An enquiry of trade costs, trade cost determinants and trade growth accounting between India and APEC Nations

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Abstract

Trade costs and its analysis has been the centre stage of economics research since long. With the advent of various trade theories, statistical sophistication and ease of data availability, there are a lot of aspects of international trade which can be analysed. This paper is a similar attempt to understand the bilateral trade costs of India and various APEC (Asia Pacific Economic Cooperation) nations over the period of 1990 to 2014. We employ the micro founded measure of trade costs derived by Novy(2013) which in turn employs the gravity formulation proposed by Anderson and van Wincoop(2003). The tariff equivalent τ_{ij} is found to decrease over time for most of the 16 APEC nations analysed albeit with fluctuations. The fixed effects and pooled OLS estimation of trade cost determinants reveal RTAs and tariff to be a statistically significant factor along with time effects. We also decompose bilateral trade growth to determine the contribution of factors like income convergence or income inequality, income growth, decline in bilateral and multilateral trade costs. As expected, income convergence contributes least whereas income growth and decline in bilateral trade costs have varied contributions for different trading partner. This has been discussed at length in the study.

Keywords: APEC, Fixed effects, Gravity model, RTA, Trade costs.
JEL Classification: F10, F14, F15.

1 Introduction

The second half of the 20th century and the beginning of 21st century has seen an enormous surge in trade across nations in various sectors. Almost every country engages in trade with multiple countries based on various factors which are an interest to academicians, politicians, bureaucratic officials, corporate firms and even activists. Trade in modern world is not just limited to fulfilling the nation's need in resources which it lacks but is also crucial from a strategic point of view. The type of trading parters of a nation also determines its stance in international politics. Another major reason why trade has become so eminent is due to the lowering of trade costs along the years. Technological advancements and better trade policies have played a major role in easing trade across nations and lowering trade barriers across the nations.
This study focuses on aggregate trade costs, its determinants and the growth of trade between India and the APEC (Asia Pacific Economic Cooperation) nations. As described in its official website:

> *The Asia-Pacific Economic Cooperation (APEC) is a regional economic forum established in 1989 to leverage the growing interdependence of the Asia-Pacific. APEC's 21 members aim to create greater prosperity for the people of the region by promoting balanced, inclusive, sustainable, innovative and secure growth and by accelerating regional economic integration.*

As quoted in APEC's website, APEC nations are home to about 2.8 billion people and represent approximately 57 % of world GDP and 47 % of world trade in 2012. The real GDP nearly doubled from USD 16 trillion in 1989 to USD 31 trillion in 2013 whereas per capital income of residents of the Asia-Pacific rose by 45 %. Its member nations are the 21 Pacific Rim nations: Australia, Brunei Darussalam, Canada, Chile, People's Republic of China, Hong Kong, Indonesia, Japan, Republic of Korea, Malaysia, Mexico, New Zealand, Papua New Guinea, Peru, The Philippines, Russia, Singapore, Chinese Taipei (Taiwan), Thailand, The United States, Vietnam. Due to data limitations and errors we have excluded Brunei Darussalam, Hong Kong, Taiwan, Thailand and Vietnam from the sample.
One of the major objectives of APEC is to facilitate trade among the member nations which in turn would lead to greater economic integration, growth and prosperity among the members. This is achieved by undertaking various measures like logistical and technological improvements so as to reduce transaction costs in trade, import regulation and tariff reduction, focusing on non tariff measures like ease of business, deregulation and other reforms to name a few. Though India does exercise multiple regional trade agreements (RTAs) and free trade agreements (FTAs) with many of the member nations in APEC, it is not formally a part of this group. As a part of ASEAN-India Free Trade Area (AIFTA), India has had significant trade relations with the ten ASEAN member nations seven of which are part of APEC as well, namely Brunei Darussalam, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam. AIFTA came into force since 1st January 2010. Apart from this India is also part of Global System of Trade Preferences among Developing Countries (GSTP) since 1989. This has allowed bilateral trade in specified goods at a lower cost with nations like Republic of Korea (South Korea), Mexico, Peru and Chile apart from some of the ASEAN nations as well [1]. The Asia Pacific Trade Agreement (APTA), the oldest trade agreement between few Asia Pacific countries (1976) has facilitated trade with nations like Republic of Korea and China which are part of APEC as well. Various bilateral trade agreements like India-Singapore, Korea,Republic-India and Chile-India are also existent which facilitate trade between India and these nations [2]. Though India is not a part of

[1] ASEAN Nations like Philippines, Indonesia, Malaysia, Singapore, Thailand, Vietnam are also part of GSTP.
[2] This information on RTAs and FTAs has been taken from the website of World Trade Organisation (WTO).

APEC, it is expected that India's induction would result in further trade facilitation between India and APEC nations and economically beneficial for India and APEC as a whole. As of 2013, India ranks 19 in the World as an exporter of merchandise goods and 12 as an importer. In case of commercial services, it is ranked 6 as an exporter and 9 as an importer [3].
The focus of this study is different. It focusses on the analysis of trade cost between bilateral trade between India and APEC nations [4] over the period of 25 years between 1990 to 2014. The tariff equivalent derived from observable trade flow of merchandise goods following the methodology adopted by Novy(2013) reveals a mean decrease of 39.92 % of tariff equivalent for the 16 APEC Nations analysed from 1990 - 2014. The decrease in tariff equivalent is found to be maximum in case of China about 68.09 %. Whereas the fall is minimum in case of Canada, only about 14.50 % from 1990 - 2010 [5]. A fall of over 50 % in tariff equivalent is observed in bilateral trade with Chile (-55.19 %), Republic of Korea (-54.26 %), Mexico (-53.31 %), Peru (-56.1 %). The trade equivalent is regressed over various trade cost determinants like distance, tariff etc. so as to find the relative significance of various factors over the years across countries. We then decompose the bilateral trade between India and APEC nations into four major components: Income convergence, Growth of income, decline in bilateral trade barriers and decline in multilateral trade barriers across 1990 - 2014. The income convergence is found to have the lowest contribution followed by decrease in multilateral trade barrier. Income growth and decline in bilateral trade barrier have different contributions across different nations. On an average both have almost the same contribution i.e. $\sim$ 61 %. We attempt to justify and interpret these results in a greater detail in later sections.
The rest of this paper is organised as follows. Section 2 is a brief review of relevant literature in this field. It primarily focuses on seminal studies pertaining to trade costs and trade growth analysis. Section 3 elucidates the methodology adopted by this study. Section 4 details the data sources and dataset of the analysis. Results are discussed at length in Section 5. Section 6 concludes.

2 Review of Literature

Trade costs have been an active area of research, primarily owing to the evolving nature of trade over time. Various theoretical and empirical studies have suggest varied methodologies to analyse trade costs and trade growth. Gravity modelling has become a center stage in studying trade relations between nations in the domain of international economics, owing to its ability to relate economic size, bilateral trade barriers to bilateral trade flows. Anderson(1979) presented the gravity model based on constant elasticity of substitution (CES) and goods differentiated by the country of origin. Bergstrand(1990) applied the CES gravity formulation in case of monopolistic competition and Ohlin-Hecksher model. One of the major theoretical underpinnings of the gravity model in trade was provided by Deardorff(1998). He demonstrated that almost any model of trade can be traced back to any form of gravity equation, suspecting its use for empirical tests. Helpman et al.(2008) derived the gravity formulation for a heterogeneous firms model of trade. It was significant as it dealt with the issue of zero trade observations, asymmetric trade flows and extensive margin of trade. The problem of zero trade data was circumvented using a 2 stage estimation, involving a probit estimation on bilateral trade between countries and gravity regression.
This paper analyses the trade costs and its determinants between India and the APEC nations

[3] Statistics according to World Trde Organisation Trade Profile.
[4] Excluding Brunei Darussalam, Hong Kong, Taiwan, Thailand and Vietnam.
[5] Data for Canada was available only till 2010.

by employing the gravity model of trade proposed by Anderson and van Wincoop (2003). This seminal paper by Anderson and van Wincoop (2003) developed a consistent and efficient method of estimating gravity equations and improved upon the analysis of McCallum (1995) by addressing a number of issues like omitted variable bias and inclusion of multilateral resistance by building upon Anderson(1979)'s assumption of constant CES and that goods are differentiated by country of origin. Several functional forms have been proposed by various researchers which basically share the same skeleton but have difference in parameter specification. Apart from the gravity model proposed by Anderson and van Wincoop (2003), the Ricardian model by Eaton and Kortum (2002) as well as the heterogeneous firms models by Chaney (2008) and Melitz and Ottaviano (2008). Although these models make different assumptions about the driving forces behind international trade, they yield a common functional specification for gravity equation in general equilibrium. Baldwin and Taglioni (2006) extend the theoretical foundation laid by Anderson and van Wincoop (2003) so as to account for the multilateral resistance terms in a panel setting using time varying country dummies and pair wise time invariant dummies for bilateral trade. Baldwin and Taglioni (2006) also redress some common mistakes made by researches while estimating the gravity equation econometrically. Since this study doesn't estimate the gravity equation, We won't discuss those results here.
This paper draws its methodology largely from Novy(2013)'s analysis of trade cost and trade growth decomposition. We do make some significant alterations like use of value added data rather than data in gross shipments terms. This follows from the study by Duval et al.(2015) who have developed a goods (total trade in manufacturing and agriculture) and services (total trade in transport and telecom, and finance and insurance) trade cost database using value added data for 20 developed and developing nations for 1995, 2000, 2005, 2008 and 2009. They show that a similar trend is followed in value added data as shown by gross shipments data, though value added trade costs tend to decline over a steeper rate. They also present comparisons of disaggregated trade costs for several nations and nation groups over the time period, hence deriving several interpretations [6].

3 Methodology

This paper employs the micro founded measure of aggregate bilateral trade costs derived by Novy(2013) in his seminal paper. This derivation of aggregate bilateral trade cost is based on the gravity model proposed by Anderson and van Wincoop(2003) but as shown by Novy(2013), the methodology can be extended to other models as well. The derived measure for trade cost expresses trade cost variables as a function of trade flows, size of the economy, bilateral and multilateral trade barriers. These bilateral and multilateral trade barrier terms implicitly take into account factors like tariffs, trade restrictions, effect of common language, ethnicity, bureaucracy and red tape, logistical and technological factors, distance to name a few, as they have been derived from the observed trade flows. The theoretical foundation and robustness of such a methodology has been elaborated by Novy(2013)[7].
The aggregate measure of trade cost between country i and j is expressed as a tariff equivalent τ_{ij} whose specification has been elaborated in the next sub-section. The tariff equivalent is then regressed over various time variant and time invariant trade cost determinants, which include geographical and institutional factors to get a better idea as to how do these factors affect the aggregate trade cost over a period of time, across countries. However the tariff equivalent is

[6] Since those comparisons aren't relevant for this study, they are not discussed here. Refer Duval et al. (2015) for details.

[7] Refer Novy(2013) for details.

itself a time varying measure as it has been derived from time varying trade flows across the nations.
The gravity specification by Anderson and van Wincoop (2003) is then used to decompose the growth of bilateral trade into components like decline of bilateral and multilateral trade barriers and the growth of income in the similar fashion as that of Novy(2013). The major difference between the decomposition by Novy(2013) and this paper is the use of income inequality or income convergence between two trading partners along with their growth in income. This extension follows from the decomposition by Baier and Bergstrand(2001), where they express the product of incomes as income share and sum of incomes. We denote the income shares as income inequality as this measure captures the relative difference between the incomes of two trading partners. Baier and Bergstrand(2001) interpret this term as the contribution of income convergence. The following sub sections dwell further into the methodology adopted for the analysis.

3.1 Trade Cost Specification

As mentioned before, we use the gravity model formulation proposed Anderson and van Wincoop(2003) and the aggregation of trade cost derived by Novy(2013). The gravity model specified by Anderson and van Wincoop(2003) is:

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

where, x_{ij} denotes nominal trade flow (or exports) from country i to j, y_i is the nominal income of country i, y_j is the nominal income of country j. y^W is the world income. $\sigma > 1$ is the elasticity of substitution. Since the model assumes consumer preferences to be identical across nations, σ is taken to be a constant equal to eight. Π_i and P_j are country i and $j's$ price index.
Bilateral trade costs are specified as t_{ij}. Both international and intra-national trade flows depend on the bilateral trade barrier. Rise in bilateral trade costs tend to decrease trade flows but they are measured relative to the price indices Π_i and P_j. These price indices are referred as *multilateral trade resistance* by Anderson and van Wincoop (2003) as they include trade costs with other nations and can be assumed as an average trade costs. Hence, Π_i is outward multilateral trade resistance and P_i is its inward multilateral trade resistance. Product of outward and inward trade resistance yields:

$$\Pi_i P_i = \left(\frac{x_{ii}/y_i}{y_i/y^W} \right)^{\frac{1}{\sigma-1}} t_{ii} \tag{2}$$

Equation 2 solves for the product of inward and outward multilateral resistance of country i. Multiplying equation 1 with the corresponding trade flow in opposite direction, x_{ji}, for bidirectional gravity equation:

$$x_{ij} x_{ji} = \frac{y_i y_j}{y^W}^2 \left(\frac{t_{ij} t_{ji}}{\Pi_i P_i \Pi_j P_j} \right)^{1-\sigma} \tag{3}$$

Substituting from equation 2:

$$\frac{t_{ij} t_{ji}}{t_{ii} t_{jj}} = \left(\frac{x_{ii} x_{jj}}{x_{ij} x_{ji}} \right)^{\frac{1}{\sigma-1}} \tag{4}$$

where, x_{ii} and x_{jj} measure intra-national trade in country i and j respectively. Two crucial distinctions are necessary at this point.

1. This study computes value added trade costs in goods. This is in contrast with Novy(2013) and various other studies conducted in this domain. This is primarily done due to ease of data availability and to maintain a uniformity in computation of intra-national trade measure [8].

2. As demonstrated by Duval et al.(2015) value added trade costs and trade costs in gross terms follow a similar trend, though value added trade costs tend to decline over a steeper rate than gross trade costs [9].

3. Since this study only considers trade costs of merchandise goods, x_{ii} is computed as: $x_{ii} = y_i - services(\text{value added}) - x_i$. Where x_i is the total exports from country i to the World as a partner.

As specified by Novy(2013), $t_{ii} \neq t_{jj}$ and $t_{ij} \neq t_{ji}$ the resulting trade cost measure or tariff equivalent can be specified as:

$$\tau_{ij} \equiv \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{1/2} - 1 = \left(\frac{x_{ii}x_{jj}}{x_{ij}x_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1 \quad (5)$$

where, τ_{ij} measures the bilateral trade costs $t_{ij}t_{ji}$ relative to $t_{ii}t_{jj}$ as a geometric mean of trade flows (and hence the trade barriers) in both the directions. The tariff equivalent is effective in case of asymmetric trade barriers and asymmetric trade flows [10].
We calculate the tariff equivalent τ_{ij} for India and the APEC nations assuming India as country i. This would provide a comparative indication of trade costs of India with all these nations over the time period 1990 - 2014.

3.2 Econometric estimation of trade cost determinants

Regressing τ_{ij} on various geographical and institutional variables will shed light on the effect of various trade cost determinants. The estimated equation is:

$$\begin{aligned}\tau_{ij} =& \beta_0 + \beta_1 \ln(dist_{ij}) + \beta_2 adj_{ij} + \beta_3 island_{ij} + \beta_4 lang_{ij} + \beta_5 \ln(tariff_{ij}) + \\ & \beta_6 ccol_{ij} + \beta_7 RTA_{ij} + \sum_{i=2}^{25} \alpha_i t_i + \epsilon_{ij}\end{aligned} \quad (6)$$

where, $\ln(dist_{ij})$ measures the logarithm of distance between country i and j (captured by great circle distance), adj_{ij} is a dummy variable which specifies if the countries i and j share a common border or not (i.e. common border with India), $island_{ij}$ is a dummy variable which takes a value 1 if country j is an island country and 0 otherwise. $lang_{ij}$ is also a dummy variable specifying if the two nations share a common language. $ln(tariff_{ij})$ considers the ratings of the tariff regime of the nations over time. It is denoted as negative of natural logarithm of product of tariff ratings of India and country j. RTA_{ij} is a dummy variable specifying if country j is part of any FTA or RTA with India (country i). $ccol_{ij}$ is also a dummy variable specifying if country j shared a common colonial rule with India.

[8] Production data on many countries is unavailable. So to compute intra-national trade data in gross shipment terms, one needs to multiply value added data to shipment/value-added ratio (Wei(1996)). This leads to inconsistency of computation across the countries. To avoid this inconsistency, we use value added data

[9] Duval et al.(2015) also enumerates various advantages of value added trade costs over gross trade costs. See Duval et al.(2015) for details.

[10] for a better exposition of τ_{ij} and its interpretation under different contexts refer Novy(2013).

Since this study incorporates a wide time period, it is important to capture time effects as well. To account for this we have added t-1 i.e. 24 time dummies from t_2 (1991) to t_{25} (2014) where 1990 is taken as the base period.
Since the time series variables tau_{ij} and $ln(tariff_{ij})$ may suffer from unit root problem, we test them for panel unit root. We use Im-Pesaran-Shin unit root test developed by Im, Pesaran and Shin(2003) as it allows for unbalanced panel as well. The estimation is performed using one way and two way (using time effects) fixed effects with robust standard errors so as to correct heteroskedasticity. Pooled OLS estimates are also reported so as to get an indication of time invariant factors as fixed effects regression omits them.

3.3 Trade Growth Accounting

In order to better understand the question of how trade between nations has evolved over time and what factor(s) contribute most, we need to look over the various components of growth of trade. The gravity model provides a simple yet powerful framework to analyse the same. We use the gravity model by Anderson and van Wincoop (2003) and follow the derivation similar to Novy(2013). Taking natural log and first difference of equation 3, we get:

$$\Delta \ln(x_{ij}x_{ji}) = 2\Delta \ln\left(\frac{y_i y_j}{y^W}\right) + (1-\sigma)\Delta \ln(t_{ij}t_{ji}) - (1-\sigma)\Delta \ln(\Pi_i P_i \Pi_j P_j) \tag{7}$$

Equation 7 related growth in bilateral trade, $\Delta \ln(x_{ij}x_{ji})$ to growth in incomes of the two countries relative to world income, change in bilateral trade barriers ($\Delta \ln(t_{ij}t_{ji})$) and change in multilateral trade barriers for both the countries ($\Delta \ln(\Pi_i P_i \Pi_j P_j)$). Substituting τ_{ij} and some manipulation of equation 7 yields:

$$\Delta \ln(x_{ij}x_{ji}) = 2\Delta \ln\left(\frac{y_i y_j}{y^W}\right) + 2(1-\sigma)\Delta \ln(1+\tau_{ij}) - 2(1-\sigma)\Delta \ln(\Phi_i \Phi_j) \tag{8}$$

where Φ_i is country i's multilateral trade barrier relative to its domestic trade costs. $\Phi_i = \left(\frac{\Pi_i P_j}{t_{ii}}\right)^{\frac{1}{2}}$.
We further decompose the product of incomes $y_i y_j$ as done by Baier and Bergstrand (2001). We define income inequality or income share as $s_i = y_i/(y_i + y_j)$. So, $\Delta \ln(y_i y_j) = \Delta \ln(s_i s_j) + 2\Delta \ln(y_i + y_j)$. Equation 8 can now be represented as:

$$\Delta \ln(x_{ij}x_{ji}) = 2\Delta \ln(s_i s_j) + 2\Delta \ln\left(\frac{(y_i+y_j)^2}{y^W}\right) + 2(1-\sigma)\Delta \ln(1+\tau_{ij}) - 2(1-\sigma)\Delta \ln(\Phi_i \Phi_j) \tag{9}$$

where $\Delta \ln(s_i s_j)$ can be interpreted as income convergence or change in income inequality between countries i and j. The second term, $\Delta \ln\left(\frac{(y_i+y_j)^2}{y^W}\right)$ can be interpreted as growth in incomes of country i and j relative to world income [11]. Dividing equation 9 throughout by left hand term, we obtain:

[11] Novy(2013) interprets $\Delta \ln\left(\frac{y_i y_j}{y^W}\right)$ as the growth in incomes of country i and j relative to world income. $\Delta \ln\left(\frac{(y_i+y_j)^2}{y^W}\right)$ has been derived from the same term by a small mathematical manipulation, hence it is plausible to assume this as income growth as well. The only difference is that we assume income growth in an additive sense whereas Novy(2013) assumes it in a multiplicative sense.

$$100\% = \underbrace{\frac{2\Delta\ln(s_i s_j)}{\Delta\ln(x_{ij}x_{ji})}}_{(a)} + \underbrace{\frac{2\Delta\ln\left(\frac{(y_i+y_j)^2}{y^W}\right)}{\Delta\ln(x_{ij}x_{ji})}}_{(b)} + \underbrace{\frac{2(1-\sigma)\Delta\ln(1+\tau_{ij})}{\Delta\ln(x_{ij}x_{ji})}}_{(c)} - \underbrace{\frac{2(1-\sigma)\Delta\ln(\Phi_i\Phi_j)}{\Delta\ln(x_{ij}x_{ji})}}_{(d)} \qquad (10)$$

Equation 10 decomposes growth of bilateral trade into four components which would be of focus in this study. The contributions are: (a) the contribution of income inequality or income convergence, (b) the contribution of growth of incomes (in an additive sense) relative to world income, (c) the contribution of change in relative bilateral trade costs measured using the tariff equivalent τ_{ij}, and (d) the contribution of change in relative multilateral resistance. The contribution of (c) and (d) can be positive or negative depending on various factors which will not be analysed in this study[12]. Novy(2013) refers to the negative contribution of (d) as trade diversion effect, i.e. if multilateral resistance of a country falls, its trade with other countries rises but bilateral trade with country j falls.

The decomposition equation takes a very similar form if other gravity model formulations like the Ricardian model by Eaton and Kortum (2000), heterogeneous firms model by Chaney (2008) and Melitz and Ottaviano (2008) are used [13]. The components of trade growth accounting (a), (b) and (c) can be calculated using the data. For computing (d) we utilize equation 2 [14]

4 Data Sources

The data for this study has been extracted from a multitude of sources. The data is compiled from the OECD, UN and IMF databases. Since this study particularly focuses on aggregate trade in merchandise goods between India and the 21 APEC nations it is essential that the services part of trade be excluded. IMF's Direction of Trade Statistics (DOTS) provides bilateral trade data of merchandise goods. Export data is free on board (FOB) and import data is cost, insurance and freight (CIF). We download the annual bilateral data from 1990 to 2014 for India and APEC nations. The export data of goods is taken from IMF's International Financial Statistics (IFS). The data on GDP and Services produced (value added) of India and APEC nations is taken from World Development Indicators from the World Bank. Since we use value added data for finding intranational trade, no further manipulation is performed on these datasets. Missing data from these sources is complemented with data extracted from OECD, Unstat and APEC database. All data is expressed in current US Dollars.

In order to construct the tariff equivalent τ_{ij} India is assumed as country i and the APEC nations are considered country j. The elasticity of substitution σ is assumed to be 8 as specified by Anderson and van Wincoop (2003).

The data on trade cost determinants to estimate equation **??** has been taken from various different sources. Distance data represents great-circle distances between capital cities (India, i.e. Delhi v.s. country j's capital). This is collected from the website http://www.indo.com/distance/. The rationale for using great circle distance is similar to that of Novy(2013). The variables for adjacency dummy, common language dummy are taken from Andrew Rose's (2000) data set made

[12]If $\Delta\ln(1+\tau_{ij}) < 0$ then contribution of (c) becomes positive and if $\Delta\ln(\Phi_i\Phi_j) < 0$ then contribution of (d) becomes negative.

[13]Refer Novy (2013) for decompositions of other models.

[14]On solving:

$$2(\sigma-1)\Delta\ln(\Phi_i\Phi_j) = \Delta\ln\left(\frac{y_i/y^w}{x_{ii}/y_i}\right) + \Delta\ln\left(\frac{y_j/y^w}{x_{jj}/y_j}\right)$$

available on his website [15]. The common colony dummy assumes a value 1 if both country j and India were part of British empire in the history. Data on tariff ratings (for constructing ln(tariff)) has been taken from the Freedom of the World report published annually by the Fraser Institute. This tariff rating assigned to each nation is a simple mean of revenue from trade taxes (% of trade sector), mean tariff rate and standard deviation of tariff rates. The variable ln(tariff) used in econometric estimation is the negative of natural logarithm of the product of tariff ratings of India and nation j. Negative sign is for a better interpretation of this variable as an increase in ln(tariff) should lead to higher trade costs between India and nation j. The RTA dummy captures the number of free trade agreements (FTAs) or regional trade agreements (RTAs) enacted between India and nation j. Since there may exist multiple RTAs or FTAs between India and country j, RTA dummy is as a discreet variable rather than a binary variable. The data on various FTAs and RTAs is taken from World Trade Organisation (WTO) website.
Although we have tried to make sure that reliable and accurate data is available for all the nations for the time period 1990 - 2014, there are many instances where data was either unavailable or was erroneous. Hence we have excluded Brunei Darussalam, Hong Kong, Taiwan, Thailand and Vietnam from the database constructed. Additionally the data on some other nations wasn't available for the whole time period: Canada (1990-2010), Japan (1990-2013), New Zealand (1990-2011), Peru (1991-2012), Papua New Guinea (1990-2004), Russia (1992-2013), Singapore (1990-2013), USA (1997-2013). Hence, this leads to an unbalanced panel with 367 observations.
The components of trade growth are computed using the aforementioned data.

5 Results

5.1 Bilateral tariff equivalent

The tariff equivalent τ_{ij} is found to decrease over time for all the APEC nations analysed with an average decrease of 39.92 % (39.26 % excluding Papua New Guinea) for the analysed time period. The magnitude of tariff equivalent is highest for Peru, i.e. 3.37 in 1995. The value of τ_{ij} for 1991 is also maximum in case of Peru. This decreases to about 1.47 in 2012, a fall of 56.14 % which is the highest drop observed after China where the tariff equivalent decreases by 68.09 %. On the other hand minimum value of tariff equivalent is found for Republic of Korea, about 0.34 in 2011. Interestingly it is minimum for Singapore in 1990 and in 2013, about 1.05 and 0.69 respectively. For nations where data till 2014 is available, tariff equivalent is minimum in case of Malaysia, about 0.86. Table 2 (Refer: Appendix) summarises the percentage change of bilateral tariff equivalent across the time periods and the mean value of tariff equivalent of that nation.

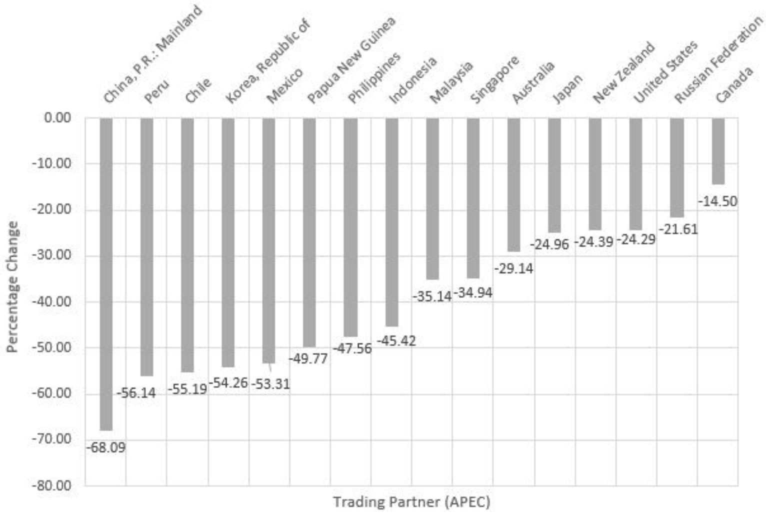
5.2 Determinants of trade cost or tariff equivalent

The estimation of various trade cost determinants was carried out as specified in equation 6. Im-Pesaran-Shin unit root tests confirm the stationarity of some of the panels [16]. Hausman Specification test (or Durban-Wu-Hausman test) developed by Durbin(1954), Wu(1973) and Hausman(1978) suggests the application of one way and two way fixed effects for this econometric model. Further diagnostic tests suggest the presence of heteroskedasticity in the dataset. Robust standard errors are computed in order to correct heteroskedasticity. Pooled OLS is also

[15] We are sincerely thankful to Dr. Rose for sharing his dataset. This is a really commendable step forward towards healthy research.

[16] This is the alternative hypothesis of IPS unit root test with the null hypothesis being that all panels contain unit roots.

Figure 1: Comparative plot of percentage change in tariff equivalent



performed so as to get an indication of time invariant factors. The results are reported in Table 1.

Table 1: Estimation result of Trade Cost Determinants

τ_{ij}	Pooled OLS		Two Way FE		One Way FE	
Variables	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.	Coef.	Robust Std. Err.
Distance	0.536*	0.040	0	(omitted)	0	(omitted)
Adjacency	0.129**	0.072	0	(omitted)	0	(omitted)
Island	0.207*	0.053	0	(omitted)	0	(omitted)
Common Colony	-0.164*	0.050	0	(omitted)	0	(omitted)
Common Language	-0.219*	0.064	0	(omitted)	0	(omitted)
Tariff	0.204*	0.017	0.628*	0.101	0.179*	0.013
RTA						
1	0.004	0.052	0.074	0.062	-0.070	0.046
2	-0.133*	0.055	0.182*	0.091	-0.162*	0.061
3	-0.263*	0.073	0.092	0.121	-0.293*	0.082
Intercept	-2.699*	0.342	1.626*	0.093	1.996*	0.047
Time Effects		No		Yes*		No
F(28, 323)		56.14		21.62		72.13
Prob > F		0		0		0
R^2		0.588		0.8856		0.8416
Adj R^2		0.349		0.8704		0.833
$\rho = \frac{\sigma_u^2}{\sigma_u^2+\sigma_e^2}$		-		0.837		0.798

Source: Author's Estimation
* significant at 5% critical level, ** significant at 10% critical level.

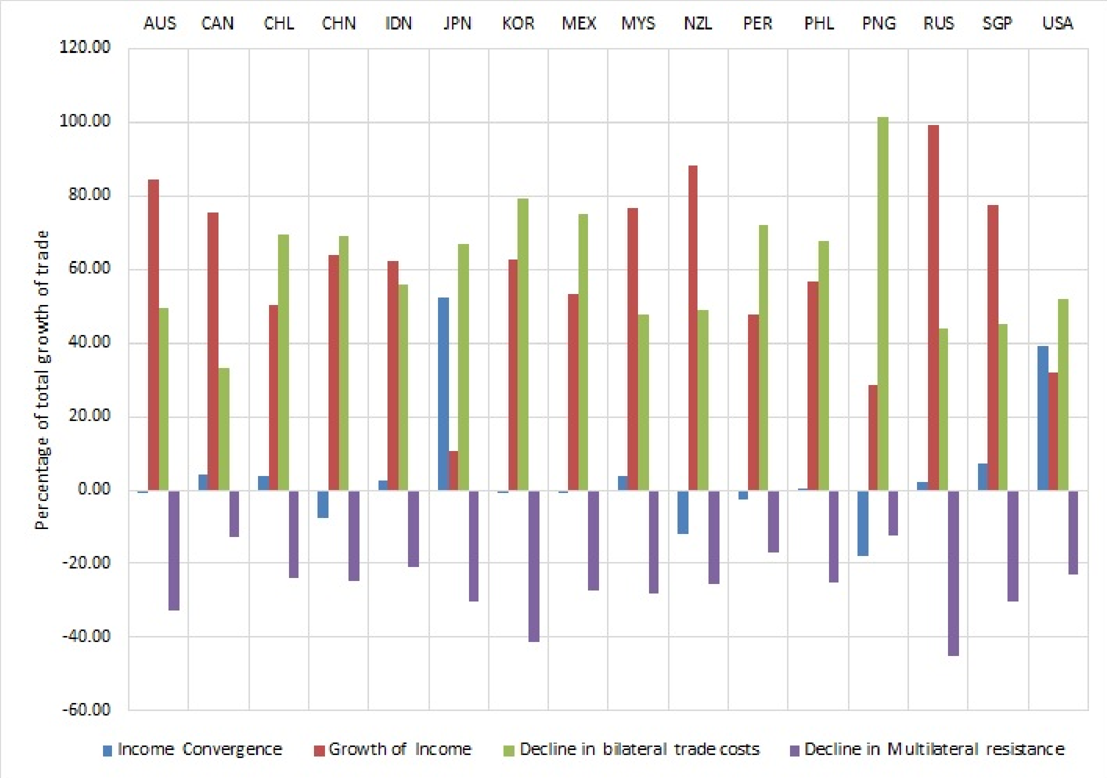
As expected, positive relationship between distance and trade costs. Generally trade costs would be higher with nations far from India. Nation j being an island leads to higher bilateral trade costs with India which is true considering the logistical and distance factors associated with the island nations of APEC and India. Common Colony and Common Language are found to lead to a decrease in bilateral trade costs as represented in pooled OLS results. The R^2 for pooled OLS is found to be 0.588.
The estimation results from all the 3 models show that rise in tariff leads to higher trade costs. This is most pronounced in two way fixed effects estimates wherein rise of 1% composite measure of tariff leads to a rise on 0.628 units of tariff equivalent. Presence of multiple RTAs and its effect on declining trade cost is evident from the pooled OLS and one way fixed effects estimates. Both report a decline in tariff equivalent τ_{ij} with respect to the base case of no RTA to 2 and 3 RTAs. As expected the decline is maximum in 3 RTAs and is statistically significant as well. The time effects captured via year dummies for 24 years with 1990 as the base case are found to be statistically significant(in two way fixed effects). These year dummies are used so as to control for time effects which are possible given the wide time period considered. The statistical significance of these dummies and higher adjusted R^2 wrt one way fixed effects reinforces this argument.

5.3 Decomposition of change in aggregate bilateral trade

Decomposing change in aggregate bilateral trade in goods of APEC nations with India into four components as specified by equation 10 for all the nations across 1990 to 2014 does provide some interesting insights. The percentage contribution of income convergence is found to be minimum at the mean, i.e. 4.57 % followed by decline in multilateral resistance by about -26.27 %. The negative sign indicates that decrease in multilateral trade barriers of country j with nations other than India led to a decline in its bilateral trade with India. The average effect of decline in bilateral trade costs and growth of incomes wrt. World income is found to have approximately the same contribution on growth of bilateral trade, i.e. 60.66 % in case of former and 61.04 % in case of latter factor.
Table 3 (refer:Appendix) provides a summary for percentage contribution of all the four components in case of all the APEC nations studied. We observe unusually high values of income convergence in case Japan (52.54%) and United States (39.18%). Excluding these two nations, the mean contributions of the four components a, b, c and d are -0.94%, 65.88%, 61.27% and -26.21% respectively.
Income convergence or income inequality is found to have the least contribution towards growth of bilateral trade. Surprisingly, this term has positive as well as negative impact on bilateral trade growth for some of the nations. The income convergence term measures the contribution of change in incomes of nation i and j wrt. the income shares on bilateral trade. Hence, a fall in incomes of either i or j in some particular period would lead to a negative contribution towards bilateral trade. In other words, a substantive fall in either trading nation in some period can impact the bilateral trade in that period. This is what is observed in case of nations like Australia, China, Republic of Korea, Mexico, New Zealand, Peru and Papua New Guinea. The overall trade growth and income convergence is constructed from individual changes between two periods. A fall in income of nation i or j or both, which is enough to lower the value of income convergence term wrt. previous period leads to a negative contribution to total bilateral trade. Such a pattern is observed in the above mentioned nations across few periods leading to an overall negative contribution of income convergence.
For a lot of nations the growth of income is the primary factor behind the rise of bilateral trade. Growth in income is the dominant factor in case of Australia, Canada, Indonesia, Malaysia, New

Zealand, Russia and Singapore with contribution of over 75% towards bilateral trade (with the exception of Indonesia where growth of income contributes 62.40% but is still the dominant factor). The other dominant factor is the decline in bilateral trade costs which in case of Chile, China, Republic of Korea, Mexico, Peru, Philippines, USA is the largest contributor in growth of bilateral trade with India. The effect of decline in bilateral trade costs is offset by the decline in multilateral trade barriers or multilateral resistance which has a negative impact on growth of bilateral trade. This is maximum in case of Russia, where decline in multilateral resistance leads to a decline in bilateral trade by about 45%. Table 3 (refer: Appendix) summarizes the growth of bilateral trade of APEC nations with India and its decomposition into the four components.

Figure 2: Decomposition of bilateral trade growth of India with APEC Nations



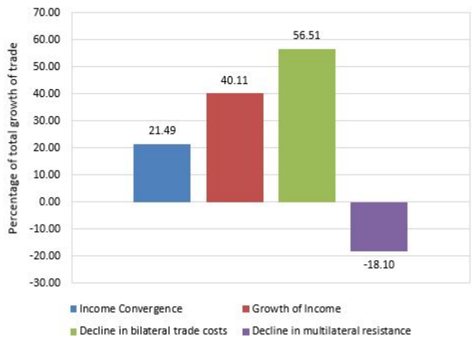
Source: Author's Estimation
AUS: Australia, CAN: Canada, CHL: Chile, CHN: China, IDN: Indonesia, JPN: Japan, KOR: Republic of Korea, MEX: Mexico, MYS: Malaysia, NZL: New Zealand, PER: Peru, PHL: Philippines, PNG: Papua New Guinea, RUS: Russian Federation, SGP: Singapore, USA: United States of America

6 Conclusions

The analysis conducted in this study spanning across three broad sections: computing tariff equivalent, estimating various trade cost determinants and trade growth accounting and decomposition of growth of trade in 4 major components, presents certain characteristics of India's trade profile with APEC over last 25 years. These characteristics are an addition to this domain

of literature. The results obtained due to income convergence term or income inequality in trade growth decomposition raises further questions which need to be pondered upon, like why do we observe positive contribution of income inequality for some nations and negative in case of some? What factors are into play leading to different scales of contributions of income growth and decline in bilateral trade cost terms across different countries? All these require a thorough analysis of the economies in context.
Considering APEC as one single bloc and calculating aggregate bilateral tariff equivalent and decomposition of trade growth with APEC, we find contribution of income convergence or income inequality to be positive about 21.49% which is substantially higher than the mean contribution obtained when individual countries were considered (4.57%). The contribution of declining bilateral trade cost is higher than income growth. The former is 56.51% whereas the latter is just 40.11%, unlike the mean contribution wherein both were about 60%. The trade diversion effect is observed with a negative contribution of decline in multilateral resistance -18.10%.

Figure 3: Decomposition of bilateral trade growth of India with APEC



Source: Author's Estimation

The estimation of trade cost determinants is also hampered due to unavailability of factors capturing logistical trade components, Government and bureaucratic red tape. Some of these factors would be crucial in explaining the behaviour of trade cost across panels over the time period. As of this this study, we find the significance of RTAs, FTAs and tariff on bilateral trade costs. It is evident from this analysis that multiple RTAs did contribute in lowering of tariff equivalent across panels over the time period of this study. Further, rise in tariff was found to have a significant impact on increase in τ_{ij} across the panels over 1990-2014. This has obvious implications on trade across India and APEC nations wherein lower tariff and strategic RTAs would play a crucial role in decreasing bilateral trade costs.

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8 Appendix

Table 2: Percentage change in τ_{ij} for all the APEC Nations analysed

Trading Partner	$t_{initial}$	$\tau_{initial}$	t_{final}	τ_{final}	τ_{mean}	Percentage Change
China, P.R.: Mainland	1990	2.78	2014	0.89	1.30	-68.09
Peru	1991	3.34	2012	1.47	2.24	-56.14
Chile	1990	2.48	2014	1.11	1.63	-55.19
Korea, Republic of	1990	1.58	2014	0.72	1.08	-54.26
Mexico	1990	2.23	2014	1.04	1.80	-53.31
Papua New Guinea	1990	3.04	2004	1.53	2.70	-49.77
Philippines	1990	2.64	2014	1.38	1.55	-47.56
Indonesia	1990	1.68	2014	0.92	1.17	-45.42
Malaysia	1990	1.32	2014	0.86	1.07	-35.14
Singapore	1990	1.06	2013	0.69	0.87	-34.94
Australia	1990	1.42	2014	1.01	1.16	-29.14
Japan	1990	1.30	2013	0.98	1.23	-24.96
New Zealand	1990	1.87	2011	1.41	1.61	-24.39
United States	1997	1.11	2013	0.84	0.99	-24.29
Russian Federation	1992	1.61	2013	1.26	1.26	-21.61
Canada	1990	1.71	2010	1.46	1.54	-14.50

Source: Author's Estimation

Table 3: Bilateral trade growth with India and its components

Trading Partner	$t_{initial}$	t_{final}	**Growth of Trade**	**Income Convergence**	**Growth of Income**	**Decline in bilateral trade costs**	**Decline in Multilateral resistance**	**Total**
Australia	1990	2014	528.51	-1.03	84.51	49.35	-32.83	100.00
Canada	1990	2010	400.81	4.11	75.63	33.12	-12.86	100.00
Chile	1990	2014	1004.16	3.90	50.36	69.53	-23.79	100.00
China	1990	2014	1411.65	-7.84	63.86	68.86	-24.88	100.00
Indonesia	1990	2014	837.01	2.60	62.40	55.83	-20.82	100.00
Japan	1990	2013	319.64	52.54	10.86	66.88	-30.27	100.00
Korea, Republic of	1990	2014	712.79	-1.03	62.86	79.44	-41.27	100.00
Mexico	1990	2014	857.76	-1.00	53.20	75.10	-27.31	100.00
Malaysia	1990	2014	656.20	3.74	76.85	47.60	-28.20	100.00
New Zealand	1990	2011	490.70	-11.91	88.15	49.11	-25.36	100.00
Peru	1991	2012	1105.48	-2.53	47.61	71.88	-16.96	100.00
Philippines	1990	2014	875.61	0.61	56.84	67.72	-25.17	100.00
Papua New Guinea	1990	2004	648.68	-17.69	28.55	101.29	-12.16	100.00
Russian Federation	1992	2013	450.94	2.23	99.17	43.76	-45.16	100.00
Singapore	1990	2013	612.72	7.18	77.54	45.38	-30.10	100.00
United States	1997	2013	363.12	39.18	32.09	51.87	-23.14	100.00
Mean			**704.74**	**4.57**	**60.66**	**61.04**	**-26.27**	100.00
Mean (excluding JPN, USA)			**753.18**	**-0.94**	**65.88**	**61.27**	**-26.21**	

Source: Author's Estimation

Figure 4: Plots of τ_{ij} of all APEC Nations

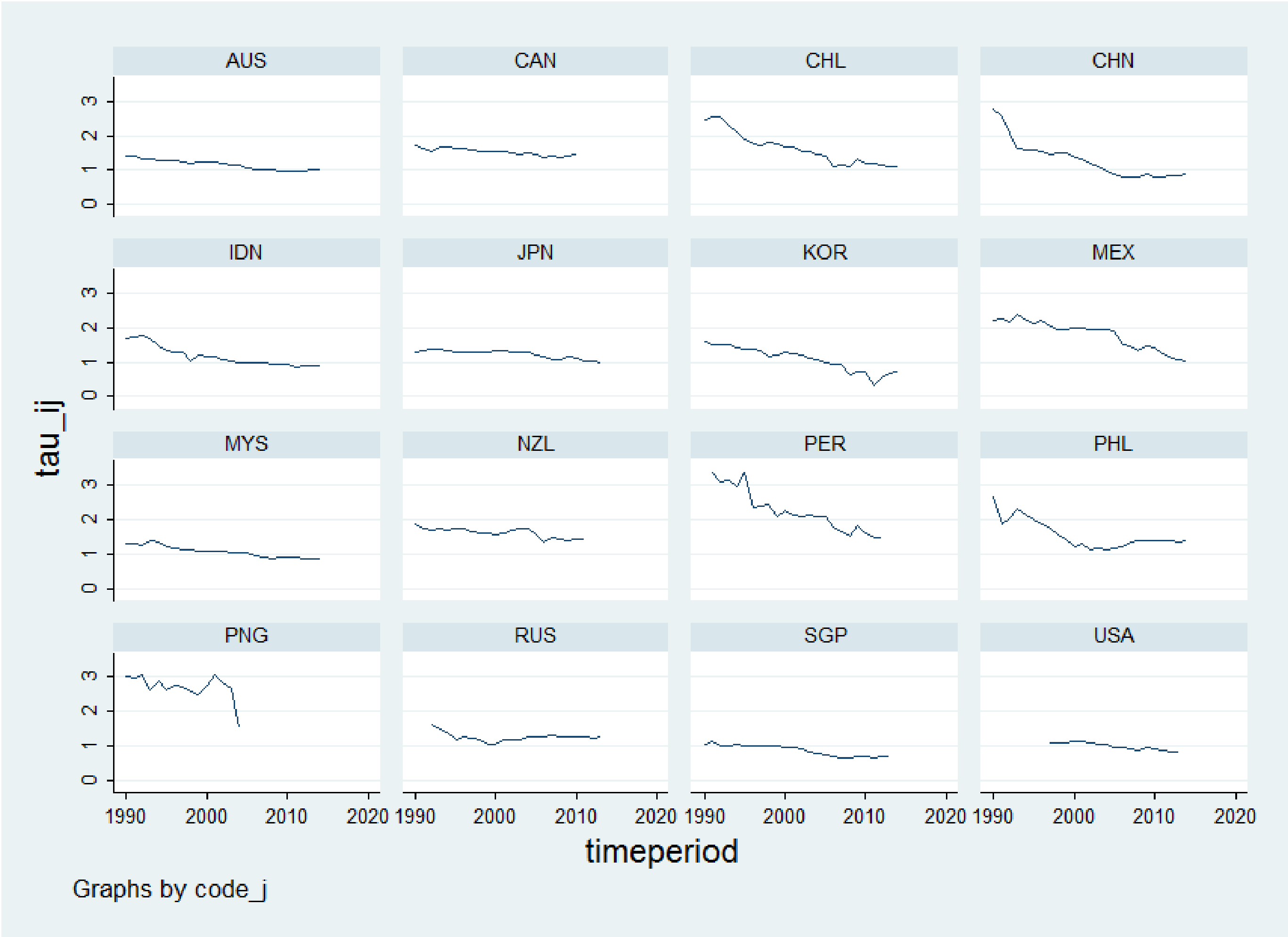

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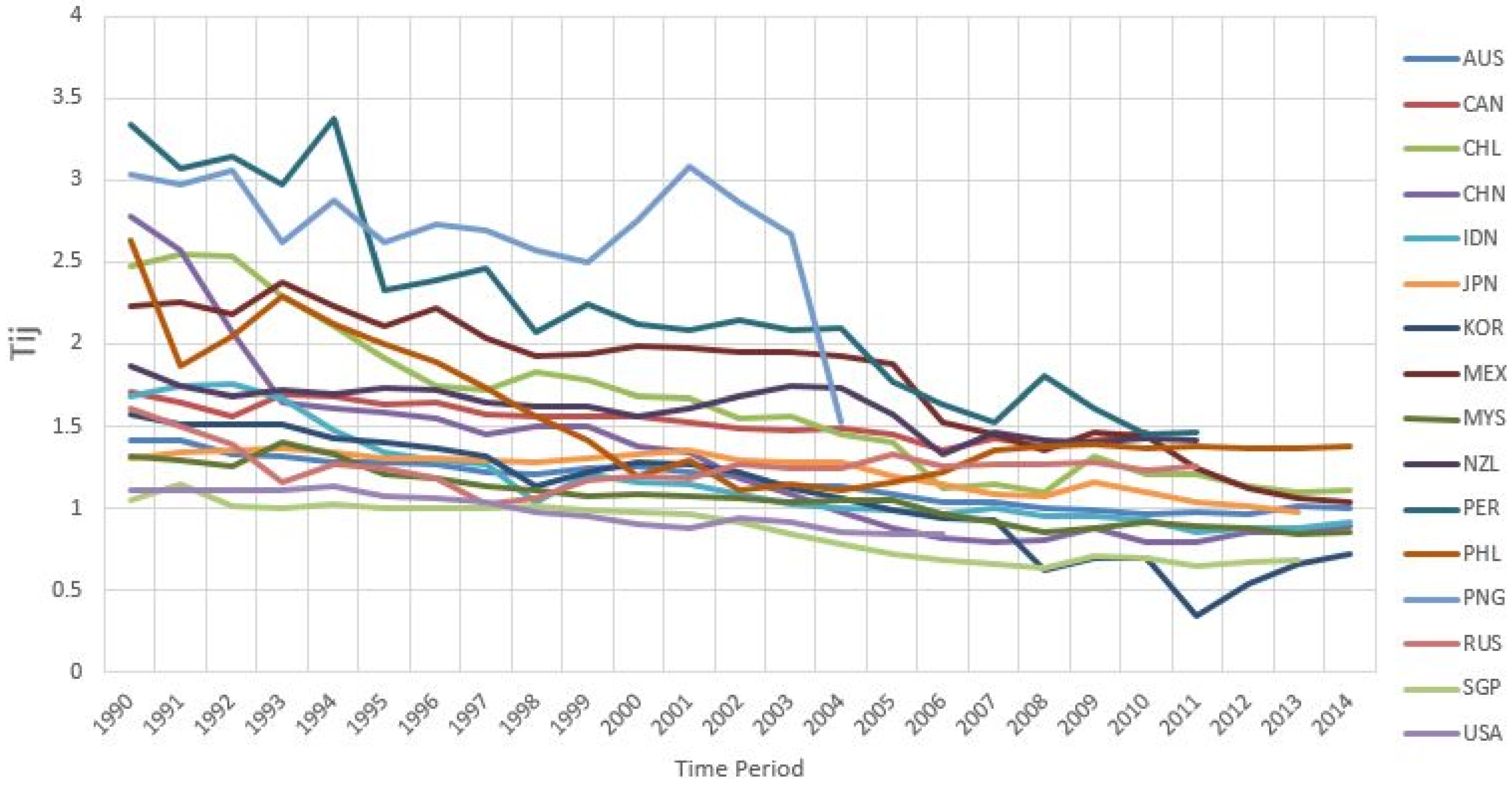
Figure 5: Overlay plot of τ_{ij} of all APEC Nations



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