A Study on Impact of Time and Cost on India's Trade: Gravity Model Approach

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ABSTRACT

International trade transactions required multiple documentation and inspection which takes time, as time increase, the cost increased. Purpose of this research paper is to discuss the impact of time and cost incurred in India's export, Import and total trade independently. In so doing, we use a unique dataset that consists of India's trade transactions over the period 2015–2018 and includes information on the time it took for documentation and cost of each of these transactions. Augmented gravity model used new dummy variable, trading across the border, with traditional variables. India's trade responds high in distance and partner's size. RTAs are important factor in India's trade. Results suggested India's export is time sensitive and import is cost sensitive.

Keywords: *Trading*; *Gravity equation*; *International trade*. *JEL classifications:* F14, F18.

1.0 Introduction

Global trade witnessed tremendous variation in the trade pattern during the last century. Various economic shocks were easily absorbs by most of the nations but still shocks made impact on nations economy which reflected in its trade policy specially in developing nations. This proves that no country in the globalisation can keep itself away from regular trade reforms. All international trade transactions are processed by various government agencies such processing takes time and time is a key trade barrier.(Hummels& sachur, 2001). They estimated that each day in transit is equivalent to an ad-valorem tariff of 0.6 to 2.3 per cent. Reduced inspections reduced mean and median time in customs and reduced uncertainty about time spent in customs. Reduced inspections produced significant increases in the level, and changes in the composition, of Albanian imports. They estimate that the impact of the reforms was roughly equivalent to an Albanian tariff cut of 1.3 percentage points.(Fernandes, 2017) Delays have a significant negative impact on firm's exports along several dimensions. Effects are more pronounced on sales to newer buyers. Customs-driven, transactionspecific delays can be substantial and highly variable, thus naturally affecting delivery dates. Accordingly, they could have significant effects on buying and selling decisions and thereby on firms' export outcomes.(Christian Volpe Martineus, 2015)Delays associated with customs inspections can be seen as trade costs accruing to each transaction. Exporters can respond to these costs by adjusting the number and size of their shipments to given destinations, which could potentially result in changes in their foreign sales, and the intensity of this adjustment can vary across products depending on their characteristics.(C Hornok, 2015)¹ These transit times are influenced by many factors, such as "Trading across Borders", which is a constituent part of

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Doing Business, is a survey focused on economies' performance with respect to border regulatory services; a number of administrations and other border agencies are greatly concerned about how accurately their efforts with respect to trade facilitation are affecting the trade.

(Okazaki, 2018) Vietnam, an economy which Doing Business 2016 ranked 108th on the trading across Borders index, jumped to 93rd in the 2017 edition, as a result of its effort to simplify Customs procedures and reduce clearance times affected businesses such as Ford Vietnam.(USAID, 2017). Delays have a relatively greater impact on exports of time-sensitive goods, such as perishable agricultural products.(Simeon Djankov, 2010)Time delays hinder exports, particularly in more timesensitive sectors. With a ten-percent export-delay reduction, sectoral exports would increase by 2.3-6.2 percent, and total manufacturing exports would increase by 4.3 percent. The magnitude of the export effect depends on sectoral time sensitivity, with more time-sensitive sectors having a larger effect.(Li, 2018)Time is found not only to reduce trade volumes, but more importantly lengthy procedures for exports and imports reduce the probability that firms will enter export markets for time sensitive products at all.(Hildegunn Kyvik Nordås, 2006).Infrastructure is an important determinant of transport costs, especially for landlocked countries. Analysis of bilateral trade data confirms the importance of infrastructure and gives an estimate of the elasticity of trade flows with respect to the trade cost factor of around -3. A deterioration of infrastructure from the median to the 75th percentile raises transport costs by 12 percentage points and reduces trade volumes by 28 percent. Analysis of African trade flows indicates that their relatively low level is largely due to poor infrastructure.(Venables, 2001)Transport time increases with distance travelled, and time is valuable. In their research paper, timely delivery is important because it allows retailers to respond to final demand fluctuations without holding costly inventories, and timely delivery is possible only from nearby locations.(HARRIGAN, 2005)Reducing waiting times at the border, which is one of the key indicators of improved TTF is hardly possible, if the Customs administrations and other border agencies are not up to modern standards, if they prefer control over fighting illegal trade, and if their organizational, operational structure or their technical facilities are not well equipped for smooth and fast processing of legal trade while detecting illegal trade. (Eva Molnar, 2003).

2.0 Statistical Model and Variables

We tried to understand the impact of time and cost on India's trade transaction with world. In this line, we used gravity model with time and cost with other dummy variables. Study carried out for the India with few dummy variables such as common language, contingency, colony, agreement and foreign exchange etc. We estimated the equation as

 $T_{ij=}\alpha + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln Dist + \beta_4 Time + \beta_5 Cost + \beta_6 Dummy Variable + \delta$

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i represents India and j represents partner country

 $ln\,GDP_i = \ Logarithm \ of \ GDP \ of \ country \ i \ and \ j$

ln Dist = Logarithm of bilateral distance between countries i and j

Time = Time involved in Documentation and Border compliance

Cost = Cost involved in Documentation and Border compliance

2.1 Dummy bariables

Comlang = Binary variable that takes the value 1 if countries have common official language, and 0 otherwise

Comborder = Binary variable that takes the value 1 if both countries share border, otherwise 0

Colony = Binary variable that takes the value 1 if countries were under the same colonizer, otherwise 0

Landlocked = Binary variable that takes the value 1 if both the country is landlocked, otherwise 0 Agreement = Binary variable that takes the value 1 if countries have trade agreement, otherwise 0

3.0 Data and Estimation

India's export and import data with all its trading partners has been taken from the Direction of Trade Statistics, IMF². The trade data is in US \$. To bring it to real terms, divided it with the consumer price index (CPI) of the US. The US CPI (for all urban consumers) data is taken from the US Department of Labour (Bureau of labour statistics). Data for GDP is taken from the PENN world table³. Study multiplied CGDP (real per capita GDP in current US \$ i.e. current GDP divided by current price) from PENN by population (taken from the same source) to arrive at the aggregate GDP of each country. The data for distance is taken from Centre D'etudesProspectivesEtD'informationsInternationales.⁴

There are total 216 countries with which India had trade relation from 2015 to 2018. As far as is data is concerned, the countries had minor contribution in India's trade we considered that also because our objective was to know the impact is positive or negative on trade whether it is small or big trade amount. We decided to take 0.00001values for missing value sin model where we considered log values of trade but this is not required for time which we took. (R Bhattacharya & T Benerjee, 2006).

A panel data of 216 trade partners of India for the year 2015 to 2018 was prepared for analysis. Heteroscedasticity and multicollinearity are the two major problems occur in the panel data. Study did some diagnostic test to check the expected assumptions of Multicoliniearity and Hetroscedesticity. The basic equation is having multicoliniearity problem with model due to high correlation between its two main independent variables such as time and cost (Appendices). To avoid multicoliniearity, we used two separate models for avoiding multicoliniarity. This is common statistical nature of the gravity model of estimation. So study used following two models

$T_{ij=}\alpha + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln Dist + \beta_4 Time + \beta_5 Dummy Variable + \delta$

&

$T_{ij=}\alpha + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln Dist + \beta_4 Cost + \beta_5 Dummy Variable + \delta$

We transform the data in to logarithm to control the hetroscedisticity problem (Appendices). There are three main models can be used to estimate in panel data: pooled model, random effects model (REM) and fixed effects model (FEM). If individual effects do not exist, the pooled model will be the best choice. But if it exists than it must be reflected in the model estimated values and preferred to use the FEM and REM. FEM will be selected if there is a correlation between individual effects and explanatory variables. Meanwhile, the regression model will be able to control over and separate the impact of individual effects from explanatory variables so that we can estimate the net effects of explanatory variables on dependent variable. But if individual effects of the entities are random and not correlated with explanatory variables, REM will be more effective. REM considers the residual of each entity (which is not correlated with explanatory variables) as a new explanatory variable and can estimate the invariant factors such as distance. (Gujarati, 2003)

The main problem of FEM is that the variables which do not change over time cannot be estimated directly in this model. So variables such as distance, time and cost of trade, in few cases, in equation will not be supported in FEM. Best fitted method to use for gravity model in case of India is FGLS with random effect regression (Ashish, 2019).

4.0 Interpretation of Results

India's trade is depending on its total cost and total time rather than partner country's time and $cost^5$. Indian government is reducing the time and cost involves in trading across the border⁶ and made the significant impact on trade. Such initiatives make the procedure easy and reduce the trade cost which makes Indian trade more competitive in the global market place. India's trade is no affected by change in partner country's time and Cost. The individual effect of time and cost also proves that the India's trade is depending on its change in time and cost. Table 1 represents the results of Panel EGCL - cross-section random effect as total trade effect, Total cost effect and total time effect which proves the same that India's trade is significant to reduction in time and cost. Totaltrade is summation of export and import so it is not appropriate to tell that reduction in time and cost will help in boosting export or import so we gave decided to understand the impact of change in the time and cost on export and import individually. To check impact of time and cost on India's export and import, we found that India's time involved in documentary and border compliance have significant impact on India's export and Import. (Table 2). India's export is significant with cost involved in documentary and border compliance as well partner country's border compliance while India's import is significant with cost involved in border and documentary compliance of both, India as well as partner countries(Table 3). India's export and import is fully dependent on cost and time. Specifically India's import is more cost sensitive than time. Cost involved in such transaction plays important role in India's trade. Cost involved in documentation is playing important role in India's export.

5.0 Conclusion

Reduction in cost and time involved in export and import transactions have significant impact. Costs involved in import transactions are higher than the export. India's export is more time sensitive and import is more cost sensitive. India is one of the leading importers of the world so if we reduces the cost involved and motivate importers, India can perform better in re-export.

6.0 Scope of Further Study

Current research work considered the limited time interval of 4 years/ Also We considered those countries who had trading across the border index. Also India is trading majorly with neighbouring Asian counties which we considered but weightage was given equal. India's trade with advance economies are not considered separately and advanced economies may have minimum time involved in such transactions may change India's bilateral trade equation.

Endnotes

- 1. Develop a simple model of shipping frequency which highlights the trade-off faced by exporters in the presence of such per-shipment costs.
- The Direction of Trade Statistics (DOTS) presents the value of merchandise exports and imports disaggregated according to a country's primary trading partners. Source : https://data.imf.org/?sk=9D6028D4-F14A-464C-A2F2-59B2CD424B85
- 3. https://www.rug.nl/ggdc/productivity/pwt
- 4. http://www.cepii.fr/anglaisgraph/bdd/distances.htm, under file name dist_cepii.xls
- 5. We calculate the total time spent in documentary and border compliance as total time and follow same procedure in calculating total cost.
- 6. https://www.doingbusiness.org/en/data/exploretopics/trading-across-borders

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Table 1: OLS OUTPUT Panel EGLS (Cross – Section random Effects)

	Total Trade Effect		Total Cost	Effect	Total Time Effect	
Variables	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value
INTERCEPT	17.37593	0.0050	14.507889	0.2006	7.146667	0.0689
GDP IND	-0.837198	0.0935	0.303617	0.1599	0.071682	0.7842
GDP PARTNER	0.402466	0.0001	0.412007	0.0000	0.409864	0.0000
DIST	-0.872602	0.0024	-0.872914	0.0030	-0.869346	0.0024
TOTAL TIME IND	-0.037055	0.0111	-	-	-0.006180	0.0016
TOTAL TIME PAR.	5.61E-05	0.8903	-	-	9.51E-05	0.8001
TC INDIA	0.009795	0.0326	-0.001750	0.0045	-	-
TC PARTNER	9.00E-06	0.9627	1.41E-05	0.9377	-	-
COM LANG	-0.844809	0.0443	-0.853500	0.0470	-0.851697	0.0425
CONTINGENCY	0.144241	0.8787	0.155073	0.8730	0.150315	0.8741

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COLONY	0.229139	0.3259	0.235662	0.3174	0.239172	0.3056
LANDLOCKED	-1.093072	0.0000	-1.100212	0.0000	-1.098977	0.0000
AGREEMENT	1.578231	0.0000	1.581891	0.0000	1.578098	0.0000

Time Effect								
		Effect o	Effect on Import					
Variables	Coefficients	P-value	Coefficients	P-value	Coefficients	P-value		
INTERCEPT	14.48779	0.0000	17.86080	0.0000	13.86948	0.0040		
GDP IND	-0.547625	0.0003	-0.547625	0.0003	-0.322565	0.3048		
GDP PARTNER	0.569909	0.0000	0.569909	0.0000	0.689762	0.0000		
DIST	-0.412795	0.0518	-0.412795	0.0518	-0.329796	0.1975		
INDIA_TIME_BORDER	-	-	-0.050752	0.0000	-0.0003434	0.0073		
INDIA_TIME_DOC	-0.052389	0.0000	-	-	-0.067648	0.0205		
PARTNER_TIME_BORDER	0.000311	0.6552	0.000311	0.6552	-0.000508	0.3248		
PARTNER_TIME_DOC	0.000707	0.3417	0.000707	0.3417	0.000409	0.3714		
COM LANG	-0.637795	0.0298	-0.637795	0.0298	-1.257136	0.0006		
CONTINGENCY	-0.180529	0.7984	-0.180529	0.7984	-0.376138	0.6597		
COLONY	-0.141930	0.0790	-0.141930	0.0790	-0.000261	0.9987		
LANDLOCKED	-0.039924	0.6782	-0.039924	0.6782	-0.346680	0.0553		
AGREEMENT	0.784630	0.0030	0.784630	0.0030	1.171172	0.0002		

Table 2: Impact of Time on Export and Import

Table 3: Impact of cost on Export and Import

Cost Effect							
	Effect or	n Export	Effect on	Import			
Variables	Coefficients	nts P-value Coefficients		P-value			
INTERCEPT	-17.59443	0.0000	10.50938	0.0097			
GDP IND	-0.771472	0.0000	-0.296747	0.3437			
GDP PARTNER	0.474242	0.0000	0.717979	0.0000			
DIST	-0.378522	0.0791	-0.217374	0.3955			
INDIA_COST_BORDER	-0.002778	0.0000	-0.014398	0.0142			
INDIA_COST_DOC	-0.016883	0.0000	-0.002035	0.0091			
PARTNER_COST_BORDER	-0.000496	0.0496	-0.000607	0.0130			
PARTNER_COST_DOC	-0.000293	0.5792	0.000907	0.0458			
COM LANG	-0.608116	0.0381	-1.232847	0.0007			
CONTINGENCY	-0.282081	0.6895	-0.193844	0.8188			
COLONY	-0.092532	0.2254	0.003638	0.9816			
LANDLOCKED	-0.034206	0.7070	-0.320435	0.0757			
AGREEMENT	0.855127	0.0013	1.198151	0.0001			

Appendices: Correlation between independent variables

	GDP_IND	GDP_PART	DIST	TIME_IND	TIME_PART	COST_INDIA	COST_PAR	COLONY	COM_LANG	CONTINGE
GDP_IND	1.000000	0.026665	1.56E-06	-0.846749	-0.024692	-0.761536	0.003241	-0.006937	2.13E-17	-1.38E-17
GDP_PART	0.026665	1.000000	0.040591	-0.030115	-0.569576	-0.029126	-0.367735	0.039077	0.046603	-0.148976
DIST	1.56E-06	0.040591	1.000000	-1.23E-06	-0.058331	-1.09E-06	0.156771	0.020832	0.283865	-0.448736
TIME_IND	-0.846749	-0.030115	-1.23E-06	1.000000	0.024241	0.986612	-0.001496	0.010654	-2.11E-17	-3.26E-17
TIME_PART	-0.024692	-0.569576	-0.058331	0.024241	1.000000	0.023232	0.748452	0.092845	0.006204	0.085582
COST_INDIA	-0.761536	-0.029126	-1.09E-06	0.986612	0.023232	1.000000	-0.001073	0.011262	1.49E-16	4.21E-17
COST_PAR	0.003241	-0.367735	0.156771	-0.001496	0.748452	-0.001073	1.000000	0.208427	0.179484	-0.006647
COLONY	-0.006937	0.039077	0.020832	0.010654	0.092845	0.011262	0.208427	1.000000	0.629487	0.082784
COM_LANG	2.13E-17	0.046603	0.283865	-2.11E-17	0.006204	1.49E-16	0.179484	0.629487	1.000000	-0.110432
CONTINGE	-1.38E-17	-0.148976	-0.448736	-3.26E-17	0.085582	4.21E-17	-0.006647	0.082784	-0.110432	1.000000

Correlation between India's time involved in documentary and border compliance

	INDIA_EXP	INDIA_EXP
INDIA_EXP	1.000000	1.000000
INDIA_EXP	1.000000	1.000000

Heteroskedasticity Test: Breusch-Pagan-Godfrey Null hypothesis: Homoskedasticity

F-statistic	8.556644	Prob. F(8,639)	0.0000
Obs*R-squared	62.70047	Prob. Chi-Square(8)	0.0000
Scaled explained SS	68.82081	Prob. Chi-Square(8)	0.0000

