Brexit and Breton Agricultural and Food Exports

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Abstract – The UK left the European Union on 31 January 2020. In the long run, Brexit disrupts trade between the UK and its partners because it alters bilateral trade costs. A stronghold of the French agricultural and food sector in terms of both production and trade, the Brittany region is also an important trade partner of the United Kingdom in this sector. We quantify the potential impacts of Brexit on Brittany's exports using a general-equilibrium structural gravity model, and propose a methodology for reconstructing unavailable trade data between and within a country's regions. Expected losses are particularly high for the flagship products exported by Brittany, in particular for meat and meat products. The lower sales on the UK market are compensated by larger exports to mainly non-European partners. The new trade agreement between the European Union and the United Kingdom permitted to avoid the more significant export losses associated with no-deal scenarios.

JEL: F14, F17, F13, Q17
Keywords: Brexit, agricultural and food trade, structural gravity, infra-regional analysis, Brittany

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Brittany has historic ties with the United Kingdom. As early as in 1828, onion producers from the Roscoff region exported most of their production to England. Since the 1960s, the agriculture and agri-food industries have played a central role in the Breton economy. These sectors remain one of the main pillars of the Breton industrial model, along with the manufacture of electrical and electronic appliances, the automobile and shipbuilding industries. Although Brittany is primarily specialized in livestock farming, the region also ranks first in terms of vegetable production in France. Accordingly, in 2019, Brittany produced 34,900 tonnes of veal calves (20% of French production), 204,158 tonnes of cauliflower (80% of French production) and 179,164 tonnes of tomatoes (27% of French production) (Agreste-Draaf Bretagne, 2020)

The UK's withdrawal from the European Union raises numerous questions on the nature of its future trade relations with both Brittany and France. The United Kingdom has long been one of Brittany's key trade partners in the agricultural and food sector. According to regional customs data, in 2019 Brittany ran a € 120 million trade surplus with the United Kingdom in this sector.[1]

The British decided to leave the European Union (EU) in a referendum hold on 23 June 2016. After many twists and postponements, the country effectively left the EU on 31 January 2020. EU law continued to apply on a transitional basis in the United Kingdom from 1 February to 31 December 2020. On 30 December 2020, the President of the European Commission, the President of the European Council, and the British Prime Minister have signed a joint trade and cooperation agreement, ratified on the same day by the British Parliament. From 1 January 2021, this agreement governs the economic relationships between the United Kingdom and the EU. Negotiations have focused mainly on trade arrangements and the agreement is based on the principle of free trade: no customs duties and no quotas for trade in goods. However, withdrawal from the EU entails the re-establishment of border checks and customs formalities. Therefore, the cost of accessing the British market for exported Breton products are expected to increase. Companies willing to export to the United Kingdom must comply with the sanitary and phytosanitary formalities that have been introduced gradually from 1 January 2021. The latter include health certificates for products of animal origin, stamps and other requested information on products and packaging. Also, sea ports in Northern Ireland have introduced customs checks on products arriving from Great Britain. Sanitary and phyto-sanitary requirements and related formalities are detailed in the UK's guide for border controls on trade with the EU, the "Border Operating Model".[2]

Costs associated with customs clearance could thus increase for some agri-food products due to the additional border checks introduced to ensure compliance with importer's (EU or UK) regulations in terms of food safety, and animal and plant health. Two types of additional costs result from this: costs induced by clearing goods through customs, and time delays required to complete customs clearance. These additional costs can be reduced, but not eliminated (Matthews, 2017). This increase in trade costs will generate changes in trade flows, not only between the UK and its partners, but also indirectly between the latter, e.g. by redirecting trade flows from the UK to third markets. Furthermore, new agreements concluded by the UK with non-European partners can reduce their costs of accessing the UK market and reinforce this diversion of trade.

The impact of Brexit on trade flows between the UK and EU countries has been extensively investigated by recent studies (e.g. Dhingra *et al.* (2017) for the UK, Lawless & Morgenroth (2019) and Cheptea & Huchet (2019) for the EU). Few studies focus on the agricultural sector (Bellora *et al.*, 2017; Choi *et al.*, 2021). All these studies find a strong negative impact on the British economy and a lesser impact on the EU, unevenly distributed across Member States. Graziano *et al.* (2021) also highlighted that uncertainty about the UK's trade policy with its partners during the negotiation and transition phases has hurt its trade with the EU. This uncertainty has affected as well non-European countries and the negotiation of new preferential trade agreements by the UK (Graziano *et al.*, 2020). The effects of Brexit on the agricultural and food sector have been investigated in the literature mainly for the UK, and less for European countries, including France.

In the present article, we quantify the impact of Brexit on Breton exports. First, Brittany is one of the largest French regions in terms of agricultural production (even after the French territorial reform of 2015) and the leading region in terms of agri-food industry turnover. Second, the United Kingdom is an important outlet for

1. Source: French customs, 571 Foreign trade statistics. DRAAF Bretagne. https://draaf.bretagne.agriculture.gouv.fr/Commerce-exterieur
2. https://www.gov.uk/government/publications/the-border-operating-model

Brittany's agricultural and food products (8% of Breton agri-food exports, in 5th place behind Italy, Spain, China and Belgium in 2015). New trade agreements negotiated by the United Kingdom with non-EU countries reduce their costs for accessing the British markets. The liberalization of the UK market can make French and Breton suppliers lose the preferential access they enjoyed before Brexit, erode their UK market shares, and push them to find alternative outlets. Up to date, only two studies have evaluated the impacts of Brexit on Brittany, CESER (2017) and CESER (2016), both consisting of very descriptive analyses that provide an overview of the Breton economy without examining potential sector-level differences.

This article aims to quantify the effects of five trade policy scenarios on the main groups of agricultural and food products exported by Brittany. Regional studies are rare in the literature and focus on effects at the macro level, disregarding differences across sectors or types of products. For example, Chen *et al.* (2018) develop an index of exposure that illustrates the vulnerability of EU regions and countries to Brexit, while Capello *et al.* (2018) measure the losses, in terms of GDP, stemming from the reintroduction of legal and administrative barriers for European regions. Our article has also a strong methodological contribution: we propose a method for predicting the lacking data on intra- and inter-regional trade flows necessary for estimating the effects of Brexit at region level.

The article is structured as follows. Section 1 discusses the main stylised facts in the agricultural and food sector. We identify Brittany's flagship products, in terms of both production and exports. In section 2, we describe the methodology for quantifying the effects of Brexit, and the considered scenarios. Section 3 summarises the employed data and the results from our reconstruction of missing data. Section 4 presents simulation results and changes in trade patterns induced by the five Brexit scenarios. In the end, we draw some concluding remarks.

1. Food and Agriculture in Brittany: Flagship Products and Preferred Trade Partners

This section employs data for 2015, the year preceding the June 2016 referendum on the United Kingdom's exit from the European Union, known as Brexit. Hereinafter, the term *agri-food* encompasses agriculture, fisheries and agri-food industries (AFIs).

Brittany is a leading French region in terms of agricultural production and of agri-food turnover. It is the largest French region in terms of livestock farming. It is also a major region for vegetables production. According to Agreste (2016), the flagship fruits and vegetables produced in Brittany are tomatoes (240,063 t in 2015) and cauliflowers (236,805 t). The region also produces shallots (36,607 t), artichokes (26,136 t), lettuce (13,802 t), leeks (8,734 t), endives (7,301 t), cabbages (7,168 t), strawberries (4,281 t), and yellow and red onions (3,613 t). In 2015, it produced 19% of French fresh vegetables. Brittany also originates 49% of the French production of eggs, 26% of pigs, 27% of poultry, 21% of cow milk, and 20% of calves. A large share of these products are processed locally. As a result, Breton agri-food industries amount to 8% of the total value added (VA) of French agri-food industries.[3] Brittany also stands out for its share in animal feed production and fish industry (21% of the French VA in both cases), meat industry (20%), and the processing of fruit and vegetables (15%) – Figure I.

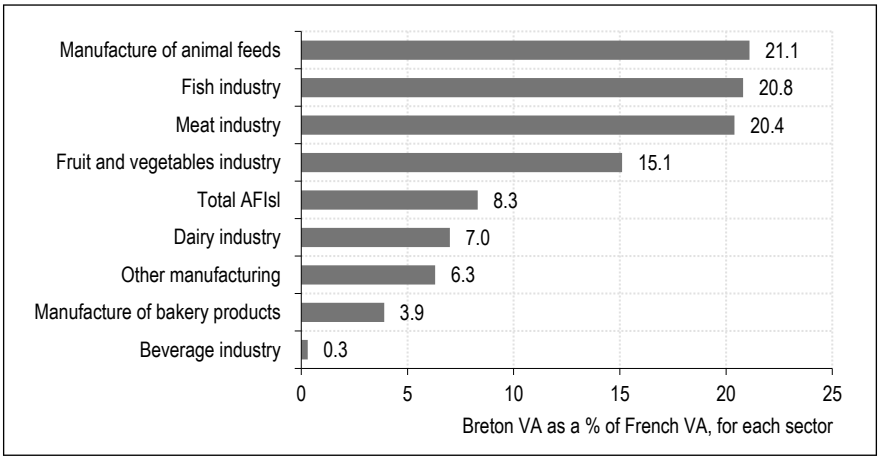
AFIs account for 6.6% of Brittany's VA, but only 2.4% for entire France (Figure II). For agriculture and fishing, these shares amount to 3.3% and 1.7%, respectively. According to the French National Institute for Statistics and Economic Studies (INSEE), the share of Brittany's workforce employed in agriculture and AFIs largely exceeds the French average. In 2014, the agriculture accounted for 2% of Brittany's employees, compared to 1% in metropolitan France. AFIs accounted for 6% in Brittany, compared to only 2% in metropolitan France.

The meat industry is the main pillar of Breton AFIs, accounting for 40% in terms of value added, followed by dairy products and animal feeds (Figure III). In contrast, the beverage industry plays a more significant role at national level than in Brittany, mainly due to wines. Unsurprisingly, the fish and seafood industry is more prominent in Brittany. Note that all four *departments* of Brittany have an extensive seashore, which makes Brittany the French region with the longest coastline.

Figures A1 and A2 of the Appendix show that meat and meat products are the most exported products by Brittany, both in terms of value and share of country-level exports (€ 1.4 billion in 2015, i.e. nearly 25% of French exports in this category), followed by dairy products (€ 601 million in 2015, i.e. 8.1% of French

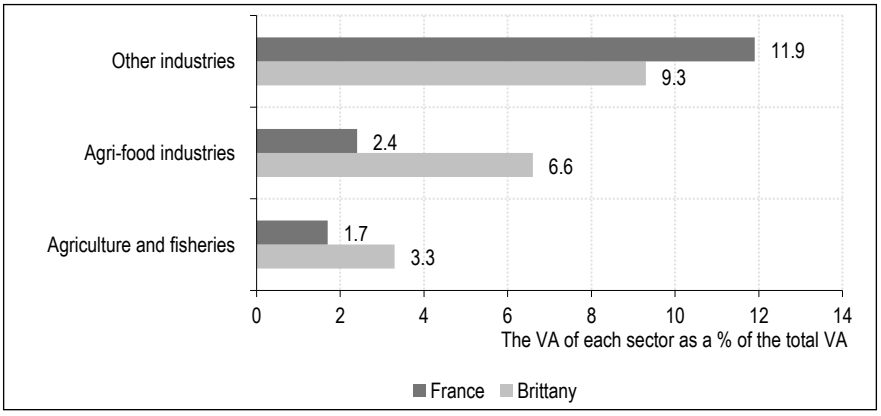
3. Source: DRAAF and INSEE data, 2015.

Figure I – **Contribution of Breton AFIs to the French value added**



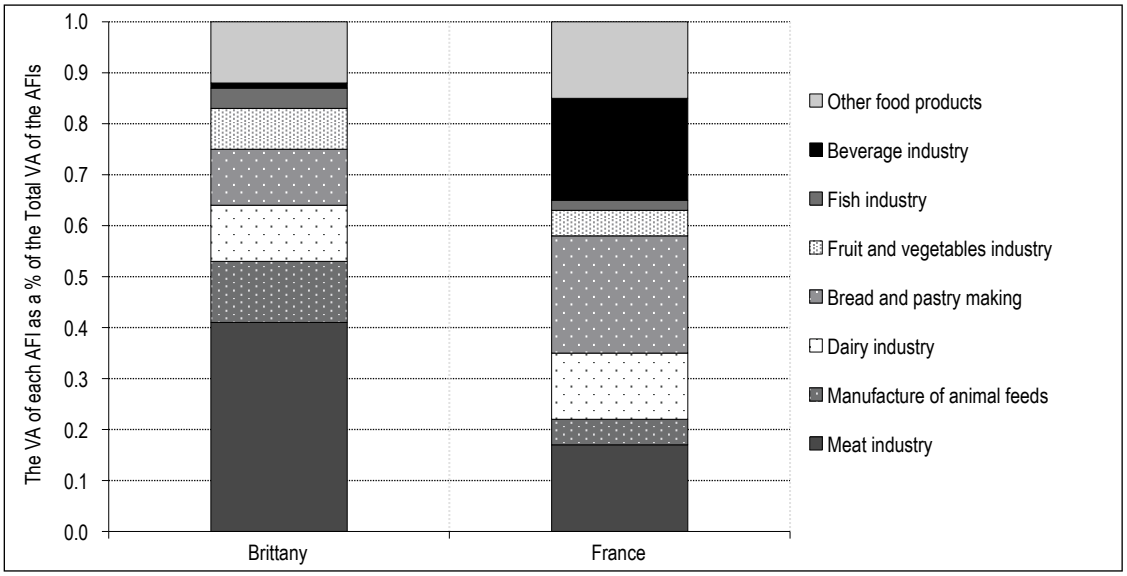
Sources: 2015 ESANE (*Élaboration des statistiques annuelles d'entreprises* – Elaboration of Annual Company Statistics) data, INSEE, authors' calculations.

Figure II – **Distribution of Breton and French value added by sector of economic activity**



Sources: 2015 ESANE (*Élaboration des statistiques annuelles d'entreprises* – Elaboration of Annual Company Statistics) data, INSEE, authors' calculations.

Figure III – **Distribution of the value added of the Breton and French AFIs**



Sources: 2015 ESANE (*Élaboration des statistiques annuelles d'entreprises* – Elaboration of Annual Company Statistics) data, INSEE, authors' calculations.

exports in this industry). Brittany is responsible for nearly 12.5% of the seafood exports of France (€ 234 million in 2015). Differently, the region produces and exports very few wines, which represent the top agri-food product exported by France (€ 9.5 billion in 2015), with the United Kingdom and the United States as main destinations.

Apart from Brittany, the United Kingdom is a major trade partner also for France, attracting 9.4% of French agri-food exports. This makes it the third largest destination for French exports in this sector, behind Germany (10.7%) and Belgium (10.5%). The main products exported by France to the UK are beverages (€ 1.8 billion, primarily wines), followed by dairy products (€ 0.6 billion) and processed cereal-based foods (€ 0.3 billion). We expect these products to depict a higher level of vulnerability to Brexit.

Finally, Brittany runs a large surplus in trade in agricultural and food products, including with the UK, which is at the same time an important supplier of some product categories (notably fish and seafood products, cereals, and meat). In 2015, Brittany's agri-food trade with the UK generated a trade surplus of 99 million euro.

The top five destination markets of Breton agri-food exports are within Europe. They include the UK, which absorbed 9.3% of Brittany's agri-food exports in 2015, i.e. € 326 million (see Figure A3 of the Appendix). This position of the UK remained stable over time, at around 8% of the region's exports from 2014 to 2018. The rest of France (without Brittany) also exports mainly to European, the main destinations, but their ranking slightly differs (Figure A3 of the Appendix). Brittany's exports to the UK are dominated by meat and cereal products (see Figure A4 of the Appendix). At country level, wines are the crown jewel of French exports to the UK, followed by dairy and cereal products.

2. Methodology and Scenarios

In the present article, we quantify the impact of Brexit on Brittany's agri-food exports. We define five trade policy scenarios reflecting the lengthy negotiations and uncertainty that preceded Brexit, and employ a general-equilibrium structural gravity model similar to Anderson *et al.* (2018). We consider Brittany and the rest of France (without Brittany) as separate trade partners.

2.1. Structural Gravity Model

We estimate the effects of Brexit on trade flows between Brittany and its partners, and compare them to the effects on trade between the rest of France and the same partners. In addition to the direct effects of Brexit, induced by changes in UK's bilateral trade costs, the model also accounts for the indirect impact on trade flows between other countries through adjustments in terms of prices, expenditure and output levels. Similarly to Anderson *et al.* (2018), our model assumes a representative consumer with homothetic preferences, which maximises a utility function with constant elasticity of substitution (CES) under budgetary constraints and market clearance. This optimisation program yields the following expression for the exports in year t of country i to destination j, expressed in consumer prices:

$$X_{ijt} = Y_{it} E_{jt} \left(\frac{\tau_{ijt}}{\Pi_{it} P_{jt}} \right)^{1-\sigma} \epsilon_{ijt}. \quad (1)$$

This equation applies for each group of products traded by countries. For simplicity of presentation, we omit the product index. E_{jt} is the expenditure in year t of country j consumers on products of all origins, Y_{it} is the output of country i in year t, $\sigma > 1$ is the elasticity of substitution between products from different countries of origin, and ϵ_{ijt} is a zero-mean error term. The term $\left(\tau_{ijt} / \Pi_{it} P_{jt}\right)$ captures the level of trade costs between i and j relative to the average trade costs of i and j with all their partners. It consists of three elements: bilateral trade costs, τ_{ijt}, associated to shipping goods from i to j and to the applied trade policy (customs duties and non-tariff measures), and two multilateral resistance terms (outward and inward), Π_{it} and P_{jt}, introduced by Anderson & van Wincoop (2003).[4] Π_{it} reflects the level of access of global consumers (from all destinations, including i) to products from origin i; P_{jt} reflects the level of access to the global market (to products of all origins, including j) of consumers in destination market j. These terms represent export (import) price indices weighted by expenditure (output), and capture the impact of trade costs on consumers (producers) in each country.[5] To estimate the effect of a change in trade policy, it is therefore important to integrate not only direct effects on affected bilateral relationships, but also indirect effects on other markets.

4. Anderson & van Wincoop (2003) show that the amount of trade between two countries depends not on the absolute level of bilateral trade costs, but on their level relative to the countries' average trade costs with all world partners.

5. $\Pi_{it}^{1-\sigma} = \sum_j \left(\frac{\tau_{ijt}}{P_{jt}} \right)^{1-\sigma} E_{jt}$; $P_{jt}^{1-\sigma} = \sum_i \left(\frac{\tau_{ijt}}{\Pi_{it}} \right)^{1-\sigma} Y_{it}$.

In this model, the impact of Brexit results from a change in trade costs. In line with the international trade literature, we use a trade costs specification that includes geographical distance, $dist_{ij}$ (capturing transport and related costs that increase with distance), the presence of a common land border, $contig_{ij}$, a common official language, $langcom_{ij}$, a common colonial past, $comcol_{ij}$, customs duties applied by the importing country on products from the exporting country, $tariff_{ijt}$, and the dissimilarity in the number of non-tariff measures (NTMs) of type m in the two countries, $dist\_MNT_{ij}^{m}$ (regulatory distances):

$$\tau_{ijt}^{1-\sigma} = dist_{ij}^{\beta_1} \exp\left(contig_{ij}\right)^{\beta_2} \exp\left(langcom_{ij}\right)^{\beta_3} \exp\left(comcol_{ij}\right)^{\beta_4} \cdot \left(1 + tarif_{ijt}\right)^{1-\sigma} \prod_m \exp\left(dist\_MNT_{ijt}^{m}\right)^{\delta_m} \quad (2)$$

We insert this expression of trade costs in equation (1), and regroup terms specific to the exporting and importing country to obtain:

$$X_{ijt} = dist_{ij}^{\beta_1} \exp\left(contig_{ij}\right)^{\beta_2} \exp\left(langcom_{ij}\right)^{\beta_3} \exp\left(comcol_{ij}\right)^{\beta_4} \cdot \left(1 + tarif_{ijt}\right)^{1-\sigma} \prod_m \exp\left(dist\_MNT_{ijt}^{m}\right)^{\delta_m} \psi_{it}\, \chi_{jt}\, \epsilon_{ijt} \quad (3)$$

The structural gravity model offers a general equilibrium perspective on trade. Accordingly, it requires the use of a complete data matrix on all explained and explanatory variables, including domestic flows (purchases by country i consumers of goods produced in i). Countries collect few or no data on trade flows within the country. We use the structure of the model and the estimated values of parameters to reconstruct the value of these flows.[6]

2.2. Estimation Strategy and Scenarios

We estimate the effects of Brexit using 2012–2015 data. Our sample runs from 2012, when the effects of the 2008–2009 economic crisis have been absorbed in most countries, until 2015, the year before the Brexit vote. The estimation strategy presented in this section relies on observed data and predicted data for intra-national trade flows, including flows between Brittany and the rest of France. The computation of the latter is explained in the Online Appendix (link to the Online Appendix at the end of the article).

In order to correctly quantify the impact of Brexit, the counterfactual value of trade is compared not to the value observed before Brexit, but to the value of the trade predicted by the model using pre-Brexit trade costs.[7] First, we compute this benchmark level for all variables in the model. For this, we estimate equation (3) on all trade flows (international and domestic), and use the estimated values of parameters, $\widehat{\beta_1}$ - $\widehat{\beta_4}$, $\widehat{\sigma}$, $\widehat{\delta_m}$, and of importer-year and exporter-year fixed effects, $\widehat{\psi_{it}}$ and $\widehat{\chi_{jt}}$, to obtain the benchmark value for each trade flow. From these results, we compute the benchmark level of annual expenditures and outputs (using budgetary constraints and market clearance), and of multilateral resistance terms.[8]

We define five scenarios for the trade costs (corresponding to different levels of import tariffs and NTMs) between the United Kingdom and its partners (Table 1). Four hypothetical scenarios cover a wide range of potential post-Brexit trade policies, while a fifth scenario illustrates the trade policy actually adopted by the UK. The first four scenarios are obtained by matching two outcomes for the UK's trade policy with the EU – a free trade agreement close to the status quo, or a return to World Trade Organization (WTO) rules with bilateral trade subject to import tariffs and NTMs that parties apply to their most-favoured-nation (MFN) partners – and two outcomes for the UK's trade policy with non-EU countries – a replication of current EU agreements (Box 1), or preferential trade agreements with main non-European partners and a return to WTO rules with the rest of countries.

The fifth scenario is shaped by the new EU-UK Trade and Cooperation Agreement (EU-UK TCA) applied since 1 January 2021,[9] the UK's new preferential trade agreements with third countries, and the new United Kingdom Global Tariff (UKGT) that replaced the EU's Common External Tariff (CET) for British imports from all countries with which the UK had no separate trade agreement.[10] British exports to the latter group of countries remain subject to WTO rules (MFN tariffs). For this scenario, we assume that non-tariff measures remain unchanged for all trade relationships.

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6. See the Online Appendix for further details.

7. Economic models predict the value of variables of interest with a certain level of error. For this reason, comparing counterfactual values with observed values can generate biased results because any statistical error in the model would be attributed to the effect of Brexit.

8. $E_{jt}^{R} = \sum_i \hat{X}_{ijt}$; $Y_{it}^{R} = \sum_j \hat{X}_{ijt}$; $\left(P_{jt}^{R}\right)^{1-\sigma} = E_{jt}^{R} / \hat{\chi}_{jt}$; $\left(\Pi_{it}^{R}\right)^{1-\sigma} = Y_{it}^{R} / \hat{\psi}_{it}$.

9. Based on recent sector-level data on the use of trade preferences by EU countries (Nilsson & Preillon, 2018), we assume that 84% of the EU-UK agri-food trade (within each product line) complies with the rules of origin and is subject to zero import tariffs, while the remaining 16% are subject to MFN tariffs.

10. The UKGT benefits mainly non-EU partners, as it offers them an improved access to the British market, with respect to their pre-Brexit situation, and to their access to the EU market. Except a small number of sensitive products, the UKGT brings to zero all customs duties smaller than 2% in the CET, increasing the share of products imported by the United Kingdom with zero customs duties from 27% (under the CET) to 47% (under the UKGT).

Table 1 – **Proposed scenarios**

		The United Kingdom's trade relations with:	
	Scenario	EU-27	Non-EU countries
(S1)	Quasi status quo	Free trade agreement	Replication of EU agreements[(a)] WTO rules with other countries
(S2)	Fortress United Kingdom	WTO rules	Replication of EU agreements[(a)] WTO rules with other countries
(S3)	Liberalised trade with the EU and main non-EU partners	Free trade agreement	Preferential trade agreements with main developed countries[(b)] WTO rules with other countries
(S4)	Liberalised trade only with main non-EU partners	WTO rules	Preferential trade agreements with main developed countries[(b)] WTO rules with other countries
(S5)	Current policy	EU-UK TCA[(c)]	New UKGT[(d)] New preferential trade agreements (PTAs)

Notes: [(a)] Countries with which the EU has a free trade agreement.
[(b)] United States, Australia, New Zealand, Switzerland, Chile and Israel.
[(c)] EU-UK Trade and Cooperation Agreement (EU-UK TCA).
[(d)] New United Kingdom General Tariff (UKGT).

Each scenario is characterised by a counterfactual level of trade costs, τ_{ijt}^{CFL}, detailed in Table A1 of the Appendix. Following Anderson *et al.* (2018), we first compute the impact of Brexit on the directly affected trade flows (i.e. the ones experiencing a change in trade costs) by replacing τ_{ijt} with τ_{ijt}^{CFL} in equation (3). Next, we use the structure of the model to compute the adjustments to the new trading environment of partners' expenditures, outputs, and multilateral resistances. We introduce the new values of these variables in equation (3), and repeat the procedure until the factory-gate price[11] of each partner converges towards an equilibrium level.[12] This permits us to compute the counterfactual trade flows in general equilibrium. Finally, the gap with respect to the benchmark value of trade flows represents the impact of Brexit for each scenario.

11. The price excluding trade costs, $p_{it} = p_{ijt} / \tau_{ijt}$, also known as the producer price.

12. Table S3-2 of the Online Appendix summarises the estimated values of model parameters. The estimated value of the elasticity of substitution σ is not always statistically significant and makes the model converge for only ten of the analysed product groups. For the remaining six groups, we set σ equal to the value estimated by Raimondi & Olper (2011), which ranges from 2.8 for wines to 9.2 for fish and seafood products.

Box 1 – **The Rules for Post-Brexit Trade**

Failure to reach a trade agreement between the UK and the EU means that bilateral trade becomes subject to the same rules that parties apply to partners with whom they have no preferential trade relationships. These rules correspond to their commitments made during multilateral negotiations under the General Agreement on Tariffs and Trade (GATT) and the WTO. They consist in applying the most-favoured-nation status, which reflects the GATT/WTO fundamental principle of non-discrimination between partners. However, as an exception to this principle, member countries may establish preferential trade rules with one or more partners with whom they negotiate a trade agreement, subject to its notification to the WTO. Free trade between EU countries represents such an exception.

For WTO countries, the most-favoured-nation status corresponds to the highest level of trade protection a country can apply to its partners. Partners with whom the country has reached a trade agreement, shares a free trade area, a customs union or a higher level of economic integration enjoy an improved market access, consisting of lower or zero customs duties and of similar or identical non-tariff measures. Thus, a return to WTO rules means a significant increase in bilateral trade costs between the UK and the EU.

As a member of the EU, the UK could not independently negotiate and sign trade agreements. Leaving the EU permits the country to define its own trade policy with all partners. At the same time, it permits the UK to continue to apply some of the EU's 40 free trade agreements, renegotiate the terms of these agreements, or conclude new agreements with other countries. Since its withdrawal from the EU on 31 January 2020, the UK has signed 20 *continuity* agreements covering 50 countries or territories and about 8% of British foreign trade. Agreements signed with the United States, Australia and New Zealand are *Mutual Recognition Agreements*, not free trade agreements. Mutual recognition permits to improve trading opportunities and facilitate trade between involved countries. This type of agreement also generates large benefits through accelerated border checks and simplified formalities for customs clearance. New trade opportunities seem to emerge between the United Kingdom and the United States, as well as with the 53 Commonwealth nations that represent 2.7 billion people and a GDP similar to that of the EU, according to the International Monetary Fund (IMF).

3. Data

The final database used for simulations is obtained by combining data from several sources. Data on international trade flows come from BACI (*Base pour l'Analyse du Commerce International*) developed by the CEPII research centre (CEPII – Gaulier & Zignago, 2010). We select the bilateral flows between the 57 top exporters and importers of agri-food products from 2012 to 2015, covering 76% of the global trade in this sector.[13] We divide France into two regions: Brittany and the rest of France (without Brittany), and obtain a panel of 58 trading partners. Data on the imports and exports of Brittany and France without Brittany are obtained from the French customs (Le Kiosque, DGDDI). BACI data are disaggregated by products defined according to the Harmonized System 6-digit classification (HS6), while customs data use a less narrow definition, the 4-digit French Product Classification (CPF4). To reconcile the two data sources, we aggregate trade flows into 16 product groups using the official correspondence table between HS6 and CPF4 classifications. Table 2 lists the product groups and their corresponding level of EU-UK trade protection for each Brexit scenarios. Domestic trade flows between Brittany and the rest of France, as well as within each region, are not observed.[14] We predict these flows by solving the structural gravity model using observed data on trade flows and trade costs components. This procedure is explained in section S1 of the Online Appendix.

We use a trade cost structure that combines import tariffs, non-tariff measures, and standard variables on bilateral linkages (geographic distance, common border, language, and colonial past). Data on the latter come from the CEPII's GeoDist database (Mayer & Zignago, 2011). Data on applied import tariffs and non-tariff measures are obtained from the Trade Analysis Information System (TRAINS) database of United Nations Conference on Trade and Development (UNCTAD), and come in a HS6 product disaggregation.[15] For non-tariff measures, we compute regulatory distances following the methodology introduced by Cadot *et al.* (2015) (Box 2). We aggregate import tariffs and computed regulatory distances from the HS6 level into the 16 agri-food product groups listed above. The values of these variables obtained for France apply to the foreign trade of both Brittany and the rest of France.[16]

13. This choice is dictated by the availability of data on non-tariff measures.
14. We cannot employ survey data on the transportation of goods within France because they are not representative (they cover only a small number of sectors and regions). We can neither compute inter- and intra-region trade flows using data on regional production. The output of agricultural goods is collected only in of quantity, and covers both the output sold directly in the market and the output transformed into more processed products.
15. https://unctad.org/topic/trade-analysis/non-tariff-measures/NTMs-data-dissemination
16. We compute separate distances for the two regions only with their closest neighbours: Germany, Switzerland, Italy, Belgium, the United Kingdom, and Ireland. For Brittany, we take the average distance from the main cities of these countries to Rennes; for the rest of France, we take the average distance to the 22 main French cities situated outside Brittany.

Table 2 – **Trade protection between Brittany/France/EU and the United Kingdom by scenario and product group**

	S1		S2		S3		S4		S5	
Product group	Tariff	NTM	Tariff	NTM	Tariff	NTM	Tariff	NTM	Tariff	NTM
Live animals	0.00	0.19	11.18	0.19	0.00	0.19	11.18	0.19	0.76	0.19
Meat and meat products	0.00	0.17	21.22	0.17	0.00	0.17	21.22	0.17	5.73	0.17
Dairy products	0.00	0.19	31.97	0.19	0.00	0.19	31.97	0.19	6.05	0.19
Fish and seafood products	0.00	0.21	8.55	0.21	0.00	0.21	8.55	0.21	1.79	0.21
Cereals and cereal products	0.00	0.00	12.33	0.00	0.00	0.00	12.33	0.00	1.22	0.00
Grain processing products	0.00	0.02	29.74	0.02	0.00	0.02	29.74	0.02	4.67	0.02
Oil and fats	0.00	0.00	6.95	0.00	0.00	0.00	6.95	0.00	1.16	0.00
Fruit and vegetables	0.00	0.00	10.92	0.00	0.00	0.00	10.92	0.00	1.61	0.00
Fruit and vegetable preparations	0.00	0.00	14.44	0.00	0.00	0.00	14.44	0.00	2.05	0.00
Coffee, spices, cocoa and sugar	0.00	0.02	11.25	0.02	0.00	0.02	11.25	0.02	1.34	0.02
Tobacco	0.00	0.06	22.97	0.06	0.00	0.06	22.97	0.06	8.01	0.06
Non-alcoholic beverages	0.00	0.00	13.31	0.00	0.00	0.00	13.31	0.00	1.25	0.00
Wines	0.00	0.00	7.61	0.00	0.00	0.00	7.61	0.00	0.81	0.00
Other alcoholic beverages	0.00	0.00	4.54	0.00	0.00	0.00	4.54	0.00	1.04	0.00
Other preparations	0.00	0.01	14.61	0.01	0.00	0.01	14.61	0.01	1.37	0.01
Other products	0.00	0.09	3.32	0.09	0.00	0.09	3.32	0.09	0.69	0.09
Total	*0.00*	*0.06*	*14.13*	*0.06*	*0.00*	*0.06*	*14.13*	*0.06*	*2.50*	*0.06*

Notes: "Tariff" and "NTM" columns indicate, respectively, the average counterfactual level of customs duties (in %), and regulatory distance for type C non-tariff measures (pre-shipment checks and formalities) under the five scenarios. These are the only elements of trade costs that change after Brexit.

For each scenario, we compute counterfactual trade costs by replacing in equation (2) the pre-Brexit import tariffs duties and regulatory distances with their corresponding hypothetical values. We assume that concluded trade agreements reduce import tariffs and regulatory distances for pre-shipment checks and formalities between the participating countries. Similarly, we model the return to WTO rules by an increase in these variables (see Table A1 of the Appendix for details).

4. Brittany's Vulnerability to Brexit

We use the methodology detailed above to estimate the effects of a change in trade costs induced by Brexit for each of the defined five scenarios. Table 3 (resp. A2) reports the change in exports from Brittany and the rest of France to different partners for each product group, expressed in relative terms (resp. in monetary terms). Changes in relative terms (in per cent) account for differences in size between these two regions. To compare impacts across product groups, one needs to control for their different contribution to the exports of each region. Results permit to identify the products most severely exposed to Brexit, and to quantify export losses and gains for the two regions.

Recall that import tariffs and the regulatory distance for pre-shipment checks and formalities are the only trade cost elements that vary across scenarios. Accordingly, for product groups for which these two variables have a non-significant effect on trade, the model will produce no impact. In particular, we can obtain similar variations in a region's exports under different scenarios. For some product groups (tobacco, other preparations, wines, and live animals), the regulatory distance for pre-shipment checks and formalities has a positive effect on trade, which may lead to counter-intuitive results.

4.1. Effect on Total Exports

Overall, scenarios S2 and S4 (no EU-UK trade deal) are the most harmful for the exports of Brittany and the rest of France, regardless the product. Brittany's overall exports are estimated to decrease by 3.54% (€ 123.51 million) and 4.97% (173.38 million euro), respectively. For the rest of France, the estimated drop are much smaller in relative terms (–1.07% and –1.58%), but larger in values (€ 673.61 million and € 1.24 billion) due to its larger economic size. Whatever the scenario, Brittany's flagship products – meat and meat products, and to a smaller extent dairy products – are highly exposed to Brexit.[17] Oppositely, the most exported products by the rest of France are slightly (wines and other alcoholic beverages) or moderately impacted (cereals, cereal products, and dairy) in relative terms. Still, we expect the exports

17. This result is in line with the findings by CESER (2016), which identifies the Brittany's meat sector as the most exposed to Brexit.

Box 2 – **The Impact of Non-Tariff Measures**

We measure the impact of non-tariff measures (NTMs) on trade through the regulatory distance introduced by Cadot *et al.* (2015), which reflects the dissimilarity between the measures imposed by the exporter and the importer. This choice differs from the usual practice in the literature, which captures non-tariff measures by their ad valorem equivalent, frequency rate, or coverage ratio. Ad valorem equivalents of NTMs are frequently computed in separate analyses, relying on assumptions different or even contradictory to those of the model that estimates their effects on trade, and using data that may differ in terms of covered period, country panel, level of analysis, etc. We also do not employ NTMs frequency or coverage rates because of their collinearity with the country fixed effects of the structural gravity model. Moreover, existing studies incorporate NTMs into their trade policy scenarios by assuming ad hoc, unexplained changes in the level of NTMs (e.g. a 25%, 50%, or 75% increase in the level of NTMs due to Brexit). For the present analysis, it seems more relevant to use as reference partners trading under most-favoured-nation terms. We consider the dissimilarity of NTMs to be very strong (the strongest) in this case, because of lacking instruments/initiatives for unifying the partners' NTMs (due to the absence of a trade agreement).

The regulatory distance is the difference between the number of NTMs of a given category applied by the exporting and the importing country for a given product, transposed on a 0-1 scale. A distance of 1 means that the two countries apply totally different NTMs, while a value of 0 indicates that they apply exactly the same number of NTMs of the same category. We calculate this distance for each category of NTMs defined at the most granular level of the UNCTAD classification and aggregate results by major classes (types) of NTMs most frequently applied in agricultural and food trade.

We include four types of NTMs into our specification of trade costs: sanitary and phyto-sanitary measures (SPSs), technical barriers to trade (TBTs), pre-shipment checks and other formalities, and measures that directly affect the quantity of imported products (import licences, quotas, import restrictions, etc.). SPSs and TBTs often apply to the same products and at similar levels. Therefore, the regulatory distances corresponding to these two types of NTMs are highly correlated, but the omission of either of them would generate an omitted variable bias. To overcome this problem, we use the average of these two regulatory distances.

Table 3 – **Changes in Exports and Sales from Brittany and the Rest of France (%)**

		Brittany					Rest of France				
		Exports + domestic sales					Exports + domestic sales				
Product group	σ	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Live animals	3.50	0.52	−0.15	−0.05	−1.00	0.09	−0.08	−0.21	−0.63	−1.11	−0.49
Meat and meat products	5.00	−0.74	−7.01	−1.37	−10.06	−3.99	−0.43	−6.18	−0.98	−9.18	−3.59
Dairy products	4.57	−0.09	−1.52	0.02	−2.47	−0.22	−0.02	−1.03	0.10	−2.01	−0.14
Fish and seafood products	9.20	−0.37	−1.61	−0.30	−1.56	−0.34	−0.25	−1.12	−0.19	−1.08	−0.23
Cereals and cereal products	4.40	0.00	−2.00	−0.16	−2.28	−0.28	0.00	−1.76	−0.13	−2.03	−0.26
Grain processing products	6.51	−0.02	−1.98	−0.12	−2.68	−0.43	−0.01	−1.68	−0.07	−2.32	−0.40
Oil and fats	4.80	0.00	−0.36	−0.16	−0.52	−0.11	0.00	−0.19	−0.12	−0.31	−0.09
Fruit and vegetables	5.02	0.00	−1.36	−0.02	−1.38	−0.41	0.00	−1.19	−0.02	−1.20	−0.36
Fruit and vegetable preparations	6.53	0.00	−1.97	0.22	−1.67	−0.37	0.00	−1.55	0.18	−1.30	−0.31
Coffee, spices, cocoa and sugar	5.56	0.02	−1.20	0.20	−0.97	−0.41	0.01	−0.66	0.19	−0.44	−0.32
Tobacco	3.39	0.23	0.00	0.27	0.04	0.66	0.28	−0.11	0.32	−0.07	0.74
Non-alcoholic beverages	3.60	0.00	−0.75	0.00	−0.75	−0.09	0.00	−0.33	0.02	−0.31	−0.06
Wines	2.80	0.00	0.09	0.63	0.66	0.01	0.00	0.10	0.63	0.67	0.01
Other alcoholic beverages	5.00	0.00	−0.49	−3.00	−3.38	0.01	0.00	−0.32	−2.81	−3.02	0.01
Other preparations	2.65	0.04	−0.37	0.09	−0.31	−0.11	0.02	−0.26	0.08	−0.20	−0.13
Other products	5.94	−0.31	−0.49	−0.47	−0.65	−0.29	−0.30	−0.46	−0.45	−0.62	−0.27
Total		*−0.32*	*−3.54*	*−0.56*	*−4.97*	*−1.73*	*−0.03*	*−1.07*	*−0.25*	*−1.58*	*−0.35*
		Exports to the United Kingdom									
Product group	σ	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Live animals	3.50	12.59	−0.37	13.83	0.07	9.82	12.74	−0.31	13.97	0.00	9.94
Meat and meat products	5.00	−9.30	−38.59	−16.04	−48.66	−17.29	−9.35	−38.70	−16.08	−48.76	−17.34
Dairy products	4.57	−2.19	−23.55	−2.36	−28.32	−3.99	−2.21	−23.62	−2.37	−28.46	−4.03
Fish and seafood products	9.20	−12.27	−51.95	−9.20	−49.43	−10.80	−12.33	−52.07	−9.24	−49.55	−10.85
Cereals and cereal products	4.40	0.00	−22.39	−2.33	−24.56	−4.21	0.00	−22.46	−2.34	−24.64	−4.23
Grain processing products	6.51	−0.44	−49.50	−4.35	−59.56	−11.24	−0.45	−49.69	−4.36	−59.73	−11.31
Oil and fats	4.80	0.00	−16.50	−3.10	−19.21	−2.37	0.00	−16.58	−3.10	−19.29	−2.38
Fruit and vegetables	5.02	0.00	−18.26	0.03	−18.26	−5.06	0.00	−18.47	0.03	−18.47	−5.13
Fruit and vegetable preparations	6.53	0.00	−28.98	2.28	−26.31	−4.66	0.00	−29.05	2.30	−26.37	−4.68
Coffee, spices, cocoa and sugar	5.56	0.47	−24.62	1.58	−23.43	−6.28	0.47	−24.78	1.60	−23.59	−6.33
Tobacco	3.39	6.36	−15.25	5.95	−15.73	12.29	6.37	−15.24	5.96	−15.73	12.29
Non-alcoholic beverages	3.60	0.00	−9.33	0.02	−9.35	−0.74	0.00	−9.50	0.02	−9.52	−0.76
Wines	2.80	0.00	−3.06	1.32	−1.41	−0.32	0.00	−3.06	1.32	−1.40	−0.32
Other alcoholic beverages	5.00	0.00	−11.32	10.04	−0.98	0.95	0.00	−11.45	9.97	−1.17	0.95
Other preparations	2.65	0.96	−9.10	0.08	−10.05	−1.68	0.96	−9.11	0.08	−10.06	−1.68
Other products	5.94	−4.95	−7.88	−6.11	−9.13	−4.59	−4.99	−7.95	−6.15	−9.19	−4.63
Total		*−3.75*	*−27.69*	*−6.58*	*−32.16*	*−8.77*	*−0.56*	*−16.42*	*−0.04*	*−16.57*	*−3.22*
		Exports (sales) to the EU (excluding the UK and France)									
Product group	σ	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Live animals	3.50	−0.83	−0.40	−1.27	−1.04	−1.21	−0.64	−0.32	−1.12	−1.11	−1.03
Meat and meat products	5.00	0.66	−3.24	0.42	−6.04	−2.34	0.58	−3.50	0.33	−6.30	−2.42
Dairy products	4.57	0.21	0.53	0.41	−0.23	0.09	0.19	0.33	0.38	−0.52	0.06
Fish and seafood products	9.20	0.91	3.59	0.78	3.47	0.76	0.85	3.33	0.73	3.22	0.71
Cereals and cereal products	4.40	0.00	0.44	0.10	0.39	0.01	0.00	0.33	0.09	0.27	−0.01
Grain processing products	6.51	0.04	0.98	0.19	0.42	−0.25	0.03	0.08	0.12	−0.53	−0.38
Oil and fats	4.80	0.00	0.69	0.07	0.74	0.00	0.00	0.60	0.06	0.64	0.00
Fruit and vegetables	5.02	0.00	1.10	−0.05	1.05	0.23	0.00	0.84	−0.04	0.79	0.16
Fruit and vegetable preparations	6.53	0.00	1.94	−0.19	1.67	0.11	0.00	1.80	−0.17	1.55	0.08
Coffee, spices, cocoa and sugar	5.56	−0.04	2.08	0.10	2.25	0.12	−0.04	1.81	0.12	2.00	0.07
Tobacco	3.39	−0.03	0.60	0.01	0.65	0.30	−0.02	0.60	0.02	0.65	0.30
Non-alcoholic beverages	3.60	0.00	1.94	0.08	2.00	−0.05	0.00	1.31	0.05	1.34	−0.06
Wines	2.80	0.00	0.53	0.59	1.15	0.00	0.00	0.53	0.59	1.15	−0.01
Other alcoholic beverages	5.00	0.00	3.54	0.26	3.58	0.04	0.00	3.37	0.17	3.33	0.04
Other preparations	2.65	−0.07	0.37	−0.01	0.43	−0.26	−0.06	0.36	−0.01	0.42	−0.27
Other products	5.94	0.08	0.17	−0.05	0.03	0.10	0.05	0.12	−0.08	−0.02	0.07
Total		*0.35*	*−0.61*	*0.28*	*−1.89*	*−0.87*	*0.05*	*0.52*	*0.12*	*0.22*	*−0.19*

Table 3 – *(contd.)*

		Brittany					Rest of France				
		Exports (sales) to the rest of the world									
Product group	σ	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Live animals	3.50	−0.17	0.73	−1.90	−1.29	0.19	−0.07	0.73	−1.92	−1.53	0.24
Meat and meat products	5.00	2.00	9.62	6.10	12.95	2.71	1.90	9.00	5.53	11.82	2.53
Dairy products	4.57	0.03	2.95	0.04	3.28	0.67	0.02	2.86	−0.03	3.05	0.72
Fish and seafood products	9.20	0.96	4.74	0.28	4.22	0.94	0.88	4.42	0.23	3.92	0.88
Cereals and cereal products	4.40	0.00	0.93	0.17	0.93	1.03	0.00	0.82	0.15	0.79	1.00
Grain processing products	6.51	0.04	8.69	0.79	10.69	2.66	0.03	7.77	0.70	9.68	2.62
Oil and fats	4.80	0.00	1.43	0.01	1.38	0.25	0.00	1.32	−0.03	1.24	0.24
Fruit and vegetables	5.02	0.00	4.69	0.10	4.88	1.49	0.00	4.25	0.08	4.41	1.39
Fruit and vegetable preparations	6.53	0.00	6.89	−0.11	7.07	1.47	0.00	6.63	−0.13	6.79	1.44
Coffee, spices, cocoa and sugar	5.56	−0.05	2.92	−0.25	2.77	1.32	−0.05	2.52	−0.21	2.41	1.18
Tobacco	3.39	0.06	0.58	0.14	0.68	−0.11	0.06	0.59	0.15	0.69	−0.11
Non-alcoholic beverages	3.60	0.00	0.92	−0.10	0.86	0.23	0.00	0.89	−0.03	0.91	0.26
Wines	2.80	0.00	1.06	0.37	1.12	0.17	0.00	1.05	0.37	1.12	0.17
Other alcoholic beverages	5.00	0.00	−1.10	−7.79	−8.59	−0.20	0.00	−1.23	−7.78	−8.67	−0.20
Other preparations	2.65	−0.08	0.98	0.26	1.34	0.57	−0.07	0.95	0.24	1.28	0.54
Other products	5.94	0.83	1.26	1.10	1.57	0.73	0.71	1.08	0.93	1.33	0.64
Total		*0.87*	*5.40*	*2.57*	*6.84*	*1.56*	*0.09*	*1.36*	*−1.43*	*−0.16*	*0.49*
		Exports (sales) to Brittany									
Product group	σ	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Live animals	3.50	−0.83	−0.40	−1.23	−1.04	−1.24	−0.70	−0.33	−1.11	−1.11	−1.13
Meat and meat products	5.00	0.69	−3.21	0.42	−6.07	−2.31	0.64	−3.39	0.36	−6.25	−2.37
Dairy products	4.57	0.21	0.47	0.40	−0.33	0.09	0.19	0.38	0.39	−0.53	0.05
Fish and seafood products	9.20	1.01	3.97	0.93	3.90	0.86	0.94	3.71	0.89	3.65	0.81
Cereals and cereal products	4.40	0.00	0.35	0.09	0.28	−0.02	0.00	0.26	0.08	0.18	−0.04
Grain processing products	6.51	0.04	0.40	0.14	−0.18	−0.32	0.03	0.00	0.13	−0.60	−0.41
Oil and fats	4.80	0.00	0.76	0.12	0.86	0.02	0.00	0.66	0.11	0.76	0.01
Fruit and vegetables	5.02	0.00	1.12	−0.04	1.07	0.23	0.00	0.86	−0.03	0.82	0.16
Fruit and vegetable preparations	6.53	0.00	2.15	−0.18	1.89	0.12	0.00	2.05	−0.16	1.81	0.10
Coffee, spices, cocoa and sugar	5.56	−0.05	2.32	0.13	2.53	0.12	−0.04	2.10	0.14	2.31	0.07
Tobacco	3.39	−0.06	0.68	−0.01	0.74	0.27	−0.05	0.68	−0.01	0.74	0.27
Non-alcoholic beverages	3.60	0.00	1.25	0.06	1.29	−0.02	0.00	1.06	0.05	1.10	−0.04
Wines	2.80	0.00	0.33	0.61	0.96	−0.01	0.00	0.33	0.61	0.96	−0.01
Other alcoholic beverages	5.00	0.00	3.95	0.89	4.60	0.05	0.00	3.80	0.83	4.41	0.05
Other preparations	2.65	−0.06	0.34	−0.02	0.38	−0.27	−0.06	0.33	−0.02	0.38	−0.28
Other products	5.94	0.24	0.42	0.14	0.32	0.25	0.20	0.35	0.10	0.25	0.21
Total		*0.30*	*−0.39*	*0.25*	*−1.57*	*−0.70*	*0.12*	*0.21*	*0.17*	*−0.43*	*−0.33*
		Exports (sales) to the Rest of France									
Product group	σ	S1	S2	S3	S4	S5	S1	S2	S3	S4	S5
Live animals	3.50	−0.93	−0.42	−1.33	−1.00	−1.32	−0.80	−0.35	−1.20	−1.07	−1.22
Meat and meat products	5.00	0.58	−3.60	0.26	−6.45	−2.44	0.53	−3.77	0.21	−6.64	−2.50
Dairy products	4.57	0.21	0.53	0.41	−0.21	0.13	0.20	0.44	0.40	−0.41	0.09
Fish and seafood products	9.20	0.98	3.85	0.90	3.78	0.84	0.92	3.59	0.86	3.53	0.78
Cereals and cereal products	4.40	0.00	0.35	0.09	0.28	−0.02	0.00	0.25	0.08	0.17	−0.04
Grain processing products	6.51	0.04	0.34	0.13	−0.24	−0.31	0.03	−0.06	0.12	−0.66	−0.40
Oil and fats	4.80	0.00	0.69	0.08	0.76	0.01	0.00	0.60	0.07	0.66	0.00
Fruit and vegetables	5.02	0.00	0.96	−0.04	0.91	0.20	0.00	0.69	−0.04	0.66	0.13
Fruit and vegetable preparations	6.53	0.00	1.95	−0.17	1.72	0.11	0.00	1.85	−0.15	1.64	0.08
Coffee, spices, cocoa and sugar	5.56	−0.04	2.13	0.14	2.35	0.14	−0.04	1.90	0.16	2.14	0.09
Tobacco	3.39	−0.07	0.71	−0.03	0.76	0.25	−0.07	0.71	−0.03	0.77	0.25
Non-alcoholic beverages	3.60	0.00	1.27	0.08	1.35	0.03	0.00	1.08	0.08	1.16	0.02
Wines	2.80	0.00	0.40	0.60	1.01	−0.01	0.00	0.40	0.60	1.01	−0.01
Other alcoholic beverages	5.00	0.00	3.84	0.77	4.37	0.05	0.00	3.69	0.70	4.17	0.05
Other preparations	2.65	−0.07	0.41	−0.02	0.46	−0.25	−0.07	0.40	−0.02	0.45	−0.26
Other products	5.94	0.22	0.39	0.12	0.28	0.23	0.18	0.32	0.08	0.21	0.19
Total		*0.34*	*−1.36*	*0.21*	*−2.96*	*−1.21*	*0.05*	*0.94*	*0.23*	*0.81*	*−0.10*

Notes: The effects of the five Brexit scenarios described in Table 1. In scenario S1, exports of live animals from Brittany to the United Kingdom would have increased by 12.59%.

of these products, except wines, to significantly diminish in monetary values.

For the actually implemented trade policy, represented by scenario S5, meat and meat products are the most harshly affected by Brexit. This product group features a 3.99% (€ 55.49 million) drop in the exports of Brittany and a 3.59% (€ 124.36 million) drop for the rest of France. Effects in relative terms are generally stronger for Brittany than for the rest of France. Notable differences are observed for fish and seafood products, dairy products, fruit and vegetables, other fruit and vegetable preparations, and coffee, spices, cocoa and sugar. Live animals stand out of this tendency, as the exports of these products increase slightly for Brittany but decrease for the rest of France.

4.2. Effect on Exports to Various Partners

Unsurprisingly, under all scenarios, exports to the United Kingdom suffer the strongest impact, both for Brittany and for the rest of France. Within each product group, the model predicts similar relative changes in the two regions' exports.

Under scenario S5, the sales of both regions to the British market fall by about 17% for meat and meat products, by 11% for processed grain products, and fish and seafood products, by 6% for coffee, spices, cocoa and sugar, and by 5% for fruit and vegetables. Positive impacts for live animals (10%) and tobacco (12%) arise due to the positive effect of the regulatory distance for pre-shipment checks and formalities estimated for these product categories, which outweighs the effect induced by the small increase in import tariffs.[18] Nevertheless, these two groups account for a small fraction of Brittany's exports (see Figure A1 of the Appendix). More pronounced differences between the two regions emerge when we account for the share of each product group in regions' exports. Brittany's industry of meat and meat products suffers, by far, the largest drop in exports; the main export losses for the rest of France are distributed across five product groups (see Table A2 of the Appendix). Unlike in the case of Brittany, the product group most heavily exported by the rest of France (wines) is very little affected. Contrary to suppliers of cereal and dairy products, Brexit does not penalize the French wine producers.

Across product groups, the decrease in exports to the United Kingdom is differently diverted to other destinations. For example, for fish and seafood products, losses on the British market are offset by homogeneous percentage increases in trade with other partners (France, Europe, and the rest of the world), which correspond to amounts of diverted trade proportional to the size of destination markets. For fruit and vegetables and dairy products, most of this trade is diverted to the rest of the world, and to a smaller degree to EU countries and France, both in percentage and value terms. For cereals and cereal products, only non-EU markets benefit from this diversion, while exports to the EU remain virtually unchanged. We obtain opposite effects for meat and meat products, and grain processing products, namely a decrease in sales on European and French markets, but an increase in exports to the rest of the world. The main destinations of this trade diversion are China, Japan, and the United States, characterised by expanding meat consumption.

4.3. Comparison of Scenarios

Scenarios S1 and S3, which assume the reintroduction of pre-shipment checks and formalities but not of import tariffs on EU-UK trade, whether the UK concludes PTAs with non-EU partners or not, generate a small overall impact on the exports of Brittany and of the rest of France. A sizable effect is obtained only for the monetary increase in the exports of other alcoholic beverages from the rest of France to the rest of the world, under scenario S3. Overall, predicted changes in Breton and French exports are larger under scenarios S2 and S4, which assume the introduction of both import tariffs and border controls between the EU and the United Kingdom due to the absence of a trade agreement. For example, under the latter scenarios exports to the UK would have decreased by approximatively 50% for meat and meat products, and fish and seafood products. The milder effects under scenario S5 place the implemented trade policy midway between the extreme scenarios mentioned above. Hence, the bilateral trade agreement signed by the EU and the UK appears as a compromise accepted by the two parties.

Comparing the results of scenarios S1 and S3 permits to understand how changes in the UK's trade policy towards non-EU countries affect Breton and French exports. Losses in terms of total exports are larger when the United Kingdom concludes preferential trade agreements with its main extra-EU partners, both for Brittany (€ 11.11 million under scenario S1 vs € 19.70 million under scenario S3) and the rest

18. In scenario S5, 16% of flows between France and the UK are subject to non-zero import tariffs due to rules of origin requirements.

of France (€ 20.42 million under scenario S1 vs € 156.32 million under scenario S3). Brittany's export losses concentrate on the British market, while for the rest of France these losses arise mainly from smaller amounts exported to non-EU destinations. Still, for some product groups, the above-mentioned PTAs reduce competition on extra-EU markets, allowing Breton and French suppliers to reinforce their market shares.

By comparing scenario S1 to scenario S2, and S3 to S4, highlights the importance of keeping import tariffs between the EU and the UK equal to zero. Abandoning bilateral free trade (scenarios S2 and S4) deteriorates the competitiveness of Breton and French products on the UK market, leading to a contraction of exports in all product groups. The sharp decrease in trade, by nearly one third for Brittany and by 16% for the rest of France, arises from the introduction of EU's very high MFN import tariffs (cf. Table 2). The drop in exports reaches 60% for grain processing products, and about 50% for fish and seafood products, and meat and meat products. Losing the preferential access to the British market also affects the performance of Breton and French exports to other markets. Brittany's sales on European markets decrease (€ −13.42 million under scenario S2 and € −41.3 million under scenario S4) due to a strong competition effect on meat and meat products. Indeed, all EU producers of these goods redirect to the intra-EU market the amounts they can no longer sell to the UK, which reinforces competition and drives prices downwards.[19] In the case of the rest of France, these losses are offset by higher exports in other product groups. Introducing imports tariffs on trade with the United Kingdom improves the export performance of both regions on non-EU markets. This reveals that large part of the exports of Brittany and the rest of France are diverted to these destinations.

4.4. Robustness of the Results

The magnitude of the effects described above depends on value of the elasticity of substitution, which is here equal to the price elasticity of demand. A higher elasticity yields larger effects, especially under scenarios S2, S3 and S4, which assume a significant increase in import tariffs on the UK's trade with the EU and/or third countries.[20] Nevertheless, the ranking of scenarios by their impact and by how exports to the UK are redirected to alternative destination markets remains broadly unaltered.[21]

Furthermore, altering the assumptions on the level of NTMs under different scenarios only slightly modifies the results, and does not affect our main findings. For example, if we assume that the UK's Preferential Trade Agreements (PTAs) with non-EU partners reduce the regulatory distance to 25% of its pre-Brexit level (instead of 50% assumed earlier), we obtain a minor amplification of export evolutions discussed above.[22] Assuming a similar drop in import tariffs between PTAs partners (to 25% of their pre-Brexit level) generates more pronounced changes in our results.[23] This indicates that Breton and French exports are more sensitive to changes in the level of tariffs than of NTMs.

If we exclude NTMs from the model and define the scenarios exclusively by changes in import tariffs, the effects of Brexit diminish significantly for all scenarios.[24] We conclude that although most of the impact of Brexit discussed above is generated by changes in imports tariffs on the UK's trade with EU and non-EU partners, NTMs also play an important role. Still, even when we modify the original scenarios, the conclusions expressed in this section, reached by comparing the evolutions of exports across destination markets, product groups, and scenarios, remain valid.

Finally, in the Online Appendix, we test the robustness of results under the implemented trade policy scenario (S5) by correcting the computation of domestic trade flows for the "border effect" documented in the literature, according to which a disproportionally larger amount of trade takes places within national borders. In this case, we find no evidence of a trade diversion towards EU and French markets, and losses in exports

19. We find a similar effect on the domestic market (sales to Brittany and to the rest of France).

20. A higher value of elasticity yields a stronger changes in exports.

21. For most product groups, including the flagship products of Breton exports (meat and meat products, and dairy products), the elasticity employed in this article is close to its value estimated by Fontagné et al. *(2022). For main product groups the most exported by the rest of France (cereals and cereal products, and wines), using the Fontagné* et al. *(2022) elasticity would slightly increase the drop in exports to the UK, and the amounts diverted to other markets, resulting into a negligible change in the effect on total exports. The few product groups for which Fontagné* et al. *(2022) estimate higher elasticities account for a small share of each region's exports. Therefore, our choice of elasticities does not affect the robustness of results.*

22. This modification of scenario S3 yields a stronger drop in Breton exports to the UK (7.12% vs 6.58%), less diversion to the EU market (0.26% vs 0.28%), and more diversion to the rest of the world (2.94% vs 2.57%). The net effect on exports to all partners is slightly smaller than wiht the unmodified scenario (–0.61% vs –0.56%). We find similar effects when we apply the same modification to scenario S4. The evolutions of the exports of the rest of France change marginally in both cases.

23. Under this variant of scenario S3, Breton exports to all destinations decrease by 2.35% (vs 0.56% in the unmodified scenario). The similar variant of scenario S4 predicts a stronger drop in exports to the UK, but larger diversions to other markets, resulting in a lower net effect on total exports than previously (−2.66% vs −4.97%).

24. In this case, Breton agri-food exports to all partners contract by 2.95% under scenario S2 (vs 3.54%), by 0.20% under scenario S3 (vs 0.56%), by 4.80% under scenario S4 (vs 4.97%), and by 0.81% under scenario S5 (vs 1.73%). Scenario S1 becomes now obsolete beacuse it assumes that i import tariffs remain at the pre-Brexit level.

to the UK are compensated by an increase in exports to extra-EU destinations alone.

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The Brittany's agri-food sector is strongly oriented to exports. The United Kingdom is a major destination for Brittany. Therefore, the region is in high need of identifying and quantifying the potential risks induced by Brexit and the associated challenges.

This article analyses the evolution of Brittany's agricultural and food exports after the United Kingdom's exit from the EU. We estimate the effects of Brexit for sixteen product groups of this sector using a structural gravity model and 2012–2015 data. We consider four extreme trade policy scenarios, which cover a wide range of possible trade policy outcomes, and a fifth scenario depicting the actual trade policy implemented since 1 January 2021, after the conclusion of a new EU-UK Trade and Cooperation Agreement. We address the lack of data on domestic trade flows, between and within a country's regions, and propose a method for predicting these data. For that, we use the structure of the model and parameter values obtained through estimations on observed trade flows.

Since Brittany and France feature a very different product composition of exports, we compute for each scenario the impact on agricultural and food exports both as percentages and monetary values. Overall, the implemented trade policy scenario emerges as a compromise outcome, producing effects of intermediate magnitude within the range defined by the extreme scenarios. We estimate Brittany's losses in agricultural and food exports generated by Brexit at € 60 million, halfway between the € 11–173 million losses obtained under the other scenarios. Although the rest of France incurs higher monetary losses due to its economic size, the percentage impact is much smaller than for Brittany.

Under all scenarios, meat and meat products stand out as the most severely impacted industry of Brittany. These products ranks top in Brittany's exports (40% of the value added of Brittany's AFIs in 2015), the region alone originating a quarter of French exports of meat and meat products. Unsurprisingly, exports to the UK market suffer the most. Under the implemented trade policy, the model predicts a 17% (€ 21 million) drop in Breton exports of meat and meat products. These exports may have dropped by 50% (€ 60 million) if different trade policies were adopted. The exports in other product categories, such as fish and grain processing products, would have suffered a strong decrease in percentage terms, but losses in monetary terms would have been considerably below those for meat because of their lower share in region's exports. Except for meat and live animals, Brexit determines suppliers to redirect their exports from the UK to the European and French markets, but above all to extra-EU destinations. Brittany's exports of meat and meat products are redirected exclusively to non-EU markets. Our results point out that Breton meat producers require a stronger support from policy makers in order to adjust to the UK's withdrawal from the EU and seize new trade opportunities. □

Link to the Online Appendix:
www.insee.fr/en/statistiques/fichier/7713592/ES540_Cheptea-et-al_OnlineAppendix.pdf

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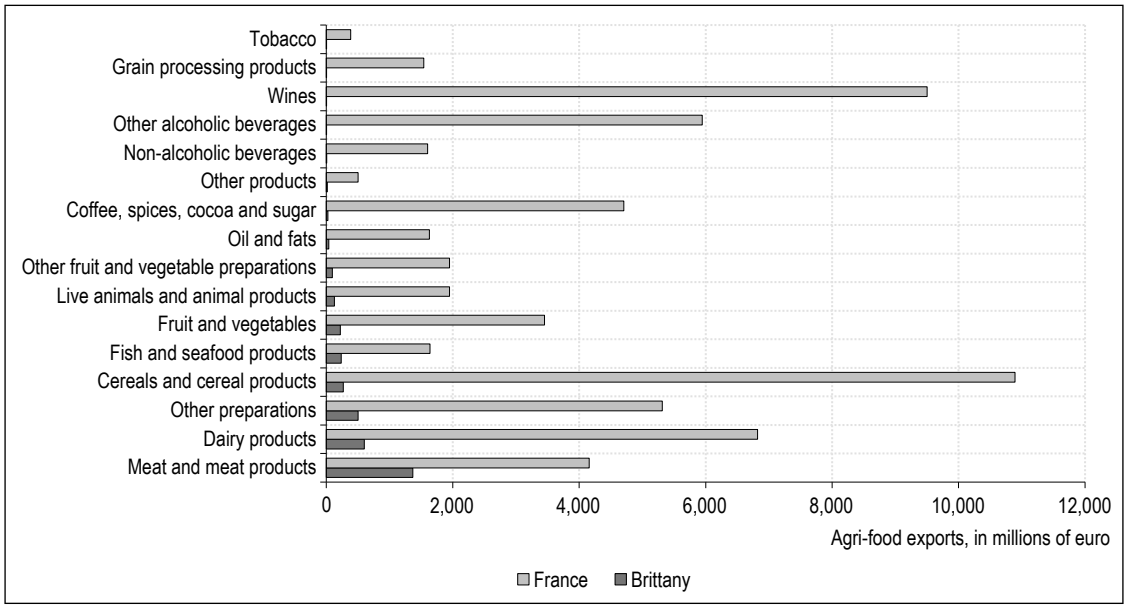
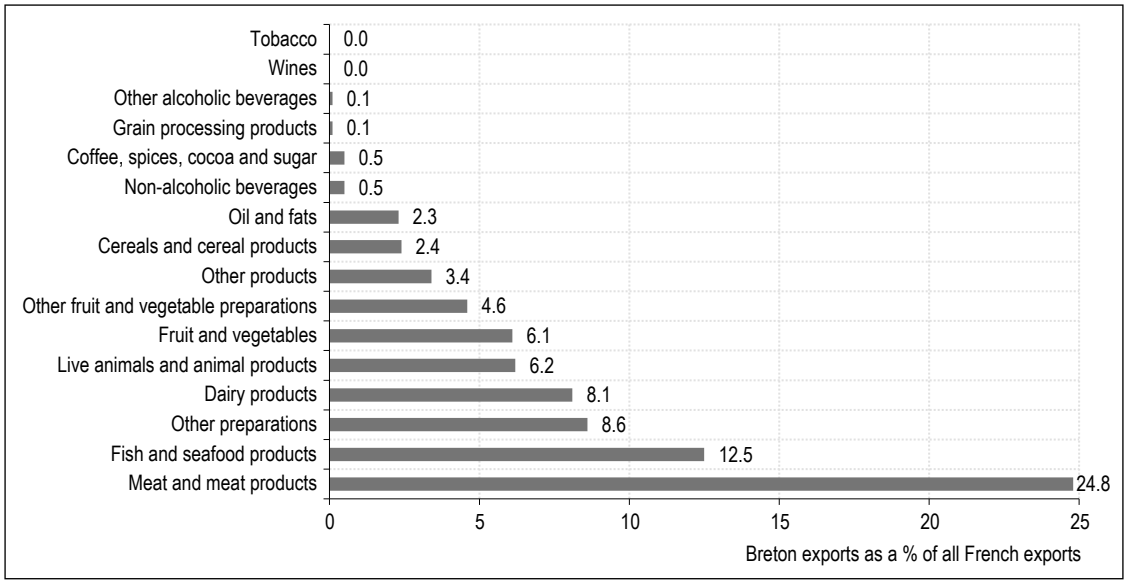
APPENDIX

Figure A1 – **Agri-food exports from Brittany and the rest of France (In millions of euro - 2015)**



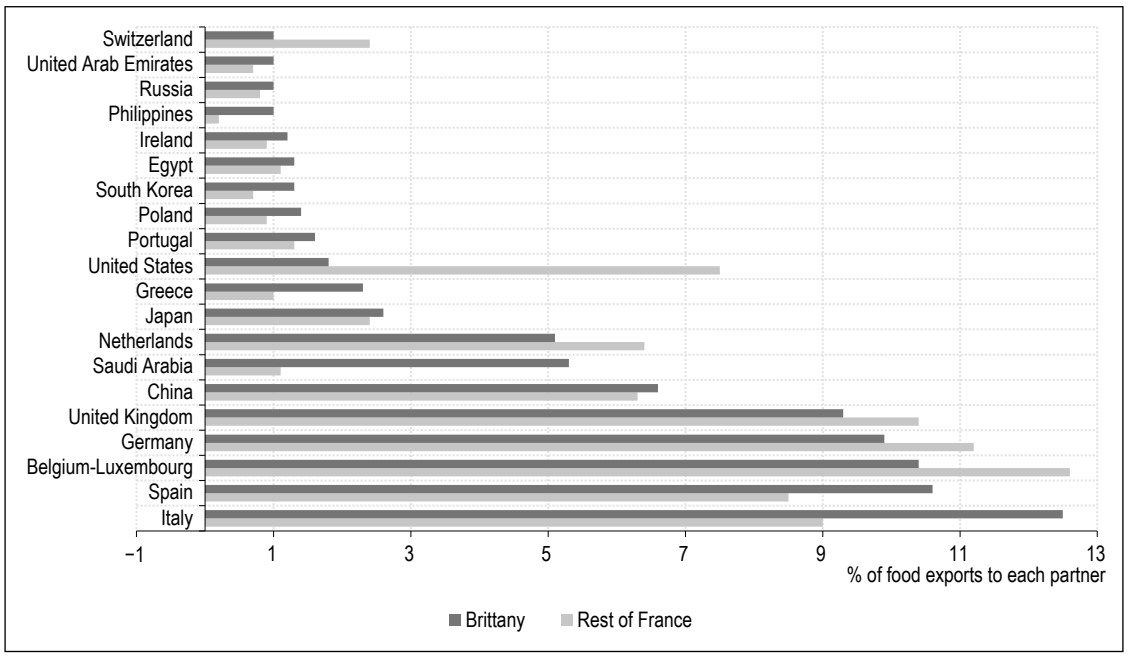
Sources: Regional customs and BACI.

Figure A2 – **Brittany's share of French exports in 2015**



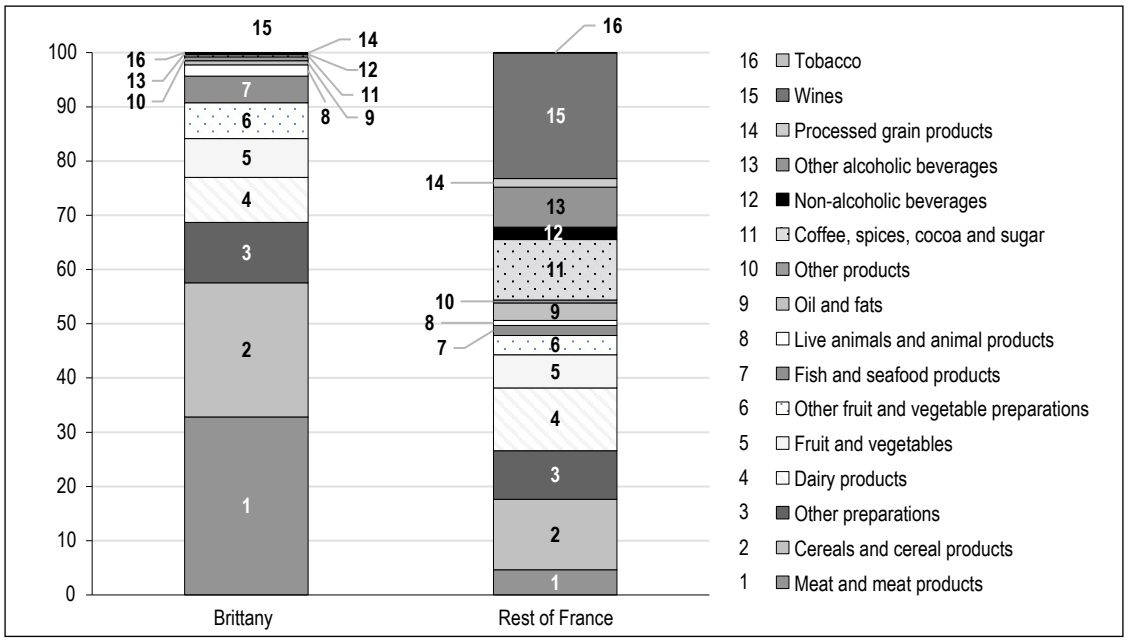
Sources: Regional customs and BACI.

Figure A3 – **Share of each destination in the agri-food exports of Brittany and the rest of France in 2015**



Sources: Regional customs and BACI.

Figure A4 – **Composition of the exports from Brittany and the rest of France to the United Kingdom in 2015**



Sources: Regional customs.

Table A1 – **Trade costs in the scenarios**

	Scenario	The United Kingdom's trade relations with:	
		EU27	Non-EU countries
(S1)	Quasi status quo	zero tariffs NTMs as for MFN status	unchanged tariffs unchanged NTMs
(S2)	Fortress United Kingdom	MFN tariffs NTMs as for MFN status	unchanged tariffs unchanged NTMs
(S3)	Liberalised trade with the EU and the main non-EU partners	zero tariffs NTMs as for MFN status	With the main developed countries[(a)]: ½ MFN tariff; NTMs as ½ MFN status With other countries: unchanged tariffs; NTMs as for MFN status
(S4)	Liberalised trade with only the main non-EU partners	MFN tariffs NTMs as for MFN status	With the main developed countries[(a)]: ½ MFN tariffs; NTMs as ½ MFN status With other countries: unchanged tariffs; NTMs as for MFN status
(S5)	Current policy	84% of flows: zero tariffs 16% of flows: MFN tariffs unchanged NTMs[(c)]	PTA[(b)]: negotiated preferential tariffs Other imports from the UK: UKGT tariffs[(c)] Other imports from the EU: MFN tariffs unchanged NTMs

Notes: [(a)] United States, Australia, New Zealand, Switzerland, Chile and Israel.
[(b)] New preferential trade agreements (PTAs) negotiated by the United Kingdom.
[(c)] New United Kingdom General Tariff (UKGT).

Under scenarios S1 to S4, the MFN NTM system means that the distance between the UK's non-tariff measures and those of the EU-27 is equal to the average level observed between the UK (EU) and the countries with which it does not have a preferential trade agreement (countries with which trade is under the MFN system). In scenario S5, we consider the distances between the UK and the EU-27 to be unchanged, compared to the period before Brexit (2012–2015), so as to reflect the announcement of flexibilities granted in terms of customs declarations for companies as well as the effort to digitalise those formalities.

Table A2 – **Changes in Exports from Brittany and the Rest of France (in millions of euro)**

		Brittany						Rest of France				
		Exports (sales) to all partners										
Product group	Share	S1	S2	S3	S4	S5	Share	S1	S2	S3	S4	S5
Live animals	3.1	0.57	−0.16	−0.05	−1.10	0.10	3.2	−1.64	−4.29	−12.88	−22.69	−10.02
Meat and meat products	39.9	−10.29	−97.49	−19.05	−139.90	−55.49	5.5	−14.90	−214.09	−33.95	−318.01	−124.36
Dairy products	19.2	−0.60	−10.19	0.13	−16.56	−1.48	11.0	−1.39	−71.67	6.96	−139.87	−9.74
Fish and seafood products	7.0	−0.90	−3.93	−0.73	−3.81	−0.83	2.4	−3.72	−16.65	−2.82	−16.06	−3.42
Cereals and cereal products	6.8	0.00	−4.74	−0.38	−5.41	−0.66	17.7	0.00	−196.90	−14.54	−227.11	−29.09
Grain processing products	0.0	0.00	−0.03	0.00	−0.04	−0.01	2.9	−0.18	−30.60	−1.27	−42.25	−7.29
Oil and fats	1.0	0.00	−0.13	−0.06	−0.18	−0.04	3.0	0.00	−3.65	−2.31	−5.95	−1.73
Fruit and vegetables	6.2	0.00	−2.92	−0.04	−2.96	−0.88	5.6	0.00	−42.47	−0.71	−42.82	−12.85
Fruit and vegetable preparations	2.9	0.00	−1.96	0.22	−1.66	−0.37	3.1	0.00	−30.86	3.58	−25.88	−6.17
Coffee, spices, cocoa and sugar	0.4	0.00	−0.17	0.03	−0.14	−0.06	7.5	0.47	−31.29	9.01	−20.86	−15.17
Tobacco	0.0	0.00	0.00	0.00	0.00	0.00	0.8	1.43	−0.56	1.63	−0.36	3.78
Non-alcoholic beverages	0.2	0.00	−0.05	0.00	−0.05	−0.01	2.5	0.00	−5.32	0.32	−5.00	−0.97
Wines	0.1	0.00	0.00	0.01	0.01	0.00	16.0	0.00	10.14	63.85	67.91	1.01
Other alcoholic beverages	0.1	0.00	−0.01	−0.08	−0.10	0.00	9.8	0.00	−19.92	−174.96	−188.03	0.62
Other preparations	12.6	0.18	−1.62	0.40	−1.36	−0.48	8.0	1.01	−13.14	4.04	−10.11	−6.57
Other products	0.6	−0.06	−0.10	−0.09	−0.13	−0.06	0.8	−1.52	−2.32	−2.27	−3.13	−1.36
Total	*100*	*−11.11*	*−123.51*	*−19.70*	*−173.38*	*−60.25*	*100*	*−20.42*	*−673.61*	*−156.32*	*−1,000.24*	*−223.32*
		Exports (sales) to the United Kingdom										
Product group	Share	S1	S2	S3	S4	S5	Share	S1	S2	S3	S4	S5
Live animals	2.1	0.89	−0.03	0.98	0.00	0.69	0.9	7.41	−0.18	8.13	0.00	5.79
Meat and meat products	36.9	−11.50	−47.71	−19.83	−60.15	−21.37	3.2	−19.69	−81.49	−33.86	−102.68	−36.51
Dairy products	9.2	−0.68	−7.27	−0.73	−8.74	−1.23	12.2	−17.79	−190.14	−19.08	−229.10	−32.44
Fish and seafood products	3.6	−1.49	−6.32	−1.12	−6.01	−1.31	1.6	−12.67	−53.52	−9.50	−50.93	−11.15
Cereals and cereal products	21.3	0.00	−15.99	−1.66	−17.54	−3.01	12.7	0.00	−187.53	−19.54	−205.73	−35.32
Grain processing products	0.0	0.00	−0.08	−0.01	−0.09	−0.02	2.0	−0.59	−64.70	−5.68	−77.77	−14.73
Oil and fats	1.4	0.00	−0.75	−0.14	−0.87	−0.11	4.0	0.00	−43.87	−8.20	−51.03	−6.30
Fruit and vegetables	7.7	0.00	−4.69	0.01	−4.69	−1.30	6.4	0.00	−78.27	0.13	−78.27	−21.74
Fruit and vegetable preparations	6.7	0.00	−6.54	0.51	−5.94	−1.05	3.0	0.00	−56.88	4.50	−51.64	−9.16
Coffee, spices, cocoa and sugar	0.2	0.00	−0.15	0.01	−0.14	−0.04	9.1	2.81	−148.30	9.58	−141.18	−37.88
Tobacco	0.0	0.00	0.00	0.00	0.00	0.00	0.0	0.17	−0.40	0.16	−0.41	0.32
Non-alcoholic beverages	0.2	0.00	−0.06	0.00	−0.06	0.00	2.2	0.00	−13.57	0.03	−13.59	−1.09
Wines	0.1	0.00	−0.01	0.00	0.00	0.00	26.2	0.00	−52.78	22.77	−24.15	−5.52
Other alcoholic beverages	0.1	0.00	−0.04	0.04	0.00	0.00	7.5	0.00	−56.76	49.42	−5.80	4.71
Other preparations	9.9	0.32	−3.01	0.03	−3.32	−0.55	8.6	5.47	−51.94	0.46	−57.36	−9.58
Other products	0.7	−0.11	−0.18	−0.14	−0.21	−0.11	0.5	−1.77	−2.82	−2.18	−3.26	−1.64
Total	*100*	*−12.57*	*−92.80*	*−22.06*	*−107.77*	*−29.41*	*100*	*−36.64*	*−1,083.14*	*−2.87*	*−1,092.90*	*−212.24*
		Exports (sales) to the EU (excluding the UK and France)										
Product group	Share	S1	S2	S3	S4	S5	Share	S1	S2	S3	S4	S5
Live animals	2.8	−0.51	−0.24	−0.77	−0.63	−0.74	4.7	−11.56	−5.78	−20.23	−20.05	−18.61
Meat and meat products	39.2	5.65	−27.75	3.60	−51.74	−20.04	6.7	14.85	−89.62	8.45	−161.31	−61.96
Dairy products	18.9	0.87	2.18	1.69	−0.95	0.37	12.3	9.02	15.67	18.05	−24.69	2.85
Fish and seafood products	9.4	1.87	7.36	1.60	7.11	1.56	2.9	9.52	37.31	8.18	36.08	7.96
Cereals and cereal products	5.4	0.00	0.51	0.12	0.46	0.01	22.4	0.00	28.42	7.75	23.26	−0.86
Grain processing products	0.0	0.00	0.01	0.00	0.00	0.00	3.4	0.40	1.06	1.58	−6.99	−5.01
Oil and fats	1.2	0.00	0.18	0.02	0.19	0.00	3.8	0.00	8.84	0.88	9.43	0.00
Fruit and vegetables	7.6	0.00	1.82	−0.08	1.73	0.38	7.0	0.00	22.73	−1.08	21.38	4.33
Fruit and vegetable preparations	2.8	0.00	1.18	−0.12	1.02	0.07	3.7	0.00	25.81	−2.44	22.23	1.15
Coffee, spices, cocoa and sugar	0.5	0.00	0.25	0.01	0.27	0.01	9.0	−1.38	62.49	4.14	69.05	2.42
Tobacco	0.0	0.00	0.00	0.00	0.00	0.00	0.9	−0.07	2.04	0.07	2.22	1.02
Non-alcoholic beverages	0.2	0.00	0.09	0.00	0.10	0.00	2.4	0.00	11.94	0.46	12.21	−0.55
Wines	0.0	0.00	0.00	0.00	0.00	0.00	8.2	0.00	16.67	18.55	36.17	−0.31
Other alcoholic beverages	0.0	0.00	0.02	0.00	0.02	0.00	4.1	0.00	52.81	2.66	52.18	0.63
Other preparations	11.8	−0.18	0.95	−0.03	1.11	−0.67	7.8	−1.80	10.77	−0.30	12.57	−8.08
Other products	0.3	0.00	0.01	0.00	0.00	0.01	0.7	0.14	0.35	−0.23	−0.06	0.20
Total	*100*	*7.70*	*−13.42*	*6.04*	*−41.30*	*−19.05*	*100*	*19.13*	*201.51*	*46.50*	*83.65*	*−74.84*

Table A2 – *(contd.)*

		Brittany					Rest of France				
		Exports (sales) to the rest of the world									
Product group	Share	S1	S2	S3	S4	S5	Share	S1	S2	S3	S4	S5
Live animals	4.3	−0.07	0.30	−0.79	−0.54	0.08	1.0	−0.13	1.31	−3.45	−2.75	0.43
Meat and meat products	42.4	8.21	39.49	25.04	53.16	11.12	3.8	13.17	62.38	38.33	81.93	17.54
Dairy products	23.5	0.07	6.71	0.09	7.47	1.52	7.7	0.28	40.18	−0.42	42.85	10.11
Fish and seafood products	2.8	0.26	1.28	0.08	1.14	0.25	1.5	2.32	11.64	0.61	10.33	2.32
Cereals and cereal products	5.0	0.00	0.45	0.08	0.45	0.50	9.6	0.00	14.27	2.61	13.74	17.40
Grain processing products	0.0	0.00	0.03	0.00	0.04	0.01	2.0	0.11	28.88	2.60	35.99	9.74
Oil and fats	0.5	0.00	0.06	0.00	0.06	0.01	1.0	0.00	2.42	−0.06	2.28	0.44
Fruit and vegetables	2.4	0.00	1.11	0.02	1.16	0.35	2.4	0.00	18.66	0.35	19.36	6.10
Fruit and vegetable preparations	1.7	0.00	1.11	−0.02	1.14	0.24	2.0	0.00	23.95	−0.47	24.52	5.20
Coffee, spices, cocoa and sugar	0.2	0.00	0.06	0.00	0.05	0.03	3.8	−0.35	17.41	−1.45	16.65	8.15
Tobacco	0.1	0.00	0.00	0.00	0.00	0.00	0.9	0.10	0.99	0.25	1.15	−0.18
Non-alcoholic beverages	0.1	0.00	0.01	0.00	0.01	0.00	3.1	0.00	4.96	−0.17	5.07	1.45
Wines	0.2	0.00	0.02	0.01	0.02	0.00	29.0	0.00	55.29	19.48	58.98	8.95
Other alcoholic beverages	0.2	0.00	−0.02	−0.14	−0.16	0.00	22.9	0.00	−51.21	−323.92	−360.97	−8.33
Other preparations	15.4	−0.12	1.46	0.39	1.99	0.85	8.2	−1.04	14.17	3.58	19.10	8.06
Other products	1.2	0.09	0.14	0.12	0.18	0.08	1.0	1.29	1.97	1.69	2.42	1.17
Total	*100*	*8.44*	*52.22*	*24.88*	*66.17*	*15.05*	*100*	*15.76*	*247.27*	*−260.42*	*−29.36*	*88.55*
		Exports (sales) to Brittany										
Product group	Share	S1	S2	S3	S4	S5	Share	S1	S2	S3	S4	S5
Live animals	6.6	−0.08	−0.04	−0.12	−0.10	−0.13	5.5	−0.32	−0.15	−0.50	−0.50	−0.51
Meat and meat products	30.5	0.32	−1.51	0.20	−2.85	−1.08	11.7	0.61	−3.23	0.34	−5.95	−2.26
Dairy products	31.5	0.10	0.23	0.19	−0.16	0.04	26.4	0.41	0.82	0.84	−1.14	0.11
Fish and seafood products	7.9	0.12	0.48	0.11	0.47	0.10	4.5	0.35	1.37	0.33	1.34	0.30
Cereals and cereal products	9.3	0.00	0.05	0.01	0.04	0.00	20.7	0.00	0.44	0.14	0.30	−0.07
Grain processing products	0.0	0.00	0.00	0.00	0.00	0.00	3.7	0.01	0.00	0.04	−0.18	−0.13
Oil and fats	0.8	0.00	0.01	0.00	0.01	0.00	5.2	0.00	0.28	0.05	0.32	0.00
Fruit and vegetables	2.9	0.00	0.05	0.00	0.05	0.01	1.7	0.00	0.12	0.00	0.12	0.02
Fruit and vegetable preparations	2.7	0.00	0.09	−0.01	0.08	0.00	3.8	0.00	0.64	−0.05	0.56	0.03
Coffee, spices, cocoa and sugar	0.1	0.00	0.00	0.00	0.00	0.00	3.0	−0.01	0.52	0.03	0.57	0.02
Tobacco	0.0	0.00	0.00	0.00	0.00	0.00	0.0	0.00	0.00	0.00	0.00	0.00
Non-alcoholic beverages	0.0	0.00	0.00	0.00	0.00	0.00	0.6	0.00	0.05	0.00	0.06	0.00
Wines	0.0	0.00	0.00	0.00	0.00	0.00	0.7	0.00	0.02	0.04	0.06	0.00
Other alcoholic beverages	0.0	0.00	0.00	0.00	0.00	0.00	1.8	0.00	0.55	0.12	0.64	0.01
Other preparations	7.3	−0.01	0.04	0.00	0.04	−0.03	10.3	−0.05	0.28	−0.02	0.32	−0.23
Other products	0.4	0.00	0.00	0.00	0.00	0.00	0.4	0.01	0.01	0.00	0.01	0.01
Total	*100*	*0.46*	*−0.59*	*0.38*	*−2.41*	*−1.08*	*100*	*1.01*	*1.72*	*1.36*	*−3.48*	*−2.70*
		Exports (sales) to the Rest of France										
Product group	Share	S1	S2	S3	S4	S5	Share	S1	S2	S3	S4	S5
Live animals	3.0	−0.37	−0.17	−0.52	−0.39	−0.52	1.2	−0.91	−0.40	−1.36	−1.21	−1.38
Meat and meat products	50.0	3.78	−23.47	1.69	−42.05	−15.91	4.7	2.32	−16.53	0.92	−29.11	−10.96
Dairy products	19.9	0.54	1.37	1.06	−0.54	0.34	10.2	1.91	4.20	3.82	−3.92	0.86
Fish and seafood products	4.7	0.61	2.38	0.56	2.33	0.52	2.6	2.21	8.61	2.06	8.47	1.87
Cereals and cereal products	4.0	0.00	0.18	0.05	0.15	−0.01	22.7	0.00	5.32	1.70	3.62	−0.85
Grain processing products	0.0	0.00	0.00	0.00	0.00	0.00	2.0	0.06	−0.12	0.23	−1.27	−0.77
Oil and fats	0.7	0.00	0.06	0.01	0.07	0.00	2.0	0.00	1.12	0.13	1.23	0.00
Fruit and vegetables	3.4	0.00	0.43	−0.02	0.41	0.09	7.7	0.00	4.99	−0.29	4.77	0.94
Fruit and vegetable preparations	2.7	0.00	0.69	−0.06	0.60	0.04	5.1	0.00	8.88	−0.72	7.87	0.38
Coffee, spices, cocoa and sugar	0.4	0.00	0.10	0.01	0.11	0.01	7.7	−0.29	13.66	1.15	15.39	0.65
Tobacco	0.0	0.00	0.00	0.00	0.00	0.00	2.0	−0.13	1.34	−0.06	1.45	0.47
Non-alcoholic beverages	0.1	0.00	0.02	0.00	0.02	0.00	2.1	0.00	2.10	0.16	2.25	0.04
Wines	0.0	0.00	0.00	0.00	0.00	0.00	7.8	0.00	2.91	4.37	7.36	−0.07
Other alcoholic beverages	0.0	0.00	0.02	0.00	0.03	0.00	14.3	0.00	49.49	9.39	55.93	0.67
Other preparations	10.6	−0.10	0.57	−0.03	0.64	−0.35	6.8	−0.44	2.54	−0.13	2.86	−1.65
Other products	0.3	0.01	0.02	0.01	0.01	0.01	1.4	0.24	0.42	0.11	0.28	0.25
Total	*100*	*4.48*	*−17.79*	*2.76*	*−38.61*	*−15.78*	*100*	*4.96*	*88.56*	*21.49*	*75.97*	*−9.55*

Notes: The effects of the five Brexit scenarios described in Table 1. In scenario S1, exports of live animals from Brittany to the United Kingdom would have increased by 0.89 million euro.