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# HOW MUCH TRADE WILL THE UK LOSE UNDER BREXIT?

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## **Abstract**

The British people narrowly voted to leave the EU in June 2016, leaving the researchers with the difficult task of predicting an event that has never taken place before. This thesis aims to contribute to the research about Brexit by analyzing, using two different methods, the effects on UK exports to the EU in the scenario of it joining the EEA after leaving the EU. The first approach uses the estimation of the trade effects after the EU Enlargement in 1995, when Austria, Finland, and Sweden joined the EU from being members of the EEA, and mirror these effects to predict the impact on UK trade. The second method uses a measure of depth of trade agreements to estimate the effects of joining a less comprehensive trade agreement. A baseline gravity equation is estimated using fixed effects PPML as well as fixed effects OLS in both methods. The results show that the UK can expect a decrease in exports to the UK in the range between 19 % and 22 % depending on method. This change equals an amount that is almost four times as high as the UK net contributions to the EU during the period 2015/2016.

*Key words: Brexit, European Union, the United Kingdom, The EEA, Trade, Gravity model, PPML*

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## 1 Introduction

In June 23, 2016, the United Kingdom (UK) voted narrowly to leave the European Union (EU) taking the first step towards being the first country ever to break the ties with the EU. This political event, commonly referred to as Brexit, is one of several recent examples of economic integration going backwards, which raises the question of how to estimate the effects of an event that has never taken place before.

What drove the British people to vote for leaving the union that they have been part of for over 40 years? According to British media covering Brexit and to surveys conducted in connection with the referendum, the main argument for voting 'Leave' was to regain sovereignty and control over UK law and economy, as it is believed that too many of the decisions about the UK are taken in Brussels. Regaining control over immigration and UK borders, as well as eliminating the UK's financial contribution to the EU was other arguments widely used by Eurosceptics before the referendum. In addition, it has been argued that the UK membership of the EU is keeping the UK from pursuing emerging markets like China or India, and that leaving the union would allow the UK to diversify its international links (The Telegraph, 2016: Lord Ashcroft, 2016: The Independent, 2016).

After the outcome of the referendum, the Brexit debate has largely focused on what will happen next, and what the UK's options are outside the EU. This paper aims to contribute to the literature by analyzing the effects of Brexit on UK trade, and will do so by assuming that the best option for the UK is to retain as close ties with the EU as possible. Therefore, the trade effects will be estimated under the scenario that the UK will replace its membership of the EU with a membership in the European Economic Area (EEA). The rationale behind this is that less economic integration reduces trade, as trade barriers are increasing, and will in turn have negative welfare effects. In the situation where the UK remains as close as possible to the EU, the least severe will thus the trade reduction be compared to current situation. Assuming the best-case scenario makes it possible to give an approximation of what least to expect from Brexit in terms

of trade, as other scenarios by default will generate worse effects.

As a country leaving the EU is an event that has never happened before, there is no established method to analyze the effects. This thesis will contribute to the research by analyzing Brexit using two different methods and further make a comparison of these methods to investigate if two very distinctive methods could generate similar results. In the first method I will estimate the trade effects of the EU Enlargement in 1995, when Austria, Finland, and Sweden joined the EU from being members of the EEA, and mirror these effects to predict the impact on UK trade. The EU 1995 Enlargement is the most similar historical event to the UK replacing its EU membership with a membership in the EEA, and will therefore be an appropriate proxy for the effects. The second approach focuses on how the content of trade agreements affects trade. By estimating how trade is affected by the depth of trade agreements in terms of number of legally enforceable provisions included, I intend to simulate the effects of the UK replacing its EU membership by a membership in the less deep agreement that is the EEA. I will use fixed effects Poisson Pseudo-Maximum-Likelihood (PPML) and fixed effects Ordinary Least Squares (OLS) to estimate the gravity equation specified for the analysis.

First, a detailed review is given of some of the options for the UK outside the EU, what they would mean in terms of the key arguments for the 'Leave' side, and economic effects. This is followed by a brief discussion about the best-case scenario for a replacement of the UK membership of the EU. Second, economic theory is used to explain the difference between a membership in the EEA and the EU, and how these differences affect trade. Third, a literature review is conducted that examines previous studies on the topic of Brexit. Thereafter, the empirical strategy is outlined, providing an insight of the methods used in the study, as well as a review of the gravity model, which is used to estimate the effects of the UK joining the EEA. Further, a suitable gravity equation is specified and methods of estimating the gravity model are discussed. Finally, the results obtained by estimating the gravity model are discussed and the scenario of the UK joining the EEA is simulated, providing an approximation of the effects on UK exports. My results indicate that the UK will experience a substantial decrease in exports

if its membership in the EU would be replaced with a membership of the EEA.

## **2 Leaving the EU: What Comes Next for the UK?**

### ***2.1 The UK Membership of the EU***

The deep integration of the EU that has evolved during the 20<sup>th</sup> century has resulted in the EU Single Market, intended to create a unified economy where all member states are to be treated equally (Baldwin et. al., 2015, pp. 45-46). The EU also forms a customs union between the member states. This means that all tariffs and quotas on goods trade within the EU are eliminated, reducing cumbersome border procedures. It also provides a common external tariff for goods imported from outside the EU. In addition, the EU Customs Union enables the European Commission to negotiate on behalf of all member states in the union in international trade deals. The EU has additionally contributed to reduce non-tariff barriers to trade within the union by harmonizing regulations, standards and specifications required to trade. The EU Single Market has provided the 'four freedoms', liberating EU firms and citizens to sell goods, services and labor as well as to invest in other member states (CER Commission, 2014, pp. 22-27; HM Treasury, 2016; Springford and Tilford, 2014).

The UK currently has a special status within the EU, as they are not part of the Euro Zone or the Schengen area. However, it is a full-boarded member of the EU Single Market, the EU Customs Union, and participates in the EU's economic decision-making. This deep integration has resulted in that the EU currently is the most important trading partner to the UK. Half of the UK's goods exports and more than a third of services exports go to the EU. During the last decade, services trade has become increasingly important to the UK. The share of UK exports of services to the EU has more than doubled during the recent decades and the importance of value-added activities in the UK, for both services and manufacturing, has increased as well (HM Treasury, 2016; Mulabdic et. al., 2017). Not only does the EU provide access to important markets, as a customs union the EU facilitates access to markets outside of the union. The UK is represented in trade negotiations with third countries, as well as in multilateral trade negotiations, through

EU, which has been beneficial as the EU has great negotiating power being a large player in global trade (HM Treasury, 2016).

By being a member of the EU, the UK has influence over EU decision-making including the rules associated with the EU Single Market. However, in return for market access and participation in the EU's government arrangements the UK must accept the obligations of a membership including accepting the regulatory framework and contributing to the EU budget (HM Treasury, 2016).

## ***2.2 Membership of the European Economic Area: The Norwegian Solution***

Since its establishment in 1994 the EEA has served as a deep free trade area between the countries of the EU and three members of the European Free Trade Association (EFTA); Norway, Lichtenstein and Iceland. This agreement allows the EFTA countries to be part of the EU Single Market and thereby to largely enjoy tariff free trade with the EU. However, the EEA is somewhat limited, as it does not cover agricultural and fishery policy, trade policy, foreign and security policy or justice and home affairs. Nor are the three EFTA countries part of the EU Customs Union, which is the main difference in market access compared to a EU membership (Emerson, 2016: Dhingra and Sampson, 2016).

An EEA membership could be an attractive option for the UK since it would still enjoy the economic benefits of being close to the EU but not participating in deeper European integration. The UK would maintain some market access by still being part of the EU Single Market and thereby benefit from the four freedoms. Even if Brexit for the UK would likely lead to reduced trade with the EU, the cost would be smaller if the UK remained more integrated with the EU. Although, the UK would be forced to comply with the rules and regulations of the EU Single Market without being able to participate in forming these, implying that the UK would have to give up some independence if joining the EEA. This could potentially be problematic as one of the main reasons for leaving the EU was to gain sovereignty and control. In addition, a membership of the EEA would mean that most of the EU policy areas are continuing to apply, including free movement of people, another key issue in the referendum campaign (Dhingra and

Sampson, 2016).

Joining the EEA would also mean that the UK would lose access to all FTAs negotiated by the EU. On the other hand it would be free to negotiate trade deals independently, which could be viewed upon as gained sovereignty. In addition, as not being part of the EU Customs Union, the UK is able to set its own external tariffs towards third countries. However, this would mean that the UK must comply with Rules of Origin for exports to the EU and additional administrative costs associated with trade. Furthermore, the EU will be able to use anti-dumping measures against British firms in order to restrict imports (HM Treasury, 2016: Dhingra and Sampson, 2016).

A membership in the EEA would reduce the UK's financial contribution to the EU, although the financial savings would be rather small. In addition to membership fees, the participants of the EEA must contribute to the EU budget by paying a fee for being a part of the EU Single Market. As of today Norway pays only 17 % less fees to the EU than the UK, which implies that the larger part of the EU financial contributions would remain (Ashworth-Hayes, 2016: Dhingra and Sampson, 2016).

### ***2.3 Bilateral Agreements: The Swiss Solution***

Switzerland is the only EFTA member that is not also a part of the EEA. Its relationship with the EU is instead based on a number of bilateral agreements, one for each EU policy where Switzerland participates beyond the free trade agreement already covered by the EFTA membership. By negotiating bilateral agreements Switzerland has achieved nearly the same relation with the EU as the member countries of the EEA but has the advantage of being more flexible towards what policies and programmes in which they wish to participate. However, Switzerland is not part of the EU Single Market for services and there is no other agreement of trade in services between Switzerland and the EU, which has led to that many Swiss financial institutions operate via the UK. Moreover, the UK would have to accept free movement of people, contributing to the EU budget and would not have access to the EU's trade agreements with the rest of the world (HM Treasury, 2016: Dhingra and Sampson, 2016).



Going for the Swiss solution could be beneficial for the UK in the sense that it provides largely tariff free trade with the EU but also greater flexibility regarding the extent to which the relationship with the EU will progress. However, as in the case of an EEA membership, the UK would have no influence in the forming of the EU policies and programmes they choose to participate in. This implies that there is a trade off between sovereignty and integration, where the UK will have to give up its influence over EU decisions to remain integrated in certain policy areas. On the other hand, even if the UK would pursue the Swiss model, there are no requirements for the EU to engage in any agreement with the UK. This means that the extent of the future relationship between the UK and the EU would be characterized by great uncertainty, leading to potential disadvantages for the UK (HM Treasury, 2016; Dhingra and Sampson, 2016).

#### ***2.4 Comprehensive EU-UK Free Trade Agreement: The Canadian Solution***

The Comprehensive and Economic Trade Agreement (CETA) is a relatively new trade agreement between the EU and Canada and currently serves as the most ambitious free trade deal the EU has ever negotiated<sup>1</sup> (European Commission, 2017). This type of a 'second generation' trade agreement could potentially be a solution for the UK when negotiating a new relationship with the EU. However, it is worth pointing out that no existing trade agreement reproduces the level of integration of the EU Single Market (Ruparel et. al. 2016).

Within CETA, the EU and Canada have agreed upon eliminating all tariffs on industrial and fisheries products and over 90 % of tariffs on agricultural products. However, even though the CETA involves a reduction of almost all tariffs, some agricultural products still is considered sensitive and are not covered by the agreement (Booth et al., 2015). This implies that the UK will experience an increase in tariff rates from the EU under an agreement in line with the CETA. The agreement would probably also be less ambitious when it comes to services trade which for the UK would be harmful considering its comparative advantage in the service sector. The UK would also have to comply with EU Rules of Origin, which, together with other non-tariff barriers, will increase UK's trade

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<sup>1</sup> CETA has not yet been approved by the EU national parliaments and is therefore not in full effect (European Commission, 2017).

costs with the EU. In addition, EU standards will apply on all export goods from the UK (LSE Growth Commission, 2017, pp. 60-62).

Following an agreement in line with CETA, the UK would no longer be required to contribute to the EU budget or participating in the free movement of people. The latter will negatively affect the many UK citizens living and working in Europe as well as the Europeans living in the UK. However, it is likely that the EU have an interest in conditioning relatively free movement in exchange for UK access to the EU markets (Booth et al., 2015).

Engaging in a trade agreement with the EU, the UK would gain political independency, although there is a clear trade-off between sovereignty and market access. Access to the EU market is more important for the UK than for Canada, as they are more dependent on the EU as a trading partner. In order to maintain EU market access, the UK would need to be involved in high levels of cooperation with the EU and thereby give up some independency. Moreover, when discussing a free trade agreement as the one between EU and Canada it is important to keep in mind that the UK currently is far more integrated with the EU than is Canada. This implies that a potential free trade agreement between the UK and the EU would inevitably have to cover areas of deeper integration (Booth et. al., 2015; Dhingra and Sampson, 2016). Leaving the EU, the UK would be free to negotiate trade agreements with third countries. However, it will at the same time have less bargaining power in the negotiations, as the UK is a much smaller market than the EU (LSE Growth Commission, 2017, pp. 60-62; Dhingra and Sampson, 2016).

Another important point is that a comprehensive trade agreement like this would probably take many years to negotiate. CETA took more than six years to negotiate and was still close to failing, as it did not get approval from all member states at first. An agreement between the UK and the EU would likely face similar issues as CETA did (Ruparel et. al. 2016).

### ***2.5 EU Customs Union: the Turkish Solution***

The Customs Union between the EU and Turkey that came into force in 1995, allowed

Turkey to adopt the common external tariffs of EU imports and exports. This means that Turkey is able to enjoy tariff free trade with the EU in all industrial products while agricultural products are outside the customs union. Moreover, there is no freedom of movement of people between Turkey and the EU, and it is not bound by the EU's Common Agricultural Policy (CAP) nor do they contribute to the EU budget (Dixon, 2015).

A scenario where UK leaves the EU but stays in the EU's customs union could be an attractive solution for a potential Brexit, and has been discussed more frequently lately, at least as an option during a transitional period whilst a new deal with the EU is being negotiated. In the short run the UK could benefit from remaining in the customs union by preventing tariffs to be imposed on UK exports to the EU (Lythgoe, 2017). However, there are several drawbacks to this option in the longer run. The UK would be worse off in terms of market access as the customs union only covers trade in goods, not services or finance. Still it would have to comply with EU rules and regulations while having no say in the setting of these rules. In other words, it would have to give up some sovereignty in order to gain access to the EU Single Market (Dixon, 2015).

As a country outside the EU, The UK would retain some access to the EU Single Market by joining the EU Customs Union. However, it will lose its independence of imposing its own external tariffs. Furthermore, it is required to adopt any trade policy that the EU decides on and to cut free trade deals on goods with whomever the EU makes agreements, without having a say in which free trade deals the EU pursues. In addition, countries outside of the EU may no longer have incentives to offer reduced tariffs for the UK, as they will be able to reach the British market going through the EU, which could make it more difficult for the UK to get access to non-EU markets (Dixon, 2015; Lythgoe, 2017).

## ***2.6 Clean Break: The WTO Solution***

The World Trade Organization (WTO) serves as the only global international organization offering a structure for the exchange of liberalization commitments with a focus on multilateral trade negotiations. One of the major roles of the WTO is to

supervise trade rules between nations as well as forming these rules through multilateral negotiations. The WTO is governed by a set of agreements out of which the most important principle is the Most Favored Nation (MFN), stating that no member country should be treated less favorable than others. In practice, this means that all tariffs imposed by a country should be non-discriminatory (Baldwin and Wyplosz, 2015).

Assuming that the UK would leave the EU without joining the EFTA or negotiating any new trade agreements mentioned above, the UK's trade with the EU, as well as with the rest of the world, would be governed by the WTO. Following WTO rules would mean that the UK must grant the same MFN tariffs to all WTO members, except for those countries with whom the UK possibly would enter free trade agreements. In this scenario the UK would have the same trade relationship with the EU as any other country and would thereby have to set a universal set of tariff rates to apply to all its trading partners. This could possibly harm UK firms if the tariffs are set too high; making imported input goods more expensive (LSE Growth Commission, 2017, pp. 60-62). Higher tariffs would also lead to increased export costs for UK firms to countries within the EU (Ottaviano et. al., 2014). On the other hand, imposing tariffs at EU levels or below would reduce import costs and increase competition for UK firms. However, the average import tariff to the EU is already low which leaves the UK with limited possibility for further tariff reductions. There is also a risk that the low tariffs will not be reciprocal, which would mean that the UK would lose bargaining power when negotiating future preferential trade agreements (LSE Growth Commission, 2017, pp. 60-62).

In addition, trade in services would also be regulated by the WTO, which would be of disadvantage for the UK as the WTO has made less progress in liberalizing services trade than the EU. Also, there would be no free labour mobility between the UK and the EU, as the WTO has no requirements for free movement of people. However, free movement of capital would likely remain since the EU has forbidden any restrictions on capital mobility both within the EU and with third countries (Dhingra and Sampson, 2016).

In the WTO scenario the UK would gain political sovereignty, as the UK is free to redesign its economic policy and regulatory standards independently of the EU. However, UK trade regulations and competition policies that fail to comply with EU and WTO standards may lead to global trading partners imposing further restrictions on UK trade. This may negatively affect exports and will leave UK firms vulnerable to antidumping measures. Furthermore, as for all third countries, the UK would have to comply with EU product standards on all exports to the EU (LSE Growth Commission, 2017, pp. 60-62). Less economic integration with the EU will in time also lead to regulatory divergence between the UK and the EU, which would act as a non-tariff barrier to trade and hence increase UK firms' costs of doing business with the EU (Dhingra and Sampson, 2016).

### ***2.7 The Best-Case Scenario***

There are two main approaches to determine the best possible scenario for the future relationship between the UK and the EU, the first being the most beneficial scenario in economic terms, and the second where the key arguments in the Brexit debate are met. This paper will focus on the first approach assuming that the UK will be better off retaining as close ties with the EU as possible.

Leaving the EU is likely to damage the UK economy by increasing trade barriers between the UK and the EU, however joining the EEA would lead to lower trade barriers than any of the alternative solutions. Remaining a part of the EU Single Market, basically no tariffs or other new border measures would exist between the EU and UK. Moreover, non-tariff barriers would be kept at low levels, as the UK would continue to adopt the EU's trade and economic regulations. Common regulatory standards across the members of the EU Single Market helps keeping the non-tariff barriers low, which increases the gains of trade, especially for the service sector. Even though the UK would experience reduced independence in terms of influencing regulations, the benefits of regulatory harmonization would likely outweigh the costs of reduced control.

The following empirical analysis in this paper will investigate what joining the EEA would mean for the UK in terms of trade. The next chapter provides a theoretical

discussion of the difference between a membership in the EEA and a membership in the EU, as well as the specific effects on trade in the case of the UK joining the EEA.

**Table 1. An overview over the alternative Brexit scenarios**

	<i>Free trade in goods</i>	<i>Free trade in services</i>	<i>Customs union</i>	<i>Independent to negotiate own trade deals</i>	<i>Free movement of people</i>	<i>EU rules and regulations</i>	<i>EU policies and programmes</i>	<i>Contributions to EU budget</i>
<i>Current UK</i>	Yes	Yes	Yes	No	Yes	Yes	Opt out of some EU programmes	Yes
<i>EFTA plus EEA: the Norwegian solution</i>	Yes	Yes	No	Yes	Yes	Yes	Opt out of some EU programmes	Yes
<i>EFTA plus Bilateral Agreements: the Swiss solution</i>	Yes	Limited	No	Subject to EU consent	Yes	Some	Opt out of some EU programmes	Yes
<i>Free Trade Agreement: the Canadian solution</i>	Mostly	Limited	No	Yes	No	EU product standards on exports	No	No
<i>Customs Union: The Turkish solution</i>	Limited	Limited	Yes	Yes	No	EU product standards on exports	No	No
<i>Clean Break: The WTO solution</i>	MFN tariffs	Limited	No	Yes	No	EU product standards on exports	No	No

### **3 The Effects of the EEA Scenario on UK Trade**

As mentioned briefly in the previous chapter, replacing the EU membership with a membership in the EEA would lead to increased trade barriers between the UK and the EU. The EEA scenario would mean that the UK would have to leave the EU Customs Union, which would be the main difference in market access compared to EU membership. The consequences are that some new costs and non-tariff barriers will emerge between the UK and the EU.

#### ***3.1 Regulatory Divergence***

In the EEA scenario, most of the EU regulatory framework would still apply to the UK. However, the UK would have little say over the design of the regulations. This will make it more difficult and costly for the UK to protect its trade interests. Further, if an EEA member fails to implement EU regulations, it risks suspension from the agreement. The increased regulatory costs may have a negative impact on UK trade, as the UK would have limited influence over EU trade policy (Springford and Tilford, 2014).

Within the Single Market, a product that is legally sold in one EU country can be sold in another, even if it does not meet all of that country's technical rules. Post Brexit, this principle would no longer extend to the UK. Instead, British exports would have to be proven to obtain all the regulatory approvals required from the country of import. To do this, it would need to comply with all technical and safety rules in the EU importing country. This may raise additional trade costs for UK exporting firms if the UK does not continue to develop its regulations in line with the EU (European Commission, 2015).

#### ***3.2 Rules of Origin***

As rules of origin are defining the sufficient level of processing needed to take place in a country in order for a product to be considered to have its origin there, they are linked to the preferences under a preferential trade agreement (PTA). The main purpose of establishing rules of origin is to prevent trade deflection, i.e. when third countries potentially could exploit trade preferences within a PTA by exporting through the country with lowest tariff rates. However, rules of origin act as non-tariff barrier to



trade as they have negative effects on trade flows and hence work in the opposite direction of preferences.

The literature regarding the impact of rules of origin on trade flows usually distinguish between two different types of costs associated with complying with origin requirements; production costs and administrative costs. The former refers to the costs from having to change production in order to follow the technical criteria of the product-specific rules of origin and can impact firms' decisions regarding investments and sourcing. In order to comply with the rules of origin, firms are somewhat encouraged to use less efficient inputs from countries within the PTA instead of cheaper and more efficient inputs from outside the PTA. Hence, rules of origin potentially lead to trade diversion as firms move production facilities within the PTA even though they would prefer producers outside the region. In this way, rules of origin act as a non-tariff barrier to trade as it protects trade within the PTA and thereby distort trade with third countries. Administrative costs, on the other hand, are costs from having to prove or certify that the rules of origin are satisfied. These costs concern both the exporting country that has to certify the origin before exporting, and the partner country that must verify the product origin (National Board of Trade Sweden, 2012).

Rules of origin apply to countries exporting to the EU from outside the customs union such as Norway, and hence the UK would have to comply with rules of origin in the EEA scenario. This will affect UK exports to the EU as both administrative and production costs increases. The increasing complexity of firms' supply chains due to the ongoing globalization imply that the costs of certifying of a product are increasing, affecting UK firms. In addition, to comply with rules of origin EU producers might have to change suppliers from UK firms to suppliers within the EU, further reducing UK exports to the EU (Dhingra and Sampson, 2016: National Board of Trade Sweden, 2012).

### ***3.3 Anti-Dumping Measures***

Not being a part of the EU Customs Union makes UK firms subject to EU anti-dumping or anti-subsidy duties (Dhingra and Sampson, 2016). Anti-dumping policy is the main trade defense policy in practice and is an allowed instrument to use under WTO rules. This

means that EU is allowed to add an additional duty to a product being sold at a price below its 'natural value' at the EU market if domestic producers are negatively affected (European Parliament, 2017).

### **3.4 Customs Procedures**

Cumbersome trade procedures work as a non-tariff barrier, as they make trade more expensive. The costs could be for instance complying with rules and quality controls, filling out complex forms, or delays in transportation (Persson, 2012). Since the UK, in the EEA scenario, will be excluded from the EU Customs Union it would be subject to EU border controls. This will generate new costs of trading, which in turn has negative effects on trade (National Border of Trade, 2016).

## **4 Previous Research**

The following chapter will outline a few of the most relevant previously conducted studies of Brexit for this paper to give a broader picture of what the research has concluded so far.

Ottaviano (2014) compares an optimistic Brexit scenario, assuming that UK obtains full access to the EU Single Market like Norway, with a pessimistic scenario where the UK have to fall back on WTO rules using a quantitative model of international trade together with a gravity model. The results show that the static economic losses range between 1.13 % (optimistic scenario) and 3.09 % (pessimistic scenario) of GDP. When including dynamic effects the losses could potentially be more than the double. He additionally concludes that even though any Brexit scenario would generate negative trade effects, the costs are predicted to be smaller when the UK remains more economically integrated with the EU.

Comparing an optimistic Brexit scenario (tariffs on goods continuing to be zero) and a pessimistic scenario (applying MFN tariffs), Dhingra et. al. (2016) use a general equilibrium trade model to predict the effects of Brexit. In their analysis they include different types of costs; tariffs, non-tariff barriers and opportunity costs. They estimate

that the negative trade effects range between 1.37 % (optimistic scenario) and 2.92 % (pessimistic scenario). They also show that other EU states lose as well but much less. Unilateral free trade could reduce the negative impact of Brexit by about 0,3 percentage points.

In 2016 Oxford Economics released a report that considers nine Brexit scenarios, from staying in the EU Customs Union to falling back on WTO. Each option includes assumptions about liberal or protectionist policy approach. The results show that the economic losses of Brexit would be somewhere between 0.1 % and 3.9 % of GDP. Further the report concludes that both imports and exports decline in all cases although the scale of the decrease varies considerably across scenarios. Exports are predicted to fall by as much as 8.8 percent and imports by up to 9.4 percent in the worst-case scenario compared to a baseline of continued EU membership.

Using a different approach, Mulabdic et. al. (2017) estimate a gravity model of what effects preferential trade agreements (PTA) have had on UK trade. Their approach is to incorporate the depth of various trade agreements to measure how much extra trade the deeper agreements has given the UK as oppose to less deep agreements. They further use these calculations to estimate how much less trade UK would experience under various possible Brexit scenarios. They find that deep trade agreements are expected to increase trade in goods and services with approximately 42 percent and value-added trade with 14 percent on average. As the membership in the EU is the deepest example of a UK trade agreement, it is expected to have a particularly strong effect on UK trade. The paper investigates three scenarios; a Norway solution, the scenario of the average PTA and if there were no agreement at all. All scenarios show decreasing UK value added trade with the EU between 6 and 28 percent. Focusing on the Norway scenario, the result shows that the UK could expect a decline in exports to the EU with about 12 percent.

Campos, Coricelli, and Moretti (2015) use a difference-in-difference method together with the synthetic control method to investigate the consequences of Norway's decision

not to join the EU's Customs Union and undertake the deeper integration pursued by EU countries in 1995. In their analysis they construct a synthetic Norwegian region using data for Austria, Finland and Sweden and compare the productivity levels with actual Norway. They conclude that not joining the EU in 1995 has generated a productivity loss for Norway with about 6 %, implying that deeper economic integration are economically beneficial.

Supporting this implication, the UK government also concludes in a report from 2016 that the UK has benefitted from a more integrated relationship with the EU. The membership in the EU is expected to have generated a significant positive impact on overall UK trade. Due to that the EU has been the negotiating part in trade agreements with the rest of the world, UK trade, as a part of national income, has increased from 30 % to 60 % since the years prior to the UK membership in the EU. In addition, being part of the EU is estimated to have generated an increase in UK trade with other EU members by about three quarters (HM Treasury, 2016).

There seem to be a broad consensus among researchers that Brexit is likely to generate negative effects on the UK economy and on UK trade with the EU even though several different methodologies have been employed. Moreover, the effects seem to be less severe the more integrated the UK end up to be with the EU, supporting the assumption of the best-case scenario in this paper.

## **5 Empirical Strategy**

With the assumption that becoming a member of the EEA would be the best option for the UK outside of the EU, and with the expectations that leaving the EU will generate negative trade effects for the UK, I will in this section outline my empirical strategy for testing this thesis. My strategy contains of two methods that will be estimated using the gravity model; the EU enlargement in 1995 and the depth of trade agreements.

## **5.1 Overview of Methods**

### **5.1.1 Method I: The EU Enlargement in 1995**

The 1995 enlargement of the EU saw Austria, Finland and Sweden accede to the EU from previously being part of the EEA by their membership in the EFTA. This was the EU's fourth enlargement and came into force on the 1 January 1995. The estimation of the trade effects for Austria, Finland and Sweden following their EU memberships will in this study be used as proxies for the effects of replacing an EEA membership with an EU membership, and are assumed to be inversely proportional for the UK leaving the EU and instead joining the EEA. The expansion of the EU in 1995 is the most similar historical event to what is assumed to be the best-case scenario for the UK as a replacement of its EU membership, and therefore employs as a suitable strategy for estimating the effects of Brexit. All three countries have economies similar in size, and are geographically close to the UK, further implying that the UK would respond to this transformation in a similar way. Moreover, since the three countries acceded the EU in the same year, the estimation of the trade effects will be more reliable.

### **5.1.2 Method II: The Depth of Preferential Trade Agreements**

During the last 25 years, the number of trade agreements in the world has increased drastically and the content of them has come to cover more policy areas comparing to traditional trade agreements, mainly focusing on reducing tariff rates. Since the 1990s, when many PTAs came into force, the number of trade agreements worldwide has increased from 51 in 1990 to 279 in 2015. In addition, the agreements have become deeper, i.e. the number of legally enforceable provisions covered by the agreements has increased from an average of between 8 and 9 provisions for PTAs in 1990 to an average of 17 provisions for PTAs between 2010 and 2015 (Mulabdic et. al., 2017).

The World Bank (Hofmann et. al., 2017) is offering a new database containing all PTAs notified to the WTO and in force until 2015, providing information on the evolution of amount and depth of trade agreements. By counting the number of legally enforceable provisions in the 279 PTAs included, they have created a measure of the depth in trade agreements used in for instance Mulabdic et. al. (2017). A policy area that is considered

legally enforceable has a sufficiently precise language and is not exempted from PTA dispute settlement procedures (Hofmann et. al., 2017). Table 2 provides an overview over the 52 policy areas covered, divided into two groups of 14 WTO+ and 38 WTO-X areas.

**Table 2. List of Legally Enforceable Provisions**

WTO+	WTO-X	
○ Tariffs Industrial goods	○ Anti-corruption	○ Health
○ Tariffs agricultural goods	○ Competition policy	○ Human Rights
○ Customs administration	○ Environmental laws	○ Illegal immigration
○ Export taxes	○ IPR	○ Illicit drugs
○ SPS measures	○ Investment measures	○ Industrial cooperation
○ State trading enterprises	○ Labor market regulation	○ Information society
○ TBT measures	○ Movement of capital	○ Mining
○ Countervailing measures	○ Consumer protection	○ Money laundering
○ Anti-dumping	○ Data protection	○ Nuclear safety
○ State aid	○ Agriculture	○ Political dialogue
○ Public procurement	○ Approximation of legislation	○ Public administration
○ TRIMS measures	○ Audiovisual	○ Regional cooperation
○ GATS	○ Civil protection	○ Research and technology
○ TRIPS	○ Innovation policies	○ SMEs
	○ Cultural cooperation	○ Social Matters
	○ Economic policy dialogue	○ Statistics
	○ Education and training	○ Taxation
	○ Energy	○ Terrorism
	○ Financial assistance	○ Visa and asylum

Based on the measure of depth using the count of legally enforceable provisions, the EU is the deepest PTA in force today. The EC Treaty<sup>2</sup> together with the EU Enlargements<sup>3</sup>

<sup>2</sup> The EC Treaty was originally signed on 25 March 1957 by Belgium, France, Italy, Luxembourg, the Netherlands and West Germany and came into force on 1 January 1958. 19

covers all WTO+ provisions and a large share of the WTO-X provisions, adding up to a number of 44 legally enforceable provisions. The EU are also involved in PTAs with 36 other countries, many of which are deep. For instance, the EEA that includes all members from the EU and EFTA covers 36 legally enforceable provisions.

Using the measure of the depth in trade agreements allows me to investigate what effect the number of legally enforceable provisions included in the agreements have had on EU exports to the countries they are engaged in PTAs with. The result will give me an effect for engaging in a deeper trade agreement that can be used to simulate the effects on trade in the scenario where the UK leaves the EU and joins the EEA, i.e. where the number of provisions included is reduced from 44 to 36.

## **5.2 The Gravity Model**

The gravity model is a commonly used method of statistical analysis of bilateral trade flows. The model originated in Newton's theory of gravity and was developed into a recognized economic model by Tinbergen in 1962. By linking trade flows directly to the economic size of countries and with trade costs, the gravity model captures regularities in the pattern of international trade (WTO and UNCTAD, 2012, pp. 103-105).

In its initial formulation, the gravity model takes a multiplicative form expressed in equation 1, where  $T_{ij}$  represents trade flows between country  $i$  and  $j$  in proportion to the countries' GDP,  $Y_i$  and  $Y_j$ , and inversely to the bilateral distance,  $D_{ij}$ .  $\beta_0$ ,  $\beta_1$ ,  $\beta_2$ , and  $\beta_3$  are unknown parameters. The importer's and exporter's GDP are used as proxies for the countries' demand and supply, and the distance variable represents bilateral trade costs between the country pair (Santos Silva and Tenreyro, 2006).

To simplify the estimation of the gravity model, the equation is commonly transformed into its natural logarithmic form, expressed in equation 2. This enables the use of the ordinary least square (OLS) estimation (WTO and UNCTAD, 2012, p. 104).

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<sup>3</sup> Since the EC Treaty, the EU's membership has grown to twenty-eight, with the latest member state being Croatia, which joined in July 2013.

$$T_{ij} = \beta_0 Y_i^{\beta_1} Y_j^{\beta_2} D_{ij}^{\beta_3} \quad (1)$$

$$\ln T_{ij} = \beta_0 + \beta_1 \ln Y_i + \beta_2 \ln Y_j + \beta_3 \ln D_{ij} + \varepsilon_{ij} \quad (2)$$

The logarithmic form of the gravity equation allows the estimated coefficients to be interpreted as elasticities i.e. the percentage change in the dependent variable following a one percent change in one of the independent variables, all others equal. However, for dummy variables, the effect from going from 0 to 1 is found by calculating the estimated coefficient using  $\exp(b) - 1$ , where  $b$  is the estimated coefficient (WTO and UNCTAD, 2012, p. 106).

### **5.3 Gravity Model Specification**

In order to estimate the trade effects of going from being part of the EEA to becoming a member of the EU, I have specified a gravity model where the dependent variable is exports from the EU. The independent variables included are the importer's and the exporter's GDP and population, the distance between the country pair's capitals, dummies for whether the country pair shares a common official language and if the country pair shares borders. Moreover, year-specific fixed effects are included as well as effects for the bilateral pair.  $\varepsilon_{ijt}$  is a disturbance term.  $i$  is the importer,  $j$  is the exporter, and  $t$  denotes time. The included variables are some of the most commonly used in the gravity model literature and are widely considered to give the model a good fit. Using commonly employed variables makes the result of the paper easier to compare to other studies.

In the first method, the regression is estimated using panel data from 1990 to 2000, and the exporting and importing countries are the members of EU12 as well as Austria, Finland and Sweden. The countries included are listed in section A2 of the Appendix. For this method, the main independent variable of interest is the EU dummy, taking the value one if both countries in a bilateral pair are members of the EU, and zero otherwise. This variable is meant to capture the effects of the EU15 enlargement for the three countries joining the EU in 1995. The gravity equation for method I is expressed in its



natural log form in equation 3.

$$\begin{aligned} \ln Exports_{ijt} = & \beta_1 EU_{ijt} + \beta_2 \ln GDP_{it} + \beta_3 \ln GDP_{jt} + \beta_4 \ln Pop_{it} + \beta_5 \ln Pop_{jt} \\ & + \beta_6 \ln Distance_{ij} + \beta_7 ComLang_{ij} + \beta_8 Border_{ij} + \tau_t + \lambda_{ij} + \varepsilon_{ijt} \end{aligned} \quad (3)$$

The second method uses panel data that covers the period 1990 to 2015. The exporting countries are the members of the EU28, and the importers are all countries that EU has PTAs with. The importing and exporting countries included are listed in section A3 of the Appendix. By including a depth-variable, the model explicitly account for the depth of EU and of the PTAs the EU has with third countries. This is the main variable of interest for this method and intends to capture the effect of signing a deeper agreement on EU exports. Equation 4 expresses the gravity equation for method II in its natural log form.

$$\begin{aligned} \ln Exports_{ijt} = & \beta_1 Depth_{ijt} + \beta_2 (Depth_{ijt})^2 + \beta_3 \ln GDP_{it} + \beta_4 \ln GDP_{jt} + \beta_5 \ln Pop_{it} \\ & + \beta_6 \ln Pop_{jt} + \beta_7 \ln Distance_{ij} + \beta_8 ComLang_{ij} + \beta_9 Border_{ij} + \tau_t + \lambda_{ij} \\ & + \varepsilon_{ijt} \end{aligned} \quad (4)$$

A list of the variables and their sources are found in the appendix, section A1.

The dependent variable,  $Exports_{ijt}$ , is exports from the EU. The data is from the Eurostat's (2017) database on international trade. Since data over imports is considered to be more reliable (WTO and UNCTAD, 2012), I have chosen to use data over imports rather than exports for the first method. This is possible considering that the exporting countries are the same as the importing countries in this method. However, in order to minimize risk of missing or defective data, I have for the second method used data over exports, as data over imports to many of the countries engaged in PTAs with the EU was unavailable.

$EU_{ijt}$ , is a dummy variable taking the value one if both countries in a bilateral pair are members of the EU, and zero otherwise. This variable is intended to capture the effect of going from being part of the EEA to becoming a member of the EU. The effect takes place when Austria, Finland and Sweden are going from being members of the inner market to begin full EU membership in 1995. Previous research has given support to the idea that joining the EU would generate positive effects on trade between member countries, hence the coefficient of the EU dummy is expected to take a positive value. This variable is manually constructed by the author.

$Depth_{ijt}$  is the number of legally enforceable provisions in the PTA between  $i$  and  $j$ , and intends to capture the effect of signing a deeper PTA on EU exports. As engaging in a trade agreement that covers more policy areas most likely increases trade between the partner countries, the coefficient is expected to take a positive value. The variable is from the content of PTAs dataset constructed by Hofmann et. al. (2016). One thing to keep in mind with this model is that the effect of an additional provision is considered to be the same regardless of what type of provision is included. Although, it is more realistic to assume that some provisions has larger effects on trade between partners in a PTA than others. Taking this into account, I include the square of the depth-variable,  $(Depth_{ijt})^2$ , in order to test if the relationship might be non-linear.

The importing country's as well as the exporting country's GDP,  $GDP_{it}$  and  $GDP_{jt}$ , are used as proxies for the economic sizes of the exporting and importing countries. Both the importer's and the exporter's GDP are expected to have positive effects on exports from the EU, as a larger GDP represents a larger demand for imports or a larger supply of exports, respectively. The GDP data is expressed in nominal Euro, and is from the CEPII (2017a) database.

The coefficient  $Pop_{it}$  and  $Pop_{jt}$ , are the importing country's and the exporting country's population sizes, and can take either a positive or negative value. The population size may have a negative impact on exports if the country export less when the population increases due to an increased rate of intra-trade, or a positive effect if it exports more as

it expands, being able to achieve economies of scale (Walsh, 2006). The data is from the CEPII (2017a) database.

$Distance_{ij}$  measures the distance in kilometers between the country pairs' capital cities. This variable is one of the most commonly used proxies for trade costs, as it is believed to be more costly to trade with countries farther away. The variable is expected to have a negative impact on exports. The data is from the CEPII (2017b) database.

$ComLang_{ij}$  is a dummy variable and takes the value one when the country pair shares a common official or primary language, and zero otherwise. Countries that share a common official or primary language are likely to trade more than countries that do not, as sharing a common language may decrease trade costs since communication becomes easier and less costly. The variable is expected to have positive impact on exports. Similarly,  $Border_{ij}$ , is also expected to have a positive impact on exports. The dummy variable, taking the value one if the country pair has a common border, and zero otherwise, are likely to decrease trade costs. The data on the two dummy variables are from the CEPII (2017a) database.

Time fixed effects,  $\tau_t$ , is included to account for variations between the years in the sample. This variable is intended to capture various year-specific events that may affect trade flows, which are not accounted for by the other variables.  $\lambda_{ij}$ , is a fixed effect for the bilateral pair, intended to capture specific characteristics for a bilateral country pair that may affect trade between the two.

#### **5.4 Data**

The gravity equations specified in the previous section will be estimated for exports at an aggregated level to offer a broad picture of how UK trade will be affected by joining the EEA. However, to provide a more detailed analysis of the trade effects, I will in separate estimations use disaggregated export data according to the Harmonized System (HS) at a two-digit level as a dependent variable.

The Harmonized System is an internationally standardized system of names and

numbers to classify traded products. The HS is organized into 96 chapters, which are further divided into more detailed subcategories. The system divides products as detailed as at an 8-digit level (World Customs Organization, 2017). An example of a product chapter at a two-digit level could be “Beverages, spirits and vinegar” (22), and a subcategory at a 6-digit level could then be “Sparkling wine of fresh grapes” (220410). To make the results easier to interpret, I will construct dummy variables for four broader product sections, Agriculture, Raw material, Manufactures, and Miscellaneous, and estimate the effects of EU membership and depth of trade agreements for each of these sections. A review of the HS product chapters and sections are found in the appendix, section A4.

One thing to note when using the gravity model with disaggregated data is that some of the logics behind the gravity model are not entirely straightforward. Large countries usually trade more as they produce more varieties of goods, hence trade volumes are increasing with GDP. However, this might not be the case for the individual product, which indicates that the coefficient for the exporters GDP might not be significant for all product chapters. In addition, zero trade flows are more likely to occur with disaggregated data, an issue that will be discussed further in the next section of the paper (WTO and UNCTAD, 2012, p. 114).

## ***5.5 Method of Estimation***

There are many methods to choose from when estimating the gravity model, each one with its own advantages and disadvantages. This section will review some of the most common issues when estimating the gravity model and outline the choice of estimation method for this study.

### **5.5.1 Unobserved Heterogeneity**

When estimating gravity models, one often has to deal with unobserved heterogeneity (WTO and UNCTAD, 2012, p. 107). Unobserved heterogeneity emerges when there are some unobserved differences between individuals (between bilateral country pairs in this study), which is not accounted for in the model. This causes the estimation to become biased and will affect the standard errors when using OLS. With panel data, this problem can be dealt with by using country pair fixed effects. However, using a fixed

effects model comes at a cost, as degrees of freedom will be lost (Dougherty, 2007, pp. 411-413).

### **5.5.2 Endogeneity**

The endogeneity problem refers to when one or more of the explanatory variables are correlated with the error term. This causes the estimated coefficients to be inconsistent. Common causes of endogeneity are measurement error, simultaneity or omitted variables (Dougherty, 2011, p. 333). There is a possibility that either of the gravity models in this study could suffer from endogeneity. For instance, it is obvious that the countries joining the EU in 1995 already had a well-established trade relationship with the EU members before their decision to become members. This indicates that the error term and the EU dummy could be correlated. Using fixed effects can partly solve the presence of endogeneity, although only endogeneity caused by omitted variables (WTO and UNCTAD, 2012, p.).

### **5.5.3 Heteroskedasticity**

Heteroskedasticity refers to when the variance of the error term is not constant for all observations and makes the estimation inefficient. When estimating the gravity model, heteroskedasticity is typically a problem (Shepherd, 2013, p. 51). One solution to the problem of heteroskedasticity is to use robust standard errors (Shepherd, 2013, p. 28). However, using OLS on the logarithmic version of the gravity equation in presence of heteroskedasticity would still lead to an inconsistent estimation. A more appropriate solution is to estimate the gravity equation in its multiplicative form using a non-linear estimation like PPML (Santos Silva and Tenreyro, 2006).

### **5.5.4 Zero Trade Flows**

As mentioned in previous section, disaggregated data usually contains many zero trade flows, which usually means that there is no reported bilateral trade in a specific product chapter during that year. Using OLS on the logarithmic version of the gravity model could lead to significant biases in the result, as all zeros will be dropped when taking the natural log of the trade volume. As zero trade could be due to high trade costs, dropping the zeros could lead to that some useful information is lost if trade actually is zero (WTO and UNCTAD, 2012, p. 112). To avoid this problem, one can instead use a non-linear

model such as PPML, as this enables the model to be estimated in its multiplicative form, and hence all zeros will be included (Santos Silva and Tenreyro, 2006).

#### **5.5.5 Choice of Estimation Method**

In order to make sure that the result is robust, the gravity equations in this study will be estimated using different estimation methods. Robust standard errors are used in all estimations, reducing the issue of heteroskedasticity.

The main method of estimation for the baseline gravity equations (3) and (4) is a PPML model with fixed effects for bilateral pair, product chapter and year. By using PPML, the gravity equation can be estimated in its multiplicative form and the issue of zero trade flows is avoided. The fixed effects are intended to capture unobserved heterogeneity for the bilateral pairs, the product chapters and over years. Including bilateral pair fixed effects means that all bilateral variables are dropped when estimating the model, as they are perfectly collinear with the fixed effects.

The effects of the gravity model are commonly estimated using fixed effects OLS. To make this paper easier to compare with previous studies, and in order to test the robustness, I will estimate the gravity equations with OLS using bilateral pair, product chapter, and year fixed effects. However, OLS has some disadvantages in comparison to the PPML method when it comes to handling zero trade flows and heteroskedasticity.

The estimations with disaggregated data will also use a fixed effects PPML model as the main method of estimation. However, instead of including fixed effects for bilateral pair, I will have fixed effects for bilateral pair and product chapter to capture specific effects for every combination of exporter, importer and product chapter. Making the filter this narrow makes the coefficients for the dummy variables for each product section to be more reliable. As in the previous regressions, I will include year fixed effects.

## 6 Empirical Results

### *6.1 Method I: The EU Enlargement in 1995*

The baseline model is estimated with aggregated export data using bilateral pair fixed effects PPML. The results are found under column (a) in table 3. The estimated coefficient for the EU dummy is 0.201, displaying the expected sign, i.e. acceding EU membership from being part of the EEA increases exports to the EU countries. The result is significant at a one per cent level. When estimating the gravity equation using OLS, displayed in column (b) in table 3, the result are very similar (0.215) and is significant at a one per cent level. The coefficient from the OLS estimation will be used to simulate the effects of the UK replacing its EU membership with a membership in the EEA, as it simplifies the calculations and interpretation.

Column (c) in table 3 shows the result from the fixed effects PPML model using disaggregated export data. The coefficients for the EU dummy variable are separated into four product sections to investigate if the effects of joining the EU had different effects on different products. The coefficients for agriculture, raw material and manufactures are all significant at a one per cent level. However only agriculture and manufactures has positive signs (0.280 and 0.0764 respectively), indicating that the countries joining the EU in 1995 all experienced increased exports in these product sections. The coefficient for raw material, on the other hand, has a negative sign (-0.122), which implies that exports to the EU for this section decreased as Austria, Finland and Sweden joined the EU. This result is somewhat unexpected but could possibly be reasonable if the EU agreement in some way disadvantages trade in raw material or if the countries are changing its export portfolio to the EU countries after joining the union. The fourth product section, miscellaneous, has a positive coefficient but is not significant. This could be because the range of products included in this section is so different from each other that there is no clear effect.

The estimated coefficient of the importer's and the exporter's GDP is positive in all three estimations, which is in line with economic theory. However it is not significant for all

estimations. The poor result could possibly be explained by the combination of relatively low time series variation in the GDP data and the bilateral fixed effects. The estimated coefficient for the importer's and the exporter's population is highly significant in all estimations, indicating that larger EU countries export more. Due to the bilateral pair fixed effects, the variables distance, common language and common border are omitted, as they are constant over time.

**Table 3. Method I: Regression results**

Dependent variable: Exports	(a)	(b)	(c)
	PPML	OLS	PPML
EU	0.201*** (0.000)	0.215*** (0.000)	
EU*Agriculture			0.280*** (0.000)
EU*Raw material			-0.122*** (0.000)
EU*Manufacturing			0.0764*** (0.008)
EU*Miscellaneous			0.0878 (0.388)
GDP importer	1.746 (0.135)	4.265*** (0.007)	0.258*** (0.000)
GDP exporter	2.229* (0.081)	0.551 (0.731)	0.126** (0.039)
Population importer	0.291*** (0.000)	0.411*** (0.000)	4.356*** (0.000)
Population exporter	0.344*** (0.000)	0.305*** (0.006)	5.261*** (0.000)
N observations	2,045	2,045	222,541
N groups	210	210	19,649
Time effects	Yes	Yes	Yes
Bilateral pair effects	Yes	Yes	No
Bilateral pair and product chapter effects	No	No	Yes

P-values in parentheses (based on robust standard errors)

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1



## **6.2 Method II: The Depth of Trade Agreements**

The results from the baseline estimation are presented in table 4. Using bilateral pair fixed effects, the dummy variables for distance, common language and common border are omitted due to collinearity. In column (a), the results from the fixed effects PPML estimation with aggregated export data is displayed. The estimated coefficient for the depth variable shows, as expected, a positive sign (0,0284). This implies that exports increases with deeper trade agreements in terms of legally enforceable provisions. The OLS estimation in column (b) confirms this results, although the coefficient differs slightly (0,0323). Both estimations are significant at a 5 per cent level. The results from the OLS estimation will be used in the simulation in section 6.4. The coefficient for the squared depth variable is significant at a 5 per cent level in the PPML estimation and at a 10 per cent level in the OLS estimation. This indicates that there might be a non-linear relationship between exports and depth of trade agreements, although it is difficult to interpret this coefficient.

In column (c), the results for the fixed effects PPML with disaggregated data are displayed. The coefficients for agriculture, raw material and miscellaneous are all positive and significant at a 10 per cent level, and for manufactures it is positive at a 5 per cent level, which means that deeper trade agreements seem to have positive effects on exports in all sections.

The coefficients for the exporter's GDP are negative in both PPML estimations, which is goes clearly against my theoretical predictions that larger countries trade more. However, it is positive in the OLS estimation and also significant at a 10 per cent level. The estimated effects on the importer's GDP are all insignificant. The coefficients for the exporter's population are all positive and significant at a one per cent level, while the coefficient for the importer's population is only significant in the PPML estimation with disaggregated data, although negative.

**Table 4. Method II: Regression results**

Dependent variable: Exports	(a)	(b)	(c)
	PPML	OLS	PPML
Depth	0.0284** (0.032)	0.0323** (0.013)	
Depth squared	-0.0006** (0.036)	-0.0006* (0.054)	-0.0005** (0.044)
Depth*Agriculture			0.0267* (0,054)
Depth*Raw material			0.0264* (0.054)
Depth*Manufactures			0.0281** (0.041)
Depth* Miscellaneous			0.0237* (0.087)
GDP exporter	-0.285** (0.046)	0.1354* (0.059)	-0.233* (0.098)
GDP importer	-0.0063 (0.959)	-0.892 (0.182)	0.0348 (0.0760)
Population exporter	1.749*** (0.000)	2.336*** (0.002)	1.673*** (0.000)
Population importer	-0.0646 (0.106)	-0.8923 (0.182)	-0.786** (0.050)
N observations	2,188	2,516	4,879,488
N groups	524	852	2,026
Time effects	Yes	Yes	Yes
Bilateral pair effects	Yes	Yes	No
Bilateral pair and product chapter effects	No	No	Yes

P-values in parentheses (based on robust standard errors)

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Note: As a robustness test, the baseline gravity equation was additionally estimated with fixed effects PPML and fixed effects OLS with additional specific effects for product chapter generating similar results for the depth variable.

### **6.3 Summary of Results**

The theoretical prediction of the first method was that joining the EU from being part of the EEA would generate positive effects on exports. Both the fixed effects PPML estimation and the fixed effects OLS estimation of the baseline model with aggregate exports data confirm this. The prediction of the second method that deeper trade agreements are leading to increased exports, are also confirmed by both the fixed effects PPML estimation and the fixed effects OLS model. In addition, the estimated coefficients for the EU variable and the depth variable are significant at a one percent level, and a five per cent level respectively, making the results rather robust.

However, the estimations of the gravity equations using disaggregated data did not generate as reliable results. At best the results imply that there are likely to be dissimilar effects on different product sections but whether the effects are positive or negative, and the size of the effects are not clarified by this analysis.

### **6.4 Simulating the Effects of the UK Leaving the EU**

The effects of the UK replacing its EU membership with a membership of the EEA are simulated using the estimated coefficients from the two different methods used in this study. To get the most reliable results and to make the simulations from the two methods comparable, the coefficients from the fixed effects OLS estimation with aggregated exports data are going to be used. The results from the simulations are presented in table 5.

It is important to note that the exact quantitative effects of the UK leaving the EU and joining the EEA might differ slightly than the chosen estimate (I obtained coefficients ranging from 0.201 to 0.215 in the first method, and 0.0284 to 0.0323 in the second method depending on the method of estimation). The aim is therefore not to provide the exact quantitative effect of the UK joining the EEA but to give an approximate idea of the potential trade effects.

The predicted value of the export volume is used to simulate the effect of the UK joining the EEA from being part of the EU. I have calculated the predicted value of exports by

fixating the EU variable and the depth variable to its values for the EU<sup>4</sup> and the EEA<sup>5</sup> respectively, and all other control variables to its mean values<sup>6</sup>. In the next step I translated the natural log of the export volume to its actual value, to be able to calculate the percentage change in exports following that the UK are going from being part of the EU to become member of the EEA, using equation 4.

$$\% \Delta Exports = \frac{(Exports\ EEA - Exports\ EU)}{Exports\ EU} \quad (4)$$

The simulation for the first method resulted in a decrease of the UK export volume to the members of the EU with 19,3 %. The UK's total exports to the EU amounted to approximately 195 000 000 000 Euro during 2016 (Eurostat, 2017). A decrease in UK export volume with 19,3 % equals about 38 000 000 000 Euro. The simulation gives similar results when calculating the percentage change in exports using the depth variable from the second method. The simulation resulted in a percentage change equal to 22,7 %. This is the decrease in exports to the EU that the UK can expect by joining an agreement with 8 less legally enforceable provisions than the EU, i.e. joining the EEA. Expressed in Euro, this equals about 44 000 000 000, just slightly different from the first method. Put into perspective, these values are almost 4 times as much as the UK net contribution to the EU budget during the period 2015/2016, which amounted about 11 400 000 000 Euro (Keep, 2017).

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<sup>4</sup> The value for the EU is in the first method 1 and the second method 44.

<sup>5</sup> The value for the EEA is in the first method 0 and in the second method 36.

<sup>6</sup> I have made use of the *margins* command in Stata for calculating the predicted values.

**Table 5. Simulating the effects of the UK joining the EEA**

	<i>Method I: The EU Enlargement in 1995</i>		<i>Method II: The Depth of Trade Agreements</i>	
	Percentage change in UK exports to the EU	Change in nominal exports to the EU (nominal Euro)	Percentage change in UK exports to the EU	Change in nominal exports to the EU (nominal Euro)
Aggregated exports	-19.3%	-37 569 586 548 €	-22.7%	-44 287 379 732 €

When using the fixed effects OLS estimations with aggregated data, the simulations are implying that the UK can expect substantial negative effects on its exports to the EU when leaving the union. As joining the EEA are assumed to be the best-case scenario for the UK outside of the EU in economic terms, the results also indicates that this probably is the least to expect from Brexit. Given that both methods are providing similar results in the simulations, the results are rather robust.

## 7 Conclusion

The intention for this paper was to investigate the impact on UK exports to the EU after leaving the EU and instead pursuing the best option outside the union. The best-case scenario was in this paper argued to be the option where the UK joins the EEA, keeping as close ties with the EU as possible.

I have used two methods in this paper in an attempt to predict the effects on UK exports to the EU, both estimating the gravity equation using fixed effects PPML, and fixed effects OLS, with aggregated export data. The first approach was to estimate the effects of the EU 1995 enlargement, when Austria, Finland, and Sweden went from being members of the EEA and instead accede EU memberships. By mirroring the results from this estimation, I came to the conclusion that the UK could expect a decrease in exports to the UK with 19,3 %. The other approach generated similar results but was based on a different method. Using the measure of the depth of trade agreements provided by Hofmann et. al. (2016), I estimated the effects on exports when engaging in a deeper

agreement. By engaging in an agreement containing of 8 less legally enforceable provisions, i.e. joining the EEA, the UK exports to the EU are expected to decrease with 22,7 %. As this paper were analyzing the best-case scenario for the UK outside the EU, any other option will likely lead to an even larger loss in UK exports to the EU. The results from this paper are however not to be interpreted as the exact quantitative effects of the UK replacing its EU membership with one in the EEA, but rather to give an approximate idea of the size of the decrease in exports.

I also estimated the gravity equations with fixed effects PPML using disaggregated data to investigate whether the effects on exports differ for different product sections. The results from these estimations were however rather weak, although they indicate that different product sections will be affected differently following Brexit. The extent of the differences is however not clarified in this paper but could be an interesting analysis for a future research.

The results from this paper are in line with previous research on the topic of Brexit, suggesting that leaving the EU will have substantial negative effects on UK-EU trade. Mulabdic et. al. (2017), for instance, came to the conclusion that the 'Norwegian solution' would decrease UK exports to the EU with approximately 12 %, which is a result in the same direction as the one obtained from this analysis. The results from this paper are however suggesting an even more severe trade reduction following Brexit, supported by two different methodological approaches. In addition, this paper makes a methodology contribution to the Brexit research by showing that two very distinct analytical methods are generating similar results.

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## 9 Appendix

### *A1. Variables and Data Sources*

<b>Variable</b>	<b>Definition and Data Source</b>
Imports	Imports in nominal Euros. Data source: Eurostat (2017).
Exports	Exports in nominal Euros. Data source: Eurostat (2017).
EU dummy	Constructed by author.
Bilateral distance	Distance in km between capital cities in two countries. Data source: CEPII (2017).
GDP	GDP in nominal Euros. Data source: CEPII (2017). Converted from USD using data from Eurostat (2017).
GDP per capita	Data source: CEPII (2017).
Common border	Dummy variable that is equal to unity if two countries share a common border. Data source: CEPII (2017).
Common official language	Dummy variable that is equal to unity if two countries share a common official or primary language. Data source: CEPII (2017).
Common currency	Dummy variable that is equal to unity if two countries have the same currency. Data source: CEPII (2017).
Depth of PTAs	The count of legally enforceable provisions included in a PTA. Data Source: The content of trade agreements database constructed by Hofmann et. Al. (2016).

## ***A2. Exporting and Importing Countries: Method I***

<b>Importing and exporting countries</b>	
Austria	Italy
Belgium	Luxembourg
Denmark	Netherlands
Finland	Portugal
France	Spain
Germany	Sweden
Greece	United Kingdom
Ireland	

## ***A3. Exporting and Importing Countries: Method II***

<b>Exporting countries</b>	<b>Importing countries</b>	
Austria	Albania	Italy
Belgium	Algeria	Jamaica
Bulgaria	Andorra	Jordan
Croatia	Austria	Latvia
Cyprus	Bahamas	Lebanon
Czech Republic	Barbados	Lithuania
Denmark	Belgium	Luxembourg
Estonia	Belize	Macedonia
Finland	Bosnia and Herzegovina	Madagascar
France	Bulgaria	Malta
Germany	Cameroon	Mauritius
Greece	Chile	Mexico
Hungary	Colombia	Moldova
Ireland	Costa Rica	Morocco
Italy	Cote d'Ivoire	Netherlands
Latvia	Croatia	Nicaragua
Lithuania	Cyprus	Norway
Luxembourg	Czech Republic	Palestine
Malta	Denmark	Papua New Guinea
Netherlands	Dominica	Peru

Poland  
Portugal  
Romania  
Slovakia  
Slovenia  
Spain  
Sweden  
United Kingdom

Dominican Republic  
Egypt  
El Salvador  
Estonia  
Faroe Islands  
Fiji  
Finland  
France  
Georgia  
Germany  
Greece  
Grenada  
Guatemala  
Guyana  
Honduras  
Hungary  
Iceland  
Ireland  
Israel

Poland  
Portugal  
Romania  
San Marino  
Seychelles  
Slovakia  
Slovenia  
South Africa  
South Korea  
Spain  
Suriname  
Sweden  
Switzerland  
Syria  
Trinidad and Tobago  
Tunisia  
Turkey  
United Kingdom  
Zimbabwe

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#### **A4. Harmonized System: Sections and Product Chapters**

<b>Section 1</b>	<b>Agriculture</b>				
		47	Pulp of wood or of other fibrous cellulosic material; recovered (waste and scrap) paper or paperboard.	52	Cotton.
1	Live animals.	49	Printed books, newspapers, pictures and other products of the printing industry; manuscripts, typescripts and plans.	53	Other vegetable textile fibres; paper yarn and woven fabrics of paper yarn.
2	Meat and edible meat offal.	68	Articles of stone, plaster, cement, asbestos, mica or similar materials.	54	Man-made filaments.
3	Fish and crustaceans, molluscs and other aquatic invertebrates.	69	Ceramic products.	55	Man-made staple fibres.
4	Dairy produce; birds' eggs; natural honey; edible products of animal origin, not elsewhere specified or included.	70	Glass and glassware.	56	Wadding, felt and nonwovens; special yarns; twine, cordage, ropes and cables and articles thereof.
5	Products of animal origin, not elsewhere specified or included.	71	Natural or cultured pearls, precious or semi-precious stones, precious metals, metals clad with precious metal and articles thereof; imitation jewellery; coin.	57	Carpets and other textile floor coverings.
6	Live trees and other plants; bulbs, roots and the like; cut flowers and ornamental foliage.	72	Iron and steel.	58	Special woven fabrics; tufted textile fabrics; lace; tapestries; trimmings; embroidery.
7	Edible vegetables and certain roots and tubers.	73	Articles of iron or steel.	59	Impregnated, coated, covered or laminated textile fabrics; textile articles of a kind suitable for industrial use.
8	Edible fruit and nuts; peel of citrus fruit or melons.	74	Copper and articles thereof.	60	Knitted or crocheted fabrics.
9	Coffee, tea, maté and spices.	75	Nickel and articles thereof.	61	Articles of apparel and clothing accessories, knitted or crocheted.
10	Cereals.	76	Aluminium and articles thereof.	62	Articles of apparel and clothing accessories, not knitted or crocheted.
11	Products of the milling industry; malt; starches; inulin; wheat gluten.	77	(Reserved for possible future use in the Harmonized System)	63	Other made up textile articles; sets; worn clothing and worn textile articles; rags.
12	Oil seeds and oleaginous fruits; miscellaneous grains, seeds and fruit; industrial or medicinal	78	Lead and articles thereof.	64	Footwear, gaiters and the like; parts of such articles.

	plants; straw and fodder.				
13	Lac; gums, resins and other vegetable saps and extracts.	79	Zinc and articles thereof.	65	Headgear and parts thereof.
14	Vegetable plaiting materials; vegetable products not elsewhere specified or included.	80	Tin and articles thereof.	66	Umbrellas, sun umbrellas, walking-sticks, seat-sticks, whips, riding-crops and parts thereof.
15	Animal or vegetable fats and oils and their cleavage products; prepared edible fats; animal or vegetable waxes.	81	Other base metals; cermets; articles thereof.	67	Prepared feathers and down and articles made of feathers or of down; artificial flowers; articles of human hair.
16	Preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates.	83	Miscellaneous articles of base metal.	84	Nuclear reactors, boilers, machinery and mechanical appliances; parts thereof.
17	Sugars and sugar confectionery.		<b>Section 3 Manufactures</b>	85	Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles.
18	Cocoa and cocoa preparations.	28	Inorganic chemicals; organic or inorganic compounds of precious metals, of rare-earth metals, of radioactive elements or of isotopes.	86	Railway or tramway locomotives, rolling-stock and parts thereof; railway or tramway track fixtures and fittings and parts thereof; mechanical (including electro-mechanical) traffic signalling equipment of all kinds.
19	Preparations of cereals, flour, starch or milk; pastrycooks' products.	29	Organic chemicals.	87	Vehicles other than railway or tramway rolling-stock, and parts and accessories thereof.
20	Preparations of vegetables, fruit, nuts or other parts of plants.	30	Pharmaceutical products.	88	Aircraft, spacecraft, and parts thereof.
21	Miscellaneous edible preparations.	31	Fertilisers.	89	Ships, boats and floating structures.
22	Beverages, spirits and vinegar.	32	Tanning or dyeing extracts; tannins and their derivatives; dyes, pigments and other colouring matter; paints and varnishes; putty and other mastics; inks.		<b>Section 4 Miscellaneous</b>
23	Residues and waste from the food industries; prepared animal fodder.	33	Essential oils and resinoids; perfumery, cosmetic or toilet preparations.	90	Optical, photographic, cinematographic, measuring, checking, precision, medical or surgical instruments and apparatus; parts and accessories thereof.



24	Tobacco and manufactured tobacco substitutes	34	Soap, organic surface-active agents, washing preparations, lubricating preparations, artificial waxes, prepared waxes, polishing or scouring preparations, candles and similar articles, modeling pastes, "dental waxes" and dental preparations with a basis of plaster.	91	Clocks and watches and parts thereof.
<b>Section 2 Raw Material</b>		35	Albuminoidal substances; modified starches; glues; enzymes.	92	Musical instruments; parts and accessories of such articles.
25	Salt; sulphur; earths and stone; plastering materials, lime and cement.	36	Explosives; pyrotechnic products; matches; pyrophoric alloys; certain combustible preparations.	93	Arms and ammunition; parts and accessories thereof.
26	Ores, slag and ash.	37	Photographic or cinematographic goods.	94	Furniture; bedding, mattresses, mattress supports, cushions and similar stuffed furnishings; lamps and lighting fittings, not elsewhere specified or included; illuminated signs, illuminated name-plates and the like; prefabricated buildings.
27	Mineral fuels, mineral oils and products of their distillation; bituminous substances; mineral waxes.	38	Miscellaneous chemical products.	95	Toys, games and sports requisites; parts and accessories thereof.
44	Wood and articles of wood; wood charcoal.	40	Rubber and articles thereof.	96	Miscellaneous manufactured articles.
45	Cork and articles of cork.	50	Silk.	97	Works of art, collectors' pieces and antiques.
46	Manufactures of straw, of esparto or of other plaiting materials; basketware and wickerwork.	51	Wool, fine or coarse animal hair; horsehair yarn and woven fabric.		

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