

## Trade Costs between India and the European Union

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### Abstract

*The present study aims to utilize the micro-founded measure of trade cost derived by Novy (2013) to estimate the relative bilateral trade costs of India with its European Union partners. The advantage of using such a model is that the trade costs can be derived entirely by using observable trade data. The results show that Indian tariff equivalent with its major EU trading partners has declined by 20 percentage points between 1995-2010, with Malta and Latvia experiencing the greatest decline. The study then decomposes the bilateral trade growth to ascertain whether it is an outcome of increased domestic production or reduction in bilateral and multilateral trade barriers. Novy's model indicates that the decline in relative bilateral trade costs explains the greatest percentage of this trade growth, which is partially offset by decline in multilateral resistance terms that has diverted trade away to other trading partners primarily in South and South-east Asia and North America.*

### 1. Introduction

1.1 All costs incurred in delivering a good from its place of production to its final consumer apart from the marginal cost of producing it, cumulatively add up to trade costs. They are influenced by several factors like – transportation costs, border barriers, common language effects, use of different currency, tariff and non-tariff barriers and other such related transaction costs like collecting information and overcoming trade barriers. (AW 2004) Trade costs significantly affect trade across countries and need to be taken into account to explain the rapid surge in bilateral and multilateral trade across nations in the past decades. However, arriving at a precise estimate of these trade costs is not easy because of the data limitations associated with capturing the aforementioned trade barriers. The problem becomes more acute when we are dealing with emerging economies where data of appropriate quality may not be available. Also, trade costs cannot be neglected in any current popular discourse of International Economics because of their significant negative impact on trade volumes (AW 2004). With greater regional and global integration in the last few decades, trade costs have shown significant declining trend. Regional blocs like ASEAN, SAFTA, SAARC, G20, EU and global bodies like WTO aim to reduce trade barriers to promote efficient trade across countries (De, Prabir 2006). The present study tries to look into the dynamics of one such regional bloc –the European Union(EU) and how its trading relationship with India has shaped up over the last two decades. Given that such a specific study to investigate the determinants of trade flow between India and EU has not been conducted in the past, we hope to obtain significant policy insights from our analysis.

1.2 European Union has emerged as a successful model of regional bloc in the last two decades since its inception in 1993. It is a union of 28 European countries which try to

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leverage the advantages of a single borderless market using standardized system of laws and regulations (Europa). Because of the inseparable nature of their political and economic partnership, the member countries of EU need to be analysed through the same lens of trade policies and design. This is especially relevant in the context of India, for which European Union was the largest trading partner in terms of trade volumes last year (The Diplomat, June 17, 2014). Also, India and EU started negotiations for a Free Trade Agreement in June 2007, which comprehensively covers a wide range of goods and services (The Indian Express, Feb 4, 2014). The negotiations, are still ongoing, and have not reached any definitive conclusion.

1.3 Indian trade policies were characterised by import substitution and quota-raj leading to an autarkic trade regime in the period 1950-1975 (Europa, June 2007). Though partial and intermittent liberalization of the economy started during the mid-seventies, a comprehensive roadmap for implementing economy-wide trade reforms could only be brought about in 1992. In the new millennium, international trade has assumed significant importance for India, being increasingly seen as a powerful instrument in driving economic growth and generating employment. The trade policies are being aimed at reducing a number of tariff and non-tariff barriers like, import quotas, quantitative restrictions and compulsory certification of a range of products which also include time consuming custom procedures. This would also help to improve the ease of doing business in India<sup>2</sup> and help to integrate Indian economy more firmly with the world economy by reducing various multilateral and bilateral trade barriers. Consequently, India has already entered into a number of preferential trade agreements with regional trading partners, key among which are - Comprehensive Economic Cooperation Agreement (CECA) with Singapore (2005), South Asia Free Trade Area (SAFTA) with SAARC nations (2004) and Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC) with Bangladesh, India, Myanmar, Sri Lanka, Thailand, Bhutan and Nepal (2004). Likewise, there has been a significant reduction of tariffs in India in 1990-2005 period, from an average of around 79% to 17%<sup>3</sup>. This decline in tariff has also manifested itself in increased openness of Indian economy, with share of exports of goods and services to GDP rising from 7.3% (1990) to 13% (2000) to 19% (2004). The share of imports of goods and services to GDP has also shown similar trends - 9.9% to 14% to 21%. The signing of the proposed FTA between India and EU is expected to bring in more substantial changes in the structure of tariffs in India for whom EU has emerged as the key trading partner over the years. From the perspective of EU, India is a large rapidly growing economy with an enormous consumer base, and thus it assumes immense potential importance as a trading partner.

1.4 In light of the above, this study tries to capture the implicit and explicit trade costs of India with its European Union trading partners over a period of 16 years (1995-2010) using the micro-founded measure of tariff equivalence. This tariff estimator measures relative bilateral trade costs over and above domestic trade using observable trade data. The study then decomposes this relative bilateral trade volumes across the partners to conclude which factors have been largely responsible for this surge in trade volumes for these years.

<sup>2</sup> India currently stands at 142<sup>nd</sup> rank with regards to ease of doing business, 2 notches lower than where it was last year. (*Doing Business Report 2015* )

<sup>3</sup>Qualitative analysis of a potential Free Trade Agreement between the European Union and India - Main Report, June 2007.

## 2. Literature Review

2.1 The area of trade cost is replete with a good amount of economic literature revolving round its theoretical foundations and empirical studies. Samuelson (1954) is credited with the seminal contribution in this area, who modelled transportation costs in trade as iceberg costs wherein only a fraction of the goods shipped aboard from the exporter country reaches its destination, the rest of it melts away in transit. Tinbergen (1962) used distance as an approximate proxy for trade costs in his famous gravity model formulation. Limao and Venables (2001) use the ratio [(cif/fob)-1] to capture transaction costs of trade across pair of countries. Obstfield and Rogoff (2001) assume iceberg shipping costs in an extremely simple two country endowment economy. Introducing a constant elasticity of substitution utility function for the representative home consumer, they arrive at a precise formulaic estimate of trade costs.<sup>4</sup> Anderson and van Wincoop (2003) incorporated exogenous bilateral trade barriers in their gravity formulation. Specifically, if  $p_i$  is the net supply price of the good originating in country  $i$ , then  $p_{ij} = p_i t_{ij}$  is the price of this good faced by consumers in country  $j$ , where  $t_{ij} \geq 1$  is the gross bilateral trade cost factor. They further assumed that bilateral trade costs are a function of two particular trade-cost proxies – a border barrier and geographical distance. The corresponding trade cost function hypothesized by them is:

$t_{ij} = b_{ij} d_{ij}^k$  where  $b_{ij}$  is a border indicator variable,  $d_{ij}$  is the bilateral distance and  $k$  is the distance elasticity. Anderson and Van Wincoop (2004) model bilateral trade barriers as a log-linear function of observable proxies- distance, adjacency, preferential trade membership, common language and a host of other factors. Hummels (2007) has studied how decline in ocean freight and air shipping costs have fuelled international trade in the last 50 years (1952- 2004). His results indicate that the decline in air shipping costs have been substantial which has acted as a critical input in increasing international trade in the latter half of the 20<sup>th</sup> century. However, ad-valorem ocean transportation costs have not undergone much decline than their levels in the 1950s. His study uses the standard ad-valorem model, denoting the origin price as  $p$ , destination price as  $p^*$ , and per unit shipping costs as  $f$ , where  $p^* = p+f$ . The ad-valorem percentage change in prices after incorporating transportation costs becomes:  $p^*/p = 1 + f/p$ . The study then employs a commonly used inaccurate approach to model per unit shipping costs  $f$  as a constant percentage  $\tau$  of the value shipped. The ad-valorem cost, thus, comes out to be  $p^*/p = 1 + \tau$ .

2.2 The problem with the models of trade costs discussed above is that a particular trade cost function has been assumed which may not accurately cover all the relevant factors concerning trade barriers. Novy (2013) resolves these issues by deriving a micro-founded measure<sup>5</sup> that can be obtained by using observable trade data of production and

<sup>4</sup>  $\frac{C_H}{pC_F} = \frac{p^* C_F^*}{C_H^*} = (1 - \tau)^{1-\theta}$ , where  $C_H$  and  $C_F$  are home-consumption of home produced good, and

home consumption of foreign produced good respectively. The foreign counterparts have similar utility functions –  $C_H^*$  and  $C_F^*$ .  $\tau$  is the iceberg shipping cost. See Obstfield and Rogoff (2001) for more details.

<sup>5</sup>Derivation of the model has been done in Novy, Dennis. "Gravity Redux: measuring international trade costs with panel data." *Economic Inquiry* 51.1 (2013): 101-12.

exports. Thus, there is no need to hypothesize a specific trade cost function. Also, the earlier studies use distance as a trade cost proxy, which does not change over time. This rules out the possibility of using time-series or panel data studies over such data. Novy's model, however, can be applied over both time series and panel data sets. Due to these significant advantages over the earlier models, we have chosen Novy's approach to trade cost modelling. An important point to note here is that Novy's model does not assume frictionless domestic trade, thus, tariff equivalent in this model, measures bilateral trade costs relative to the domestic trade costs. All such factors which increase the transaction costs of international trade over and above the domestic trade are captured in his measurement of tariff equivalence. This micro-founded measure of tariff equivalent is also in line with the trade theories of Chaney (2008) and Melitz and Ottaviano (2008) who assume heterogeneous firms in the model. However, we shall not discuss this in our paper given the limited scope of our study.

### 3. Methodology

3.1 Novy (2013) uses the famous gravity equation of Anderson and Van Wincoop (2003) to derive the following expression for bilateral tariff equivalent. This formulation of tariff equivalent relationship is generalizable and can also be derived from other well-known gravity models like the Ricardian Model by Eaton and Kortum (2002) as well as the heterogeneous firm model by Chaney (2008) and Melitz and Ottaviano (2008)<sup>6</sup>.

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

where,

$t_{ij}$  &  $t_{ji}$  are bilateral trade costs

$t_{ii}$  &  $t_{jj}$  are domestic trade costs

$\sigma > 1$  is the elasticity of substitution across goods<sup>7</sup>

$x_{ij}$  denotes nominal exports from country  $i$  to country  $j$

3.2 From Equation 1, we can see that if the bilateral trade flows  $x_{ij}x_{ji}$  increase relative to domestic trade flows  $x_{ii}x_{jj}$ , then the value of tariff equivalent  $\tau_{ij}$  would go down indicating that it has become easier to trade between the two countries  $i$  and  $j$ .  $\tau_{ij}$  measures the geometric mean of the relative trade barriers in both the directions. Novy (2013) decomposes the Anderson van Wincoop (2004) gravity model<sup>8</sup> as below to provide an analytical

<sup>6</sup>See Novy (2013) for details.

<sup>7</sup>This implies that the goods are imperfect substitutes. When the elasticity of substitution across goods is greater than 1, then an increase in the relative price of a good causes a decline in its share of total expenditure, in line with the law of demand. As we will see later the value has been assumed to be 8 (AW 2004).

<sup>8</sup>Basic Gravity Model Anderson-van Wincoop (2004):  $x_{ij} = \frac{y_i y_j}{y^w} \left( \frac{t_{ij}}{P_i P_j} \right)^{1-\sigma}$

framework of bilateral trade growth accounting. Equation<sup>9</sup> 2 is obtained by taking natural logarithm of the basic gravity model of Anderson-van Wincoop and taking difference on both sides.

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

Here,  $y_i$  is the nominal income of country  $i$

$y_w$  is the world income defined as  $y_w \equiv \sum_j y_j$

$\Phi_i$  is a proxy for the country  $i$ 's multilateral resistance relative to the domestic trade costs, estimated as-

$$\Phi_i = \left(\frac{\prod_i P_i}{t_{ii}}\right)^{\frac{1}{2}} \quad (3)$$

where  $P_i$  and  $t_{ii}$  are the price indices of country  $i$ .

$$100\% = \frac{2\Delta \ln\left(\frac{y_i y_j}{y_w}\right)}{\Delta \ln(x_{ij} x_{ji})} + \frac{2(1-\sigma)\Delta \ln(1+\tau_{ij})}{\Delta \ln(x_{ij} x_{ji})} - \frac{2(1-\sigma)\Delta \ln(\Phi_i \Phi_j)}{\Delta \ln(x_{ij} x_{ji})} \quad (4)$$

3.3 Equation 2 is divided by the left hand side to arrive at the bilateral decomposition in terms of percentages as given in equation 3. This relates the growth of bilateral trade  $\Delta \ln(x_{ij} x_{ji})$  to three distinct factors: the first term outlines the contribution of income growth, the second term is a contribution of the decline in the relative bilateral trade costs and the last term is the contribution of the decline in the multilateral resistance to bilateral trade expansion. The negative contribution of multilateral resistance term decline to trade costs can be interpreted in the manner that if trade barriers with the rest of the world falls then the bilateral trade between country  $i$  and country  $j$  decreases. The multilateral resistance terms can be evaluated using observable trade data as using simple substitutions<sup>10</sup> in the theoretical gravity model.

$$2(1-\sigma)\Delta \ln(\Phi_i \Phi_j) = \Delta \ln\left(\frac{y_i / y_w}{x_{ii} / y_i}\right) + \Delta \ln\left(\frac{y_j / y_w}{x_{jj} / y_j}\right) \quad (5)$$

#### 4. Data

4.1 The bilateral trade flow data has been extracted from IMF International Financial Statistics. Production data has been obtained from the World Bank database. All the figures used, are nominal values and denominated in U.S. dollars. Greece has been excluded from the study for lack of requisite data in the study period. From equation 1 and 2, we note that both tariff equivalence calculation and trade growth accounting require proxies for national income. Novy (2013) mentions that GDP data is not suitable for trade calculations as it incorporates the contribution of service sector and is based upon value-added methodology. This is not in line with trade volume figures which include gross shipment figures. Thus,

<sup>9</sup>The derivation of equation 2 has been discussed in detail in section 1 of the appendix.

<sup>10</sup>The derivation of equation 2 has been discussed in detail in section 2 of the appendix.

the present study follows the methodology of Wei (1996)<sup>11</sup> in constructing a proxy for national income using the production data of agriculture, manufacturing and mining sector. Nominal values of these production figures have been taken from the World Bank database. is expressed as a difference of nominal GDP minus total exports of the *i*th country to the rest of the world (Shang-Jin Wei (1996)). The value of  $\alpha$  has been taken to be eight (Anderson and van Wincoop (2004)). The study period which runs from 1995-2010, helps us to ascertain how the post liberalized India has been able to forge trade relations with European Union – the largest unified global market. EU itself came into existence on November 1, 1993, so any relevant study revolving around EU would begin after 1993. Post 2010, both India and EU have been characterized by increasing economic turbulence in the wake of the great recession. So, these may not be the appropriate years for analysis. Keeping these considerations, our study ranges from 1995-2010.

## 5. Tariff Equivalent Measure of bilateral trade for India with EU Partners

5.1 Figure 1 illustrates the cumulative percentage decline in the relative bilateral trade cost measure for India with all its EU trading partners for 1995-2010. The tariff equivalent measure has significantly fallen for countries like – Poland, Malta, Latvia, France, Estonia and Slovenia. On an average the tariff equivalent has fallen cumulatively by 20 percentage points for European Union Trading partners. Interestingly, tariff equivalent has increased for three European Zone countries – Slovakia, Denmark and Bulgaria. One possible reason which is also supported by data is that the domestic tariffs in these nations have fallen much faster<sup>12</sup> than the corresponding bilateral tariffs. Since, Novy (2013) measures relative bilateral tariff equivalent, it shows a spike for these countries.

5.2 Though countries like Germany and United Kingdom share high trade volume trade partnership with India, their tariff equivalent has not gone down significantly as compared to the overall average. This is one area which could be looked into by the policymakers, wherein we can try reducing trade barriers with countries which are already our big shot partners. We have created a unified index for European Union by summing the production and export levels to the rest of the world of 27 EU countries<sup>13</sup> so that we have consolidated trade and production volumes for EU as a whole. EU can then be treated as a single country which engages in bilateral trade with India.

5.3 Given that EU region has a high degree of economic integration and a common currency, our assumptions gain some ground and the analysis becomes far simpler. Figure 2 illustrates the variation of tariff equivalent for euro zone as a whole over the years with India. Having shown a consistent decline till 2001, the tariff equivalent has stabilised at around 0.5, hence forth.

<sup>11</sup>Wei(1996) uses production data for agriculture, mining and total manufacturing.

<sup>12</sup> Bulgaria's domestic trade volumes ( $X_{ii}, X_{jj}$ ) shot up by 412% as compared to the bilateral trade volumes  $X_{ij}, X_{ji}$ . For Denmark and Slovakia, this number was – 720% and 580% respectively.

<sup>13</sup>Greece has been excluded from the analysis because appropriate data was not available.

## 6. Decomposing growth of Indian Bilateral Trade with EU trading partners

6.1 Table 1 gives the country wise decomposition of bilateral trade growth for India in the period 1995-2010. The countries have been arranged in the decreasing order of their average bilateral trade volume with India in the aforementioned period. Germany was the biggest trade partner of India in this period, and understandably, has a low tariff equivalent. The same holds for countries like UK, Belgium, Italy and France. Apart from Germany, income growth in all these countries is able to explain more than half of the bilateral trade growth with India. For countries which feature lower down in the table, income growth's contribution to trade growth decreases significantly, with countries like Cyprus, Malta and Estonia showing negative trends. The interpretation of coefficients in the Column 5, 6 and 7 is fairly intuitive. Ideally, one would expect that the growth in income would give a positive stimulus to bilateral trade between countries<sup>14</sup> and correspondingly, the terms appearing in column 5 should ideally have a positive sign. Likewise, decline in bilateral trade barriers relative to the domestic trade should also have a positive impact on percentage trade volume transacted between countries, as given in column 6. Column 7 contains contribution of the decline in multilateral resistance on the relative bilateral trade between countries, which should ideally be negative as a negative term implies that easing of trading with the rest of the world (the other EU countries in this case) has diverted bilateral trade away from the trading partners under consideration.

6.2 Equation 2 has been utilized to decompose the growth of Indian bilateral trade. Figure 3 illustrates the contribution of each of the three factors which we discussed above towards the growth in bilateral trade for India with the entire EU region in the period from 1995-2010.

6.3 The decline in relative bilateral trade costs have had the highest positive impact, 109%. Income growth proxied by GDP levels explain 26% of this growth. Decline in multilateral resistance term has had a negative impact on bilateral trade with EU. This indicates that reduction of multilateral barriers has diverted significant portion of trade from Indian and EU to other regions in the world. However, we note that the results are not very consistent across the various partners of EU.

## 7. Conclusions

7.1 The results indicate that trade liberalisation in the last two decades in India has had a significant impact on its bilateral trade with EU. This may also have to do with the European Union countries gaining higher degree of political and economic integration in the same period. On an average, the Novy tariff equivalent has declined by 20 percentage points in the period of the study (1995-2010). This relative bilateral trade growth has been fuelled mainly by the decrease of bilateral resistance values across the countries which explains 109% of the trade growth. This spurt in trade has been partially offset by the consequent decrease of multilateral resistance terms (-35%) in the same period. India, particularly, has forged ahead on various trade partnerships in South and South East Asia. India's trade with Middle East countries and U.S. has also picked up in this period which has diverted trade away from EU that is reflected by negative contribution of multilateral

<sup>14</sup>See Gravity Model ( Tinbergen 1962, AW 2001) for details.

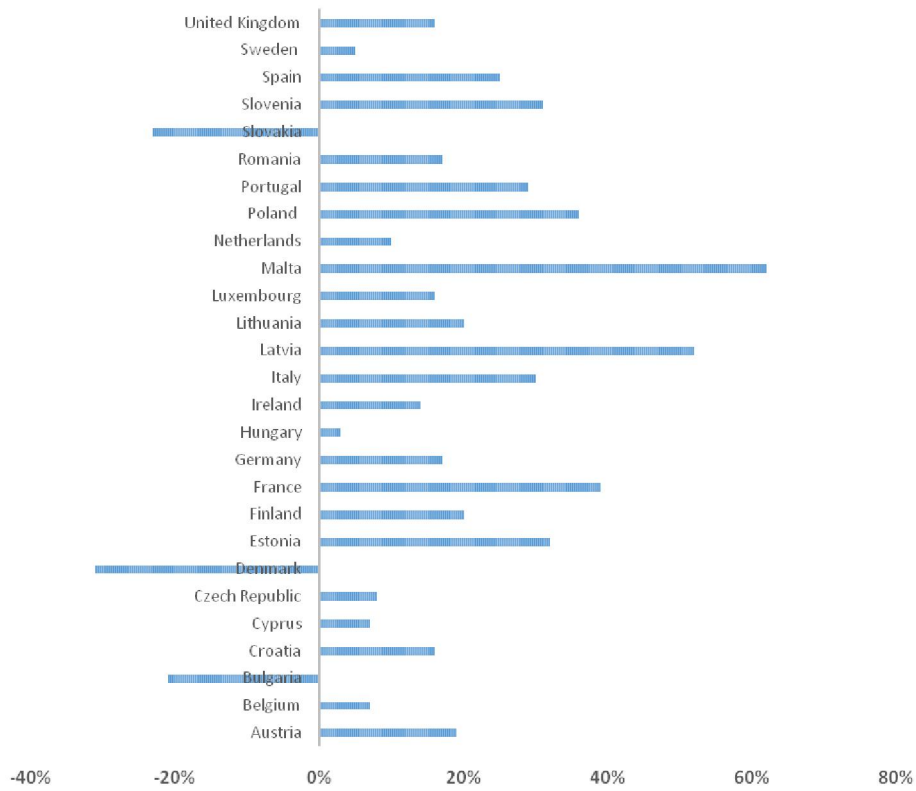
resistance term. Since 1994, WTO has started playing a major role in trade liberalisation worldwide, which also explains the results of the study. In line with the gravity model framework, the increase in incomes is found to have a substantial impact (26%) on trade growth. Amongst the EU countries, Latvia and Malta have experienced the largest decline in their tariff equivalent for trade with India in the study period. Data shows that this tariff equivalent measure is sensibly related to the average bilateral trading volumes of India with the EU countries so that countries which have traded larger volumes of merchandise goods with India in the study period have lower average tariff equivalents.

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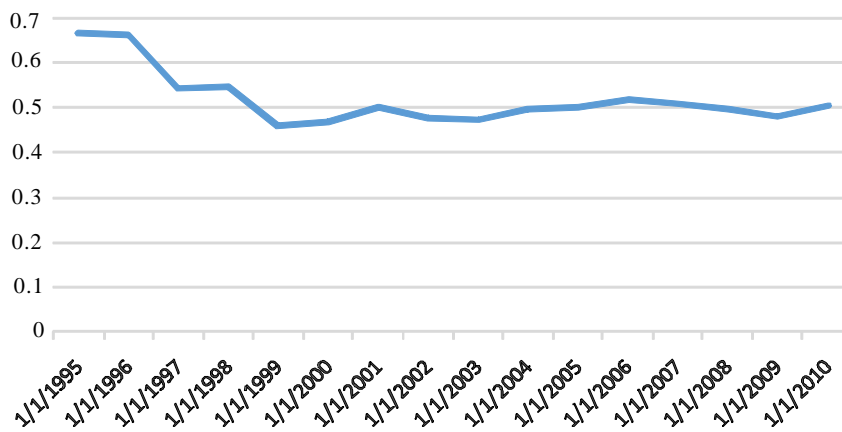
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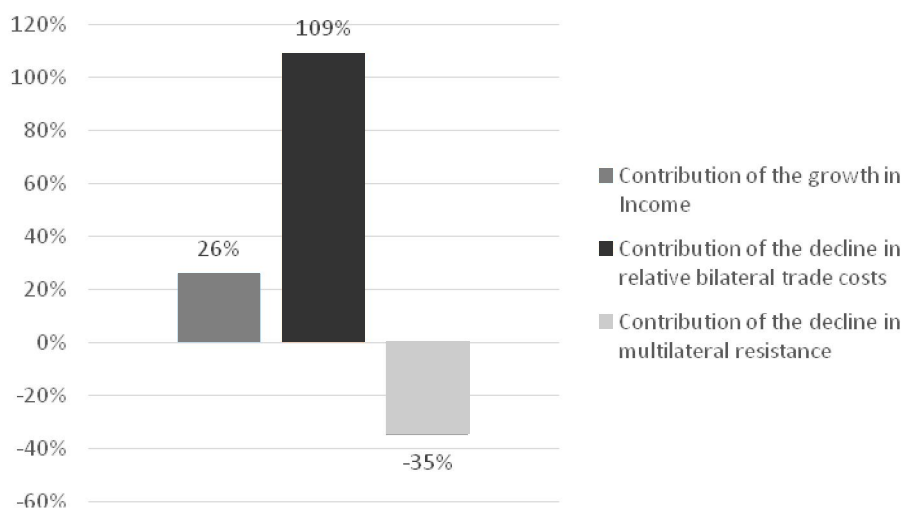


**Fig. 1 : Percentage decline in Novy Tariff Equivalent (1995 - 2010)**



**Fig. 2 : Novy Tariff Equivalent of India with European Union**



**Fig. 3 : Percentagewise decomposition of bilateral trade growth****Table : 1**

Column 1 Partner Country	Column 2 Average Bilateral Trade Volume (In million USD)	Column 3 Percentag e Growth in Bilateral Trade	Column 4 Average Novy's Tariff Equival ent	Column 5 Contributi on of the growth in Income	Column 6 Contribution of the decline in relative bilateral trade costs	Column 7 Contributio n of the decline in multilateral resistance	Column 8 Total
Germany	22123085.893	248%	0.765	32%	-82%	150%	100%
United Kingdom	16403803.781	195%	0.679	89%	90%	-79%	100%
Belgium	15072182.617	256%	0.825	81%	72%	-53%	100%
Italy	5788532.936	286%	0.850	59%	105%	-63%	100%
France	4937667.515	326%	0.766	84%	9%	7%	100%
Netherlands	4115913.027	376%	1.076	-25%	174%	-50%	100%
Spain	905534.618	362%	1.227	50%	67%	-17%	100%
Sweden	329639.787	319%	1.103	55%	49%	-4%	100%
Denmark	106998.472	165%	1.160	21%	104%	-25%	100%
Austria	101082.612	390%	1.307	44%	-12%	68%	100%
Finland	60764.359	304%	1.000	42%	136%	-78%	100%
Poland	45158.352	357%	1.381	52%	-37%	84%	100%
Czech Republic	35877.076	437%	1.441	-16%	101%	15%	100%
Romania	31279.841	333%	1.557	30%	40%	30%	100%
Ireland	28768.510	366%	1.597	64%	68%	-32%	100%
Hungary	14468.488	501%	1.707	98%	11%	-8%	100%
Portugal	9483.872	276%	1.505	26%	154%	-80%	100%
Slovenia	5507.145	412%	1.694	88%	-31%	42%	100%
Lithuania	2136.857	684%	1.843	-135%	86%	149%	100%
Slovakia	1304.179	169%	1.874	22%	73%	5%	100%
Bulgaria	1167.995	292%	1.613	-50%	-78%	227%	100%
Malta	918.376	852%	1.857	-10%	389%	-279%	100%
Latvia	439.451	1023%	1.920	35%	-22%	86%	100%
Croatia	387.344	343%	2.217	0%	100%	0%	100%
Cyprus	354.052	326%	1.946	-10%	97%	13%	100%
Estonia	302.634	759%	2.117	-4%	66%	38%	100%
Luxembourg	229.819	422%	2.283	32%	29%	39%	100%

## Appendix

### 1. Derivation of Trade Growth Accounting term

Gravity eqn. for trade for trade from  $i^{th}$  country to  $j^{th}$  country

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

Gravity eqn. for trade for trade from  $i^{th}$  country to  $j^{th}$  country

$$x_{ji} = \frac{y_j y_i}{y^w} \left( \frac{t_{ji}}{\prod_j P_i} \right)^{1-\sigma} \quad - \quad (2)$$

Multiplying the above two eqns. we have –

$$x_{ij} x_{ji} = \left( \frac{y_i y_j}{y^w} \right)^2 \left( \frac{t_{ij} t_{ji}}{\prod_i P_i \prod_j P_j} \right)^{1-\sigma} \quad - \quad (3)$$

Taking logarithms both sides, we have –

$$\ln(x_{ij} x_{ji}) = 2 \ln \left( \frac{y_i y_j}{y^w} \right) + 2(1-\sigma) \ln(1 + \tau_{ij}) - 2(1-\sigma) \ln(\Phi_i \Phi_j) \quad - \quad (4)$$

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

$$\text{And } \Phi_i = \left( \frac{\prod_i P_i}{t_{ii}} \right)^{\frac{1}{2}}$$

Taking difference on both sides we have the final equation of trade growth accounting

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

### 2. Derivation of the Multilateral Resistance Term

$\Phi_i$  is a proxy for the country  $i$ 's multilateral resistance relative to the domestic trade costs, estimated as-

$$\Phi_i = \left( \frac{\Pi_i P_i}{t_{ii}} \right)^{\frac{1}{2}}, \text{ where } \Pi_i \text{ and } P_i \text{ are the price indices of country } i$$

$$\text{Using the above formulation for } \Phi_i, \text{ we have } -\Phi_i \Phi_j = \left( \frac{1}{x_{ii} x_{jj}} \right)^{\frac{1}{1-\sigma}} \left( \frac{y_i y_j}{y_w} \right)^{\frac{2}{1-\sigma}} \quad - (4)$$

$$\text{Also from gravity model, we have } x_{ii} x_{jj} = \left( \frac{y_i y_j}{y_w} \right)^2 \left( \frac{t_{ii} t_{jj}}{\Pi_i P_i \Pi_j P_j} \right)^{1-\sigma} \quad - (5)$$

Substituting  $t_{ii} t_{jj}$  from here, in the previous  $\Phi_i \Phi_j$  equation we have –

$$\Phi_i \Phi_j = \left( \frac{1}{x_{ii} x_{jj}} \right)^{\frac{1}{2(1-\sigma)}} \left( \frac{y_i y_j}{y_w} \right)^{\frac{1}{1-\sigma}} \quad - (6)$$

Taking natural logarithm, followed by differencing on both sides, we arrive at the final expression for multilateral resistance term

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

**3. Listed below is the analysis of the top 5 trading partners of India in EU:**

**A. Germany**

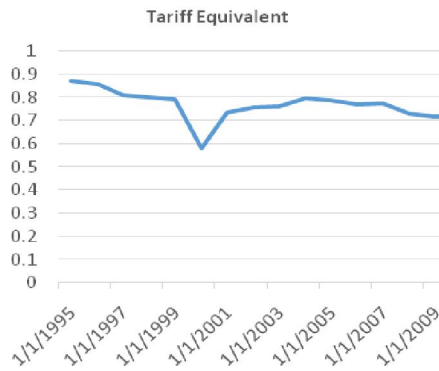


Fig. 4

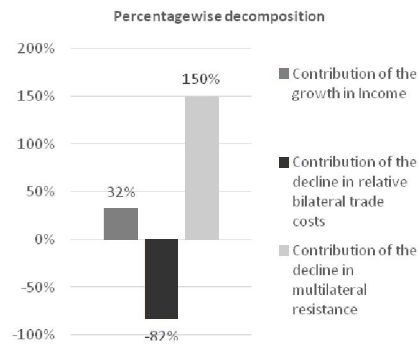


Fig. 5

**B. United Kingdom**

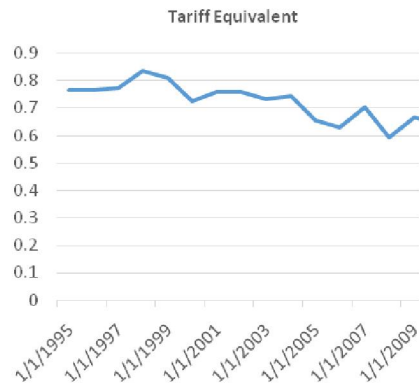


Fig. 6

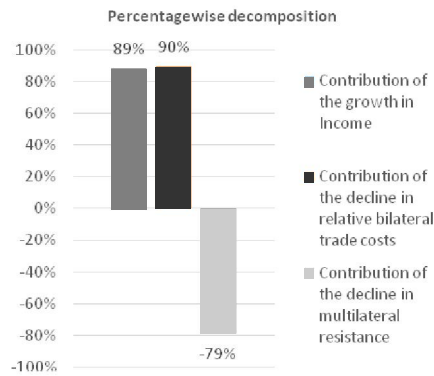


Fig. 7

**C. Belgium**

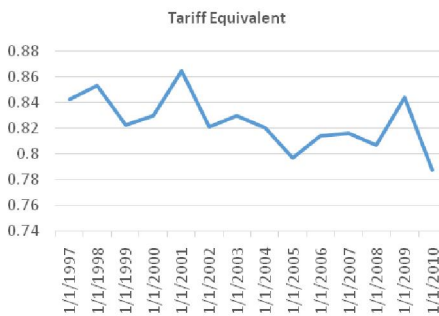


Fig. 8

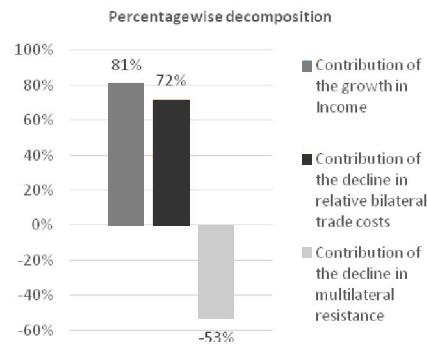


Fig. 9

**D. Italy**

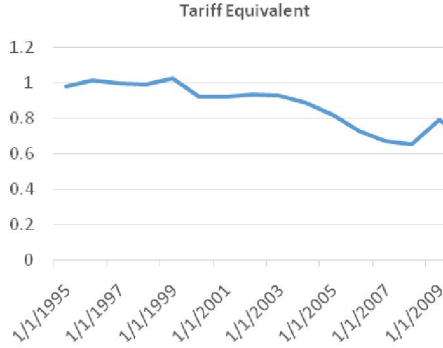


Fig. 10

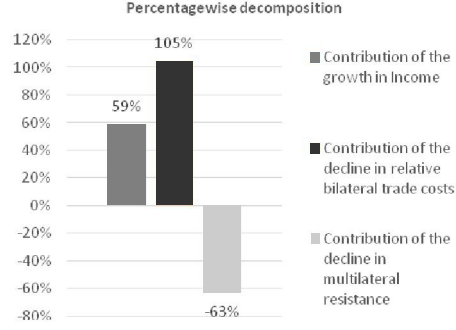


Fig. 11

**E. Netherlands**

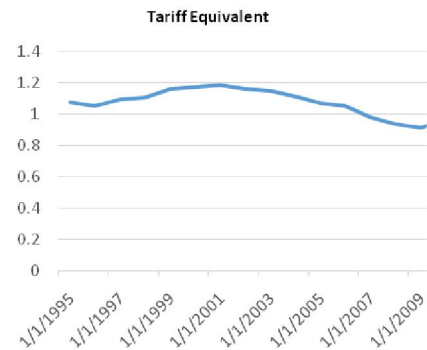


Fig. 12

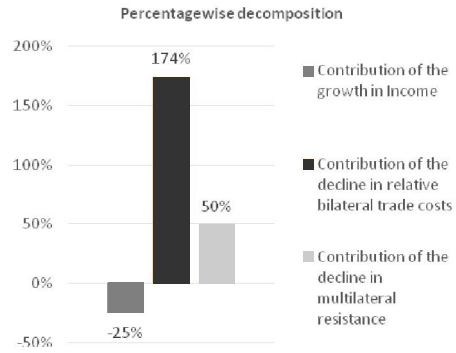


Fig. 13

**4. Derivation of Trade Costs of Novy (2008)**

Anderson and Wincoop (2003)'s framework

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

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

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

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

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

Where  $t_{ii}$  represents intranational trade costs, for example domestic transportation costs. Equation (4) can be solved for the product of outward and inward multilateral resistance as:

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

The explicit solution for the multilateral resistance variables can be exploited to solve the general equilibrium model bilateral trade costs. Gravity equation (1) contains the product of outward multilateral resistance of one country and inward multilateral resistance of another country,  $\pi_i p_j$ , whereas equation (5) provides a solution for  $\pi_i p_i$ . It is therefore useful to multiply gravity equation (1) by the corresponding gravity equation for trade flows in the opposite direction,  $x_{ji}$ , to obtain a bidirectional gravity equation that contains both countries' outward and inward multilateral resistance variables:

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

Substituting the solution from equation (5) yields,

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

$$\begin{aligned}
 x_{ij}x_{ji} &= \left(\frac{y_i y_j}{y^w}\right)^2 \left(\frac{y^w}{y_i y_j}\right)^2 (x_{ii}x_{jj}) \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{1-\sigma} \\
 x_{ij}x_{ji} &= (x_{ii}x_{jj}) \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{1-\sigma} \\
 x_{ij}x_{ji} &= (x_{ii}x_{jj}) \left(\frac{t_{ii}t_{jj}}{t_{ij}t_{ji}}\right)^{\sigma-1} \quad (7)
 \end{aligned}$$

The size variables in the gravity equation (7) are not total income  $y_i y_j$  as in traditional gravity equations but intranational trade  $x_{ii} x_{jj}$ . Intranational trade does not only control for the countries' economic size, but according to equation (5) it is also directly linked to multilateral resistance. (7) can be rearranged as:

$$\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}} = \left(\frac{x_{ii}x_{jj}}{x_{ij}x_{ji}}\right)^{\frac{1}{\sigma-1}} \quad (8)$$

As shipping costs between  $i$  and  $j$  can be asymmetric ( $t_{ij} \neq t_{ji}$ ) and as domestic trade costs can differ across countries ( $t_{ii} \neq t_{jj}$ ), it is useful to take the geometric mean of the barriers in both directions. It is also useful to deduct one to get an expression for the tariff equivalent. The resulting micro-founded trade cost measure is denoted as  $\tau_{ij}$ :

$$\tau_{ij} = \left(\frac{t_{ij}t_{ji}}{t_{ii}t_{jj}}\right)^{\frac{1}{2}} - 1 = \left(\frac{x_{ii}x_{jj}}{x_{ij}x_{ji}}\right)^{\frac{1}{2(\sigma-1)}} - 1 \quad (9)$$

$\tau_{ij}$  measures bilateral trade costs  $t_{ij}t_{ji}$  relative to domestic trade costs  $t_{ii}t_{jj}$ . It therefore does not impose frictionless domestic trade and captures what makes international trade more costly over above domestic trade.