ERASMUS UNIVERSITY ROTTERDAM
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Master Thesis International Economics

"The Tariffs-Imports Relationship: An Empirical Analysis Based on Developed and Developing Countries"

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The views stated in this thesis are those of the author and not necessarily those of Erasmus School of Economics or Erasmus University Rotterdam.

Abstract

In this thesis the impact of tariffs on trade flows, in particular import flows, is the center of attention. The aim is to empirically estimate if a possible negative/positive (causal) relationship between tariffs and imports exists concerning a panel of multiple developed and developing countries. Based on relevant literature the theoretical dynamics of the relationship are stated, before advancing to dicuss the economic effects of the relationship. Employed is data that is of relevance with regard to 37 developed and 35 developing countries, and spans the period 1993 – 2018. The panel-data regression model is then applied in order to estimate the tariffs-imports relationship using the fixed-effects method of estimation (FE). In addition, carried out is the Breusch-Pagan F test to test for evidence of heteroscedasticity, and carried out is the Hausmann test to validate the optimal method of estimation. Furthermore, also accounted for in this thesis is estimation and sample sensitivity analysis and the reverse causality problem. The regression results indicate that a significant negative relationship exists between tariffs and imports.

Preface

In preparation for the completion of my Master study International Economics at the Erasmus University Rotterdam; I decided to write a thesis on tariffs, empirically estimating the relationship between tariffs and imports. This relevant economic subject is taking center stage in current international trade, in particular because applied worldwide as a protectionist measure, thereby distorting trade-flows. The knowledge that I acquired during my bachelor and master study is included in the thesis, especially, that acquired during the seminar international trade and firms. I would like to thank Dr. Aart Gerritsen for his support and advice during the construction stage of my thesis.

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1. Introduction

At the current stage of international economics, one commercial policy tool previously out of favor for macroeconomic objectives, seems to make a comeback, namely tariffs. Superior alternatives like monetary and fiscal policy used for economic expansionary objectives have long despise the need of tariffs for economic protectionist objectives. Still, the third largest exporting and second largest importing economy in the world, the U.S., decided to increase the number of tariffs on imports "Financial Times (2018)". Surprising, given the fact that the U.S., a determined free trade advocate, has signed and enforced multiple bilateral and multilateral free trade agreements with many trading-partner countries prior to 2017. The Trump government justified the introduction of higher tariffs as a mean to act against unfair trade, but this could be translated as protectionism in a bid to fulfill a key election campaign promise of 2016, that is to scale back imports from especially China and stimulate domestic production in the U.S. instead. Tariffs, however, have a trade distortionary effect stemming from economic inefficiencies and retaliatory measures. Retaliation relating to international trade is evidence by the numerous WTO[1] dispute complaints concerning mercantilist-trading measures initiated by different trading-partner countries, leading to both advocates[2] and opponents[3] of tariffs. These tit-for-tat retaliation measures form a significant obstruction for international trade and could possibly lead to less efficient economies as well. Consequently, the importance of the tariffs-imports relationship in international trade is once again emphasized and thus a relevant subject of analysis.

Research about this subject on a multiple country-level is mainly limited to developed or developing countries, extensions to both developed and developing countries are difficult to

[1] The World Trade Organization: the international organization whose primary purpose is to open trade for the benefit of all, this includes the reduction or elimination of obstacles to trade (import tariffs, other barriers to trade) and agreeing on rules governing the conduct of international trade (e.g. antidumping, subsidies, product standards, etc.).

[2] Advocates of tariffs consists of many different interest groups, for example, domestic companies, labor unions, and environmentalists, aiming to increase domestic production and employment or protect the environment (Van Marrewijk, 2007).

[3] Opponents of tariffs consists of interest groups, for example, foreign companies and domestic consumer associations, aiming to increase exports to trading partner countries and reduce the tax-burden of tariffs on consumers (Van Marrewijk, 2007).

source. Following a reduction of tariffs, the expectation is that a (positive) import-effect is more significant for developed countries in comparison to developing countries. This stems from the fact that developed countries in general have an incentive to put higher tariffs on the imports of finished products than on the imports of raw materials, resulting in higher effective tariffs in the processing stage (Van Marrewijk, 2007). The removal of high tariffs in turn has a greater effect on imports.

This study is an attempt to empirically estimate the tariffs-imports relationship and to see if causal inference can be established for both developed and developing countries. In addition, a comparison analysis is conducted to see how developed and developing countries are differently affected.

With this ambition, the following problem statement and partial research question are formed:

"What is the effect of import tariffs on imports? And how does it differ between developed and developing countries?"

To find an answer to the problem statement and partial research question, firstly the study outlines the theoretical framework and state its predictions concerning the tariffs-imports relationship. Suitably, consulted will be relevant literature and previous studies concerning this relationship in order to derive the explanatory, response, and control variables in advance of empirical tests that will be carried out later on. Moving on, carried out will be empirical tests with the application of a panel regression model and the use of the fixed-effects method of estimation (FE) to estimate the effects of the explanatory variables on the response variable. This is done for a large sample of developed and developing countries over a prolonged period. The empirical tests are followed by a final analysis to either reject the null hypothesis or not. Fundamentally, the FE method estimates the (causal) effect, represented by the betas, through the elimination of the unobserved country specific characteristics (a_i), intercept (β_0), and all remaining time-constant variables for all observational units. This is done through isolation of the tariffs-imports relationship within the econometric system. Furthermore, emphasized in the study is the reverse causality problem hampering panel studies in particular.

Post empirical analysis, evidence was found that a highly statistically significant negative relationship exists between tariffs and imports concerning countries that are developed or in a developing stage. The import-effect following a reduction of tariffs by 1.0 percent was twice as large for developed countries compared to developing countries. The results are in line with the theoretical framework predictions. However, causal establishment was not possible due to limited data availability.

Previous studies, focused mostly on a panel of developed countries or on a panel of developing countries, and employed the fixed effects (FE), random effects (RE), or first differenced (FD) methods of estimation in combination with generalized methods of moments (GMM) application. The findings of some of the studies were in line with theoretical framework predictions, others were not. Previous panel studies, frequently hampered by the reverse causality problem, applied different methods of estimation in dealing with endogeneity while taking into account the unobserved effect. In this context, the Arellano-Bond (AB) method of estimation has been successfully employed before. This study followed previous studies in application of the FE and AB methods of estimation, but deviated by increasing the sample size and taking into account panels of both developed and developing countries.

Structure of the Study:

Section 2 illustrates the tariffs-imports relationship in a theoretical framework. Described in this section are the characteristics of the relationship, with respect to the economic effect of tariffs on imports.
Section 3 gives a review of the literature with regard to the tariffs-imports relationship.
Section 4 gives the empirical methodology in order to estimate the tariffs-imports relationship for a large panel of developed and developing countries. In this section is described the data that is employed in the model, followed by the formation of the hypotheses and the empirical model equation.
Section 5 gives the empirical results by developed and developing countries, segmented by the human development index, after regressions are carried out with the application of a panel regression model and the use of the fixed-effects method of estimation (FE).
Section 6 examines the empirical and sensitivity issues. Furthermore, in this section, robustness checks are carried out.
Section 7 addresses the reverse causality problem.
Section 8 compares the import-effect of tariffs in developed to that of developing countries.
Section 9 concludes the thesis by giving an answer to the problem statement.

2. Theoretical Framework

Described in this section, are the main characteristics of the theoretical framework regarding the tariffs-imports relationship. Firstly, outlined is the theoretical framework and main properties that describe the economic effect of an import tariff on imports. Moving on, described are the characteristics in a general equilibrium setting. Subsequently, the tariffs-imports relationship is described in the context of the Ricardian model, the Heckscher-Ohlin model, and the Melitz model.

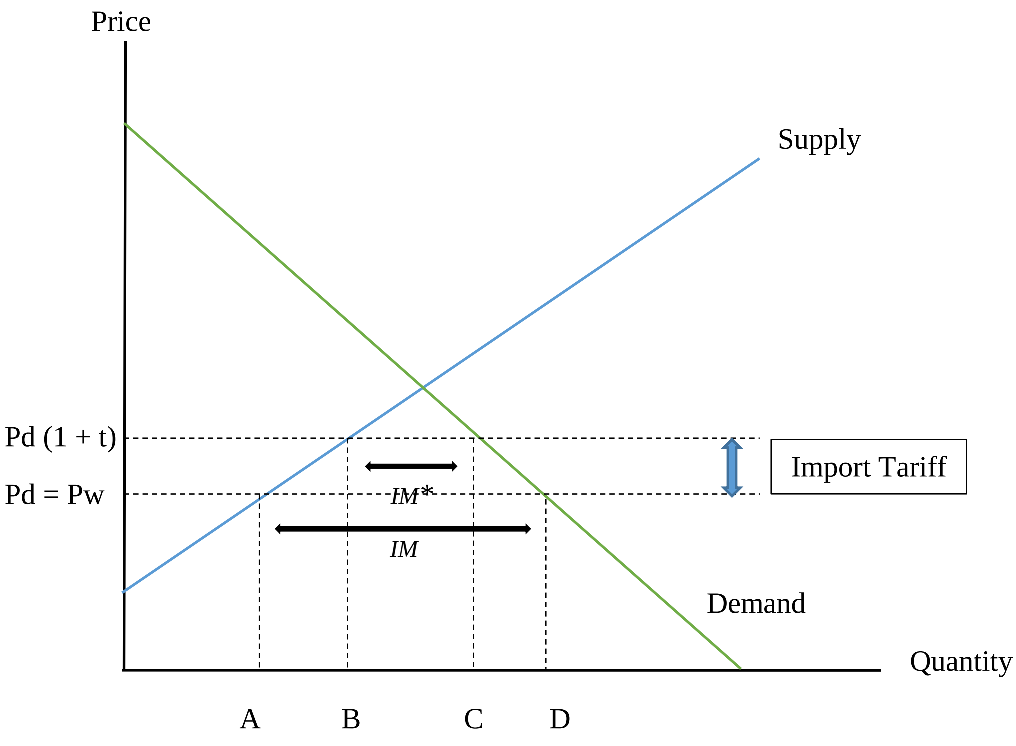
2.1 Economic Effect of an Import Tariff

The theoretical framework follows two established assumptions (Van Marrewijk, 2007):

1. The level of imports of goods and services decreases with an increase of import tariffs;
2. The level of imports of goods and services increases with a decrease of import tariffs.

Figure 1

Effect of an Import Tariff in Partial Equilibrium



Given this inverse relationship, import tariffs, therefore qualify as an ideal option for governments seeking to protect their markets. With the aim of adequately explaining the economic effect of import tariffs on the import level, introduced first is a partial equilibrium setting concerning a small country with a simple supply-demand market mechanism illustrated in figure1. This country is small in terms of trade and is therefore not able to affect the world price (Pw) of the imported good; as a result, it takes pw as given. Starting in partial equilibrium emphasizes the need for countries to import from other countries when domestic demand (point D) exceeds supply (point A). For that reason, this equilibrium is only transitory. Consequently, in order for supply to equal demand in a subsequent equilibrium the import level of the good needs to increase, from point A to D (*IM*, figure1).

Following the partial equilibrium setting, this small country changes trade policy and decides to introduce an *ad valorem* tariff (t) on the imported good.

The characteristics of the introduction of an *ad valorem* tariff (t) on imports in a partial equilibrium setting concerning a small country (Van Marrewijk, 2007):

1. The domestic price level increases ↑ Pd (1+t);
2. The domestic production level increases ↑ (point A → point B);
3. Domestic demand decreases ↓ (point D → point C);
4. The import level decreases ↓ (From A↔D to B↔C) (*IM**, figure 1).

The above characteristics equivalently hold in the case of a large country that is able to influence Pw, the world price. However, in contrast to the small country setting, foreign producers now finance part of the government revenue. Alternatively, reversed is this process, with a reduction or removal of import tariffs.

2.2 Economic Effect of an Import Tariff in a General Equilibrium Setting

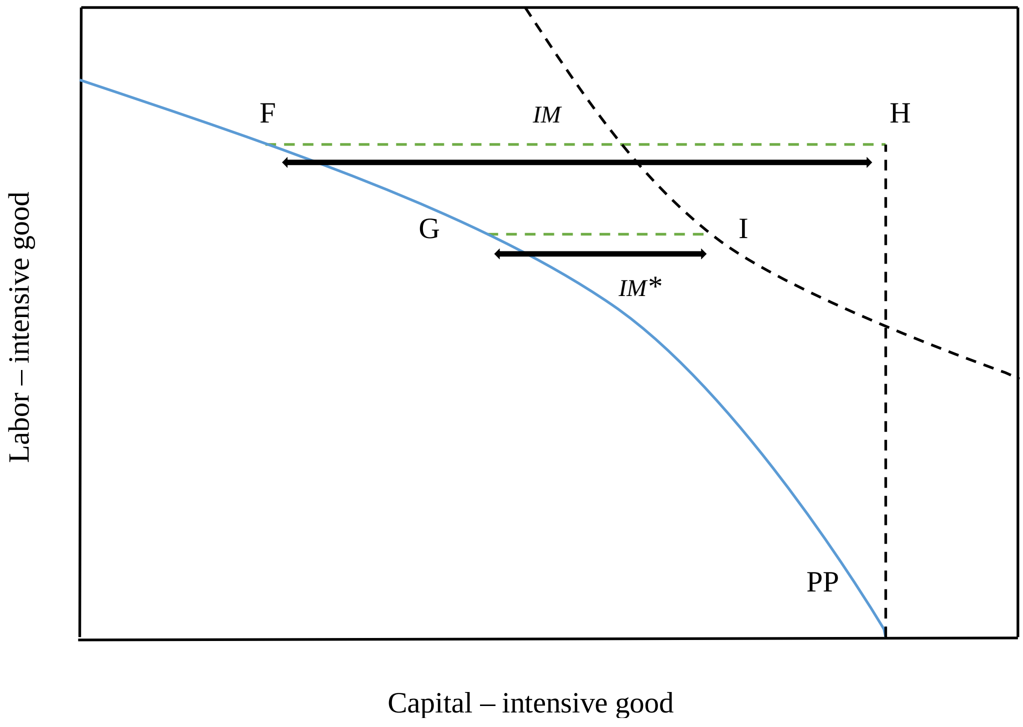
Preliminary to examining the augmenting impact of the imposition of import tariffs in a general equilibrium setting, introduced first are a set of *neoclassical model assumptions* concerning the trading country (Van Marrewijk, 2007):

- The trading country consists of high levels of labor and low levels of capital. The trading country imports the capital-intensive good, and exports the labor-intensive good.

- The trading country is not able to influence the world price level and thus trade. As a result the price of Pc (price capital-intensive good) relative to Pl (price labor-intensive good) is given.

Figure 2

Effect of an Import Tariff in General Equilibrium



Note. This figure shows the production points and import levels of a labor-intensive and a capital-intensive good for country i trading with the rest of the world. *PP* = Production points. *IM* = Imports pre tariffs. *IM** = Imports post tariffs.

Equilibrium pre import tariff imposition (*free trade*):

Marginal rate of substitution (MRS)[4] = Pc / Pl = Marginal rate of transformation (MRT)[5]

Equilibrium post import tariff imposition (*protectionism*):

$$Pc\,(1+t) / Pl \;>\; Pc / Pl$$
$$\Leftrightarrow \quad MRS \;>\; MRT$$

The above disequilibrium induced by the introduction of import tariffs distorts the economy of the trading country in two ways. The first distortion comes from the fact that Pc (1+t) > Pc, the domestic price level of the capital-intensive good exceeds the world price level of that good leading to a lower point of production than optimal of the labor-intensive good, moving from point F to point G illustrated in figure 2. The second distortion comes from the fact that Pc (1+t) > Pc induces a lower point of consumption than optimal of the capital-intensive good, moving from point H to point I.

The characteristics of the introduction of an *import tariff* (t) on imports in a general equilibrium setting (Van Marrewijk, 2007):

1. The price level of the capital-intensive good increases ↑ Pc (1+t). The trading country will produce more of the capital-intensive good and less of the labor-intensive good (point F → point G);
2. The import level of the capital-intensive good decreases ↓ (From F↔H to G↔I);
3. The export level of the labor-intensive good decreases ↓ (F → G);
4. Economic efficiency decreases ↓ since the trading country is better in producing the labor-intensive good but now produces less of it;
5. The total volume of trade decreases ↓, in terms of imports this is a decrease of F↔H minus G↔I.

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[4] Marginal rate of substitution (MRS): The quantity of the capital-intensive good the consumer is prepared to exchange for a specific quantity of the labor-intensive good.

[5] Marginal rate of transformation (MRT): The quantity of the labor-intensive good foregone to produce one extra quantity of the capital-intensive good.

2.3 Trade Models

The Ricardian model of differentials in technological comparative advantage shows that the effect of tariffs, in terms of trade, lead to smaller (developing) countries producing less of their highest technological comparative advantage goods and more of their lowest comparative advantage goods, as a result of higher prices for the latter stemming from tariffs P (1 + t). This creates, within international trade, a large non-tradeable sector with less imports and less exports. Opp (2010) found that the technological comparative advantage was completely offset by tariff rates in his study on tariffs in the Ricardian model.

The Heckscher-Ohlin model of differentials in factor abundances shows that the effect of tariffs, in terms of trade, lead to larger (developed) countries producing more of their scarce factor / labor-intensive goods in addition to the production of their factor abundant / capital-intensive goods. Basically, developed countries protect their scarce factor producing sector by implementing import tariffs at the expense of the production capacity of smaller (developing) countries that are more labor abundant and less capital abundant. As a result, imports decrease for developed countries in the HO-model. Zandano (2014) found evidence that the HO-model predictions with regard to tariffs still hold for a sample of industrialized countries.

The Melitz (2003) model of heterogeneous firm productivity within a Krugman (1979) monopoly setting shows that the effect of a reduction of tariffs / a reduction of entry costs, in terms of trade, lead to a decrease of the minimum export productivity level for firms to be profitable. This in turn induces new firms to enter international trade. As a result, imports in the importing countries increase and the productivity level in both importing and exporting countries increases. Alternatively, reversed is this process, with an increase of import tariffs.

3. Literature Review

In this section a review of the literature with regard to the tariffs-imports relationship on an empirical level is given.

A.U. Santos-Paulino (2002), studied the tariffs-imports relationship on a multiple country-level. In her study concerning a panel of 22 developing countries, the emphasis is on the effects of liberalizing trade through a reduction of tariffs (explanatory variable) and non-tariffs (explanatory variable) on the import-level (response variable). As an empirical approach, firstly, a dynamic panel data model is applied and a FE method and generalized methods of moments (GMM) used to estimate the tariffs (non-tariffs)-imports relationship for all countries, secondly applied is a time series and cross section technique (TSCS) for regional segmentation. For reasons of lagged adjustments[6] of import growth, Santos-Paulino opted for the dynamic panel model approach, and for reasons of group heteroscedasticity[7], cross-correlation[8], and autocorrelation[9] a TSCS was opted. Notable statistically significant results show that a negative relationship exists between tariffs and the import-level and that income (real GDP) positively affects the import-level. Furthermore, the results show that by reducing tariffs, developing countries see a significant increase in the import-level affecting international trade, reaching as much as +1000% in the African region.

Santos-Paulino and Thirlwall extended the trade liberalization study concerning 22 developing countries and found that excessively relaxing import restrictions, however, can lead to a deterioration of the trade balance and the balance of payments (Santos-Paulino and Thirlwall, 2004). Employed was an equivalent empirical method, extended by incorporating a relaxation of export duties as an explanatory variable. As a result, Santos-Paulino and Thirlwall were able to analyze the effects of mainly import and export duties on import growth, export growth, trade balance and the balance of payments. Their results are robust and as expected, a reduction of import (export) duties leads to an increase in import (export) growth, albeit that the former

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[6] Lagged adjustments indicates that a tariff reduction could affect the import-level with a lag, for example after 1 month or 1 year.

[7] Heteroscedasticity indicates that not all residuals drawn from a population have the same variance. This is a problem because Ordinary Least Squares (OLS) regression assumes constant variances (homoscedasticity).

[8] Cross-correlation could indicate a relationship between variables where there is none.

[9] Autocorrelation (or serial correlation) indicates that deviations of a variable are the result of lags of the same variable giving distorted results.

increases faster than the latter, consequently deteriorating the trade balance. The study adds that countries should reduce trade barriers with caution and try to maintain a balance to trade through the real effective exchange rate (RER) and a balance to payments through foreign capital inflows[10].

Ju, Wu, and Zeng, in an attempt to validate the results of the trade liberalization study, went further and increased the sample size of 22 developing countries into two samples of respectively 39 and 77 developing countries concerning two episodes of trade liberalization dates (Ju, Wu, and Zeng, 2010). After FE and GMM estimations, the results concerning the import and export growth level followed previous studies. However, in contrast to the Santos-Paulino and Thirlwall study, the results did not show a definitive negatively affected trade balance only mixed results.

Ostry and Rose (1992) were the first to evaluate, on an empirical level, the economic effects of tariffs as an explanatory variable on international trade, the real exchange rate, the real trade balance, and real output as response variables concerning mainly the US economy. Employed were multiple data sets consisting of: short (long) run bilateral (aggregate) data between the US and its trading partner-countries, and short (long) run aggregate data concerning multiple countries. Utilized was a vector autoregressive (VAR) model to estimate the effects of the explanatory variable on the response variables. Ostry and Rose found negative statistical significant results relating to international trade, indicating a strong negative effect of an increase of tariffs on the import (export) level. The effects on the other response variables were not statistically significant, indicative of the influence of explanatory variables other than tariffs.

Imbruno (2016) in his study with regard to trade liberalization in China tested, on a product-level, how effective different barriers to trade are on Chinese imports. The panel data spanned the period 2000 to 2006 and consisted of 6-digit HS[11] product-level observations. Following China's acceptance in the WTO, average bound tariffs[12] and applied MFN tariffs[13] decreased

[10] For example, foreign direct investment (FDI).

[11] The Harmonized System (HS) is a six-digit international code system for the categorization of products. The system helps countries identify traded products for customs reasons.

[12] Average Bound Tariffs are the level of tariffs, bound by a minimum and a maximum rate, agreed between WTO member countries on a bilateral level. Bound tariffs are the maximum Most-Favored Nation tariffs.

[13] Applied Most-Favored Nation (MFN) Tariffs are the level of tariffs that WTO member countries agree to impose on imports within WTO membership. MFN Tariffs are the highest effectively applied tariffs within WTO membership.

by approximately 2.4% and the simple tariffs[14] decreased by 2.5%. To account for possible lagged adjustments, Imbruno lagged the explanatory variables: tariff, quota, license, and tendering one period before using a multiple regression analysis to estimate the effects. As expected, the results with regard to the tariffs-imports relationship have the negative sign and are statistical significant at the 1%-level indicating that a 10 percentage point reduction in tariffs leads to 9.7% increase of Chinese imports. Imbruno further emphasized the endogeneity problem relating to the tariffs-imports relationship, highlighting that reverse causality could be of concern. However, relevant studies show that Chinese tariffs are set exogenous and not sensitive to internal influences.

With regard to trade in China, Tian and Yu (2019), conducted a trade liberalization study as well and tested how a reduction of tariffs affected imports of inputs for Chinese companies. Where Imbruno (2016) found evidence of a higher import-level, Tian and Yu (2019) went further and found evidence that Chinese companies not only imported more but switched imports from developing to developed countries, following a reduction of tariffs. Product-level data spanned the period 2000 to 2006, when tariffs decreased the most. The empirical methodology applied was the First Differencing (FD) method of estimation to test the tariffs-imports relationship in both the intensive and extensive margin. To address the endogeneity problem, Tian and Yu, used as an instrumental variable, the difference in the tariff. Their results are robust and significant and show that imports from both developing and developed countries increase at a fast pace following a reduction of tariffs. Furthermore, their results for reasons of innovation and quality improvements by Chinese companies indicate that imports from developed countries increased more compared to developing countries.

Mohsen, Chua, and Che Sab (2017) also studied the effects of trade liberalization on imports and in addition on exports. Applied were a VAR model and Impulse Response Functions (IRFs) to estimate the trade openness-imports and trade openness-exports[15] relationship in their study on trade-openness in Syria. The data spanned the period 1980 – 2010 and includes imports (response variable), trade-openness (explanatory variable), the real exchange rate (control variable), oil-production growth-rate (control variable), gross fixed capital formation (control variable), and GDP per capita (control variable). After running the VAR model, the optimal lag

[14] Simple Tariff (Uniform Rate Tariff): The simplest of all tariff-types. It is a tariff imposed as a fixed rate per unit; as a result, the price will not vary with deviations in the number of units imported/consumed.

[15] Trade openness as an explanatory variable incorporates: free trade zones, simplification of import and export procedures, and the removal or lowering of tariffs.

length was determined through the Akaike Information Criterion (AIC)[16]. Their results indicate a positive effect of trade openness on both imports and exports. Furthermore, with focus on imports, a rising real exchange rate, a rising oil production, and a rising GDP per capita all have a positive effect. After running the IRFs, the dynamic effects estimation indicate that over a period of ten years following a shock to trade openness in one year, imports response is positive in the next year. Thus, following a reduction of trade barriers, the expectation is that imports increase.

Davaakhuu, Sharma, and Bandara (2018) were the first to study the effects of a reduction of trade barriers on the import intensity regarding the Mongolian manufacturing sector. The study included panel data spanning from 1995 to 2008 concerning multiple manufacturing sectors. Employed was the Fixed-Effects (FE) method of estimation and different empirical tests like Regression specification error tests (RESET)[17], Heteroscedasticity-tests, and F-tests[18]. Their results show a positive statistical significant relationship between foreign direct investments (FDI) as an explanatory variable and import intensity as a response variable and that the explanatory power reaches 73%, indicative of robust results. Furthermore, their results show a negative statistical significant relationship between tariffs and non-tariffs as explanatory variables and import intensity as a response variable.

Allaro (2012) followed the Santos-Paulino and Thirwall (2004) study in an attempt to estimate the impact of a reduction of barriers to trade on the trade balance for the economy of Ethiopia. In addition, Allaro implemented a unit root test through regression estimation for the identification of the input of all variables in the model and a Johannes test for the identification of cointegration. The results follow that of Santos-Paulino and Thirwall (2004), a decrease in tariffs leads to an increase in imports albeit at a higher rate than an increase in exports leading to a deterioration of the trade balance.

Santos-Paulino did found evidence of an improved trade balance following trade liberalization in her study on the economy of the Dominican Republic (Santos-Paulino, 2006). Annual data spanned 1960-2000 and the empirical approach was a short and long run cointegration analysis through an Autoregressive Distributed Lag (ARDL) model. Emphasized was that domestic income (GDP) and relative prices (PM) are the two most important determinants of import

[16] Akaike Information Criterion (AIC) is an estimator of prediction errors. It gives the quality of a statistical model.

[17] Regression Specification Error Test (RESET) is a functional form test. It adds polynomials in the OLS fitted values to detect nonlinearities.

[18] F-tests used to test the exclusion of a single variable in the model.

demand, both were included in the regression model as explanatory variables. The results indicate a strong positive but lagged response of import growth following a reduction of trade barriers. Furthermore, export growth increased by more leading to an improvement in the balance of trade.

Armah, Brafo-Insaidoo, and Akapare (2014) studied the relationship between trade liberalization and imports on an empirical level concerning the economy of Ghana. The emphasis was on the causality direction between the response and explanatory variables. Employed was quarterly time series data spanning the period 1972 Q1 – 2010 Q4 and for empirical estimation, the Johansen and Juselius cointegration approach[19] and Granger-Causality test[20] was opted. Firstly, carried out were the Phillips-Perron[21] and the Dickey-Fuller[22] tests to determine whether all the variables were stationary or not. They found non-stationary variables and, as a result, successfully used first differencing (FD) to comply with the Johansen and Juselius requirement of all variables integrated of order one. Secondly, carried out were the Johansen and Juselius cointegration and Granger-Causality tests. The results confirm a positive short and long run relationship between import revenue (response variable) and trade liberalization (explanatory variable), real GDP (control variable), nominal exchange rate (control variable), foreign exchange reserve (control variable), foreign asset (control variable), and government expenditure (control variable). With regard to causality, found was one-direction positive causality from trade liberalization to import revenue with no feedback.

Russ and Swenson (2019) in their study on trade liberalization with regard to the Korea-U.S. trade relationship, found evidence of trade diversion and increasing trade deficits following the implementation of the Korea-U.S. Free Trade Agreement (KORUS)[23]. The study lays focus on trade creation and trade diversion from low-cost producing FTA partner countries to high-cost producing FTA partner countries following a significant reduction and/or complete removal of

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[19] The Johansen and Juselius cointegration approach is a multivariate method that makes use of the vector autoregressive (VAR) and the vector error correction (VECM) model to identify possible cointegration of short and long run relations of non-stationary time series.

[20] The Granger-Causality test is a minimum assumption of causality where past values of one time series are useful for predicting future values of another, after controlling for past values of that times series.

[21] The Phillips-Perron test is a unit root test. The test deals with the possibility of higher autocorrelation than allowed and invalidates the Dickey-Fuller test or not.

[22] The Dickey-Fuller test is a t test of the unit root null hypothesis in an (autoregressive) AR(1) model.

[23] The U.S. – Korea Free Trade Agreement (KORUS) is a bilateral trade agreement between the U.S. and South Korea signed on June 30, 2007 and enforced on March 15, 2012.

tariffs. Employed was data that consists of 6-digit HS product-level import data and most favored nation (MFN) U.S. and KORUS tariff data. The advantage of their regression model is the implementation of year fixed effects that take into account different aggregate growth rates and variations in the exchange rates that could have explained deviations in the U.S. import level. The results indicate trade diversion in terms of higher U.S. imports from South Korea stemming from a reduction and/or removal of tariffs because of KORUS FTA.

Unlike Russ and Swenson (2019), Yi (2020), moving beyond, found that trade creation and trade diversion are enhanced even further in the case of a trilateral FTA in comparison to a bilateral FTA. Through the implementation of mainly a computable general equilibrium (CGE) model, the study aimed to measure the economic effects of a removal of import tariffs and NTMs[24] on GDP, exports, and imports on a multi-region, multi-sectoral level. The trilateral FTA is inclusive of the three economic regions: Japan, Korea, and the EU and the section of most interest is the complete removal of import tariffs within this FTA and the economic effects that follow. With an emphasis on imports, the results indicate an increase for all three economic regions because of the positive income-effect within the Korea-Japan-EU FTA following an expansion to trade. In contrast, expected to decrease are the imports of countries that are not participating within this trilateral FTA because of the negative substitution-effect. Furthermore, the results show that it is economically more beneficial for Korea, Japan, and the EU to participate in a trilateral FTA in preference to a Korea-EU, Japan-EU, and Korea-Japan bilateral FTA due to trade and efficiency gains.

The key positive take away of this section is that, based on previous studies, a possible negative (statistical significant) relationship exists between tariffs and imports which contributes to trade concerning partner countries, developed and developing. Furthermore, for reasons of lagged adjustments, an advanced panel model approach e.g. FE could be advisory. And concerning the endogeneity problem, reverse causality should be of focus. In addition, highlighted were the multiple variables other than tariffs, e.g. real GDP, RER, and FDI mainly, that affect imports and need to be controlled. The key negative take away of this section is that no study extends to both developed and developing countries to which this study attempts to add in this regard.

[24] Non-tariff Measures (NTMs) include all policy measures except tariffs and tariff-rate quotas that affect international trade. Technical NTMs include, for example, standards and regulations. Non-technical NTMs include, for example, price measures and forced distribution channels.

4. Empirical Model Framework

Reviewed in this section, is the empirical methodology applied to estimate the tariffs-imports relationship and to see if causal establishment is possible. The section starts with an analysis of the econometric methods used in this study, followed by a detailed discussion of the data employed, before moving on to the formation of the hypotheses. Set up, in the last part of the section, is the empirical model equation.

4.1 Panel Data Analysis

Opted for in this study, is the panel-data regression model in an attempt to empirically estimate the relationship between tariffs, as an explanatory variable, and imports, as a response variable concerning a panel of 37 developed and 35 developing countries[25] (cross-sectional units) over the period 1993 – 2018. Observed then, is this same group of cross-sectional units over a period of 25 years. For this reason, it seems warranted, more than cross-sectional and pooled cross-sectional data that panel data is better applicable in this study. More strongly, observing the same units over a given time period, panel data, gives several other advantages over cross-sectional and pooled cross-sectional data (Wooldridge, 2015). First, by applying 72 observational units in the analysis and not only a single cross-section enables the possibility to try to establish causal inference. Second, it enables the possibility to control for unobserved country-specific characteristics[26]. Third, it excludes trending[27] and seasonality[28] concerns. Fourth, it enables the possibility to take into account the significance of lags in responses or the process of making choices for multiple cross-sectional units. This last advantage is important, because tariffs as an economic-policy tool tend to have the desired effect only after the passing of several years. However, employing panel data has its disadvantages because of the time aspect included. Not adhered to therefore, is the assumption of independent distribution of the

[25] Countries with HDI > .80 are categorized as developed, otherwise as developing (see Appendix 1, Figure 1).

[26] For example, GDP and GDP growth.

[27] Trending is a time series data issue not a panel data issue. Trending can lead to misleading results regarding correlation of time series. Two time series trending at the same time can project a statistical relationship where there is none.

[28] Seasonality is a time series data issue not a panel data issue. Quarterly, monthly, weekly, and daily time series data may contain seasonality and thus non-random observations. Seasonally adjustment of the data before employment is necessary. For example, Christmas holiday season leading to higher retail sales in December.

observational units across time. This frequently leads to panel data correlation. As a result, this study accounts for this issue by applying the FE method of estimation, an advanced panel data method aiming to remove, over time, the unobserved characteristics of the observational units. Both panel data sets are balanced, organized, and stored in records, these records are adjacent.

4.2 Random Effects Method of Estimation

Observable characteristics other than tariffs affect a country's imports, these observable characteristics need to be controlled for in order to isolate the actual effect of tariffs on imports. GDP, for example, affects a country's imports as well. It is an economic indicator that is observable and measurable. Therefore, GDP needs to be held fixed (controlled) within the econometric system. Besides GDP, sufficient good control variables that affect imports need to be held fixed. Country's, however, also have unobservable characteristics that affect the explanatory variable, tariffs ($T_{i\,t}$). These characteristics are country-specific i.e. country 1 has a larger group of environmentalists advocating for tariffs than country 2. When dealing with the unobserved characteristics (a_i), the goal is to remove these country-specific differences to estimate the variation in the tariffs-imports relationship.

On the other hand, suppose that these country-specific characteristics don't affect tariffs, then it does not make sense to remove them. Then the RE method of estimation is the preferred option if sufficient good control variables have been included, because it keeps the country-specific characteristics in the model. In econometric terms, the assumption of no correlation between a_i and the explanatory variable, $T_{i\,t}$, hold since underestimated heterogeneity still present in the econometric system only leads to serial-correlation in $[a_i + u_{i\,t}]$, the composite error term in the model. In contrast to the FE model, the RE model in this study includes an intercept (β_0) and thus the assumption that a_i and $T_{i\,t}$ are not correlated, could hold. Consequently, the a_i has zero mean and no loss of generality (Wooldridge, 2015). In contrast to the FD and FE methods of estimation in this study, the RE method aims not to remove a_i since the assumption is made of no correlation between a_i and $T_{i\,t}$. In this model, removing a_i would yield poor estimators. If $T_{i\,t}$ would be constant over time, the RE method would be the preferred method of estimation above FE and FD, because the latter two methods remove all constants.

This is not the case in this study; $T_{i\ t}$ significantly decreases over time as countries opened up their economies more to globalization and trade efficiencies[29].

Strengths of the RE method of estimation:

- The model is able to deal with time constant explanatory variables; constants do not drop out of the model.
- If all RE assumptions hold, then with a large sample of observational units and constant period the RE estimator is more efficient than FE, FD, and pooled OLS.

Weaknesses of the RE method of estimation:

- Sufficient good control variables should be included in the model. Certain variables could be challenging to source.
- It is less effective in estimating causal relationships, because it assumes zero correlation between the explanatory variables and the unobserved effect.
- It is deficient if the sample under study is non random, for example, in the case of large geographical units like countries.

4.3 Fixed Effects Method of Estimation

Alternatively, suppose that the country-specific characteristics do affect tariffs, then leaving them in the model could generate biased results. For example, in the case that country 2 has a larger group of domestic consumer associations opposing tariffs than country 3, then the effect of tariffs on imports could be biased downward in country 3. Or, in the case that country 4 has a large group of lobbyists aiming to reduce tariffs on behalf of foreign exporting companies and country 5 has none, then the effect is biased downward in country 5[30]. In econometric terms, to estimate the within variation of the tariffs-imports relationship in this case the unobserved country-specific characteristics, a_i, need to be removed prior to estimation. Then an alternative method of estimation is better applicable, when dealing with a_i, namely FE. This method of estimation, unlike RE, does permit causal correlation between a_i and $T_{i\ t}$. Since the aim of this

[29] For example, specialization and operational efficiencies.

[30] In econometric terms, referred to as Omitted Variable Bias.

study is to try and estimate if causal inference can be established, FE qualifies as a superior method of estimation to RE. Furthermore, in many panel-data studies it is common and positive to accept correlation between a_i and $T_{i\,t}$. When dealing with a_i in FE, the within transformation (FE transformation) in this study eliminates the effect of a_i, β_0, and all remaining time-constant variables for all (i) in an attempt to isolate and estimate the (causal) effect between $T_{i\,t}$, tariffs (explanatory variable) and $IM_{i\,t}$, imports (response variable). This is done by way of demeaning the data. For this reason, it is better to look at a_i in FE as omitted variables that the study controls for in the FE transformation. Regarding policy analysis, i.e. the introduction of tariffs, FE in general is the preferred method of estimation in comparison to RE.

The FE method of estimation makes the following assumptions (Wooldridge, 2015):

FE.1 Strict exogeneity with regard to the explanatory variables. The error $U_{i\,t}$[31] needs to be uncorrelated with the explanatory variables. This leads to an unbiased FE estimator.

$$\Delta\, u_t \neq \Delta\, x_t$$

FE.2 Allowed is arbitrary correlation between a_i and the explanatory variables. This enables the possibility to estimate causal inference, after time-constant variables are isolated within the model.

FE.3 Homoscedasticity with regard to $U_{i\,t}$. Meaning $U_{i\,t}$ does not vary much with a variation in the explanatory variables, emphasizing that sufficient good explanatory and control variables are included in the model.

$$\text{Var}\,(u \mid x_1, x_2, \ldots, x_t) = \sigma^2,$$

The error term does not vary with variations of the explanatory variables.

[31] $U_{i\,t}$, in this study, indicates the error term housing unobserved variables for each country i at time t.

FE.4 Serially uncorrelated $U_{i\ t}$. Meaning that there is no serial correlation in the errors, equivalently that the model is dynamically complete[32]:

$$E\ (u_t \mid x_t, y_{t-1}, x_{t-1}, y_{t-2}, x_{t-2},\ldots) = 0,$$

Sufficient explanatory power comes from x_t, no additional lags for x and y are necessary.

Strengths of the FE method of estimation:

- Permits causal correlation between the unobserved effect a_i and the explanatory variable $T_{i\ t}$, making it more effective in estimating causal relationships.
- Better, in the case that significant negative serial correlation is present in the error term $U_{i\ t}$.
- Immediately applicable to unbalanced panels.
- It is sufficient if the sample under study is non random, for example, in the case of large geographical units like countries.

Weaknesses of the FE method of estimation:

- The model is not able to deal with time constant explanatory variables; constants drop out of the model.
- Unclear how to conduct a goodness-of-fit estimation, because R^2 stems from the FE transformation (within transformation).

4.4 First Differenced Method of Estimation

The FD method of estimation is closely related to FE in removing the unobserved country-specific characteristics in order to isolate the effect of tariffs on imports, but instead of demeaning the data the FD method removes the unobserved country-specific effect by way of subtraction. Therefore the effects on the tariffs-imports relationship of the large group of

[32] This assumption may be too strict, especially in the case of static models and ARDL models with a finite time horizon.

enviromentalists in country 1, the domestic consumer associations in country 2, and the lobbyists in country 4, is subtracted by FD. Basically, imports as a response variable is differenced across time for the same countries, thus cancelling out the unobserved effects. Still, it is not easy to choose between FE and FD. As a result, following a comparison analysis of the RE and FE methods of estimations, and in the case that the FE estimator > RE estimator, this study in addition compares the FE estimator to the FD estimator as it is common that the results under both methods of estimation are insensitive. This is a positive sign since it emphasizes comparable results. It is more complicated to select FE or FD as a method of estimation when the results differ significantly. For two periods (t = 2), the FE and FD estimators are equivalently and it does not matter what method of estimation is opted for. For more than two periods (t > 2), the FE and FD estimators are not equivalently and as a consequence it is necessary to do a comparison analysis of both methods, as is the case in this study.

Fixed Effects (FE) vs. *First Differencing* (FD) (Wooldridge, 2015):

- In the case that $U_{i\,t}$ is serially uncorrelated; $E\,(u_t \mid x_t, y_{t-1}, x_{t-1}, y_{t-2}, x_{t-2},\ldots) = 0$, RE is better than FE and FD.
- In the case that $U_{i\,t}$ follows a random walk, FD is better.
- In the case that $U_{i\,t}$ is significant negatively serially correlated, FE is better.
- In comparison to FE, the FD estimator is more sensitive in the case of heteroscedasticity, non-normality, and serial correlation in the idiosyncratic errors.

4.5 Breusch-Pagan F Test

This study applies the Breusch-Pagan F test (1979) in an attempt to test whether heteroscedasticity is present within the econometric system. In the previous section, namely under the FE and FD methods of estimation the assumption is made of no heteroscedasticity with regard to $U_{i\,t}$ and why this is important,

$$\text{Var}\,(u \mid x_1, x_2, \ldots, x_t) = \sigma^2,$$

Alternatively, homoscedasticity with regard to $U_{i\,t}$, unless the opposite is present within the panel-data.

The presence of heteroscedasticity in the econometric system is problematic, because it diminishes the effect of tariffs on imports. This stems from the fact that factors still housed in the error term, $U_{i\ t}$, could still affect imports, giving misleading results. For example, failing to include foreign direct investment (FDI) in the model as a control variable, could lead to a tariffs-imports effect where there is none. If FDI is not included in the model, it is housed in $U_{i\ t}$. To solve this issue, FDI along with other factors that affect tariffs, need to be removed from $U_{i\ t}$ and included in the model as control variables.

The Breusch-Pagan F Test for Heteroscedasticity (Wooldridge, 2015):

1. Regression model estimation. Derive $U^2_{i\ t}$.
2. Conduct the linear regression analysis to obtain R^2u^2.
3. Compute the *p*-value by forming the F statistic. Evidence of no heteroscedasticity is present if the *p*-value is not significantly small.

If evidence of no heteroscedasticity is present within the econometric system, this study concludes that sufficient good explanatory and control variables are included in the model.

4.6 Hausmann Test

This study applies the Hausmann Test (1978) to conduct a comparison analysis between the RE and FE method of estimation in order to differentiate which method is better applicable. The test is conducted under the RE assumptions and therefore RE will be applied unless the test rejects it. In the case of no rejection, the indication is that the RE and FE estimations are sufficiently close and that it does not matter which one is applied in the study, or that the FE estimations are significantly large that differentiation is not possible. In the case of rejection, the full set of RE assumptions do not hold, and the FE method of estimation is applied.

4.7 Data

As previously mentioned, this study employs panel data collected on a country-level concerning economic indicators of 37 developed and 35 developing countries over a prolonged period. The data included in the model consists of eight variables: Import goods and services (*IM*), Effectively applied weighted average tariffs (*T*), Gross domestic product (*GDP*); constant 2015 prices, Real effective exchange rate REER (*e*), Inflation (*INF*); constant 2010 prices, Broad money M3 (*M*); annual index 2015=100, Foreign direct investment, net inflows (*FDI*), and Labor force participation rate (*LFP*).

The panel data collected on country-level spans the period 1993 – 2018 and are on a yearly basis. This concerns the transition period from high tariffs to low tariffs, globally.

Data sourced comes from the World Bank, World Bank World Integrated Trade Solution (WITS), International Monetary Fund (IMF), and OECD databases.

Table 1

Descriptive Statistics

	Foreign direct investment (% of GDP)	Gross domestic product (constant 2015 US$ x 1000)	Import goods and services (current US$ x 1000)	Inflation (Consumer price index)	Real effective exchange rate	Broad money	Effectively applied weighted average tariffs
M	50.86990	1035.985.126	243.504.909	87.98368	4.596204	56.44180	8.082294
Median	44.12500	265.480.141	93009308	90.87136	4.601458	52.09548	7.145034
Maximum	490.3700	19551.981.480	3129.697.000	203.5454	5.621780	159.9140	38.55753
Minimum	1.000000	4146923	1589080	0.512240	3.816871	0.078157	0.825931
SD	30.73821	2563.683.549	401.265.151	23.69015	0.182513	35.17283	4.772492
N	956	956	956	956	956	956	956

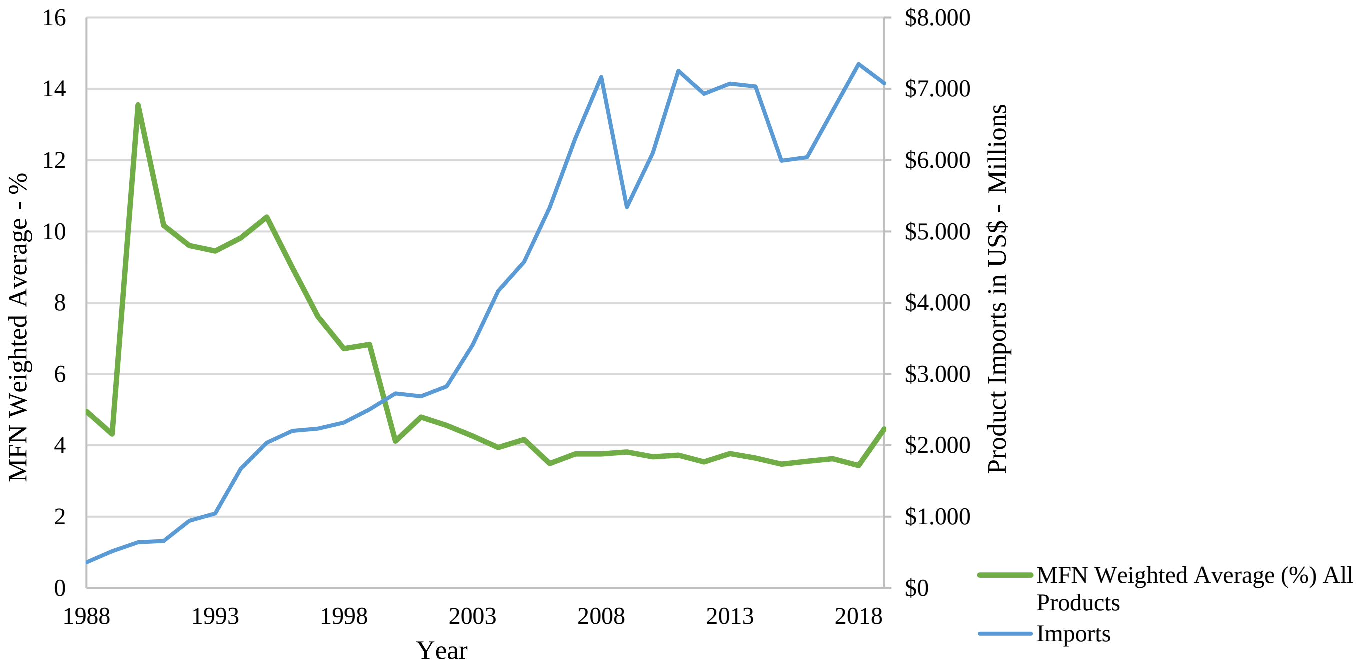
Note. This table represents the descriptive statistics of the econometric system. *M* specifies mean. *SD* specifies standard deviation. *N* specifies number of observations.

4.7.1 Import Goods and Services

IM is the variable of interest for which this study attempts to estimate responses to changes in tariffs. In consequence, *IM* represents the response variable in the econometric system and is opted based on economic theory and past studies on trade like that of Santos-Paulino (2002). The *IM* data is measured in US$ - Millions and consists of goods and services on country-level imported from the rest of the world. *IM* is collected from the World Bank database.

Figure 3

Effect of Tariff Reductions on Imports: Europe & Central Asia



Data source: World Integrated Trade Solution (WITS)[33].

Figure 3. Illustrates MFN (Most Favored Nation) weighted average import tariff data (percentage change, all products) and products import data (in US$ - Millions) concerning Europe and Central Asia that was collected from the WITS database and spans the period 1988 – 2018. After the data was plotted in the graph the inverse relationship between import tariffs and imports became clearly noticeable. Following a year of high-level protectionism in 1990,

[33] www.wits.worldbank.org

Europe and Central Asia started significantly reducing import tariffs that resulted in a considerable increase of the import level of products. The year 2000 in the graph indicates the reversal point; at this point, a stabilized period of low import tariffs induces a significant increase in imports.

4.7.2 Effectively Applied Weighted Average Tariffs

The effectively applied weighted average tariffs (*T*) represent the explanatory variable in the econometric system and is measured in percentage for all products. By dividing the total revenue of the tariffs by the total value of imports, *T* is calculated. This method of computing import tariffs is commonly applied but not perfect for several reasons. Firstly, excluded could be goods and services with a very high rate of protection (high tariff goods and services) leading to a complete import stop and thus given zero weight. As a result, missing in the calculation are the significant tariff weights of these goods and services leading to a lower weighted average tariff rate instead. Secondly, this method of calculation could also lead to under estimation when specifying different markets[34]. For this reason, calculating the effective average tariff rate could be better applicable for an in-depth micro-level analysis. Nonetheless, since more broadly applied across countries, opted for in this study is the weighted average tariff rate for a broader macro-level analysis instead. The expectation is that increases (decreases) in *T* lead to decreases (increases) in *IM*, indicating an inverse relationship. Successfully applied in previous studies on trade like that of Ju, Wu, and Zeng (2010), *T* qualifies as a good explanatory variable leading to strong results. Data on *T* collected comes from the WITS database.

4.7.3 Gross Domestic Product

Gross domestic product (*GDP)* is a determinant of aggregate import demand and is therefore included as a control variable in the econometric system. The expectation is that increases

[34] For example, a final good on the final goods market is $200 and imposing a 10% tariff rate while the price of raw material on the raw materials market is $120 and imposing a 5% tariff resulting in a total protection of 10% + 5%. However, when calculating the effective tariff rate the total protection appears to be higher in reality. With tariffs: $200 x 1.10 - $120 x 1.05 = $94 and without tariffs: $200 - $120 = $80. Therefore, the effective average tariff rate is 100% x [(94 – 80)/80] = 17.5%, higher than the weighted average tariff rate.

(decreases) in income, *GDP*, leads to increases (decreases) in *IM*. Consequently, controlled for is the possible (positive) income-effect in order to estimate causal inference establishment concerning the *T-IM* relationship. The income-effect is directly related to *IM*. Concerning *T*, the income-effect is decreased (increased) with an increase (decrease) in *T*. Lo, Sawyer, and Sprinkle (2007), for example, found evidence that as countries develop there is a natural tendency for manufacturers to import more following income increases. *GDP*, in this study is included as annual constant 2015 prices (real *GDP*) and the data collected is from the World Bank database.

4.7.4 Real Effective Exchange Rate

Real effective exchange rate REER (*e*) measured in percentage, is a determinant of aggregate import demand and included in the econometric system as a control variable. It translates the value of foreign currency in terms of a country's domestic currency at any point in time. Movements in the real effective exchange rate are concomitant to changes in a country's import and export levels. An appreciation of *e* (strengthening of a country's domestic currency), for example, makes imports less expensive leading to a higher import-level as a result. The opposite holds in the case of a depreciation of *e* (weakening of a country's domestic currency). Narayan and Smyth (2005) found evidence of an elastic aggregate import demand with respect to the real effective exchange rate and emphasized that the effects exceed that of population growth. The REER data collected is from the World Bank database.

4.7.5 Inflation

Inflation (*INF*) is measured by the percentage change in the consumer price index (*CPI*) and is a determinant of aggregate demand[35]. Aggregate demand in turn houses import demand via the *net exports* indicator, and for this reason, *INF* is included in the econometric system as a control variable. Assumed is that an increase (decrease) in *INF*, a rise (fall) of domestic consumer prices, leads to an increase (decrease) in *IM*, stemming from the fact that domestic goods and services are substitutes to imports. Zhou, Iormom, Azhar, and Peng (2020), for example, found evidence of this relationship; their results indicate an increase of 1.17% in import demand

[35] AD (Aggregate Demand) = C (Consumer Spending) + I (Investments) + G (Government Spending) + nX (Net Exports).

following an increase of 1% in CPI. *INF* data, in this study is from the OECD and the World Bank databases.

4.7.6 Foreign Direct Investment

Foreign direct investment (*FDI*) is a determinant of aggregate import demand and included in the econometric system as a control variable. The expectation is that *FDI* carried out by a company, usually a multinational, in a foreign entity by acquiring a stake that establishes control, positively affects import demand. *IM* thus increases with an increase in *FDI*, this holds especially in the case of intra-firm trade incentives as was found by Davaakhuu, Sharma, and Bandara (2018) in their study on trade liberalization and import intensity in the Mongolian manufacturing sector. *FDI* net inflows data, in this study is included as annual percentage of GDP and sourced from the World Bank database.

4.7.7 Broad Money

Broad money growth (*M*) is a determinant of aggregate demand (*AD*) and included in the econometric system as a control variable. Through monetary expansionary policies, for example interest rate reductions, Central Bankers attempt to strengthen a country's economy by increasing the money stock (*M*). The relationship between monetary policy and aggregate demand is given by AD = C + I + G + nX, and the expectation is that an increase (decrease) in *M* leads to an increase (decrease) in *C* and to an increase (decrease) in net Imports. Reversed is this process in case of interest rate increases as was emphasized by Bhat, Kamaiah, and Acharya (2020) in their study on monetary policy in India. Broad money growth (*M*), in this study is included as an annual index based on 2015=100 and is collected from the OECD and the World Bank databases.

4.7.8 Labor Force Participation Rate

Labor force participation (*LFP*) data in this study, is included in order to conduct sample sensitivity analysis. Inserted in the econometric system is *LFP*, and capital / broad money (*M*) dropped. The expectation is that an increase (decrease) in *LFP* leads to an increase (decrease) in *IM*, equivalently in the case of an increase (decrease) in *M*. The ambition is that the results hold under both samples. Narayan and Smyth (2005) found evidence that population growth positively affects aggregate import demand in Brunei Darussalam. *LFP* data is included as annual percentage of total population and collected from the World Bank database.

4.8 Hypotheses

Inspired by studies on the economic effects of tariffs on imports following a reduction of barriers to trade like that of Santos-Paulino (2002) concerning 22 developing countries and that of Mohsen, Chua, and Che Sab concerning trade liberalization, exports and imports in Syria (Mohsen, Chua, and Che Sab, 2017), hypotheses are formed and tested. This is to set out and find evidence of causal inference concerning the relation between tariffs and imports.
Formed and tested are the following hypotheses:

- The first hypothesis of this study is that the import level *increases* for developed and developing countries following a *decrease* of tariffs as a barrier to trade. The alternative hypothesis is that the null hypothesis is false.

- The second hypothesis of this study is that the import level *increases* more for developed countries compared to developing countries following a reduction of tariffs as a barrier to trade. The alternative hypothesis is that the null hypothesis is false.

4.9 Empirical Model Equations

Using the FE method of estimation, employed is the following regression model transformed into a system of levels. The regression model is on a country-level and constructed to estimate the economic effect of a reduction of tariffs on the import-level:

$$\log(IM)_{\mathrm{i\,t}} = \mathrm{Z_i} + \beta_1 \log(T)_{\mathrm{i\,t}} + \beta_2 \log(T)_{\mathrm{i\,t-1}} + \beta_3 \log(GDP)_{\mathrm{i\,t}} + \beta_4 \log(GDP)_{\mathrm{i\,t-1}} + \beta_5 \log(e)_{\mathrm{i\,t}} + \beta_6 \log(e)_{\mathrm{i\,t-1}} + \beta_7 \log(INF)_{\mathrm{i\,t}} + \beta_8 \log(FDI)_{\mathrm{i\,t}} + \beta_9 \log(M)_{\mathrm{i\,t}} + \mathrm{a_i} + \mathrm{U_{i\,t}} \quad (1)$$

The model is constructed connecting the import level to tariffs in an attempt to estimate the relationship and to see if causal inference establishment is possible. $IM_{i\ t}$ (i=1,….n), is the response variable that is expected to increase (decrease) with a decrease (increase) of the explanatory variable for each country i at time t (n countries total), that is the expectation that countries both developed and developing import more following a reduction of tariffs as a barrier to trade. Z_i, is the country-fixed effect for each country i. β, are the coefficients of most importance in this study, they give the directions and strengths of the variable of interest, $IM_{i\ t}$, to changes in the tariff. $T_{i\ t}$, indicates the explanatory variable: effectively applied weighted average tariffs for country i in relation to trading partner world at time t, and concern import tariffs. $T_{i\ t-1}$,indicates the effect (increase/decrease) of the lagged explanatory variable for country i at time t to control for adjustment dynamics. $T_{i\ t}$, is inserted with a lag, because many economic policies, including tariffs, are expected to have an effect only over time. $GDP_{i\ t}$, indicates the control variable gross domestic product for country i at time t. $GDP_{i\ t-1}$,indicates the lagged control variable gross domestic product for country i at time t to control for adjustment dynamics. $e_{i\ t}$, indicates the control variable real effective exchange rate for country i at time t, and $e_{i\ t-1}$ indicates the lagged control variable real effective exchange rate for country i at time t to control for adjustment dynamics. The real exchange rate is an important transmission mechanism displaying tariff shocks and is therefore essential in the model. $INF_{i\ t}$, indicates the control variable inflation for country i at time t. $FDI_{i\ t}$, indicates the control variable foreign direct investment inflows for country i at time t. $M_{i\ t}$, indicates the control variable money supply for country i at time t. $U_{i\ t}$, indicates the error term housing unobserved variables (a_i) for each country i at time t.

The aim is to estimate β_1, the effect on $IM_{i\ t}$ for a change in $T_{i\ t}$, while controlling for the variables: $GDP_{i\ t}$, $e_{i\ t}$, $INF_{i\ t}$, $FDI_{i\ t}$, and $M_{i\ t}$ for each country i at time t. Expected is that a reduction of tariffs $T_{i\ t}$, as a barrier to trade, leads to an increase in $IM_{i\ t}$.

Using the RE method of estimation in a comparison analysis to FE, the same regression model as previously mentioned is employed with one adjustment, namely, β_0 enters the model. β_0, indicates the intercept that is included to make the assumption that the unobserved effect, a_i, has zero mean without loss of generality. All other coefficients and variables are the same as in the regression model used for the FE method of estimation.

Using the FD method of estimation in a comparison analysis to FE, employed is the same FE regression model on a country-level, differenced for one period.

Conducting a Sample Sensitivity Analysis as a robustness check, the FE method of estimation is used and the following regression model in logarithmic form is employed with $M_{i\ t}$ dropped and $LFP_{i\ t}$ included in the econometric system:

$$\log(IM)_{i\,t} = Z_i + \beta_1 \log(T)_{i\,t} + \beta_2 \log(T)_{i\,t-1} + \beta_3 \log(GDP)_{i\,t} + \beta_4 \log(GDP)_{i\,t-1} + \beta_5 \log(e)_{i\,t} + \beta_6 \log(e)_{i\,t-1} + \beta_7 \log(INF)_{i\,t} + \beta_8 \log(FDI)_{i\,t} + \beta_9 \log(LFP)_{i\,t} + a_i + U_{i\,t}$$

(2)

$LFP_{i\ t}$ in the model, indicates the control variable labor force participation rate for country i at time t.

Conducting an Estimation Sensitivity Analysis as an additional robustness check, the Two-Stage Least-Squares (2SLS) Regression method of estimation and instrumental variables are used. The following regression model in logarithmic form is employed:

$$\log(IM)_{i\,t} = \beta_0 + \beta_1 \log(T)_{i\,t} + \beta_2 \log(T)_{i\,t-1} + \beta_3 \log(GDP)_{i\,t} + \beta_4 \log(GDP)_{i\,t-1} + \beta_5 \log(e)_{i\,t} + \beta_6 \log(e)_{i\,t-1} + \beta_7 \log(INF)_{i\,t} + \beta_8 \log(FDI)_{i\,t} + \beta_9 \log(LFP)_{i\,t} + \beta_{10} \log(M)_{i\,t} + IV_{i\,t} + a_i + U_{i\,t}$$

(3)

$IV_{i\ t}$ in the model, indicates the internal instrumental variable for country i at time t and is included in the econometric system as changes of the tariff rate in logarithmic form. ($IV_{i\ t}$) = $\Delta \log (T)_{i\ t}$.

5. Empirical Results

In this section given and analyzed, are the empirical results of the econometric system. The results stem from the FE method of estimation and give an insight into the directions and strengths of the betas, statistical – and economic significance.

5.1 Fixed Effects Results

Table 1A

Fixed Effects Analysis: Imports for Developed Countries

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-9.063161	1.033503	-8.769361	0.0000
Log Tariffs	-0.064025	0.029672	-2.157765	0.0312
Lags of log Tariffs	-0.109020	0.028413	-3.836911	0.0001
Log GDP	2.000184	0.205455	9.735402	0.0000
Lags of log GDP	-0.705186	0.204501	-3.448323	0.0006
Log E	0.555755	0.110715	5.019675	0.0000
Lags of log E	-0.155539	0.110063	-1.413175	0.1580
Log Inflation Rate	-0.071005	0.028502	-2.491206	0.0129
Log FDI	0.033234	0.024263	1.369750	0.1711
Log Broad Money	0.238795	0.020172	11.83785	0.0000
	Effects Specification			
Cross-section fixed (dummy variables)				
R^2	0.986504	Mean dependent var		18.30129
Adjusted R^2	0.985809	SD dependent var		1.606208
SE of regression	0.191343	Akaike info criterion		-0.420745
Sum squared resid	31.96225	Schwarz criterion		-0.179318
Log likelihood	239.3322	Hannan-Quinn criter.		-0.328610
F-statistic	1418.109	Durbin-Watson stat		0.347631
Prob(F-statistic)	0.000000			

Note. Response variable: Log Imports. Sample period 1994-2018. Cross-sections included = 37. *N* = 919. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 1A gives the FE results in levels concerning the panel of developed countries, and shows that the import level *increases* 0.064 percent, following a *decrease* in the tariff rate of 1.0 percent. Furthermore, the import level *increases* 0.109 percent, following a *decrease* in t of 1.0 percent, one period back. In free trade; after complete removal of tariffs, this results in an increase of 6.4 percent and 10.9 percent respectively. The results are statistically significant and highly statistically significant, and in line with the theoretical framework predictions[36]. Through calculated setting of tariffs, developed countries, are therefore able to significantly increase (decrease) the import level for environmental, productivity, employment, consumption, and or trade expansion purposes.The results indicate that the import level, in addition, increases with: an increase in gdp, a decrease in gdp one period back, an appreciation of the exchange rate, a decrease of the inflation rate, and an increase in the money stock. The results are highly statistically significant with regard to lagged t, gdp, lagged gdp, e, m, and statistically significant with regard to inf. An increase in *IM* due to gdp, stems from the income effect. Developed countries that see an increase in income, for example, are able to import more for consumption, value-added, and or productivity purposes. An increase in *IM* due to an appreciation of the exchange rate, stems from the strengthening of the domestic currency that enables developed countries to import more. With regard to the money stock, an increase in most cases enables developed countries to import more without weakening of the domestic currency. And, with regard to a decrease of the inflation rate, developed countries see their imports increase due to the law of demand; imports (demand), changes inversely to movements in price. However, the results show that foreign direct investment and lagged values of the exchange rate do not affect the import level. Foreign direct investment, in developed countries is more impactful in the financial sector, due to an established financial system. As a result, foreing direct investment is less impactful in the trade sector.

[36] ($p < .05$).
(.0001 < .001).

Table 2A

Fixed Effects Analysis: Imports for Developing Countries

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-5.109031	1.139175	-4.484852	0.0000
Log Tariffs	-0.029908	0.018440	-1.621901	0.1052
Lags of log Tariffs	-0.025894	0.018281	-1.416457	0.1570
Log GDP	1.960353	0.242574	8.081453	0.0000
Lags of log GDP	-0.839703	0.225068	-3.730881	0.0002
Log E	0.233823	0.107461	2.175893	0.0298
Lags of log E	-0.137720	0.099853	-1.379221	0.1682
Log FDI	0.004278	0.043364	0.098655	0.9214
Log Inflation Rate	0.014547	0.022484	0.647020	0.5178
Log Broad Money	0.232391	0.026941	8.625797	0.0000
	Effects Specification			
Cross-section fixed (dummy variables)				
R^2	0.980458	Mean dependent var		15.94792
Adjusted R^2	0.979440	SD dependent var		2.165472
SE of regression	0.310503	Akaike info criterion		0.548062
Sum squared resid	79.54015	Schwarz criterion		0.789446
Log likelihood	-194.1328	Hannan-Quinn criter.		0.640427
F-statistic	962.6158	Durbin-Watson stat		0.495384
Prob(F-statistic)	0.000000			

Note. Response variable: Log Imports. Sample period 1994-2018. Cross-sections included = 35. *N* = 869. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 2A gives the FE results in levels concerning the panel of developing countries, and shows that no significant relationship was found between an *increase* of the import level and a *decrease* in the tariff rate. This result is in contrast of the predictions made by the theoretical framework and will be subjected to a deeper analysis in this study due to a suspicion of reverse causality. Moving on, the results show that the import level increases with: an increase in gdp, a decrease in lagged gdp, an appreciation of the exchange, and an increase in the money stock. The economic reasoning related to the import level follows that of developed countries, with one deviation, namely that the income effect is instantaneously. The results are highly statistically significant with regard to gdp, lagged gdp, m, and statistically significant with regard to e. No significant relationship was found between the import level and t, lagged t, lagged e, fdi, and inf.

5.1.1 Comparison Analysis: Fixed Effects and Random Effects Results

Table 3A

Comparison Analysis Fixed Effects and Random Effects: Imports for Developed Countries

Variable	FE		RE	
	Developed Countries		Developed Countries	
	Coefficient Sign + / -	*P*	Coefficient Sign + / -	*P*
Log Tariffs	-	.0312*	-	.0050**
Lags of log Tariffs	-	.0001***	-	.0000***
Log GDP	+	.0000***	+	.0000***
Lags of log GDP	-	.0006***	-	.0000***
Log E	+	.0000***	+	.0000***
Lags of log E	-	.1580	-	.0909
Log Inflation Rate	-	.0129*	-	.0022***
Log FDI	+	.1711	+	.0161*
Log Broad Money	+	.0000***	+	.0000***
Effects Specification	R^2	.9865	R^2	.8723
	SE of regression	.1913	SE of regression	.1977

Note. *p < .05, **p < .01, ***p < .001. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

The FE and RE methods of estimation indicate comparable results with regard to the panel of developed countries (Table 3A). This holds in terms of the coefficient signs, significant levels, and the statistical measure of fit. With regard to the accuracy of the regression model output, when taking into account the response variable, the results are comparable as well. The close proximity of the results are a positive sign, albeit that no clarity is given as to what the optimal estimation method is. For this reason, the Hausmann test will be employed. Table 4A (see Appendix 2) gives the RE results concerning the panel of developed countries.

Table 3B

Comparison Analysis Fixed Effects and Random Effects: Imports for Developing Countries

Variable	FE		RE	
	Developing Countries		Developing Countries	
	Coefficient Sign + / -	***P***	**Coefficient Sign + / -**	***P***
Log Tariffs	-	.1052	-	.0782
Lags of log Tariffs	-	.1570	-	.1140
Log GDP	+	.0000***	+	.0000***
Lags of log GDP	-	.0002***	-	.0004***
Log E	+	.0298*	+	.0150*
Lags of log E	-	.1682	-	.1552
Log Inflation Rate	+	.5178	+	.6135
Log FDI	+	.9214	-	.8457
Log Broad Money	+	.0000***	+	.0000***
Effects Specification	R^2	.9805	R^2	.8340
	SE of regression	.3105	SE of regression	.3108

Note. *p < .05, **p < .01, ***p < .001. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

With regard to the panel of developing countries, again the estimation output shows comparable results in terms of coefficient signs, significant levels, measure of fit, and standard error (Table 3B). Clearly, the results are not in line with the theoretical framework predictions. Nevertheless, in this section, this is not where the emphasis lies and this shortcoming will be subjected to deeper analysis further in the study. The optimal method of estimation will be determined with the help of the Hausmann test. Table 5A (see Appendix 2) gives the RE results concerning the panel of developing countries.

5.1.2 Hausmann Test Results

Table 4B (see Appendix 2) gives the Hausmann test results concerning the panel of developed countries. In order to interpret the results, hypothesis are formed with regard to the RE method of estimation. The *null* hypothesis is that the RE method of estimation is suitable. The *alternative* hypothesis is that FE method of estimation is suitable. The estimation output yields highly statistically significant evidence against the *null* hypothesis. As a result, the *null* hypothesis is rejected and concluded is that the FE method of estimation is the appropriate method in this study.

Table 5B (see Appendix 2) gives the Hausmann test results concerning the panel of developing countries. The estimation output also yields highly statistically significant evidence against the *null* hypothesis. As a results, the *null* hypothesis is rejected and the FE method of estimation is employed in this study as the optimal method.

5.1.3 Comparison Analysis: Fixed Effects and First Differenced Results

Table 4A

Comparison Analysis Fixed Effects and First Difference: Imports for Developed Countries

Variable	**FE**		**FD**	
	Developed Countries		**Developed Countries**	
	Coefficient Sign + / -	***P***	**Coefficient Sign + / -**	***P***
Log Tariffs	-	.0312*	-	.3053
Lags of log Tariffs	-	.0001***	-	.2218
Log GDP	+	.0000***	+	.0000***
Lags of log GDP	-	.0006***	-	.0158*
Log E	+	.0000***	+	.0000***
Lags of log E	-	.1580	+	.2237
Log Inflation Rate	-	.0129*	+	.6969
Log FDI	+	.1711	+	.7654
Log Broad Money	+	.0000***	+	.6424
Effects Specification	R^2	.9865	R^2	.3860
	SE of regression	.1913	SE of regression	.1048

Note. *p < .05, **p < .01, ***p < .001. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

After concluding that FE is the optimal method of estimation compared to RE, it is appropriate to conduct a comparison analysis with regard to FE and FD[37]. The expectation is that the results should be comparable. However, this expectation does not hold with regard to the panel of developed countries (Table 4A). The estimation methods differ strongly in terms of coefficient

[37] First Differenced Results, Developed Countries (see Appendix 2, Table 4C).

signs, significant levels, measure of fit, and standard errors. The deviated FD results could be caused by serial correlation in the error term which is common when applying this estimation method. The results are in favor of FE as the optimal method of estimation in this study.

Table 4B

Comparison Analysis Fixed Effects and First Difference: Imports for Developing Countries

Variable	**FE**		**FD**	
	Developing Countries		**Developing Countries**	
	Coefficient Sign + / -	***P***	**Coefficient Sign + / -**	***P***
Log Tariffs	-	.1052	-	.1740
Lags of log Tariffs	-	.1570	-	.6801
Log GDP	+	.0000***	+	.0000***
Lags of log GDP	-	.0002***	-	.1388
Log E	+	.0298*	+	.5670
Lags of log E	-	.1682	-	.2023
Log Inflation Rate	+	.5178	+	.2198
Log FDI	+	.9214	+	.0270
Log Broad Money	+	.0000***	+	.0229
Effects Specification	R^2	.9805	R^2	.1136
	SE of regression	.3105	SE of regression	.2092

Note. *$p < .05$, **$p < .01$, ***$p < .001$. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Comparing the FE and FD[38] results with regard to the panel of developing countries, again shows that the results differ strongly in terms of significant levels, measure of fit, and standard errors (Table 4B). The results are again in favor of FE as the optimal method of estimation in this study.

5.1.4 Breusch-Pagan F Test Results

Following employment of the FE method of estimation in levels, the Breusch-Pagan F test is carried out to test whether heteroscedasticity, a second-moment issue, is present within the econometric system. Equivalently, to test if sufficient good explanatory and control variables

[38] First Differenced Results, Developing Countries (see Appendix 2, Table 5C).

are included that affect imports of developed and developing countries other than tariffs, e.g. import duties and other non-tariff barriers (NTB's).

Table 6A (see Appendix 2) gives the Breusch-Pagan F test results concerning the panel of developed countries and table 7A (see Appendix 2) gives the Breusch-Pagan F test results concerning the panel of developing countries . After deriving $U^2_{i\ t}$, the measure of fit estimate with regard to $U^2_{i\ t}$ was conducted through linear regression analysis, the *p*-value was then computed through formation of the F statistic. The results show strong evidence against the presence of no heteroscedasticity. As a result, insufficient good explanatory and control variables are included in the econometric system. This result is in line with expectations, since data collection of more and qualitative variables is constraint[39].

5.1.5 Endogeneity Issues

With regard to the issue of endogeneity, a firtst-moment issue, the FE results for the panel of developed countries show that after employment of the Breusch-Pagan F test (Table 6A, see Appendix 2) insufficient other factors have been controlled for. Therefore, the error term, housing unobserved factors, is not uncorrelated with the explanatory variable, tariffs. Endogeneity in this panel stems from omitted factors (variables), halting causal inference establishment concerning the tariffs-imports relationship, for developed countries. Any leftover influences that are overseen and housed in the error term, are thus not controlled for, e.g. foreign companies, and consumer associations, who are lobbying for lower tariffs. As a result, the strong estimated tariffs-imports effect could stem from these influences and not solely from tariffs, leading to no causal-effect.

The FE results of the panel of developing countries also show that after employment of the Breusch-Pagan F test (Table 7A, see Appendix 2) not enough other factors have been controlled for, other than tariffs. The endogeneity issue in this panel stems from omitted variable bias, as dicussed above. Moreover, it is suspected that reverse causality in addition is the source of endogeneity concerning the panel of developing countries, because one-way correlation between tariffs and imports is not present in the econometric system. This is in contrast to the

[39] For example, including Import duties as an explanatory variable and Interest rates as a control variable was not possible due to limitations of data collection.

theoretical dynamics of the tariffs-imports relationship. The reverse causality problem, arises from imports affecting tariffs, in conflict to dynamics. Imports, for example, can affect tariffs through opponents of trade liberalization, e.g. domestic companies, labor unions, and environmentalists, who are lobbying for higher tariffs as a result of an overwhelming influx of imports. As a result, imports (response variable) affects tariffs (explanatory variable), and the response variable encompasses the error term leading to endogeneity and no causal-effect.

6. Robustness Checks and Sensitivity Analysis

In this section, firstly addressed is the robustness of the FE results through a sample sensitivity analysis, performed by dropping *M* (money) as a control variable and including *LFP* (labor) in the econometric system. Subsequently, an estimation sensitivity analysis is conducted through employment of an alternative method of estimation than the FE method, namely panel Two-Stage Least-Squares (2SLS).

6.1 Sample Sensitivity Analysis

In an effort to conduct a sample sensitivity analysis, dropped is capital / broad money (*M*) and included is labor (*LFP*) alternatively into the econometric system. The ambition, after substituting capital for labor, is that the econometric system remains static in terms of directions, strengths, and significant levels.

Table 8A (see Appendix 2) gives the results with regard to the panel of developed countries. Table 8B (see Appendix 2) gives the results with regard to the panel of developing countries. The results, concerning both panels, show that an *increase* (*decrease*) in *LFP* leads to an *increase* (*decrease*) in *IM*, equivalently in the case of an *increase* (*decrease*) in *M*. In terms of strength, an increase in *LFP* affects *IM* significantly more than *M*. Nonetheless, population growth and broad money growth both affect the import level positively. The results are highly statistically significant, in line with the theoretical framework predictions, and emphasizes the robustness of the econometric system.

6.2 Estimation Sensitivity Analysis

In order to conduct an estimation sensitivity analysis, the econometric system is altered in an alternative estimation method to FE. Employed then is the Two-Stage Least-Squares (2SLS) regression method of estimation. Furthermore, an instrumental variable (IV) approach is applied, with Δt as an IV. The expectation is that the altered econometric system in comparison to FE, yields the same results. Consequently, emphasizing the robustness of the econometric system.

Table 9A (see Appendix 2) gives the results with regard to the panel of developed countries. Table 9B (see Appendix 2) gives the results with regard to the panel of developing countries. Concerning the panel of developed countries, the tariffs-imports relationship holds in terms of direction and significant level. This is not the case with regard to the panel of developing countries. Post Two-Stage Least-Squares (2SLS) and IV approach, the negative effect of *t* on *IM* turns highly statistically significant. This is an indication that the FE method of estimation is limited in this study and will be subject to deeper analysis moving on.

6.3 Empirical Issues

In the process of this study, the following empirical issues were encountered:

1. Establishing causal inference.
2. Controlling for unobserved country-specific characteristics.
3. Trending and seasonality.
4. Delayed responses.
5. Panel data correlation.
6. Reverse causality.

With regard to the issues of: establishing causal inference, unobserved country-specific characteristics, trending, and seasonality, this study applied 72 observational units in the analysis and not only a single cross-section. Furthermore, multiple control variables were inserted in the econometric system in an attempt to address the difficulty of establishing causal inference. However, after employment of the Breusch-Pagan F test the results show that insufficient good control variables were inserted. As a result, this issue could not be fully addressed because of limited data availability.

In order to address the issue of delayed / lagged responses of the explanatory variable, *t* was inserted in the econometric system with a lag. The results were in line with the theoretical framework predictions.

The issue of panel data correlation stems from the time aspect included in the data. As a consequence, independent distribution of the observational units across time is not adhered.

This study accounted for this issue by applying the FE method of estimation, an advanced panel data method of estimation with the aim to remove, over time, the unobserved characteristics of the observational units.

The reverse causality problem, hampering panel studies in general, is the issue of most importance in this study. Therefore, the next section is dedicated to solving this problem.

7. Reverse Causality

Concerning the panel of developed countries, the directions, strengths, and significant levels are in line with the theoretical framework predictions. However, in contrast to expectations this does not hold for the panel of developing countries (see Table 2A). Reverse causality is suspected, with *IM* as a response variable, explanatory variable, or both. As a consequence, setting up causality ordering is fundamental in addressing this problem.

When dealing with reverse causality, a good starting point is the decomposition of the error term ($U_{i\ t}$) in a unit specific error and an idiosyncratic error through the employment of FE, as was conducted by Brüderl and Ludwig (2015). In the presence of reverse causality, in other words if *IM* affects *T*, the *FE.1* assumption of strict exogeneity does not hold. *FE.1* assumes that the explanatory variable (*T*) is not correlated with the error term ($U_{i\ t}$) (Wooldridge, 2015). However, if *IM* affects *T*, $U_{i\ t}$ affects *T* as well. As a result, the econometric system with application of the FE method of estimation becomes deficient in this study. Turning to the RE method of estimation as an alternative, it is clear that in this case too the assumption of strict exogeneity does not hold in the presence of reverse causality.

Reed (2015) and Bellemare (2017), in an attempt to overcome this endogeneity problem, put forward the proposition of inserting lagged values of the explanatory variable in the econometric system. This was done with the expectation that, $U_{i\ t}$ affects *T* but $U_{i\ t-1}$ does not. However, their attempts were unsuccessful and simultaneity that causes the endogeneity problem remained within the system. Inserting $T_{i\ t-1}$ adheres to the assumption of strict exogeneity, but simultaneously introduces the strict assumption that unobserved variables housed in $U_{i\ t}$ should be serially uncorrelated.

After the insertion of $T_{i\ t-1}$ and application of FE, the results of this study show that no significant relationship exists between the explanatory variable, *T*, and the response variable, *IM*, concerning the panel of developing countries (see Table 2A). These findings are in the line with expectations when endogeneity exists, as emphasized by Reed (2015) and Bellemare (2017). As a result, the econometric system including lagged values of the explanatory variable and with application of the FE method of estimation remains deficient.

Lee (2016) proposed a method of estimation, when dealing with reverse causality, that does not assume strict exogeneity, namely the FD method of estimation. Through first differencing the unobserved effect and all time constant explanatory variables are removed from the econometric system. Therefore the unit specific error term is removed, and along with it the assumption of strict exogeneity. In the case that $U_{i\ t}$ is serially correlated; E (u_t | x_t, y_{t-1}, x_{t-1}, y_{t-2}, x_{t-2},…) ≠ 0, FD is better than FE (Wooldridge, 2015). However, the downside is that when employing the FD method of estimation the system only accounts for the differenced panel wave, one period back. In contrast, the FE method of estimation employs every panel wave, previous and forward-looking.

After employment of the FD method of estimation, the results in this study with regard to the panel of developing countries do not improve and the tariffs-imports relationship remains non significant (see Table 5C, Appendix 2). Even stronger, concerning the panel of developed countries the tariffs-imports relationship now turns non significant as well (see Table 4C, Appendix 2). The results are not in line with the theoretical framework predictions and are indicative that the FD method of estimation is secondary to FE. In the context of this study, the deficiency of FD stems from the insufficiency of including forward-looking panel waves. As a result, FD only accounts for the unobserved effect but not for reverse causality. Therefore, following FD application, the econometric system remains deficient.

Moving on, it appears that the way of solving the reverse causality problem while at the same time accounting for the unobserved effect is through the adjustment of FD for lags inclusion. Leszczensky and Wolbring (2019), suggested application of the lagged first differencing (LFD) method of estimation. LFD guarentees control of the unobserved time constant effect and reverse causality, whereas FE and FD in comparison only account for the unobserved time constant effect. Therefore, the LFD method of estimation materializes as a better application.

Table 10A (see Appendix 2) gives the LFD results with regard to the panel of developed countries. Table 10B (see Appendix 2) gives the LFD results with regard to the panel of developing countries. In terms of directions, both panels show that an *increase* (*decrease*) in *T* leads to a *decrease* (*increase*) in *IM*. However, concerning both panels the results lack in terms of strength. Following a *decrease* of *T* by 1 percent, *IM* only *increases* by 0.003 percent in the case of the developed countries panel. Following a *decrease* of *T* by 1 percent, *IM* only *increases* by 0.024 percent in the case of the developing countries panel. Furthermore, in terms of significant levels only the results with regard to the panel of developing countries are statistically significant. Both panels give mixed results concerning the import-effect stemming from *GDP*, *e*, *FDI*, *INF*, and *M*. The results are not in line with the theoretical framework predictions, and hint at insufficiency of the LFD method of estimation as an application in this study. The limitation of LFD is that the method is unable to incorporate, in the econometric system, the true number of lags that mirror reality. As a result, yielding poor and even contrasting output.

Leszczensky and Wolbring (2019) mentioned that apart from LFD, the FE or RE method of estimation inclusive of lags of the response variable emerges as an answer to the reverse causality problem. Including the lagged response variable rightward of the regression model enables the possibility to capture the dynamics between the response and explanatory variables. This approach, however, has a significant drawback because it violates the *FE.4* assumption of serially uncorrelated $U_{i\,t}$. Meaning that there is serial correlation in the errors, equivalently that the model is dynamically incomplete; $E\,(u_t \mid x_t, y_{t-1}, x_{t-1}, y_{t-2}, x_{t-2},\ldots) \neq 0$ (Wooldridge, 2015). Consequently, the FE or RE inclusive of the lagged response (dependent) variable (LDV) method is also deficient and is not employed in this study.

It surfaces that in order to tackle reverse causality and accounting for the unobserved effect while at the same time preventing violation of non serial correlation in the errors, the LDV method of estimation needs to be modified. Anderson and Hsiao (1981) proposed to firstly, deal with the unobserved effect through first differencing since $IM_{i\,t-1}$ is correlated with $U_{i\,t}$. And then secondly, to instert in the econometric system, $IM_{i\,t-2}$ the second order lag of the response variable as an instrumental variable (IV).

Following Anderson and Hsiao's approach, the results are given in Table 10C (see Appendix 2) concerning the panel of developed countries and in Table 10D (see Appendix 2) concerning the panel of developing countries. In terms of directions, both panels show that a *decrease* (*increase*) in *T* leads to an *increase* (*decrease*) in *IM*. This is in line with the theoretical framework predictions. However, in terms of strength, both panels show imperfect results and only the panel of developing countries shows that a statistical significant relationship exists between *T* and *IM*. The below par results stem from the fact that the Anderson and Hsiao's approach is limited in the number of instrumental variables included, as was emphasized by Leszczensky and Wolbring (2019).

Arellano and Bond (1991) extended the Anderson and Hsiao's approach with the inclusion of every previous panel wave of the lagged response variable, $IM_{i\,t-2}$, $IM_{i\,t-3}$,…, as instrumental variables, in the econometric system. Furthermore, advocated was to employ the generalized method of moments (GMM) to increase the number of instruments and to attain a higher robustness level. This method of estimation, encompassing: the lagged first difference variable (LFD), the lagged dependent variables (LDV), and application of the generalized method of moments (GMM), is referred to as the Arellano-Bond method of estimation.

In dealing with the endogeneity problem stemming from reverse causality, this study proceeds with the employment of the Arellano-Bond (AB) method of estimation.

Table 10E (see Appendix 2) gives the AB results with regard to the panel of developed countries. Table 10F (see Appendix 2) gives the AB serial correlation test results with regard to the panel of developed countries. After AB application, the optimal number of previous LDV panel waves is determined. The econometric system attains the highest robustness level after inclusion of the previous five LDV panel waves. In terms of significant levels, the previous four panel waves are highly statistically significant and the fifth panel wave is statistically significant. Ceteris paribus, concerning the tariffs-imports relationship the results show that when a country is categorized as developed and implementing policy that *induces* (*hampers*) trade in the form of a 1 percent *decrease* (*increase*) in the tariff rate, the trade effect is a 0.118 percent *increase* (*decrease*) of the import level. This finding is in line with the theoretical framework predictions and highly statistically significant. In addition, the results show that an *increase* in GDP, an *appreciation* of e, a *decrease* in INF, and an *increase* in M lead to an *increase* of the import level. The results are highly statistically significant. Furthermore, no relationship was found between FDI and IM. The AB serial correlation test results show that no serial correlation is present within the econometric system.

Table 10G (see Appendix 2) gives the AB results with regard to the panel of developing countries. Table 10H (see Appendix 2) gives the AB serial correlation test results with regard to the panel of developing countries. The optimal number of previous LDV panel waves is one. This result is higly statistically significant. Ceteris paribus, concerning the tariffs-imports relationship the results show that when a country is categorized as developing and implementing policy that *induces* (*hampers*) trade in the form of a 1 percent *decrease* (*increase*) in the tariff rate, the trade effect is a 0.047 percent *increase* (*decrease*) of the import level. Compared to the methods of estimation previously applied, the AB result is finally in line with the theoretical framework predictions concerning developing countries and highly statistically significant. Additionally, the results show that an *increase* in GDP, a *depreciation* of e, an *increase* in FDI, and a *decrease* in INF lead to an *increase* of the import level. The results are highly statistically significant. Furthermore, no relationship was found between M and IM. The AB serial correlation test results show that no serial correlation is present within the econometric system.

8. Comparison Analysis: Developed and Developing Countries

Countries are segmented according to *Human Development Index* (see Figure 1, Appendix 1). Table 1 (see Appendix 1) depicts the panel of developed countries. Table 2 (see Appendix 1) depicts the panel of developing countries. Furthermore, the comparison analysis in this section is performed after employment of the optimal method of estimation that takes into account the unobserved effect and reverse causality, namely the Arellano-Bond method of estimation.

Table 11A

Comparison Analysis Arellano-Bond: Imports for Developed and Developing Countries

Variable	**Arellano-Bond Developed Countries**		**Arellano-Bond Developing Countries**	
	Coefficient	***P***	**Coefficient**	***P***
Log Tariffs	-0.1181	.0005***	-0.0471	.0000***
Log GDP	0.7856	.0000***	0.4085	.0000***
Log E	0.2506	.0001***	-0.2671	.0000***
Log FDI	0.0450	.4641	0.0755	.0031***
Log Inflation Rate	-0.1600	.0091***	-0.0295	.0122*
Log Broad Money	0.2405	.0000***	0.0244	.1491
Effects Specification	SE of regression	.1352	SE of regression	.2663

Note. $*p < .05$, $**p < .01$, $***p < .001$. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Following a reduction of tariffs by 1.0 percent, the results indicate that imports more than doubles for countries that are developed compared to countries that are developing. In terms of directions, the results clearly show an inverse relationship between tariffs and imports for both panels. In terms of significant level, the results are highly statistically significant for both panels. These findings are in line with the theoretical framework predictions. Furthermore, noteworthy is that *GDP* impacts imports positively and that *INF* impacts imports negatively concerning both developed and developing countries. With regard to developing countries, an appreciation of the exchange rate *e* leads to a decrease of imports, *IM*. This is in contrast to the outcome in developed countries and could stem from the fact that developing countries are more trade dependent. In fact, for developing countries a stronger domestic currency translates into more expensive domestic products resulting in less exports and subsequently less imports. The results also indicate that foreign direct investments are more impactful for developing countries and that the money stock is more impactful for developed countries, because of a less established financial system in developing countries than in developed countries.

9. Conclusion

In this section, the thesis is concluded and an answer is given to the following problem statement:
"What is the effect of import tariffs on imports? And how does it differ between developed and developing countries?"

In the quest of finding an answer to the problem statement, firstly relevant literature on the economic effects of tariffs on imports was studied. The main contribution of studying the effects of the tariffs-imports relationship in the context of the thesis is to emphasize the robustness of this relationship through an effort of causation establishment. This is of great significance, in view of the fact that governtments worldwide easily reach for tariffs as a protectionist measure in an attempt to increase domestic production, leading to cross-border trade distortions and production inefficiencies. The main shortcoming of the thesis is that, due to limited data availability, it was not possible to insert more qualitative variables in the econometric system (e.g. import duties, interest rates).

In an attempt to empirically test the relationship between tariffs and imports and to see if causal establishment is achievable, yearly data on a country-level was collected and ordered adjacent spanning the period 1993 – 2018 concerning two panels, namely the panel of 37 developed countries and the panel of 35 developing countries. This concerned the transition period from high tariffs to low tariffs, globally. In order to find the optimal method of estimation, the FE, RE, and FD methods of estimation were employed. Following comparison analysis, the FE method of estimation yielded the optimal output concerning the directions and strengths of the betas, in line with theoretical framework predictions. The employment of FE, as the optimal method of estimation, compared to RE was then validated by conducting the Hausmann test. However in first instance, concerning the significant levels, the tariffs-imports relationship did not hold for countries that were in a developing stage. Furthermore, the Breusch-Pagan F test results indicated that insufficient good explanatory and control variables were included in the econometric system, halting causality establishment. Nonetheless, the robustness of the econometric system was further strengthed through a sample sensitivity analysis, and an estimation sensitivity analysis. Post robust checks, the system was insensitive under sample and estimation analysis, an encouraging sign.

The theoretical framework predictions, concerning a statistical significant inverse relationship between import tariffs and the import level, did not hold for countries that were in a developing stage. Endogeneity was suspected, stemming from reverse causality with IM as a response variable, explanatory variable, or both. As a consequence, setting up causality ordering was fundamental in dealing with this problem. First, the error term ($U_{i\,t}$) was decomposed in a unit specific error and an idiosyncratic error before employing FE or RE. This effort was shortlived, because both methods of estimation assumed strict exogeneity resulting in a deficient econometric system. Second, in dealing with the strict exogeneity assumption, lagged values of the explanatory variable ($T_{i\,t-1}$) were instered in the system with application of FE. This attempt, adhered to the strict exogeneity assumption, but simultaneously introduced the strict assumption that unobserved variables housed in $U_{i\,t}$ should be serially uncorrelated, the system remained deficient. Third, with the employment of FD the unit specific error was removed, and along with it the strict exogeneity assumption. However, due to insufficient inclusion of forward-looking panel waves, the output of the system deteriorated. Fourth, applied was the lagged first differencing (LFD) method of estimation; an adjustment of FD for lags inclusion, that deals with the reverse causality problem and the unobserved effect. The results were not in line with the theoretical framework predictions, the reason for this was the system's inability to include the true number of lags. Fifth, the Anderson and Hsiao's lagged dependent variable (LDV) approach was followed, the unobserved effect was isolated through first differencing, since $IM_{i\,t-1}$ is correlated with $U_{i\,t}$, and $IM_{i\,t-2}$ the second order lag of the response variable was inserted in the system as an instrumental variable (IV) to deal with the reverse causality problem. Below par results were yielded, because of the system's inability to include the optimal number of IV's. Sixth, the Arellano and Bond (AB) approach was employed encompassing: the lagged first difference variable (LFD), the lagged dependent variables (LDV), and application of the generalized method of moments (GMM). All previous panel waves of the lagged response variable, $IM_{i\,t-2}$, $IM_{i\,t-3}$,…, as IV's were included in the econometric system. The higly statistically significant results, concerning both panels of developed and developing countries, were robust in terms of directions and strength and now in line with theoretical framework predictions.

Post comparison analysis of both panels, the import-effect following a reduction of tariffs by 1.0 percent was significantly larger for developed countries compared to developing countries, namely twice as large. Comparison analysis, also indicated that *GDP* positively and *INF* negatively impacted *IM* for both panels. However, with regard to developing countries an appreciation of the exchange rate *e* leads to a decrease of the import level *IM*, this is in contrast to the panel of developed countries and could stem from the fact that developing countries are more trade dependent. Furthermore, indicated was that *FDI* is more impactful for developing countries and that *M* is more impactful for developed countries, because of differences in an established financial system.

This study found evidence that a highly statistically significant inverse relationship exists between tariffs and imports concerning countries that are developed or developing. However, evidence of a causal relationship was not found.

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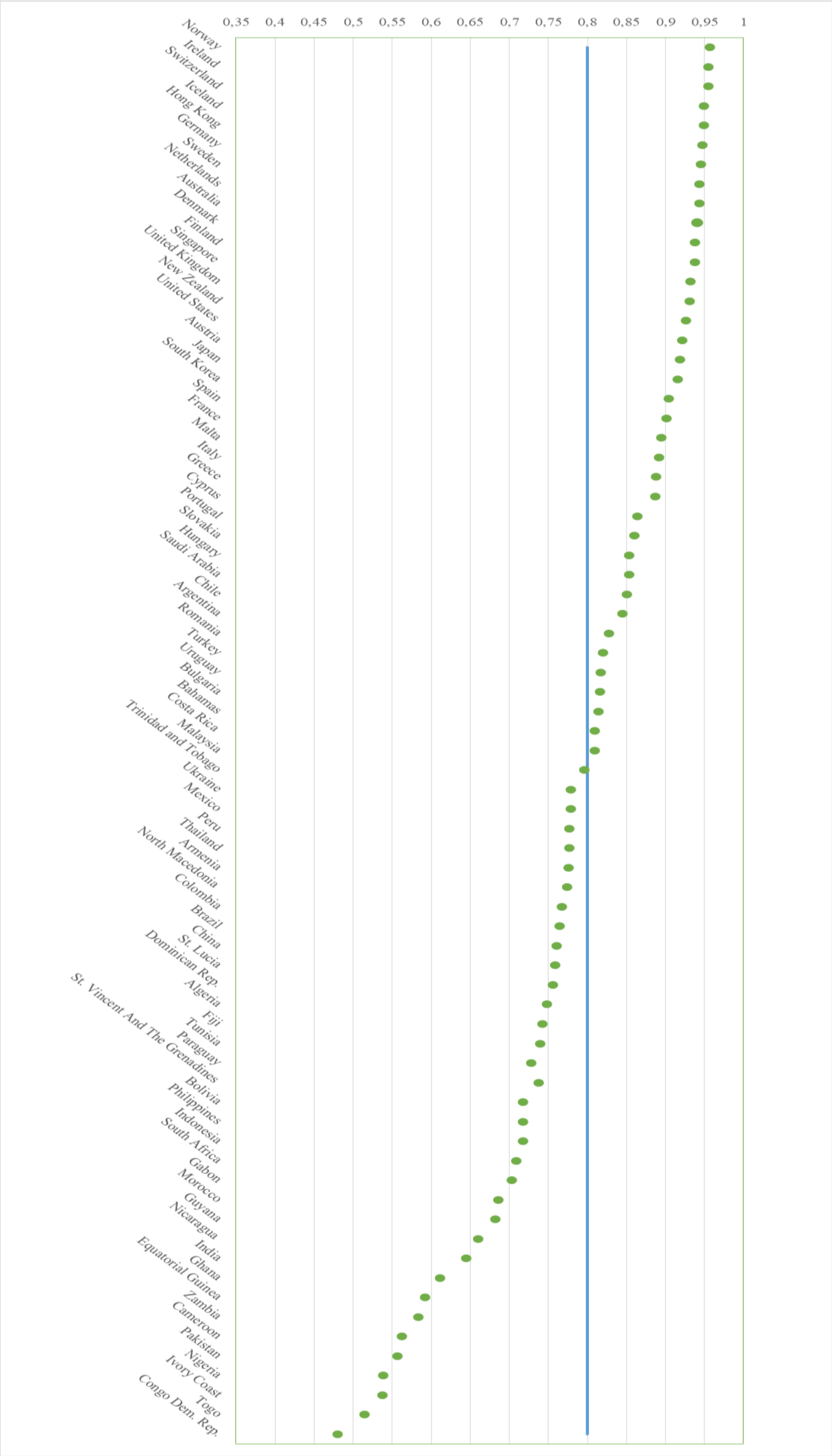
6. United Nations Human Development Report:https://hdr.undp.org/en/indicators/137506

Appendix 1

Figure 1. Human Development Index by Country (2019)



● Human Development Index by Country

- Developed Country Baseline by HDI

Data source: United Nations Development Programme.

Table 1. Panel Developed Countries:

Country	Human Development Index (2019)
1 Norway	0,957
2 Ireland	0,955
3 Switzerland	0,955
4 Iceland	0,949
5 Hong Kong	0,949
6 Germany	0,947
7 Sweden	0,945
8 Netherlands	0,944
9 Australia	0,944
10 Denmark	0,94
11 Finland	0,938
12 Singapore	0,938
13 Unt Kingdom	0,932
14 New Zealand	0,931
15 United States	0,926
15 Austria	0,922
17 Japan	0,919
18 South Korea	0,916
19 Spain	0,904
20 France	0,901
21 Malta	0,895
22 Italy	0,892
23 Greece	0,888
24 Cyprus	0,887
25 Portugal	0,864
26 Slovakia	0,86
27 Hungary	0,854
28 Saudi Arabia	0,854
29 Chile	0,851
30 Argentina	0,845
31 Romania	0,828
32 Turkey	0,82
33 Uruguay	0,817
34 Bulgaria	0,816
35 Bahamas	0,814
36 Costa Rica	0,81
37 Malaysia	0,81

Table 2. Panel Developing Countries:

Country	Human Development Index (2019)
1 Trinidad and Tobago	0,796
2 Ukraine	0,779
3 Mexico	0,779
4 Peru	0,777
5 Thailand	0,777
6 Armenia	0,776
7 North Macedonia	0,774
8 Colombia	0,767
9 Brazil	0,765
10 China	0,761
11 St. Lucia	0,759
12 Dominican Rep.	0,756
13 Algeria	0,748
14 Fiji	0,743
15 Tunisia	0,74
16 Paraguay	0,728
17 St. Vincent And The Gr.	0,738
18 Bolivia	0,718
19 Philippines	0,718
20 Indonesia	0,718
21 South Africa	0,709
22 Gabon	0,703
23 Morocco	0,686
24 Guyana	0,682
25 Nicaragua	0,66
26 India	0,645
27 Ghana	0,611
28 Equatorial Guinea	0,592
29 Zambia	0,584
30 Cameroon	0,563
31 Pakistan	0,557
32 Nigeria	0,539
33 Ivory Coast	0,538
34 Togo	0,515
35 Congo Dem. Rep.	0,48

Data source: United Nations Development Programme[40].

[40] https://hdr.undp.org/en/indicators/137506

Appendix 2

Table 1. Abbreviations:

IM	Imports	LT	Log of T
T	Tariffs	LGSLT	Lags of log T
LGST	Lags of Tariffs	LGDP	Log of GDP
GDP	Gross Domestic Product	LGSLGDP	Lags of log GDP
LGSGDP	Lags of GDP	LINF	Log of INF
LE	Log of Exchange Rate	LFDI	Log of FDI
LGSLE	Lags of LE	LM	Log of M
INF	Inflation Rate	DLT	1st Difference of log T
FDI	Foreign Direct Investment	DLGSLT	1st Difference of log LGST
M	Money Stock	DLGDP	1st Difference of log GDP
DT	1st Difference of T	DLGSLGDP	1st Difference of LGS log GDP
DLGST	1st Difference of LGST	DLE	1st Difference of LE
DGDP	1st Difference of GDP	DLGSLE	1st Difference of LGSLE
DLGSGDP	1st Difference of LGSGDP	DLINF	1st Difference of log INF
DLE	1st Difference of LE	DLFDI	1st Difference of log FDI
DLGSLE	1st Difference of LGSLE	DLM	1st Difference of log M
DINF	1st Difference of INF	LLFP	Log of Labor Force Participation Rate
DFDI	1st Difference of FDI	DLGSLINF	1st Difference lags of LINF
DM	1st Difference of M	DLGSLFDI	1st Difference lags of LFDI
LIMP	Log of Imports	DLGSLM	1st Difference lags of LM
		DLGS2LIMP	1st Difference of 2nd order lag of LIMP

Tables

Table 4A

Random Effects Analysis: Imports for Developed Countries

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-3.820866	0.669865	-5.703933	0.0000
Log Tariffs	-0.082853	0.029440	-2.814295	0.0050
Lags log Tariffs	-0.126639	0.028262	-4.480842	0.0000
Log GDP	1.868112	0.204174	9.149598	0.0000
Lags log GDP	-0.848226	0.203353	-4.171204	0.0000
Log E	0.570639	0.110674	5.156021	0.0000
Lags log E	-0.186089	0.109946	-1.692547	0.0909
Log Inflation Rate	-0.086735	0.028299	-3.064986	0.0022
Log FDI	0.057944	0.024038	2.410484	0.0161
Log Broad Money	0.292575	0.018312	15.97707	0.0000
	Effects Specification			
			SD	Rho
Cross-section random			0.434734	0.8377
Idiosyncratic random			0.191343	0.1623
	Weighted Statistics			
R^2	0.872300	Mean dependent var		1.609800
Adjusted R^2	0.871036	SD dependent var		0.550191
SE of regression	0.197663	Sum squared resid		35.51533
F-statistic	689.9191	Durbin-Watson stat		0.333627
Prob(F-statistic)	0.000000			
	Unweighted Statistics			
R^2	0.848260	Mean dependent var		18.30129
Sum squared resid	359.3743	Durbin-Watson stat		0.032971

Note. Response variable: Log Imports. Estimation method: Panel EGLS (Cross-section random effects). Sample period 1994-2018. Cross-sections included = 37. *N* = 919. Swamy and Arora estimator of component variances. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 4B

Hausmann Test Results for Developed Countries

Correlated Random Effects - Hausman Test
Equation: REEQ2
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	*P*
Cross-section random	69.962300	9	0.0000

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	*P*
Log Tariffs	-0.064025	-0.082853	0.000014	0.0000
Lags log Tariffs	-0.109020	-0.126639	0.000009	0.0000
Log GDP	2.000184	1.868112	0.000525	0.0000
Lags log GDP	-0.705186	-0.848226	0.000468	0.0000
Log E	0.555755	0.570639	0.000009	0.0000
Lags log E	-0.155539	-0.186089	0.000026	0.0000
Log Inflation Rate	-0.071005	-0.086735	0.000012	0.0000
Log FDI	0.033234	0.057944	0.000011	0.0000
Log Broad Money	0.238795	0.292575	0.000072	0.0000

Cross-section random effects test equation:

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-9.063161	1.033503	-8.769361	0.0000
Log Tariffs	-0.064025	0.029672	-2.157765	0.0312
Lags log Tariffs	-0.109020	0.028413	-3.836911	0.0001
Log GDP	2.000184	0.205455	9.735402	0.0000
Lags log GDP	-0.705186	0.204501	-3.448323	0.0006
Log E	0.555755	0.110715	5.019675	0.0000
Lags log E	-0.155539	0.110063	-1.413175	0.1580
Log Inflation Rate	-0.071005	0.028502	-2.491206	0.0129
Log FDI	0.033234	0.024263	1.369750	0.1711
Log Broad Money	0.238795	0.020172	11.83785	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R^2	0.986504	Mean dependent var	18.30129
Adjusted R^2	0.985809	SD dependent var	1.606208
SE of regression	0.191343	Akaike info criterion	-0.420745
Sum squared resid	31.96225	Schwarz criterion	-0.179318
Log likelihood	239.3322	Hannan-Quinn criter.	-0.328610
F-statistic	1418.109	Durbin-Watson stat	0.347631
Prob(F-statistic)	0.000000		

Note. Response variable: Log Imports. Estimation method: Panel Least Squares. Sample period 1994-2018. Cross-sections included = 37. *N* = 919. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 4C

First Difference Analysis: Imports for Developed Countries

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	0.009752	0.005901	1.652714	0.0987
D log Tariffs	-0.017161	0.016732	-1.025664	0.3053
D lags log Tariffs	-0.019495	0.015946	-1.222517	0.2218
D log GDP	2.019914	0.111561	18.10586	0.0000
D lags log GDP	-0.263034	0.108729	-2.419180	0.0158
D log E	0.610328	0.059965	10.17812	0.0000
D lags log E	0.070988	0.058301	1.217622	0.2237
D log Inflation Rate	0.017480	0.044856	0.389698	0.6969
D log FDI	0.004465	0.014961	0.298453	0.7654
D log Broad Money	0.019723	0.042454	0.464559	0.6424

R^2	0.386039	Mean dependent var	0.063695
Adjusted R^2	0.379702	SD dependent var	0.133059
SE of regression	0.104796	Akaike info criterion	-1.662338
Sum squared resid	9.576399	Schwarz criterion	-1.608118
Log likelihood	743.0909	Hannan-Quinn criter.	-1.641605
F-statistic	60.92069	Durbin-Watson stat	1.732831
Prob(F-statistic)	0.000000		

Note. Response variable: first Difference of Log Imports. Estimation method: Panel Least Squares. Sample period 1995-2018. Cross-sections included = 37. *N* = 882. *D* = first Difference. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 5A

Random Effects Analysis: Imports for Developing Countries

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-3.450267	0.719543	-4.795083	0.0000
Log Tariffs	-0.032385	0.018366	-1.763271	0.0782
Lags log Tariffs	-0.028805	0.018208	-1.582023	0.1140
Log GDP	1.813064	0.228318	7.940970	0.0000
Lags log GDP	-0.795391	0.223331	-3.561482	0.0004
Log E	0.259361	0.106423	2.437079	0.0150
Lags log E	-0.141962	0.099787	-1.422647	0.1552
Log FDI	-0.008293	0.042588	-0.194722	0.8457
Log Inflation Rate	0.011255	0.022276	0.505228	0.6135
Log Broad Money	0.263342	0.020093	13.10630	0.0000
	Effects Specification			
			SD	Rho
Cross-section random			0.528758	0.7436
Idiosyncratic random			0.310503	0.2564
	Weighted Statistics			
R^2	0.834042	Mean dependent var		1.866526
Adjusted R^2	0.832303	SD dependent var		0.759323
SE of regression	0.310831	Sum squared resid		82.99298
F-statistic	479.6661	Durbin-Watson stat		0.475035
Prob(F-statistic)	0.000000			
	Unweighted Statistics			
R^2	0.922665	Mean dependent var		15.94792
Sum squared resid	314.7757	Durbin-Watson stat		0.125247

Note. Response variable: Log Imports. Estimation method: Panel EGLS (Cross-section random effects). Sample period 1994-2018. Cross-sections included = 35. *N* = 869. Swamy and Arora estimator of component variances. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 5B

Hausmann Test Results for Developing Countries

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	*P*
Cross-section random	10.870220	9	0.2847

Cross-section random effects test comparisons:

Variable	Fixed	Random	Var(Diff.)	*P*
Log Tariffs	-0.029908	-0.032385	0.000003	0.1333
Lags log Tariffs	-0.025894	-0.028805	0.000003	0.0743
Log GDP	1.960353	1.813064	0.006713	0.0722
Lags log GDP	-0.839703	-0.795391	0.000779	0.1123
Log E	0.233823	0.259361	0.000222	0.0865
Lags log E	-0.137720	-0.141962	0.000013	0.2429
Log FDI	0.004278	-0.008293	0.000067	0.1237
Log Inflation Rate	0.014547	0.011255	0.000009	0.2799
Log Broad Money	0.232391	0.263342	0.000322	0.0846

Cross-section random effects test equation:

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-5.109031	1.139175	-4.484852	0.0000
Log Tariffs	-0.029908	0.018440	-1.621901	0.1052
Lags log Tariffs	-0.025894	0.018281	-1.416457	0.1570
Log GDP	1.960353	0.242574	8.081453	0.0000
Lags log GDP	-0.839703	0.225068	-3.730881	0.0002
Log E	0.233823	0.107461	2.175893	0.0298
Lags log E	-0.137720	0.099853	-1.379221	0.1682
Log FDI	0.004278	0.043364	0.098655	0.9214
Log Inflation Rate	0.014547	0.022484	0.647020	0.5178
Log Broad Money	0.232391	0.026941	8.625797	0.0000

Effects Specification

Cross-section fixed (dummy variables)

R^2	0.980458	Mean dependent var	15.94792
Adjusted R^2	0.979440	SD dependent var	2.165472
SE of regression	0.310503	Akaike info criterion	0.548062
Sum squared resid	79.54015	Schwarz criterion	0.789446
Log likelihood	-194.1328	Hannan-Quinn criter.	0.640427
F-statistic	962.6158	Durbin-Watson stat	0.495384
Prob(F-statistic)	0.000000		

Note. Response variable: Log Imports. Estimation method: Panel Least Squares. Sample period 1994-2018. Cross-sections included = 35. *N* = 869. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 5C

First Difference Analysis: Imports for Developing Countries

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	0.003138	0.011940	0.262857	0.7927
D log Tariffs	-0.017294	0.012711	-1.360501	0.1740
D lags log Tariffs	-0.004919	0.011925	-0.412456	0.6801
D log GDP	1.354269	0.162392	8.339487	0.0000
D lags log GDP	-0.232948	0.157221	-1.481654	0.1388
D log E	0.041773	0.072946	0.572659	0.5670
D lags log E	-0.082030	0.064287	-1.275989	0.2023
D log FDI	0.033978	0.027669	1.228030	0.2198
D log Inflation Rate	0.108709	0.049061	2.215772	0.0270
D log Broad Money	0.135778	0.059553	2.279973	0.0229

R^2	0.113568	Mean dependent var	0.075353
Adjusted R^2	0.103886	SD dependent var	0.220987
SE of regression	0.209194	Akaike info criterion	-0.279194
Sum squared resid	36.05992	Schwarz criterion	-0.222524
Log likelihood	126.4237	Hannan-Quinn criter.	-0.257467
F-statistic	11.72996	Durbin-Watson stat	2.175547
Prob(F-statistic)	0.000000		

Note. Response variable: first Difference of Log Imports. Estimation method: Panel Least Squares. Sample period 1995-2018. Cross-sections included = 35. *N* = 834. *D* = first Difference. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 6A

Breusch-Pagan F Test Results for Developed Countries

Response Variable: UT ²

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	0.233238	0.053050	4.396589	0.0000
Log Tariffs	0.006978	0.006989	0.998377	0.3184
Lags log Tariffs	-0.006640	0.007169	-0.926228	0.3546
Log GDP	-0.008077	0.049997	-0.161546	0.8717
Lags log GDP	0.006207	0.049858	0.124484	0.9010
Log E	-0.036906	0.028794	-1.281707	0.2003
Lags log E	0.026403	0.027828	0.948780	0.3430
Log Inflation Rate	-0.018633	0.006447	-2.890055	0.0039
Log FDI	-0.007845	0.005337	-1.469896	0.1419
Log Broad Money	-0.000338	0.003445	-0.098159	0.9218

R^2	0.049204	Mean dependent var	0.034779
Adjusted R^2	0.039790	SD dependent var	0.051588
SE of regression	0.050552	Akaike info criterion	-3.120824
Sum squared resid	2.322913	Schwarz criterion	-3.068340
Log likelihood	1444.019	Hannan-Quinn criter.	-3.100795
F-statistic	5.226733	Durbin-Watson stat	0.740256
Prob(F-statistic)	0.000001		

Note. Response variable: U^2_t. Estimation method: Panel Least Squares. Sample period 1994-2018. Cross-sections included = 37. *N* = 919. U^2_t = Error term housing unobserved variables. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 7A

Breusch-Pagan F Test Results for Developing Countries

Response Variable: UT ²

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	0.470595	0.208750	2.254347	0.0244
Log Tariffs	-0.017798	0.009326	-1.908402	0.0567
Lags log Tariffs	-0.007338	0.009436	-0.777710	0.4370
Log GDP	-0.097031	0.117030	-0.829108	0.4073
Lags log GDP	0.089025	0.117372	0.758489	0.4484
Log E	0.013123	0.058452	0.224514	0.8224
Lags log E	-0.058627	0.054866	-1.068539	0.2856
Log FDI	-0.003604	0.020618	-0.174813	0.8613
Log Inflation Rate	-0.002766	0.011194	-0.247068	0.8049
Log Broad Money	0.008699	0.007941	1.095415	0.2736

R^2	0.036472	Mean dependent var	0.091531
Adjusted R^2	0.026377	SD dependent var	0.177919
SE of regression	0.175557	Akaike info criterion	-0.630267
Sum squared resid	26.47456	Schwarz criterion	-0.575407
Log likelihood	283.8509	Hannan-Quinn criter.	-0.609275
F-statistic	3.612812	Durbin-Watson stat	0.674344
Prob(F-statistic)	0.000196		

Note. Response variable: U^2_t. Estimation method: Panel Least Squares. Sample period 1994-2018. Cross-sections included = 35. *N* = 869. U^2_t = Error term housing unobserved variables. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 8A

Sample Sensitivity Analysis Fixed Effects: Imports for Developed Countries

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-17.60590	1.071580	-16.42986	0.0000
Log Tariffs	-0.097451	0.030979	-3.145706	0.0017
Lags log Tariffs	-0.160804	0.029890	-5.379856	0.0000
Log GDP	1.933838	0.220380	8.775023	0.0000
Lags log GDP	-0.413308	0.217546	-1.899861	0.0578
Log E	0.502413	0.117828	4.263954	0.0000
Lags log E	-0.109932	0.117876	-0.932606	0.3513
Log FDI	0.016023	0.026204	0.611491	0.5410
Log Inflation Rate	0.200847	0.021802	9.212494	0.0000
Log LFP	0.973861	0.245210	3.971542	0.0001

Effects Specification

Cross-section fixed (dummy variables)

R^2	0.984506	Mean dependent var	18.30128
Adjusted R^2	0.983711	SD dependent var	1.607171
SE of regression	0.205123	Akaike info criterion	-0.281864
Sum squared resid	36.90005	Schwarz criterion	-0.041267
Log likelihood	176.0804	Hannan-Quinn criter.	-0.190066
F-statistic	1238.321	Durbin-Watson stat	0.312507
Prob(F-statistic)	0.000000		

Table 8B

Sample Sensitivity Analysis Fixed Effects: Imports for Developing Countries

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-17.17458	1.671183	-10.27690	0.0000
Log Tariffs	-0.047347	0.019040	-2.486733	0.0131
Lags log Tariffs	-0.036143	0.018954	-1.906857	0.0569
Log GDP	2.535062	0.245887	10.30989	0.0000
Lags log GDP	-0.952940	0.234860	-4.057482	0.0001
Log E	0.207697	0.111590	1.861255	0.0631
Lags log E	-0.123510	0.103721	-1.190790	0.2341
Log FDI	0.081215	0.044063	1.843159	0.0657
Log Inflation Rate	0.123591	0.020034	6.169231	0.0000
Log LFP	1.008988	0.347676	2.902093	0.0038

Effects Specification

Cross-section fixed (dummy variables)

R^2	0.978911	Mean dependent var	15.94792
Adjusted R^2	0.977812	SD dependent var	2.165472
SE of regression	0.322561	Akaike info criterion	0.624254
Sum squared resid	85.83737	Schwarz criterion	0.865639
Log likelihood	-227.2384	Hannan-Quinn criter.	0.716620
F-statistic	890.5887	Durbin-Watson stat	0.474642
Prob(F-statistic)	0.000000		

Note. Table 8A. Response variable: Log Imports. Estimation method: Panel Least Squares. Sample period 1994-2018. Cross-sections included = 37. *N* = 923. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments. *LFP* = Labor force participation rate.

Note. Table 8B. Response variable: Log Imports. Estimation method: Panel Least Squares. Sample period 1994-2018. Cross-sections included = 35. *N* = 869. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments. *LFP* = Labor force participation rate.

Table 9A

Estimation Sensitivity Analysis 2SLS:

Imports for Developed Countries

Instrument specification: C LT LGSLT DLT LGDP LGSLGDP LE LGSLE LFDI LINF LM

Constant added to instrument list

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-1.295456	0.555005	-2.334132	0.0198
Log Tariffs	-0.228067	0.033267	-6.855656	0.0000
D log Tariffs	0.171428	0.075212	2.279258	0.0229
Log GDP	0.866144	0.010953	79.07495	0.0000
Log E	-0.115203	0.107386	-1.072790	0.2836
Log FDI	0.517074	0.055963	9.239501	0.0000
Log Inflation Rate	0.253829	0.067429	3.764397	0.0002
Log Broad Money	0.169669	0.035759	4.744784	0.0000

R^2	0.891804	Mean dependent var	18.30129
Adjusted R^2	0.890972	SD dependent var	1.606208
SE of regression	0.530360	Sum squared resid	256.2472
F-statistic	1072.695	Durbin-Watson stat	0.116174
Prob(F-statistic)	0.000000	Second-Stage SSR	256.2472
Instrument rank	10	Prob(J-statistic)	0.000002

Table 9B

Estimation Sensitivity Analysis 2SLS:

Imports for Developing Countries

Instrument specification: C LT DLT LGSLT LGDP LGSLGDP LE LGSLE LFDI LINF LM

Constant added to instrument list

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-2.482249	0.686979	-3.613283	0.0003
Log Tariffs	-0.148947	0.022873	-6.512009	0.0000
D log Tariffs	0.071917	0.031637	2.273225	0.0233
Log GDP	0.984199	0.010580	93.02462	0.0000
Log E	-0.012493	0.114875	-0.108757	0.9134
Log FDI	0.077251	0.066929	1.154222	0.2487
Log Inflation Rate	0.124662	0.037062	3.363646	0.0008
Log Broad Money	0.174220	0.025990	6.703316	0.0000

R^2	0.926479	Mean dependent var	15.947
Adjusted R^2	0.925881	SD dependent var	2.1654
SE of regression	0.589545	Sum squared resid	299.25
F-statistic	1549.987	Durbin-Watson stat	0.1334
Prob(F-statistic)	0.000000	Second-Stage SSR	299.25
Instrument rank	10	Prob(J-statistic)	0.0858

Note. Table 9A. Response variable: Log Imports. Estimation method: Two-Stage Least Squares. Sample period 1994-2018. Cross-sections included = 37. *N* = 919. *D* = first Difference. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Note. Table 9B. Response variable: Log Imports. Estimation method: Two-Stage Least Squares. Sample period 1994-2018. Cross-sections included = 35. *N* = 869. *D* = first Difference. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Table 10A

Lagged First Difference (LFD) Analysis: Imports for Developed Countries

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	0.004812	0.005627	0.855120	0.3927
D lags log Tariffs	-0.002598	0.014595	-0.178017	0.8588
D lags log GDP	1.936195	0.105562	18.34177	0.0000
D lags log E	0.619766	0.059570	10.40398	0.0000
D lags log FDI	0.023290	0.021824	1.067202	0.2862
D lags log INF	0.003148	0.043224	0.072827	0.9420
D lags log M	0.028644	0.041383	0.692178	0.4890
R^2	0.390103	Mean dependent var		0.064416
Adjusted R^2	0.385939	SD dependent var		0.134405
SE of regression	0.105322	Akaike info criterion		-1.65572
Sum squared resid	9.750527	Schwarz criterion		-1.61790
Log likelihood	740.4827	Hannan-Quinn criter.		-1.64126
F-statistic	93.70431	Durbin-Watson stat		1.821813
Prob(F-statistic)	0.000000			

Table 10B

Lagged First Difference (LFD) Analysis: Imports for Developing Countries

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	0.003067	0.011356	0.270090	0.7872
D lags log Tariffs	-0.024386	0.011132	-2.190640	0.0288
D lags log GDP	1.190446	0.138634	8.586990	0.0000
D lags log E	0.026853	0.068904	0.389715	0.6968
D lags log FDI	0.029804	0.028957	1.029246	0.3037
D lags log INF	0.094263	0.029476	3.197940	0.0014
D lags log M	0.175426	0.048765	3.597375	0.0003
R^2	0.122080	Mean dependent var		0.086250
Adjusted R^2	0.115687	SD dependent var		0.233554
SE of regression	0.219630	Akaike info criterion		-0.185359
Sum squared resid	39.74747	Schwarz criterion		-0.145578
Log likelihood	84.01686	Hannan-Quinn criter.		-0.170105
F-statistic	19.09701	Durbin-Watson stat		1.959936
Prob(F-statistic)	0.000000			

Note. Table 10A. Response variable: first Difference Log Imports. Estimation method: Panel Least Squares. Sample period 1995-2018. Cross-sections included = 37. *N* = 886. *D* = first Difference. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments. *INF* = Inflation rate. *M* = Broad money.

Note. Table 10B. Response variable: first Difference Log Imports. Estimation method: Panel Least Squares. Sample period 1995-2018. Cross-sections included = 35. *N* = 831. *D* = first Difference. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments. *INF* = Inflation rate. *M* = Broad money.

Table 10C

Anderson and Hsiao Lagged First Difference (LFD)
Lagged Dependent Variable (LDV)
Instrumental Variable (IV) Analysis:
Imports for Developed Countries

Instrument specification: C DLGS2LIMP DLGSLT DLGSLGDP DLGSLE DLGSLFDI DLGSLINF DLGSLM

Constant added to instrument list

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	0.002697	0.005840	0.461770	0.6444
D lags log Tariffs	-0.006957	0.015836	-0.439292	0.6606
D lags2 log IM	0.044396	0.027126	1.636647	0.1021
D lags log GDP	1.930307	0.108514	17.78851	0.0000
D lags log E	0.610841	0.061057	10.00446	0.0000
D lags log FDI	0.022378	0.022094	1.012857	0.3114
D lags log INF	0.028481	0.045483	0.626182	0.5314
D lags log M	0.009797	0.043207	0.226759	0.8207

R^2	0.389235	Mean dependent var	0.062735
Adjusted R^2	0.384163	SD dependent var	0.135744
SE of regression	0.106526	Sum squared resid	9.566156
F-statistic	76.74806	Durbin-Watson stat	1.786455
Prob(F-statistic)	0.000000	Second-Stage SSR	9.566156
Instrument rank	8		

Table 10D

Anderson and Hsiao Lagged First Difference (LFD)
Lagged Dependent Variable (LDV)
Instrumental Variable (IV) Analysis:
Imports for Developing Countries

Instrument specification: C DLGS2LIMP DLGSLT DLGSLGDP DLGSLE DLGSLFDI DLGSLINF DLGSLM

Constant added to instrument list

Variable	Coefficient	*SE*	t-Statistic	*P*
Intercept	-0.005916	0.012197	-0.485011	0.6278
D lags log Tariffs	-0.023269	0.011766	-1.977704	0.0483
D lags2 log IM	-0.061813	0.034760	-1.778272	0.0757
D lags log GDP	1.320624	0.144699	9.126707	0.0000
D lags log E	0.100560	0.073972	1.359425	0.1744
D lags log FDI	0.032699	0.028431	1.150096	0.2505
D lags log INF	0.178623	0.048902	3.652661	0.0003
D lags log M	0.150978	0.061680	2.447756	0.0146

R^2	0.129083	Mean dependent var	0.077560
Adjusted R^2	0.121414	SD dependent var	0.228381
SE of regression	0.214068	Sum squared resid	36.43085
F-statistic	16.83299	Durbin-Watson stat	1.932069
Prob(F-statistic)	0.000000	Second-Stage SSR	36.43085
Instrument rank	8		

Note. Table 10C. Response variable: first Difference Log Imports. Estimation method: Two-Stage Least Squares. Sample period 1996-2018. Cross-sections included = 37. *N* = 851. *D* = first Difference. *Lags2* = second order lags. *IM* = Imports. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments. *INF* = Inflation rate. *M* = Broad money.

Note. Table 10D. Response variable: first Difference Log Imports. Estimation method: Two-Stage Least Squares. Sample period 1996-2018. Cross-sections included = 35. *N* = 803. *D* = first Difference. *Lags2* = second order lags. *IM* = Imports. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments. *INF* = Inflation rate. *M* = Broad money.

Table 10E

Arellano and Bond (AB) LFD LDV IV Generalized Method of Moments (GMM) Analysis: Imports for Developed Countries

White period (period correlation) instrument weighting matrix
White period (cross-section cluster) standard errors & covariance (d.f. corrected)

Standard error and t-statistic probabilities adjusted for clustering
Instrument specification: @DYN(LIMP,-2) LGSLT LGSLGDP LGSLE LGSLFDI LGSLINF LGSLM

Constant added to instrument list

Variable	Coefficient	*SE*	t-Statistic	*P*
Log Imports(-1)	0.692070	0.074800	9.252334	0.0000
Log Imports(-2)	-0.272680	0.021141	-12.89795	0.0000
Log Imports(-3)	0.178613	0.058237	3.067024	0.0041
Log Imports(-4)	-0.190780	0.016283	-11.71675	0.0000
Log Imports(-5)	-0.073342	0.033932	-2.161435	0.0374
Log Tariffs	-0.118082	0.030904	-3.820920	0.0005
Log GDP	0.785576	0.126565	6.206875	0.0000
Log E	0.250608	0.058126	4.311464	0.0001
Log FDI	0.044965	0.060765	0.739991	0.4641
Log Inflation Rate	-0.159773	0.057931	-2.758012	0.0091
Log Broad Money	0.240542	0.049340	4.875195	0.0000

Effects Specification

Cross-section fixed (first differences)

Mean dependent var	0.060904	SD dependent var	0.134013
SE of regression	0.135226	Sum squared resid	13.25734
J-statistic	35.05357	Instrument rank	37
Prob(J-statistic)	0.110495		

Table 10F

Arellano and Bond (AB) Serial Correlation Test: Developed Countries

Equation: ABGMMFDL5

Sample: 1993 2018

N: 736

Test order	m-Statistic	rho	*SE*(rho)	*P*
AR(1)	NA	-5.801645	NA	NA
AR(2)	0.306188	0.353953	1.155997	0.7595

Note. Table 10E. Response variable: Log Imports. Estimation method: Panel Generalized Method of Moments. Sample period 1999-2018. Cross-sections included = 37. *N* = 736. *Log Imports (-1), (-2), (-3), (-4), (-5)* = Previous five lagged dependent variables (LDV) panel waves. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Note. Table 10F. Estimation method: Arellano-Bond Serial Correlation Test. Sample period 1993-2018. *N* = 736.

Table 10G

Arellano and Bond (AB) LFD LDV IV Generalized Method of Moments (GMM) Analysis: Imports for Developing Countries

White period (period correlation) instrument weighting matrix
White period (cross-section cluster) standard errors & covariance (d.f. corrected)

Standard error and t-statistic probabilities adjusted for clustering
Instrument specification: @DYN(LIMP,-2) LGSLT LGSLGDP LGSLE LGSLFDI LGSLINF LGSLM

Constant added to instrument list

Variable	Coefficient	*SE*	t-Statistic	*P*
Log Imports(-1)	0.677763	0.029783	22.75652	0.0000
Log Tariffs	-0.047050	0.008539	-5.510286	0.0000
Log GDP	0.408532	0.077402	5.278036	0.0000
Log E	-0.267113	0.044495	-6.003213	0.0000
Log FDI	0.075524	0.023753	3.179594	0.0031
Log Inflation Rate	-0.029470	0.011127	-2.648379	0.0122
Log Broad Money	0.024437	0.016554	1.476237	0.1491

Effects Specification

Cross-section fixed (first differences)

Mean dependent var	0.074583	SD dependent var	0.221344
SE of regression	0.266255	Sum squared resid	58.41482
J-statistic	29.10923	Instrument rank	35
Prob(J-statistic)	0.407003		

Table 10H

Arellano and Bond (AB) Serial Correlation Test: Developing Countries:

Equation: ABGMMFDL1

Sample: 1993 2018

N: 735

Test order	m-Statistic	rho	*SE*(rho)	*P*
AR(1)	-0.001635	-29.076939	17782.454845	0.9987
AR(2)	-0.000021	-0.274832	12991.131093	1.0000

Note. Table 10G. Response variable: Log Imports. Estimation method: Panel Generalized Method of Moments. Sample period 1995-2018. Cross-sections included = 35. *N* = 831. *Log Imports (-1)* = Previous LDV panel wave. *GDP* = Gross domestic product. *E* = Real effective exchange rate. *FDI* = Foreign direct investments.

Note. Table 10H. Estimation method: Arellano-Bond Serial Correlation Test. Sample period 1993-2018. *N* = 735.

Limitations

1. Substitution bias. High tariff goods will probably not be imported, leading to underemphasizing of the actual tariff rate (Ostry and Rose 1992).
2. Bias from the effect of non-tariff barriers (NTBs). NTBs affect the import-level as well, making the tariff rate non or weakly exogenous (Ostry and Rose 1992).
3. Changes in tariffs in one country could be highly correlated with foreign tariff rates. For example, as a result of retaliatory measures (Ostry and Rose 1992).
4. Limitations of data collection. For example, including import duties as an explanatory variable and interest rates as control variable was not possible.
5. Limitation in adapting the econometric system for maximum likelihood (ML) estimation within a structural equation modeling (SEM) framework, the ML-SEM method of estimation (Moral-Benito, Allison, and Williams 2019).