in Table 1.

Table 1
Region-Wise Description of Asian Countries

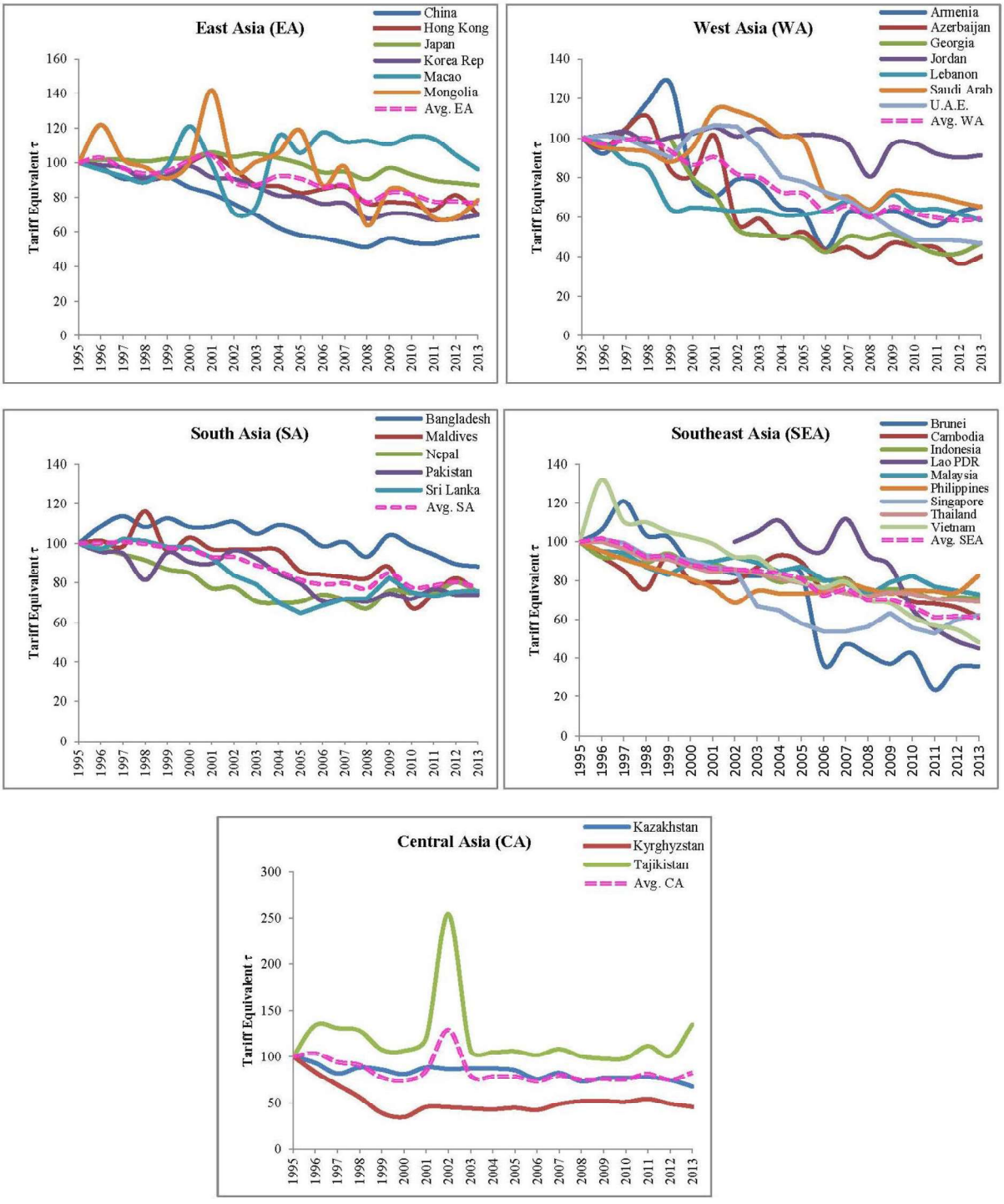
East Asia	West Asia	South Asia	Southeast Asia	Central Asia
China	Armenia	Bangladesh	Brunei	Kazakhstan
Hong Kong	Azerbaijan	Maldives	Cambodia	Kyrgyzstan
Japan	Georgia	Nepal	Indonesia	Tajikistan
Republic of Korea	Jordan	Pakistan	Lao	
	Lebanon	Sri Lanka	Malaysia	
Macao	Saudi Arabia		Philippines	
Mongolia	United Arab Emirates (U.A.E.)		Singapore	
			Thailand	
			Vietnam	

[3] Novy (2011) and Duval and Utoktham (2011a) also assumed the same elasticity.

Measurement of Trade Costs

By using Novy's measurement (2011), trade costs have been calculated for India with each of the above mentioned regions: East Asia, West Asia, South Asia, Southeast Asia and Central Asia for the period of 1995 to 2013. The behavior of Indian trade costs with each of these Asian regions is shown in Figure 2. To make the comparison overtime, the trade costs for all countries, except Hong Kong, Georgia and Lao, are normalized to 1995. The trade costs for Georgia, Hong Kong and Lao are normalized to the initial years from which the data is available: these are 1999, 2000, and 2002, respectively.

International Center for Promotion of Enterprises
ICPE



Note. Source: Authors' calculations.

Figure 2. Indian trade costs within Asia: Region-wise.

Trade Costs of India with East Asia

The upper left panel of Figure 2 shows that Indian trade costs with East Asia have declined by almost 24 percent from the initial year (1995) to the ending year (2013). Decline in trade costs is the highest with China, which can be a reason of a very high level of trade of India with China, among others. After China, the decline in trade costs is further followed by Hong Kong, Republic of Korea, Mongolia, Japan, and Macao. Under the Look East Policy (LEP), India signed various trade agreements with China, Japan, and Republic of Korea, which are the dominant players in the East Asia. These agreements could be a reason of the decline in the Indian trade costs with East Asia.

Trade Costs of India with West Asia

In Western Asia, most of the countries are the oil and gas producing countries, which are the basic needs of any economy. The top right panel of Figure 2 shows that trade costs of India with West Asia declined by 41 percentage points over the years 1995 to 2013. Here, decline in Indian trade costs was the highest (60%) with Azerbaijan and the lowest (9%) with Jordan. With Azerbaijan, Indian trade relations are improving day by day and the growth of bilateral trade of India with Azerbaijan is witnessing this[4]. In the present study, the West Asian region also includes two of the Gulf Cooperation Council (GCC) countries, namely: Saudi Arabia and United Arab Emirates. India's tie ups with the GCC and other oil exporting countries might have acted as a reason of the decline in trade costs of India with West Asia.

Trade Costs of India with South Asia

The South Asian region includes the neighboring countries of India and the majority of them share a common border with India. As depicted in the middle left panel of Figure 2, Indian trade costs with the South Asian countries have declined by almost 22 percent on an average from 1995 to 2013. To promote the regional cooperation in South Asia, the South Asian Association of Regional Cooperation (SAARC) was created in 1985.The study covers six members of SAARC including India, and the remaining two – Afghanistan and Bhutan – have been left out due to data limitations. In 2004, India signed South Asian Free Trade Area (SAFTA) with other member countries and committed to promote the free trade area through the elimination of trade barriers, which might be the possible reason that caused Indian trade costs to decline.

Trade Costs of India with Southeast Asia

Indian trade costs with the Southeast Asian countries have gone down over the whole study period as shown in the middle right panel of Figure 2. On an average, India's trade costs with Southeast Asia declined by 40 percent from 1995-2013. In Southeast Asian region, there exists an economic community called the Association of Southeast Asian Nations (ASEAN) and, except Myanmar, the study included all of them. Under the LEP, India has made many friendly connections with ASEAN members. The first phase of India's LEP was officially defined and articulated in September 1994 by Prime Minister Narasimha Rao in his Singapore lecture. He emphasized the development of a strong economic and security relationship between India and its eastern neighbors[5]. In the initial years, the emphasis was put on the economic tie ups and institutional partnership, particularly with ASEAN. In 2003, India's then foreign minister Yashwant Sinha announced the second phase of LEP by expanding the definition of East, extending from Australia to East Asia, with ASEAN at its core. Thus, Look East Policy was India's strategy

[4] See the change in RankingofAzerbaijan from 1995 to 2013 in Appendix C.
[5] Text of Prime Minister NarasimhaRao's speech, Institute of Southeast Asian Studies, Singapore, 1994.

to rebuild cooperative relations with its eastern neighbors in general and ASEAN in particular (Muni, 2011). Since 2002, India is having annual summits with ASEAN and signed the initials of ASEAN – India Free Trade Area (AIFTA) in 2003. In the 12th ASEAN-India summit – held at Nay Pyi Taw, Myanmar on12th November, 2014 – the prime minister of India, Narendra Modi, upgraded the "look east policy" to the "act east policy". This Look East Policy could be a reason of the decline in the trade costs of India with Southeast Asia and East Asia.

Trade Costs of India with Central Asia

Due to the scarceness of the data, the present study incorporates only three countries from the Central Asia, namely: Kazakhstan, Kyrgyzstan, and Tajikistan. Except Kazakhstan, the rest of the two countries are having minimal amount of trade with India[6]. The bottom panel of Figure 2 depicts the trade cost of India with the Central Asian Countries. It is clear that Indian trade costs with Central Asia fell by 17 percent on average. In 2012, India joined its hands with Central Asia by the framework of "Connect Central Asia" policy, which may help in upcoming future to reduce the trade costs further.

It becomes clear from the above discussion that the trade costs of India have declined with almost all the trading partners from Asia. Region-wise, the decline in Indian trade costs was the highest with West Asia followed by Southeast Asia, East Asia, South Asia, and Central Asia. Among others, one reason of this decline could be the reduction in policy barriers (tariff and non-tariff) due to bilateral or multilateral trade agreements of India with its Asian trading partners and the study basically emphasized on the same.

Determinants of Bilateral Trade Costs of Asia

Now, the question which comes into mind: Is there any connection between the trade costs inferred from the trade flows itself and the proxies generally used as measures of trade costs? The present section is devoted to answer this question by finding out the extent of the relationship between the observed values of bilateral trade costs and the proxies of trade costs for all the thirty-one (India plus thirty) economies of Asia. This task was carried forward by regressing the calculated trade costs on the list of available proxies, known as determinants of trade costs. The regression model has been used:

$$ln\,\tau_{ijt} = \alpha_{it} + \beta_1 Contig_{ij} + \beta_2\, ln\, Dist_{ij} + \beta_3 Land_{ij} + \beta_4 Comlang_{ij} + \beta_5\, ln\, Tariff_{ijt} + \beta_6 \ln NTB_{ijt} + \beta_7 \ln ER_{ijt} + \beta_8 \ln(PI_{it} * PI_{jt}) + \mathcal{E}_{ijt} \quad (8)$$

where, τ_{ijt} is the calculated trade costs, $Contig_{ij}$ is a dummy whether two countries are contagious to each other or not, $Dist_{ij}$ denotes distance between reporter and partner country, $Land_{ij}$ is a dummy variable equal to one if both i and j countries are landlocked, $Comlang_{ij}$ is also dummy variable having a value equal to one if both the reporter and partner countries have a common official language, $Tariff_{ijt}$ is the product of tariff rakings[7] of reporter and other trading partners, $NTB_{ijt}$is the product of non-tariff rankings of reporter and partner countries, ER_{ijt} is the average official exchange rate with respect to reporter (in USD), $\left(PI_{it} * PI_{jt}\right)$ is the product of Port Infrastructures of reporter and partner country.

[6] See Appendix C for ranking of these countries as India's trading partners.
[7] Data on tariff and non-tariff barriers are difficult to obtain for many countries across the years (see Anderson and Wincoop, 2004)

The data for contiguity, distance, exchange rate, and port infrastructure are taken from CEPII[8] and World Development Indicators (WDI). Tariff and non-tariff rankings are taken from the Economic Freedom of the World 2014 (Gwartney, Lawson and Hall, 2014) Annual Report published by Fraser Institute. The components 4A and 4B of this report are used for the tariff and non-tariff rankings. The report gives a rating on a scale from 0 to 10, where 10 is given for the low tariff and non-tariff revenues. To make the coefficients in the regression more intuitive, the study follows Novy (2011) and multiplies the logarithmic values of tariff and non-tariff rankings by (-1) such that higher values indicate higher tariff and non-tariff barriers. For the estimation purpose, firstly, the OLS regressions have been run for the years 1995, 2000, 2005, 2010 and 2012 and then Pooled OLS was applied by combining all these years. The estimated results of these six models are given in the Table 2.

Table 2
Determinants of Bilateral Trade Costs of Asia

Model	**(1) 1995**	**(2) 2000**	**(3) 2005**	**(4) 2010**	**(5) 2012**	**(6) Pooled**
Contiguity	0.043	0.003	-0.130**	-0.147**	-0.173**	-0.139**
Ln(Distance)	0.067**	0.108**	0.256**	0.185**	0.188**	0.196**
Landlocked			-0.498**	-0.629**	-0.346**	-0.524**
Common Language	0.090**	-0.099**	-0.010	-0.048	-0.050	-0.044**
Ln(Tariffs)	-0.034	20.79**	-20.88	50.61	104.30	0.128*
Ln(Non-Tariff Barriers)	7.435**	-8.145	29.940**	-6.579	-32.460	8.793*
Ln(Exchange Rate)	0.0483**	-0.020	-0.013	-0.008	-0.003	-0.009
Ln(Port Infrastructure)				0.834	-3.127*	
Constant	24.92	62.77	17.91	201.30	352.20	28.56
Observations	**57**	**154**	**441**	**575**	**603**	**1,830**
R-squared	**0.95**	**0.90**	**0.86**	**0.82**	**0.81**	**0.83**

Note. The dependent variable is logarithmic value of Trade Costs, robust OLS estimation. Country and time effects are included in the pooled regression but are not reported. ** $p < 0.01$, * $p < 0.05$. *Source:* Authors' calculations.

For discussion purposes, the study will concentrate only on the pooled Model (Model 6). The first variable (contiguity) is inversely and significantly affecting the trade costs of Asia, which has amply and clear intuition that in case of Asia, if the trading partners are sharing a common border, then the trade costs they are facing are low as compared with the courtiers that do not share common border with each other. The next variable is distance and it is significantly aggravating the trade costs of Asian trading partners with each other, meaning that the Asian countries are facing high trade costs from its far located trading partners within Asia. These two variables, contiguity and distance, come under the category of geographical/natural barriers which cannot be reduced through the policy reforms[9].

The third variable is the dummy variable having positive value if both the reporter and partner countries are landlocked countries. This variable is negatively and significantly affecting the bilateral trade costs in Asia. The fourth variable is the language spoken by the trading partners, and if the trading partners speak a common language then they are facing lower trade costs.

[8] CEPII data can be retrieved from: http://www.cepii.fr/cepii/en/bdd_modele/bdd.asp
[9] Anderson and Wincoop (2004); Chen and Novy (2009); Jacks, Meissner, and Novy (2008); Duval and Utoktham, (2011b); Khan and Kalirajan (2011).

The fifth and sixth determinants of trade costs are tariffs and non-tariff barriers. Both of these direct policy variables are affecting trade costs positively and significantly, by meaning that if the tariffs and non-tariff barriers are high then trade costs faced by trading partners will be high and vice versa. The next determinant of trade costs is the exchange rate. Here, the exchange rate is defined in terms of home currency of reporter country, so if the exchange rate rises it leads to the depreciation of home currency. Due to depreciation, home exports will increase and imports will go down, if Marshall Lerner Robinson conditions[10] are satisfied then the increase in exports outweighs the decline in imports. Hence, the total trade goes up, which also means that trade costs are declining because of inverse relationship between trade costs and trade. In the present study, the official exchange rate is inversely and insignificantly affecting the trade costs. Furthermore, the quality of port infrastructure also matters in the smooth movement of a tradable commodity (Abe & Wilson, 2011). But the data on quality of port Infrastructure is available only from the year 2007 and that is why coefficient of the same variable is present only in the two Models (4 and 5). Only in Model 5, its coefficient is significant and it is inversely affecting the trade costs of Asian countries which imply that if the level of port infrastructure is further improved, it will lower down the trade costs of Asia.

Decomposition of Growth of Indian Trade within Asia

As the Indian trade is growing with its Asian partners, the present section is a step to decompose this growth into the three components given by Novy (2011): the economic growth proxied by growth in income; reduction in the trade barriers (trade costs); and the increase in the resistance from the rest of the trading partners. To start with, take logarithms and first differences of Equation (6).

$$\Delta ln\left(x_{ij}x_{ji}\right) = 2\Delta ln\left(\frac{y_i y_j}{y^w}\right) + (1-\sigma)\Delta ln\left(t_{ij}t_{ji}\right) - (1-\sigma)\Delta ln\left(\pi_i p_i \pi_j p_j\right) \quad (9)$$

Bilateral trade cost factors $\Delta ln\left(t_{ij}t_{ji}\right)$ are unknown in the above Equation, but recalling Equation (7) of trade cost measure τ_{ij}:

$$\tau_{ij} = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{\frac{1}{2}} - 1 \quad => \tau_{ij} + 1 = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{\frac{1}{2}}$$

$$\left(\tau_{ij} + 1\right)^2 = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)$$

$$\left(t_{ij}t_{ji}\right) = \left(\tau_{ij} + 1\right)^2\left(t_{ii}t_{jj}\right)$$

Substitute $t_{ii}t_{jj}$ into Equation (9):

$$\Delta ln\left(x_{ij}x_{ji}\right) = 2\Delta ln\left(\frac{y_i y_j}{y^w}\right) + (1-\sigma)\Delta ln\left(\left(\tau_{ij} + 1\right)^2\left(t_{ii}t_{jj}\right)\right) - (1-\sigma)\Delta ln\left(\pi_i p_i \pi_j p_j\right)$$

$$\Delta ln\left(x_{ij}x_{ji}\right) = 2\Delta ln\left(\frac{y_i y_j}{y^w}\right) + 2(1-\sigma)\Delta ln\left(\tau_{ij} + 1\right) - 2(1-\sigma)\Delta ln\left(\Phi_i \Phi_j\right) \quad (10)$$

Where Φ_i and Φ_j stand for country *i* and *j*'s multilateral resistances in relation to their own domestic trade costs:

[10] See Kenen (2000), p. 323.

$$\Phi_{\mathrm{i}} = \left(\frac{\pi_i p_i}{t_{ii}}\right)^{\frac{1}{2}} \; and \; \Phi_{\mathrm{j}} = \left(\frac{\pi_j p_j}{t_{jj}}\right)^{\frac{1}{2}} \tag{11}$$

Finally, dividing by the left hand side:

$$100\% = \underbrace{\frac{2\Delta ln\left(\frac{y_i y_j}{y^w}\right)}{\Delta ln(\, x_{ij}x_{ji})}}_{(I)} + 2(1-\sigma)\underbrace{\frac{\Delta ln(\tau_{ij}+1)}{\Delta ln(\, x_{ij}x_{ji})}}_{(II)} - 2(1-\sigma)\underbrace{\frac{\Delta ln(\Phi_{\mathrm{i}}\Phi_{\mathrm{j}})}{\Delta ln(\, x_{ij}x_{ji})}}_{(III)} \tag{12}$$

In Equation (12), the growth of bilateral trade is bifurcated into three contributions: (I) the contribution of growth of income, (II) the contribution of the decline in relative bilateral trade costs, and (III) the contribution of the decline in relative multilateral resistance. Three kinds of possibilities are there: (a) If overtime, there is no change in trade barriers then contributions (II) and (III) will have zero value and growth of income solely drives the growth of bilateral trade overtime; (b) If bilateral trade costs fall$\left(i.e.,\ \Delta ln(\, \tau_{ij}+1) < 0\right)$, then contribution (II) enters positively in the model because $2(1-\sigma)$is already a negative value[11], and (c) If multilateral trade barriers/resistances fall $\left(i.e.,\ \Delta ln(\Phi_{\mathrm{i}}\Phi_{\mathrm{j}}) < 0\right)$, then it negatively contributes in the bilateral growth of trade, known as trade diversion effect.

The data on the contribution (I) $\left(\text{i.e.}\left(2\Delta ln\left(\frac{y_i y_j}{y^w}\right)/\Delta ln(\, x_{ij}x_{ji})\right)\right)$ is directly available. To calculate the contribution (II), recall Equation (7): this implies: $2(1-\sigma)\Delta ln(\tau_{ij}+1) = \Delta ln(x_{ij}x_{ji}) - \Delta ln(\, x_{ii}x_{jj})$. By using the data of $\Delta ln(x_{ij}x_{ji})$ and $\Delta ln(\, x_{ii}x_{jj})$, the contribution (II) can be calculated. For the calculation of contribution (III), use Equation (5): $2(1-\sigma)\Delta ln(\Phi_{\mathrm{i}}\Phi_{\mathrm{j}}) = \Delta ln\left(\frac{y_i/y^w}{x_{ii}/y_i}\right) + \Delta ln\left(\frac{y_j/y^w}{x_{jj}/y_j}\right)$. One thing that becomes apparently clear is that σ does not have any role to play in the decomposition of the growth of bilateral trade.

Table 3 shows the results of decomposition of growth of Indian trade with Asia. Region wise, the first component, the contribution of growth in income, has played a positive role only in case of growth of Indian trade with South Asia (22%) and Southeast Asia (37%). The second component, the decline in the trade costs, has explained all the trade growth of India with West Asia (100% = 259 - (102+57)) and Central Asia (100% = 119 − (13+6)), and majority of growth of Indian trade with East Asia (95%) and South Asia (90%) and Southeast Asia (77%). The last component, the decline in the relative multilateral resistance term, has a positive effect on the Indian trade with East Asia (49.6%) only, meaning that on an average the relative multilateral trade barriers of East Asia had increased with their other trading partners except India and this resistance from the other world has made the Indian trade more attracted for this region. However, for the rest of the regions: West Asia (-57%), South Asia (-12%), Southeast Asia (-13%) and Central Asia (-6%), the decline in relative multilateral trade barriers with the other trading partners except India is diverting the trade of these regions from India to other countries and this diversion is the most in case of West Asia followed by South Asia, Southeast Asia, and Central Asia.

[11]As $\sigma > 1$, therefore $[2(1-\sigma)] < 0$.

Table 3
Decomposition of Growth of Indian Trade within Asia

Partner	Average Change in Total Trade (USD M)	Contribution of the growth in income	Contribution of the decline in relative bilateral trade costs	Contribution of the decline in relative multilateral resistance	Total
			East Asia		
China	3,744.34	-374.23	179.04	295.21	100
Republic of Korea	944.18	60.90	59.37	-20.26	100
Hong Kong	929.54	-43.19	59.56	83.64	100
Japan	676.45	111.75	13.49	-25.23	100
Mongolia	1.25	-26.97	126.22	0.75	100
Macao	0.28	3.70	132.59	-36.29	100
Avg. East Asia	1,049.34	-44.68	95.04	49.64	100
			West Asia		
United Arab Emirates	3,570.77	87.95	75.29	-63.24	100
Saudi Arab	2,516.18	57.43	65.24	-22.66	100
Kuwait	989.02	55.53	74.95	-30.47	100
Jordan	96.64	-1091.14	1459.58	-268.44	100
Azerbaijan	60.27	155.06	-15.84	-39.22	100
Lebanon	18.26	24.80	79.25	-4.05	100
Georgia	5.50	31.54	71.51	-3.06	100
Armenia	4.00	18.56	82.09	-0.65	100
Avg. West Asia	895.95	-102.26	259.59	-57.33	100
			South Asia		
Bangladesh	299.62	-69.73	111.13	58.60	100
Sri Lanka	268.48	-23.29	96.42	26.87	100
Nepal	185.80	35.34	77.73	-13.07	100
Pakistan	135.22	72.47	119.70	-92.17	100
Maldives	7.05	96.79	47.07	-43.86	100
Avg. South Asia	179.23	22.32	90.41	-12.73	100
			Southeast Asia		
Indonesia	1,000.51	118.38	-112.53	94.15	100
Singapore	798.56	18.85	391.25	-310.10	100
Malaysia	726.25	-349.65	243.20	206.45	100
Vietnam	481.94	68.62	66.75	-35.38	100

Partner	Average Change in Total Trade (USD M)	Contribution of the growth in income	Contribution of the decline in relative bilateral trade costs	Contribution of the decline in relative multilateral resistance	Total
Thailand	454.44	-107.28	149.12	58.16	100
Philippines	53.16	746.57	-393.24	-253.33	100
Brunei	44.39	-14.76	113.82	0.94	100
Lao	15.50	-16.04	121.83	-5.79	100
Cambodia	9.07	-132.86	110.79	122.06	100
Avg. Southeast Asia	398.20	36.87	76.78	-13.65	100
			Central Asia		
Kazakhstan	42.49	-18.34	106.73	11.61	100
Tajikistan	2.41	107.62	32.00	-39.62	100
Kyrgyzstan	1.69	-127.47	219.22	8.25	100
Avg. Central Asia	15.53	-12.73	119.32	-6.59	100

Note. Source: Author's calculations.

In a nutshell, Table 3 is putting forward the evidence that the decline in the relative bilateral trade costs is a major factor in explaining the growth of Indian trade with its Asian partners. The decline in Indian trade costs had been the highest with West Asia and in the present section, the decline in trade costs is explaining all the growth of Indian trade with the same region. The second highest decline in trade costs had been with Southeast Asia and this decline has explained 76 percent growth of Indian trade with this region and rest (24%) has been explained by the growth of income. The decline in Indian trade costs was the third highest with East Asia and here also, the same factor is explaining the growth of Indian trade with East Asia. Moving to the South Asia, the decline in the Indian trade costs was second lowest with this region and this decline in trade costs explains the 90 percent growth of Indian trade with the same region. The decline in the Indian trade costs was the lowest with the Central Asian economies and this decline explains all the growth of Indian trade with Central Asia. Hence, trade costs play a major role in explaining the growth of Indian trade with its Asian trading partners over the study period.

Conclusions

Trade costs are the costs that are incurred to move a good from the production site to the site of final consumer. Due the paucity of data on the direct measures of trade costs, the present study infers trade costs from the available trade data. Basically, the study has three main objectives: to measure the trade costs for India with its trading partners from the Asian region; to find out the determinants of these calculated trade costs by using the data on the available trade cost proxies; and to decompose the growth of Indian trade with Asian partners into the contribution of growth in income, the contribution of the decline in bilateral trade costs and the contribution of the decline in multilateral resistance.

It is found that trade costs of India with its all Asian partners have declined across the whole the study period (1995-2013). The decline in Indian trade costs was the highest with West Asia followed by Southeast Asia, East Asia, South Asia and Central Asia. Then, the study has found that the variables, used as determinants of trade costs – namely: contiguity, distance, tariffs, non-tariff barriers, exchange rate and port infrastructure – behaved in the proper

way as predicted by theory. Furthermore, the decomposition of the growth of Indian trade with the Asian regions reveals that the decline in the relative bilateral trade costs has been the driving force of growth of Indian trade with all the regions of Asia.

References

Abe, K., & Wilson, J. S. (2011). Investing in port infrastructure to lower trade costs in East Asia. *Journal of East Asian Economic Integration*, *15*(2), 3–32. dx.doi.org/10.11644/kiep.jeai.2011.15.2.228

Anderson, J. E. (1979). A Theoretical foundation for the gravity equation. *The American Economic Review, 69*(1), 106–116.

Anderson, J. E., & Wincoop, E. V. (2003). Gravity with gravitas: A Solution to the border puzzle. *The American Economic Review*, *93*(1), 170–192. dx.doi.org/10.1257/000282803321455214

Anderson, J. E., & Wincoop, E. V. (2004). Trade costs. *Journal of Economic Literature*, *42*(3), 691–751. dx.doi.org/10.1257/0022051042177649

Chaney, T. (2008). Distorted gravity: The Intensive and extensive margins of international trade. *American Economic Review*, *98*(4), 1707–1721. dx.doi.org/10.1257/aer.98.4.1707

Chen, N., & Novy, D. (2009). *International trade integration: A disaggregated approach* (Cesifo Working Paper No. 2595, Category 8: Trade Policy).

Duval, Y., & Utoktham, C. (2011a). Intraregional trade costs in Asia: A primer. *Asia-Pacific Development Journal*, *18*(2), 1–23.

Duval, Y., & Utoktham, C. (2011b). *Trade costs in the India-Mekong Subregion: Identifying policy priorities for trade facilitation* (Trade and investment division, staff working paper No. 04/11).

Eaton, J., & Kortum, S. (2002). Technology, geography, and trade. *Econometrica*, *70*(5), 1741–1779.

Gwartney, J., Lawson, R. and Hall, J. (2014), Economic Freedom Dataset, *Economic Freedom of the World: 2014 Annual Report,* Fraser Institute.

Jacks, D. S., Meissner, C. M., & Novy, D. (2008). Trade costs, 1870–2000. *American Economic Review: Papers & Proceedings*, *98*(2), 529–534. dx.doi.org/10.1257/aer.98.2.529

Kenen, P. B. (2000). *The international economy*, (4th ed.). Cambridge, UK: Cambridge University Press.

Khan, I. U., & Kalirajan, K. (2011). The impact of trade costs on exports: An empirical modeling. *Economic Modelling*, *28*, 1341–1347. dx.doi.org/10.1016/j.econmod.2011.02.031

McCallum, J. (1995). National borders matter: Canada-U.S. regional trade patterns. *The American Economic Review*, *85*(3), 615–623.

Melitz, M. J., & Ottaviano, G. I. (2008). Market size, trade, and productivity. *Review of Economic Studies, 75*, 295–316. dx.doi.org/10.1111/j.1467-937x.2007.00463.x

Muni, S. D. (2011). *India's 'look east' policy: The strategic dimension* (ISAS Working Paper No. 121).

Novy, D. (2011). Gravity redux: Measuring international trade costs with panel data. University of Warwick, United Kingdom. Retrieved from http://www2.warwick.ac.uk/fac/soc/economics/staff/dnovy/redux.pdf.

Obstfeld, M., Rogoff, K., & (eds.). (2000). The six major puzzles in international macroeconomics: Is there a common cause? In B. S. Bemanke, & K. Rogoff (Eds.), *NBER macroeconomics annual* (pp. 339–390). Cambridge, UK: MIT Press.

Tinbergen, J. (1962). An analysis of world trade flows. In J. Tinbergen(Ed.), *Shaping the world economy*. New York, NY: Twentieth Century Fund.

International Center for Promotion of Enterprises
ICPE

Authors Note

The authors are thankful to the anonymous reviewers for their useful comments to improve the quality of this work.

Correspondence concerning this article should be addressed to Sarbjit Singh, Department of Humanities and Social Sciences, IIT Kanpur Faculty building, IIT Kanpur – 208016 (UP), India. Email: sarbjit@iitk.ac.in, singhsarbmatharu@gmail.com

Biographical Notes

Sarbjit Singh is a Senior Ph.D. student in Economics in the Department of Humanities and Social Sciences at IIT Kanpur, India. His broader area of research is Quantitative analysis of International Trade. In his Ph.D., he is working on the Calculation of Trade Costs and their impact on Trade Flows. His detailed academic profile can be viewed at: http://www.iitk.ac.in/new/sarbjit-singh.

Rahul Arora is a Senior Ph.D. student in Economics in the Department of Humanities and Social Sciences at IIT Kanpur, India. His broader area of research is Quantitative analysis of International Trade. In his Ph.D., he is working on the General Equilibrium evaluation of proposed RTAs using GTAP model. His detailed academic profile is available at: http://www.iitk.ac.in/new/rahul-arora.

Somesh K. Mathur, M.A., M. Phil, Ph.D., is an Associate Professor of Economics in the Department of Humanities and Social Sciences at IIT Kanpur, India. His main area of interest is the empirical analysis of international trade and applied econometrics. He teaches international economics and econometrics at IIT Kanpur. His area of interest lies in efficiency and productivity analysis, new trade and growth theories, evaluating Economic agreements, Gravity Analysis convergence issues, TRIPS and other WTO issues. He has participated in various national and international conferences and has published in refereed national and international journals.

S. Singh et al. (2016)
Public Enterprise
Volume 22, Issue 1, pp. 35-55, 2016
https://doi.org/pehyj.2016.2201.03

International Center for Promotion of Enterprises
ICPE

Appendix A

Derivation of Trade Costs from Anderson and Wincoop (2003)

Anderson and Wincoop (2003)'s framework

$$x_{ij} = \frac{y_i y_j}{y^w}\left(\frac{t_{ij}}{\pi_i p_j}\right)^{1-\sigma} \tag{1}$$

and

$$\pi_i{}^{1-\sigma} = \sum_j p_j^{1-\sigma}\theta_j t_{ij}^{1-\sigma}\ \forall_i \tag{1.A}$$

$$p_j{}^{1-\sigma} = \sum_i \pi_i^{1-\sigma}\theta_i t_{ij}^{1-\sigma}\ \forall_j \tag{1.B}$$

By using gravity Equation (1) to find the expression for country *i*'s intranational trade:

$$x_{ii} = \frac{y_i y_i}{y^w}\left(\frac{t_{ii}}{\pi_i p_i}\right)^{1-\sigma} \tag{2}$$

Equation (4) can be solved for the product of outward and inward multilateral resistance as:

$$\pi_i p_i = \left(\frac{x_{ii}/y_i}{y_i/y^w}\right)^{\frac{1}{(\sigma-1)}} t_{ii} \tag{3}$$

Multiply Equation (1) withx_{ji}, to obtain a bidirectional gravity Equation that contains both countries' outward and inward multilateral resistance variables:

$$x_{ij}x_{ji} = \left(\frac{y_i y_j}{y^w}\right)^2\left(\frac{t_{ij}t_{ji}}{\pi_i p_i \pi_j p_j}\right)^{1-\sigma} \tag{4}$$

Substituting the solution from Equation (5) yields:

$$x_{ij}x_{ji} = \left(\frac{y_i y_j}{y^w}\right)^2\left(\frac{t_{ij}t_{ji}}{\left(\frac{x_{ii}/y_i}{y_i/y^w}\right)^{\frac{1}{(\sigma-1)}} t_{ii}\left(\frac{x_{jj}/y_j}{y_j/y^w}\right)^{\frac{1}{(\sigma-1)}} t_{jj}}\right)^{1-\sigma} \tag{5}$$

$$x_{ij}x_{ji} = \left(\frac{y_i y_j}{y^w}\right)^2\left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\left(\frac{x_{ii}/y_i}{y_i/y^w}\right)^{\frac{1}{(1-\sigma)}}\left(\frac{x_{jj}/y_j}{y_j/y^w}\right)^{\frac{1}{(1-\sigma)}}\right)^{1-\sigma}$$

$$x_{ij}x_{ji} = \left(\frac{y_i y_j}{y^w}\right)^2\left(\frac{x_{ii}/y_i}{y_i/y^w}\right)^{\frac{1-\sigma}{(1-\sigma)}}\left(\frac{x_{jj}/y_j}{y_j/y^w}\right)^{\frac{1-\sigma}{(1-\sigma)}}\left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{1-\sigma}$$

$$x_{ij}x_{ji} = \left(\frac{y_i y_j}{y^w}\right)^2 \left(\frac{x_{ii}}{y_i}\frac{y^w}{y_i}\right)\left(\frac{x_{jj}}{y_j}\frac{y^w}{y_j}\right)\left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{1-\sigma}$$

$$x_{ij}x_{ji} = \left(\frac{y_i y_j}{y^w}\right)^2 \left(\frac{y^w}{{y_i}^2}\right)\left(\frac{y^w}{{y_j}^2}\right)(x_{ii}x_{jj})\left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{1-\sigma}$$

$$x_{ij}x_{ji} = \left(\frac{y_i y_j}{y^w}\right)^2 \left(\frac{y^w}{y_i y_j}\right)^2 (x_{ii}x_{jj})\left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{1-\sigma}$$

$$x_{ij}x_{ji} = (x_{ii}x_{jj})\left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{1-\sigma}$$

$$x_{ij}x_{ji} = (x_{ii}x_{jj})\left(\frac{t_{ii}t_{jj}}{t_{ij}t_{ji}}\right)^{\sigma-1}$$

$$\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}} = \left(\frac{x_{ii}x_{jj}}{x_{ij}x_{ji}}\right)^{\frac{1}{\sigma-1}} \quad (6)$$

As $(t_{ij} \neq t_{ji})$ and $(t_{ii} \neq t_{jj})$, so it is useful to take the geometric mean of the barriers in both directions. To make it tariff equivalent deduct one from the final measure.

$$\tau_{ij} = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{\frac{1}{2}} - 1 = \left(\frac{x_{ii}x_{jj}}{x_{ij}x_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1 \quad (7)$$

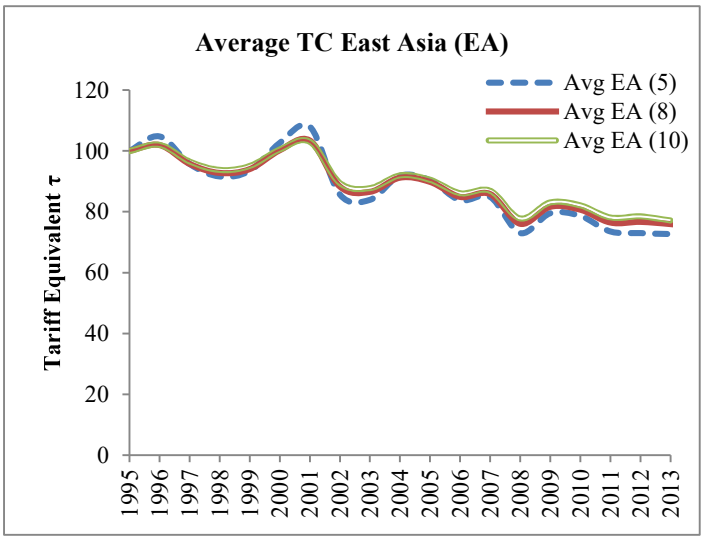
τ_{ij} measures bilateral trade costs $t_{ij}t_{ji}$ relative to domestic trade costs $t_{ii}t_{jj}$.

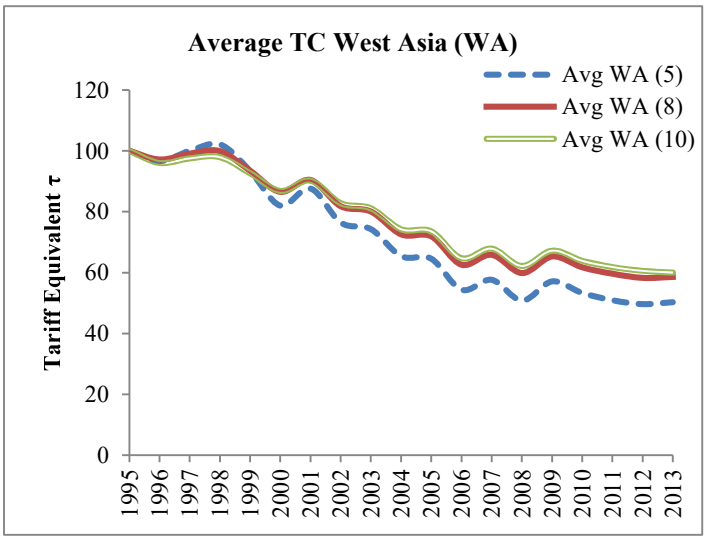
S. Singh et al. (2016)
Public Enterprise
Volume 22, Issue 1, pp. 35-55, 2016
https://doi.org/pehyj.2016.2201.03

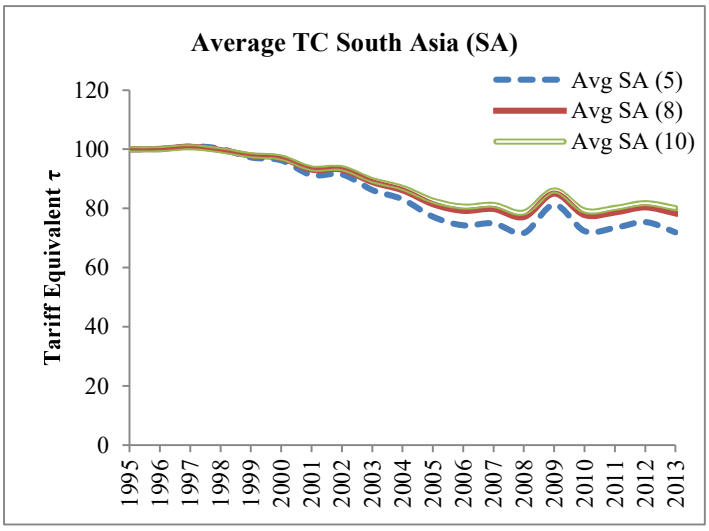
International Center for Promotion of Enterprises
ICPE

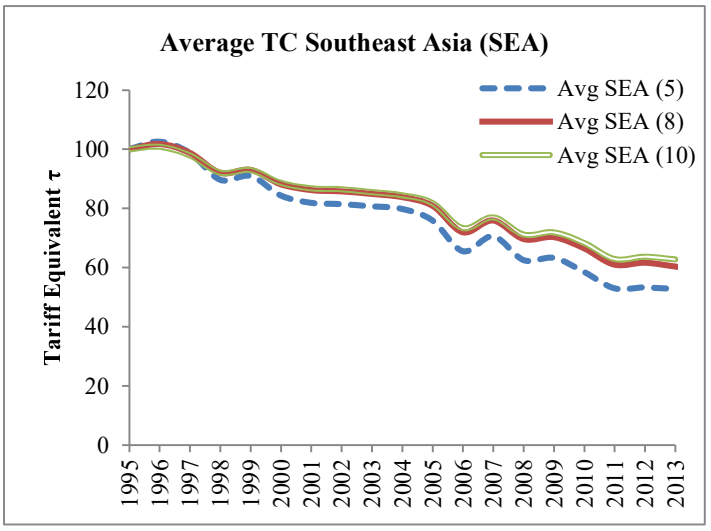
Appendix B

Sensitivity Analysis of Trade Costs (TC) for each Region with Sigma 5, 8, and 10



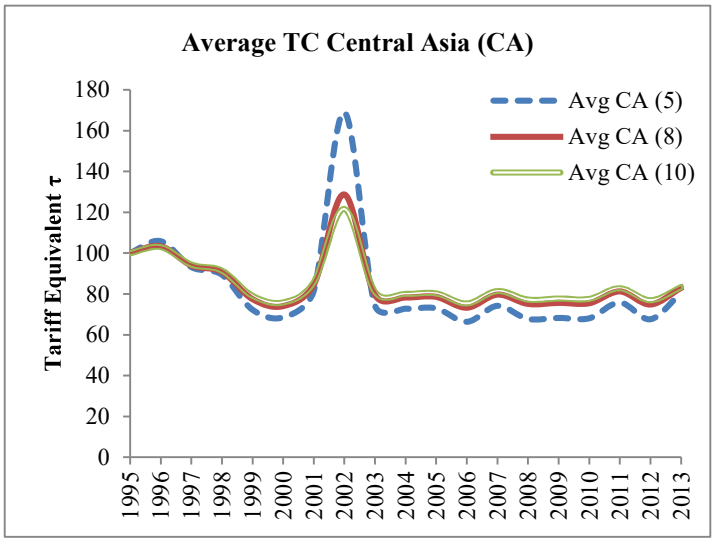






S. Singh et al. (2016)
Public Enterprise
Volume 22, Issue 1, pp. 35-55, 2016
https://doi.org/pehyj.2016.2201.03

International Center for Promotion of Enterprises
ICPE



Note. Source: Authors' calculations.

Appendix C

Region	Reporter	Trade Costs		Percentage decline in Trade Costs	Partner Rankings	
		1995	2013		1997	2013
East Asia	China	146	84	42	13	1
	Hong Kong	78	54	31	10	7
	Japan	116	101	13	4	16
	Republic of Korea	124	86	30	18	14
	Macao	355	334	6	206	188
	Mongolia	327	257	22	145	171
	Avg EA	214	142	33	--	--
West Asia	Armenia	445	291	35	168	145
	Azerbaijan	423	171	60	128	61
	Georgia	450	211	53	182	131
	Jordan	120	110	9	42	50
	Lebanon	322	185	43	94	95
	Saudi Arab	100	62	38	9	4
	United Arab Emirates	77	36	53	7	3
	Avg WA	248	152	39	--	--
South Asia	Bangladesh	117	103	12	26	30
	Maldives	218	170	22	114	135
	Nepal	127	96	24	38	44
	Pakistan	182	134	26	49	47
	Sri Lanka	129	98	24	31	38
	Avg SA	155	120	22	--	--
	Brunei	358	128	64	133	77
	Cambodia	329	203	38	124	123

Southeast Asia	Indonesia	128	91	29	21	8
	Lao	366	149	59	157	139
	Malaysia	104	76	27	15	21
	Philippines	201	166	18	39	55
	Singapore	92	57	38	14	10
	Thailand	138	95	31	30	27
	Vietnam	176	85	52	59	29
	Avg SEA	191	117	39	--	--
Central Asia	Kazakhstan	223	151	32	77	73
	Kyrghyzstan	549	255	54	109	163
	Tajikistan	222	299	-35	212	153
	Avg CA	331	225	32	--	--

Note. Source: Authors' calculations.