THE IMPACTS OF BREXIT FOR THE BRAZILIAN TRADE

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ABSTRACT

The decision to leave the European Union (EU), made by the United Kingdom (UK) in 2016 (Brexit), was an event that surprised the world and will affect many countries in different ways. The countries that will feel the effects of this change the most, however, are the ones in the United Kingdom itself, and the literature suggests that this decision will come at great costs. Among them, perhaps one of the most impactful of these costs is the loss of previously established trade relations, if the exit from the European Union is made more conservatively and with fewer agreements. Taking this into account, it is relevant to analyze trade relations between Brazil and the United Kingdom, to verify from a historical series of exports how the effects of Brexit may influence changes in international trade between these two countries. To try to capture the Brexit effect and make it measurable, the exchange rate volatility between the pound sterling and the Euro (named as Third Country effect) was calculated, as it also captures the uncertainty generated after the exit statement, and is used as a proxy for Brexit. The strategy used in this study was to estimate the impacts of the GDPs, exchange rate volatility between the two countries, and the Third Country effect on trade relations between Brazil and the UK over a period of fifteen years through a Gravity Trade Model. The data was estimated via Pooled Ordinary Least Squares (OLS), panel data with fixed and random effects, and by the Poisson Pseudo-Maximum Likelihood (PPML) model. The results confirm that exchange rate volatility between the Real and the Pound is an obstacle commercially between the two economies. The Third Country effect, when analyzed for a shorter period of time, also shows a negative relationship with trade. In other words, the news of Brexit unfavorably impacts trade between Brazil and the UK. However, when a longer period is considered when calculating exchange rate volatility, the Third Country variable shows a shift in its behavior, becoming positive, which implies in greater trade opportunities between Brazil and the UK after a longer period of time.

Keywords: Brexit, International Trade, Exports, Brazil.
JEL Classification: F1, F2, F14.

RESUMO

A decisão de deixar a União Europeia (UE), tomada pelo Reino Unido (Reino Unido) em 2016 (Brexit), foi um evento que surpreendeu o mundo e afetará muitos países de maneiras diferentes. Os países que sentirão mais os efeitos dessa mudança, no entanto, são os do próprio Reino Unido, e a literatura sugere que essa decisão terá grandes custos. Entre eles, talvez um dos mais impactantes desses custos seja a perda de relações comerciais previamente estabelecidas, se a saída da União Europeia for feita de maneira mais conservadora e com menos acordos. Levando isso em consideração, é relevante analisar as relações comerciais entre o Brasil e o Reino Unido, verificar a partir de uma série histórica de exportações como os efeitos do Brexit podem influenciar mudanças no comércio internacional entre esses dois países. Para tentar capturar o efeito Brexit e torná-lo mensurável, foi calculada a volatilidade da taxa de câmbio entre a libra esterlina e o euro (denominado efeito de Terceiro País), pois também captura a incerteza gerada após a declaração de saída e é usada como proxy para o Brexit. A estratégia utilizada neste estudo foi estimar os impactos dos PIBs, a volatilidade da taxa de câmbio entre os dois países e o efeito do Terceiro País nas relações comerciais entre o Brasil e o Reino Unido durante um período de quinze anos através de um Modelo de Comércio Gravitacional. As estimações foram feitas através de mínimos quadrados ordinários (OLS), dados em painel com efeitos fixos e aleatórios e pelo modelo de pseudo máxima verossimilhança de Poisson (PPML). Os resultados confirmam que a volatilidade da taxa de câmbio entre o Real e a Libra é um obstáculo comercial entre as duas economias. O efeito Terceiro País, quando analisado por um período mais curto, também mostra uma relação negativa com o comércio. Em outras palavras, as notícias do Brexit impactam desfavoravelmente o comércio entre o Brasil e o Reino Unido. No entanto, quando se considera um período mais longo no cálculo da volatilidade da taxa de câmbio, a variável Terceiro País mostra uma mudança de comportamento, tornando-se positiva, o que implica em maiores oportunidades comerciais entre o Brasil e o Reino Unido após um período mais longo.

Palavras-Chave: Brexit, Comércio Internacional, Exportações, Brasil.

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1 INTRODUCTION

On the 23rd of June of 2016, through a referendum, the United Kingdom's (UK) people voted to leave the European Union (EU), with a majority of 52%. The decision of whether the "British Exit" will be done with trade agreements between the UK and the EU, or without any, is still being made by the British representatives and will ultimately define the nature and scale of any economic impacts to come in the near future. Either way, as will be discussed during the Literature Review portion of this study, authors seem to be in consensus that this will imply in losses to all sides: to EU members, but especially to the UK.

On the other hand, this could prove beneficial to countries outside the EU, which could make new agreements with the UK to supply it with goods that they previously imported from countries through the free market.

When analyzing the situation of Brazil, it is perceived that the country does not export a great variety of goods to the UK. However, there are some sectors that already have high exportation rates to the UK, and since the UK will probably need to enact new trade agreements after leaving the EU, the impacts this could have on Brazil export trends is relevant.

The main objective of this study is to analyze the impact that Brexit will have on Brazilian-UK trade relations, by using a Gravity Trade Model to estimate trade flows between the two countries. In the same context, some secondary objectives have been determined: i) to present the general observations from the literature regarding trade induced impacts from Brexit; ii) through the Gravity Trade Model, to analyze a historical trend of trade flows between Brazil and the UK; iii) to estimate, through the use of a panel data estimation of the Gravity Trade Model, the effects that exchange rate volatility has had on British x Brazilian trade relations throughout the past years.

Regarding the empirical strategy used in the present study, the total volume of trade flows from Brazil to the UK through a period of 15 years (2004 to 2018) was observed by adjusting the export values by the size of both markets, within a range of 97 sectors. Subsequently, this variable (size-adjusted trade) was used as a dependent in a gravity model, estimated by Pooled Ordinary Least Squares (OLS) and also by panel analysis (fixed and random effects) along with Poisson Pseudo Maximum Likelihood (PPML). The results indicate that while Brazilian Real and Sterling Pound volatility had a negative effect on trade, and the volatility between the Pound and the Euro has been shown to have a negative effect on Brazilian relations in a shorter period, it has also shown to have a positive impact for Brazilian trade relations with the UK after a longer period has taken place, which could indicate that Brexit can produce positive impacts on the Brazil-UK trade.

Aside from this introduction, which briefly discusses the topics to be reviewed throughout this research, the present work is divided into 4 more sections. A thorough literature review is shown, where a historical background of the EU is examined, along with the opinions and study results of various authors of the topic. Afterwards, the chosen methodology will be presented, with each parameter explained and justified. Along with the methodology, the database will be discussed. The fourth section consists of the results, obtained from the estimations through the chosen methodology and the study of the literature. Lastly, a section to conclude this research will be presented, showing final takeaways and possible topics of study and considerations for future works.

2 LITERATURE REVIEW

2.1 A HISTORICAL BACKGROUND OF BREXIT

The Second World War was an unparalleled event in world history, affecting economies around the globe; a true demonstration of the horrors of warfare, political extremism and intolerance. However, most of the battles took place on European soil and, hence, the damages were also concentrated in the neighboring countries that initiated the conflict. In an attempt to prevent history from repeating itself –

especially with the new possibility of nuclear warfare –, Europe as a whole realized that there was an imminent need to unite and become more allied economically. In 1948, the British Prime Minister Winston Churchill already advocated in favor of the establishment of a "United States of Europe".

The Treaty of Paris – signed by France, Italy, Western Germany and Benelux countries (Belgium, Netherlands and Luxembourg) in 1951 – founded the European Coal and Steel Community (ECSC), one of the first institutions to encompass many European countries in a unified manner (BALDISSERA, 2018). As early as 1955 there were already ideas about creating a single currency and an integrated market.

In 1960, in Stockholm, a more economically integrated initiative was conceived, adhered to by the United Kingdom, Portugal, Denmark, Norway, Austria, Sweden and Switzerland[3]. It was the dawn of the European Free Trade Association (EFTA).

In 1986, the Single European Act (SEA) was signed, a major step toward the establishment of a fortified union (BALDISSERA, 2018). The main mission of the act was to successfully establish a single market by 1992. Eleven countries, Belgium, the Federal Republic of Germany (FRG), France, Ireland, Luxembourg, the Netherlands, Portugal, Spain, the United Kingdom, Denmark and Italy signed the SEA.

Finally, Europe came together to sign the Maastricht Treaty in February of 1992, which effectively founded the European Union (EU) and built the pillars that characterized the agreement. By adjusting and modifying some of the previous treaties between the European countries – such as the Treaty of Paris, Rome, SEA, etc. – a new discussion began: a political unification along with a more effective economic one (BALDISSERA, 2018).

The three pillars that are the foundation for the EU are: the European Communities pillar – meant to handle economic, social and environmental policies, involving the European Community (EC), the ECSC (up to 2002 when it expired), and the European Atomic Energy Community (EURATOM); the Common Foreign and Security Policy – to look after military and foreign policy matters; and the Police and Judicial Co-operation in Criminal Matters pillar (originally named Justice and Home Affairs) – meant to fight against bribery and fraud, drug and human trafficking, organized crime and other safety related issues (DENZA, 2002). It was also with the Maastricht Treaty that a single European currency was envisioned: the euro. Later on, in 2009, the Treaty of Maastricht was amended by the Treaty of Lisbon, signed in 2007.

As their main goals, the EU aims to guarantee an economic and monetary union, whose currency is the euro; offer freedom, security and justice without internal borders; maintain sustainable development based on balanced economic growth and price stability, a highly competitive market economy with full employment and social progress, and environmental protection; respect its rich cultural and linguistic diversity[4], etc.

More recently, the EU has begun an unprecedented chapter in its history: The UK, one of the founding members and whose past leader advocated in favor of a unification of Europe, voted in favor of leaving the EU on the 23rd of June of 2016. This decision was named Brexit – a British Exit from the EU.

2.2 SIMULATIONS AND ESTIMATES OF THE IMPACT OF BREXIT

2.2.1 GDP and living standards

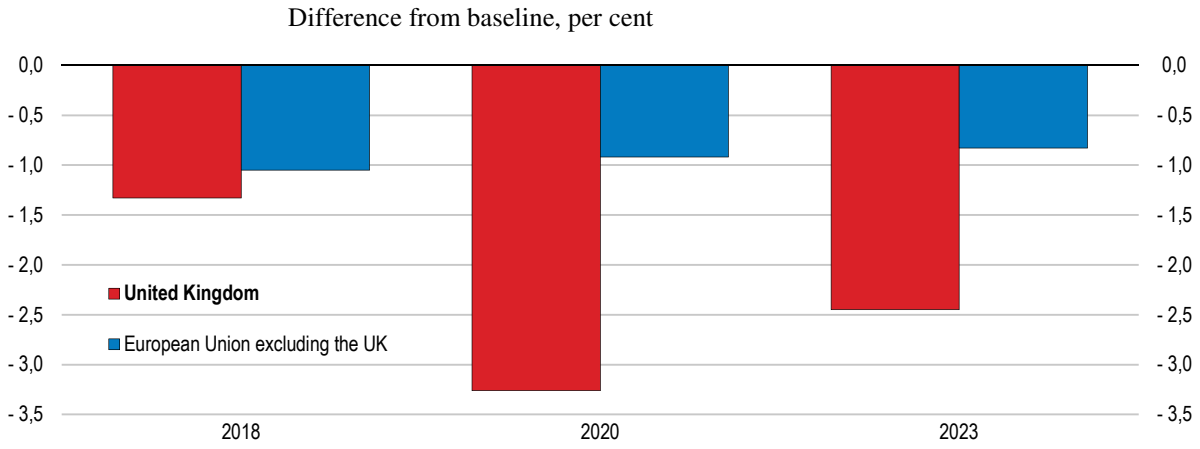
Due to the uncommon scenario that arose from the perspectives of a Brexit, the worldwide academic community has been abuzz to try and estimate the impacts that this might have on both the UK's economy and society, as well as of the remaining members of the EU. Extensive discussions regarding immigration, import and export flows, the UK's general government deficit and labor market oscillations have been arising in various studies.

Firstly, economic growth should be inspected. Kierzenkowski et al. (2016) claim that the UK GDP growth would have been reduced by 0.5 percentage point in both 2017 and 2018 if Brexit would have been established already in 2016. Additionally, they state that "Brexit would generate a large negative shock to the UK economy, which would spillover to other European countries" (KIERZENKOWSKI et al., 2016).

[3] About EFTA: The European Free Trade Association. <https://www.efta.int/about-efta/european-free-trade-association>
[4] The EU in brief: Goals and values of the EU. <https://europa.eu/european-union/about-eu/eu-in-brief_en>

In the figure below, composed from OECD data and calculations, it is possible to see the extent of a hard Brexit happening in 2016, in terms of economic growth, which provides a good idea of how the impact could still occur with a hard Brexit in 2019.

FIGURE 1 - NEAR-TERM EFFECTS OF BREXIT ON REAL GDP IN THE UNITED KINGDOM AND THE EUROPEAN UNION



SOURCE: Kierzenkowski et al. (2016) via OECD calculations.

As is evident from the graph above, the UK would suffer substantial losses in GDP and, hence, in GDP per capita, which in turn can possibly affect the well-being and living standers of its citizens in the near future. Even though in 2023, according to OECD calculations, the economy begins to adjust to the large trade shock and the UK's GDP loss is reduced, they still suffer a 2.5 real GDP loss that they wouldn't otherwise suffer if they remained in the EU.

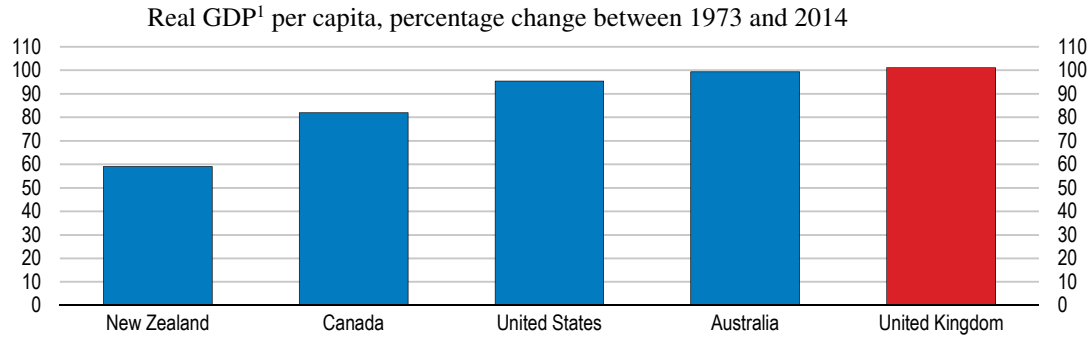
Also according to Kierzenkowski et al. (2016), in a long term analysis, the cost of Brexit in Great British Pounds (GBP), measured in prices of 2016, would be equivalent to 3,200 GBP per household and, in an even more pessimistic scenario, the cost would be even greater, reaching 5,000 GBP per household, implying in a direct effect on family's available income and living standards.

Dhingra et al. (2016) also studied the impacts of Brexit on the people income and living standards. In line with all EU members, the UK is obliged to contribute to the EU budget. The UK's net fiscal contribution is estimated to be around 0.53% of national income (HM TREASURY, 2013). However, contrary to one of Brexit's expected benefits, leaving the EU does not necessarily mean that the UK would be free from paying the contribution. EEA (European Economic Area) members who want access to the single market must continue to make payments to the EU. Norway, for example, in per capita terms, contributes about 83% as much as the UK (HOUSE OF COMMONS, 2013 apud. DHINGRA et al., 2016).

According to Dhingra et al. (2016), the savings that the UK could obtain from a Brexit – via reduced fiscal contributions to the EU budget – would not be enough to compensate the fall in income per capita. By their estimations, Dhingra et al. (2016) concluded that the UK's income would suffer a reduction between 1.3% to 2.6%, which translates to a decline in average annual household income of between £850 and £1,700 per year. In any case, independent of which of these estimations is more realistic, the literature seems in consensus that UK income per capita would suffer a great blow.

It is also valid to point out that, since the UK's admission to the EU in 1973, GDP per capita doubled, increasing more than other developed English speaking countries outside the EU, including in the United States (US), as is evidenced by figure 2 below, by Kierzenkowski et al. (2016).

FIGURE 2 - SINCE EU MEMBERSHIP IN 1973, UK LIVING STANDARDS HAVE RISEN MORE THAN IN PEERS



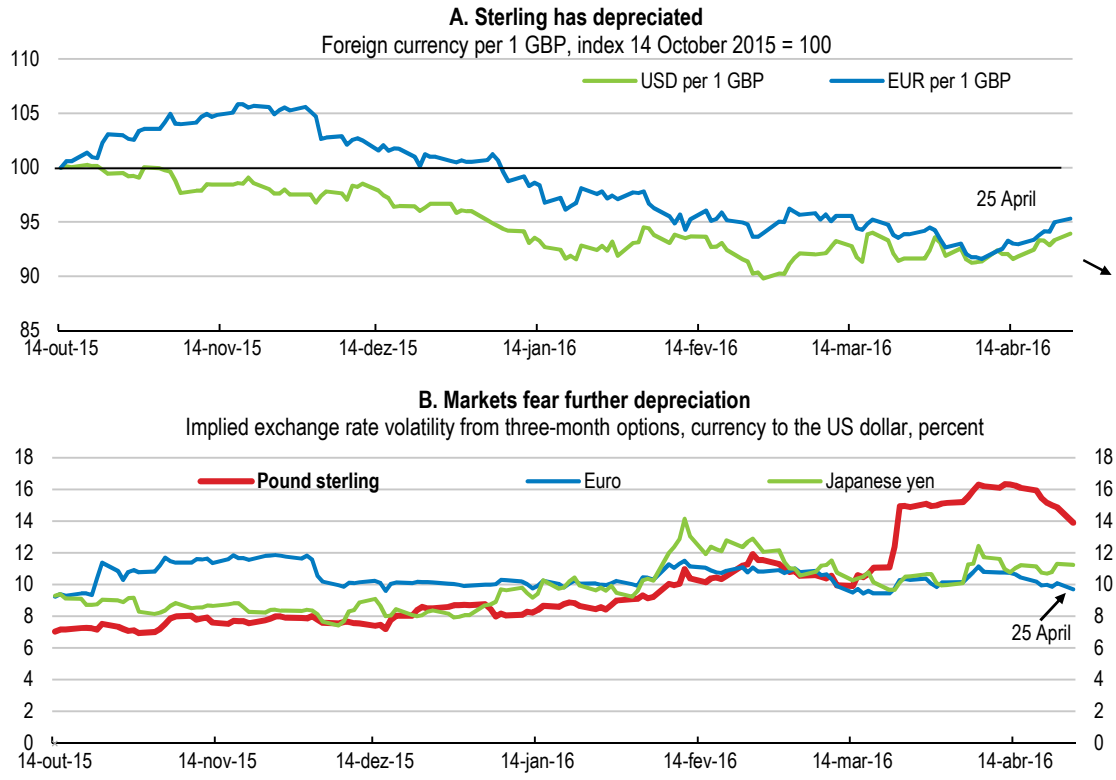
1. In constant purchasing power parities.

SOURCE: Kierzenkowski et al. (2016) via OECD (2016), OECD National Accounts Statistics (database), April.

2.2.2 Exchange rate and terms of trade

Ever since discussion about the UK leaving the EU began, it has led to increasing uncertainty regarding the UK as a country. Worldwide responses have been generally negative, as economic expectations for the UK begin to fall. Public expectations directly impact cash inflows, foreign direct investments and a country's growth. The uncertainty around Brexit has led to capital outflows and a weaker exchange rate for the UK, as is evident by studies from (KIERZENKOWSKI et al., 2016), demonstrated in the figures below.

FIGURE 3 - UNCERTAINTY OVER BREXIT HAS LED TO CAPITAL OUTFLOWS AND A WEAKER EXCHANGE RATE



Source: Datastream via Kierzenkowski et al., 2016.

According to Dhingra et al. (2016), we can expect a reduction in foreign direct investments after a Brexit, with the magnitude of this reduction depending on whether the exit will be with or without an agreement. This is yet another complication for the UK's economy, as foreign direct investments have been found to bring about higher productivity (HASKEL et al., 2002). Also, as reported by Pain and Young's (2004) assessment, membership to the EU adds about 2.25% to the UK's GDP via foreign direct investments.

Uncertainty is, of course, a terrible factor for a country, as it not only affects investors, but also internal market consumers. When facing great uncertainty, it is likely that consumers reduce their consumer demand and increase any precautionary savings (BANSAL and YARON, 2004). There is a risk that these savings leak to foreign countries, and the lack of consumption can lead to a contraction of the economy in the short run.

With deteriorated terms of trade, a decline in UK import demand would soon ensue, and this decline, along with a larger depreciation of sterling against domestic currencies, could magnify negative effects on other European countries, an expected spillover caused by a deep confidence shock.

Additionally, UK firms have also reacted to an increasing risk of Brexit. According to Bloom et al. (2019), by means of The Decision Maker Panel survey,

> (…) most recently, in the August to October 2018 surveys, 19 per cent of firms reported that Brexit was their largest current source of uncertainty, 29 per cent said that it was not the top source but in the top two or three, 39 per cent said it was one of many sources of uncertainty, with the remaining 13 per cent declaring that it was not important as a source of uncertainty. (BLOOM et al., 2019, p 567-568.)

Where industries more exposed to the EU through exports and through employing EU migrant labor were more likely to have responded that they are affected by Brexit uncertainty. However, that is not a rule, as the construction sector, according to Bloom's et al. (2019) study, has little to no exports to the EU, and still had a meaningful share of firms that see Brexit as a significant source of uncertainty. Of course, this could reflect expectations on the future of the UK's property market, along with the availability of migrant labor.

For the most part, Brexit's uncertainty has impacted consumers, investors and businesses, especially in regards to their access to the Single Market, availability and cost of labor, customs and product regulations to come and, of course, the impact that all these factors combined will have on sales, supply and general market reactions.

2.2.3 Free movement of persons

Immigration and free movement are, as is well known, one of the main considerations that pushed the referendum vote in favor of an exit by the British population. Despite that, immigration is a very important ingredient in the functioning of a country, one that directly affects employment, and there is no doubt that how the circulation of workers will react or be affected by Brexit will reverberate to their economy.

While the UK is a part of the EU, they are entitled to the Free Movement of Persons, one of the many policies of the EU, which secures the right to move freely within the territory of member States, to remain in a member State after being employed, as well as abolish discrimination against nationality between workers of these States (MARZOCCHI, 2018).

Because of this policy, the UK has both been a supplier, as well as a consumer, of foreign workers through migration, and migration in general has been found to stimulate growth and relieve budget deficits without serious adverse labor market effects (WADSWORTH, 2015). Portes and Forte (2017) also argue that free movement policies have a higher impact on trade volumes than trade liberalization – for example, tariff reductions or membership of a free trade area.

Still in their study, by utilizing the International Passenger Survey to calculate flows, Portes and Forte's (2017) results reaffirm that free movement leads to a rise in migration flows from EU countries into the UK and, likewise, Brexit would likely result in a considerable reduction in these flows. According to Portes (2016), this reduction is likely to affect medium and high skilled migration, as well as low-skilled. In a similar tone, Vargas-Silva (2016) claims that the UK's pull-factor for immigrants can likely suffer

post-Brexit, as an economic decline – which is likely, as was discussed previously as a general consensus – would make the country less attractive to both current foreign residents, as well as to potential migrants.

Still, there is a lot of uncertainty regarding how migration will be regulated post-Brexit, and it ultimately depends on the negotiations that the UK will or will not make with the rest of the EU. While there can be a fixed set of rules applying between the EU and the UK, it is also possible for the UK to make bilateral arrangements with other EU countries, making this one of the most difficult topics to try to predict while no agreements are established yet.

2.2.4 Trade relations and networks

Another factor of interest that affects UK growth, if not the most important one, is their trade relations prior and post Brexit. Historically, the UK has become less efficient in producing goods (and hence, exporting them) and more so in services, specifically in the financial sector. This is called, by Mulabdic et al. (2017) the "servification" of UK trade, an intriguing case of de-industrialization which, no doubt, has sprouted various studies in itself. In fact, according to Giammetti (2019):

> "(…) the UK trade deficit is largely comprised of manufacturing sectors whilst the UK's trade surplus includes mostly knowledge-based service sectors such as Financial and Administrative Services". (GIAMMETTI, 2019, p.8).

Rowthorn and Coutts (2013) reveal that over the years the UK has been in need of larger net earnings from exporting services, in order to maintain their expanding manufactured goods deficit.

By having access to the single market and by having the EU as its main trade partner, the financial and administrative services have benefited greatly over the years and had the opportunity to enhance the UK's comparative advantages in these sectors. As is known, and as Dhingra et al. (2016) highlights, trade generally has positive effects on the economies involved. It increases competition, which in turn reduces excess profits, promotes efficiency, stimulates innovation and provides a wider variety of goods to the population, often of superior quality, with reduced prices to the market – as trade also allows countries to specialize in industries in which they might have a comparative advantage. Therefore, it is arguably beneficial for a country to maintain many trade agreements, not dissolve them.

According to Brautzsch and Holtemöller (2019), the EU is the UK's most important trading partner quantitively, for both intermediate inputs and also final products. By focusing on the World Input-Output Table provided by the WIOD project[5], Giammetti (2019) asserts that the USA and Germany accounted for 23% of the UK's imports and 18% of exports in 2014. Other top source partners include France, Netherlands, Ireland, Italy, Belgium and Spain; while top destination partners are the same, with the inclusion of Luxembourg substituting Spain.

Of course, it is challenging to foresee the exact aftermath that a Brexit would cause on the UK's import and export behavior, as the potential effects depend on the exit scenario that is taken. However, it is possible to estimate these consequences. As Brautzsch and Holtemöller (2019) emphasized, in the case of a no agreement exit, trade between the EU and the UK would follow World Trade Organization rules, which would imply in the obligation of tariffs.

Due to an exit without an agreement, and hence the implementation of aforementioned tariffs on traded goods and services, many countries would be affected, not only the UK and EU. As Gallegati, Giammetti and Russo (2019) confirm, global economic markets are highly interlinked, making it possible for several heterogeneous industries to be connected within and across different countries by means of input-output trade linkages. That being said, micro and macroeconomic shocks can propagate throughout the production web, affecting various countries at a time (CARVALHO, 2014). Likewise, as production is organized in global value chains, the decline of exports to the UK will have a negative indirect effect on countries that supply intermediate inputs to the firms that provide final goods to them.

[5] Timmer et al. 'An Illustrated User Guide to the World Input–Output Database: The Case of Global Automotive Production.' (2015)

Considering an export decline to the UK of 25% in the short-run, as assumed by Hantzsche et al. (2018), "About 433,000 persons will be affected by second-round effects that hit firms delivering intermediate inputs" (BRAUTZSCH and HOLTEMÖLLER., 2019).

Brautzsch and Holtemöller (2019) also illustrate the magnitude of a hard Brexit by exemplifying the motor vehicle industry in Germany. According to them, this would be the most affected industry and, in Germany alone, about 15,000 people that are employed in this sector are directly or indirectly involved in goods exported to the UK. That automatically makes Germany very exposed to employment problems after a hard Brexit. However, it is important to not lose sight that other countries outside the EU are also prone to employment risks, though admittedly in a smaller scale, through their indirect supplies to Germany's vehicle industry, for example.

Gallegati, Giammetti and Russo's study (2019), through Input-Output calculations on the European production network (EPN), identified key industries in the complex UK-EU trade grid. As stated in their work, the UK would suffer more in its administrative and support activities and auxiliary financial services. Comparatively, the EU would have a great impact in its food sector, along with manufacturing industries such as petroleum and chemical products, electronics and computers, etc. However, the most sensitive aspect of the EU production network would be the vehicle industry.

A study by Chen et al. (2018), suggests that the risk of Brexit would be very costly for EU countries, especially Ireland, Germany, Belgium, and the Netherlands, with Ireland understandably facing losses in a scale similar to those estimated for the UK, due to its immediate proximity to the union.

In addition to these dilemmas, which already account for much, the UK will not only face new tariffs and trade barriers, but will also not be able to benefit from new trade agreements between the EU and extra-EU countries. In turn, it will have to pursue its own trade agreements, either still with EU members, or extra-EU nations.

When raising the question of whether Brazil can become one of the new integral trading partners for an "independent" UK, it is important, firstly, to understand where Brazil stands in the international market, as well as a supplier to the UK.

Brazil is the 22nd largest export economy in the world, with important trading partners such as China, the United States, Argentina, the Netherlands[6], Germany and South Korea. The goods that rank highest in Brazil's exports are Soybeans, Iron Ore, Crude Petroleum, Raw Sugar and Cars (THE OBSERVATORY OF ECONOMIC COMPLEXITY, 2017). Even with Brazil's solid trade relations with the EU, it's trade flows with the UK haven't been the most voluminous.

However, according to the DCI (Commerce, Industry and Services Diary, 2018) trade flows between Brazil and the UK have increased in 5% in the period of January to October of 2018, due to an increase in Brazilian exports to the union. Even so, it is uncertain whether these increases will continue to arise after Brexit ensues, which only supports the importance of a fragmentized view of the Brazilian goods market in relations to UK demand.

2.3 THE EVOLUTION OF THE GRAVITY MODEL

The gravity equation has its origin in the law of universal gravitation, formulated by Isaac Newton, whose thesis defended that the attraction between two bodies is directly proportional to the mass of the bodies and inversely proportional to the square of the distance between them (Nascimento and Júnior, 2013). Isard (1960) was the first author to introduce the use of the gravitational model in the economic field, more specifically within regional economics. Soon after, other researchers adapted the model to estimate the flow of bilateral trade between two countries, such as Tinbergen (1962), Pöyhönen (1963) and Linnemann (1966).

Many authors have used and tried to refine the model over the subsequent decades, but Krugman's (1980) idea is the most widespread theoretical justification that bilateral trade flows depend positively on countries' income and negatively on the distance between them. Further attempts in applying the model to trade include Leamer and Stern (1970) who derived the gravity equation from a probability model of

[6] The Netherlands, in this case, symbolize the entirety of the European Union, as most goods that are exported to the union arrive via the port of Rotterdam.

transactions, Anderson (1979) was a pioneer in assuming product differentiation, first considering Cobb-Douglas preferences and then, constant-elasticity-of-substitution (CES) preferences. Bergstrand (1989, 1990) derived a version of the gravity equation under the assumptions of monopolistic competition and product differentiation among firms rather than countries.

Sá Porto and Canuto (2004), argue that there can be two different types of resistance to trade: natural and artificial. Natural resistances are obstacles imposed by nature, such as costs of shipping time due to distance; and artificial resistances are those imposed by governments, such as tariffs and import quotas. Kume and Piani (2000) point out that some natural resistances generate additional resistances on trade, for example how the distance between two countries can generate greater ignorance of the market, its institutions, laws, habits and other factors.

Other authors contributed in different ways to the construction of the gravity model. Among them, Aitken (1973), used the model to assess the impact of the European Economic Community (EEC) and the European Free Trade Association (EFTA) on the trade relations of their members between the years of 1959 and 1967. In works carried out by Polak (1996) and Smarzynska (1999), the elaboration of more adjusted and appropriate models for international trade were envisioned. Among these collaborations, the introduction of a variable named "relative distance" is worth highlighting, which aims to avoid possible distortions caused by the isolation of certain countries from the most important trading partners – when analyzed by their GDPs.

Other useful applications of the gravity model consist of assessing regional biases in international trade and predicting potential trade flows. Regarding regional biases, a study by Frankel and Wei (1998) is an example, where the authors map out the current pattern of regionalization in trade via a gravity model. On the topic of predicting trade flows, Hamilton and Winters (1992) and Baldwin (1994) examine the impact of changes in the former communist countries on world trade. Further experimentation of the model includes estimating the effect of exchange rate volatility on trade (Frankel and Wei, 1998) and the role of trade in spreading innovation (Eaton and Kortum, 1997).

3 METHODOLOGY

2.4 APPLYING THE GRAVITY EQUATION

As was discussed in the previous section, the gravity model estimated in this paper is analogous to gravitation models from physics, where factors such as distance and the economical dimensions of countries (GDP) influence international trade between them. The model predicts that the volume of trade between two countries will be proportional to their GDPs and inversely related to any trade barriers between them (Sheldon et al. 2013) such as distance, population size, cultural similarities or differences – spoken language, colonial relationships, etc – transportation costs, exchange rate volatility, among other factors.

Therefore, the gravity model can be described, in its most simplistic form, as follows:

$$Trade_{ij,t} = \frac{Y_i Y_j}{D_{ij}} \qquad (1)$$

In logarithmic form, the gravity model can be represented as:

$$lnTrade_{ij,t} = \beta_1 + \beta_2 ln(Y_{i,t}Y_{j,t}) + \beta_3 lnDist_{ij,t} + \beta_4 lnPop_{ij,t} + \beta_5 Lang_{ij,t} + \beta_6 lnVol_{ij,t} + u_{it} \qquad (2)$$

The dependent variable $lnTrade_{ij,t}$ is the natural logarithm of annual trade flows between Brazil and the UK in thousands of dollars, representing trade. As explanatory variables, we have $ln(Y_{i,t}Y_{j,t})$ as the natural logarithm of the product of both countries' GDPs in period t; $lnDist_{ij,t}$ as the natural logarithm of the distance between the two territories; $lnPop_{ij,t}$ is the logarithm of their respective population levels; $Lang_{ij,t}$ is a dummy for language, being 1 if both countries share a common language and 0 if otherwise; and $lnVol_{ij,t}$ is the exchange rate volatility between the currencies in period t.

Due to the dynamics of this study, which consists of focusing on the trade relations between Brazil and the EU leaving country, aspects such as distance are not relevant, as the data will remain unalterable in both cross section analysis, as well as intertemporally. To avoid collinearity effects, and since both country's wealth are already contemplated in the study, population data was not included as a regressor.

The exchange rate volatility of the Pound Sterling and the volatility of the Brazilian Real is added to the right-hand side of the gravity equation, in order to evaluate the flow of trade between Brazil and the UK, similarly to what was done in Bittencourt et al. (2007), Lin (2012), Sheldon et al. (2013), among others. Also, another variable was included, in an attempt to capture a third country effect. The third country effect, investigated by Wei (1996), Dell'Ariccia (1998), Cho et al. (2002) and Bittencourt et al. (2007), is a measure of the volatility between countries that are not being analyzed in the study. Since commerce between the UK and the EU is not the focus of this investigation, their volatility will be used as a way to capture any potential effects that Brexit might have on the UKs trade relations with Brazil. Thus, the theoretical model to be used is as follows:

$$lnTrade_{ij,t} = \beta_1 + \beta_2 lnGDP_t + \beta_3 lnReal_{ij,t} + \beta_4 lnThirdC_{jh,t} + u_{it} \quad (3)$$

Where $lnGDP_t$ is still the product of the GDPs; $lnThirdC_{jh,t}$ is the real exchange rate volatility for the Euro against the Pound Sterling, representing the aforementioned third country effect and acting as a proxy for uncertainty, in an attempt to measure the impact that Brexit can potentially cause in the UKs trade relations with Brazil; $lnReal_{ij,t}$ is the real exchange rate volatility for the Brazilian Real against Sterling; β_1 is the intercept term; and lastly u_{it} corresponds to variables not captured by the model.

2.5 VARIABLES AND DATA SOURCES

2.5.1 Dependent variable

As stated before, $Trade_{ij,t}$ in this model, similarly to Carmo and Bittencourt (2014), represents the intensive margin (the monetary value of transactions) of international trade between countries i (exporter) and j (importer) at time t. In order to calculate $lnTrade_{ij,t}$, data was collected through *Trademap* statistics – an online platform that provides trade indicators for 220 countries and territories – depicting the bilateral trade between Brazil and the UK in the selected period.

Considering that statistics from *Trademap* are available throughout a time series and cross-sections, the model previously discussed will be estimated through panel data analysis, which will be detailed subsequently.

With the intent to eliminate heteroscedasticity from trade data, a new variable was created based on suggestions from Yotov et al. (2016) to be estimated instead of the absolute values of exports. According to the authors, trade data are plagued with heteroscedasticity, and, according to Santos Silva and Tenreyro (2006) apud Yotov et al. (2016):

> "In the presence of heteroscedasticity (…), the estimates of the effects of trade costs and trade policy are not only biased but also inconsistent when the gravity model is estimated in log-linear form with the OLS estimator (or any other estimator that requires non-linear transformation)". (YOTOV et al, 2016, p.20)

The variable consists of weighting the exports by the product of the size of these two markets (Anderson and van Wincoop, 2003). Yotov et al. (2016) defines this variable as size-adjusted trade.

$$ExPonder_{ij,t} = \frac{X_{ij,t}}{Y_{i,t}\,Y_{j,t}} \quad (4)$$

Where $ExPonder_{ij,t}$ is the new dependent variable, representing size-adjusted trade; $X_{ij,t}$ is the exports value of the designated country in period t; $Y_{i,t}$ is the domestic product of country i and $Y_{j,t}$ the aggregate expenditure of country j (Yotov et al., 2016).

2.5.2 Independent variables

$Y_{i,t}Y_{j,t}$, representing annual GDP values for Brazil and the UK in the years depicted in this study, 2004 through 2018, were obtained through World Bank data[7].

It is known that exchange rate uncertainty can hinder international trade due to the instability affecting possible importation and exportation contracts, or leading more risk averse firms to relocate their

[7] Obtained via <https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2018&locations=BR-GB&start=2009&view=chart>

activity, reducing their presence in the country of the volatile currency (Dell'ariccia, 1998). Because of this characteristic, the volatility factor was seen as imperative for this econometric model.

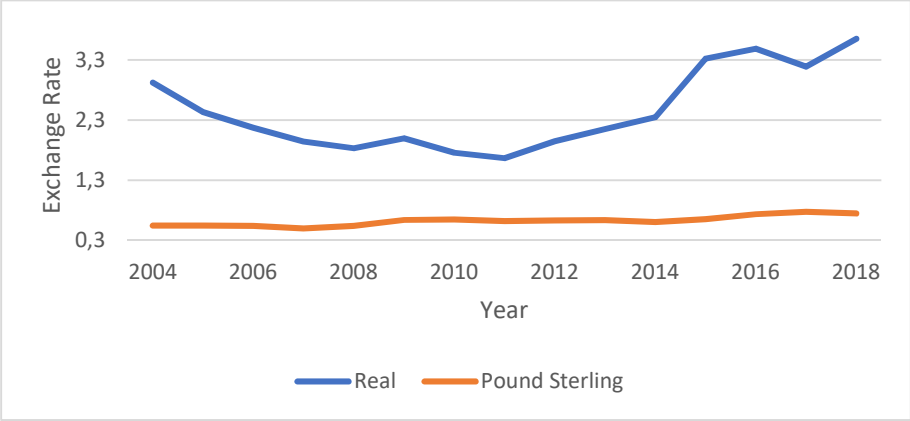
Similarly to other empirical studies (Dell'ariccia, 1998; Rose, 2000; Bittencourt and Correa, 2017), a way to measure bilateral real exchange rate volatility in time t is through calculating the standard deviation of the first difference of the natural logarithm of the annual bilateral real exchange rate between Brazil (country i) and the UK (country j) in period t, for a period of 2, 4 or 6 years.

$$Vol_{ij,t} = \delta_{ij,t} = \sqrt{\frac{\sum_{l=1}^{k}(x_{ij,t} - \bar{x}_{ij,t})^2}{k-1}} \qquad (5)$$

Here, $x_{ij,t} = \ln(X_{ij,t}) - \ln(X_{ij,t-1})$, where $X_{ij,t}$ is the real bilateral exchange rate and k is equal to 2, 4 or 6. Also, $\bar{x}_{ij,t}$ is the mean of the values of $x_{ij,t}$ in the last k years and $\delta_{ij,t}$ represents the standard deviation which is used as an estimate to exchange rate volatility.

Below is a graphic representation depicting the volatility results for the real exchange rate of the Pound Sterling and Brazilian Real. The Brazilian Real shows a larger variability than the Pound Sterling for the whole period considered.

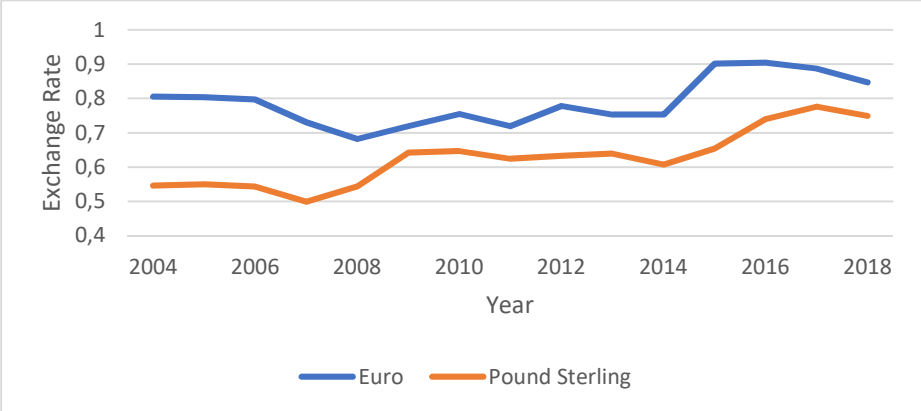
GRAPH 1 – EXCHANGE RATE VOLATILITY OF POUND STERLING AND BRAZILIAN REAL FOR THE PERIODS OF 2004 TO 2018



SOURCE: Elaborated by the author through data from Faostat.

Additionally, to the exchange rate between the two main trade partners, the exchange rate of the European Union was also seen as important for the model, as its fluctuation can also generate uncertainty and affect trade decisions. Due to its close relations to both the UK and Brazilian exports, this variable was calculated similarly to how the Pound Sterling and Brazilian Real volatilities were measured (equation 5).

GRAPH 2 – EXCHANGE RATE VOLATILITY OF THE EURO AND POUND STERLING FOR THE PERIODS OF 2004 TO 2018



SOURCE: Elaborated by the author through data from Faostat.

2.6 PANEL DATA ANALYSIS

Panel data or longitudinal data is a method of analysis containing time series observations, which can contain multiple events over multiple time periods. Yotov et al. (2016) asserts that panel data should be used to obtain structural gravity estimates whenever possible, since it tends to lead to improved estimation efficiency. According to Hsiao (2007), panel data usually contain more degrees of freedom and reduce collinearity among the chosen explanatory variables. An analysis through panel data has more sample variability than cross-sectional data which may be viewed as a panel with only one-time period, or time series data which is a panel with only one observation, hence improving the efficiency of econometric estimates.

In order to estimate the effects of exchange rate volatility in trade patterns between the two designated countries, the estimation contained 2724 observations distributed across all the available sectors at a two-digit disaggregation level (97 sectors), evaluating both countries export trends in the time frame determined (15 years). The sample was composed originally of 2910 observations, however exports values for 186 observations were null, therefore they were not considered when calculating the natural logarithm of the Gravity Equation, but were included when estimating through Poisson Pseudo Maximum Likelihood estimator (PPML).

Three different estimation techniques were tested: Pooled Ordinary Least Squares (OLS), Fixed Effects (FE) panel data analysis and Random Effects (RE) panel data analysis. The controlled time effects were also considered when analyzing FE and RE, in order to precisely capture any impactful events that could help explain trade behavior.

The Pooled OLS model consists of simply stacking all observations and estimate a "large" regression, disregarding the cross-sectional and time series nature of the data. However, according to Gujarati (2011), pooled OLS data can camouflage heterogeneity that may exist between observations. In other words, the error term may correlate with some of the regressors included in the model. If this happens, the estimated coefficients may be biased and inconsistent. On the other hand, if unobserved heterogeneity is not correlated with the regressors of the equation, the method of Pooled OLS provides unbiased and consistent estimates of the parameters.

FE estimations are based on the assumption that although the intercept may differ across individuals, each individual's intercept does not vary over time. According to Gujarati (2011), the difference between FE and RE models is that:

> "In FE each cross-sectional unit has its own (fixed) intercept value, in all N such values for N cross-sectional units. In RE, on the other hand, the intercept $\beta 1$ represents the mean value of all the (cross-sectional) intercepts and the error component εi represents the (random) deviation of individual intercept from this mean value". (GUJARATI, 2011, p648.)

It is also worth noting that the error term of the RE estimation should not correlate with any of the explanatory variables included in the model. If there is any correlation, the RE will result in inconsistent estimation of the regression coefficients. The Hausman test will then need to be performed, informing whether the RE or the FE model is the most appropriate (GUJARATI, 2011).

The Hausman test consists of verifying the statistical significance between the two methods. A statistically significant difference is interpreted as evidence against the RE assumption (WOOLDRIDGE, 2010), but the null hypothesis of the Hausman test is that the FE and RE estimators do not differ substantially (GUJARATI, 2011) and therefore one cannot be preferred by the other.

Additionally to the methods above, Santos Silva and Tenreyro (2006) advocate in favor of estimating the gravity equation in its multiplicative form by utilizing the Poisson Pseudo Maximum Likelihood estimator (PPML), since it is a convenient solution to the presence of zero trade flows and can also solve heteroscedasticity issues simultaneously. According to Mnasri and Nechi (2019), PPML is a special case of the Generalized Nonlinear Linear Model (GNLM) framework, where the variance is assumed proportional to the mean. When applying the PPML approach to the chosen gravity model, the equation is as follows:

$$ExPonder_{ij} = \exp\left[\beta_1 + \beta_2 lnGDP_t + \beta_3 lnReal_{ij,t} + \beta_4 lnThirdC_{jh,t} + u_{it}\right] \quad (6)$$

Where u_{it} is a log normal random variable with mean 1 and variance σ_i^2. Due to these suggestions, PPML estimators will be included when running the chosen gravity equation through panel analysis.

3 RESULTS

The present study seeks to capture the effects of volatility when a longer period is studied for volatility, derived from Brexit, on Brazilian sectoral trade with the UK. In Table 1 below, the statistical description of all variables is available.

TABLE 1 – DESCRIPTIVE STATISTICS OF THE VARIABLES

	N	Mean	Std. Dev.	Min	Max
lnTrade	2724	7.543	2.981	0	14.042
ExPonder	2910	0.007	0.020	0	0.220
lnGDP	2910	15.337	0.416	14.290	15.824
lnReal2	2910	-2.697	0.729	-4.614	-1.648
lnReal4	2910	-1.967	0.316	-2.523	-1.325
lnReal6	2910	-1.680	0.320	-2.298	-1.067
lnThirdc2	2910	-3.691	1.244	-6.108	-2.227
lnThirdc4	2910	-3.145	0.896	-5.505	-2.041
lnThirdc6	2910	-2.762	0.396	-3.340	-2.092

SOURCE: Elaborated by the author
lnReal and lnThirdc accompanied by 2,4 or 6 implies that a 2, 4 or 6-year volatility lag was used to generate these variables

As is evidenced by the description above, all variables are composed of 2910 observations. The only exception is $lnExport$ due to the issue of zero-trade flows mentioned in section 3.2.1. In a similar light, variable $ExPonder$ includes zero-trade flows, which is why it has a total of 2910 observations.

Table 2 reflects the panel data results for size-adjusted trade between Brazil and the UK from 2004 to 2018, with a 2-year volatility lag. Table 3 reflects the same result, but with a 4-year lag, and Table 4 with a 6-year lag. The results obtained through OLS pooled estimations can be found in the appendix of this study.

TABLE 2 – RESULTS OF PANEL ANALYSIS WITH A LAG OF 2 YEARS FOR VOLATILITY AND WITH SIZE-ADJUSTED TRADE

	Fixed Effects (1)	Fixed Effects (2)	Random Effects (3)	Random Effects (4)
lnGDP	-0.810***	-0.967***	-0.809***	-1.085***
	(-8.73)	(-8.10)	(-8.74)	(-9.13)
lnReal	-0.0714***	-0.133***	-0.0709***	0.0449
	(-2.73)	(-3.08)	(-2.70)	(0.68)
lnThirdc	-0.0400*	-0.0240	-0.0395*	0.0556
	(-1.85)	(-0.64)	(-1.83)	(0.43)
Fixed Time Effect	No	Yes	No	Yes
Intercept	4.285***	6.541***	3.980***	8.555***
	(3.12)	(3.81)	(3.02)	(4.82)

Hausman Test	10.29**	23.46**	10.29**	23.46**
N	2724	2724	2724	2724

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
SOURCE: Elaborated by the author

Through a 2-year volatility lag, it is shown that exchange rate volatility between Real and Pound Sterling – represented by $lnReal$ – is significant at 1% (excluding in the case of random effects and with time effects controlled) and is negative, incurring in less trade amounts whenever more volatility between Brazil and the UK is present, which is an expected result.

The exchange rate volatility (2-year lag) between the Euro and Sterling – represented by $lnThirdc$ – is significant at 10% and negative (when time effects are not controlled), which would indicate that Brexit happening could affect Brazilian trade relations with the UK by potentially reducing trade flows.

Although it is usual for an economy's expenditure to be positively related to trade flows, in this case, since variable $lnGDP$ is composed of the product of both countries' GDPs, the results are ambiguous and the variable's relationship with the dependent variable cannot be interpreted in that manner.

TABLE 3 – RESULTS OF PANEL ANALYSIS WITH A LAG OF 4 YEARS FOR VOLATILITY AND WITH SIZE-ADJUSTED TRADE

	Fixed Effects (1)	Fixed Effects (2)	Random Effects (3)	Random Effects (4)
lnGDP	-0.881***	-0.668***	-0.881***	-0.994***
	(-8.00)	(-7.06)	(-8.01)	(-8.53)
lnReal	-0.208***	0.152	-0.209***	-0.720**
	(-2.71)	(1.33)	(-2.71)	(-2.48)
lnThirdc	-0.0581**	-0.0471*	-0.0572**	-2.103***
	(-2.43)	(-1.84)	(-2.39)	(-4.39)
Fixed Time Effect	No	Yes	No	Yes
Intercept	5.127***	2.703**	4.825***	-
	(3.26)	(1.99)	(3.16)	-
Hausman Test	8.98**	62.33***	8.98**	62.33***
N	2724	2724	2724	2724

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.
SOURCE: Elaborated by the author

When using a 4-year lag, results begin to alter. $lnReal$ is again significant at 1% and remains negative when significant. When estimated with RE and time effects controlled, $lnReal$ is significant at 5%, and when estimated with FE and time effects controlled, it is not significant.

$lnThirdc$ is significant at a 5% level when time effects are not controlled, at 10% under FE assumptions and time effects controlled, and is significant at 1% under RE with time controlled. This variable remains negative with a 4-year lag through all estimations. A negative and significant estimator again withstands the assumption that Brexit induced uncertainties would generate fewer trade opportunities for Brazil and the UK.

TABLE 4 – RESULTS OF PANEL ANALYSIS WITH A LAG OF 6 YEARS FOR VOLATILITY AND WITH SIZE-ADJUSTED TRADE

	Fixed Effects (1)	Fixed Effects (2)	Random Effects (3)	Random Effects (4)
lnGDP	-1.412***	-0.800***	-1.414***	-1.185***
	(-7.58)	(-8.79)	(-7.59)	(-5.31)
lnReal	-0.833***	-	-0.836***	0.115
	(-4.95)	-	(-4.97)	(0.41)
lnThirdc	0.391***	0.0788	0.394***	0.648
	(3.82)	(0.98)	(3.85)	(0.68)

Fixed Time Effects	No	Yes	No	Yes
Intercept	13.54***	4.771***	13.27***	11.80**
	(4.78)	(3.17)	(4.73)	(2.07)
Hausman Test	12.54***	2.83	12.54***	2.83
N	2724	2724	2724	2724

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
SOURCE: Elaborated by the author

Table 4 presents the most interesting results. With a 6-year volatility period, $lnReal$ is now significant at 1% with time effects not being controlled as well as $lnThirdc$. However, the behavior of variable $lnThirdc$ has shifted, now becoming positive. With these results, it is possible to imply that with higher volatility between the Euro and Pound Sterling, or in other words, with the impact of Brexit, trade flows between Brazil and the UK should rise after a longer period of time. However, the same cannot be said when the time fixed effects are considered.

Table 5 represents the same variables, but with estimations through the Poisson Pseudo Maximum Likelihood estimator (PPML), again with a 2-year, 4-year and 6-year lag. Again, since PPML estimations can include zero trade flows, all 2910 observations are encompassed in the sample.

TABLE 5 – RESULTS OF PANEL ANALYSIS WITH SIZE-ADJUSTED TRADE THROUGH PPML ESTIMATIONS

	(1)	(2)	(3)
lnGDP	-0.462***	-0.493***	-0.941***
	(-3.53)	(-3.38)	(-3.18)
lnReal	-0.0725	-0.123	-0.627*
	(-0.89)	(-0.65)	(-1.73)
lnThirdc	0.0191	0.0213	0.411**
	(0.44)	(0.38)	(2.01)
Intercept	1.988	2.409	9.536**
	(1.00)	(1.16)	(2.15)
N	2910	2910	2910

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
(1) Using 2 lags for volatility; (2) Using 4 lags for volatility; (3) Using 6 lags for volatility
SOURCE: Elaborated by the author

Although through PPML estimations regressions using a 2 and 4-year lag do not present significant coefficient for $lnThirdc$ variable, when estimating with a 6-year lag it is significant at 5% and also positive, which aligns with the results from the panel data estimations for a 6-year volatility lag. Both results seem to confirm that the third country effect, with a longer period being considered when calculating volatility, is consistently positive and significant, and imply in greater trade relations after Brexit for the two studied economies.

4 CONCLUSIONS

The most recent literature on the topic of Brexit seems to be in a clear consensus that severing the ties that the UK has with the EU will bring forward negative effects, varying in accordance with the types of agreements the government chooses to make in the unfolding of this event. Even in a best-case scenario, author's such as Dhingra et al. (2016) and Kierzenkowski et al. (2016) argue that there will still be a negative impact to the British economy, even if in a smaller magnitude. Author's such as Gallegati, Giammetti and Russo (2019) and Brautzsch and Holtemöller (2019) illustrate how a negative shock in the UK's demand for final and intermediate goods will ripple down to the rest of the interlinked global chain, affecting many different countries inside and outside of the EU.

Political and economic uncertainty has already been a relevant topic in the minds of consumers and entrepreneurs alike, as discussed by Bloom et al. (2019). This reaction encompasses not only residents of the UK, but also firms and entities situated in other nations that are suppliers of the UK, being that of goods, services or labor. This will likely lead to the UK having to seek supply elsewhere – again, the magnitude of this effect depends on the nature of agreements – which is a problematic factor for them, since they have become more specialized in services and more dependent on foreign supplies of goods (Mulabdic et al. 2017 and Giammetti 2019).

This has led to the importance of this study, an attempt to use the exchange rate volatility between the UK and the EU as a proxy for the uncertainty caused by the news of an imminent Brexit in the trade relations of the exiting nation with Brazil. The main results obtained by the estimations of this study suggest that the Brazilian trade flow towards the UK is directly and significantly affected by the volatility of the exchange rate between Brazil and the United Kingdom and by the GDP levels of both countries. As expected, product growth contributes to increase bilateral trade towards the United Kingdom, and the volatility between the Real and the Pound Sterling contributes to a decrease in trade flows.

Exchange rate volatility of EU countries against the UK's (also considered as a third country effect) seems to affect Brazilian trade in different ways, varying according to the volatility lag that was considered. According to the panel data analysis, as a measure of exchange rate volatility, the third country effect was statistically significant at 2, 4 and 6-year volatility lag levels of estimation. This variable was shown to have a surprisingly positive and significant influence on trade from a 6-year lag standard, suggesting that exchange rate variability between the UK and the EU contributes to greater Brazilian export opportunities to the UK. However, when using smaller intervals for exchange rate volatility calculations, the third country effects were consistently negative.

When analyzing the third country effect as a form of measuring uncertainty, and therefore as a proxy for the Brexit impact, these results imply that these effects take some time to return positive results to Brazilian trade relations with the UK. When a shorter period is considered, Brexit affects Brazilian exports negatively, but with an extended period analysis, effects tend to be positive. Even though Brazil's trade relations with the UK is not one of the most expressive, the results when analyzing a longer period for volatility could imply in further trade opportunities and agreements between the two economies under the hypothesis of a Brexit.

Future opportunities to extend this study should seek to use data with a higher level of disaggregation, as well as other proxies for the Brexit impact and other methods of obtaining volatility indicators, in order to corroborate or refute the findings of this study. Regarding the empirical approach, an analysis based on different econometric techniques such as exploring instrumental variables is another interesting option. Extended studies should also be conducted after the Brexit is effectively enacted, since, at the time of this study, the details of the departure of the UK from the EU is still being debated politically and the UK remains a member.

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APPENDIX

TABLE 6 – RESULTS OF POOLED OLS ANALYSIS WITH A LAG OF 2 YEARS FOR VOLATILITY AND WITH SIZE-ADJUSTED TRADE

	OLS	OLS with Third Country Effect	OLS with Time Effects
	(1)	(2)	(3)
lnGDP	-0.791***	-0.776***	-1.089***
	(-6.02)	(-5.85)	(-5.35)
lnReal	-0.0931	-0.0632	0.0568
	(-1.15)	(-0.68)	(0.22)
lnThirdc	No	-0.0348	0.0832
		(-0.67)	(0.16)
Time Effects Controlled	No	No	Yes
Intercept	4.082**	3.805*	8.987***
	(2.06)	(1.89)	(2.64)
N	2724	2724	2724

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
SOURCE: Elaborated by the author

TABLE 7 – RESULTS OF POOLED OLS ANALYSIS WITH A LAG OF 4 YEARS FOR VOLATILITY AND WITH SIZE-ADJUSTED TRADE

	OLS	OLS with Third Country Effect	OLS with Time Effects
	(1)	(2)	(3)
lnGDP	-0.881***	-0.874***	-1.144*
	(-5.47)	(-5.42)	(-1.64)
lnReal	-0.285	-0.266	0.442
	(-1.31)	(-1.21)	(0.20)
lnThirdc	No	-0.0448	1.153
		(-0.70)	(0.15)
Time Effects Controlled	No	No	Yes
Intercept	5.154**	4.944**	13.32
	(2.30)	(2.20)	(0.40)
N	2724	2724	2724

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
SOURCE: Elaborated by the author

TABLE 8 – RESULTS OF POOLED OLS ANALYSIS WITH A LAG OF 6 YEARS FOR VOLATILITY AND WITH SIZE-ADJUSTED TRADE

	OLS	OLS with Third Country Effect	OLS with Time Effects
	(1)	(2)	(3)
lnGDP	-0.981***	-1.480***	-1.206
	(-4.80)	(-4.93)	(-1.41)
lnReal	-0.386	-0.949**	0.174
	(-1.41)	(-2.56)	(0.15)
lnThirdc	No	0.484**	0.821
		(2.25)	(0.22)
Time Effects Controlled	No	No	Yes
Intercept	6.605**	14.65***	12.95
	(2.37)	(3.25)	(0.59)
N	2724	2724	2724

t statistics in parentheses; * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$
SOURCE: Elaborated by the author