University of York

MERCOSUR AND THE IMPACT OF TRADE FLOWS IN BRAZIL: A GRAVITY MODEL APPROACH

DISSERTATION

Submitted in fulfilment of the requirement for the

Master in Economics

By

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York, UK

September, 2021

Word count: 8.000

I declare that this thesis is a presentation of original work, and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References. (University of York)

AKNOWLEDGEMENTS

To my parents, to whom I dedicate my safe, my foundation, my inspiration, for believing in my potential and trust in me. There are no words to thank them for all their dedication, affection and love dedicated to me. Thank you for being by my side at all times. This achievement would be worthless if it weren't for you, Hertha and Marcos, my life.

I am profoundly grateful to Professor Thilo Huning, my supervisor, who with great enthusiasm always helped me during this trajectory, passing on his knowledge with great confidence, believing in my success. With a lot of affection, patience and determination, he helped me to reach my goals. To you, professor, I will be eternally grateful for believing in me.

To all the University of York Professors who, in some way, contributed to my training.

Abstract

This study analyses the impact of trade structures in a framework of the gravity equation model focusing on Brazil's bilateral trade flows after entering into Mercosur (Mercado Común del Sur) in 1994 over the period 1990-2020. The following major trade partners were selected to carry out an estimation of the trade bilateral flows: Argentina, Bolivia, Canada, Chile, China, Germany, Japan, Mexico, Netherlands, Paraguay, Singapore, Spain and the United States. The measure of trade structure is constructed by the degree of trade Log-linearized a gravity model using panel data. Estimations suggest that trade can be explained by the gravity model, where distance and GDP impact trade. These results demonstrate that gravity model can explain the pattern of bloc' trade to some degree. The study nonetheless identified that being part of a free trade agreement increased the trade flows between Brazil and partners in the block.

Key Words: Trade, Brazil, Gravity model, Mercosur.

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Abbreviations

CNI – National confederation of industry
DOTS – Direction of Trade and Statistics
EEC – European Economic Community
EFTA – European Free Trade Agreement
Mercosur – Mercado Común del Sur
WTO – World Trade Organization
IMF – International Monetary Fund
GDP – Gross domestic product
GATT – General Agreement of Tariffs and Trade

INTRODUCTION

The trade and economic impact generated by the creation and development of Mercosur (Mercado Común del Sur), a South American trade bloc is hotly debated and researched among scholars. It is still unsettled to which extent and even if the bloc's members benefit from the system. According to Sam Laird (1997) the bloc was established by the Treaty of Asunción in 1991 to promote trade and integration between Brazil, Argentina, Uruguay and Paraguay. The goal was to establish a common market that would allow the free movement of commodities, services, capital, and labour.

A famous paper written by Batista (1994) was one of the first to examine the formation of Mercosur and how Brazil should cope with it on commercial, political, and economic grounds. One of his ideas was that Brazil should be regarded as a global trader with interests that extend beyond commodities trade, particularly financial flows.

Dupeyron (2009) presented a historical study of Mercosur formation, beginning with discussions on regional economic integration problems between Brazil and Argentina in the second half of the 1980s.

The effectiveness of Mercosur in increasing commerce between the countries participating is still an unresolved empirical topic. Most publications address the issue on a nation-by-country basis, neglecting regional variations within each country. According to Sa Porto (2002a), while commerce between Brazilian states and Mercosur nations increased between 1990 and 1998, the impact was not uniform throughout Brazilian states. Sa Porto and Canuto (2002, 2004) expanded on that research (see also Sa Porto, 2002b), demonstrating that the effects of Mercosur on Brazilian state commerce are significant.

Sa Porto and Canuto (2002, 2004) expanded on that research (see also Sa Porto, 2002b), demonstrating that the effects of Mercosur on Brazilian state commerce are significant. Regardless of the model employed, flows remain resilient. According to Azzoni and Sa Porto

(2007), Mercosur had a beneficial influence on Brazilian exports. Baumann provides a more recent entry evaluation (2011).

The current Brazilian scenario demonstrates economic-political volatility, which has strained Brazil's political connections with the world's major markets—persisting in the contraction of the Brazilian economy. Since they are unfriendly to trade talks, mainly due to tariff barriers, which are typically the first significant restricting factor for selling Brazilian products abroad (Souza, 2015).

Brazil's exclusion from global production networks, and the resultant density of domestic value, can only be explained partly by its geographical and institutional distance. From major economic centres, as can other Latin American Countries nations. However, it is also a product of previous and contemporary Trade and local content policy choices (World Bank 2014, Canuto 2014).

This dissertation aims to analyse the determinants of trade flows between Brazil and Countries from 1990 to 2020, attempting to distinguish when possible a comparative analysis between the major partners and comparing when Brazil joined Mercosur. Since the model is a gravitational model I built manually my own dataset picking the data from the Direction of Trade Statistics (DOTS), which provides the values of imports and exports disaggregated. Also, the other variables that I used as explanatory variables were taken from the World Bank.

This dissertation is divided into six parts, including this introduction as part one. The introduction presents the scope and object of the study. It identifies the research question, which investigates the trade bilateral flows between Brazil and their 13 major partners juxtaposing to Brazil’s integration to Mercosur. The second chapter introduces the literature review, where briefly I comment on the gravity model and trade agreements. In Chapter three, I described the gravity model and the methodology that is going to be used to estimate the models. Chapter 5 refers to the analysis of the model estimated. Finally, the chapter six develops the conclusion of the paper.

2 LITERATURETURE REVIEW

According to Sarquis (2011), commercial and financial relations were still limited until the 20th century. "Between 1913 and 1950, the world economy expanded considerably more slowly than in 1913-1970, global commerce expanded considerably slower than global income, and regional inequality developed significantly."

Around three decades after World War II, the economy worldwide began to flourish with an increase in trade and direct investment that outpaced the global output rate of expansion. The expansion was driven by lower transportation and communication costs, as well as global trade barrier reductions. Nonetheless, globalisation occurred, and as a result, international trade grew. Outsourcing of productive activities and knowledge of new goods and cultures from other nations has increased and continues to drive international trade.

According to Cavusgil (2010), an increasing number of governments have introduced aggressive policies targeted at building competitive advantage in recent decades. The growth of world-class economic sectors and affluent geographical locations has resulted in firms acquiring benefits.

The World Trade Organization (WTO) arose as a result of the increased flow of commerce. As a result, other organisations arose to control international commerce, for example, to strengthen the market and globalisation among American nations, Mercosur was established, and according to Gill and Lamberti (2016, p.2), to promote the free circulation of services and factors of productions between countries through the elimination of restrictions and the establishment of an external tariff and the adoption of a common commerce policy.

Brazil, Argentina, Paraguay, and Uruguay are currently members of Mercosur. Brazil's relationship with Mercosur is critical for the country's economy, given that, as a result of globalisation, foreign Trade has grown in strength. However, since each country can generate or buy whatever it wants, the Mercosur relationship is crucial for its economy. (World Trade Organization, 2019)

The President of the Republic sets foreign policy priorities. Every year, during the United Nations General Assembly, generally in September, the President of the Republic or the Minister of Foreign Affairs speaks to present or reiterate the Brazilian government's issues of more excellent governance. (LANDAU, 2003).

According to Almeida (2010), when corporations wish to grow their business by looking for new markets in other countries, they must follow a set of rules and laws to be permitted to export. This means they must have the product and look for a new market and settle in the country.

As a result, when it comes to internationalisation, export is an important model to use. Second Cavusgil (2010), exportation is a type of entry that aims to sell a particular product that has been manufactured in one country and moved to another. Because selling to a foreign market differs from selling to a local market in terms of process and method, it must establish a target market with permission to acquire the goods.

2.2 The Impact of Free Trade Agreements in Gravitational Approaches

When it comes to understanding what drives international trade, the gravity model has become a standard approach. Beginning with Tinbergen (1962), the gravity model has resulted in literally hundreds of articles and working papers spanning a wide range of geographies, time periods, and industries. Disdier and Head (2008), for example, include 1,052 precise estimates in 78 publications in their meta-analysis of the influence of distance on commerce (KALAMOVA, 2012).

The gravity model is a valuable resource for academics interested in the impacts of trade policy. It serves as a suitable testing ground for evaluating the trade effects of various approaches. Gravity models now frequently incorporate factors that go well beyond those imposed at the border, like tariffs, to account for behind-the-border obstacles as well. As represented in the gravity framework, nations' regulatory measures and underlying political and institutional features have been proven to impact Trade. The extensive empirical literature on trade using the gravity equation reveals a few key facts: i) trade volume decreases substantially with increasing distance and trade costs; ii) trade costs are high; iii) national boundaries reduce trade

volumes; and iv) trade liberalising agreements have a contradictory effect on trade (KALAMOVE, 2012).

Whereas the gravity model is an appealing platform for applied international trade scholars, it does have certain drawbacks. The most crucial of these is deciding which model to estimate (specification). For example, given a time series, one can select many years and compare different cross-sections, assessing how the predicted coefficients develop with time. Despite its strong R-squared, this technique underestimates trade volume between pairings of nations with high volumes of Trade and overestimates it between pairs of countries with low volumes of Trade. This leads to a heterogeneity bias, which may be addressed by eliminating the gravity model's assumption of a single intercept for all trade flows between nations (Cheng and Wall 1999).

Gravity models have always been built primarily on intuitive notions about which variables are likely to impact Trade. Nevertheless, various "hypothetical" gravity models had recently been constructed, employing different micro-founded world trade theories to develop gravity-like models. Likewise, Deardorff (1995) contended that an equation resembling gravity must arise from "just about every rational trade model."

Since the early 1970s, the expansion of gravitational techniques to assessing the impact of free trade agreements on commerce has been accompanied by a change in the methodologies used to evaluate it. The inclusion of a second and subsequently a third regional dummy variable in a gravity equation enhanced both the interpretation of data and the impacts of trade formation and diversion.

The first set of estimates dealing with big integrated groupings utilises just one regional dummy (£)/) to evaluate commerce between its member nations. Overall, they show a favourable and substantial effect.

Using similar approach to those used by J. Tinbergen (1962) and H. Linnemann (1966) in conjunction with cross-sectional data (1961), N. Aitken (1973) shows that Trade between EEC members (European Economic Community) is five times higher than it would have been had the EEC not been formed; in the case of EFTA, this multiplicative factor of intra-bloc Trade is only 1.2. (European Free Trade Association).

ording to J. Frankel, E. Stein, and S. Wei (1995), the EEC result was somewhat higher in 1990. Bergstrand (1985) estimates that intra-EFTA commerce was multiplied by 2, whereas intra-EEC Trade was multiplied by 1.3 in 1965. Accordenaway (2000) obtains the same multiplicative factor as Bergstrand for the European Community, but the 1993 and utilising panel data with country-specific effects. L. Fontagn and S.Zignago (2007) achieved a value of 2.4 for 1976-2000 using the same technique.

The results for EFTA in the latter two studies differ considerably, with values of 1.2 and 2.7, respectively, whilst the estimate by M. Bussiere, J. Fidrmuc, and B. Schnatz (2005), utilises particular effects panel data, yields an intermediate result. NAFTA oscillates between relatively modest (I. Cheng and H. Wall, 2005; Bussiere et al., 2005) and significant (Fontagn and Zignago, 2007) stimulus for commerce between Canada, the United States, and Mexico.

Additionally, the studies that have previously been noted as employing panel data, including those on various Latin American groups, show the beneficial effect that Mercosur and the Andean community have on intra-bloc Trade with varied degrees of intensity. For intra-ACN commerce, C. Carrillo and C. Li (2004) discover a multiplicative factor of around 1.6. Differences in results between writers are caused by different research periods and the presence or absence of explanatory factors such as "relative distance," which is crucial for the analysis.

2.2 Protectionism, General Agreement on Tariffs and Trades (GATT) and Trade Barriers

According to Oliveira (2017), tariff barriers are regulated by the General Agreement on Tariffs and Trade (GATT), established in 1947 to consolidate and maintain market balance through customs policies between signatories.

According to what was imposed in 1994, the GATT's essential principles attempted to maintain a balance and a minimum of equity between states, ensuring that exchanges supported the projection of the international economy, centred on rules of transparency, equality, and methods that provide fair competition, as well as avoiding restrictive measures that lack common sense, allowing emerging countries to access new markets (OLIVEIRA, 2017).

The main impediment for exportation of products is the tariff, which is considered a direct impediment that affects the transaction of barriers between countries, i.e., they are protectionist measures imposed by numerous countries to benefit domestic producers, in comparison to foreign competitors in specific categories of products or services, imported products are taxed, affecting the final price of the goods, perhaps discouraging consumers and leading them to seek out domestic and cheaper alternatives.

Customs fees are another protectionist strategy used in exports, in which goods are taxed upon entering the country of destination, such as in Brazil, where products imported into the country are subject to payment of the import tax (IPI) when they are industrialised, in addition to PIS, COFINS, and ICMS (ABRACOMEX, 2018).

In the case of exports, tax exemption incentives and non-taxed exported items promote Brazilian exports, assisting entrepreneurs in exports, making them more competitive in overseas Trade, resulting in business expansion and diversification of sales destinations. (ABRACOMEX, 2018).

This was only possible because of globalisation, which reduced distances and facilitated consumption between distant countries. Nevertheless, it is much simpler to make purchases from one country to another, with the product arriving at one's doorstep. Trade stimulates countries that invest in low-cost manufacturing, such as China, a significant exporter of various goods (SOUTO, 2015).

Economic globalisation, on the other hand, has both benefits and drawbacks. According to this author, Brazil's economy is now open to the international market, selling and buying items from many countries. Access to overseas things, which are often cheaper or better than those made in Brazil, would be one of the advantages (SOUTO, 2015).

On the other hand, global crises immediately affect Brazil because its economy is so intertwined with the worldwide financial system. Foreign investors begin to invest in Brazil, primarily through the stock exchange, bringing capital in to the country. Disadvantages are products that enter the Brazilian market at low prices, producing unfair competition with

domestic products, forcing enterprises to fail, and resulting in job losses. This is currently the case with a large number of Chinese goods (SOUTO, 2015).

To gain a favourable position in the worldwide market, Brazil must first enhance its modes of transportation, which cause significant damage to exports. Because the poor quality of Brazilian roads causes damage to both trucks, the primary method of product transportation, and the items themselves, which are damaged along the way. In addition, the most expensive modal, the waterway and railroad models are preferred. Brazil's current low costs lack the essential structure, necessitating investment in studies and technology to improve them. (SOUTO, 2015).

Non-tariff barriers, which according to Garrido (2010), are those connected to the payment of taxes on exports or imports, are among the principal obstacles imposed and posing a challenge to Brazilian exports to North America and Europe. They are related to the necessity to comply with technical requirements, such as rules or administrative requirements that impose pre-determined quotas on exports.

According to Cavalcante (2010), the fundamental goal of technical standards is to "create technical standards or laws with criteria about the quality and safety of items that circulate internally." As a result, importing foreign goods that do not satisfy the limits outlined in such agreements will be more difficult.

Brazil's problems in exporting its food products to the European Union market are due to quality and animal health standards, despite the European Union adopting the principle of regionalization (enabling the country to export even if there is a disease outbreak in a specific area). European subsidies, used on a massive scale by the blocs' nations, create an artificial scenario for their exports, directly influencing the exports of countries with Brazil. (SILVA, TRINCHES AND MALAFAIA, 2011).

Trade policies in developing countries are centred on tariff barriers, but non-tariff barriers are more commonly used in developed countries since they have higher trade restriction authority, diverting trade flows. These countries continue to offer large amounts of subsidies, which is unusual behaviour in developing countries (BENDER FILHO, 2006).

The tax system is inextricably linked to export-related and domestic-market-oriented economic activity. The National Tax Code (CTN) contains the tax disciplines and regulations. The export tax is established by Decree 1578/77.

According to the CNI (National Confederation of Industry), inadequate infrastructure quality, transportation and logistical issues are among the three significant impediments for Brazil's exports to adjacent countries, trailed only by barriers to import taxes in the countries of destination.

3 METHODOLOGY

The gravity model used to analyse international commerce flows is similar to Newton's law, which relates the gravitational attraction between two objects to their masses and distance apart. By the same token, according to the gravity approach, bilateral commerce between two areas (countries) is directly connected to their incomes (GDP, GNP) and inversely related to their distance.

A famous paper by McCallum (1995) studied trade flows data between the US-Canada and found that borders have a decisive effect on trade patterns. The model estimated the impact of border effects on Canada and the United States.

Following the equation below, we have on the left-hand side of the equation the log of X^{ij} That is the exports from province I to j; β_1 that is the bilateral flow; and log $Y^i$and log $Y^j$are the gravity terms of the effect size; the indicator δ^{ij} is characterised by a dummy variable between two Canadian provinces. If γ is positive, the trade flows would be more significant, controlling for the other variables.

$$lnX^{ij} = \alpha + \beta_1 lnY^i + \beta_2 \ln Y^j + \gamma\delta^{ij} + \rho lnd^{ij} + \varepsilon_{ij} \quad (1)$$

Where,

X^{ij} = exports from province/ state I to j,

Y^i = GDP of the province/state I;

δ^{ij} is an indicator variable that equals Canadian and zeroes otherwise;

d^{ij} is the distance between any two provinces or states.

This gravity equation is regarded as one of the most stable and reliable empirical relationships in economics (T. Mayer, 2001). It was initially criticized, as it represents a basic intuitive drawn from physical principles of attraction and repulsion and lacks empirical theoretical basis. Krugman (1980) proposes a solution to this problem by including transportation costs into monopolistic competition model, resulting in a demand equation near the gravity equation. (Sunanda, 2010)

The structural gravity model that is known as Armeto model is similar to the Krugman's model, where each county produces several varieties and countries differ in terms of the number of combinations they make and their type of varaities to their produce. However, they assume perfect competition, so the standard utility function and the utility in a country j equals the summation across all origins I and the varieties that they produce index by k of your consumption of a good k variety k from I to j to the power of $(\sigma - 1)/\sigma$.

Main assumptions

$$U^j = \Sigma_{i=1}^{c} \Sigma_{k=1}^{N^i} \left(c_k^{ij}\right)^{(\sigma-1)/\sigma} \quad (2)$$

c_k^{ij} = aggregate consumption of variety K from I to J.

$p_k^{ij} = p^{ij}$ all varieties from one country have the same price.

Also, some kind of assumptions that all varieties that come from a particular country are sold at the same price, so this means that the agent will consume the same amount for all the types that he will import from a country. So, the utility simply becomes c_k^{ij} quantity consumed for any variety from I to j to the power of $\sigma - 1)/\sigma$ times the number of varieties you are importing from country I N^i.

$$U^j = \Sigma_{i=1}^{c} N^i \left(c_k^{ij}\right)^{(\sigma-1)/\sigma} \quad (3)$$

Iceberg trade cost $\tau^{ij} > 1, \tau^{ii} = 1$

$p^{ij} = \tau^{ij} p^{i}$

Aggregate demand $c^{ij} = \left(\frac{p^{ij}}{p^{j}}\right)^{-\sigma} \left(\frac{Y^{j}}{p^{j}}\right)$

Price Index $p^{j} = \left(\Sigma_{i=1}^{c} N^{i} \left(p^{ij}\right)^{1-\sigma}\right)^{1/(1-\sigma)}$

Exports $X^{ij} = N^{i} p^{ij} c^{ij} = N^{i} P^{i}$

Anderson and Vanwincoop (2003) found out a method to estimate the well know Mccallum border puzzle. Implicit solution for price indexes is equal to indexes of multilateral resistance.

Since it incorporates variables – the multilateral resistance terms – that are excluded from the intuitive model, this model has important consequences for the estimate approach used. Furthermore, because these variables do not correspond to any price indices gathered by national statistics organisations, they are unobservable. As a result, even though these parameters cannot be explicitly incorporated in the model as data points, we require an estimating technique that allows us to account for the impacts of inner and outward multilateral resistance. So, let's look at two methods for doing so: fixed effects estimates and Baier and Bergstrand's approximation methodology (2009).

$(\tilde{p}^{j})\text{^}\, 1-\alpha \quad = \Sigma_{i=1}^{c} s^{i} (\tau^{ij} / \tilde{p}^{i})\text{^}1-\sigma$

Where $s^{i} = Y^{i}/Y^{w}$

The price index in country j to the power of 1-σ is a sum of the other price index of all nations, and we haves^{i} that is GDP share. The Gravity Model of Trade is an empirical model that describes the general partner of how countries Trade. The model represents Trade between country i and j. We expect big economies to trade more, which means that bilateral Trade between two countries is proportional to their GDP and is inversely proportional to their distance. On the right-hand side, we have A, a normalising constant, mostly to calculate the

model. However, the critical part is the GDP of country I and country j, which is taken to the power of alfa. Similarly, in the denominator, we have the geographical distance between countries

$$TRADE_{ij} = A * \frac{(Y_i * Y_J)\alpha}{D_{ij}^{\beta}} \quad (4)$$

$TRADE_{ij}$ the Trade between countries I and j

Y_i GDP of the country I

Y_j GDP of country j

D_{ij} the geographical distance between countries I and j

Head and Hies (2001) found out that it costs 48% more to export a good than to sell it domestically on average. Indeed, distance means trade costs and is characterised by policy barriers, tariffs and non-tariff measures. Also, some variables like transportation costs, shipping, insurance, transaction costs, currency barriers, and language barriers. To estimate how significant are these trade costs

Using model (1) as its basis and giving a temporal dimension to most of the variables, the equation becomes:

The Model transformation of the gravity equation:

$$\ln(\text{TRADEij}) = \ln(\text{A}) + \alpha\ln(Y_i * Y_j) - \beta lnD_{ij} \quad (5)$$

Adding stochastic component we obtain:

$$\text{Ln (TRADEij)} = \ln(\text{A}) + \alpha\ln(\text{Yi* Yj}) - \beta lnD_{ij} + \in_{ij} \quad (6)$$

Within this framework, we can test the impact of other variables without worrying about omitted variable bias:

$$\ln(TRADEij) = \ln(A) + \alpha\ln(Yi^* Yj) - \beta lnD_{ij} + \gamma Xij + \in_{ij} \quad (7)$$

Using model (1) as its basis and giving a temporal dimension to most of the variables, the equation becomes:

$$\ln(TRADEij) = \alpha + \beta_1\ln(Y_i * Y_j) + \beta_2 lnD_{ij} + \beta_3 ln + \beta_4 lnKapEndowement + \beta_5 lnLand\ Endowement + \beta_6 SCALE + \beta_7 FTAdummy + \beta_8 Exchange \quad (8)$$

The dependent variable in the study is a natural logarithm of the sum of annual real exports and imports (in 2010 US dollars) between country I and j averaged over the 1990-2020 period:

$$TRADE_{ij} = \ln IMPORT_{ijt} + lnEXPORT_{ijt}$$

There are five types of independent variables that were included in the study. Of course, certain variables may belong to more than one category, thus the split is rather arbitrary. Nonetheless, it is a useful tool for arranging the regressors. Gravity variables make up the first group. The group begins with a natural logarithm of Distance and a natural logarithm of real GDP products and population of two nations averaged during 1990-2020.

Variables:

LNTRADE - natural logarithm of bilateral Trade
LNRGDPPROD - natural logarithm of real GDP
lnDistance - natural logarithm of geographical distance
FTA dummy- average number of years both countries spent in the block region Mercosul.
SCALE - natural log of the product of population of two countries in the case Brazil and trade partner
Kap Endowement - natural log of ratio of capital per worker ration in Brazil and partner (I devided the maximum value by the minimum value, depending who has the maximum and I took the natural log of this)
Land Endowement - natural log of land per worker ratio in Brazil and partner

EXCH exchange rate volatility – two proxy bilateral exchange rate between two countries and I calculated its variance and divided by mean and I obtained the coefficient of variation.

The suggested strategy is to estimate Brazil's trade flows, controlling whether or not a country is part of Mercosur or not. To calculate the effects of being in the Mercosur, I looked at a time variation (panel data) to compare the impact of entering the Mercosur with the values before entering.

Where,

Table 1 - Descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
lnTRADE	403	3.649	0.538	2.231	4.88
lnDistance	403	3.78	0.379	3.09	4.24
lnGDP	403	23.796	0.948	21.352	25.601
SCALE	403	36.601	1.566	33.849	40.236
Kap endowement	403	7284963.8	3412678	0.016	12116582
Land endowement	403	1.74	1.592	0.003	6.073
FTA dummy	403	0.112	0.315	0	1
Exchange	403	2.595	2.601	0.007	6.17
Countries	403	7	3.746	1	13

Source: Author's calculation.

4 Data

I used International Monetary Fund (IMF)[1] trade statistics for trade-in, bilateral trade flows. I analysed the adverse effect on trade volume between Brazil and countries outside the Mercosur; the period covered was from 1990 to 2020. Since I wanted to explore Brazil's international Trade I choose it as a counterpart country and the indicators for exports and imports. Gravity model is a multiplicative model so, to estimate the Trade I took the log form and becomes more convenient for estimation.

[1] https://data.imf.org/?sk=9D6028D4-F14A-464C-A2F2-59B2CD424B85&sId=1390030341854

Also, I collected data from the World Bank[2] concerning the GDP, population variable for the countries. The variable distance was taken from google maps. The distance matters and the relative importance of the trade partner, so if we discuss more significant economies, they have an advantage in terms of better infrastructure compared to small economies.

It is worth noting that the econometric analysis with respect to the gravity model was carried out using the computer and statistical software STATA (STATA, 2017).

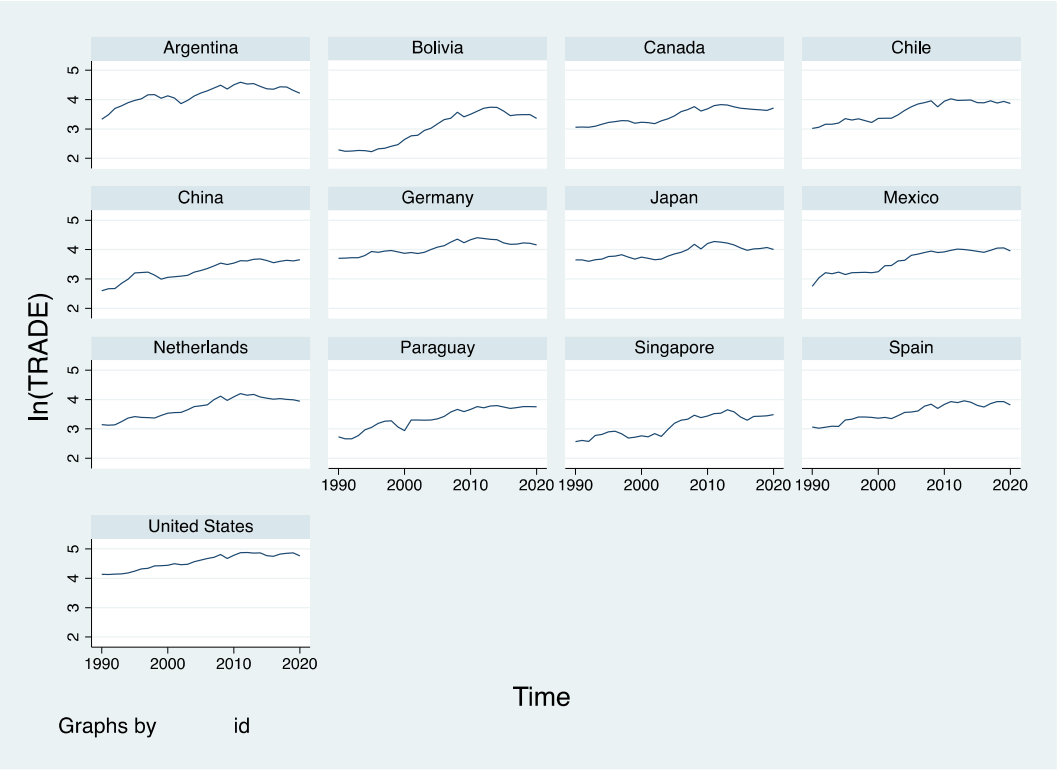
5 ECONOMETRIC ANALYSIS

Analysis in this section will be based on data from the IMF database and World Bank, seeking to understand the Trade flows between Brazil and their significant partners. Also, I will aggregate the countries between Mercosur members and non-members. The level of detail was dependent on what the data allows me to do. The characteristics I considered were (Trade, Distance, GDP, Country and Exchange rate.) Furthermore, I analysed the impact of entering the Mercosur (those who joint in1994) and compare with other countries that are not part of it.

Figure 1 reports the panel data line plot for the dependent variable. The dependent variable "lnTrade" is the output (value added) and the countries' explanatory variables. The data (all in logarithms) represents the sum of trade flows between Brazil and the major trade partners from 1990 through 2020. Although some countries have a growing or declining trade over time, this is by no means of a general characteristics of the data.

[2] https://databank.worldbank.org/home.aspx

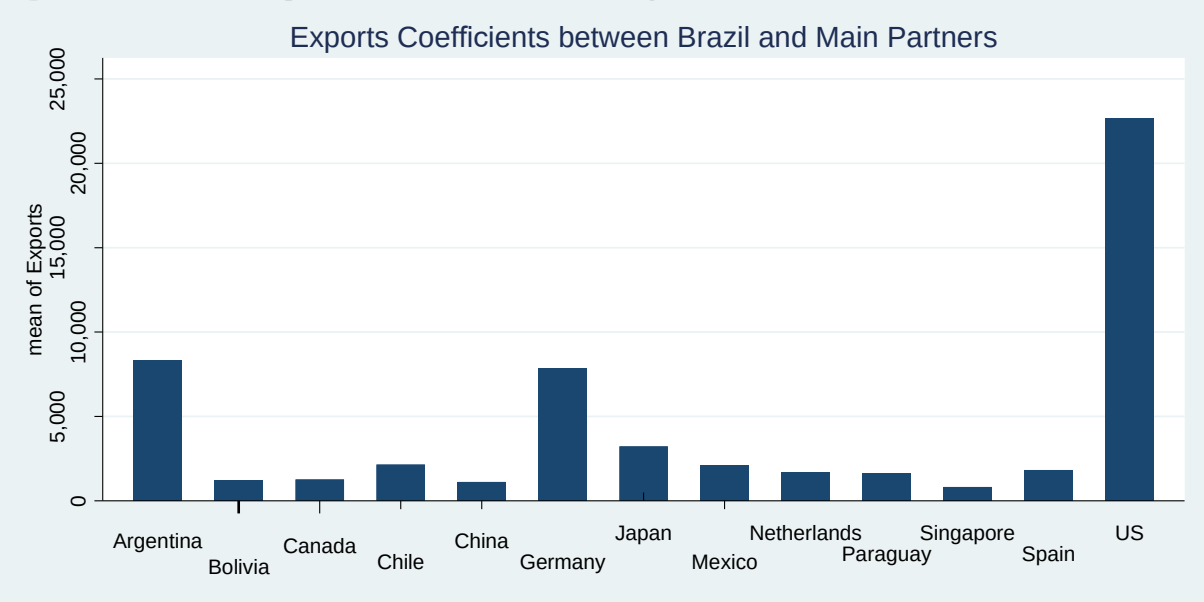
Figure 1- Panel data line plot. Bilateral Trade between Brazil and trade partners



Source: Author's calculation.

Figure 2 demonstrates the mean average of exports from Brazil to the significant partners from 1990 to 2020. Since Brazil is the reference country, it means that we have volume of Brazil's exports to these countries and the United States is still the most significant trade partner with Brazil.

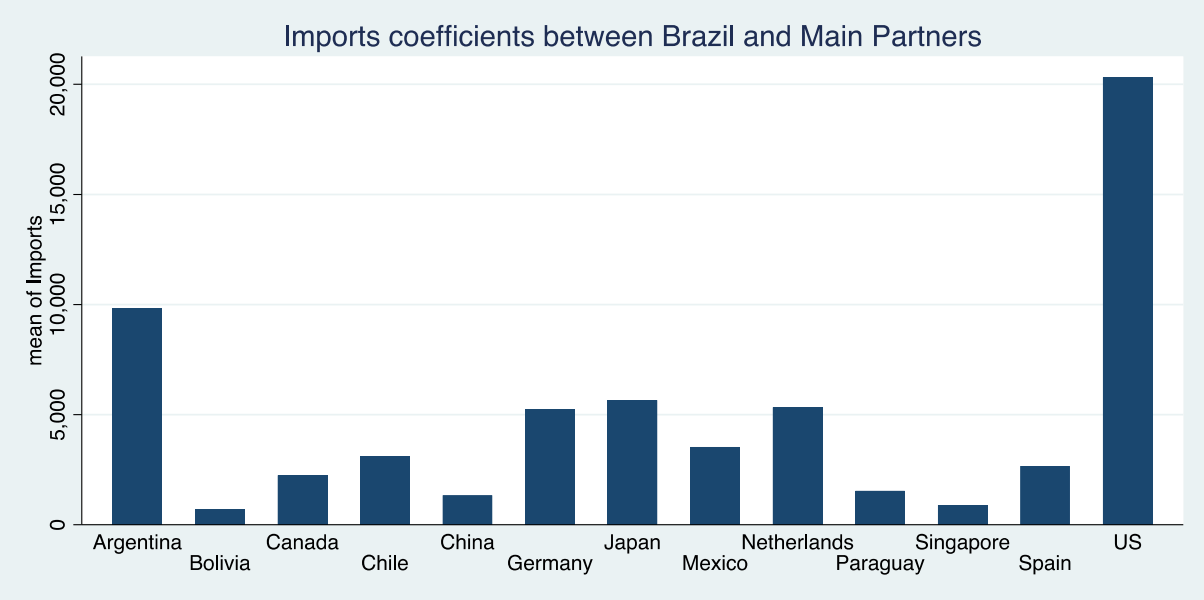
Figure 2 - Mean of Exports between Brazil and major Partners from 1990 to 2020.



Source: Author's calculation.

By contrast, Figure 3 represents the average mean of imports from volume of imports to Brazil from these countries. As we can see, the United States and Argentina have more trade flows with Brazil in overall.

Figure 3- Mean of Imports coefficients Between Brazil and Main Partners from 1990 to 2020.



Source: Author's Calculation.

Table 2 shows the intuitive gravity equation estimated coefficients for the entire sample (13 countries) from 1990 to 2020. The equation was estimated by OLS robust. The dependent variable was "lntrade" (volume of Brazil exports to the countries and volume of Brazil imports from these countries and I took the log-linearized form). The dependent variables like distance and a number of other trade cost observables as control variables. Specifically, I included a dummy variable equal to the unit for countries that are part of Mercosur. According to the gravity model literature, each component can considerably influence Trade flows at times, probably because they raise or lower the costs of shipping products globally.

These first estimations reveal several intriguing characteristics. Firstly, the model fits the data relatively well: 0.85 and 0.94 for both robust OLS and robust OLS dummies, respectively; the explanatory factors explain more than 85% of the observed variance in Trade.

As expected, the distance between partners reduces bilateral Trade. At the same time, the joint GDP of Partners, expressed in either level or per capita form, expands bilateral commerce in

the model, holding other factors constant. This conclusion may be consistent with the fact that cross-border services trade does not directly include transportation expenses, which tends to mitigate the influence of geographical distance as a source of trade costs. Nevertheless, distance has a considerable impact on commerce means that services do not travel costless across borders. The product of lnGDP of two countries increases by 74% per cent, the trade drops by 0.74. and this effect is statistically significant (indicated by a p-value less than 0.001). By contrast, in model 2 with the OLS dummies included the trade falls by 34%.

The variable Kapital Endowment indicates the difference between two countries in terms of capital endowment. If neoclassical international Trade is valid then this variable should have a positive effect on international Trade. If its invalid instead new trade theory is valid, then it should negatively impact international Trade. In the second model the variable was statistically significant.

The variable Land Endowement was calculated by the difference between Brazil land ratio (Country land/Country labour) and Partner land ratio (Partner land/Partner labour). These results contradict the H-O theory predictions that the differences in relative factor abundance stimulate international trade.

In the model estimated, I aimed to check the effects of the variable's FTA (a dummy variable =1 for countries that are part of MERCOSUR) on Trade holding the variables, distance, GDP, scale, Kap endowment, Land endowment, exchange, country and time. The FTA represents 30% trade creation effects and indicates that intra-regional Trade has been promoted more by the free trade agreement and is higher than normal trade levels.

Also, the variable exchange rate is not statistically significant in the first model, however when the model was estimated with the dummy variables for countries it was statically significant with P-value lower than 0.05.

It is interesting to point out that when estimated in the second model with country-dummies, Bolivia and Paraguay has a negative impact on Trade controlling for the other variables.

Table 2 - Estimation of an intuitive gravity model OLS.

Dep. Variable lnTRADE	(1) Model 1	(2) Model 2
lnDistance	-0.396***	-12.07***
	(0.0664)	(1.028)
lnGDP	0.747***	0.334***
	(0.0377)	(0.0452)
Ln SCALE	-0.156***	1.061***
	(0.0228)	(0.120)
Ln Kap_endowement	-7.43e-09	-1.96e-08***
	(5.01e-09)	(6.69e-09)
Ln Land_endowement	-0.0769***	-0.0837*
	(0.0127)	(0.0454)
FTA_dummy	0.366***	0.00261
	(0.0478)	(0.0526)
Exchange	-0.00592	0.0385***
	(0.00408)	(0.00712)
Bolivia		-3.482***
		(0.312)
Canada		5.563***
		(0.551)
Chile		0.904***
		(0.167)
China		4.495***
		(0.430)
Germany		4.899***
		(0.444)
Japan		7.803***
		(0.695)
Mexico		2.973***
		(0.274)
Netherlands		6.531***
		(0.610)
Paraguay		-2.733***
		(0.284)
Singapore		11.07***
		(1.025)
Spain		4.316***
		(0.423)
United States		-
Constant	-6.750***	-0.601**
	(0.313)	(0.333)
Observations	403	403
R-squared	0.857	0.947

Source: Author's calculation. Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Although Judson and Owen (1999) expressly state that fixed effects are often more appropriate than random effects, various approaches are used to choose the right model. They suggest that a typical macro panel, such as one used in this study, contains the majority of the countries of interest.

Nonetheless, the Hausman specification test (Hausman, 1978) is used to compare fixed effects and random effects model. The null hypothesis of the test is that individual effects are unrelated to other regressors. If the null hypothesis is rejected, the fixed effects model is preferred. So, the Hausman test was lower than 0.0577.

Dummy variables provide for unobservable multilateral resistance in the fixed effects model, making it a handy approach to estimate the theoretical gravity model reliably. The process is straightforward to develop and is simply an extension of regular OLS. However, it has one significant drawback: I must exclude any collinear variables with the model's fixed effects.

One solution to this challenge is intentionally converting variables that vary by exporter or importer into ones that change bilaterally. In fact, following the approach of the United Nations in how to estimate these models, I did this by multiplying the GDP of the countries and taking the log form to create a variable that is unique to each nation pair. The estimation of fixed effects models is straightforward. Using the panel data methodology of fixed effects estimate is one method for reliably estimating the theoretical gravity model. I estimated dummy variables equal to unity each time a particular country appears in the dataset by fixed effects.

Because the fixed effects are just dummy variables for each nation, all required is to generate the dummies and then add them to the model as explanatory variables. OLS remains a consistent, unbiased, and efficient estimator if its three fundamental assumptions are met. There is, therefore, one dummy variable for Argentina as an exporter, another for Chile, etc.

According to the panel data literature, this method accounts for all forms of unobserved heterogeneity that are constant for a particular exporter across all importers and constant for a given importer across all exporters. The GDP and multilateral resistance terms fulfil these conditions. Thus, the theory provides a solid rationale for such an approach.

Tables 3 and 4 show a panel data analysis estimated for fixed effects and random effects. Not surprisingly, the product of real GDPs and geographical distance appear to have the most robust substantial trade flows.

Indeed, the main problem of fixed effects is that the variables which do not change over time cannot be estimated directly in this model. So, variables such as distance will not be supported in FEM. To solve this problem, the choice of many studies is using random effects. In addition, there is a method to estimate these invariant variables in FEM, as the method which Cheng and Wall (2005) used in their study, running another regression with the dependent variable as independent personal effects and the independent variant variables. However, this method can affect the accuracy of the regression and the Hausman test for FEM and REM.

Dummy variables provide for unobservable multilateral resistance in the fixed effects model, making it a handy approach for reliably estimating the theoretical gravity model. The procedure is straightforward to develop and is simply an extension of regular OLS. However, it has one significant drawback: excluding any collinear variables with the model's fixed effects. This constraint means that unless the dataset includes intra-national Trade and thus allows for the inclusion of an interaction term of the type described above, it is impossible to estimate a fixed-effects model. Unfortunately, many policy data all policies implemented on a most-favored-nation basis—fall into this category, making the limitation particularly difficult for applied policy researchers. The services dataset utilised in these instances does not contain intra-national Trade. Obtaining such data for a large variety of nations would be extremely difficult, as services output is not well documented in national accounts, particularly in poorer countries.

I did with the ln GDP product. By multiplying them together (GDP from Brazil and GDP partner and taking the log), the result is a variable unique to each pair and therefore varies across countries. Such variables can be included in a fixed-effects model without difficulty.

Table 3 - Fixed Effects Regression

VARIABLES	(1) Fixed Effects
lnDistance	-
lnGDP	0.334***
	(0.0919)
SCALE	1.061***
	(0.306)
Kap_endowement	-1.96e-08
	(1.41e-08)
Land_endowement	-0.0837
	(0.0824)
FTA_dummy	0.00261*
	(0.0907)
Exchange Rate	0.0385***
	(0.00811)
Constant	-42.96***
	(9.731)
Observations	403
Number of Countries	13
R-squared	0.864
Country FE	YES

Source: Author's calculation.
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4 describes the estimations of a gravity model with country and year for fixed effects and random effects. In overall, the variables are significant with p-value less than 0.005. for Model 1 and Model 3.

As said before, random effects assume the entity's error term is not correlated with the predictors which allows for time-invariant variables to play a role as explanatory variables. In random -effects, which leads to a problem that some variables might not be available resulting in omitted variable bias in the model.

As expected, distance has a negative impact in model 1 and model 3, and the product of GDP has a positive impact on trade. The factors endowment, which basically says that countries export products that use their abundant and cheap factors of production, and imports products

that use the countries scarce factors, signalized by Kapital Endowement and Land endowement has a negative impact on trade flows between Brazil and trade partners

Table 4 - Comparing the fixed effects.

VARIABLES	(1) OLS	(2) Fixed Effects	(3) Random Effects
lnDistance	-0.396***		-0.549**
	(0.0664)		(0.244)
lnGDP*GDP	0.747***	0.111	0.202**
	(0.0377)	(0.0628)	(0.105)
SCALE	-0.156***	0.775**	0.165***
	(0.0228)	(0.328)	(0.0624)
Ln Kap Endowement	-7.43e-09*	-2.04e-08	-2.30e-08*
	(5.01e-09)	(1.77e-08)	(1.58e-08)
Ln Land_Endowement	-0.0769***	-0.0212	0.0106*
	(0.0127)	(0.0608)	(0.0617)
FTA_dummy	0.366***	0.104	0.161***
	(0.0478)	(0.0708)	(0.0568)
Exchange	-0.00592	0.0168	0.0486
	(0.00408)	(0.0250)	(0.0366)
Constant	-6.750***	-27.54**	-5.533
	(0.313)	(12.21)	(4.202)
Observations	403	403	403
R-squared	0.857	0.920	0.864
Number of id		13	13
country FE		YES	
Year FE		YES	
Country RE			YES
Year RE			YES

Source: Author's calculations.
Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 6 shows the matrix of correlations. The correlations of interest are contained in the non-diagonal elements of the matrix. It demonstrates that Trade and GDP are strongly positively correlated, confirming the basic intuition that more prominent countries trade geographical distance. By contrast, there is a strong negative correlation between Trade and distance: country pairs tend to trade less further apart.

Table 5 - Matrix of Correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) lnTRADE	1.000							
(2) lnDistance	0.044	1.000						
(3) lnGDP	0.723	0.607	1.000					
(4) SCALE	0.415	0.448	0.745	1.000				
(5) Kap endowement	0.235	0.478	0.522	0.230	1.000			
(6) Land endowement	-0.317	0.662	0.051	-0.227	0.234	1.000		
(7) FTA_dummy	0.240	-0.410	-0.181	-0.125	-0.489	-0.259	1.000	
(8) Exchange	0.203	0.374	0.375	0.012	0.315	0.291	-0.335	1.000

Source: Author's Calculation.

CONCLUSION

The paper analysed the impact of free trade agreements between Brazil and Mercosur, focusing on their trade creation. I used data from Brazil's major partners (13 different countries: Argentina, Bolivia, Canada, Chile, China, Germany, Japan, Mexico, Netherlands, Paraguay, Singapore, Spain, United Nations.) and covering the period of dating from 1990 to 2020.

First, it affirmed that real GDP and geographical distance are two main driving forces of international Trade accreting validity of the gravity model. Membership in the Mercosur also has a very profound impact on Trade. On average, each year of membership in the Mercosur is associated with a growth rate of bilateral trade between 0.366 and 0.16, representing 36% and 16%, respectively, which is an impressive result. This cannot be solely attributed to trade creation, as it can result from trade diversion from the countries outside of the Mercosur. My results give empirical evidence that nonmember countries are likely to suffer from regional integration.

It is worth noting that, since Brazil did not have Portugal as their major partner when I estimated it separately, including Portugal's dummy variable as a partner, it did not have any impact improving my estimations. So, I decided not to include the variables colonization and language as explanatory variables since the other countries do not have any common language.

It is common knowledge that different nations (regions) have varied productive elements necessary for product manufacturing. Some countries have more capital, some have more labour, and some have more land than others. As a result, factor endowments and factor prices, according to Ohlin, are inextricably linked. The cost of a relatively significant factor in a country will tend to be cheaper, whereas the price of a relatively rare factor will likely be higher.

The Heckscher-Ohlin theory predictions are also reflected in the data. Three measures of the difference in relative factor abundance influence bilateral trade flows: capital endowment and land endowment both negatively impact trade.

Finally, Trade economists are shifting their focus to numerous problems that trade data alone—whether examined using gravity or another framework—is ill-equipped to explain in the context of inclusive and sustainable growth. Examining the effects of trade on inequality, the environment, or the general public behavior. The Gravity model can be a helpful initial indicator of changes in trade flows connected with a policy shift. However, it is difficult to simulate the influence of a policy change on other development factors.

The conclusion is that while gravity is still an excellent starting place for empirical work in international trade, including applied policy analysis, research should explore alternative models and techniques. The analyst's job is to identify the appropriate tool for the study, given the data limitations, to provide a comprehensive and relevant solution to the topic at hand.

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