ESRI ECONOMIC & SOCIAL RESEARCH INSTITUTE

ESRI Working Paper No. 735

October 2022

How has Brexit changed EU-UK trade flows?

Janez Kren[a,b] & Martina Lawless[a,b*]

a) Economic and Social Research Institute, Dublin, Ireland
b) Trinity College Dublin, Dublin, Ireland

***Corresponding Author:**
Dr Martina Lawless
Economic and Social Research Institute,
Whitaker Square, Sir John Rogerson's Quay,
Dublin, Ireland
Email: Martina.Lawless@esri.ie

Acknowledgements:
Thanks to Eimear Flynn for help with earlier versions of the data used in this paper.

How has Brexit changed EU-UK trade flows?

Abstract

This paper estimates how Brexit has affected goods trade between the United Kingdom and European Union. Using product-level trade flows between the EU and all other countries in the world as a comparison group, we find a sharp decline in trade from the UK to the EU and significant but smaller reductions in trade from the EU to the UK. However, when we estimate the size of the Brexit impact on trade using UK data and UK global trade as a benchmark, we find strikingly different results. We identify two key sources of this discrepancy. First, the UK's global exports grew relatively slowly. We argue these are not suitable as a no-Brexit counterfactual. Second, Brexit also led to breaks in the measurement of trade flows, particularly for the EU data. To resolve these issues, we combine UK-reported data for its trade with EU and EU data for its trade with the rest of the world to use as the appropriate benchmark for comparison. This generates an estimate that Brexit reduced trade by close to 20% in both directions.

JEL codes: F10
Keywords: Brexit; free trade agreements; customs checks

1 Introduction

Following the decision to leave the European Union (EU) taken by a referendum in the United Kingdom (UK) in June 2016, a process of extensive negotiations on the withdrawal arrangements and future trading relationship began. These continued up until days before the agreed (and several times rescheduled) exit of the UK from the EU's Single Market and Customs Union on 31st December 2020.[1] In the intervening years, many potential scenarios on the degree of continued trade links were considered and a wide literature on the potential impacts of Brexit emerged. These covered the impacts on the UK, the EU as a whole, individual member states and specific sectors.[2] The immediate impact of the uncertainty induced by the referendum on economic outcomes led to negative impacts on investment and exports during the period before the UK official exit from the EU.[3]

This paper examines how trade between the UK and EU reacted once the UK exited the EU's Single Market and Customs Union and the Trade and Cooperation Agreement (TCA) came into force.[4] It uses granular high-frequency product-level data on trade flows in goods across all EU member states and the UK to estimate the effect from the exit date of 1st January 2021 on the levels and composition of trade throughout 2021. To isolate the impact of Brexit, a comprehensive set of product-time and product-partner fixed effects are applied to control for other changes in trade patterns, most specifically the changes in trade flows as a result of the COVID-19 pandemic.

When the effect of Brexit is estimated using EU data, it first appears that the impact was highly asymmetric, with trade from the EU to the UK declining by considerably less than that from the UK to EU. These results differ substantially from those of Freeman et al. (2022) who used UK data and found a positive impact of Brexit on UK to EU trade and a strongly negative effect on EU to UK trade. We investigate these apparently contradictory estimates and identify two key factors driving the divergence.

First, there is the choice of benchmark against which the impact of Brexit is measured. Freeman et al. (2022) used UK trade with rest of the world (RoW) as the comparison group while our benchmark is EU-RoW trade. When considering Brexit as a "treatment" applied to EU-UK trade, the choice of the untreated control group is an important factor in the estimation process. We argue that there are several reasons why the EU-RoW benchmark is a better control group than UK-RoW trade. With close to half of UK international trade accounted for by the EU, a substantial change in the UK-EU trade relationship is likely to have had

[1] Formally, UK withdrew from the EU on 31 January 2020. However, it remained in the EU's Single Market for the rest of 2020. From an international trade perspective, and for the purpose of this paper, January 1st 2021 is used as a start of post-Brexit trade relationship.

[2] A small number of examples include Ebell & Warren (2016), Dhingra et al. (2017), Chen et al. (2018) and Lawless & Morgenroth (2019).

[3] For example, Born et al. (2019), Davies & Studnicka (2018), Dhingra et al. (2022), Graziano et al. (2020), Douch & Edwards (2022) and Crowley et al. (2020).

[4] This paper uses data on the UK as a whole although different trade arrangements are in place for Northern Ireland. The special case of Northern Ireland's trade with the EU is examined in Flynn et al. (2021).

spillover effects on trade with non-EU countries. These effects could have operated via altered supply chains, changes in transportation costs, uncertainty about the status of trade deals with non-EU countries or reductions in the ability of firms to cover fixed costs of exporting. These spillover effects on broader economic activity are consistent with evidence on the decline in investment in the UK (Springford (2022)) and specifically in inward investment from the EU (Breinlich et al. (2020). These effects of Brexit on other trade links are less likely to be a consideration for EU trade with the rest of world, making it a more appropriate choice of benchmark to isolate the impact of Brexit.

The second reason for divergence in the estimated effects of Brexit is the difference in data sources. The exit of the UK from the EU Single Market resulted in data collection changes, which caused a noticeable discrepancy in values that EU and UK statistical agencies report for the same trade flow. We find that collection methods for bilateral EU-UK trade changed less in the UK-reported data than in the EU-reported data. Therefore, we suggest the most accurate estimation of the impact of Brexit can be found by combining EU data for its trade with the rest of the world (to generate the comparison group) with UK data as the source for bilateral UK-EU trade. Using this 'hybrid' dataset, we find that that Brexit has substantially reduced trade in both directions relative to the no-Brexit benchmark. In our baseline model, UK to EU trade declined by 16% and trade from EU to UK by 20%. We further examine the variation across member states, monthly variation and role of extensive and intensive margin.

The paper is organised as follows: Section 2 describes the methodology and the data. Section 3 presents the initial estimations from the separate EU-reported and UK-reported data and discusses the key reasons why they give different results. In section 4 we show our baseline estimates of the impacts of Brexit on trade between the UK and the EU using the hybrid dataset. Section 5 examines how the results vary by intensive and extensive margins of trade. Section 6 concludes.

2 Methodology and data

2.1 Econometric approach

The baseline specification is to estimate the following:

$$T_{ijpm} = \exp\left[\beta_0 + \beta_1 \cdot Post\text{-}ref_m * UK_j + \beta_2 \cdot Brexit_m * UK_j + \gamma_{pm} + \delta_{jp}\right] + \epsilon_{ijpm} \quad (1)$$

where T represents trade flows into and out of i (either the EU27 total or a specific member country), to each partner country j of product p in month m. *Post-ref* is a dummy equal to one for each month following the referendum (from July 2016 onwards), including 2021. *Brexit* is a dummy variable equal to one for each month following the exit of the UK from the EU (i.e. from January 2021 onwards). Both dummies are interacted with a UK dummy. All other potential drivers of trade flow variation are subsumed in the fixed effects at the product-month (γ_{pm}) and partner-product (δ_{jp}) level. These fixed effects should absorb other

confounding influences on the overall movement of trade, particularly those related to the COVID-19 pandemic, and allow us to isolate the specific impact of Brexit on trade with the UK alone. The regressions are estimated using the Poisson pseudo-maximum likelihood (PPML) estimator developed by Silva & Tenreyro (2006) to address both heteroscedasticity and zero trade flows. The estimation also uses high dimension fixed effects, developed by Correia et al. (2020). The β_2 coefficient estimated from this specification can be converted into a form that can be interpreted as a percentage change using the transformation $e^{\beta_2} - 1$.

In this difference-in-difference specification, product-level trade in 2021 is compared to trade between the referendum and Brexit day and then EU-UK trade is compared to EU-RoW trade. Thus, EU-RoW acts as a control group on how EU-UK trade would have evolved in the absence of Brexit. In alternative specifications, we also use UK-RoW trade as a control group.

When considering Brexit as a "treatment" applied to EU-UK trade in this difference-in-difference specification, the choice of the untreated control group is an important factor in the estimation process. There are a number of reasons why the EU's trade with the rest of the world is a more suitable choice as the untreated control group than that of UK-RoW trade. These largely arise from the likelihood that a change in UK trade policy as substantial as Brexit would also have impacts on other UK trade relationships beyond the EU. Examples of potential secondary impacts of Brexit on trade with the rest of the world include supply chain disruption and corresponding impacts on investment and productivity. For example, a UK firm that found key inputs more difficult to source may have had difficulty producing sufficient amounts to continue exporting the same amounts as previously to non-EU countries. Firms that are focused on producing exports for both EU and non-EU markets may have seen reduced investment given their reduced access to the EU markets. Delays at UK ports may have also impacted the cost and efficiency of shipping goods to non-EU destinations.

While some of these issues may affect EU trade patterns as well as those of the UK, Brexit has likely affected UK trade with the rest of the world much more than it has EU-RoW trade. One simple reason for this is the sheer size difference between the two economies. Before Brexit, the EU market represented about 50% of UK goods trade, while the UK's share in EU total trade was around 5%. Apart from the difference in direct exposure this brings, it also increases the likelihood that exporting and importing firms in the UK are trading both with the EU and RoW and that their activities and decisions in both regions are intertwined. This would reduce the incentive for investment in the UK, early evidence of which is documented by Springford (2022) and Breinlich et al. (2020). Similarly, delays at UK ports from the changes in customs requirements impacted a large proportion of UK trade but would not have any notable impact on EU trade with the rest of the world because UK ports are not significant shipping hubs. Finally, UK trade could have been affected by uncertainty related to roll-over of existing trade deals with third countries, which did not directly impact business in the EU.

2.2 Data

EU trade data

Our first source of our data for the impact of Brexit on goods trade between the EU and UK comes from Comext, the official trade database for the EU produced by Eurostat.[5] The data contains trade flow information for each of 27 current EU member state with all 200+ partner countries and territories at a monthly frequency. For most of our specifications, we aggregate members' trade to EU27 trade for computational reasons. Our sample period starts in January 2015 to control for pre-Brexit referendum trade patterns and continues for 84 months until December 2021. The data are recorded at the 8-digit Combined Nomenclature product level (CN8). At this level there are around 9,500 unique products traded by the EU in each month.[6]

Unhelpfully for economists interested in estimating precisely the impact of Brexit on trade, the statistical agencies in both the UK and EU made changes to data collection when the UK left the EU Single Market. In both cases, this arose because the UK's exit from the EU Single Market also resulted in it leaving the EU's internal trade reporting system (Intrastat) which compiles data from VAT returns in each member state. The UK's exit from this system meant trade flows from the EU side moved to being collected through the Extrastat system used for non-EU member states.[7]

The Extrastat system collects data from customs forms and applies a lower threshold for trade declarations on imports coming from outside the EU than the Intrastat system applies to those on internal EU trade.[8] Perhaps more importantly, import trade within the EU is collected on a country of consignment basis - where the import source is recorded as being from the last country where a change was made to the goods whether that was a change in ownership, repackaging or further processing. In the Extrastat system, import trade is defined on an origin basis.[9] This change in definition would directly reduce Eurostat's measure of UK to EU trade as goods previously consigned through the UK (e.g. a UK-based firm purchasing bulk goods from China and then repackaging and selling them on to the EU) would no longer be included in the figures.

[5] Data does not include trade in services.

[6] In order to account for zero trade flows which are not directly reported, we expand the data for all months across all product-partner combinations to include zero observations for any goods that were traded at least once between 2015 and 2021. For the closest comparison with related literature on Brexit trade we exclude seven CN8 products that relate to trade in gold: 71081100, 71081200, 71081310, 71081380, 71090000, 71123000 and 71129100.

[7] Trade from Northern Ireland continues to be collected via Intrastat.

[8] The precise reporting thresholds vary somewhat across EU member states, depending on country size.

[9] See https://ec.europa.eu/eurostat/documents/6842948/11003521/Availability_of_UK_trade_data_after_BREXIT_FAQs.pdf/ce8cc509-8429-943f-5de3-a5d20cd33344?t=1614360113585

UK trade data

Likewise, as the UK was no longer part of the Intrastat system from January 2021, a new system for collecting data on trade with the EU was introduced by HMRC.[10] The change was initially applied to exports from the UK to the EU to use customs documentation. Import data continues to be collected on the same basis as before Brexit. Freeman et al. (2022) use this source of UK data as their key source to compare the effect of Brexit on trade with the EU relative to UK trade with the rest of the world along with data on rest of world trade from the EU and USA.

Some differences when comparing one country's reported exports to a partner country to that partner country's reported imports are normal as exports are typically valued at factory-gate prices whereas imports generally include the costs of transport, insurance and charges.[11] In reported flows between the EU and UK datasets the extent of the differences is relatively modest but a more substantial gap opened up in January 2021 as shown in Figure 1.[12] Panel (a) shows trade flows from the UK to the EU from both sources and panel (b) shows trade from the EU to UK. Prior to January 2021, the movements in two data sources are almost perfectly in line for both directions of trade.[13]

There is a fairly consistent gap over time between the two sources of data for EU to UK trade which does not change substantially in January 2021. However, a much more notable gap emerges in 2021 between the two measures of UK to EU trade with UK-reported exports well above EU-reported imports. This is consistent with the changed definition applied by the EU to include as imports from the UK only goods originating in the UK. Prior to the change in data collection, goods consigned from UK wholesalers but produced elsewhere would have also been captured as trade from the UK.

2.3 Descriptive evidence on the evolution of UK-EU trade

Using the Comext measures of EU trade, Figure 2 shows the evolution of total trade values into and out of the EU27 between January 2015 and December 2021. These are divided into trade with the UK, internal trade between EU member states (excluding the UK) and trade with the rest of the world. For trade flows into the EU27 (panel a), there is a notable drop in trade originating in the UK in early 2021, followed by a rapid bounce back to levels that are close to but below the pre-Brexit average. Looking at trade from the EU to the other regions (panel b), the reduction in trade to the UK in January 2021 is less apparent. In terms of our estimation of the impact of Brexit, the rapid growth in intra-EU trade and trade between

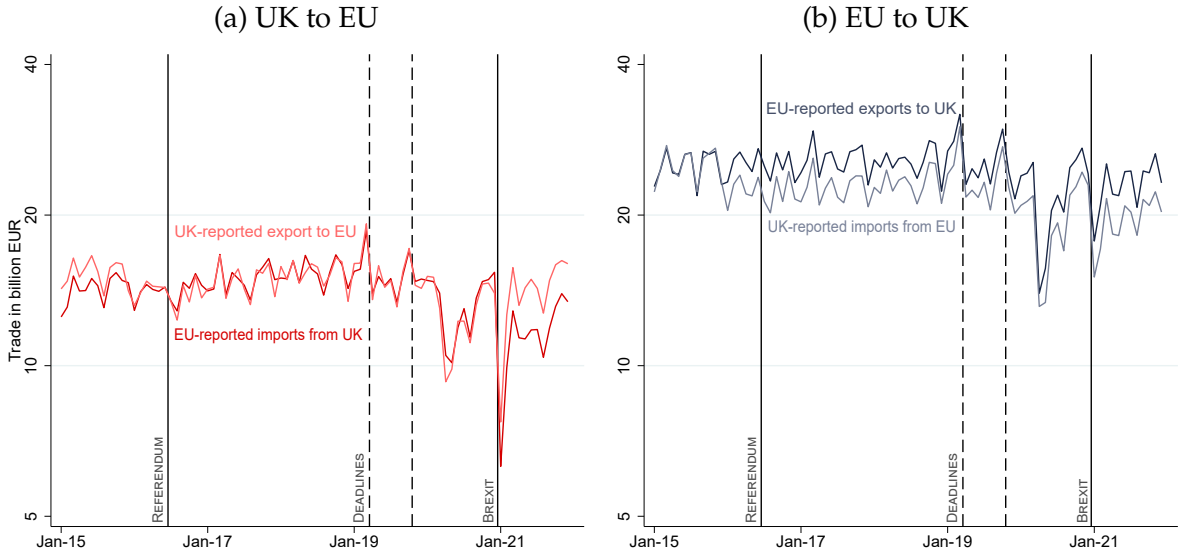
[10] Her Majesty's Revenue and Customs, the UK's tax, payments and customs authority.

[11] Other reasons and size of asymmetries for the UK are summarised on https://www.ons.gov.uk/economy/nationalaccounts/balanceofpayments/articles/asymmetriesintradedataaukperspective/2017-07-13.

[12] For the UK data, some graphs exclude data of May 2016 due to technical issues with the data collection for that month: see https://www.ons.gov.uk/economy/nationalaccounts/balanceofpayments/bulletins/uktrade/may2016 for more information.

[13] Currency conversion in both directions is done using monthly values for Euro-British pound, taken from the Central Bank of Ireland https://www.centralbank.ie/statistics/interest-rates-exchange-rates/exchange-rates

Figure 1: Comparison between reported EU-UK trade by Eurostat and HMRC



Total bilateral trade in goods in euros, log scale. Two full vertical lines represent the Brexit referendum and withdrawal from the Single Market. Dashed lines show two missed deadlines in 2019 when Article 50 was extended. *Sources:* Eurostat Comext database (EU) and HRMC trade data (UK).

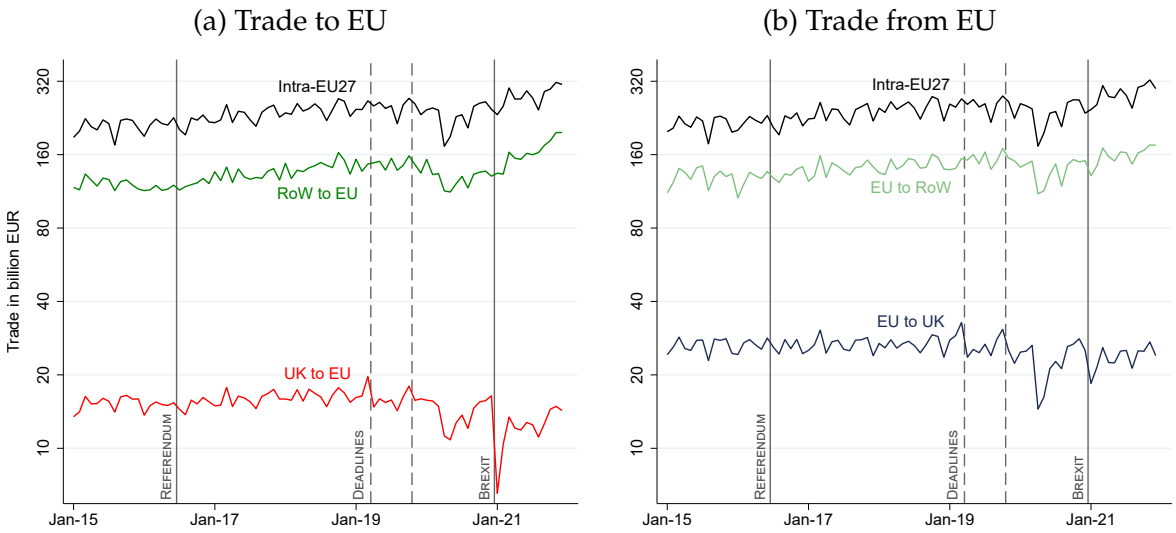
the EU and rest of the world in the aftermath of COVID-19 disruptions will be important in determining the comparison path for EU-UK trade if the UK had not exited the Single Market.

To take into account these developments in total EU trade, Figure 3 plots how the *share* of the UK in EU members' imports and exports has evolved from January 2015 to the end of 2021, again based on the Comext data. The share of trade is used to allow us to control even in this descriptive analysis for effects such as the COVID-19 pandemic which would affect the levels or growth of trade across all partner countries.[14] This figure shows that the importance of the UK as a trade destination for EU member states has been consistently higher than that of the UK as a share of EU imports. The most notable aspect of this figure is the strong decline in the UK's share of EU trade in 2021, which occurs in both trade directions. Unlike the recovery in values shown in Figure 2, the reduction in the share of the UK as both an origin and destination for EU trade stabilised at a lower level throughout 2021, as EU trade elsewhere grew more rapidly. There is also a slight suggestion of a gradual reduction in the share of EU trade going to the UK throughout the period with a possible uptick in the last months of 2020, which we will investigate as a potential indicator of pre-Brexit stockpiling.

The extent to which Brexit impacted individual EU member states depends to a large extent on the initial scale and composition of their trade with the UK. Table 1 shows the share of the UK as a source of imports and as an export destination for each country in the EU at

[14] Note that when referring to overall EU trade in this section, we use the aggregation of trade from all current 27 member states (hence including intra-EU trade flows between members), and excluding UK trade when it was still a member.

Figure 2: Total EU27 trade by broad region, 2015-2021

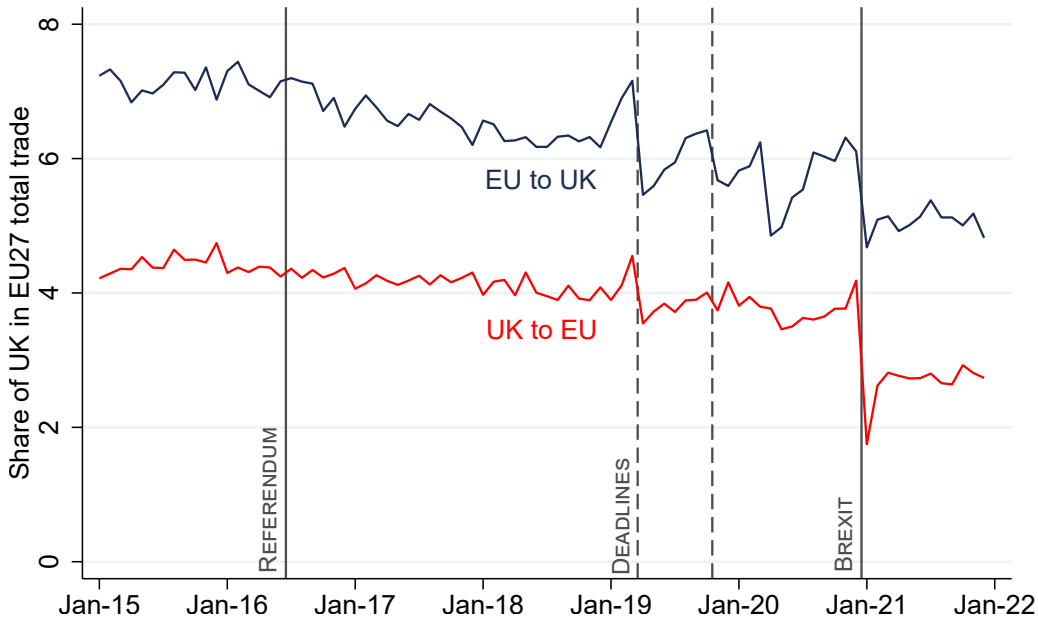


Total bilateral trade in goods in euros, log scale. Two full vertical lines represent the Brexit referendum and withdrawal from the Single Market. Dashed lines show two missed deadlines in 2019 when Article 50 was extended. *Source:* Eurostat Comext database.

three points in time (2015, 2019 and 2021). Looking first at trade coming from the UK to each member state as a share of their total imports, most are close to the 4% share observed in the aggregate graph in 2015 and 2019. Ireland is a substantial outlier, with one-third of its imports coming from the UK in 2015, with closely integrated wholesale and retail sectors an important factor. This had reduced to 28% in 2019 before falling further to 19% after the UK exit from the EU. Ireland also had one of the highest export shares going to the UK relative to other EU member states. Across most EU members, we find reductions in the share of the UK in overall trade, both inwards and outwards, with the shift most evident for those where the UK accounted initially for a higher share of trade.

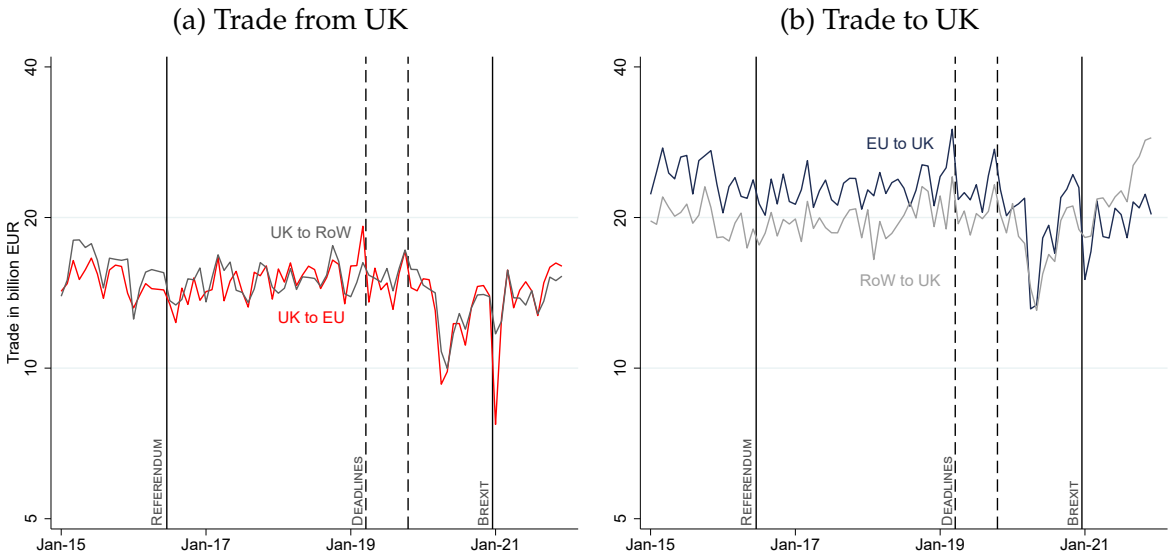
Figures 4 and 5 show the evolution in trade values and share in the same period from the UK perspective. Prior to Brexit, the EU accounted for almost 54% of total UK imports, falling to 46% in 2021. There was almost no change in the importance of the EU in total UK exports on the other hand - staying at just under 50% before and after Brexit.

Figure 3: UK as a share of EU members imports and exports, 2015-2021



Source: Eurostat Comext database.

Figure 4: Total UK trade by broad region, 2015-2021

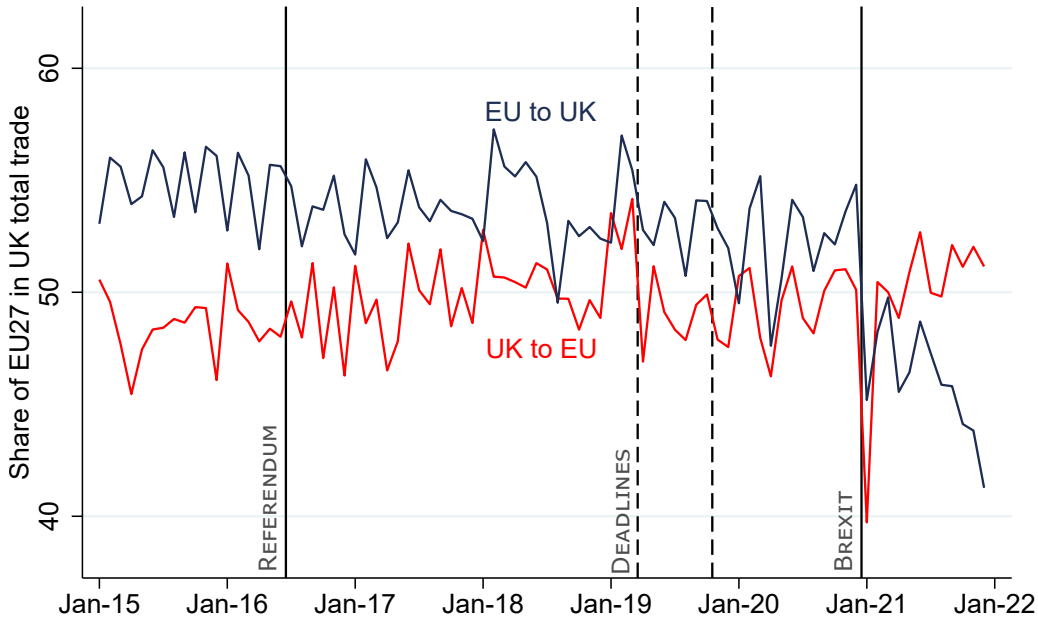


Total bilateral trade in goods in euros, log scale. Two full vertical lines represent the Brexit referendum and withdrawal from the Single Market. Dashed lines show two missed deadlines in 2019 when Article 50 was extended. *Source:* HRMC database.

Table 1: UK share of total trade for EU member states (%)

	(1) 2015	(2) 2019	(3) 2021	(4) 2015	(5) 2019	(6) 2021
	Trade from UK to ...			**Trade to UK from ...**		
Austria	2%	2%	1%	3%	3%	3%
Belgium	5%	4%	4%	9%	8%	6%
Bulgaria	2%	1%	1%	3%	2%	2%
Croatia	1%	1%	0%	2%	2%	1%
Cyprus	9%	7%	3%	4%	6%	7%
Czechia	3%	2%	1%	5%	5%	4%
Denmark	5%	4%	2%	6%	6%	5%
Estonia	3%	2%	1%	3%	2%	3%
Finland	3%	2%	1%	5%	4%	4%
France	5%	4%	3%	7%	7%	6%
Germany	4%	4%	2%	7%	6%	5%
Greece	3%	2%	1%	4%	4%	3%
Hungary	2%	2%	1%	4%	3%	3%
Ireland	31%	28%	19%	14%	10%	11%
Italy	3%	2%	2%	5%	5%	5%
Latvia	2%	3%	1%	5%	5%	7%
Lithuania	3%	3%	1%	4%	4%	4%
Luxembourg	1%	1%	2%	5%	4%	3%
Malta	8%	21%	5%	5%	2%	4%
Netherlands	5%	5%	4%	9%	8%	6%
Poland	3%	3%	1%	7%	6%	5%
Portugal	3%	3%	1%	7%	6%	5%
Romania	2%	2%	1%	4%	4%	3%
Slovakia	1%	2%	1%	5%	5%	4%
Slovenia	1%	1%	1%	2%	2%	1%
Spain	5%	4%	2%	7%	7%	6%
Sweden	6%	5%	3%	7%	5%	6%
EU27	4%	4%	3%	7%	6%	5%

Figure 5: UK as a share of EU members imports and exports, 2015-2021



Source: HMRC.

3 Initial estimates

While the decline in the UK's share of EU trade observed in Figure 3 is suggestive of the impact of Brexit, confounding factors could be at play. In particular, product-level shifts attributable to the COVID-19 pandemic or differences in composition of trade could explain some of these declines in trade. We therefore estimate a model with all EU trade partners and controlling for product-month and partner-product fixed effects as described in Section 2.

Table 2: EU-UK trade and Brexit: initial estimates

	(1)	(2)	(3)	(4)
	EU-reported data EU-RoW benchmark		UK-reported data UK-RoW benchmark	
	UK to EU	EU to UK	UK to EU	EU to UK
Referendum*UK/EU	−0.103***	−0.129***	0.050***	0.062***
	(0.011)	(0.012)	(0.014)	(0.013)
Brexit*UK/EU	−0.402***	−0.198***	0.081***	−0.344***
	(0.026)	(0.015)	(0.023)	(0.018)
Constant	16.925***	16.212***	15.075***	15.670***
	(0.001)	(0.001)	(0.006)	(0.006)
Observations	63,509,677	107,600,956	49,817,624	25,793,141
Pseudo R-squared	0.973	0.962	0.920	0.937

Standard errors clustered by partner-period in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Partner-product and product-month level fixed effects included.

The initial results based on EU data are presented in columns 1 and 2 of Table 2, with our key variable of interest being the interaction of a Brexit dummy variable (equal to one from January 2021 onwards) with trade with the UK. These initial results relate to aggregate EU trade with the UK and with each direction of trade estimated separately. The estimates from column 1 suggest that Britain's exit from the EU led to a 33% decline in aggregate trade coming from the UK into the EU.[15] The impact on EU trade flows to the UK is found to be statistically significant but not as severe, falling by 18% as a result of Brexit (column 2). Some reduction in trade in both directions relative to the counterfactual evolution across products and markets is also identified as having occurred from the date of the referendum.

These results differ substantially from those of Freeman et al. (2022) who found a positive impact of Brexit on UK to EU trade and a strongly negative effect on EU to UK trade. This section examines what might explain the differences in results. Three possible explanations present themselves: the data differences described in Section 2, econometric specification and the difference in comparison group. We look at the contribution of each of these reasons below.

[15] Recall that the β coefficient is converted to a percentage change using the transformation $e^{\beta} - 1$ so this is $e^{0.402} - 1 = 0.33$.

Econometric specification

The approach taken by Freeman et al. (2022) was similar in concept to the one we use - controlling through a wide set of fixed effects to isolate the impact of Brexit on UK-EU trade. The key differences between the approaches were the source and level of granularity of the data and that our specification estimates a single Brexit coefficient starting from January 2021 rather than time-varying effects. However, we find that these specification differences do not play any substantial role in the explaining the inconsistency in the ultimate findings. When we apply the same specification to both data sources, the results we get from the UK data are essentially the same as those in Freeman et al. (2022). This can be seen in Table 2, which shows a positive impact of Brexit on UK to EU trade (column 3) and a negative effect on EU to UK trade (column 4). This is almost entirely the opposite of our findings using EU data in columns 1 and 2. Econometric specification can therefore be dismissed as the source of the different results.

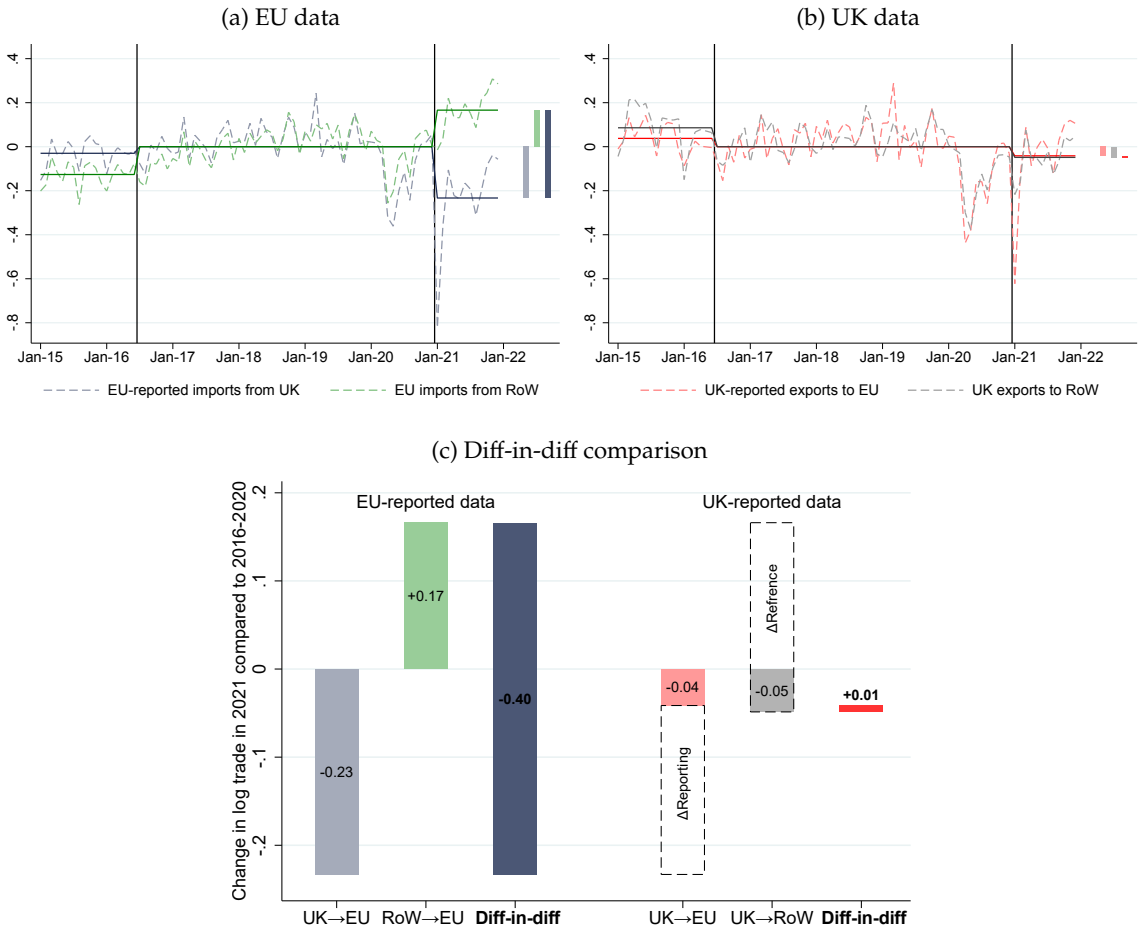
Data and counterfactual comparison group

The third potential explanation for different estimates of the impact of Brexit on UK-EU trade from our approach and that of Freeman et al. (2022) is the role played by the comparator group in the difference-in-difference methodology. Our specification estimates the impact of Brexit by comparing change in EU-UK trade flows with the EU's trade in the same products at the same time with other partner countries. Freeman et al. (2022) meanwhile use the UK's trade with the rest of the world as their comparison group. Figures 6 and 7 show that this difference in comparison group is a key factor in understanding why the results generate almost completely opposite answers to what is apparently the same question with the differences in data definitions filling the rest of the gap. Both figures use only total trade between EU, UK and the rest of the world (RoW). Consequently the differences in product composition and composition of RoW partner countries are ignored in those figures.

Panel (a) of Figure 6 shows how trade from the UK to the EU compares to the evolution of EU imports from the rest of the world (RoW). The overall patterns were broadly similar up until January 2021, including parallel reductions in trade during the COVID-19 pandemic. At that point, strong growth continued in EU imports from the rest of the world while UK to EU trade dropped sharply. Although the initial drop was temporary, the recovery in EU to UK trade was to a level below the previous trend and well short of the trade with the rest of the world.

The UK data for UK to EU and UK to RoW trade are presented in panel (b). We noted the difference in measurement in these UK to EU flows directly in Figure 1. Here, we want to focus on the comparison between the patterns of UK trade to the EU and that to the rest of the world. As discussed in a number of other papers, such as Du & Shepotylo (2022) and Springford (2022), UK trade globally has experienced a much slower recovery from the COVID-19 pandemic than other comparable countries. Apart from the temporary large fall

Figure 6: Comparing estimates from Eurostat and HMRC: UK to EU flows

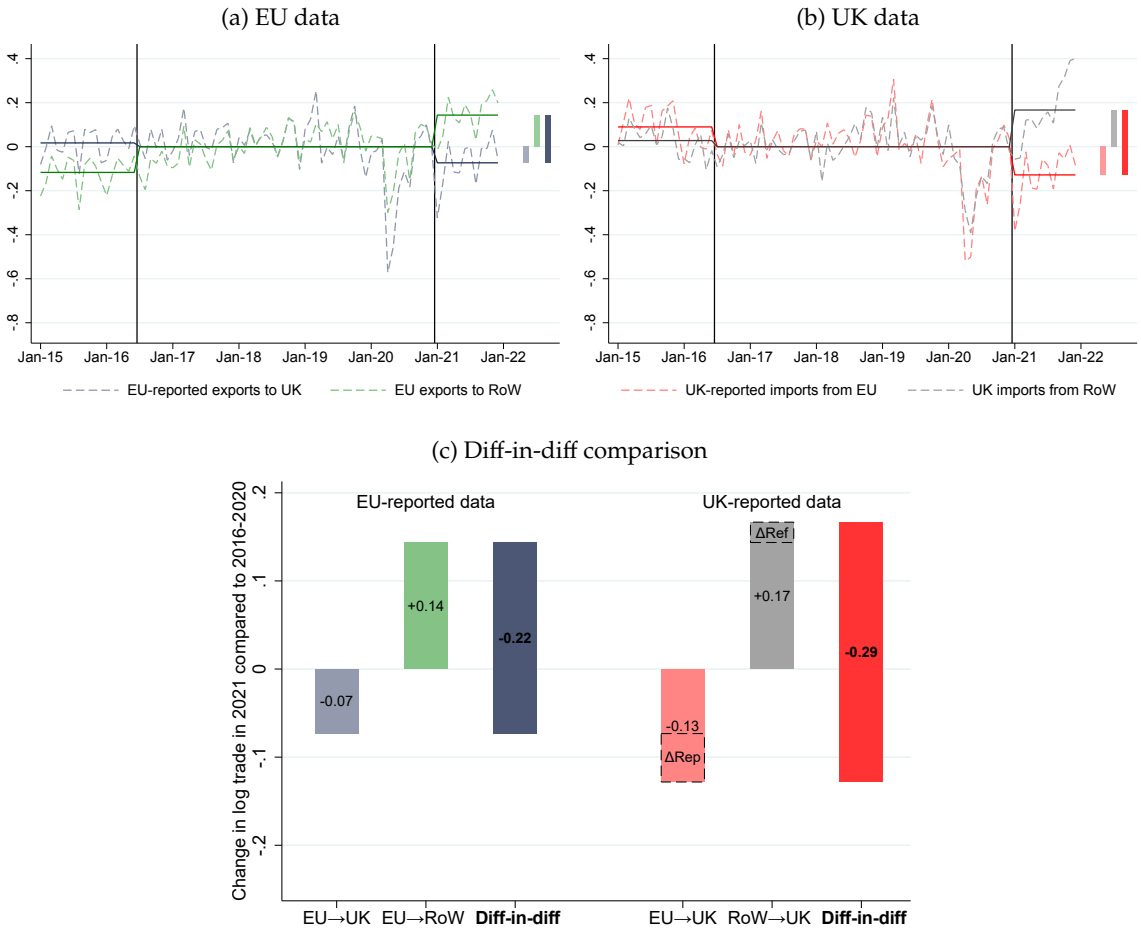


Log of total trade (in euros) relative to July 2016-December 2020 average. EU-RoW includes intra-EU trade.

in UK to EU trade in January 2021, the pattern of UK exports to the EU is not dramatically different from that of its trade with the rest of the world for the remainder of 2021.

Panel (c) of Figure 6 illustrates the difference-in-difference approach on total trade data using both EU data with RoW→EU as reference comparator and UK data with UK→RoW as a reference. This is broadly analogous to our and Freeman et al. (2022) approaches respectively. Because both EU-reported UK→EU trade fell (first bar) and RoW→EU trade (second bar) increased substantially, the total diff-in-diff effect (third bar) is very large. As mentioned before, the decline in UK→EU trade is noticeably smaller (fourth bar) when using UK data. However, because UK→RoW trade has declined by even more (fifth bar), the diff-in-diff results give a small positive overall impact. Panel (c) of Figure 6 also shows the contribution of the different data sources and comparison groups with dashed-line bars. In summary, out of the overall 0.41 points difference, 0.19 can be attributed to the data reporting gap while 0.22 is due to the comparator reference gap.

Figure 7: Comparing estimates from Eurostat and HMRC: EU to UK flows



Log of total trade (in euros) relative to July 2016-December 2020 average. EU-RoW includes intra-EU trade.

Figure 7 repeats the same diff-in-diff analysis for EU to UK trade flows. Here we find that there has been similarly strong growth in both UK imports from and EU exports to the rest of the world, thus, the gap of 0.03 between reference group is smaller than in Figure 6. The reporting gap (0.05 points) is also smaller. However, both gaps are in the same direction which makes the EU→UK decline look larger when using the UK data with RoW→UK as a control group than is the case with EU-data and the EU→RoW comparator. Thus, while measurement differences therefore certainly play a role, the choice of counterfactual is also a crucial element in assessing the impact of Brexit.

4 Estimates of Brexit using hybrid dataset

Having established that both data differences and choice of comparator group contribute to the divergent results, how substantial is the effect on our estimated baseline coefficients? To examine this, we repeat the specifications of Table 2 but switch the source of data for trade between the EU and UK. In other words, we take the HMRC data as "truth" and use those values for EU-UK trade while having EU trade with the rest of the world as our comparison group. This way we have what we believe is the best of both datasets - the more consistent trade definition from HMRC and the appropriate counterfactual of EU trade with other countries which is not impacted by the Brexit effect that we are interested in estimating. The results are presented in Table 3. In both Comext and HMRC Imports valuations include cost of freight and insurance (CIF) while valuations of exports do not (FOB). Thus, the hybrid dataset will have inconsistent valuations across partner countries. However, because of partner-product fixed effects this difference should not affect the results.

Table 3: EU-UK trade and Brexit impacts: main estimates

	(1)	(2)
	HMRC data for EU-UK flows Comext data otherwise EU-RoW benchmark	
	UK to EU	EU to UK
Referendum*UK	−0.082*	−0.171***
	(0.049)	(0.021)
Brexit*UK	−0.174***	−0.221***
	(0.026)	(0.023)
Constant	16.931***	16.207***
	(0.002)	(0.001)
Observations	63,492,216	107,603,567
Pseudo R-squared	0.973	0.962

Standard errors clustered by partner-period in parentheses. *** p<0.01, ** p<0.05, * p<0.1.
Partner-product and product-period level fixed effects included.

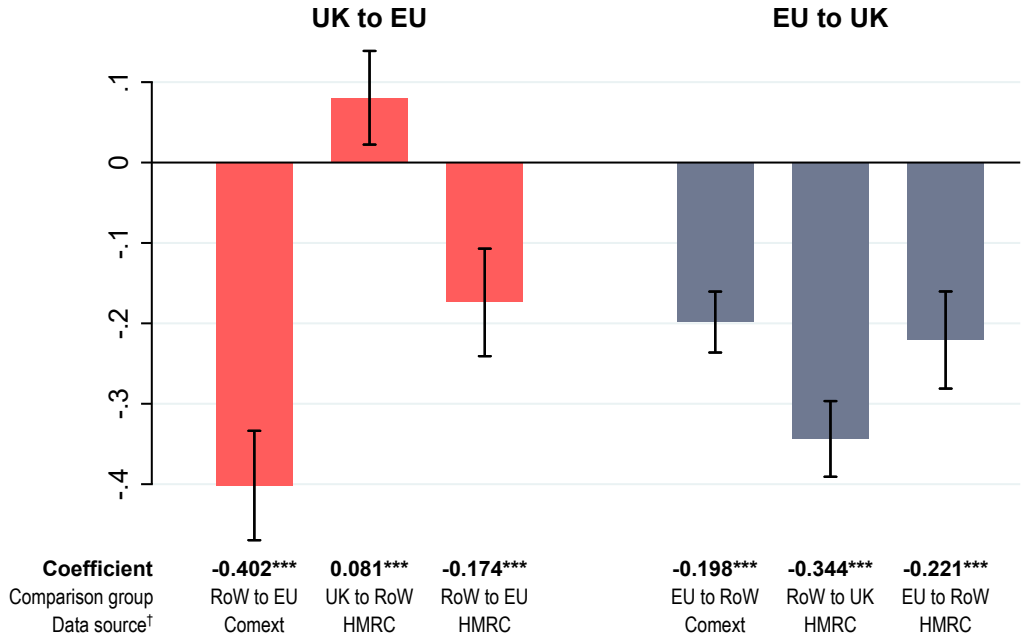
The striking finding of Table 3 is the extent to which the results have converged, with a substantial negative impact of Brexit found for trade in both directions. From column 1 we get that trade from UK to EU declined by 16% and column 2 that trade declined 20% in the opposite direction.

Figure 8 compares these new estimates to the initial estimates using only Comext and only HMRC data from Table 2. Using the EU data on trade from the UK to EU, we had estimated a reduction attributable to Brexit of 33%. In contrast, the specification using UK data and UK-RoW trade as a control group suggested a 8% increase in trade since Brexit. In our new baseline model, when the measurement of these flows from the UK sources is used but we take EU-RoW trade as the control group, this effect becomes a reduction of 16%. This

again highlights that both data differences and choice of control group both affect the results substantially.

The change in the estimated effect of EU to UK trade between the three specifications is less severe: our initial estimate was that EU to UK trade fell by 18% (Comext data) or 29% (HMRC data). When using the hybrid data, we estimate a fall of 20%.

Figure 8: Comparison of estimated coefficients of Brexit impact on EU-UK trade



† Data source for flows between EU and UK.
Based on regression results in Table 2 and 3. Bars represent 99% confidence intervals.

4.1 Variation across EU Member States

The results above relate to aggregate trade between the EU27 and UK. In this subsection, we investigate the variation across EU Member States in the impact of Brexit on their trade with the UK. To do this, we run the same specification described above but this time on using data on each EU member state separately. The UK-EU member data are again taken from HMRC with the comparison group being each member state's trade with all other countries from Comext. For computational reasons, we aggregate trade to quarterly data for these estimates.

Table 4 reports the direct impacts of Brexit on trade with the UK as a percentage of trade, controlling for all other factors through a comprehensive set of product-quarter and product-partner fixed effects. The full set of results for each country can be found in Tables A.2 and A.3 in the appendix. The coefficients on the estimates of the Brexit impact for all members are shown graphically in Figure 9 which also includes the estimates using only Comext data for comparison.

The results show that Brexit has led to a significant decline in trade coming from the UK into a majority of EU countries. As with the EU aggregate, the reductions in trade going from each EU member state to the UK are considerably smaller than those from the UK to the EU (although still substantial in several instances).

Table 4: Estimated direct impact of Brexit on EU-UK trade (% change)

	Imports from UK	Exports to UK		Imports from UK	Exports to UK
EU27	**-16%**	**-20%**	Ireland	-40%	n.s.
Austria	-25%	n.s.	Italy	-18%	-12%
Belgium	n.s.	-26%	Latvia	n.s.	38%
Bulgaria	-45%	-23%	Lithuania	n.s.	n.s.
Croatia	-49%	-28%	Luxembourg	76%	-28%
Cyprus	-47%	34%	Malta	-59%	-46%
Czechia	-32%	-23%	Netherlands	n.s.	-29%
Denmark	-19%	n.s.	Poland	-34%	-21%
Estonia	-18%	n.s.	Portugal	-39%	-20%
Finland	-31%	-33%	Romania	-35%	n.s.
France	-13%	-27%	Slovakia	n.s.	n.s.
Germany	-24%	-14%	Slovenia	-37%	n.s.
Greece	-45%	-29%	Spain	-32%	-19%
Hungary	-21%	-24%	Sweden	-25%	-19%

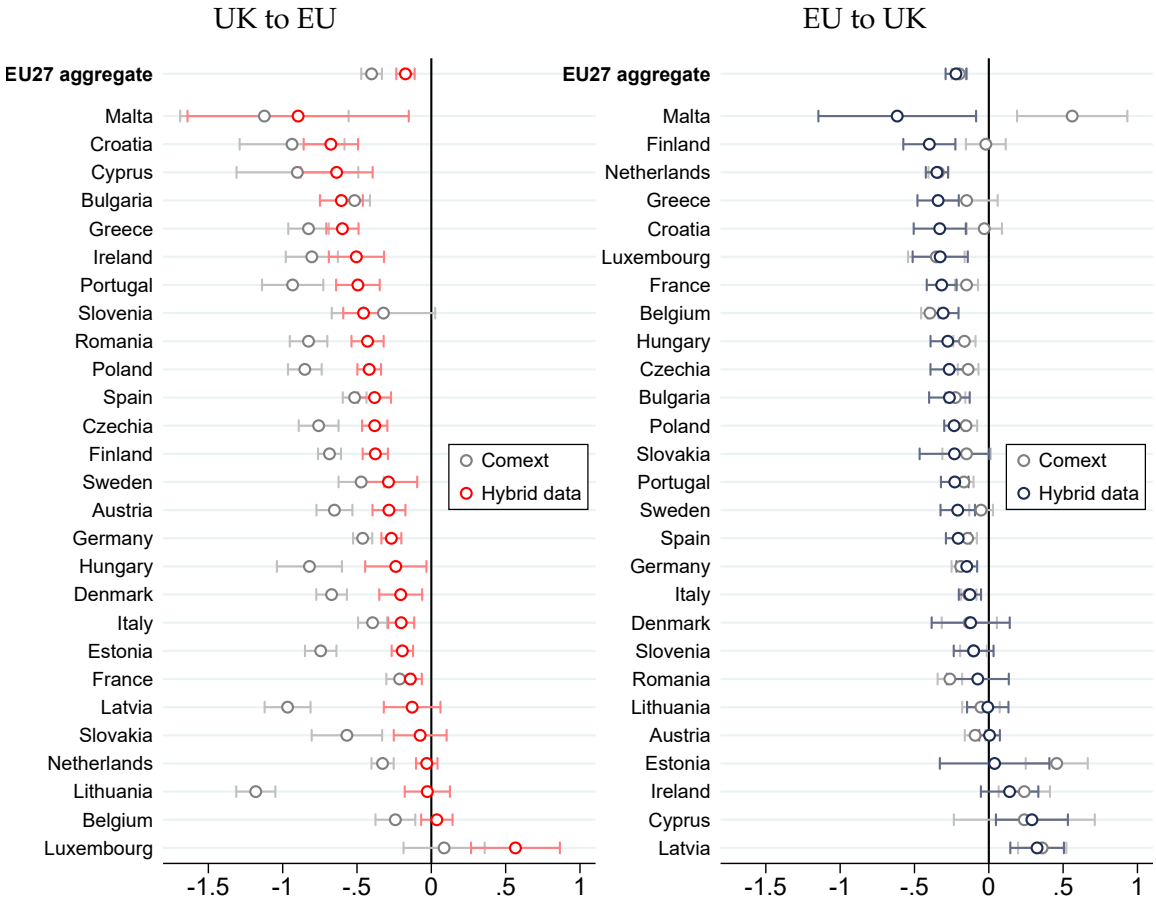
Elasticities converted from PPML estimates of Brexit effect on trade flows by country controlling for product-month and partner fixed effects. Full results are in Appendix tables A.2 and A.3. Statistically insignificant (p>0.01) estimates are denoted by n.s.

With the exception of Luxembourg and five insignificant results, most of the individual countries show a fall in trade coming from the UK after Brexit. In the other direction, a majority of countries show evidence of falls in trade as well, but the magnitudes are smaller. There are a number of countries where no statistically significant evidence of Brexit impacting trade from that country to the UK is found and we find increases in trade after Brexit from Cyprus and Latvia to the UK. However, for these countries, the share of trade with the UK tends to be small. An exception is Ireland, where sales to the UK accounted for ten percent of total Irish exports in 2019. For Ireland, we find no significant change in trade going to the UK following Brexit, although some of this effect may come from increased trade between Ireland and Northern Ireland. However, in the other direction, we find a fall in trade coming from the UK into Ireland of 40%.

4.2 Stockpiling and learning: variation of impact over time

Estimating the immediate impact of Brexit on trade is potentially complicated by the possibility of pre-Brexit stockpiling in the months leading up to the UK's exit from the EU. Some portion of the decline in EU-UK trade since January could be explained by an unwinding of stocks built up in the months prior to the December 2020 Brexit deadline. To test this hypothesis, we

Figure 9: Brexit impact on country level PPML regressions

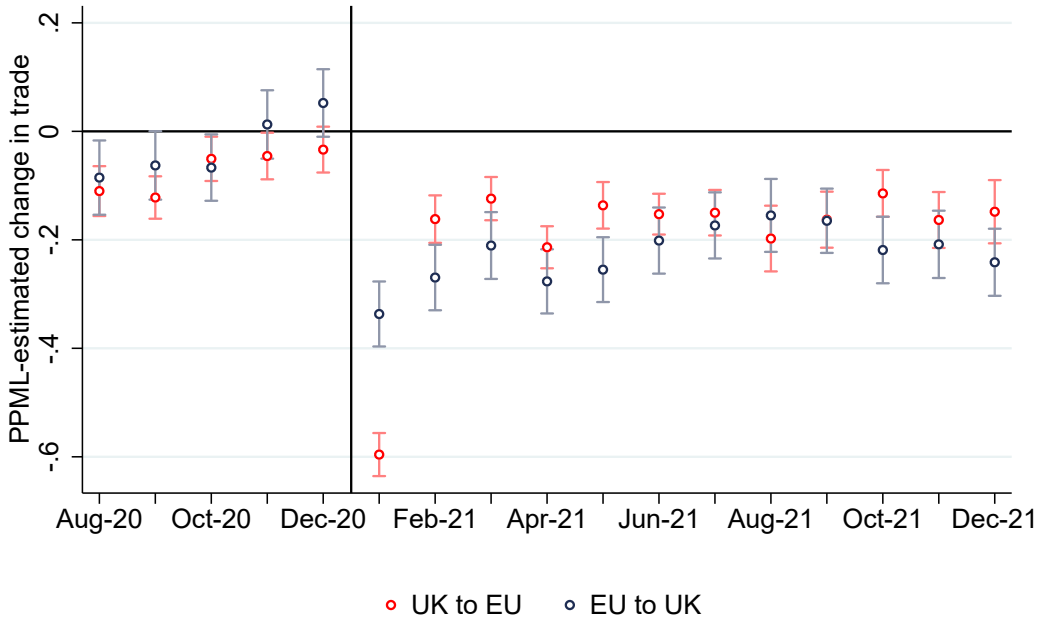


Based on regression results in Tables A.2 and A.3 using 'hybrid' dataset. Gray circles show estimates using Comext data for member-UK trade flows. Bars represent 99% confidence intervals. *Source:* HRMC trade data for EU-UK flows, Eurostat Comext database for EU-RoW flows.

allow for monthly changes in trade between the EU and UK in the five months prior to Brexit (i.e., from August 2020) and in each individual month in 2021. The individual monthly effects are displayed graphically in Figure 10 with the detailed results in the Appendix Table A.1.

This shows an increasing trend in trade between the EU and UK in the months prior to Brexit, particularly in November and December 2020, although not all estimates are statisically signficant. On the other hand, we can see that Brexit led to significant declines in trade across all months of 2021. The time path of the Brexit impact shows that the reductions in both directions of trade were particularly sharp in January followed by some recovery in February and March. The subsequent effects, from April to December, have been relatively stable although this is a short amount of time to establish if trade has settled down to new post-Brexit levels at this stage. The overall pattern of greater changes in the UK to EU trade direction relative to trade from the EU to UK is evident across all months of 2021. The largest individual impact, for trade from the UK to EU in January 2021 is in line with the more immediate introduction of customs procedures on the EU side and hence perhaps greater learning and adaption requirements for UK businesses selling into the EU compared to those on trade flows in the opposite direction.

Figure 10: Monthly profile of Brexit impact, August 2020 to December 2021



Based on regression results in Table A.1 using 'hybrid' dataset. Bars represent 99% confidence intervals.

5 Intensive and extensive margin effects

In this section, we extend the analysis from our examination of total trade to decompose the effects into extensive and intensive margins of trade. First we decompose trade from and to the EU (i) with each partner country j in each month m into its extensive and intensive margins. In product-level datasets, the extensive margin is typically defined as number of products being traded (N), while the intensive margin represents the average value per product ($\overline{T}$). In order to control for compositional differences in regressions, we count the number of 8-digit CN products within each 3-digit SITC group. Thus, the extensive margin is number of CN8 products within the SITC3 group being traded with each partner country in each month. Consequently, the intensive margin is average value of trade of product combinations within the same group.

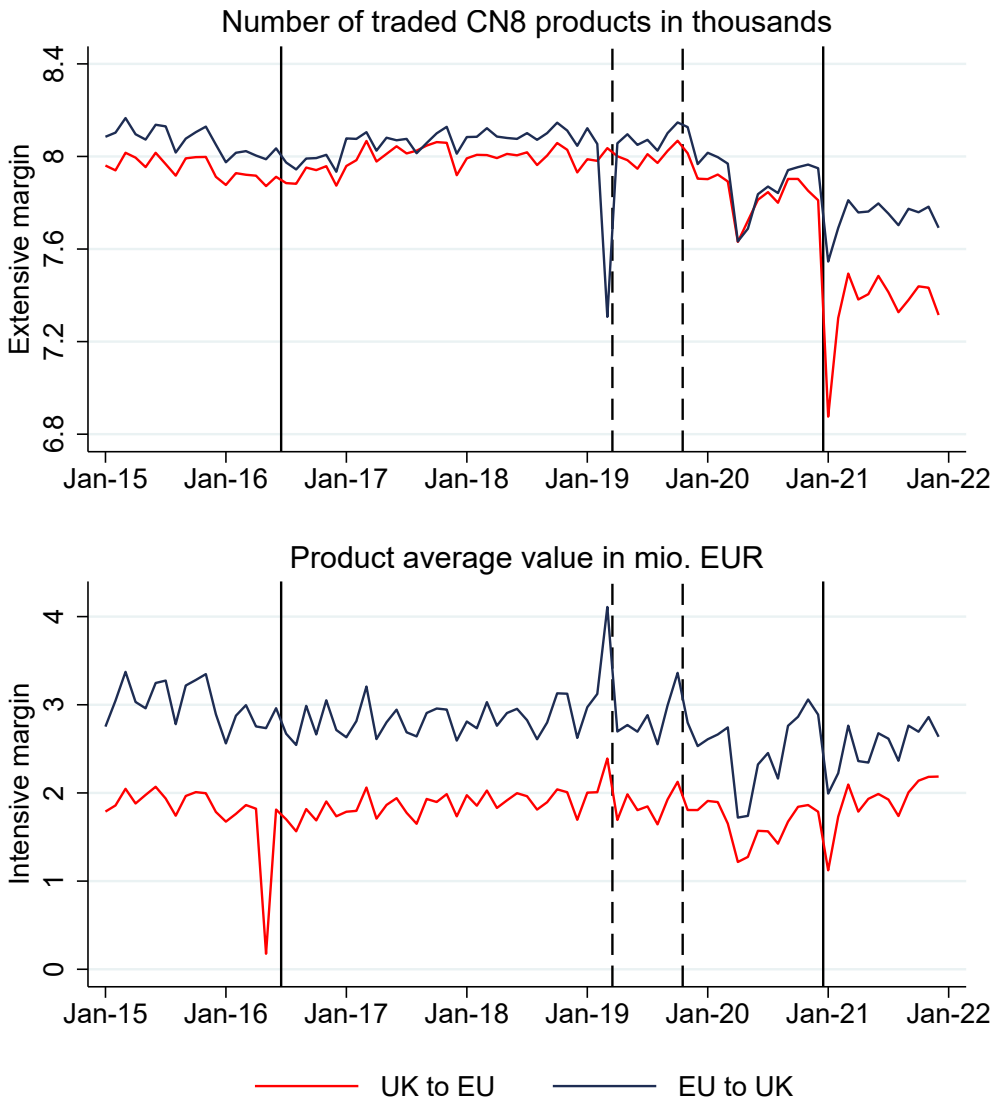
$$T_{i,j,\text{SITC3},m} = \sum_{p \in \text{SITC3}} T_{i,j,p,m} = N_{i,j,\text{SITC3},m} \cdot \overline{T}_{i,j,\text{SITC3},m} \tag{2}$$

Summarising this data, Figure 11 shows the total number of products (across all product groups) for EU27 trade with UK in the top panel and their average value in the lower panel. A substantial reduction in the number of products traded from the UK to the EU is evident in January 2021, followed by a slight recovery later in the year but remaining well below pre-Brexit counts. The product count going from the EU to the UK also dipped in January 2021 but then returned quickly to previous levels. On the intensive margin side, we see no notable changes in average product values in either direction.

Table 5 presents the regression results for this margins decomposition on 3-digit SITC trade. Each of the regressions include two sets of fixed effects where 3-digit SITC is interacted with partner country and month, respectively. Unlike the other specifications in this paper, this table uses standard linear regressions with the logs of N and $\overline{T}$ as dependent variables. Unlike PPML, this approach has a useful property whereby the estimated coefficients of total trade (shown in column 1) precisely decomposes into the contributions of the extensive (column 2) and intensive margins (column 3).

These results show that since Brexit, UK to EU trade has seen a decline almost entirely concentrated on the extensive margin. However, for EU to UK trade, most of the change is on the intensive margin. Over three quarters the overall decline in trade can be attributed to the intensive margin, while the remaining 22% is due to changes on extensive margin. This is broadly consistent with the increased customs requirements on the UK to EU side having a greater impact on low value trade trade flows causing them to cease trading completely.

Figure 11: Margins of EU-UK trade



Source: HMRC trade data.

Table 5: Decomposition of intensive and extensive margin effects (SITC3-level)

	(1) Total trade	(2) Extensive margin	(3) Intensive margin
		UK to EU	
Referendum*UK	0.007	-0.093***	0.100
	(0.132)	(0.011)	(0.127)
Brexit*UK	-0.153***	-0.127***	-0.026
	(0.051)	(0.007)	(0.051)
Constant	11.909***	1.742***	10.167***
	(0.002)	(0.001)	(0.002)
Observations	2,012,861	2,012,861	2,012,861
R-squared	0.891	0.945	0.843
		EU to UK	
Referendum*UK	-0.115***	-0.034***	-0.081***
	(0.020)	(0.008)	(0.017)
Brexit*UK	-0.223***	-0.050***	-0.174***
	(0.020)	(0.008)	(0.019)
Constant	12.270***	2.001***	10.268***
	(0.001)	(0.001)	(0.001)
Observations	3,319,905	3,319,905	3,319,905
R-squared	0.883	0.935	0.829

Standard errors clustered by partner-period in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Partner-SITC3 and SITC3-month level fixed effects included. Estimated using standard log-linear regression.

6 Conclusions

Following much anticipation and negotiation, the UK exited the EU Single Market and Customs Union on January 1, 2021. This paper examines how trade flows in goods between the UK and EU changed throughout the first year post-Brexit. While it may not be possible to say that these will be the levels at which trade between the two stabilises, the extent of the initial impact and its variation across member states and trade margins is of considerable interest. To examine the immediate effects of Brexit, we use detailed data on monthly goods trade to and from the EU and apply a comprehensive set of product-time and partner-product fixed effects to isolate the Brexit effect from other drivers of changes in trade patterns, most specifically the changes in trade flows across 2020 as a result of the COVID-19 pandemic.

Initial estimates using EU data and the EU's trade with the rest of the world as a control group show a big decline in UK to EU trade, and a smaller impact on EU to UK trade. These results differ substantially from those of Freeman et al. (2022) who found a positive impact of Brexit on UK to EU trade and a strongly negative effect on EU to UK trade. We replicate their finding using UK data and UK trade with rest of the world as a comparison group, showing that the conflicting results cannot be attributed to the (minor) differences in specification.

We investigate deeper the potential reasons for this difference. Some of the gap can be explained by the use of different data sources and changes in data collection methods, particularly on the EU side. A further important element in answering the question of how much Brexit affected EU-UK trade is "compared to what?" Our initial results estimated the impact of Brexit by comparing EU-UK trade flows with the EU's trade in the same products at the same time with other partner countries. Freeman et al. (2022) use the UK's trade with the rest of the world as the comparison group. Following the COVID-19 pandemic, there was strong growth in EU imports and export trade with the rest of the world. In contrast, UK export trade globally has experienced much slower growth in the aftermath of the pandemic while UK imports from the rest of the world increased considerably.

To get the best possible estimate of the impact of Brexit, we create a hybrid dataset that we argue takes the strongest elements of both approaches. We take the EU's trade data for its trade with the rest of the world as the most appropriate comparison group and combine this with UK-reported statistics on bilateral trade EU-UK trade, which had less substantial changes in data collection. From this hybrid dataset we estimate that Brexit decreased trade from the UK to the EU by 16% and trade from the EU to the UK by 20%.

Across EU member states, we find that Brexit has led to a significant decline in trade with the UK in almost all cases although by varying magnitudes. Looking at the different margins of trade, we find a substantial reduction in the number of products traded from the UK to the EU. However, for EU to UK trade, three quarters of the estimated fall in trade can be attributed to the intensive margin. This is consistent with a pattern of smaller trade flows more impacted by changes in trade costs in the UK to EU direction and hence ceasing to trade.

While measurement differences do play a role, the difference in counterfactual is also a crucial element in assessing the impact of Brexit. This leaves open for future research the question of whether the patterns of relatively slow UK export growth to the rest of the world and more rapid import growth can themselves be attributed a Brexit effect, perhaps via changing supply chains. Over time, firm-level data may help to shed light on this issue.

References

Born, B., Müller, G. J., Schularick, M., & Sedláček, P. (2019). The costs of economic nationalism: evidence from the brexit experiment. *The Economic Journal*, 129(623), 2722–2744.

Breinlich, H., Leromain, E., Novy, D., & Sampson, T. (2020). Voting with their money: Brexit and outward investment by UK firms. *European Economic Review*, 124(C).

Chen, W., Los, B., McCann, P., Ortega-Argilés, R., Thissen, M., & van Oort, F. (2018). The continental divide? Economic exposure to Brexit in regions and countries on both sides of The Channel. *Papers in Regional Science*, 97(1), 25–54.

Correia, S., Guimarães, P., & Zylkin, T. (2020). Fast Poisson estimation with high-dimensional fixed effects. *Stata Journal*, 20(1), 95–115.

Crowley, M., Exton, O., & Han, L. (2020). *Renegotiation of trade agreements and firm exporting decisions: Evidence from the impact of Brexit on UK exports*. Working Paper Series 2018/10, Cambridge-INET.

Davies, R. B. & Studnicka, Z. (2018). The heterogeneous impact of Brexit: Early indications from the FTSE. *European Economic Review*, 110, 1–17.

Dhingra, S., Fry, E., Hale, S., & Jia, N. (2022). The big Brexit: An assessment of the scale of change to come from Brexit.

Dhingra, S., Huang, H., Ottaviano, G., Pessoa, J. P., Sampson, T., & Reenen, J. V. (2017). The costs and benefits of leaving the EU: trade effects. *Economic Policy*, 32(92), 651–705.

Douch, M. & Edwards, T. H. (2022). The bilateral trade effects of announcement shocks: Brexit as a natural field experiment. *Journal of Applied Econometrics*, 37(2), 305–329.

Du, J. & Shepotylo, O. (2022). UK trade in the time of COVID-19: A review. *The World Economy*, 45(5), 1409–1446.

Ebell, M. & Warren, J. (2016). The Long-Term Economic Impact of Leaving the EU. *National Institute Economic Review*, 236(1), 121–138.

Flynn, E., Kren, J., & Lawless, M. (2021). *Initial impact of Brexit on Ireland-UK trade flows*. Working Paper Series tbc, ESRI.

Freeman, R., Manova, K., Prayer, T., Sampson, T., et al. (2022). *Unravelling deep integration: UK trade in the wake of Brexit*. Working paper, London School of Economics.

Graziano, A. G., Handley, K., & Limão, N. (2020). Brexit uncertainty and trade disintegration. *The Economic Journal*, 131(635), 1150–1185.

Lawless, M. & Morgenroth, E. L. W. (2019). The product and sector level impact of a hard Brexit across the EU. *Contemporary Social Science*, 14(2), 189–207.

Silva, J. S. & Tenreyro, S. (2006). The log of gravity. *The Review of Economics and statistics*, 88(4), 641–658.

Springford, J. (2022). What can we know about the cost of Brexit so far? *Centre for European Reform*.

Appendix

Table A.1: Monthly estimations of Brexit impact

	(1) UK to EU	(2) EU to UK
Referendum*UK	−0.076	−0.169***
	(0.049)	(0.023)
Aug2020*UK	−0.110***	−0.085***
	(0.018)	(0.027)
Sep2020*UK	−0.122***	−0.063**
	(0.015)	(0.025)
Oct2020*UK	−0.051***	−0.067***
	(0.016)	(0.024)
Nov2020*UK	−0.045***	0.013
	(0.017)	(0.024)
Dec2020*UK	−0.034**	0.052**
	(0.016)	(0.024)
Jan2021*UK	−0.596***	−0.337***
	(0.015)	(0.023)
Feb2021*UK	−0.162***	−0.270***
	(0.017)	(0.023)
Mar2021*UK	−0.124***	−0.211***
	(0.015)	(0.024)
Apr2021*UK	−0.214***	−0.277***
	(0.015)	(0.023)
May2021*UK	−0.136***	−0.255***
	(0.017)	(0.023)
Jun2021*UK	−0.153***	−0.201***
	(0.015)	(0.024)
Jul2021*UK	−0.150***	−0.173***
	(0.016)	(0.024)
Aug2021*UK	−0.198***	−0.155***
	(0.024)	(0.026)
Sep2021*UK	−0.163***	−0.165***
	(0.020)	(0.023)
Oct2021*UK	−0.114***	−0.219***
	(0.017)	(0.024)
Nov2021*UK	−0.163***	−0.208***
	(0.020)	(0.024)
Dec2021*UK	−0.148***	−0.241***
	(0.023)	(0.024)
Constant	16.931***	16.207***
	(0.002)	(0.001)
Observations	63,492,216	107,603,567
Pseudo R-squared	0.973	0.962

Standard errors clustered by partner-period in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Partner-product and product-month level fixed effects included. Estimated using PPML.

Table A.2: Brexit impact on trade from UK to EU members

	(1) Referendum*UK		(2) Brexit*UK		Observations	Pseudo R^2
EU aggregate	−0.082	(0.051)	−0.174***	(0.024)	21,183,102	0.981
Austria	−0.096**	(0.048)	−0.285***	(0.043)	7,084,076	0.963
Belgium	−0.179***	(0.064)	0.037	(0.041)	7,974,997	0.961
Bulgaria	−0.073	(0.070)	−0.605***	(0.056)	4,247,927	0.919
Croatia	0.050	(0.097)	−0.676***	(0.071)	4,440,170	0.928
Cyprus	−0.225*	(0.122)	−0.637***	(0.094)	2,899,665	0.875
Czechia	−0.191***	(0.061)	−0.381***	(0.033)	6,583,003	0.961
Denmark	−0.041	(0.059)	−0.206***	(0.056)	7,043,711	0.941
Estonia	−0.041	(0.055)	−0.195***	(0.028)	3,897,759	0.927
Finland	−0.244***	(0.064)	−0.377***	(0.033)	5,085,283	0.952
France	0.035	(0.048)	−0.141***	(0.030)	10,850,404	0.968
Germany	−0.154***	(0.052)	−0.269***	(0.026)	9,941,608	0.970
Greece	−0.133**	(0.061)	−0.598***	(0.042)	4,625,130	0.943
Hungary	−0.235***	(0.074)	−0.239***	(0.080)	5,425,470	0.953
Ireland	−0.049	(0.041)	−0.504***	(0.072)	5,454,641	0.955
Italy	−0.109**	(0.048)	−0.203***	(0.034)	8,464,230	0.958
Latvia	−0.015	(0.062)	−0.129*	(0.074)	3,947,914	0.931
Lithuania	0.278***	(0.091)	−0.027	(0.059)	4,650,419	0.935
Luxembourg	0.279***	(0.093)	0.566***	(0.116)	3,192,815	0.958
Malta	0.934***	(0.252)	−0.896***	(0.289)	2,660,869	0.891
Netherlands	0.010	(0.054)	−0.031	(0.028)	12,377,741	0.963
Poland	−0.066	(0.045)	−0.418***	(0.031)	6,988,919	0.953
Portugal	−0.121**	(0.060)	−0.494***	(0.057)	5,124,381	0.940
Romania	−0.104	(0.067)	−0.429***	(0.042)	5,890,677	0.943
Slovakia	0.179**	(0.083)	−0.075	(0.069)	4,883,570	0.956
Slovenia	−0.135*	(0.075)	−0.456***	(0.053)	4,663,743	0.941
Spain	−0.123**	(0.062)	−0.382***	(0.043)	9,038,403	0.955
Sweden	−0.142**	(0.060)	−0.288***	(0.075)	7,603,522	0.956

Standard errors clustered by partner-period in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Partner-product and product-quarter level fixed effects included. Estimated using PPML. Constants omitted from the output.

Table A.3: Brexit impact on trade from EU members to UK

	(1) Referendum*UK		(2) Brexit*UK		Observations	Pseudo R^2
EU aggregate	−0.171***	(0.023)	−0.221***	(0.027)	35,897,992	0.975
Austria	−0.131***	(0.025)	0.005	(0.027)	11,536,381	0.953
Belgium	−0.123***	(0.028)	−0.307***	(0.040)	15,787,892	0.962
Bulgaria	−0.054	(0.043)	−0.265***	(0.053)	4,021,626	0.921
Croatia	0.164	(0.121)	−0.330***	(0.068)	3,608,074	0.920
Cyprus	−0.422***	(0.104)	0.290***	(0.094)	658,453	0.865
Czechia	−0.267***	(0.034)	−0.266***	(0.049)	9,281,076	0.964
Denmark	0.300***	(0.059)	−0.122	(0.102)	9,877,463	0.930
Estonia	−0.362***	(0.138)	0.039	(0.143)	2,933,885	0.919
Finland	−0.202***	(0.052)	−0.400***	(0.068)	6,046,690	0.933
France	−0.141***	(0.022)	−0.317***	(0.039)	18,984,903	0.948
Germany	−0.179***	(0.025)	−0.148***	(0.027)	20,486,222	0.967
Greece	−0.238***	(0.038)	−0.341***	(0.054)	4,943,397	0.927
Hungary	−0.352***	(0.049)	−0.276***	(0.045)	6,176,230	0.955
Ireland	−0.152***	(0.048)	0.140*	(0.075)	3,868,686	0.961
Italy	−0.123***	(0.021)	−0.127***	(0.029)	17,900,472	0.942
Latvia	−0.096	(0.089)	0.325***	(0.070)	3,389,754	0.930
Lithuania	−0.359***	(0.077)	−0.007	(0.054)	4,904,651	0.926
Luxembourg	−0.005	(0.129)	−0.327***	(0.072)	3,028,929	0.949
Malta	−0.641**	(0.295)	−0.616***	(0.206)	563,558	0.928
Netherlands	−0.131***	(0.028)	−0.349***	(0.029)	18,846,606	0.961
Poland	−0.112***	(0.020)	−0.233***	(0.026)	12,041,903	0.953
Portugal	−0.200***	(0.036)	−0.229***	(0.036)	8,295,845	0.947
Romania	−0.131***	(0.042)	−0.074	(0.081)	5,122,599	0.945
Slovakia	−0.281***	(0.046)	−0.231**	(0.091)	4,275,814	0.959
Slovenia	−0.228***	(0.036)	−0.102*	(0.052)	5,345,955	0.943
Spain	−0.222***	(0.031)	−0.206***	(0.032)	17,868,147	0.942
Sweden	−0.319***	(0.049)	−0.209***	(0.045)	9,875,340	0.950

Standard errors clustered by partner-period in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Partner-product and product-month level fixed effects included. Estimated using PPML. Constants omitted from the output.