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Quantifying Non-Tariff Barriers and Assessing their impacts on India’s key Agricultural exports using a Gravity Model

Saarthak Sharma

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Saarthak Sharma

Centre for WTO Studies, Indian Institute of Foreign Trade

saarthak.cws@iift.edu

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ABSTRACT

It is certain that the new world order in international trade restriction for domestic industry protection are not only tariffs but also various non-tariff barriers. As a matter of fact, identifying and measuring the extent of such barriers is far harder, whereas for tariffs, its simply, a numerical value that can be used to estimate the loss of trade and even the loss of welfare to an extent.

However, this is not possible for non-tariff barriers simply due to their complexity and intertwining nature with other laws of the particular country as well as with its governmental structure. Thus, measuring such barriers and the extent to which such barriers cause damage to trade is extremely hard to measure accurately.

Despite the hardships, several studies have been undertaken to analyse the impact of such barriers on exports of nations. This study aims to conduct a similar analysis for India, keeping in mind the variables that may affect India’s exports, there shall be an attempt to keep the model as explanatory and dynamic as possible.

The study will consider data for a period of 10 years, 2010-2020, since the purpose is to judge and compare the impact of Non-tariff barriers relative to tariffs, all the variables included in the model will be considered with the view that they contribute more to the explanatory power of the model and are impacted by or are impactful on non-tariff barriers. The methodologies that are used, as well as the expected results, are discussed in the subsequent sections.

INTRODUCTION

Since the 1980s, when non-tariff barriers (NTB's) actually started to catch the attention of trade analysts worldwide, there have been several attempts at quantifying them. Most of these attempts stem from the premise that services exports are also a key part of several nations' international trade, and since tariffs are not applicable to services, the only way of restricting services trade is to impose non-tariff barriers. Thus, not just for trade in goods, measuring NTBs and quantifying them is very important for services trade, which in today's world, is a very significant part of the total global trade value. The first of these studies was the idea of formulating a trade model and then using it to infer the gap between actual and predicted trade volume to measure the extent of protection (Leamer, 1988). However, considering the nature of this exercise itself and the incremental rise in dynamism in international trade, the requirement for a new and more dynamic method for such estimation emerged.

Major developments in this area came in 1995, with a study conducted on measuring these costs for Japan (Sazanami, Urata, & Kawai, 1995), which used detailed trade data to derive unit values and estimate price gaps to determine the impact of Non-tariff barriers. While this provided a better result in the context of statistical significance, conducting such a study requires a lot more prowess and conversion for prices may not be precisely accurate.

However, a very significant development in this field came in 1994, with the development of a new NTB numerical equivalents estimation technique, simplified and standardized for usage for almost anyone intending to study this area (Linkins & Arce, 1994). The formula given uses domestic prices, a relative world price, and transport margin as well as the ad valorem tariff to estimate a tariff equivalent for non-tariff barriers.

In 2009, a study conducted on agricultural exports of Iran to estimate the non-tariff barrier equivalents used the methodology from (Linkins & Arce, 1994) and further estimated the impact of non-tariff barriers on Iran's Agricultural exports (Ardakani, Yazdani, & Gilanpour, 2009). Considering the proximity being an important part of NTB equivalents estimation and other indicators that are similar between India and Iran, this study gave extremely important insights for conducting this project.

However, given all the NTB estimation methods that have been developed, one of the most popular is the one developed in a study for OECD countries for estimating final goods protection (Bradford, 2003). This methodology involves estimating a parameter called PPR (Preliminary Measure of Protection) to estimate NTB numerical equivalents, comparing it with the tariff rate and choosing the one higher of both as a measure of the level of protection.

The results estimated using NTB estimation techniques gives us a quantified value for all trade barriers that exist which cannot be classified as a tariff[1]. It is imperative to understand the impact of these barriers on countries trade. Classified as SPS (Sanitary and Phytosanitary Measures) as well as TBT (Technical Barriers to Trade) by the World Trade Organization, most barriers are under the purview of these two WTO agreements, which aim at protection of human rights of access to non-hazardous products as well as maintaining quality based on

[1] It is important to note that several barriers cannot be accounted for by using this technique, however these barriers have minimal impact in estimations where they are internalized and hence can be ignored.

countries demands and requirements in the context of environment as well as human and animal safety (Debroy, 2005).

However, it is possible to use such barriers to deter imports for the protection of domestic industries rather than use them for the purposes intended. And that is the motivation for quantifying non-tariff barriers, to understand fully the impact on a country’s exports not by the notified barriers that are under the purview of SPS and TBT but by the price differences that may exist owing to hidden NTBs by accounting for domestic and world producer prices.

Such techniques may not be precisely accurate in estimating the extent of such barriers, however, they tend to give us a far better idea of the extent of protection a country is facing from its other trading partners. Government structures worldwide are very complicated, and several barriers can be hidden under the layers of intricate structures that may take months or years to investigate to find their actual effects, thus it is better to undertake a macro approach and do enough to get an approximate estimate of the barriers imposed by a country.

Once the NTB equivalent estimation is concluded, the data can be used to understand its impacts using various models and on different trade related aspects. One of those is to compare the impact of non-tariff or indirect barriers with that of direct barriers or tariffs to understand which of these barriers is more impactful in reducing a country's exports. That is the purpose of this study, drawing insights from several other studies done with the same intent (Ardakani, Yazdani, & Gilanpour, 2009) and (Befus, Brockmeier, & Bektasoglu, 2016).

The question then is why should one use a gravity model for the same purpose when other techniques are available. The answer is that estimating the trade forgone as a result of NTBs is an alternative approach to capturing the trade impacts of NTBs (Beghin & Bureau , 2002).

Further, it requires a relatively limited amount of data, also theoretical considerations are fully elaborated and developed for the gravity model. Thus, the model can estimate the effects of protection on the volume of trade. Finally, the gravity model is able to contain the trade-enhancing effect of regulations and the distinct forms of NTBs in estimating trade flows. Thus, the gravity model can be considered a reasonable model for such estimation as it eliminates several problems and provides insights that other methodologies may or may not.

After building a model for the required estimation, we shall examine the effects of the non-tariff barriers on the exports of India for the products considered and compare them with the tariff’s impacts on exports. The result would help us understand which of the two barriers is more effective in deterring Indian exporters from its top 10 trading partners.

LITERATURE REVIEW

The discussion about non-tariff barriers on trade forums has gone on for a considerably long period of time. Considering the arbitrary and diversified nature of this topic, plenty of empirical and theoretical work has been done on the same in the past. The attention garnered has been such that WTO has itself created public sources for general users to be able to understand the implications of NTBs and identify as well as read any information related to NTBs that come under the purview of SPS or TBT agreements directly or government policies or notifications that can directly impact international trade amongst world trade organization members (World Trade Organization, 2021).

The Integrated Trade Intelligence Portal (ITIP)- World Trade Organization resource itself is extremely helpful as a starting point for plenty of modern literary works about non-tariff barriers. For this research itself, the ITIP resource played a very significant role. The website is used as a secondary verification tool to understand significant changes encountered in NTB equivalents on a yearly basis. A significant jump in the value of NTB equivalent from one year to the next could be some form of restriction or regulation being put in place that has restricted or reduced the value of trade to an extent.

However, in earlier works that came out before the existence of resources that collected, classified and notified NTBs, most works based on the estimation of NTB equivalents took a macro approach, explaining why producer prices are a better measure to estimate final domestic and world prices for the product under consideration and took other costs such as export margins and transportation costs into consideration to estimate a final number. "*The final goods price estimation for OECD countries*", see (Bradford, 2003), discusses the earlier works and their limitations as well as explains the technique developed in the paper itself in detail and also provides explanations as to why some parameters are excluded or included based on economic rationality. It is important to note that the same estimation technique may not be ideal for other nations owing to different economic structures as well as the lack of availability of data.

Recent models have been developed based on the GTAP framework, which help in estimating such costs for integrated economic unions, such as the European Union (Befus, Brockmeier, & Bektasoglu, 2016). Owing to the creation of economically integrated unions such as the European Union as well as larger organizations like the OECD, data availability is no longer a problem, and comprehensive models can be developed.

However, the insights from older models based on classical international trade theories still hold their place, and earlier works such as (Leamer, 1988) are very helpful in providing clarity and simplifying the concept of NTB's and their equivalents estimations.

Data availability has always been a problem, however, if detailed data is available, comprehensive analysis can be conducted for very accurate estimations, see (Sazanami, Urata, & Kawai, 1995). It is however, important to note that quantification techniques only exist only as a tool for better estimation in other models or for better insights; quantifying a qualitative measure is always a tough task and the concept of precision is hard to apply since, there is no specific standard that can be followed.

However, studying trends and the effects of barriers in the past years as well as aligning them with the notifications of NTB's can indicate that the estimation is on the right track. The magnitude however, shall be different in most cases, however standardized.

Significant breakthroughs were made, aiming at simplification of NTB equivalent estimation techniques that aimed at using producer prices along with transport margins as a variable that contains all required information about the non-tariff barrier (Linkins & Arce, 1994). While a standardized technique was developed 8 years later, which explained the use of some variables while explaining the exclusion of others. This study also provided insights as to why the gravity model is the best possible model for comparison of NTB's effects on other variables.

A summarized explanation of all possible NTB equivalent estimation techniques was published as a United Nations publication in 2002; the report contained all the information that one can or should consider before NTB equivalents estimation. New approaches such as the inventory approach, the role of subsidies and trade restrictiveness index in Non-tariff barrier equivalent estimation as well as effective protection were discussed (Bora, Kuwahara, & Laird, 2002).

Papers concentrating on sectoral trade and related policies have been extremely helpful in gaining insights into estimating non-tariff barrier equivalents for related sectors. Agricultural distortions were studied in developing countries in the 1960s, see (Krueger, Schiff, & Valdes, 1988), not only did this and similar studies help with very useful insights and results for later studies, but they also helped in generating ideas for creating data variables for countries where data wasn't available in the first place. Similar studies for different sectors have been conducted in the past as well, all of which have been extremely helpful towards the cause of NTB equivalent estimation.

While sectoral analysis reports have been published in plenty, another interesting aspect of non-tariff barriers is the study of non-tariff barrier equivalents from different points of view. While some NTBs have been connected with trade facilitation, in some, price and quantity gaps have been considered to measure the impact of non-tariff barriers. However, for our purpose, we consider price gaps since they keep the analysis relatively less complicated to an extent and help us focus on the subsequent objective of the study.

Plenty of literature has also been written on the problems that one can encounter while attempting to estimate NTBs, see (Ferrantino & Dee, 2005). These can be avoided if an extremely detailed approach is not taken but instead a macro approach that simply focuses on finding the gaps between the key variables and then doing some simple estimations to arrive at final values. Such estimations have been done in the past and have been found to be suitably aligned with real-world scenarios based on matching them with past trends, thus a similar approach is used in this study to avoid getting stuck into the intricacies of non-tariff barriers estimation and focus on the paramount goal of this study.

The second part of this study focuses on, estimating the impacts of non-tariff barriers on India's key exports using a gravity regression model. Similar studies have been conducted for Iran and the European Union in the past, see (Ardakani, Yazdani, & Gilanpour, 2009) as well as (Befus, Brockmeier, & Bektasoglu, 2016). The premise of all these studies as well as this study, are the same, i.e. to collect the required data and to develop a regression model using suitable variables and then finally estimate the impacts to obtain the required results. The intricacies or details in such estimation can differ widely, hence explanation of what has been done in the studies mentioned above has not been briefed, whereas the methodologies used in this study are discussed in detail in the following sections.

Elements of the NTB equivalent estimation shall be discussed in detail. Information about the data collected and processed will be provided. Explanations as to why the specifically mentioned data is chosen are also given.

However, it is important to note that the choice of data is specifically made to serve the purpose of the study with utmost accuracy and not specifically to show any existing trends. However, if any trends have been discovered in the data analysis, they are specifically mentioned in the report.

In the following sections, the development of the gravity model is detailed along with the variables chosen and details about the variables chosen and the econometric analysis are also provided. In case a variable does not show up as significant in the regression analysis, possible explanations for them have been looked into from the aspect of econometrics as well as the practical aspects, and a possible explanation for it has also been provided. In further sections, the empirical findings are also explained, followed by a conclusion.

DATA AND METHODOLOGY

The data used in this study is collected and compiled from different sources as well as fully verified from secondary sources to ensure no empty data points exist or incorrect values are taken to avoid erroneous results.

Data for top 10 importers of the three commodities are selected for this analysis. The commodities chosen are based on their total weightage in the overall exports of the country as well as subject to data availability to achieve explanatory power and a result that is sound with economic theory. The products thus chosen are (HS 6 digit)- Wheat/Meslin Flour (HS-110100), Cashewnuts (Shelled), (HS-080132) and Coffee (Roasted, Not decaffeinated), (HS-090111). The products are chosen to ensure that commodities that emerge from specific parts of India are taken into consideration to understand the possible effects they can have on regional development and export opportunities for different parts of the country. Hence wheat, whose growth is concentrated mostly in Northern and Central India, is chosen, as well as Cashewnuts, which come from South West India along with Coffee which comes from Eastern as well as Southern India, is chosen, with the aim of covering most parts of the country.

The top 10 countries to which these commodities are exported also have an import share or from the aspect of India, an export share of more than 80 per cent cumulatively for the year 2019 and have had a rising trend in the previous years to reach 80 per cent in total. This information has been tabulated and is shown below: -

Table 1- Export Shares of India to Top 10 importers for the product Wheat/Meslin Flour (HS-110100)

Years	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Importers	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share
UAE	10.26%	28.35%	22.87%	16.41%	22.89%	26.71%	27.80%	20.76%	14.41%	15.54%
Australia	11.00%	7.43%	3.83%	2.68%	3.21%	6.26%	6.10%	7.25%	7.53%	7.98%
Canada	1.33%	1.86%	4.48%	7.08%	1.63%	2.38%	4.84%	5.29%	6.50%	6.47%
United Kingdom	5.95%	5.23%	3.43%	6.95%	2.82%	3.07%	4.47%	5.97%	5.55%	6.85%
Sri Lanka	1.56%	2.66%	1.65%	3.26%	0.44%	0.65%	1.11%	1.14%	1.46%	2.13%
Malaysia	2.67%	1.84%	2.50%	4.17%	2.56%	2.84%	3.51%	4.19%	3.90%	4.82%
New Zealand	1.69%	1.76%	1.65%	0.40%	0.54%	0.75%	1.15%	1.34%	1.26%	1.49%
Singapore	7%	0.33%	0.27%	0.24%	4.42%	0.91%	2.94%	5.70%	7.76%	9.07%
Qatar	0.95%	4.27%	6.55%	1.87%	2.09%	2.45%	3.27%	3.80%	2.94%	2.97%
USA	35%	29.24%	23.71%	24.55%	31.97%	36.09%	25.22%	31.92%	36.39%	26.82%
Total Share of Top 10 Countries	77.10%	82.97%	70.92%	67.61%	72.58%	82.10%	80.41%	87.35%	87.70%	84.12%

The same information is presented for Cashewnuts (HS-080132) as well as Coffee (HS-090111) below: -

Table 2- Export Shares of India to Top 10 importers for the product Cashewnuts-Shelled (HS-080132)

Years	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Importers	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share
UAE	34.83%	14.22%	37.32%	10.43%	14.75%	10.66%	13.09%	13.48%	12.89%	16.95%
Germany	1.41%	2.12%	1.03%	2.06%	0.92%	2.35%	1.08%	8.38%	1.20%	3.36%
Spain	2.69%	2.38%	2.42%	1.65%	2.47%	2.30%	2.07%	2.26%	2.78%	2.68%
France	3.03%	2.79%	2.55%	2.78%	1.98%	3.10%	2.67%	2.71%	2.56%	4.42%
Japan	5.88%	3.70%	4.32%	3.60%	3.84%	4.11%	4.52%	3.51%	5.87%	5.85%
Kuwait	1.04%	2.22%	2.07%	0.63%	0.68%	0.72%	0.80%	1.15%	1.48%	1.03%
Netherlands	10.41%	6.55%	7.64%	6.38%	6.80%	7.27%	8.00%	10.46%	8.80%	10.36%
Qatar	0.23%	0.15%	1.21%	9.84%	0.15%	0.16%	1.14%	4.17%	0.20%	0.23%
Saudi Arabia	4.05%	2.54%	2.97%	2.48%	2.64%	2.83%	3.11%	2.41%	3.42%	4.03%
USA	28.31%	40.19%	20.78%	39.14%	41.71%	44.64%	49.12%	31.75%	44.97%	35.26%
Total Share of top 10 Countries	91.88%	76.87%	82.31%	79.00%	75.93%	78.14%	85.61%	80.28%	84.17%	84.17%

Table 3- Export Shares of India to Top 10 importers for the product Coffee-Roasted, Not Decaffeinated (HS-080132)[2]

Years	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Importers	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share	Export Share
Australia	7.70%	1.37%	1.51%	8.75%	1.73%	1.72%	5.35%	3.03%	1.81%	5.85%
Belgium	7.23%	4.06%	15.97%	22.65%	5.14%	5.13%	5.03%	4.33%	5.37%	43.54%
Germany	10.33%	1.37%	1.51%	1.64%	1.73%	1.72%	1.69%	1.45%	3.76%	1.85%
Spain	7.23%	4.06%	4.50%	4.88%	23.85%	23.81%	5.03%	32.68%	5.37%	5.50%
Greece	2.43%	1.37%	4.79%	1.64%	1.73%	7.33%	1.69%	4.60%	5.72%	1.85%
Italy	12.50%	43.98%	4.50%	22.65%	5.14%	5.13%	8.69%	4.33%	5.37%	5.50%
Jordan	7.70%	1.37%	6.43%	6.97%	1.73%	1.72%	1.87%	1.45%	1.81%	1.85%
Kuwait	7.23%	4.06%	4.50%	4.88%	5.14%	23.81%	6.86%	35.83%	44.49%	7.50%
Saudi Arabia	2.43%	2.84%	12.98%	5.19%	3.60%	3.59%	3.52%	6.18%	3.76%	2.05%
Slovenia	7.23%	14.41%	20.89%	4.88%	23.85%	5.13%	41.65%	4.33%	5.37%	5.50%
Total Share of top 10 Nations	72.03%	78.89%	77.59%	84.13%	73.63%	79.10%	81.40%	98.20%	82.84%	81.00%

[2] The estimations in the tables given above have been made based on data collected from WITS

The data presented in the table above signifies that the data collected for the study contains a very significant part of the total exports of the selected products. Thus, the impact of NTB equivalents estimated for the countries chosen is expected to measure the reduction caused in exports with the appropriate magnitude.

The process created and explained in "*The final goods price estimation for OECD countries"* (Bradford, 2003) is followed for NTB equivalents estimation. Bradford's technique is based on the simple premise that accounting for the macro effects of price changes (minus the tariff) will consider any changes in exports that the non-tariff barriers have caused. We discuss this technique in detail below: -

We start off by estimating the Unit Value of Imports for each country to which India exports the products concerned. For this, we use the data collected and verified from different sources[3].

The Unit Value of Exports is estimated using the following formula: -

$$\frac{\textbf{(Value of Exports from the country to the Total World for the Product Concerned)}}{\textbf{(Quantity of the product exported by the country to the world/907)}}$$

This formula gives us the price of the exported product charged from the importing country per unit (i.e. per ton). Since per unit price is accounted for, the non-tariff barrier equivalent will also account for marginal changes in the export value. The value is divided by 907 to convert per kg into per ton. This is done to standardize the values to align with the results of the model described in the later sections.

The value thus obtained from the formula is the domestic producer price, i.e. the price at which the producer is willing to export the commodity. This price is the same for the entire world, with adjustments for tariffs that are made later, which are considerably lower relative to the macro effect of NTBs.

The values we obtain by the formula given above are thus called domestic producer prices and are denoted by $\mathbf{P_d}$.

Using the same data sources, the Unit value of Imports is estimated, the formula for which is given as follows:-

$$\frac{\textbf{(Value of Imports by the Country from another country for the Product Concerned)}}{\textbf{(Quantity of the product imported by the country from another country/907)}}$$

The exercise for estimating the Unit Value of Imports is slightly different from that of Unit Value of Exports. In this case, the world prices are not considered since an NTB is not levied on the entire world, but measures can wary from country to country and also depend on various dynamic circumstances. In this case, to fully capture the magnitude of the NTB, we choose the minimum of all the Unit Values of Imports for that country and denote it as $\mathbf{P_w}$. A country would always want to get the maximum value for its exports and minimize the cost of its imports. Since an NTB is intended to help with the latter by deterring imports from various countries based on different factors and aims, it is safe to assume that the dynamism

[3] The data is collected from WITS and ITC Trademap.

of such barriers can only be estimated to a fuller extent with a higher preliminary measure of protection value. Also, owing to the macro approach taken to estimate the non-tariff barrier equivalents, this would make sense since a country would always want to buy from a country offering a commodity at a lesser price. Thus, we take the minimum value of all the given Unit Values of Imports for a particular year.

Following the same technique, a unit of value of exports (P_d) as well as a unit value of imports min (P_w) is obtained for each year for each country to estimate the NTB equivalent levied by that country on the rest of the world.

Using this data, we estimate the preliminary measure of protection (PPR), the formula for which is given as follows: -

$$\mathbf{PPR = P_d / P_w}$$

The preliminary measure of protection (PPR) value indicates the level of total protection levied by a country on other countries' imports. This PPR value is compared with the value of tariff levied on a country, and the value higher from the two is chosen as a measure of protection. In this case, if the tariff value is higher than PPR, it can be said that the value of the NTB equivalent is zero since the tariff levied is higher than that of the preliminary measure of protection, indicating that tariff is the only measure used for protection or if NTB's are used, their effect is marginal.

However, if the value of the PPR is higher than that of the tariff, in that case, we obtain the value of the non-tariff barrier equivalent by subtracting the tariff from the PPR. Since the exclusion of tariffs would make it certain that only the Non-tariff barriers are accounted for in the analysis.

The final value of NTB equivalents is thus obtained by multiplying the value of NTB equivalents in percentages since tariffs are measured in percentages as well in most cases, and using percentages aligns well with our further analysis. We can now state the final formula as follows: -

$$\left\{ \begin{array}{ll} \textbf{NTB Equivalent} & \mathbf{= 0 \text{ if } PPR<1+t} \\ & \mathbf{= 100*[PPR-(1+T)] \text{ if } PPR>1+t} \end{array} \right\}$$

The same exercise is repeated for all the countries in the analysis, and NTB equivalents are obtained (for example, for the product Wheat/Meslin Flour (HS-110100), 100 values of non-tariff barrier equivalents are obtained i.e. for the top 10 countries considered, we obtain a value for each year, thus a total of 100 values for each product).

One of the estimations (for the product Wheat/Meslin Flour i.e. HS-110100 for United States) for non-tariff barrier equivalents is shown below: -

Table 4. Bradford analysis for Non-Tariff Barriers for the product Wheat/Meslin Flour (HS-110100), Country-United States

Year	Pd (per ton)	Pw (per ton)	PPR	Tariff	1+t	Max(PPR,1+t)	100*[Max(PPR,1+t)-1+t]	NTB Equivalent
2010	399	372	1.072862	1.08	1.0108	1.072862	6.206249	6.21
2011	486	297	1.637938	1.08	1.0108	1.637938	62.71381	62.71
2012	480	154	3.116471	1.02	1.0102	3.116471	210.6271	210.63
2013	443	504	0.879166	1.02	1.0102	1.0102	0	0
2014	476	155	3.072949	1.02	1.0102	3.072949	206.2749	206.27
2015	464	148	3.133391	1.09	1.0109	3.133391	212.2491	212.25
2016	437	296	1.47748	1.09	1.0109	1.47748	46.65805	46.66
2017	436	494	0.882205	1.14	1.0114	1.0114	0	0
2018	462	482	0.958936	1.14	1.0114	1.0114	0	0
2019	476	466	1.022191	1.14	1.0114	1.022191	1.079115	1.08

Source-Author's Estimation

The technique we use to estimate the impact of NTBs is a very important aspect of the subsequent gravity model. Thus, to be certain and drawing inspiration from previous works (Ardakani, Yazdani, & Gilanpour, 2009), (Genc & Law, 2014) and (Befus, Brockmeier, & Bektasoglu, 2016), we use the gravity model for the analysis of Non-tariff barrier impacts, which is also the ensuing goal of this study.

A gravity model, in general cases, uses distance as a parameter for measuring its impact on trade. The theory describes that the gravity model explains the inverse relationship between the volume of trade and the distance between two countries. There are several cases, however, in which this may not be true owing to factors that are qualitative and hard to internalize within a quantitative model, like the one developed in this study.

The evolution of the gravity model as a diverse estimation mechanism, used for innumerable forms of analysis, going from trade openness to impacts on trade based on different variables, the flexibility is immense. The extent of literature based on the gravity model itself is very vast, so much so that there has been a study about compiling the literature based on the gravity model for simplifying the intricacies of the model structure (Shahriar, Qian, Kea, & Abdullahi, 2019).

One of the variables, which is by virtue a part of any gravity model, is the distance between two nations. In this study, we estimate the distance between the two countries as the distance between their capitals. However, the problem with this is the inconsistency that it causes since distance is a constant. To convert the distance into a variable, i.e. to convert the distance into the weighted distance, we use a formula as used in existing literature (Chakraborty & Aggarwal, 2017) and (Turkcan & Ates, 2010). The formula is as follows: -

$$\mathbf{WDIST_{it} = \frac{DIST_I * GDP_{it}}{\Sigma^{10}_{i=1} GDP_{it}}}$$

$DIST_I$ represents the distance from one country's capital to another for the two countries involved in trade. Here, GDP_{it} represents the GDP of the trading partner concerned. In this case, that would be the GDP of India's trading partners considered in this study for the time duration considered in this study i.e. 10 years.

This formula for estimation of weighted distance gives us 100 values for the WDIST variable, thus making the observations for the variables aligned, thus helping in improving the results of the model. The formula for estimation of the Weighted Distance variable, involves the usage of GDP of the concerned goods importing nations. Thus, GDP of importing countries itself becomes a variable used in the model. The GDP of India for the years chosen for this study is also one of the variables. A description of the variables of the model is given in the table below: -

Table 5. Description of the variables used in the gravity model

Variable	Description
α	Represents the Intercept Term
β's	Represents the Coefficient Terms
Ln $VEXP_{it}$[4]	Represents the Logarithm of Value of Exports from India to the respective nations for the products concerned (independent variable)
Ln GDP_{it}	Represents the Logarithm of the GDP's of the nations that import the products considered in the study from India
Ln $GDPIND_{t}$	Represents the Logarithm of the GDP of India
Ln $WDIST_{it}$	Represents the Logarithm of the Weighted Distance between the capitals of the importing and exporting country estimated using the weighted distance formula
Ln NTB_{it}	Represents the Logarithm of the Non-Tariff Barrier Equivalents levied by the countries concerned estimated using the Bradford method for estimation of NTB Equivalents
Ln $TARIFF_{it}$	Represents the Logarithm of the ad valorem tariff levied by the importing nations on the product concerned
LANDLOCKED	Represents the Dummy Variable which takes a value of 1 if the country to which India exports is landlocked and a value of 0 if the country is not landlocked
RTA	Represents the Dummy Variable which takes a value of 0 if the country to which India exports has a regional trade agreement with India and a value of 0 if it does not have a regional trade agreement with India

Thus, the model equation can be written as: -

$$\text{Ln } VEXP_{it} = \alpha + \beta_1 \text{Ln } GDP_{it} + \beta_2 \text{Ln } GDPIND_{t} + \beta_3 \text{Ln } WDIST_{it} + \beta_4 \text{Ln } NTB_{it} + \beta_5 \text{Ln } TARIFF_{it} + \beta_6 \text{ LANDLOCKED} + \beta_7 \text{ RTA} + \varepsilon_{ij}$$

The variables used in the models are given a logarithmic form, thus, the coefficients post-regression can be interpreted as the relevant elasticities. The logarithm of the value of exports is taken as the dependent variable; since the purpose of the paper is to try and understand the impacts of trade restrictive tools on India's exports, this choice of dependent variable is intuitive.

[4] I as well as t in subscript represents the concerned country and the year where i=country and t=year

The usage of GDP as a variable in the model is also a key aspect of the analysis. It can be observed from Table-1, Table-2 and Table-3 that plenty of the demand for the products chosen for this analysis comes from developed nations, countries that have a relatively higher GDP compared to developing nations. Since some of these nations also feature in the tables for export shares more than once as well as in some cases for the same products out of the 3, it can be said that the demand patterns for such nations are to an extent similar (eg.- USA and UAE featuring in the list for Wheat Flour [HS-110100] as well as Cashewnuts [HS-080132]).

Even, if demand patterns differ, a significant share of what formulates the GDP is still the international trade in total (Exports-Imports), thus including the GDP in the analysis will show us the impact of GDP on the volume of exports of India, by rest of the world (Ln GDP_{it}) as well as the GDP of India (Ln $GDPIND_{t}$).

The rest of the two dependent variables are the logarithm of Non-Tariff Barrier Equivalents (Ln NTB_{it}) as well as the logarithm of tariffs (Ln $TARIFF_{it}$). The two variables are the comparison parameters for this analysis and have been used in similar studies in the past. The aim is to determine what is the impact of these two restrictions on the exports of India and which of these measures is more impactful in deterring exports of India.

The last two variables are dummy variables (LANDLOCKED & RTA), which have been included with the sole aim of improving the results of the model as well as capturing features that may not be inherently visible. The two dummies are also relevant considering the area of study, where both factors have a significant impact on the volume of exports, where intuitively, the former is expected to affect the exports negatively, whereas the latter is expected to affect them positively.

EMPIRICAL FINDINGS

At first, we delve into the details of the non-tariff barrier equivalents and use the WTO ITIP resource, to verify if our non-tariff barrier equivalents align with the values for NTB equivalents that we have estimated.

For Australia, we see that the number we get is gradually rising from 45 to 150, however in 2014, we observe that the non-tariff barrier equivalent value goes up to 827. To understand why we get this result, we check the ITIP database for any notified restrictions by Australia. From the database we see that in 2014, Australia had notified a new restriction on HS-110100, where the OIE categorization was changed along with more specific labelling requirements for products, which further extended to coverage of other products under the purview of SPS (World Trade Organization, 2014).

A similar verification is done for the values displayed in Table 4. In 2012, the United States laid down safeguard duties on the import of Wheat/Meslin Flour (HS-110100) from the entire world, thereby raising their overall NTB equivalent levied for the product (World Trade Organization, 2014). This also aligns with the estimations shown in the table, as the non-tariff barrier equivalents rose in 2012 to 206.27. However, the effect of duties eventually wears out as the tariff component of PPR rises, and the non-tariff barrier equivalent reduces to zero.

We now consider the model used in the estimation. The analysis is conducted in STATA. The summary statistics of all the variables used in the estimation are displayed below: -

Table 6.-Summary Statistics of the variables for the model for Wheat/Meslin Flour (HS-110100)

Variable	Observations	Mean	Std. Dev.	Min	Max
Ln $VEXP_{it}$	100	14.71749	1.399846	11.56741	17.408
Ln GDP_{it}	100	27.17313	1.556816	24.7615	30.69595
Ln $GDPIND_t$	100	28.3964	.1814907	28.14743	28.68498
Ln $WDIST_{it}$	100	6.311114	.6836415	5.180955	7.269411
Ln NTB_{it}	100	4.06294	1.94447	0	8.794142
Ln $TARIFF_{it}$	100	.4395365	.8989242	0	2.70805
RTA	100	.3	.4605662	0	1
LANDLOCKED	100	.1	.3015113	0	1

Source- Author's Estimation

Table 7.-Summary Statistics of the variables for the product Cashewnuts Shelled (HS-080132)

Variable	Observations	Mean	Standard Deviation	Min	Max
Ln $VEXP_{it}$	100	17.35719	1.097806	14.07644	19.52932
Ln GDP_{it}	100	27.81659	1.480835	25.41846	30.69595
Ln $GDPIND_{t}$	100	28.3964	.1814907	28.14743	28.68498
Ln $WDIST_{it}$	100	6.1636	.5336186	5.180955	7.269411
Ln NTB_{it}	100	.6437752	.7924325	0	1.609438
Ln $TARIFF_{it}$	100	4.269379	2.200849	0	8.974725
RTA	100	.1	.3015113	0	1
LANDLOCKED	100	.2	.4020151	0	1

Source- Author's Estimation

Table 8.-Summary Statistics of the variables for the product Coffee-not roasted nor decaffeinated (HS-090111)

Variable	Observations	Mean	Std. Dev.	Min	Max
Ln $VEXP_{it}$	100	17.0542	.8964585	15.64699	19.13965
Ln GDP_{it}	100	26.81209	1.510473	24.02405	29.00827
Ln $GDPIND_{t}$	100	28.3964	.1814907	28.14743	28.68498
Ln $WDIST_{it}$	100	6.256657	.394375	5.396295	7.072264
Ln NTB_{it}	100	.2696159	.861643	0	2.995732
Ln $TARIFF_{it}$	100	4.391125	1.648956	0	7.358022
RTA	100	.2	.4020151	0	1
LANDLOCKED	100	.2	.4020151	0	1

Source- Author's Estimation

Since our model in this analysis, includes time series as well cross section components, we undertake panel data regression analysis for this model. Pooled OLS regression technique is not an appropriate model for estimation in dynamic panel data models, as fixed and random effects are not accounted for in OLS (Schmideheiny, 2020). Thus, we use fixed-effect and random-effect models for our estimation[5]. However, for the wheat/meslin flour (HS-110100) regression, the fixed-effect model result shows only one variable as significant and omits three others, thereby not yielding any useful results for the study.

Since the individual effects are considered in a fixed-effect model, three variables are omitted because of multicollinearity. The random-effect model (GLS) however, provides with better results. Where, most of the variables are significant. However, despite the results being better

[5] The results for fixed and random-effect models are presented in the annexure.

than that of a fixed-effect model, other tests are conducted to ensure that the best possible model is selected.

The Hausman Specification Test for Panel data, however indicates presence of fixed-effects, thus indicating that the fixed-effect model is a better fit for this data. However, as we have seen, the fixed-effect model results indicate the existence of a problem.

One of the problems that the fixed-effect model results explicitly indicated is the issue of Multicollinearity, further diagnostics using the Philip Enders Collins program (Enders, 2015). The Collins program displays a mean VIF of 2.49, along with eigenvalues for some variables tending to zero. This indicates that there is multicollinearity in data, but the effects are minimized to an extent where the results are not significant at all. The mean VIF, as well as the individual VIFs estimated, also indicate this[6].

To check if the data contains heteroskedasticity, Kit Baum's test is conducted, which is a modified Wald test for group-wise heteroskedasticity (Baum, 2000), used for checking the presence of Heteroskedasticity in data for a panel data regression. The test indicates the presence of heteroskedasticity in the data.

The Pesaran test is further conducted to check for serial autocorrelation in the dataset. The Pesaran test helps to check for first-order serial autocorrelation in panel datasets (Pesaran, 2004). The Pesaran test also yields a probability value of 0.0038, less than the significance level of 5%, indicating the presence of serial autocorrelation.

The tests discussed above are for a fixed-effect model, as the Hausman test had recommended the use of a fixed-effect model over a random-effect model. However, since the fixed-effect model runs into severe problems, as we have discovered above, using several diagnostic tests, it can be said that a refined modelling approach is required.

We now conduct the same operations for the datasets for the other two products that we have i.e., Cashewnuts Shelled (HS-080132) as well as Coffee (HS-090111).

A fixed-effect as well as random-effect model regression for the dataset for the product Cashewnuts Shelled (HS-080132) shows to an extent, similar results where a lot of variables are excluded in the fixed-effect model because of multicollinearity. The random-effect model yields better results however, the statistical insignificance of some variables is a problem, requiring further diagnostic checks.

In this dataset, however, the Hausman Specification test recommends the random-effect model over the fixed-effect model. The Philip Enders Collin program for multicollinearity yields a mean VIF of 5.51, with individual VIFs going beyond 10 for two variables indicating that multicollinearity is a problem in this dataset.

Since, the Hausman test recommended a random-effect model in this case, we cannot use the Kit Baum's test for Heteroskedasticity as it is only used for a fixed-effect model. In this case, we use the Breusch and Pagan Lagrangian multiplier test for random-effects, to check for heteroskedasticity in random-effect model (Greene & Mckenzie, 2012). The test indicates

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[6] The detailed statistics for the tests conducted pertaining to the models can be found below the preliminary regression results in the appendix.

presence of heteroskedasticity in the data. The Pesaran test for this model as well indicates existence of Serial Autocorrelation in this dataset.

We finally, conduct the analysis, for the dataset of the product Coffee-Not Roasted nor decaffeinated (HS-090111). The fixed-effect model once again, omits 3 variables sighting multicollinearity. Whereas, the random-effect model yields a slightly better result. The Hausman test recommends the usage of a random-effect model over a fixed-effect model.

The Philip Enders Collin program shows a Mean VIF of 3.47, with all the individual VIFs being below five, indicating that the multicollinearity problem is under control to an extent.

The Breusch and Pagan Lagrangian multiplier test for random-effects indicates the presence of Heteroskedasticity in the data since the probability value is 0 i.e. less than the level of 5 per cent, leading to rejection of the null hypothesis of no heteroskedasticity, indicating the presence of Heteroskedasticity in the data. Finally, the Pesaran test for serial autocorrelation also indicates the presence of serial autocorrelation in the data.

From the data analysis conducted above, it is easy to observe that the three datasets chosen run into precisely the same problems and require a more refined modelling approach which helps overcome the problems of heteroskedasticity and serial autocorrelation in our panel datasets.

One way to resolve the specific issues discussed above is to use a Feasible Generalized Least Squares (FGLS) model. However, this method is infeasible if the panel's time dimension, T, is smaller than its cross-sectional dimension i.e., N, which is the case for plenty of micro econometric models (Hoechle, 2007) and is so in our case[7].

Thus, we need to look further for an alternative approach. In such a case, a correlated panel corrected standard errors (PCSE-Prais Winsten) regression can be used, which provides relatively efficient results in case of observations being greater than the time series component values (N>T) (Beck & Katz, 1995).

It is worth noting that heteroskedasticity is taken account of by default in case of a PCSE-Prais Winsten regression, whereas a specification for the serial correlation is to be made. In this analysis, we shall specify panel-specific auto correlation-1 (PSAR-1) in STATA to make corrections for serial correlation in the model. It is also worth noting that, cross-sectional dependence is also accounted for in a panel-corrected standard errors regression by default, thus the errors and problems we had encountered in the preliminary panel data analysis are taken care of and we can use the panel corrected standard errors (Prais Winsten) regression for our model, the results of which are reported below. Please note that, three different regression results are reported, one for each of the products selected for the study.

Table 9. Regression results based on the gravity regression model for the product (HS-110100) dependent variable- Ln $VEXP_{it}$)[8,9]

[7] The results of FGLS regressions are shown in the appendix with PSAR-1 (panel specific auto correlation-1) errors and heteroskedasticity robust standard errors.

[8] Figures in the parentheses below the regression coefficients represent heteroskedasticity robust as well as panel corrected standard errors.

[9] ***, ** and * in the superscript of the coefficient figures imply the estimated coefficient is significant at 1%,5% and 10% level of significance respectively.

Independent Variables	Model-1	Model-2	Model-3	Model-4	Model-5
Constant	-88.74239***	-93.39213***	-104.3179***	-103.4432***	-103.3814***
	(21.73297)	(21.66025)	(22.11964)	(22.31085)	(23.53243)
Ln GDP_{it}	0.4041952***	0.340137***	0.6937899***	0.6646644***	0.5956364***
	(0.0669388)	(0.1229056)	(0.1073244)	(0.1016696)	(0.0774979)
Ln GDPINDt	3.249447***	3.47163***	3.699815***	3.726115***	3.869505***
	(0.7677837)	(0.7614388)	(0.7847987)	(0.7975232)	(0.8376292)
Ln WDISTit			-0.8204907***	-0.9351095***	-1.237796***
			(0.2812487)	(0.2972703)	(0.1991287)
Ln NTBit		0.0139036	0.0213718	0.0194045	0.0184178
		(0.0225415)	(0.0224409)	(0.0224104)	(0.0220719)
Ln TARIFFit		-0.42387	-0.0087452	-0.1041408	-0.1162584
		(0.22975872)	(0.2090634)	(0.1849617)	(0.1954519)
LANDLOCKED				-0.560708	-1.265789**
				(0.5981565)	(0.6424504)
RTA					-0.7162983**
					(0.2826287)
N	100	100	100	100	100
Wald Chi^2	58.55	69.17	121.88	142.75	219.53
R-Squared	0.9745	0.9755	0.9776	0.9801	0.9805

Source-Author's Estimation

The regression results for the products Cashewnuts-Shelled (HS-080132) as well as Coffee-Roasted Not Decaffeinated (HS-090111) are displayed below: -

Table 9. Regression results based on the gravity regression model for the product (HS-080132)

Independent Variables	Model-1	Model-2	Model-3	Model-4	Model-5
Constant	-32.89025*	-42.33838***	-43.00614***	-24.45945	-21.54362
	(17.09891)	(11.92469)	(12.22957)	(19.56568)	(16.94949)
Ln GDP_{it}	0.4654009**	0.6876468***	0.6770775***	0.0107884	-0.0581569
	(0.0430595)	(0.0671005)	(0.061351)	(0.2139172)	(0.2119113)
Ln GDPINDt	1.303687**	1.41316***	1.397748***	1.271803*	1.218204**
	(0.5962401)	(0.4195474)	(0.4169982)	(0.6712306)	(0.5625116)
Ln WDISTit			0.2158425	0.8047191*	0.8837874*
			(0.3524409)	(0.4335321)	(0.4504876)
Ln NTBit		-0.0382474**	-0.0399296**	-0.0308641**	-0.0279157**
		(0.0152393)	(0.01594)	(0.0127713)	(0.0132515)
Ln TARIFFit		0.6681005***	0.7763475	1.07169***	1.310715***
		(0.0998518)	(0.2156374)	(0.3371369)	(0.3923375)
LANDLOCKED				-2.260854***	-2.708966***
				(0.1966141)	(0.2377821)
RTA					0.9228109***
					(0.2283191)

N	**100**	**100**	**100**	**100**	**100**
Wald Chi^2	**117.75**	**152.18**	**196.84**	**181.72**	**317.62**
R-Squared	**0.9933**	**0.9967**	**0.9965**	**0.9840**	**0.9936**

Table 10- Regression results based on the gravity regression model for the product (HS-090111)

Independent Variables	Model-1	Model-2	Model-3	Model-4	Model-5
Constant	**-6.373957**	**3.846841**	**4.454278**	**-1.74243**	**-1.903389**
	(18.07669)	**(11.1122)**	**(11.99854)**	**(9.810818)**	**(11.6898)**
Ln GDP_{it}	**0.2268441****	**0.2397457*****	**0.3352567*****	**0.6609792*****	**0.6808306*****
	(0.10735)	**(0.0717898)**	**(0.0616255)**	**(0.0266145)**	**(0.0781361)**
Ln GDPINDt	**0.6022103**	**0.2255776**	**0.116445**	**0.1877672**	**0.309087**
	(0.6405898)	**(0.401874)**	**(0.4381396)**	**(0.3426447)**	**(0.408045)**
Ln WDISTit			**-0.0049551**	**-0.7543412*****	**-1.346883*****
			(0.2468179)	**(0.1501332)**	**(0.2144515)**
Ln NTBit		**0.0138141**	**0.0127248**	**0.0289567**	**0.0139658**
		(0.0299949)	**(0.0328445)**	**(0.0344441)**	**(0.029883)**
Ln TARIFFit		**0.3014113*****	**0.3659538**	**0.1202131*****	**0.0744123****
		(0.0597426)	**(0.0824305)**	**(0.0379926)**	**(0.368614)**
LANDLOCKED				**1.392255*****	**1.39748*****
				(0.111739)	**(0.363347)**
RTA					**-1.410061*****
					(0.2787616)
N	**100**	**100**	**100**	**100**	**100**
Wald Chi^2	**5.86**	**37.02**	**42.31**	**1764.16**	**987.62**
R-Squared	**0.9916**	**0.9963**	**0.9952**	**0.9982**	**0.9978**

Source-Author's Estimation

Before the results are interpreted, it is important to mention that one of the key parameters that establishes the goodness of fit of the model i.e. R-squared is not precisely interpretable as a generic R-squared in this case. For Prais-Winsten, the R-squared comes from the final regression of the transformed dependent variable on the transformed independent variables; thus, it is not specified what this R^2 is actually measuring (Wooldridge, 2012).

We first interpret the results from the regression model for the product Wheat/Meslin Flour (HS-110100). The coefficients for Ln GDP_{it} (GDP of importing countries) as well Ln GDPINDt (GDP of India) are both statistically significant as well as positive, and it can be observed that the coefficients are rising as we add more variables to the model, going from Model-1 to Model-5. However, the impacts differ as the GDP of importing countries impacts Wheat/Meslin Flour exports of India less than proportionately while the GDP of India impacts the exports of Wheat/Meslin Flour at a much higher than proportional level. This result is expected since the GDP of India is expected to impact its trading activities more, as it could possibly mean that a larger share of money is invested into trade facilitation and providing support to exports.

The weighted distance variable (Ln $WDIST_{it}$) is statistically significant and impacts the exports of India negatively and at a slightly higher than proportional rate. This result is in line with the theory of the traditional gravity model.

The most important aspect of the model, however, is that the crucial variables i.e., the tariff (Ln $TARIFF_{it}$) as well the non-tariff barrier equivalents variable (Ln NTB_{it}), are both statistically insignificant. Despite the coefficient for the tariff variable being relatively lower than the one for non-tariff barriers, implying that tariffs are more effective in deterring trade as compared to non-tariff barriers for Wheat/Meslin flour, we cannot interpret this result as tariffs being a more effective protectionist tool in this case due to the insignificance. This implies, that statistically, these two variables are not useful in explaining the impacts on the value of exports by India for Wheat/Meslin Flour.

In terms of practicality, it can be said that despite the existence of tariffs and non-tariff barriers on the product, their impact on the value of exports cannot be nullified. However, it can be said that they have not been inherently successful in deterring India from exporting to other nations. At first, the tariff rates of several nations to which India exports wheat/meslin flour in large quantities have been bounded at zero. Second, the non-tariff barriers that may have been levied by the importing nations, such as standardized requirements for labelling or amendments in the composition of the flour to avoid health hazards, have been successfully complied with by the Indian exporters.

This argument is bolstered by the fact that several safeguard duties have been imposed by the United States since 2012 on wheat/meslin flour exports (World Trade Organization, 2014) as well, despite the labelling requirements changed by Australia in 2019 (World Trade Organization, 2019) have had no specific impacts on India's exports of Wheat/Meslin flour to these nations and the exports have seen a steady rise.

Additionally, the two countries with consistently highest shares of import of Wheat/Meslin flour from India for the last 10 years are the UAE and the USA, two countries with a large share of immigrants from Southern Asia where wheat flour is an essential ingredient of the staple diets of the people. Apart from this, the purposes of the product are not limited to this use, making it a well-demanded product, and India's surplus capacity to produce it and the quality comes as an advantage. Thus, it is possible that with a stable or rising demand for the product, the protectionist tools are not effective in deterring the exports for this product or are not being utilized to deter its exports or simply, Indian exporters have improved the standards and complied with the requirements of the non-tariff barrier restrictions. However, this does not mean in any way that the export potential is fully utilised; it is possible that a lot more of this product can be exported; the potential of exports is, however not something that is the subject matter of this study.

Finally, the two dummy variables (LANDLOCKED) and (RTA) have a more than proportionate and a less than proportionate, however, negative impact on the value of exports of India for wheat/meslin flour. Landlocked countries cannot import via sea or have to use another country's port and pay taxes, which is undesirable. This can deter trade. Further, 70 per cent of India's exports in terms of value as well as 95 percent of exports in terms of

quantity, are transported via sea routes (Dasgupta, 2018). Thus, not having a seaport i.e., being a landlocked country, has a negative impact on exports of wheat/meslin flour from India.
The other dummy variable, which accounts for a Regional Trade Agreement between India and the importing country, also indicates a less than proportionate negative impact of RTAs on the value of exports. This is explicable from the fact that India has not had much success with RTA, and its major trading partners are Western as well as Gulf nations that do not have a trade agreement with India (Saha, 2018). Thus, since the volume of exports for this product to countries with which India has an RTA is low, we see a negative coefficient in this case.

The empirical results of the model for the second product i.e. Cashewnuts-Shelled (HS-080132), provide with several insights as well. The variable representing the GDP of the importing countries is statistically significant at first, however, it loses its significance as more variables are added to the model (Models-4 & 5); the impact in models 1,2 and 3 is positive and statistically significant, very small. This impact turns negative in Model-5, which does not make for any practical explanation and also loses its statistical significance. The variable representing the GDP of India (LN $GDPIND_t$) is statistically significant in all the models and has a more than proportionate impact on the exports of shelled cashew nuts. Thus, a rising Indian GDP is a booster towards the exports of shelled cashew nuts.

The weighted distance variable comes out as insignificant in the third model; however, it turns out to be significant at the 10% level when the dummy variables are added to model-4&5. However, the impact of weighted distance, in this case, turns out to be positive on the exports of shelled cashew nuts from India, which is not aligned with the theory of the gravity model. On further observation of the data, it was seen that the top 10 importing nations for shelled cashew nuts are the European Union, the USA and the Gulf nations such as UAE, Saudi Arabia, Kuwait and Qatar. While the United States and European Union charge a zero tariff for the product concerned, the Gulf nations have levied a positive tariff of 5%. However, the trajectory of exports to these nations for this product shows that the exports have risen at a higher rate in the second half of the previous decade (2010-2020), where the trajectory has been steeper for several nations farther away from India. This could be a possible reason that we see a less than proportionate positive impact of distance on the exports of Shelled Cashewnuts (HS-080132).

The two key comparison variables for this product are statistically significant i.e. Ln $TARIFF_{it}$ as well as Ln NTB_{it} at the 1 percent and 5 percent levels, respectively. However, we see that the tariff variable has a more than proportionate positive coefficient, whereas the non-tariff barrier variable has a less than proportionate negative coefficient. It is an intuitively unexpected result at first to see that the tariffs have a positive impact on the exports. It is highly likely that a correlational impact is being captured rather than a causal impact in this context.

Further, the impacts of nominal tariffs can wear out after a small period of time, whereas more dynamic demand effects can outweigh the impacts of such a tariff.

While the non-tariff barriers have a nominal yet negative impact on the exports of shelled cashewnuts. It can be said that for this product, the non-tariff barriers act as a bigger deterrent for the Indian exports than the tariffs.

Further, the dummy variables LANDLOCKED and RTA are both statistically significant, and the coefficients are in line with the real-world expected scenarios. Being a landlocked country has a strong negative impact on the imports of shelled cashew nuts, whereas having a regional trade agreement with India has a positive impact towards the shelled cashew nuts exports of India; however, the impact is slightly less than proportionate, yet it is positive.

Finally, the results from the regression of the model for the product Coffee-Roasted (Not Decaffeinated) also offer important insights. Surprisingly, in the context of GDP, we see opposite results, as the GDP of India becomes an insignificant variable, whereas the GDP of importing countries becomes a significant variable. The only possible explanation for the GDP of India not being significant is that the contribution towards enhancing this product's export opportunities has not been explored; this could also be because the product is a regional crop. However, this is only a hypothesis.

However, the GDP of other countries is statistically significant and has a less than proportionate but positive impact on coffee exports of India. A plausible explanation could be that coffee being a staple drink for plenty of nations that are considered in this study, the GDP of those nations would impact the imports of coffee since it has a high demand in those nations. The variable for weighted distance is statistically significant and has a more than proportionate negative impact on coffee exports of India, which is in line with the theory of the gravity model.

For the two comparison variables, we get the result that the non-tariff barriers variable is not significant for this model, whereas the tariffs are significant and have a positive impact on coffee exports though less than proportionate. It is worth noting that in our analysis, 9/10 of the top 10 countries importing from India have not levied a tariff on coffee imports, and the tariffs have been static at that level. Thus, the exports adjust based on the tariff effects and have a less than proportionate yet positive impact on coffee exports of India. This is similar to the case we saw for shelled cashew nuts exports.

Whereas the non-tariff barrier variable comes out as statistically insignificant. We have seen this earlier in the model for the product wheat/meslin flour, where the demand for the product is expected to be higher than the possible impacts that a protectionist tool can have on exports of India, similarly here we see that coffee is an essential commodity for several nations that import it and are a part of this analysis, possibly the demand outweighs the impacts that non-tariff barriers can have on exports of coffee from India.

Finally, the dummy variables in this analysis are highly significant, with LANDLOCKED having a more than proportionate positive coefficient, implying that India exports plenty of its coffee to landlocked nations. Whereas the RTA dummy variable has a negative coefficient, higher than proportionate, implying that having an RTA with India is a strong deterrent towards exports of coffee from India. This is an unexpected result, which can only be explained by the same fact as mentioned for wheat/meslin flour exports, where RTA's have not been beneficial for India as majority of its trading partners are not located in its close geographic proximity (Saha, 2018).

CONCLUSION

This study begins by mentioning how non-tariff barriers have become a relatively more utilized protectionist tool as compared to tariffs. Plenty of discussions, debates and academic research has been done in the past aiming at explaining the impact of such barriers as well as how to ensure that such barriers are not over utilized or used unethically.

This study has attempted at measuring the costs of such protection utilizing a fairly well-used and popular international trade model in the context of India. There is stark evidence to show that non-tariff barriers have been utilized far more by developed nations than developing nations (World Trade Organization, 2021), while this record has only been maintained for the actual notified barriers. It is also worth noting that plenty of non-tariff barriers can exist hidden beneath the complicated structures of governance and laws, owing to the more evolved structure of governance in the West.

While developing nations are still evolving in terms of their governance structure, they may not be able to utilise this protectionist tool fairly well. They can, however, make use of the rights that the World Trade Organization membership provides under the SPS and TBT provisions of restricting trade for the protection of environmental and human life as well as maintaining technical standards.

While going through the premise of this study or any similar study, it is instinctive to consider that the impacts of non-tariff barriers will be higher on the exports of a particular nation owing to their dynamism and the possibility of their usage going undetected without robust investigations. However, this may not be the case if the demand for the products is always higher; some products can be essential or popular amongst the masses, and it is possible that creating production capacity for such products may not be possible in a small period of time, thus importing them is the best option and laying down restrictive barriers on the imports of such products can be considered an insensible activity.

In this study, we have encountered some surprising results; the absence of tariffs or the tariff rates being constant for the period of study leads to it being positive for two products (shelled cashew nuts and roasted coffee), whereas it comes out as insignificant for an essential food product i.e. wheat/meslin flour. It is worth noting that the reduction of tariffs has given India a boost in the past for exporting these products to the nations concerned, as can be seen from the trajectory of their rise, however, it remains a question whether there was potential for exporting the same products in higher quantities? And if there were, is it possible that unnotified non-tariff barriers were the cause of these products not being exported to the fullest potential? The answer to these questions can be the source of another study, however, it is important to analyse the impact of non-tariff barriers from this other side of the coin.

It is imperative to state one of the key observations that one can make based on the results of this study i.e. Non-tariff barriers are not a matter of immense concern; when it comes to the products considered for this study, the impacts, if at all significant are minimal. Whereas, from preliminary observation of the data, it can be seen that tariffs have not been levied by the majority of nations but wherever they have, the impact of such restrictions has been largely minimal.

Thus, it can be concluded that non-tariff barriers, wherever significant, have a greater impact at deterring trade as compared to tariffs. However, the magnitude of such deterrence is expected to be minimal owing to the less than proportionate coefficients of the concerned variables.

Now the concern shifts from, which of the two is more useful in deterrence of exports to why the magnitude of the trade barriers is low. The low impact of tariffs on the value of exports can be explained by low and static tariff rates as well as in plenty of cases zero tariff rates, provided the fact that the benefits of importing these products outweighs the benefits of restricting their imports.

As far as non-tariff barriers magnitude is concerned, the explanations for the low magnitudes can be traced into the sectoral coverage ratio analysis done for such barriers in the past.

Most of the developed nations have had a low to moderate overall coverage ratio for non-tariff barriers, lying somewhere between 15-20 per cent, with the highest for New Zealand being 32.4 per cent as well as the lowest at 7.9 per cent for Denmark. Such numbers have only been formulated for OECD nations subject to data availability. Further conclusive evidence is found when the sectoral coverage ratios are checked, which are as low as 0 for the United States and 5.1 per cent for New Zealand for cereals and related products whereas 0 and 5.6 per cent for beverage inputs, respectively (Coughlin & Wood, 1989). While these figures are old, further evidence is collected from newer studies indicating that the coverage did not rise even 15 years later, with a coverage of 1.3 per cent for cereals and related crops in the United States and 1.7 per cent for fruits and related products (cashew nuts are a part of this category) (Haveman & Thursby, 2012).

Thus, a reason, as cited above, for the low magnitude of non-tariff barriers coefficients i.e., their impact being minimal on deterring exports from India, can be that the non-tariff barrier sectoral coverage ratios for the sectors chosen for analysis in this study are relatively lower than it is for other sectors of products.

While this is the key insight that emerges from this study, the other important aspect that has not been discussed in detail in this study is the question of whether India is exporting the products to their fullest potential. This means that there might be some unexplored opportunities that have not been paid attention to or are hidden because of some specific barrier.

Earlier in this report, we pointed out that there are several points of view from which the quantification of non-tariff barriers can be conducted, such as trade facilitation (Ferrantino & Dee, 2005). While the price gaps mechanism is used to quantify non-tariff barriers in this study, it is important to note that trade facilitation is also linked to the potential of exporting. Thus, trade facilitation acts as an indirect link between non-tariff barriers as well as export potential. Whereas a generic theory would suggest an inverse relationship between the two.

Thus, it is possible that a country may use its trade facilitation policy to identify and utilize the barriers as more efficient tools, serving the completely opposite purpose of what trade facilitation is supposed to help with.

Detection of such barriers can also be harder because of the research involved in implementing the barrier itself. Such barriers can possibly put a halt towards the growth of the volume of exports for any country, and India is no different.

Thus, based on the findings of this study, it can be said that for the products selected, the exports of India are not drastically impacted by barriers such as the tariff and NTB’s. Distance itself has a negative impact on the exports and a more significant impact than non-tariff barriers and tariffs themselves. However, the low impact of the GDP of India on the exports is a concern (for cashewnuts and coffee exports) and helps us conclude that export promotion and facilitation is required at a larger extent which would also help products that come from specific regions of the country (such as coffee itself) get better market access and make use of the export potential to the best possible extent. Since, the trade barriers are not a deterrent in stopping the exports to a large extent, export facilitation and export promotion policies can actually improve India’s GDP from the export of these products.

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ANNEXURE

Table 1A- Description of Variables and the data sources for their estimation

Variable	Variable Description	Data Source
Ln $VEXP_{it}$	The logarithm of value of exports of India to the countries with top 10 export shares for the products selected for the analysis. Value of exports data collected from WITS (World Integrated Trade Solutions)	https://wits.worldbank.org/WITS/ Logarithms are Self-Estimations
Ln GDP_{it}	The logarithm of the GDP's of the nations to which India exports the products selected for the study.	www.imf.org Logarithms are self-estimations
Ln $GDPIND_{t}$	The logarithm of the GDP of India.	www.imf.org Logarithms are self-estimations
Ln $WDIST_{it}$	The logarithm of the weighted distance between the capitals of the importing and the exporting country.	Self-estimation
Ln $TARIFF_{it}$	The logarithm of the tariff rates that importing countries have levied on exports of the products selected for this study	https://wits.worldbank.org/WITS/ Logarithms are self-estimations
Ln NTB_{it}	The logarithm of the non-tariff barrier equivalents, put in place by the importing countries, estimated using the Bradford's method of estimating final goods protection (Bradford, 2003).	https://wits.worldbank.org/WITS/ https://comtrade.un.org/ https://www.trademap.org/ https://tao.wto.org/ The values are estimated using data from the data sources mentioned above.
LANDLOCKED	Countries that are landlocked have a dummy value of 1, 0 otherwise	Self-construction
RTA	Countries that have an RTA with India have a dummy value of 1, 0 otherwise	Self-construction

Table 2A- Fixed-effect model regression results for the product Wheat Flour (HS-110100)

```
note: lnwdist omitted because of collinearity
note: rtadummy omitted because of collinearity
note: landlockeddummy omitted because of collinearity

Fixed-effects (within) regression               Number of obs      =       100
Group variable: countrycode                     Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.6403                                        min =        10
     between = 0.3378                                        avg =      10.0
     overall = 0.2316                                        max =        10

                                                F(4,86)            =     38.27
corr(u_i, Xb)  = -0.9859                        Prob > F           =    0.0000
```

lnvexp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lngdpother	.7285967	.7009303	1.04	0.301	-.6648066	2.122
lngpdind	4.088794	.4228345	9.67	0.000	3.248227	4.929361
lnwdist	0	(omitted)				
lnntb	.0170953	.042281	0.40	0.687	-.0669566	.1011472
lntariff	-7.061613	4.776587	-1.48	0.143	-16.55715	2.433928
rtadummy	0	(omitted)				
landlockeddummy	0	(omitted)				
_cons	-118.1534	15.92486	-7.42	0.000	-149.811	-86.49584
sigma_u	6.808751					
sigma_e	.61498556					
rho	.99190781	(fraction of variance due to u_i)				

```
F test that all u_i=0:  F(9, 86) = 11.82                 Prob > F = 0.0000
```

Table 3A.- Random-effect model regression results for the product Wheat Flour (HS-110100)

```
Random-effects GLS regression                   Number of obs      =       100
Group variable: countrycode                     Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.6243                                        min =        10
     between = 0.8331                                        avg =      10.0
     overall = 0.7357                                        max =        10

                                                Wald chi2(7)       =    169.29
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0000
```

lnvexp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lngdpother	.5858184	.2137172	2.74	0.006	.1669402	1.004696
lngpdind	4.300963	.3753691	11.46	0.000	3.565253	5.036673
lnwdist	-.8632345	.3955017	-2.18	0.029	-1.638404	-.0880655
lnntb	.0210884	.0416229	0.51	0.612	-.060491	.1026679
lntariff	-.0655857	.283631	-0.23	0.817	-.6214921	.4903208
rtadummy	-.6913437	.5491279	-1.26	0.208	-1.767615	.3849272
landlockeddummy	-1.167874	.8025598	-1.46	0.146	-2.740863	.4051142
_cons	-117.6176	11.29931	-10.41	0.000	-139.7639	-95.47136
sigma_u	.54884862					
sigma_e	.61498562					
rho	.4433561	(fraction of variance due to u_i)				

Table 4A. Hausman test results for the model for the product Wheat/Meslin Flour (HS-110100)[10]

	Coefficients			
	(b) fixed	(B) random	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lngdpother	.7285967	.5858184	.1427784	.6675539
lngpdind	4.088794	4.300963	-.2121691	.1946461
lnntb	.0170953	.0210884	-.0039931	.0074309
lntariff	-7.061613	-.0655857	-6.996027	4.768159

```
                     b = consistent under Ho and Ha; obtained from xtreg
      B = inconsistent under Ha, efficient under Ho; obtained from xtreg

  Test:  Ho:  difference in coefficients not systematic

                 chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                         =      172.09
               Prob>chi2 =      0.0000
               (V_b-V_B is not positive definite)
```

Table 5A- Heteroskedasticity test results for the model recommended by Hausman test for the product Wheat/Meslin Flour (HS-110100)

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (10)  =      612.43
Prob>chi2 =       0.0000
```

Table 6A- Pesaran Serial correlation test results for the model of the product Wheat/Meslin Flour (HS-110100)

```
Pesaran's test of cross sectional independence =     5.264, Pr = 0.0000

Average absolute value of the off-diagonal elements =     0.567
```

[10] The Hausman specification test recommends using the fixed-effect model for this dataset.

Table 7A- Phil Ender's Collin Programme collinearity diagnostics for the model of the product Wheat/Meslin Flour (HS-110100)

Collinearity Diagnostics

Variable	VIF	SQRT VIF	Tolerance	R-Squared
lnvexp	3.93	1.98	0.2544	0.7456
lngdpother	5.00	2.24	0.1999	0.8001
lngpdind	2.28	1.51	0.4387	0.5613
lnwdist	3.71	1.93	0.2696	0.7304
lnntb	1.45	1.20	0.6910	0.3090
lntariff	2.32	1.52	0.4311	0.5689
rtadummy	2.29	1.51	0.4364	0.5636
landlockeddummy	2.20	1.48	0.4538	0.5462
Mean VIF	2.90			

	Eigenval	Cond Index
1	6.4401	1.0000
2	1.1750	2.3412
3	0.7547	2.9212
4	0.4874	3.6350
5	0.1336	6.9422
6	0.0063	32.0043
7	0.0023	53.3122
8	0.0006	99.6593
9	0.0000	844.4098

Condition Number 844.4098
Eigenvalues & Cond Index computed from scaled raw sscp (w/ intercept)
Det(correlation matrix) 0.0248

Table 8A- Fixed-effect model regression results for the product Cashewnuts-Shelled (HS-080132)

```
Fixed-effects (within) regression               Number of obs      =       100
Group variable: countrycode                     Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.1114                                         min =        10
     between = 0.2939                                         avg =      10.0
     overall = 0.1518                                         max =        10

                                                F(3,87)            =      3.64
corr(u_i, Xb)  = -0.6166                        Prob > F           =    0.0159
```

lnvexp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lngdpoth	-.1729244	.4108328	-0.42	0.675	-.9894992	.6436504
lngdpind	.6849839	.238395	2.87	0.005	.2111481	1.15882
lnwdist	0	(omitted)				
lntariff	0	(omitted)				
lnntb	.0237976	.0239575	0.99	0.323	-.0238205	.0714156
rtadummy	0	(omitted)				
landlockeddummy	0	(omitted)				
_cons	2.614679	12.53132	0.21	0.835	-22.29268	27.52204
sigma_u	1.2427441					
sigma_e	.41592689					
rho	.89926962	(fraction of variance due to u_i)				

F test that all u_i=0: F(9, 87) = 46.24 Prob > F = 0.0000

Table 9A.- Random-effect model regression results for the product Cashewnuts-Shelled (HS-080132)

```
Random-effects GLS regression                   Number of obs      =       100
Group variable: countrycode                     Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.1107                                          min =        10
     between = 0.6019                                          avg =      10.0
     overall = 0.5321                                          max =        10

                                                Wald chi2(7)       =     17.72
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.0133
```

lnvexp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lngdpoth	.2924089	.4921986	0.59	0.552	-.6722826	1.2571
lngdpind	.678917	.2377781	2.86	0.004	.2128804	1.144954
lnwdist	-.3581814	.6820408	-0.53	0.599	-1.694957	.9785941
lntariff	.5898647	.5809415	1.02	0.310	-.5487596	1.728489
lnntb	.0219813	.0238368	0.92	0.356	-.0247381	.0687006
rtadummy	.2126844	1.123569	0.19	0.850	-1.98947	2.414839
landlockeddummy	-2.016635	1.121485	-1.80	0.072	-4.214706	.1814361
_cons	-7.939267	12.64502	-0.63	0.530	-32.72304	16.84451
sigma_u	.94279666					
sigma_e	.41592688					
rho	.837083	(fraction of variance due to u_i)				

Table 10A.- Hausman test results for the model for the product Shelled Cashewnuts (HS-080132)[11]

	Coefficients (b) fixed2	(B) random2	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lngdpoth	-.1729244	.2924089	-.4653333	.
lngdpind	.6849839	.678917	.0060669	.0171381
lnntb	.0237976	.0219813	.0018163	.0024011

```
                          b = consistent under Ho and Ha; obtained from xtreg
           B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(3) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.51
                Prob>chi2 =      0.9158
                (V_b-V_B is not positive definite)
```

Table 11A.- Heteroskedasticity test results for the model recommended by Hausman test for the product Shelled Cashewnuts (HS-080132)

```
Breusch and Pagan Lagrangian multiplier test for random effects

        lnvexp[countrycode,t] = Xb + u[countrycode] + e[countrycode,t]

        Estimated results:
                         |       Var     sd = sqrt(Var)
                ---------+-----------------------------
                  lnvexp |   1.205179       1.097806
                       e |   .1729952       .4159269
                       u |   .8888655       .9427967

        Test:   Var(u) = 0
                             chibar2(01) =   145.52
                          Prob > chibar2 =   0.0000
```

[11] The Hausman specification test recommends using the random-effect model for this dataset.

Table 12A-Pesaran Serial correlation test results for the model of the product Cashewnuts-Shelled (HS-080132)

```
. xtcsd, pesaran abs


Pesaran's test of cross sectional independence =     6.018, Pr = 0.0000

Average absolute value of the off-diagonal elements =     0.399
```

Table 13A- Phil Ender's Collin Programme collinearity diagnostics for the model of the product Cashewnuts-Shelled (HS-080132)

```
  Collinearity Diagnostics

                        SQRT                   R-
  Variable      VIF     VIF    Tolerance    Squared
----------------------------------------------------
     lnvexp     2.56    1.60    0.3910      0.6090
  lngdpoth      8.04    2.84    0.1244      0.8756
  lngdpind      1.08    1.04    0.9226      0.0774
   lnwdist     13.98    3.74    0.0715      0.9285
  lntariff     10.49    3.24    0.0953      0.9047
     lnntb      1.39    1.18    0.7208      0.2792
  rtadummy      1.89    1.37    0.5299      0.4701
landlockeddummy      4.62    2.15    0.2162      0.7838
----------------------------------------------------
  Mean VIF      5.51

                          Cond
        Eigenval          Index
---------------------------------
    1     6.5902          1.0000
    2     1.2639          2.2834
    3     0.7300          3.0046
    4     0.2975          4.7067
    5     0.1160          7.5367
    6     0.0013         70.2630
    7     0.0008         89.5484
    8     0.0002        166.7981
    9     0.0000        591.9054
---------------------------------
 Condition Number       591.9054
 Eigenvalues & Cond Index computed from scaled raw sscp (w/ intercept)
 Det(correlation matrix)    0.0035
```

Table 14A- Fixed-effect model regression results for the product Coffee Roasted not decaffeinated (HS-090111)

```
Fixed-effects (within) regression               Number of obs      =       100
Group variable: countrycode                     Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.0255                                         min =         10
     between = 0.1445                                         avg =       10.0
     overall = 0.1231                                         max =         10

                                                F(4,86)            =      0.56
corr(u_i, Xb)  = 0.2670                         Prob > F           =    0.6900

------------------------------------------------------------------------------------
          lnvexp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-----------------+------------------------------------------------------------------
     lngdpothers |   .0574062   .2471697     0.23   0.817    -.4339509    .5487633
        lngdpind |   .0405276   .1462981     0.28   0.782    -.2503035    .3313587
         lnwdist |          0  (omitted)
        lntariff |    .107574   .0959783     1.12   0.265    -.0832246    .2983725
lnntbequivalent  |  -.0112534   .0240187    -0.47   0.641     -.059001    .0364942
        rtadummy |          0  (omitted)
landlockeddummy  |          0  (omitted)
           _cons |   14.38459   7.778453     1.85   0.068     -1.07846    29.84764
-----------------+------------------------------------------------------------------
         sigma_u |  .87704528
         sigma_e |  .25215719
             rho |  .92365048   (fraction of variance due to u_i)
------------------------------------------------------------------------------------
F test that all u_i=0: F(9, 86) = 84.30                      Prob > F = 0.0000
```

Table 15A- Random-effect model regression results for the product Coffee Roasted not decaffeinated (HS-090111)

```
Random-effects GLS regression                   Number of obs      =       100
Group variable: countrycode                     Number of groups   =        10

R-sq:                                           Obs per group:
     within  = 0.0247                                          min =        10
     between = 0.4571                                          avg =      10.0
     overall = 0.4266                                          max =        10

                                                Wald chi2(7)       =      8.17
corr(u_i, X)   = 0 (assumed)                    Prob > chi2        =    0.3174
```

lnvexp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lngdpothers	.5435257	.3125856	1.74	0.082	-.0691308	1.156182
lngdpind	.0365727	.1472266	0.25	0.804	-.2519861	.3251315
lnwdist	-.546439	.3976301	-1.37	0.169	-1.32578	.2329017
lntariff	.116653	.0933503	1.25	0.211	-.0663103	.2996162
lnntbequivalent	-.0080057	.0241018	-0.33	0.740	-.0552444	.0392331
rtadummy	-.7751037	.6565444	-1.18	0.238	-2.061907	.5116996
landlockeddummy	.8584812	1.109489	0.77	0.439	-1.316076	3.033039
_cons	4.848514	7.952351	0.61	0.542	-10.73781	20.43484
sigma_u	.73941149					
sigma_e	.25215719					
rho	.89581856	(fraction of variance due to u_i)				

Table 16A- Hausman test results for the model for the product Coffee Roasted not decaffeinated (HS-090111)[12]

	Coefficients			
	(b) fixed3	(B) random3	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lngdpothers	.0574062	.5435257	-.4861195	.
lngdpind	.0405276	.0365727	.0039549	.0060676
lntariff	.107574	.116653	-.009079	.0251135
lnntbequiv~t	-.0112534	-.0080057	-.0032477	.0020824

```
                          b = consistent under Ho and Ha; obtained from xtreg
           B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(4) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.29
                Prob>chi2 =      0.9903
                (V_b-V_B is not positive definite)
```

Table 17A.- Heteroskedasticity test results for the model recommended by Hausman test for the product Coffee roasted not decaffeinated (HS-090111)

```
Breusch and Pagan Lagrangian multiplier test for random effects

        lnvexp[countrycode,t] = Xb + u[countrycode] + e[countrycode,t]

        Estimated results:
```

	Var	sd = sqrt(Var)
lnvexp	.8036378	.8964585
e	.0635832	.2521572
u	.5467294	.7394115

```
        Test:   Var(u) = 0
                             chibar2(01) =   198.71
                          Prob > chibar2 =   0.0000
```

[12] The Hausman specification test recommends using the random-effect model for this dataset.

Table 18A-Pesaran Serial correlation test results for the model of the product Coffee roasted not decaffeinated (HS-090111)

```
Pesaran's test of cross sectional independence =     9.975, Pr = 0.0000

Average absolute value of the off-diagonal elements =     0.505
```

Table 19A- Phil Ender's Collin Programme collinearity diagnostics for the model of the product Coffee roasted not decaffeinated (HS-090111)

Collinearity Diagnostics

Variable	VIF	SQRT VIF	Tolerance	R-Squared
lnvexp	2.26	1.50	0.4432	0.5568
lngdpothers	6.35	2.52	0.1575	0.8425
lngdpind	1.05	1.03	0.9508	0.0492
lnwdist	5.28	2.30	0.1895	0.8105
lntariff	1.91	1.38	0.5231	0.4769
lnntbequivalent	1.78	1.33	0.5622	0.4378
rtadummy	4.42	2.10	0.2265	0.7735
landlockeddummy	4.73	2.17	0.2114	0.7886
Mean VIF	3.47			

	Eigenval	Cond Index
1	6.4024	1.0000
2	1.4601	2.0940
3	0.7611	2.9004
4	0.3079	4.5598
5	0.0653	9.8983
6	0.0022	54.2442
7	0.0006	101.0652
8	0.0003	141.1850
9	0.0000	580.5409

Condition Number 580.5409
Eigenvalues & Cond Index computed from scaled raw sscp (w/ intercept)
Det(correlation matrix) 0.0123

Table 20A- Parker's Feasible Generalized Least Squares (FGLS) regression model results for the product Wheat/Meslin Flour (HS-110100) with AR-1

```
Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        heteroskedastic
Correlation:   panel-specific AR(1)

Estimated covariances      =        10          Number of obs      =       100
Estimated autocorrelations =        10          Number of groups   =        10
Estimated coefficients     =         8          Time periods       =        10
                                                Wald chi2(7)       =    131.08
                                                Prob > chi2        =    0.0000
```

lnvexp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lngdpother	.601516	.142508	4.22	0.000	.3222054	.8808266
lngpdind	3.290601	.3872793	8.50	0.000	2.531548	4.049655
lnwdist	-.9950599	.2551322	-3.90	0.000	-1.49511	-.4950099
lnntb	-.0012522	.0203795	-0.06	0.951	-.0411953	.0386909
lntariff	-.0583293	.177752	-0.33	0.743	-.4067167	.2900582
rtadummy	-.7094523	.4280661	-1.66	0.097	-1.548446	.1295418
landlockeddummy	-1.087022	.8201863	-1.33	0.185	-2.694558	.5205137
_cons	-88.54037	11.10726	-7.97	0.000	-110.3102	-66.77054

Table 21A- Parker's Feasible Generalized Least Squares (FGLS) regression model results for the product Cashewnuts Shelled (HS-080132) with AR-1

```
Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        heteroskedastic
Correlation:   panel-specific AR(1)

Estimated covariances      =        10          Number of obs      =        100
Estimated autocorrelations =        10          Number of groups   =         10
Estimated coefficients     =         8          Time periods       =         10
                                                Wald chi2(7)       =     143.58
                                                Prob > chi2        =     0.0000
```

lnvexp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lngdpoth	-.2459645	.2397391	-1.03	0.305	-.7158444	.2239155
lngdpind	1.537014	.2771628	5.55	0.000	.9937848	2.080243
lnwdist	.8522171	.3329931	2.56	0.010	.1995626	1.504872
lntariff	.9629258	.3036718	3.17	0.002	.3677401	1.558112
lnntb	-.0280803	.0110013	-2.55	0.011	-.0496424	-.0065182
rtadummy	1.001545	.2256368	4.44	0.000	.5593051	1.443785
landlockeddummy	-2.755323	.4634042	-5.95	0.000	-3.663578	-1.847067
_cons	-24.975	9.497042	-2.63	0.009	-43.58886	-6.361138

Table 22A- Parker's Feasible Generalized Least Squares (FGLS) regression model results for the product Coffee Roasted not decaffienated (HS-090111) with AR-1

```
Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        heteroskedastic
Correlation:   panel-specific AR(1)

Estimated covariances      =        10          Number of obs      =        100
Estimated autocorrelations =        10          Number of groups   =         10
Estimated coefficients     =         8          Time periods       =         10
                                                Wald chi2(7)       =     397.09
                                                Prob > chi2        =     0.0000
```

lnvexp	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lngdpothers	.7818279	.074508	10.49	0.000	.6357948	.927861
lngdpind	.2453023	.1994711	1.23	0.219	-.1456538	.6362585
lnwdist	-1.228136	.1577195	-7.79	0.000	-1.537261	-.9190117
lntariff	.0931171	.0358077	2.60	0.009	.0229353	.163299
lnntbequivalent	.0003975	.0211106	0.02	0.985	-.0409785	.0417736
rtadummy	-1.301698	.22408	-5.81	0.000	-1.740887	-.8625097
landlockeddummy	1.740055	.3487271	4.99	0.000	1.056563	2.423548
_cons	-3.653475	5.570497	-0.66	0.512	-14.57145	7.264498