How will Brexit affect the patterns of French agricultural and food exports?

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Abstract

UK's decision to leave the EU in June 2016 marks a turning point in European history and raises many questions on future economic relationships and especially on the evolution of agricultural trade. We analyze how Brexit will affect agri-food trade between the UK and France, UK being a main trade partner of France in this sector. Using a structural gravity model with PPML estimator, we estimate trade costs effects such as tariffs or non-tariff measures on bilateral trade flows. We also review the main scenarios usually inferred on the future trade policies governing UK's trade with EU and third partners. We propose four scenarios of trade policy, not only between the UK and the EU but also the UK and the third (non-EU) countries. We find a high significance of some trade costs components, such as the real exchange rate or non-tariff measures. Concerning the latter, their effects, in magnitude and direction, vary with the category (SPS, TBT, etc). Results should permit to guide French decision-makers in the ongoing negotiations, and to anticipate the negative effects for France.

Key words: International trade, agricultural and trade policies, structural gravity estimation, Brexit
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1. Introduction

United Kingdom's decision to leave the European Union in June 2016 and the notification to the EU on 29 March 2017 marks a turning point in European history and raises many questions on future economic relationships and especially on the evolution of agricultural trade. With € 57 billion, agri-food exports represent 13 % of total French exports. In 2015, 9 % of this amount went to the UK, 54 % to the rest of the EU (Comext database). UK is the third destination of French agri-food exports (after Germany and Belgium). Reciprocally, UK is highly dependent on agri-food EU imports (69 %). France accounts for 10 % of UK's agri-food imports (third supplier, after Netherlands and Ireland).

The objective of this paper is to analyze how Brexit will affect agri-food trade between UK and France. The aim of this paper is twofold. First, we identify the products exported by France most likely to be affected by Brexit. Second, we estimate the post-Brexit changes in French agri-good trade patterns under four scenarios on the future trade policies governing UK's trade with EU and third partners, using a structural gravity model. Differently from previous studies, we make assumptions on the outcome of EU-UK trade negotiations, and on the future trade relationships between UK and its non-EU partners (third countries thereafter). We first consider two scenarios for future UK-EU trade: (1) a UK-EU free trade agreement similar to, but deeper than, CETA (EU-Canada Comprehensive Economic and Trade Agreement), and (2) a return to WTO rules. Then, for each of these scenarios, we consider two assumptions on the post-Brexit trade rules between UK and its non-EU partners. These combinations lead us to four scenarios. Both direct and indirect consequences are taken into account. We focus not only on the direct changes in trade flows between the UK and France, but also on the consequences of changes in other trade flows affecting indirectly trade between the UK and France.

The two usual approaches to quantify trade policy effects are the ex-post and ex-ante analyses. The first one quantifies the effects of trade policies using existing data. The second anticipates the future impact of alternative trade policies, via simulations. Both of them are needed, regarding our aim to estimate and predict economic consequences of Brexit.

Since the Brexit referendum announcement (i.e. even before the vote), a large amount of studies have been run, in order to bring out a maximum of angles for the vote. They concern specifically Brexit, or more generally EU disintegration. Various types of economic consequences of Brexit are considered in the literature. It may be trade flows, welfare, foreign direct investments (FDI) or other quantities. For instance, Holobiuc (2018) proposes a review of the economic consequences of the UK withdrawal from the EU, in terms of GDP, stocks of FDI, trade in goods and services. In their paper, Dhingra et al. (2017) focused on effects on welfare. Explanatory factors remain mainly changes in tariffs, but also in non-tariff measures (NTM).

The two main models generally used for such goals are computable general equilibrium models (CGE) and gravity models. CGE models are a class of macroeconomic models. They use economic data to estimate how an economy might react to changes in trade policy for example, i.e. external factors. A CGE model consists of equations describing the whole economy: different markets and sectors, and their interconnections, assuming cost-minimizing behaviour by producers, average-cost pricing, and household demands based on maximizing utility. Until now, the effects of Brexit have been estimated mainly with CGE analyses, and much less with gravity models.

Unlike most studies on the consequences of Brexit that rely on computable general equilibrium models, we use a structural gravity approach. This choice is motivated by a number of factors. We focus on the bilateral UK-France trade relationship, and want to asses and account for trade diversion effects. Structural gravity is more suitable for estimating effects at product (product group) level. It also allows to better include bilateral trade determinants and to avoid making strong (and hard to check) economic assumptions. We estimate the

direct effects of Brexit corresponding to changes in trade costs (partial equilibrium effects), as well as the indirect effects induced by changes in multilateral resistance, output, and expenditure (general equilibrium effects). We base our computations on data for the year 2015, the year before the Brexit vote in UK.

A lot of uncertainty hangs over the outcome of UK's trade negotiations. Future trade agreements will affect the costs of trading with UK (higher for EU countries, possibly lower for some non-EU countries), and will strengthen the competition on the UK market, as well as on all markets to which trade will be diverted. Results should permit to guide French decision-makers in the ongoing negotiations, and to anticipate the negative effects for France.

The remainder of the paper is structured as follows. The second section summarizes the on-going UK-EU negotiation process. Section 3 presents the theoretical approach based on the gravity model and the trade cost elements considered in the analysis. Section 4 describes the scenarios, data and methodology. Results are presented in section 5 and section 6 summarizes our conclusions.

2. Context of negotiations and scenarios: a brief review of the literature

The future relationship of the UK with the EU is still to be shaped. The UK will cease to be an EU member state on 29 March 2019. The process of leaving the EU is set out in Article 50 of the EU Treaty.

2.1. Ongoing onegotiations

On 29 March 2017 the UK notified its intention to withdraw from the EU. The European Council's guidelines agreed in June 2017 establish a two-phase negotiation process.

In June 2017 Mrs. May called for a general election in the aim to strengthen her position within the UK and obtain higher political leverage for negotiating a hard(er) Brexit. Ironically, the election resulted in the loss of Parliament majority for the governing party and the formation of a minority government. This softened Mrs. May's position on Brexit negotiations and determined her to become open to new arrangements.

In December 2017, the European Council accepted that sufficient progress had been made in the negotiations on the first phase dealing with issues related to citizens' rights, UK's 'divorce bill' and the Irish border for paving the way for discussions on the future trade relationships (European Commission (2017). The need for a transition arrangement has been accepted by both parties.

On 28 February 2018, the European Commission published a draft Withdrawal Agreement between the EU and the UK on the progress achieved during phase 1 of the negotiations. On 19 March 2018, an updated version of the Withdrawal Agreement is published, outlining (in green, yellow, and white) the areas of agreement and disagreement between the negotiators of the EU and the UK (respectively David Davis –he resigned on 8 July 2018- and Michel Barnier). The European Council (Article 50) welcomed this agreement on 23 March 2018 and adopted guidelines on the framework for the future EU-UK relationship. The two parties agreed on the key points of the future divorce agreement (except on the major issue of the Irish border) and in particular on the terms of the transition period. This period will follow the exit of the UK, 29 March 2019, and will last until 31 December 2020. Even if the UK will officially leave the EU on 29 March 2019, the transition period, or implementation phase, is supposed to 'allow businesses time to prepare for the new arrangements'[1] and 'enable the public administration in Britain to get prepared for the challenges they have to face'[2].

The UK has set out its ambition for a bold and ambitious free trade agreement with the EU while respecting its four red lines of ending the jurisdiction of the European Court of Justice, controlling immigration from the EU, ending most contributions to the EU budget and being able to strike trade deals with third countries. Prime Minister Theresa May pointed out that the interim agreement reached on a post-Brexit transition had required 'compromises on both sides'. The UK Government wishes that UK be treated as if it were an EU Member State during the transition period. The Government's aim is to roll over the EU's trade agreements into equivalent UK-third country agreements.

On the EU side, the position is that a non-member of the Union cannot have the same rights or the same benefits as a member. The EU insists on these guidelines for a future free trade agreement to preserve the indivisibility of its single market, recalling one of its basic principles in this negotiation: no 'à la carte' trade agreements, sector by sector. The 27 also hope, in the long term, to maintain zero customs duties and the absence of quantitative restrictions. The EU has proposed a free trade agreement covering all goods, including agriculture, but with limited market access for services, common discipline on sanitary and phytosanitary standards as well as a framework for voluntary regulatory cooperation (European Council

[1] The Guardian website viewed on September 2018 : https://www.bbc.co.uk/news/uk-politics-42906950
[2] BBC website viewed on September 2018 : https://www.bbc.co.uk/news/uk-politics-42906950

(2018a)). A new joint statement from the negotiators of the EU and the UK government on the progress of negotiations under Article 50 has been presented during the meeting of the European Council (Article 50) of 29 June 2018 (European Council (2018b))[3].

British Prime Minister Theresa May thought she had finally agreed with her government on a common line on Brexit in hopes of speeding up negotiations on the exit of Britain from the EU, scheduled March 29, 2019. Her proposal is to create a free trade area between the UK and the EU with a set of common rules for industrial goods and agricultural products. However, she faced opposition in her own camp at the beginning of July 2018, with the resignation of David Davis, the UK negotiator -replaced by Dominic Raab- and of Boris Johnson, the UK Foreign secretary -replaced by Jeremy Hunt-, two strong pro-Brexit voices of the government. Both did not support May's plan to maintain close trade and regulatory ties with the EU. These resignations came just days after Mrs. May announced she had finally united her quarrelsome government behind her plan for a divorce deal with the EU. The plan seeks to keep the UK and the EU in a free-trade zone for goods, and commits Britain to maintaining the same rules as the bloc for goods and agricultural products.

Less than six months remain until Britain leaves the bloc on March 29, 2019, and the EU has warned Britain repeatedly that time is running out to seal a divorce deal.

A final version of this Withdrawal Agreement should be agreed by the EU and the UK by 18 October 2018 to allow for the timely ratification by the European Parliament, the Council (Article 50) and the UK, according to its own constitutional requirements. Discussions on these points are ongoing. But we may have some doubt on the schedule.

2.2. What about the possible scenarios?

If the UK leaves the EU without a trade agreement, traders would be required to absorb all the additional trade costs (customs clearance costs, tariffs, regulatory checks on food products, road transport services), which are particularly high in case of agri-food products (see Matthews (2017a) for details). The objective on both sides is to limit these trade costs.

Probable scenarios are emerging, but uncertainty still looms, on both sides, especially about how much integration should remain between the UK and the EU. The shape of the future trade relationship will not be known until the negotiations successfully concluded during the transition period.

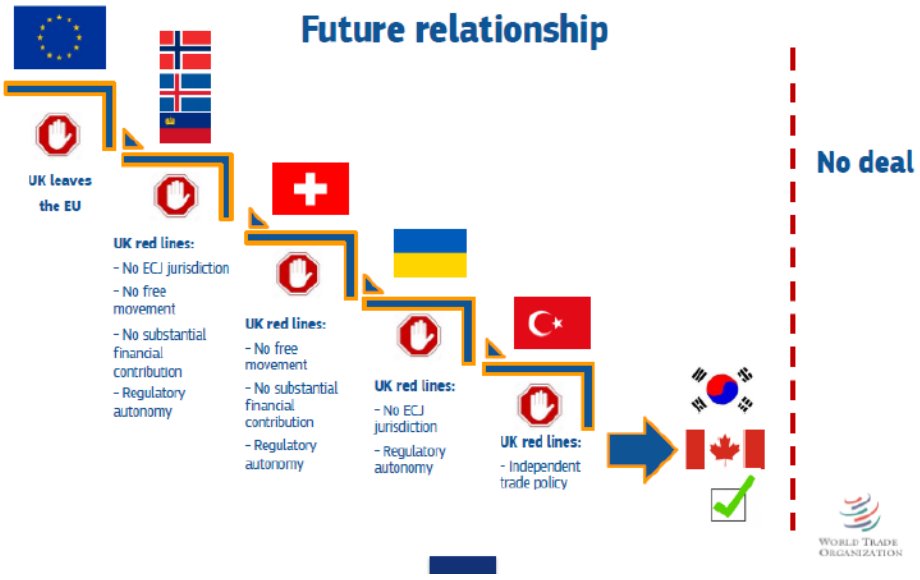
Matthews (2018) summarizes the outcomes according to the degree of agreements between the EU and UK parties:

- If the Withdrawal Agreement is ratified, UK would remain an EU Member State and part of the Custom Union and Single Market until the end of the transition period, i.e. by 31 December 2020;
- If UK and EU cannot agree or fail to ratify the Withdrawal Agreement, it would lead to a 'hard' Brexit in March 2019. After that date, trade would thus take place on WTO terms. MFN tariffs would apply on bilateral trade and customs and regulatory checks would be required for goods crossing the UK-EU border (like for other third countries). These trade costs would be significant: e.g. according to Dhingra et al. (2017), in a pessimistic scenario where the UK and EU impose MFN tariffs on each other, non-tariffs barriers increase to 75 % of the reducible barriers faced by US exporters to the EU, which means 8.31 % of increase.
- If the UK maintains its 'red lines' (no customs union, no single market), additional trade costs on trade between the UK and the EU27 couldn't be avoided after 2020.

[3] The European Council (Art. 50) guidelines on the framework for the future EU-UK relationship, 23 March 2018, viewed on September 2018: http://www.consilium.europa.eu//media/33458/23-euco-art50-guidelines.pdf

A number of models for the future long-term relationship between the UK and the EU27 have been studied in the literature according to the implied potential additional trade costs. Matthews (2017a) describes and explains clearly the differences between the 'Canada', 'Turkey', 'Ukraine', 'Swiss' and 'Norway' models. As mentioned earlier, the UK Prime Minister Theresa May imposed four 'red lines' not to be exceeded, which come into conflict with these possible agreements (see figure 1, prepared for the 15 December 2017 European Council meeting and presented by Michel Barnier, European Commission Chief Negotiator, to the Heads of State and Government at the European Council (Article 50)).

Figure 1: Future UK-EU relationship



***Source**: European Commission, TF50 (2017) 21, link: https://ec.europa.eu/commission/sites/beta-political/files/slide_presented_by_barnier_at_euco_15-12-2017.pdf, downloaded July, 12 2018.*

Taking into account the UK red lines, the most probable trade agreement seems to be a 'CETA+', a deep and Comprehensive Economic and Free Trade Agreement like the EU-Canada model (Matthews (2017a)). It provides for a duty-free access for all goods (no tariffs, with some restrictions on sensitive agricultural products). It does not require full freedom of movement, nor budgetary transfers. It has also minimal requirements for regulatory alignment, but some non-tariff measures (NTM) would be imposed.

Still, this type of agreement does not match the negotiation position (preferences and conditions) defended by each party (UK and EU).

In addition to the relationship with the EU, the UK trade relationships with third countries (i.e. outside the EU) will also be subject to change. Thus, another aspect of the scenarios concerns the future UK-third countries trade agreements.

The most common approach in Brexit literature is the consideration of two extreme scenarios, for example in Oberhofer and Pfaffermayr (2018): a 'hard' and a 'soft' Brexit scenarios are compared. In the 'hard-Brexit', it is assumed that the UK will leave the EU and lose current free trade agreements with third countries.

Furthermore, this scenario assumes that no new free trade agreement between the EU and UK could be established. As a consequence, UK would trade with all countries in the world based on the WTO regulations. The 'soft-Brexit' scenario assumes that all existing trade agreements with third countries are inherited from the EU and remain. Concerning the agreement with EU, the literature usually assumes several scenarios. For example, Dhingra et al. (2017) assume: 1. The UK remains part of the Single Market like Norway; or 2. The UK negotiates bilateral agreements with the EU as Switzerland and Canada have done; or 3. The UK and the EU trade under WTO terms.

In the present study, we choose to consider two scenarios for the future UK-EU trade arrangements: (1) a free trade agreement similar to, but deeper than, CETA, usually referred in the literature as the 'optimistic scenario', (2) a return to WTO rules, usually referred in the literature as the 'pessimistic scenario'.

For each of these scenarios, we set two possible outcomes for the UK's arrangements with non-EU trade partners. We consider (a) a replication of current EU agreements with third countries, (b) preferential trade agreements with UK's main extra-EU partners (more ambitious than EU agreements) and a return to WTO rules for the rest of countries. We detail more precisely these scenarios in section 3.

Comparing the results of different scenarios, we show how French agri-food exports to the UK, intra-EU and extra-EU markets are exposed to UK's future trade deals with EU and with third countries.

2.3. Are French wines, dairy, and bakery products in danger?

In a previous work based on 2015 Comext data (Henry et al., 2018), we pinpointed the French agri-food products the most exported to the UK and the most likely to be affected by the Brexit (at the 4-digit and 6-digit level of the Harmonized System product classification). The main features are summarized below.

The UK, a major partner for France

The UK represents a major partner for France, since 9 % of total French agri-food exports go to the UK market. 54 % are sold to the EU26 trade partners (EU except France and the UK). This represents, respectively, € 5.4 billon and € 30.8 billion in terms of 2015 trade.

High concentration of French agri-food exports in few products

It appeared that French exports to the UK are concentrated in few sectors. Beverages are, by far, the first group of products exported by France worldwide. Dairy products and preparations of cereals come in the second and, respectively, third position. Wines, dairy, and bakery products, cumulate more than 30 % of French agri-food exports to the UK, and therefore are likely to be the most affected by post-Brexit trade arrangements.

At a higher level of product disaggregation, wines (HS code 2204) come on top of French exports. They account for 14.4 % of French agri-food exports to all markets, including the UK and the rest of EU. They are followed by stronger spirituous beverages (HS code 2208, i.e. beverages of less than 80 % alc/vol), with a share of 6.9 %. Within the group of dairy products, cheese and curd stand out with the largest share: 5.2 % of French exports. In the cereals preparations category, bakery products (HS code 1905 'Bread, pastry, cakes, biscuits') come first. They represent 2.8 % of French agri-food exports, all destinations combined. For each of these products, the UK is an important destination of French imports, and France is a one of the main sources of British imports. For instance, the British market is the second largest destination of French exports of wines (after USA), and the largest outlet of French exports of bakery products. France is the largest UK supplier of wines (one third of UK imports) and the second largest for cheese and curd and bakery products (about 20% of imports), competing strongly against Irish and German producers.

Other UK partners, trade diversion and competition with French exports

Brexit may generate trade diversion if non-EU countries with benefit from an easier access to the UK market than France and other EU countries. Trade will most easily be redirected towards non-EU partners with the largest market share (that can increase their supplies). The introduction of border controls and trade barriers for the UK-EU trade will shrink the share of EU exports on the British market and intensify the competition among EU countries selling the most to UK[4].

To study the impact of Brexit on French exports, we first highlighted the main other partners of UK and the potential trade diversion or competition with French products. For example, Ireland is an interesting UK partner. Due to its high trade intensity with the UK, Ireland is the most exposed to these effects. Its production system and supply chains are strongly integrated with the UK economy, and it does not share a land border with other EU countries. UK is by far Ireland's main trade partner. Over 40 % of Irish exports of agri-food products are channeled to the UK. For comparison, the second destination of Irish agri-food exports (the U.S.) absorbs only 6.5 %. In addition, many Irish agri-food products (especially dairy and bakery products) cross repeatedly the UK-Ireland at different production stages. Border controls for these flows after Brexit will challenge the profitability and resilience of these highly integrated production processes. Redirecting Irish exports to other EU countries will imply in most cases transiting the UK and facing double border checks, penalizing again Irish producers against the rest of EU producers. The special case of Irish high exposure to Brexit has recently been the subject of literature (see Copenhagen Economics (2018) and Matthews (2017b)).

Outside the EU, concerning the agri-food sector, the main UK trade partners include Canada USA, Australia, India, China, Singapore, and New Zealand. These countries will be considered in our study as the UK's main extra-EU partners with which it may conclude trade agreements more ambitious than with EU.

In the present paper we focus on the whole agri-food sector. Further work will include the distinction of the different chapters, and the focus on products of interest for French exports (wines, for example).

[4] For example in the wine sector, French exports will face increased competition from New World producers (Australia, New Zeeland, Chile and USA), as well as from other EU producers (Italy and Spain). We expect trade diversion effects to be lower for dairy and bakery products, that the UK imports mainly from EU countries. Still, the future UK's trade arrangements may foster the emergence of new non-EU suppliers.

3. Trade costs and selected scenarios

3.1. Quantifying trade policy effects

Motivated by a number of factors explained earlier, we choose a structural gravity approach. Focusing on the bilateral UK-France trade relationship (and more generally UK-EU), we aim to estimate the effects of Brexit in terms of changes in trade flows.

The gravity model has been (and still remains) used as a workhorse model in empirical international trade analyses, more precisely for analyzing the determinants of bilateral trade flows since being introduced and used empirically by Tinbergen (1962). In its simplest form, the gravity equation for trade may be written in the following expression:

$$X_{ij} = \mathrm{A}\frac{Y_i^{\alpha} Y_j^{\beta}}{\mathrm{d}^{\theta}}. \qquad (1)$$

With X_{ij} the amount of bilateral trade between countries i and j, Y_i and Y_j the economic sizes of the two countries, d_{ij} the distance between the two economies capturing all factors that might create trade resistance, A a constant and α, β, θ the parameters.

Over the last decade, concentrated efforts of trade theorists have established that gravity equations emerge from mainstream modeling frameworks in economics. The model has been first explained theoretically by Anderson (1979), followed by Bergstrand (1985, 1989), Helpman (1987), Anderson and van Wincoop (2003, 2004).

The gravity model provides the main link between trade barriers and trade flows (Anderson and Van Wincoop, 2004).
Besides, Huchet-Bourdon and Cheptea (2011) argued that trade in agricultural and food products in Europe fits well the Armington (1969) assumption (all goods are differentiated by place of origin).

There is a long tradition in the trade literature of log-linearizing this equation. This transformation allows interpreting the parameters of log-linearized models estimated by ordinary least squares (OLS) as elasticities. This is also convenient in the methodology we plan to use, as the effect of multilateral resistances terms can be captured by exporter and importer fixed effects, under the log-linearized equation (see section 4).

This model has been used by economists to analyze the determinants of bilateral trade flows such as common borders, common languages, common legal systems, common currencies, common colonial heritage, the effectiveness of trade agreements, etc. In the basic gravity model, distance is used as a proxy for trade costs, including transport, search, etc.. However a number of studies have shown that transaction costs in international trade are considerably larger than previously thought (Anderson and van Wincoop, 2003, 2004; McCallum, 1995; Wolf, 2000)

Trade costs are a key element in the process of quantification of trade policy analysis and they are at the core of our paper. First, we estimate trade costs between UK and EU countries (including France) using an aray of observable proxy variables. In a second step, we infer counterfactual trade costs under four post-Brexit scenarios on the outcome of UK's trade negotiations with EU and third countries. We measure then the consequences of changes in trade policy under each scenario on bilateral trade flows.

In the trade literature, the list of observable variables used to estimate trade costs includes distance, adjacency, common language, tariffs, membership of preferential trade agreements, etc. As already mentioned, trades costs have usually been approximated in the literature simply by distance: $t_{ij} = d_{ij}^{\beta}$, with d_{ij} the distance between i and j and β the distance elasticity of trade.

We consider the following trade costs specification for exports of country i to destination market j:

$$t_{ij} = {d_{ij}}^{\beta_1} \cdot \left(1 + tar_{ij}\right) \cdot {NTM_{ij}}^{\beta_2} \cdot {RER_{ij}}^{\beta_3} \cdot e^{RTA_{ij}^{\beta_4}} \cdot e^{CNTG_{ij}^{\beta_5}} \cdot e^{LANG_{ij}^{\beta_6}} \cdot e^{\cdot CLNY_{ij}^{\beta_7}} . \quad (2)$$

where tar_{ij} are the tariffs on the imports of j from i, d_{ij} stands for the bilateral distance between i and j, NTM_{ij} are the non-tariff measures, RER_{ij} is the bilateral real exchange rate. The exponential terms are dummies. RTA_{ij} is a dummy denoting the existence of a regional trade agreement between i and j. $CNTG_{ij}$ is a variable capturing the presence of common borders between i and j, LANG denotes a dummy variable for the existence of a common official language between i and j, and CLNY is an indicator for the presence of colonial ties between i and j (Larch et al., 2016).

Most of these economic components are measurable or available in economic databases from CEPII[5], for example bilateral values and quantities of exports (BACI database) or gravity variables (distance, common language, contiguous border, colonial relationship). UNCTAD TRAINS provides tariffs and non-tariffs measures.

With the UK example, the different trade costs components and related stakes are detailed below. Note that some of these variables vary in time, such as tariffs or NTMs, while others are time-invariant, such as distance.

Trade costs in the EU Single Market

The main changes in UK's trade costs induced by Brexit will refer to its relationship with EU partners. The EU Single market is the world' most integrated economic region, defined by 'four freedoms': the free movement of goods, services, capital and people. All EU members are treated as a single economic area. It has reduced trade costs significantly, not only between its members but also third countries.

The EU Single Market is a highly integrated free trade area. It has made the trade within the EU easier, as it reduced trade costs, by removing tariffs and quotas. The trade relationship between Third (non-EU) countries has been made easier too, as the EU Single Market created a customs union which reduces cross-border costs, and creating a level playing field, for example, by reducing NTM (such as regulations, standards or specifications required to trade).

Concerning trade with third countries, the later benefit from the same level of access to the internal market of all EU countries, as access to one EU market implies the same type of access to the entire Single Market. The EU has signed FTA with several individual countries. As an EU member and part of the customs union, UK's trade with these countries is regulated by these trade deals. All these trade arrangements will end when the UK exits the EU (and the EU customs union). Brexit allows the UK to sign new trade deals with third partners, different and possibly deeper than the EU trade deals with these countries.

An other element which can influence the trade cost changes is the non-membership of the UK to the European Economic Monetary Union. Keeping control on its own money has some economic advantages, but in terms on trade costs, it nevertheless opens the possibility of changes in real exchange rate.

[5] CEPII website, viewed on June 2018 : http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=1

3.2. Post Brexit scenarios

In the present study we name scenarios 'Sx'. For each scenario, we have a corresponding trade cost $t_{ij}(Sx)$:

$$t_{ij}(Sx) = {d_{ij}}^{\beta_1} \cdot \left(1 + tar_{ij}\,(Sx)\right) \cdot NTM_{ij}(Sx)^{\beta_2} \cdot RER_{ij}(Sx)^{\beta_3} \cdot e^{\beta_4 \cdot RTA\,(Sx)_{ij}} \cdot e^{CNTG_{ij}^{\beta_5}} \cdot e^{LANG_{ij}^{\beta_6}} \cdot e^{\cdot CLNY_{ij}^{\beta_7}} . \quad (3)$$

With t_{ij} the trade costs for exports from i to j, tar_{ij} the tariffs for exports from i to j, d_{ij} the distance between i and j, NTM_{ij} the Non-Tariff Measures for exports from i to j, RER_{ij} the Real Exchange Rate between i and j, and RTA_{ij} the Regional Trade Agreement between i and j.

Each scenario is composed of a combination of two parts: i) future UK-EU trade [(1) and (2)] and ii) future UK-Third countries trade [(a) and (b)]. Each combination x= 1a, 1b, 2a or 2b corresponds to one of the scenarios.

i) Future UK-EU trade: some possible scenarios

(1) A deep FTA

Given the recent developments of the EU-UK trade negotiations (UK's four red lines are incompatible with EU's conditions for granting access to the single market), we rule out a scenario under which future UK's trade with EU partners is governed by a trade agreement close to EU membership. In the case of a free trade agreement (CETA-like), the UK remains part of the Single Market and there are no tariffs on goods trade between the UK and the EU: $tar_{EU\text{-}UK} = tar_{UK\text{-}EU} = 0$.

Nevertheless, we assume that the future UK-EU trade agreement will imply some (quite low) NTM, similar to the EU relationship with non-EU members of the European Economic Area (EEA). UK has formulated its intention to develop its own standards that do not ideally match those of EU.

In the literature, different methods exist to compute the corresponding trade costs components. For example, Dhingra et al. (2017) assume that, in the case of EEA membership, the EU-UK trade will be subject to a NTM that is only one quarter of the reducible barriers (i.e. the fraction of the trade cost that could in principle be eliminated by policy action) faced by US exporters to the EU, resulting in a tariff equivalent of 2.77 %.

We opt for an alternative method, consisting in estimating the current (year 2015) weighted average number of NTM between the EU countries: $NTM_{EU\text{-}UK}$ corresponds to the mean number of NTM imposed by the EU27 countries on the UK for its exports to EU countries, after Brexit. In this scenarios this number will be equal to the current (2015) average number of NTM imposed by an EU country j on the others for their exports to j.

$NTM_{UK\text{-}EU}$ corresponds to the mean number of NTM faced by the UK for its exports to the EU27 countries, after Brexit. This number will be equal to the current (2015) average number of NTM faced by an EU country i for its exports to the others.

(2) A return to WTO rules

In the case of a return to WTO rules, we more precisely assume that the UK leaves the Single Market and trades with the EU under WTO terms. Similar to previous studies (Dhingra et al., 2017, Bellora et al., 2017, Connell Garcia et al., 2017,…) we assume that in this case MFN tariffs will apply to bilateral UK-EU flows.

Accounting for the product composition of the EU-UK agri-food trade, EU exports to the UK will be subject to an average 7.26 % import tariff, while UK exports to the EU to an average 4.96 % import tariff, according to Dhingra et al. (2017).

Bellora et al. (2017) assume that tariff rates between the UK and EU are set at their MFN values. In terms of NTM, they suppose the UK loses two-thirds of its preferential access to the single market. According to Connell Garcia et al. (2017), a return to WTO rules corresponds to a 'hard Brexit': + 8.31 % NTM. This number corresponds to three quarters of the reducible barriers faced by US exporters to the EU (Dhingra et al., 2017).

We consider, both for tariffs and NTM, the average barriers applied (imports) or faced by (exports) the EU with whom the EU does not have trade agreements (WTO rules). We assume these current averages will be applied for the UK imports and exports to and from the EU.

ii) UK's trade with non-EU partners ('third' partners)

(a) A replication of current EU agreements with third countries

In this scenario, current EU-Third applied by or faced by the EU to third countries will be transposed to future UK-Third partners.

$Tar_{Third\text{-}UK}$ = Current $Tar_{Third\text{-}EU}$ and $Tar_{UK\text{-}Third}$ = Current $Tar_{EU\text{-}Third}$

$NTM_{Third\text{-}UK}$ = Current $NTM_{Third\text{-}EU}$ and $NTM_{UK\text{-}Third}$ = Current $NTM_{EU\text{-}Third}$

(b) A PTA with UK's main extra-EU partners (more ambitious than EU agreements) and a return to WTO rules for the rest of countries

Third countries (outside the EU) are divided into 2 groups: 'Third 1' are the favored partners of the UK, and 'Third 2' are the others. 'Third 1' are the main recipients of British exports already mentioned: Canada, USA, Australia, India, China, Singapore, and New Zealand. With them, a PTA will be set, assumed to correspond to half of tariffs and NTM between EU and third countries. For the 'Third 2' group, a return to WTO rules is planned, corresponding to the current MFN tariffs and NTM between the EU and third countries 'Third_MFN'.

$Tar_{Third1\text{-}UK}$ = Current $Tar_{Third\text{-}EU}/2$

$Tar_{UK\text{-}Third2}$ = Current $Tar_{EU\text{-}Third\_MFN}$

$NTM_{Third1\text{-}UK}$ = Current $NTM_{Third\text{-}EU}/2$

$NTM_{UK\text{-}Third2}$ = Current $NTM_{EU\text{-}Third\_MFN}$

Table 1 summarizes the scenarios to understand them at a glance.

Table 1- Sum up of the scenarios

	(1)	**(2)**
(a)	**S1a.** Ambitious FTA for EU and replication of current EU agreements with third countries. ***Low tariffs and NTMs***	**S2a.** WTO rules for EU and third countries ***'UK Fortress'***
(b)	**S1b.** FTA with EU, PTA with UK's main extra-EU partners and a return to WTO rules for the rest of countries. ***EU and some third countries as favored partners***	**S2b**. WTO rules for EU, PTA with UK's main extra-EU partners and a return to WTO rules for the rest of countries. ***Some third countries as favored partners***

Comparing the results of different scenarios, we show how French agri-food exports to the UK, intra-EU and extra-EU markets are exposed to UK's future trade deals with EU and with third countries.

4. Data and methodology

Several databases are used and a hard work of collecting and organizing the data has been done .

We use the BACI database, from CEPII[8], which is the world trade database built at a high level of product disaggregation (HS 6-digit level). It provides bilateral values and quantities of exports. We start with the 2000-2015 panel, and finally focus on the year 2015. Gravity variables are also extracted from CEPII (distance and common language) or from the World Development Indicators (WDI) database of the World Bank (GDP and population). Regional trade agreements are built from (among others) Baier and Bergstrand[10] and the WTO web site. EIA (Economic Integration Agreement) database from Baier and Bergstrand provides economic integration agreement dataset indexes indicating the amount of trade openness. The scale goes from 1 to 6, between each country pair between 1950 and 2012. This dataset tracks trade openness over time. It was updated on April 30, 2017 and concerns the years until 2012. Tariffs and non-tariffs measures are extracted from UNCTAD TRAINS via the World Integrated Trade Solution (WITS) software[11], from the World Bank. It consists more precisely in annual tariffs structures (MFN applied and preferential tariffs, ad valorem or not) and Non-Tariff Measures information since 1988 at the National Tariff Line (NTL) level. TRAINS also contains imports statistics by origin and Bound Tariff data at HS 6-digit level. NTM are separated into 'partial product coverage' or 'full product coverage'. The reason is that some products concerned by regulation or policy could me more specific or at a more disaggregated level than the HS 6-digit. In some cases, the detailed specification of 'partial coverage' of registered product codes is required. Finally, IMF database gives the annual real exchange rates or RER (local currency per USD), for each country and year. RER rate is based on Consumer Price Index. RER_{ij} has been calculated as followed: $RER_{ij}=RER_i/RER_j$ i.e. exporter RER/importer RER. The depreciation of the pound against the euro and a British policy of import substitution may decrease the competitiveness of French exports on the UK market.

From a database to another, level of aggregation, years available and Harmonized System (HS) were often different. Data harmonization has been highly necessary and represents a major preliminary work. For example, data have been converted from HS 2007 and HS 2012 norms into HS 1992 norms, when necessary.

Methodology

The structural gravity model is the basis for the methodology of estimation and prediction proposed by following Anderson et al. (2015). The 3 main equations used in this methodology are (4), (5) and (6).

$$X_{ij} = Y_i E_j \left(\frac{t_{ij}}{\Pi_i P_j}\right)^{1-\sigma}. \quad (4)$$

With:
X_{ij} : Value of exports from i to j (value of shipments at destination prices from region of origin i to region of destination j);
E_j : Expenditure at destination j from all origins;
Y_i : The sales at destination prices from i to all destinations;
t_{ij} : Trade costs (vector of trade cost variables);
Π_i : Outward Multilateral Resistance (OMR - exporter);
P_j : Inward Multilateral Resistance (IMR - importer);

[8] CEPII website, viewed on June 2018 : http://www.cepii.fr/CEPII/en/bdd_modele/presentation.asp?id=1
[10] Jeffrey Bergstrand's Homepage, viewed on June 2018 https://www3.nd.edu/~jbergstr/
[11] WITS World Bank website, viewed on June 2018 : https://wits.worldbank.org/

σ >1 : Elasticity of substitution of goods from various countries.

With the two constraints on multilateral resistances (MLR) Π_i and P_j:

$$\Pi_i = \sum_j \left(\frac{t_{ij}}{P_j}\right)^{1-\sigma} E_j. \quad (5)$$

$$P_j = \sum_i \left(\frac{t_{ij}}{\Pi_i}\right)^{1-\sigma} Y_i. \quad (6)$$

According to Brakman et al. (2017), these MLR terms are at the core of modern formulations of the gravity models. They are related to price indices, and are crucial to analyze the effects of a trade policy. Without these terms, the simulated effects of a trade policy change would only affect the two countries involved. With these price index terms, a trade policy variation changes the MLR terms and thus affects the whole trading system.

Equation (4) can be rewritten under the following multiplicative form:

$$X_{ij} = exp\left(\boldsymbol{t_{ij}}\,\boldsymbol{\beta} + \pi_i + \chi_j\right) + \varepsilon_{ij}. \quad (7)$$

With π_i the exporter fixed effect, χ_j the importer fixed effect, β the vector of coefficients (trade cost elasticities), and ε_{ij} the error term.

First, the parameters (or elasticities) associated to the different trade costs components are estimated via the structural gravity model. Counterfactual scenarios are then inferred (see section 3). This is the work we present in this paper. It can constitutes the basis for the prediction of the consequences on bilateral trade flows of trade policy change.

Following the three steps methodology of Anderson et al. (2015), counterfactual trade costs inferred, and the estimations of the current coefficients β, and MLR allow such predictions.

From this point of view, our work would be the 'Baseline' scenario. It consists in estimating the average effects trade costs on bilateral trade flows and associated elasticities.

Estimation of the 'baseline' scenario.

We estimate the baseline, using trade data. Estimates are noted: $\hat{\beta}$, $\widehat{\pi_i}$, $\widehat{\chi_j}$.

$\widehat{\pi_i}$ and $\widehat{\chi_j}$ are fixed effects. Fixed effects are one of the solutions against the bias of omitted variables (which is the 'Gold medal mistake' according to Baldwin and Taglioni (2006)).

To estimate `Baseline' Gravity, we use the PPML estimator, and OLS, for the comparison. The first one allows to estimate gravity with exporter and importer fixed effects on the equation (7). Poisson estimators such as PPML have several advantages, compared to OLS. For instance, Fally (2015) shows that when gravity is estimated with PPML, the estimated fixed effects are exactly equal to the multilateral resistances that satisfy the equation system. Under the PPML structure, the estimated fixed effects provide strong fit to the data and satisfy equilibrium market clearance and budget constraints. Anderson et al. (2015) add that PPML estimator for gravity regressions account for heteroscedasticity and take advantage of the information contained in the zero trade flows. See also Santos Silva and Tenreyro (2011) or Pfaffermayr (2017) for the use of PPML in structural gravity models and more details about the advantages.

5. Results

For a comparison purpose, two types of estimations are run: OLS and Poisson. We may stay at a HS 6-digit level (corresponding to k index). This level is, to our sense, the most suitable for the French case and our purpose. As French exports are concentrated in few products or categories, we aim to highlight the effects on these products. We are not interested in the whole agri-food sector. As a consequence, estimation at the product level is more suitable.

Estimations are run with 2015 trade flows values.

Before running estimations with fixed effect, simple estimations (not repeated here) allow pinpointing the potential collinearity between our explanatory variables and, where appropriate, choose the most relevant.

OLS are run with country-product fixed-effect (importer: FE_{jk}, exporter: FE_{ik}) .

One of the issue is that some main explanatory variables could be endogenous (e.g. tariffs, NTM, RTA) and can give biased results. It is likely that trading pairs sharing trade agreements might be characterized by some other bilateral proximity factors. One of the most common solutions consists in using fixed effects for trading pairs: FE_{ij} (Baier and Bergstrand, 2007). Another issue is the zero flows, even at the aggregate level, resulting from the combination of country-pairs that do not trade. They can introduce a selection bias. With PPML estimator, this bias can be avoided.

a. OLS, importer and exporter fixed effects

Table 2 presents the comparison of several OLS, with and without zero trade flows included, with and without country-pair fixed effects.

In the specification (1) there is no bilateral fixed effect FE_{ij}, and zero trade flows are excluded. In the specification (2) there is still no bilateral fixed effect FE_{ij} but zero trade flows are included. Bilateral fixed effects FE_{ij} are introduced in the specifications (3a) and (3b), and zero trade flows are excluded. In (3a) we run the regression with FE_{ij} and (3b) consists in a regression of FE_{ij} on bilateral explanatory variables. (4a) and (4b) are similar to (3a) and (3b) but zero trade flows are included.

The results show that considering country-pair fixed effects does change the estimates of bilateral variables effects. Tariffs and distance remains in both cases highly negatively significant as trade flows determinants. Contiguity and common language may contribute to increase bilateral trade flows. Colonial relationship effect is significant in the columns (1) and (2), i.e. when there is no country-pair fixed effects. It is not significant otherwise. RER becomes significant when bilateral fixed effects are introduced.

More surprisingly, the category D of NTM (Antidumping, countervailing and safeguard) in specification (4), and the category E of NTM in every specification seem to promote trade flows quantities between two countries. A possible interpretation is the increasing of product quality.

The category F of NTM (Price-control measures) has contradictory effects in function of the specifications.

These changes highlight the importance of country-pair fixed effects. Correcting some potential omitted variables, estimated elasticities change. For example, tariffs and EIA are partially collinear. Using FE_{ij} may allow a better estimation of each variable.

Table 2 - OLS estimations of the baseline (dependent variable ln (X_{ij}))

	(1)	(2)	(3a)	(3b)	(4a)	(4b)
	Flows>0	Flows >=0	Flows>0		Flows >=0	
Fixed effects	FE_{jk}, FE_{ik}	FE_{jk}, FE_{ik}	FE_{jk}, FE_{ik},FE_{ij}		FE_{jk}, FE_{ik}, FE_{ij}	
ln(distance)	-1.14***	-1.39***		-0.37***		-0.52***
	(0.04)	(0.05)		(0.04)		(0.03)
ln(1+tariff)	-2.74***	-4.37***	-1.90***		-2.37***	
	(0.23)	(0.30)	(0.12)		(0.11)	
Contiguity	0.77***	1.26***		1.21***		1.80***
	(0.08)	(0.12)		(0.11)		(0.14)
Common language	0.28***	0.40***		0.76***		1.05***
	(0.07)	(0.08)		(0.08)		(0.09)
Colonial relationship	0.43***	0.49***		0.11		0.08
	(0.09)	(0.13)		(0.12)		(0.15)
NTM A.SPS measures	-0.00	0.02	0.02		0.02	
	(0.04)	(0.05)	(0.02)		(0.02)	
NTM B.TBT measures	0.32	0.34	0.13		0.09	
	(0.31)	(0.34)	(0.13)		(0.15)	
NTM C.Pre-shipment	-0.09	-0.01	0.00		-0.03	
	(0.13)	(0.15)	(0.07)		(0.08)	
NTM D.Antidumping, countervailing and safeguard	0.17	0.41	0.20		0.61***	
	(0.33)	(0.33)	(0.22)		(0.23)	
NTM E.Quotas, TRQ, import licensing, etc.	0.66***	1.16***	0.49***		0.68***	
	(0.21)	(0.28)	(0.16)		(0.20)	
NTM F.Price-control measures	0.13	0.79***	-0.21*		-0.08	
	(0.20)	(0.25)	(0.12)		(0.12)	
Level of economic integration	0.08***	0.22***		0.05***		0.09***
	(0.02)	(0.02)		(0.02)		(0.01)
RER rate based on Consumer Price Index	0.25	0.13		0.39**		0.42***
	(0.71)	(0.86)		(0.16)		(0.10)
_cons				2.04***		3.13***
				(0.39)		(0.34)
Explained variable	ln_X_{ij}	ln_X_{ij}	ln_X_{ij}	F_{ij}	ln_X_{ij}	F_{ij}
Observations	272,569	704,931	449,466	274,532	1E+06	706,823
Clusters	4,532	5,256	9,824	3,967	12,964	4,813
R2	0.652	0.702	0.667	0.486	0.723	0.495
Adjusted R2	0.576	0.675	0.589	0.486	0.696	0.495

*Note: NTM are split into different NTM categories. Only the NTM concerning all the products of the hs6 category are kept ('full coverage' number). To avoid collinearity, only one indicator concerning colony heritage is kept, and likewise for the language indicators and the level of economic integration (we kept EIA indicator). Concerning the tariffs, we kept the AVE effectively applied. Year 2015. Standard errors clustered over country-pairs. *, **, ***… Significant at 10 %-, 5 %- and 1 % level.*

b. PPML, importer and exporter fixed effects, zero trade flows

Table 3 presents the comparisons of two PPML estimations, with and without country-pair fixed effect.

PPML are run with country only fixed-effect (importer: FE_j, exporter: FE_i). These fixed effects will be particularly useful for the next steps (simulations). We also aim to run the estimation, in a further work, with country-product fixed-effect (importer: FE_{jk}, exporter: FE_{ik}).

Zero trade flows are kept in both estimations. Estimates are identical to the maximum likelihood results. In the specification (1) there is no bilateral fixed effect FE_{ij}, contrary to specifications (2a) and (2b). In (2a) we run the regression with FE_{ij} and (2b) consists in a regression of FE_{ij} on bilateral explanatory variables[12].

Contrary to the OLS estimations, the category C of NTM (Pre-shipment) seems to slow down trade flows quantities between two countries.

Categories B (TBT measures), D (Antidumping, countervailing and safeguard) and E (Quotas, TRQ, import licensing) promote trade flows.

RER_{ij} has a significant positive impact on trade flows.

[12] We do not strictly used the PPML estimator on STATA, but 'reg2hdfe'. This command allows for estimation of a Poisson regression model with two high dimensional fixed effects. Estimates are identical to the maximum likelihood results.

Table 3- Poisson estimations of the baseline (dependent variable X_{ij})

	(1) Flows>=0	(2a) Flows >=0	(2b)
Fixed effects	FE_j, FE_i	FE_j, FE_i , FE_{ij}	
ln(distance)	-0.60***		-0.14*
	(0.05)		(0.08)
ln(1+tariff)	-1.31***	-0.60***	
	(0.21)	(0.21)	
Contiguity	0.69***		2.50***
	(0.08)		(0.20)
Common language	0.18**		0.91***
	(0.08)		(0.15)
Colonial relationship	0.27***		0.62***
	(0.09)		(0.20)
NTM A.SPS measures	-0.00	-0.00	
	(0.00)	(0.00)	
NTM B.TBT measures	0.04***	0.03***	
	(0.01)	(0.01)	
NTM C.Pre-shipment	-0.09*	-0.04	
	(0.05)	(0.03)	
NTM D.Antidumping, countervailing and safeguard	0.81*	0.80***	
	(0.44)	(0.26)	
NTM E.Quotas, TRQ, import licensing, etc.	0.52***	0.50***	
	(0.04)	(0.03)	
NTM F.Price-control measures	0.08*	0.04	
	(0.05)	(0.03)	
Level of economic integration	0.07***		-0.01
	(0.02)		(0.04)
RER rate based on Consumer Price Index	1.06		-0.49**
	(0.73)		(0.24)
_cons			-2.27***
			(0.75)
Explained variable	X_{ij}	X_{ij}	F_{ij}
Observations	713457	1162326	699075
Clusters	5325		4365
R2		0.088	0.117
Adjusted R2		0.079	0.117

*Note: NTM are split into different NTM categories. Only the NTM concerning all the products of the hs6 category are kept ('full coverage' number). To avoid collinearity, only one indicator concerning colony heritage is kept, and likewise for the language indicators and the level of economic integration (we kept EIA indicator). Concerning the tariffs, we kept the AVE effectively applied. Year 2015. Standard errors clustered over country-pairs. *, **, ***… Significant at 10 %-, 5 %- and 1 % level.*

6. Discussion, conclusion and further work

Discussion and conclusion

The French agri-food sector is strongly internationalized and trade flows with UK represent a high percentage of total French trade flows. Therefore, it is important to characterize the challenges and potential risks faced by different producers, and draw some guidance for the EU-UK trade negotiations.

In the present paper, we infer some probable scenarios, taking into account the recent developments of the ongoing negotiations and political reversals. Inferring some counterfactual tariffs and NTM is the thorny part and the methods differ greatly in the literature. We aimed to be as precise as possible and take into account not only tariffs and distance but also the RER and the different categories of NTM.

PPML is traditionally preferred with the gravity model, due to its numerous advantages concerning heteroscedasticity, zero trade flows and consistency of the fixed effects with the multilateral resistance indexes. We compared OLS and Poisson estimations to highlight the PPML benefits.

We find traditional determinant of trade flows, consistent with the existing literature: distance and tariffs influence negatively the trade flows, whereas contiguity, common language and colonial relationship increase them.

More surprisingly, some categories of NTM promote trade.

Further work

The estimations we run will help to identify the trade cost elements to include when defining scenarios. Non-significant elements will be deleted. This work constitutes the basis for the next steps of the Anderson et al. (2015) methodology. It consists in predicting, with partial and full endowment, the impact of Brexit the bilateral trade flows between France and the UIK, at the agri-food trade or at the product level.

Using country-pair fixed effects is part of traditional recommendation to avoid to classical biases, but it is generally associated with panel data. Further work will consist in using such data for our estimations.

As trade flows with UK are concentrated on a very small number of products, the consequences of Brexit on trade patterns will probably differ greatly across products. Consequently, our gravity model might be run for products of interest for France, such as wines, dairy, and bakery products (HS 6-digit level).

We also plan to use the gravity model for Brittany-UK trade flows, since Brittany region is an historical agri-food trade partner of the UK.

Furthermore, depending the evolution of ongoing negotiations, more counterfactual scenarios could be inferred and implemented in the model.

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