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United Kingdom's exports following Brexit

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Bachelor Thesis

January 2017

Abstract

This paper investigates the effects of Brexit on export performance of the United Kingdom towards the rest of the EU15. It does so by first establishing a "hard Brexit" as the probable outcome. Using the gravity model it then establishes the effect of variables such as distance and GDP per capita on exports. These effects are found by running the regression on a sample of four non-EU countries during the period 1995-2012. This regression results in fitted values that when adapted to the United Kingdom estimates potential exports. These potential exports are significantly lower on average than actual exports during the time period. If the trend continues the United Kingdom would face a 2% reduction of relative trade on average due to trade effects of Brexit.

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Introduction

Following the Second World War and its devastating effects on the European continent, Europe has strived to integrate economically to avoid future conflict and to attempt to mend the damages that had been inflicted. Over the last 70 years this has progressed rather far. In the 21st century 28 European countries are integrated in a so called common market which spans the European continent. This development is impressive but it may be about to change. European economic integration has reached a pivotal point in its history as Euroscepticism is brewing. One threat is the Brexit vote of 2016 in the United Kingdom (UK) which may have harsh consequences. The outcome of this Brexit is and will be debated for quite some time as it has consequences not only for the UK but for economic integration as a whole. If Brexit can be shown to have significantly negative effects as the country moves away from the European single market towards economic isolationism it may act as an example for countries with similar tendencies. For this reason, the Brexit debate - or at least the debate in the aftermath of Brexit, is relevant for Europe as well as the world as a whole.

In this paper we aim to predict what could happen to the exports of the UK towards the European Union (EU) once it has left the union. By conducting an historical investigation with the help of the gravity model we will be able to make such a prediction. This by finding out how much smaller trade would be in recent history if the UK would not have been a part of the union. It is however worth mentioning that our results of the impact on the UK economy are quite limited as we limit our analysis to trade towards the EU14. Not included are consequences for trade with the rest of the European Union or the effects of not being included in the large labor and capital pool that is the single market, as well as trade towards the rest of the world. As a part of the EU the UK has not had an independent trade policy for decades since the EU has a common trade policy (Baldwin et al., 2015, page 46-47) and as a part of leaving the union the UK will also be forced to abandon trade agreements signed as a part of the EU. What this will mean for the UK and trade is an interesting and valid discussion, one that will unfortunately not be covered by this paper.

Much of our discussion will be centered on results using a statistical analysis with the help of STATA, a program and tool for conducting statistical analysis. The model used will be the Gravity model which will be extensively discussed and explained later on in the paper. By using this Gravity model applied to four non - EU countries with certain similarities of the United Kingdom towards the EU14[1] we hope to achieve indicators for variables that are thought to affect trade. By applying these indicators on the UK for the years 1995 up to 2012 we calculate a potential non-EU membership trade. The trade figures that we will be using are cross-country data for exports of goods. This potential trade will then be compared to the actual trade at the time. It is our initial guess that Brexit will lead to lower exports consequently towards the EU14. However, this is a mere speculation based on theoretical understandings of world trade and economic integration. The actual conclusions at the end of this paper will be based on a statistical analysis and will therefore be more valid.

This paper will begin with a quick description of the Brexit phenomena, where we discuss the general theoretical implications of such a move as well as the possible outcomes besides the "hard" Brexit and why we assume this to be the logical solution. We will then move on to discussing the Gravity model, how it is built and what variables we have used in constructing our model. In the later sections of the paper our results will be published and discussed.

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[1] EU15 minus the United Kingdom.

Brexit

"Brexit" implies a British exit from the European Union as a whole, the political institutions, negotiations and perhaps most importantly the single market. The exit from the single market is the basis of a lot of concerns for the UK economy.

The single market within the European Union is the result of European economic integration. It has its roots in 1957 in the Rome treaty which specified the intentions to create a unified economy where consumers, producers, capital and labor from all different countries were treated equally (Baldwin et al., 2015, page 45-46). This has paved the way for the "Four freedoms" which make up the single market today. These freedoms are the freedom of movement for people, goods, services and money within the union. Basically, the now 28 countries act as they are one, as far as markets are concerned. However, some barriers to trade remain such as tax systems which are still different for each member state (European Commission, 2016).

With the four freedoms in place, goods services, money and people can cross any border. The freedom of movement for money as well as financial services might prove to be a pivotal part of negotiations between the UK and the EU in the future while freedom for people to cross borders has been a decisive reason for why the UK would want to leave the union. Another key reason for leaving is contributions to the EU's budget. First of all, the United Kingdom's vote to leave the EU was in part a vote for restricting the freedom of movement for people, believing that (especially eastern) Europeans living and working in the country were contributing to economic hardships for the British-born population. Secondly, the money which the UK provided to the EU's budget was thought to have better uses domestically (Hunt & Wheeler, 2016). While it is true that the UK is one of EU's largest contributors (Statista, 2016), this paper will not concern itself with the validity of these arguments, but merely inform the reader of which issues were important for the leave campaign and decision.

These two major reasons for desiring a Brexit are important to keep in mind when discussing potential outcomes of it. There are several different outcomes for UK-EU relations discussed

today, these differ from preferential trade agreements (PTAs) of different levels of complexity to an arrangement without a PTA[2]. These outcomes are discussed as:

- The Norwegian solution
- The Swiss solution
- The Turkish solution
- The Canadian solution
- The WTO solution

Worth mentioning is also the fact that the EU has strong strategic (as well as sentimental) reasons not to allow the UK to come out as the winner from negotiations with the EU. Partly because of the bad blood which has been created during the Brexit debate but mostly to act as a deterrent for other member states who would wish to exit. If the EU shatters dreams of a great deal for the UK, other exit-movements throughout Europe will have a harder time arguing for an exit. This is especially true when it comes to the four freedoms. The four freedoms are seen as being the core of any European deal and it will be hard for the UK to convince the EU to split up these freedoms into four separate pieces of negotiations. Guy Verhofstadt, the EU parliament's negotiator for Brexit had this to say to a reporter from Reuters in late November of 2016:

"These four freedoms are key, they are a basic element of the European Union… We will certainly not accept whatever development where these four freedoms at put at risk" (Blenkinsop et al., 2016).

Leaving the single market will lead to a disadvantage in trade because of raised costs of exports as well as imports due to higher tariffs, not to mention other barriers such as differences in regulations. The UK will go from a situation where they do not have to pay taxes on their exports[3] to EU14 countries to a situation where they do. Such a move would not only make the exported goods more expensive on the European market (and as a consequence less competitive) but UK exporters would also receive less profit as the EU border price decreases (van Marrewijk, 2012, pages 161-162). This loss of competitiveness is the main

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[2] The term "PTA" simply stands for "Preferential trade agreement" and indicates that the two countries have made a deal to somehow increase bilateral trade.

[3] A tax on exports is in this case a tariff.

reason for why it is believed that a Brexit should results in fewer exports from the UK to EU14.

The Norwegian solution

Norway is both inside and outside the EU. While not being a full member it has access to the single market. This also means that Norway accepts the four freedoms of the single market. Norway as a non-member of the EU contributes to the budget of the EU: "Access to the common market is not free." (Busch & Matthes, 2016, page 32).

We do not consider this as a likely outcome. Partly because of the fact that the EU would perhaps not want to grant the UK such a deal but also because the UK would probably also not be satisfied by it. If the UK wanted a solution such as the Norwegian one, it would still have to allow for the free movement of people and contribute to the budget of the EU. This would probably not be too popular in the UK as the only noticeable change would be that the UK would be left out of EU - negotiations.

The Swiss solution

The Swiss relationship with the EU is a rather complex one. It is built up around approximately 120 trade agreements. Together they amount to a Switzerland which has substantially lower integration than Norway, while still having access to most of the Single market. Between Switzerland and the EU three out of the four freedoms have been enacted, the trading partners have not been able to reach an agreement concerning the freedom of movement for services. Like Norway, the Swiss provides the EU with funds as a payment for access to the single market (Busch & Matthes, 2016, page 32-34).

However, this was meant to be a transitory arrangement before the accession of Switzerland as a full member of the EU. This makes it highly unlikely for the EU to allow the UK such a deal, even if it did not have strategic reasons not to (Busch & Matthes, 2016, page 32-34).

Secondly, just like in the Norwegian case, the Swiss solution includes some of what the Brexit vote wanted to avoid while excluding the perhaps most important point for the UK. What makes this solution much worse for the UK than the Norwegian one is the fact that the

freedom of movement for services is not included. Trade in services and especially financial services are important for the UK, notably for the city of London which is considered the financial capital of Europe.

The Turkish solution

Turkey is currently in a customs union with the EU covering the tariff-free movement of manufactured goods and processed agricultural products, but no other goods or services. However, Turkey does stand outside the single market of the EU. Because of this they do not have to comply to the same extent with EU regulations and rules on services or movement of people (Busch & Matthes, 2016, page 34).

Membership of a customs union might give the UK an opportunity to retain several advantages such as free movement of goods and not being required to comply with certain EU policies. They would also not be required to contribute to the EU budget. However, a customs union such as this one would not include free trade in services. The UK would have to counteract this in some way through a separate trade agreement. The negotiating power of the UK would be quite weak, and it might be hard for them to achieve free movement of services without complying with other EU regulations. (Busch & Matthes, 2016, page 34-35).

Likewise, the UK would have a significantly reduced negotiating power with third party countries. The UK would not get as comprehensive access to the markets of third party countries that have PTAs with the EU. As a weaker negotiator, the UK will be worse off than if they were part of the single market. This is because Turkey, as a substantially weaker member in a customs union, committed itself to having the same tariffs towards third parties while negotiating separately with said countries (Busch & Matthes, 2016, page 35).

The Canadian solution

In late 2014 negotiations of the Comprehensive Economic Trade Agreement, or the CETA for short, was finished. The CETA is a deep[4] trade agreement between the EU and Canada that has been implemented in late 2016 (European Commission, 11-2016).

The Canadian solution has a lot of pros and cons for a country such as the United Kingdom. First of all, the market access that such an agreement would provide is perhaps the most extensive that the UK can hope for without having to pay for access to the single market by allowing for labor immigration and contributions to the EU budget. On the other hand, Norway and Switzerland do get significantly better market access and the conditions for service trade would be uncertain but worse.

However, this solution is highly unlikely to be accepted by the EU bloc. Again, the EU does have strategical reasons for not wanting to give the UK a generous deal that fulfills their wish list. Add to this that such a deep FTA would likely take many years to negotiate. Negotiations on CETA started in 2009 and the EU did not vote on it until late 2016 (European Commission, 4-2016). Additionally, the CETA was close to failing at the finish line as it did need approval from all member states. The Belgian region of Wallonia almost stopped the whole agreement before approving the document as the last obstacle to it being enacted (Economist, 10-2016). A deal between the UK and the EU would probably face similar issues as CETA did. Probably, the agreement will be unpopular in some regions of Europe.

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[4] The concept of "deep integration" refers to integration that is not limited to raising existing barriers to trade, but also creates new common institutions (Hoekman & Kostecki, 2009, page 502).

The WTO solution - the "hard Brexit"

Even though the countries within the EU generally negotiate as only one party in World Trade Organization (WTO) negotiations, each country is a member on its own. This means that if there is no other solution in place when the UK leaves the EU, the UK will trade with countries within the EU as a member of the WTO. As a member of the WTO, they will face MFN-tariffs[5] like any other WTO-member who does not have a trade agreement with the EU. With this solution, the UK will sever all ties to the EU, they will not have to comply with any EU-regulation that they do not want to comply with and they would not have to contribute money to the EU budget (Busch & Matthes, 2016, page 36).

However, firms in the UK will now face a more limited access to the single markets as the four freedoms would also not apply to the UK anymore. This will be negative for the import and export firms of the UK since there will not be any freedom of movement for goods and services, but they would also be able to stop any labor immigration from other EU countries because they would no longer have to comply with the freedom of movement for persons (Busch et al, 2016, page 36). In fact, the UK would have some of the world's worst trading conditions with the union since it would be one of a very select few trading partners not to have a PTA in place with the EU (European Commission, 2015).

As this solution is the default one, and because of the fact that the rest of the solutions are not probable, we believe that this is what will happen. We have therefore based our statistical analysis on the characteristics of this outcome.

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[5] The MFN tariff, or the "Most favoured nation" tariff is the tariff which face all countries who do not have any kind of PTA with a certain country (Hoekman et al., 2009, p .41-42).

Gravity model and methodology

Theoretical foundation

Just as the name would suggest, the gravity model of international trade can be explained through Newtonian thinking. The rough interpretation of this model is that bilateral trade is determined through size of the relevant economies and their distance from each other (Bacchetta et al., 2012, page 103). In the article "Free exchange: Down to Earth" (Economist, 2016) it is argued that the gravity model should be taken more seriously in the post-Brexit debate. It criticizes some of the logic used by Brexit supporters as well as dismisses some criticism towards using the gravity model in the Brexit case. First of all, the article responds to the Brexit argument of replacing lost EU trade by expanding trade with emerging countries by observing the logic of the gravity model: the EU is close, the rest of the world is far away. Secondly, as a response to the criticism of distance as being an obsolete variable for trade the article reminds the reader that the UK does in fact export far more to the EU than to the US (Economist, 2016). It would seem that using and understanding the gravity model is befitting when discussing the implications of Brexit on trade.

The theoretical basis of the gravity model has been a source of some research throughout the late 20th and 21st century. One view was formulated by an economist named Anderson (1979). The theory presented by Anderson renders a situation in which the gravity model has its theoretical basis in a world where all countries trade and goods are differentiated between countries. In this reality, consumers are assumed to have some demand for and consume all goods from each country. These first assumptions result in a situation where a country's income is derived from both domestic and foreign demand and therefore larger countries are assumed to have more trade, since they produce and demand more. Trade costs are in this situation seen as the risk of a shipped good not reaching its destination and does increase with distance traveled (Bacchetta et al., 2012, page 104). Add to this logic the contribution of Anderson and Wincoop (2003) that showed that it was necessary to add relative trade costs along with absolute trade costs. These relative trade costs, also known as "multilateral trade-resistance" (MTR) explain why bilateral trade might be lacking due to the fact that any two countries are not only trading with the other (Bacchetta et al., 2012, page 105).

Additionally, a gravity model, or equation, usually contains proxy variables for other social or otherwise non-numerical variables that may induce or repress bilateral trade. These could for example be if the countries share a language, a border, a history, a culture or a trade agreement (Bussière et al, 2005, page 15). Such variables, although not numerical, can be accounted for in a statistical analysis by using dummy variables.

Another thing to consider while setting up a gravity framework is that you would preferably like to use data not only for different countries, but also for different time periods. Therefore, it is fitting to use the natural logarithm of your gravity equation and thereby create linear results from a regression. The linear results are not only easier to interpret and handle, but also more viable to adapt on a third party such as the UK in our case.

There is some variation in which actual gravity model, or equation, is used. One example is:

$$X_{ij} = \frac{Y_i Y_j}{Y} \left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}$$

or

$$lnX_{ij} = a_0 + a_1 lnY_i + a_2 lnY_j + a_3 lnt_{ij} + a_4 ln\Pi_i + a_5 lnP_j + \varepsilon_{ij}$$

where "ε" is the random error term, the denoted "i" and "j" stands for country "i" and country "j", X is exports from country "i" to country "j" and Y means GDP. "1-σ" represents elasticity of substitution, Π and P represents ease of market access. Finally, t denotes the cost of importing goods from country i to country j. This can be seen as an absolute cost, increasing strictly with distance. However, when put relatively to both ease of access to markets as well as elasticity of substitution it also represents relative and multilateral trade costs (Bacchetta et al., 2012, page 105-106).

Earlier applications of the gravity model concerning potential trade

In 2005, Bussière et al. wanted to see if the rapid trade integration between the euro area and the central and south eastern European (CSEE) countries would continue. To do this they employed the gravity model and used a sample of 61 countries' bilateral trade flows between the years of 1980 and 2003. They used a subsample of only OECD countries to estimate the model parameters and then used these parameters to estimate the potential trade value for CSEE countries. By using this method, they argue that they avoid getting distorted results. They also modify the gravity model with variables for common language, common border, if countries used to be part of the same territory and if they participate in a free trade agreement. Furthermore, they choose to look at fixed effects between countries to account for unobservable factors (Bussière, M. et al., 2005).

Bussière et al. conclude that the rapid trade integration with the euro area is likely to decrease in the coming future, since the countries in CSEE are moving closer to their estimated potential, and some small countries in SEE might have a bit more to go before they reach their potential. Furthermore, they stress that if you fail to account for heterogeneity between countries or transitional periods such as the immediate time after the fall of the Soviet Union, it might lead to distorted results (Bussière, M. et al., 2005).

Christos Papazoglou (2007) investigates if Greece's low openness and trade integration is a result of the poor export performance of Greece. He does this by (similarly to the approach of this paper) applying the gravity model to a sample of other EU countries and their most important trading partners. The result from this regression was applied to Greece in order to produce a potential trade and compare it to actual trade. Papazoglou constructs his gravity equation using GDP and population for both countries, the distance between them and dummies for common borders, EU membership as well as a measurement for intra-industry trade.

Papazoglou concludes that the actual exports of Greece are far lower than the potential trade, both towards other EU states and third countries. One explanation mentioned for poor trade performance towards the other EU countries and the seeming failure to take advantage of the

single market is the geography of Greece which has no shared land border with any EU country (Papazoglou, C. 2007).

Building our equation

When building the initial regression, or gravity equation, we chose countries that were comparable or preferably similar to the UK. This would allow for a minimization of the number of included variables and achieve stronger results. By using the four countries Canada, New Zealand, Australia and USA we achieve this. First of all, these are all old colonies of the UK, meaning that the historical ties to the EU14 are not as apparent. Secondly, these countries share similarities with the UK such as having the same language, not being landlocked and not having a land border with any of the countries within the EU14[6]. These countries all have independent currencies as well as having a high GDP per capita. It is also possible to argue that these five countries share a common culture. Thirdly, none of the four chosen countries have any significant trade deals with the EU, at least not during the time for which we have collected data, meaning that they all export to the EU at MFN tariffs[7].

After selecting these sample countries, the final equation becomes fairly straight forward. We choose to include the mass (M) as the sum of importer and exporter GDP, both countries' GDP per capita and the distances between the capitals of the two countries[8] as explanatory variables for the exports of goods (X) from the reporter country to the importing partner country. The GDP per capita of exporter and importer as well as the mass represents demand, supply and the gravity between the two countries, respectively. The distance represents trading costs. We choose to include the mass as a term because of the fact that we are interested to see if the combined size of the two economies would affect trade. In doing so, we can try to interpret if size or distance is more important for continued trade, if, for example,

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[6] Excluded is the border between Northern Ireland and Ireland, something we are aware of. We do however choose to proceed with not having a dummy variable for land borders.

[7] Worth mentioning is that Canada and the EU has signed a trade agreement during late 2016 as mentioned earlier, as well as the fact that Australia and the EU has a trade facilitation agreement in place. A trade facilitation agreement is interesting but not too relevant. It is focusing heavily on service trade and investments (European Commission, 4/2016). Our export data is solely for the exports of goods.

[8] Using capitals may be misleading considering the sheer size of explanatory countries. However, this is a practice that is used within economic research using the gravity model (Papazoglou, C. 2007, page 408). This does make sense as it in ways represent the political or social distances between countries. Additionally, considering the USA and Canada their capitals are located close to their eastern Atlantic border from where it is perhaps reasonable to assume that trade with Europe would be centered.

the UK will lose relatively more exports to Germany or Belgium. Other notable researches with the gravity model choose to separate the two GPDs, such as Anderson and van Wincoop (2003) or Papazoglou (2007). It is however not unheard of to use the sum of GDPs in a gravity model, a notable example of this is Bussière et al. (2005) who applied this method.

However, this equation needs to become more robust. First of all, we are investigating a timeframe from between 1995 to 2012. This leads to a risk of business cycles affecting the regression. These business cycles could be local or global, such as the financial crisis in the late 2000s which saw international trade suffer. Therefore, a year dummy is needed and introduced.

Additionally, it is necessary to correct for MTRs (multilateral trade resistance) in some way. This is crucial as we are not just investigating bilateral trade between two countries in a vacuum. The regression takes into account the exports of four countries towards fourteen importing countries. Benedicti and Vicarelli (2005, page 7) also argue for the importance of checking for country specific effects. It is reasonable to assume that consumption preferences vary within these fourteen countries depending on what the country of origin is. This could be a cultural phenomenon in which, for example Swedish consumers would value American imports higher than those from New Zealand. It could also manifest as a political demonstration in which consumers in a specific EU country does not agree with policies or methods of production[9] and therefore disregard products originating in that country. In any case, allowing for MTRs is the logical thing to do and in this case an importer dummy is introduced. This importer dummy will help separate the sought after general trade effects of the variables from the country specific effects. Using a country dummy to adjust for country specific effects could also help correct for some endogeneity problems in the data due to variables being left out (Bacchetta et al., 2012, page 118).

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[9] A notable example of a production processed that has threatened global trade is the one concerning Chlorinated Chicken produced in the US. Europeans have reacted with force to this practice and the chickens have become a symbol of opposition to a trade agreement between the two major blocs (Faiola, 2014).

The final equation becomes:

$$lnX = c + lnM + lnGDP \text{ } per \text{ } capita \text{ } exporter + lnGDP \text{ } per \text{ } capita \text{ } importer \\ + \ln dist + yeardummy + importerdummy + \varepsilon$$

where c is a constant.

Our initial predictions of the coefficients for these variables, their elasticity, is that the mass and GDP per capita for both countries should be positive while the distance should be negative. This is because we believe that an increase in either mass or GDP per capitas should lead to more exports while an increase in distance would make it more expensive to trade, leading to less export. However, not all of these variables are equally important or equally interpretable. Firstly, we do not find the constant or coefficients of either the constant yeardummy or importerdummy relevant as the dummies are included as a way of controlling for non-included effects. Secondly, the mass and the distance are the key variables as they are the foundation of the gravity model, distance and size. Thirdly, the GDP per capita terms are hard to interpret. We include them as a way of measuring demand level but we realize that such a measurement is much more complicated[10]. The GDP per capita term, as it stands, includes both income and population. Furthermore, GDP per capita is perhaps not a solid measurement for trade in goods as richer economies tend to export and import relatively more services.

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[10] A proper measurement of demand should perhaps include purchasing power (as a PPP measurement) or exchange rates. However, since all income is measured in dollars we have skipped the inclusion of exchange rates and an add on of a PPP measurement will have to also include such things as inflation or perhaps taxes. This would make the equation and the measurement far too complicated as well decreasing its relevance for our main task.

Data

Our data for GDP and population were collected from the World Bank, distance was collected from CEPII and total trade from the UN Comtrade database. GDP in this case is nominal income, measured in dollars. Trade values are also measured in dollars. The data covers the years 1995 until 2012[11] and our total number of observations amount to 988 when not including the UK as an exporter, meaning, when running the initial regression. There is of course some correlation between the explanatory variables for demand (GDP per capita) and mass as they both include the GDP measurement. However, for mass, the GDP measurement of one country is blended with the same value for the second country and for GDP per capita the GDP measurement is complemented by population.

A common critique of using the gravity model is the issue of reverse causality or endogeneity. Meaning that a large trade flow may be what causes a large GDP and not the other way around as stated in the gravity model. An article from the Economist in 2016 argue that this critique is misplaced and that the gravity model in fact has been able to predict actual world trade rather well (Economist, 2016).

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[11] Except for the case of Luxumbourg as the UN Comtrade database did not have full data for all of the measured years.

Results

Table 1 is the result from running the above established regression in STATA. Most variables are within relevant at a 5% level and the "R-squared" measurement (also known as goodness of fit) is remarkably high. The R-squared variable ranges between 0 and 1 where 1 is a perfect fit. A value of 0.926 is therefore a promising result, one that tells us that we can trust the results of our regression when predicting potential trade.

The results are mostly in line with previous predictions. The coefficients for the sum of exporter and importer GDP (lngdpsum) and exporter GDP per capita (lngdppc_rep) are positive. The coefficient for distance (lndist) is negative, also in line with predictions. However, the coefficient for importer GDP per capita (lngdppc_part) is negative. This is to us rather surprising, but as mentioned earlier the term for importer wealth level (GDP per capita) is hard to interpret. It is however not a variable that counts as it is not statistically significant. This is because the "P>|t|" value is large for the GDP per capita of the importer country, 0.738. This number indicates that the variable is not significant and can be discarded. This result is in itself rather surprising as you would assume that an increase in GDP per capita with an importer would lead to more imports. Initial interpretations of this above result are that an increase in importer demand level would lead to a lower export. This seems unlikely in itself. Since the variable can be discarded from a statistical standpoint, the more realistic and accurate interpretation is that the differences in importer GDP per capita is covered by the year- and importerdummy. These were added to correct for country-specific effect and in this case they have done just that.

It is important to remember that the coefficient for importer GDP per capita is also a relatively small number at -0.0894746 compared with the effect on exports from an increase in mass (1.073555) or distance (-.8694319)[12]. As expected, distance and mass are dominating the effects on exports, well in line with the theory.

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[12] This number is in the spectrum in which the WTO defines as the "usual" spectrum, ranging from -0.7 to -1.5 (Bacchetta et al., 2012, page 127).

Variable	Coefficient	95% coefficient interval min-value	95% coefficient interval max-value	P>|t|
lngdpsum	1,073555	1,011084	1,136026	0
lngdppc_part	-0,0894746	-0,614268	0,4353187	0,738
lngdppc_rep	0,3832162	0,0767698	0,6896626	0,014
lndist	-0,8694319	-0,9763708	-0,762493	0
Constant	-6,308368	-12,5671	-0,0496379	0,048

Table 1.

With these results in place it is possible to predict a potential trade for the UK during this time period. Lastly we divided this potential trade with the actual trade and found the "change in exports" variable used below. The change variable indicates how much UK would export to each country a specific year divided by how much they actually exported. Therefore, a change result of .95 in 2010 indicates a potential trade that is 5% lower than it actually was, or in the context of this paper: an exit from the EU before 2010 would have resulted in a 5% decrease in exports during 2010. This is done for every importer and every year.

Table 2 and 3 are summaries of the change variable for all importers and during every single year. Table 2 tells us that at most the UK could lose 8.2% or gain 5.2% exports, depending on the importer and year. Table 2 also tells us that the mean change during this period and for all importers is .9805, almost a 2% relative decrease in exports. As the years are treated separate because of the year dummy, both mean value and min/max values are relevant. These numbers are interesting in themselves but it is however important to realize that they may be for different countries during different years and perhaps most importantly that they are relative changes. That means that they do not conclude if total trade would have increased or decreased. However, it is worth mentioning that except for the Netherlands, France and

Belgium the change variable is consistently below 1 for the remaining 11 countries, hinting that total trade would decrease as well. This will be discussed later.

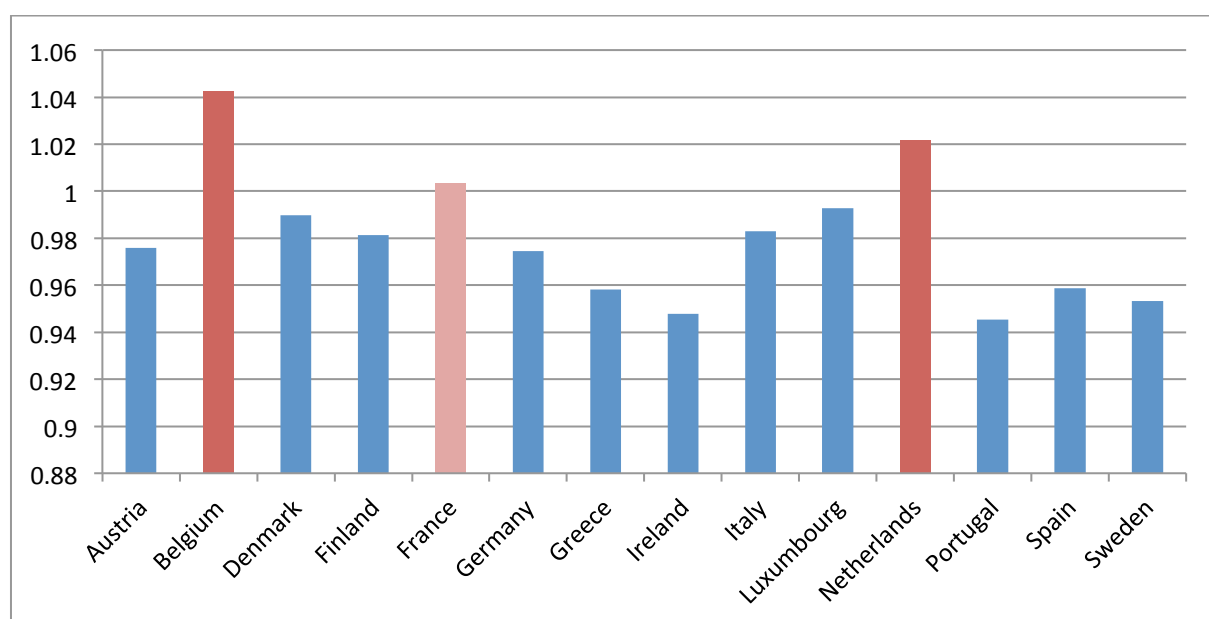|	Obs	Mean	Min	Max
Change in Exports	248	0,9805061	0,9184314	1,052828

Table 2.

Table 3.

Below we have chosen to present change over time for a select group of importers. These importers stick out from the rest due to interesting results. The tables are summaries for the change variable over the entire period.

Furthermore, looking at the data for all of the importers, many of them have in common a sharp decline in potential trade when approaching the late 2000s. We interpret this as being a result of the financial crisis of 2008 which rocked the world economy and had large effects on world trade. It is perhaps because the EU economy turned inwards during the period, trading more amongst themselves. This would explain why the potential trade relative to actual trade decreased as it stems from a regression of non-EU countries. This is in itself an ominous sign for the UK as it may find itself being left out during similar circumstances in the future.

When looking at results for specific countries we found some interesting results. We found that for Belgium, France and the Netherlands, the potential trade under MFN tariffs is actually higher than the actual trade during this period. We believe that this is because the distance between countries plays a big role in our prediction and since these three countries are relatively close to the UK they would increase their trade according to our model. It also seems to suggest that, since the UK would face the same tariffs across the board, distance is more important than mass since countries like Germany have a lower relative potential trade than Belgium[13]. This could mean that the UK will divert its trade from bigger countries on the continent, to smaller ones in the closer coastal proximity. This does however not imply that a positive change in relative export to these three exceptions would outweigh the potential losses from a relative decrease in exports towards the rest of the EU14. For example, a larger relative increase in exports to Belgium and a small decrease in exports to a larger economy such as Germany would probably still result in a total loss of exported value.

Contrary to this point is the example of Ireland. Ireland is indisputably close to the UK, but the potential relative export to Ireland from the UK falls instead of rises. First of all, this might be a result of how we calculated distance, London is actually closer to Brussels than Dublin. Secondly, in our regression we did not account for common borders, but since Ireland shares a border with Northern Ireland, this might skew the result in a negative way for Ireland. However, to estimate the potential export for the UK, we used countries that share no border with any of the countries in EU14, which means that the result might have been the same for Ireland even if we would have accounted for common borders.

	Obs	Mean	Min	Max
Change in Exports	18	1,042656	1,03113	1,052828

Table 4: UK - Belgium

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[13] Worth noting is also that, as discussed in previous sections, some argue that the UK could supplement its lost EU trade with trade towards other continent. Our results make this seem rather unrealistic as distance is such an important variable.

	Obs	Mean	Min	Max
Change in Exports	18	0,9746167	0,9606031	0,9842514

Table 5: UK - Germany

	Obs	Mean	Min	Max
Change in Exports	18	0,9477534	0,9398066	0,9554769

Table 6: UK - Ireland

Comparing Sweden and Finland also makes for an interesting analysis. We have previously discussed the relative importance of size and distance. In the case of Sweden versus Finland however, Sweden is both a bigger economy and is also situated closer to the UK. Because of the way that the model is set up, it is reasonable to assume that potential exports to Sweden would benefit more from the large positive mass variable and be affected less from the large negative distance variable. Still, the relative decrease in exports from the UK to Sweden would decrease more than that of the exports from the UK to Finland. We conclude that this curious result must stem from a difference in import patterns between Sweden and Finland. Similarly, Finnish potential imports from the UK do not share the large dip after the financial crisis of 08 which characterizes the other EU member states. If Finland were already importing largely from other EU countries or countries that were not included such as Russia, an inwards-facing EU trade would not affect the potential trade in such a large extent. From another point of view, this anomaly could also be explained by a relatively small actual export to Finland, making the decline in exports from Brexit less severe.

	Obs	Mean	Min	Max
Change in Exports	18	0,9532728	0,9391468	0,9660907

Table 7: UK - Sweden

	Obs	Mean	Min	Max
Change in Exports	18	0,9812115	0,9564926	0,9920765

Table 8: UK - Finland

Concluding remarks

The primary results of this paper is that the move of the UK to leave the EU will result in a drop in export to the EU14 countries, some of which are important trading partners for the UK. Even though there might be some exceptions, the relative potential export is below 1 with a mean of 0.98 (Table 2), a 2% decrease. This tells us that exports from the UK to EU14 are likely to fall when they face MFN-tariffs. These results are in line with our initial predictions as to what would happen when the UK committed a "hard Brexit", the WTO solution. The WTO-solution is presently the only relevant solution of the ones that are currently being discussed through process of elimination. This is also the worst case and default scenario for the United Kingdom and it is therefore safe to say that the results of this paper are relevant to the future of the country in its post-EU state.

The fact that the results are relative trade changes makes it difficult to predict actual changes in total exported value. It is however reasonable that an increase in relative export to France, Belgium and the Netherlands would be outweighed by the decrease in relative exports towards the rest of EU14 if one were to convert these relative changes into actual numbers. Predicting the future is always difficult, especially when reality must be compressed into one mathematical equation such as the gravity model. Assumptions need to be made and uncertain measurements created. However, based on the model that we set up and the validity of this particular model (not to mention logical thinking), we feel safe to conclude that the Brexit will in fact lower the value of exports originating in the UK and ending up in EU14. If the trend from between 1995 and 2012 continues, there will be a substantial drop of 2%.

One could continue and speculate what the UK's response to this drop of exports will be. Obviously this will result in a big hit to the UK economy as a drop in exports would include a drop in private income as well as an increased unemployment when producers are forced out of the market, needs to produce less or move production abroad. What Prime Minister Theresa May and her government probably will attempt is to lower costs of these firms, as to make sure that they can still compete on the European market. This can be done in a number of ways ranging from subsidies and tax breaks to relaxing labor laws or accepting lower wages. Either way, we would predict that consumers and private homes in the UK would suffer the greatest blow, something which is a cause of concern for the political future of the country if the economic hardships evolve into social tension.

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