Impact of Brexit: Firm Exit and Loss of Variety

Nobuhiro Hosoe

August 2016

GRIPS

NATIONAL GRADUATE INSTITUTE
FOR POLICY STUDIES

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August 23, 2016

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Abstract

The impact of Brexit is investigated using two computable general equilibrium (CGE) models, featuring conventional constant-returns-to-scale (CRS) technology and increasing-returns-to-scale (IRS) technology with firm heterogeneity, à la Melitz. The imposition of trade barriers would trigger a significant contraction of the bilateral trade between the United Kingdom (UK) and the rest of the European Union (EU). While a CRS CGE model predicts that the trade barriers would benefit or only marginally harm the UK's welfare, the IRS model predicts a larger loss through firm exit and loss of varieties, comparable to the expected saving of the UK's contribution to the EU budget. Among the UK industries, the textiles and apparel, steel and metal, and automotive and transportation equipment sectors would suffer most severely from their sharp fall in exports.

Keywords

Brexit; Computable General Equilibrium Analysis; Firm Heterogeneity

JEL Classification: F13, F17, C63

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* 7-22-1 Roppongi, Minato, Tokyo 106-8677, Japan. E-mail: nhosoe@grips.ac.jp.

1. Introduction

The Internal Market of the European Union (EU) has grown continuously by accepting new member countries, with Croatia being the 28th country to join in 2013. On June 23, 2016, the referendum for the withdrawal of the United Kingdom (UK) from the EU—Brexit—shook the EU, which has managed to maintain regional cohesion even following the European sovereign debt crisis. Just before the referendum, many economic studies assessed the impacts of Brexit quantitatively. They employed structural general equilibrium models, especially computable general equilibrium (CGE) models and new quantitative trade models (NQTMs) based on a gravity model to predict the consequences of Brexit. These studies tried to analyze the Brexit impact, based mainly on a theoretical framework because empirical data are not available to measure the impact before the event.

Brexit has created many uncertainties regarding the future of Europe—including the short-run and long-run impacts of tariff and nontariff barriers between the UK and the rest of the EU (EU27), the common agricultural policy (CAP), regulatory policy and standards, and foreign direct investment (FDI)—however, the UK's contributions to the EU budget can be estimated based on recent data. As a result of these uncertainties, even when similar frameworks are used, the estimates of the macroeconomic effects vary widely among studies. The majority of studies estimate a moderate decline, "in the low single digit percentage range," in terms of GDP, as surveyed by Busch and Matthes (2016). For example, using a GTAP-based world trade dynamic CGE model, Booth et al. (2015) estimated a worst-case reduction in GDP of 2.2% in 2030 for the UK, from losses associated with tariff imposition (−0.9%), border costs (−1.2%), and nontariff barriers (NTBs) on goods (−0.5%), but a saving from its EU budget contribution (+0.5%). Boulanger and Philippidis (2015) used their world trade CGE model calibrated to the GTAP Database and estimated an income effect for 2020. They found that a 2% trade cost rise would almost cancel out the benefit of the EU budget saving

and that a 5% rise would lead to a 0.7% loss in terms of UK GDP.[1] PwC (2016), using a single-country dynamic CGE model, estimated a total loss of GDP of 1.2–5.5%, through anticipated trade-related barriers (0.5–2.1% GDP loss), short-run uncertainty in capital markets (0.9–2.6% GDP loss), and migration (0.8–1.6% GDP loss). Ottaviano et al. (2014), using a NQTM, estimated a total loss of GDP of 1.1–3.1%, which they attributed to most favored nation (MFN) tariff imposition (0.14%), short-run NTBs (0.4–0.9%), and long-run NTBs (1.3–2.6%).

These analyses suffer from two drawbacks.[2] One is that they focused only on a few aggregate outcome measures, such as the change in GDP or net household income—i.e., Hicksian equivalent variations (EVs)—and thus did not analyze sectoral output and trade changes, though their multisectoral models were capable of such analyses. This was probably for convenience and simplicity of presentation for the voters. The other drawback is that they did not consider heterogeneity of firms and increasing returns to scale with love of variety, which have been recognized as a key driver of the strong growth in trade in the globalized world economy (Melitz (2003)).[3] Brexit will cause the restoration of some forms of trade barriers and reduce the level of trade between the UK and the EU27. This negative impact would be intensified if firms exit from export markets. Such firm exit would reduce firm productivity and harm consumers directly through the loss of the varieties supplied by the trade partners who have enjoyed free access to the Internal Market.

In this study, we develop two world trade CGE models. One is a standard constant-returns-to-scale (CRS) model. The other is an increasing-returns-to-scale (IRS) model, featuring the Melitz (2003) structure. We conduct the Brexit experiments with these two

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[1] They assumed no tariffs between the UK and the EU27 after Brexit.

[2] Another drawback is that the GTAP Database that these CGE studies used was version 8 with a reference year of 2007, which is one version older than the current version 9.

[3] PwC (2016) incorporated imperfect competition with product differentiation, à la Dixit and Stiglitz (1977), in a single-country dynamic CGE model.

models, particularly focusing on the effect of firm exit and loss of variety induced by restoration of trade barriers. In the experiments, we examine (1) the imposition of import tariffs between the UK and the EU27, (2) an increase in transportation costs, and (3) an increase in the fixed costs of exporting. Our numerical simulations using a standard CGE model without firm heterogeneity show that the restoration of tariff barriers alone would be beneficial for the UK. An increase in transportation costs would only slightly reduce UK welfare. In contrast, our Melitz CGE model predicts that Brexit would be harmful for the UK through firm exit and the resulting substantial loss of variety for consumers. UK industries, especially textiles and apparel, steel and metal, and automotive and transport equipment, would experience a sharp reduction in both exports and production.

Section 2 describes our CGE models with/without IRS technology and firm heterogeneity. Section 3 presents our Brexit simulation scenarios. The simulation results are presented in Section 4. Section 5 provides concluding comments, followed by some qualifications of the analysis, which suggest future research using a CGE model. The appendix presents the sensitivity analysis of the simulation results in Section 4.

2.   World Trade CGE Model with Melitz Structure

Our world trade CGE model is a static model with three regions (the UK, the EU27, and the rest of the world (ROW)), 10 sectors, and three primary factors (skilled and unskilled labor, and capital). The primary factors are flexibly reallocated among sectors to achieve price equalization within each region. We develop two CGE models:

(1)   Armington CGE model with CRS technology
(2)   Melitz CGE model with IRS technology

In the Melitz CGE model, we assume that six manufacturing sectors are equipped with the features of the Melitz (2003) model (Table 2.1). Based on the standard CGE model with CRS technology by Hosoe et al. (2010), we incorporate firm heterogeneity, product

differentiation, and monopolistic competition, following Dixon et al. (2016), and refer to this as the Melitz structure subsequently. Figure 2.1 describes the core part of the model structure. The domestic output in the i-th sector in the r-th region $Z_{i,r}$ is made using primary factors and intermediates with a fixed setup cost $H_{i,r}^{MLZ}$. Out of $Z_{i,r}$, $ZZ_{k,i,r,s}$ is used to produce the k-th variety shipped to the s-th region (including that shipped to the domestic region r) $QT_{k,i,r,s}$ with a fixed variety production cost $F_{i,r,s}^{MLZ}$. The variety $QT_{k,i,r,s}$ is aggregated into a variety composite good $QT_{i,r,s}$ in a constant elasticity of substitution (CES) function with the elasticity of substitution σ_i^{MLZ}, à la Dixit and Stiglitz (1977).

Table 2.1: List of Sectors, Elasticity of Substitution σ_i^{ARM}

Sectors (abbreviation)	Elasticity of substitution σ_i^{ARM} [b]	UK/EU27 tariff rates applied to non-EU members (%)[b]
Agriculture (AGR)	2.39	2.2/2.6
Mining (MIN)	5.31	0.0/0.0
Textiles and Apparel (TXA)[a]	3.78	6.3/7.2
Food and Beverages (FOD)[a]	2.49	10.0/11.9
Chemical (CHM)[a]	2.80	1.2/1.4
Steel and Metal (STL)[a]	3.54	0.9/1.0
Automotive and Transport Equipment (AUT)[a]	3.16	2.7/2.6
Other Manufacturing (MAN)[a]	3.89	1.0/1.1
Transportation (TRS)	1.90	–/–
Services (SRV)	1.94	–/–

Note:
a: Indicates sectors equipped with the Melitz structure in the Melitz CGE model.
b: Obtained from the GTAP Database version 9A.

Figure 2.1: Melitz CGE Model Structure
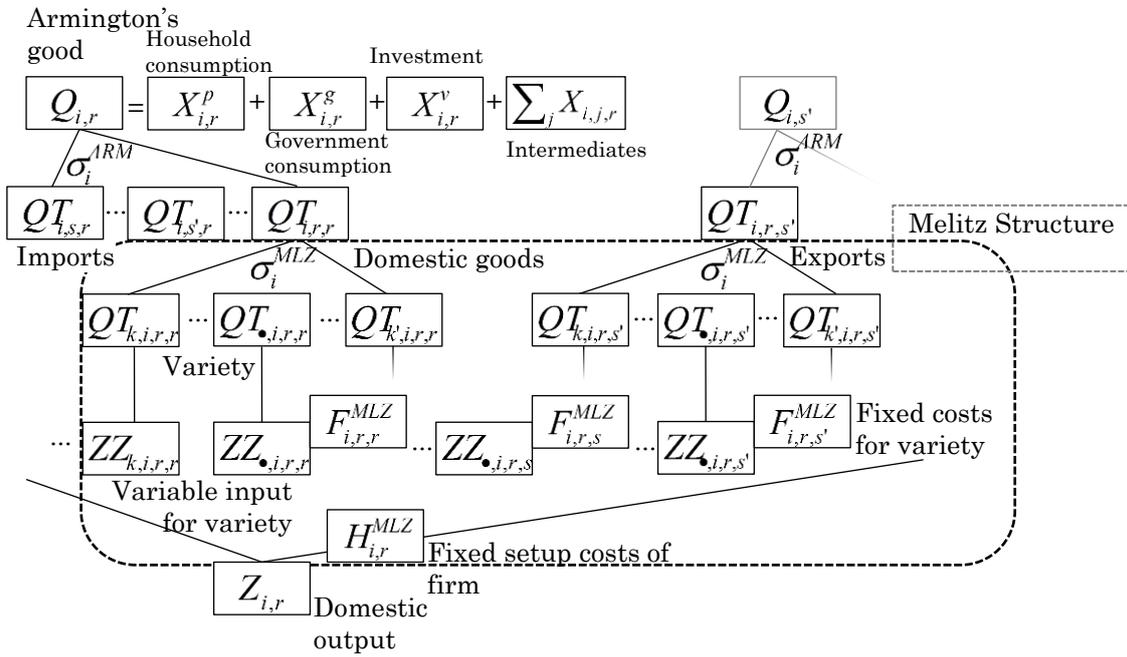
Note: This figure shows the commodity flows of the i-th sector in the r-th region, as illustrated for a single-country model by Hosoe et al. (2010). The production process of the domestic output $Z_{i,r}$ is omitted for simplicity. The trade partners are denoted by r, s, and s'; variety producers are denoted by k and k'. The dot $\bullet$ represents the "average productivity firm."

The fixed costs $H_{i,r}^{MLZ}$ and $F_{i,r,s}^{MLZ}$ are measured in terms of domestic output $Z_{i,r}$ units, following Itakura and Oyamada (2015). While Melitz (2003) originally measured these fixed costs in terms of labor units, various approaches have been used in CGE analysis. Zhai (2008) assumed a combination of capital, labor, and intermediates for the fixed inputs, while Balistreri and Rutherford (2013) used a composite factor (i.e., a mix of capital and labor). A firm's productivity is determined by a draw from a Pareto distribution, following Melitz (2003). In this setup, while all the operating firms ship their output to the domestic market, only very productive ones that can afford to pay the fixed cost of exporting are engaged in exporting.[4]

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[4] Details of the model are available upon request.

The Armington (1969) composite good $Q_{i,r}$ is made using the variety composite $QT_{i,s,r}$ suppled from the three regions according to a CES aggregation function with an elasticity of substitution of σ_i^{ARM}. When we use the same elasticity value for σ_i^{ARM} and σ_i^{MLZ}, the two-stage nested CES functions reduce to a single-stage one, as originally employed by Melitz (2003). Departing from Melitz's original model, we distinguish between these two elasticities so that we can separately examine the effect of heterogeneity of goods among sources (the Armington structure) and that of firm heterogeneity and product differentiation in the four IRS sectors (the Melitz structure).

The Armington composite good $Q_{i,r}$ is used by domestic agents: household $X_{i,r}^p$, government $X_{i,r}^g$, investment $X_{i,r}^v$, and intermediates $X_{i,j,r}$. We assume a Cobb–Douglas-type utility function for the household. The government consumption and the investment uses are exogenous, while a lump-sum direct tax and household savings are adjusted endogenously to cover these expenses. Regarding macro-closure, we assume that the current account deficits are exogenous in terms of the ROW's currency.

The Armington CGE model (as well as the CRS sectors in the Melitz CGE model) is not equipped with the abovementioned Melitz structure. In this case, the domestic output $Z_{i,r}$ is used directly in the production of $QT_{i,r,s}$ without any variety or fixed costs. Many models are equipped with a constant elasticity of transformation (CET) function to determine allocation between exports and domestic supply (i.e., imperfect transformation between them). However, we do not include a CET function (or, equivalently, assume perfect transformation between exports and domestic supply) in order to make the model structures of these two CRS and IRS models similar. This highlights the role of the Melitz structure in our simulation analysis.

The model is calibrated to the GTAP Database version 9A, whose reference year is 2011, with the elasticity of substitution σ_i^{ARM} taken from the same database (Hertel (1997)).

Regarding the parameters that characterize the Melitz structure, we use the estimate of 3.8 by Bernard et al. (2003) for σ_i^{MLZ} and the estimate of 4.6 by Balistreri et al. (2011) for the shape parameter of the Pareto distribution, which determines firms' productivities. We apply these parameters for the six IRS sectors in all the regions, following the common practice in CGE analysis (e.g., Dixon et al. (2016) and Balistreri and Rutherford (2013)).

3. Simulation Scenarios

While Brexit is anticipated to trigger various changes in economic and political systems, we focus on the essential factors that are likely to be realized in the near future and to affect the trade between the UK and the EU27. We consider the following three scenarios.

Scenario 1: Tariff Imposition

Both parties impose import tariffs as high as those that they apply to the non-EU members. In many Brexit studies, this is called the World Trade Organization (WTO) option, which follows the MFN principal. In reality, after negotiations for (successful) Brexit, the UK and the EU27 may reach a free trade agreement (FTA), similar to that with Switzerland or Norway. In this sense, this is a pessimistic scenario in terms of the size of the tariff barriers.

As indicated in Table 2.1, the MFN tariff rates are very low, as often observed in many developed countries, except for TXA and FOD. These two sectors are major sources of goods for household consumption. Therefore, the MFN tariff imposition between the UK and the EU27 is expected to affect household welfare substantially.

Scenario 2: Transportation Cost Rise + Tariff Imposition

Transportation costs between the two parties are assumed to increase by 10% or 20%, on top of the tariff imposition assumed in Scenario 1. The sizes of these increases in transportation costs are chosen arbitrarily, because it is difficult to estimate the additional

pecuniary and nonpecuniary transportation costs at the border between the UK and the EU27 without the free movements of goods, as guaranteed within the Internal Market. The status quo transportation costs are calibrated to the international transportation costs reported in the GTAP Database.

Scenario 3:   Export Fixed Cost Rise + Tariff Imposition

In addition to the tariff imposition assumed in Scenario 1, export fixed costs between the two parties are assumed to increase by 10% or 20%. This increase is also assumed arbitrarily because the actual cost increases are unknown. This shock is assumed only for the IRS sectors in the Melitz CGE model. This experiment is not conducted for the Armington CGE model, which is not equipped with the Melitz structure.

We simulate Brexit under these three scenarios in the absence/presence of firm heterogeneity. We did not consider the impact of the EU budget contribution in our simulation experiments but will compare it with the welfare impact predicted by the CGE models in our discussion. We do not consider many other factors that are related to the "other three freedoms" in the Internal Market. In this sense, our simulation scenarios are conservative in terms of the coverage of the anticipated shocks and thus indicate the minimum impact of Brexit.

4.   Simulation Results

4.1   Shrinking UK–EU27 Trade

When we employ the Armington CGE model—without any firm heterogeneity—the tariff imposition (Scenario 1) would reduce exports from the UK to the EU27 and that from the EU27 to the UK in almost all the sectors (Figure 4.1). Among them, TXA and FOD would experience the largest reduction in trade of 6–12% following the tariff imposition. The trade loss seems to be similar between the UK and the EU27. AUT in the UK, which serves as the

bridgehead to the Internal Market, is the only exception in that it would experience trade losses that are twice as large as those in the EU27. Even when we additionally include a transportation cost increase of 10% or 20% (Scenario 2), the trade losses are similar in terms of both pattern and magnitude.

Figure 4.1: Impact of Brexit on Bilateral Exports from the UK (top) and EU27 (bottom) (change from the base, %)

As the theory of firm heterogeneity suggests, our Melitz CGE model predicts significantly larger trade losses, especially in the six IRS sectors. The predicted losses are double in TXA, STL, AUT, and MAN, compared with the predicted losses in the Armington CGE model. The trade losses in the transportation cost rise case (Scenario 2) are only marginally different from those in the tariff-imposition-only case (Scenario 1) also in the Melitz model. The export fixed cost rise, in contrast, would cause large additional trade losses. This is particularly marked in CHM, STL, AUT, and MAN.

In the Melitz CGE model, these trade losses are closely linked to firm exit from the export markets (Figure 4.2). The tariff imposition (Scenario 1) would reduce the number of the UK exporters by 30–50% in TXA and 25–40% in FOD. The number of AUT exporters, or the number of model types produced in the UK, would be reduced by 14% following the imposition of small tariffs—less than 3%—and further by the export fixed cost increase. This could lead to a drastic contraction of this industry in the UK as an export platform of automotive and aviation products to the Internal Market as discussed by, e.g., Inagaki (2016).

Figure 4.2: Impact of Brexit on the Number of Exporting Firms in the UK (top) and EU27 (bottom)
(change from the base, %)

4.2 Costs and Benefits of Protectionism

Brexit could protect some particular sectors in the UK, such as AGR and FOD in the Armington CGE model case (Figure 4.3). This protection is possible only by sacrificing production in many other sectors, especially TXA, CHM, STL, and AUT. While the UK output loss would sometimes exceed 1%, the EU27 would experience only marginal losses or gains.

This is because of the difference in the sizes of these economies. The EU27 is 4.7 times larger than the UK in terms of GDP and 6.9 times larger in terms of population. Trade losses of the same size, therefore, would be translated into significantly different output losses because of the differences in the sizes of these two economies.

Figure 4.3: Impact of Brexit on Output in the UK (top) and EU27 (bottom) (change from the base, %)

The trade reduction under the Melitz structure would lead to a larger Brexit impact on output. This is particularly obvious in the losing sectors TXA, STL, and AUT and in the gaining sectors AGR and FOD. However, the impact is complex in some sectors. For example, in Scenarios 1 and 2, the results for MIN and MAN in the UK have opposite signs between the two models. The loss in CHM in Scenario 1 as predicted by the Melitz CGE model is smaller than that predicted by the Armington CGE model. The impact of the export fixed cost increase (Scenario 3) on output is not necessarily straightforward, either. The output loss in TXA would be alleviated by the export fixed cost rise in Scenario 3, compared with that predicted in Scenario 1. This is because, in a general equilibrium framework, an increase/decrease of output in one sector must be accompanied by output changes in the opposite direction under a resource constraint. The consequence of Brexit is complex, especially under the Melitz structure.
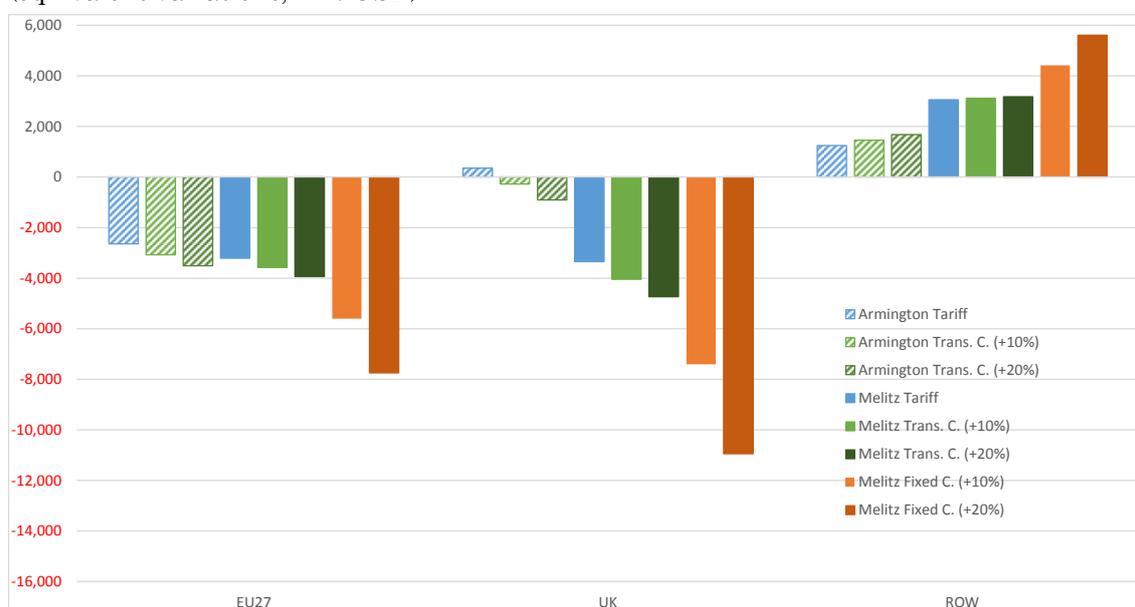
4.3   Macroeconomic Consequences

In the previous section, the impact of Brexit was analyzed for the industrial sectors. In this subsection, we examine the overall macroeconomic impact. In particular, does the EU budget contribution saving of around 0.5% of UK GDP justify Brexit? Figure 4.4 shows the welfare impact using EVs, which measure the total income effects on the household in the three regions. When we employ the Armington CGE model, Brexit with tariff imposition only (Scenario 1) would create a small welfare gain in the UK.[5] With a transportation cost increase (Scenario 2), the welfare impact would be negative but not large. These welfare impact estimates imply that the UK voters might well favor the Brexit option for the EU budget savings.

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[5] The UK's positive gain from MFN tariff imposition becomes smaller with larger Armington elasticities σ_i^{ARM}. When we assume a 40% larger value for σ_i^{ARM}, the welfare impact would be negative.

Figure 4.4: Impact of Brexit on Welfare
(equivalent variations, mil. USD)

Legend:
- Armington Tariff
- Armington Trans. C. (+10%)
- Armington Trans. C. (+20%)
- Melitz Tariff
- Melitz Trans. C. (+10%)
- Melitz Trans. C. (+20%)
- Melitz Fixed C. (+10%)
- Melitz Fixed C. (+20%)

In contrast to the finding of a small Brexit welfare gain or loss for the UK under the Armington CGE model, the Melitz CGE model suggests that the welfare impact is consistently negative and significantly larger. This indicates that the firm exit and the loss of variety, shown in Figure 4.2, are critical for the UK consumers, especially when we assume the export fixed cost increase. For example, a 10% increase in export fixed cost would double the UK's loss associated with the tariff imposition alone.

The welfare impact for the EU27 in Scenarios 1 and 2 would be small, even in the Melitz CGE model. This is because the EU27 can maintain the large size of the Internal Market without the UK and, thus, the number of varieties available to it. The economies of scale originating from product varieties, however, would be damaged significantly by the export fixed cost rise in Scenario 3. The welfare loss for the EU27 would be twice as large as that predicted in Scenario 1.

Both of the UK and the EU27 would suffer comparable losses in total, but their size is quite different in terms of GDP and population. Therefore, the losses would hit the UK

harder. Behind the "lose–lose" deal between the UK and the EU27, the ROW would always gain by exploiting the benefits of trade diversion from the Internal Market to the ROW.

We have not explicitly considered the saving of the EU budget contribution by the UK in our scenarios or models. Now, we compare the estimated loss for the UK with this EU budget saving of about 0.5% of UK GDP. The predicted UK welfare impact ranges from a loss of as much as 0.48% of the base run GDP (Scenario 3: the tariff imposition plus a 20% increase of export fixed costs in the Melitz CGE model) to a 0.02% gain (Scenario 1: only the tariff imposition in the Armington CGE model). Although we assume only trade-related barriers anticipated after Brexit, this indicates that the worst case in our simulations could yield a large welfare loss comparable to the budget saving that Brexit advocates expected at the referendum.

As mentioned in many CGE analyses, the simulation results depend on the assumed parameters, especially the elasticity of substitution. We conduct a sensitivity analysis and find that a larger σ_i^{ARM} and smaller σ_i^{MLZ} result in a larger welfare impact of Brexit. On the other hand, the EU27 would suffer slightly less under a smaller σ_i^{ARM}. Its welfare impact is unclear under an alternative σ_i^{MLZ} (detailed results of the sensitivity analysis are shown in the Appendix). Note that all CGE studies with the Melitz-type IRS feature, to the best of the author's knowledge, combine these two elasticities and collapse the two-stage CES nests of the Armington and the variety composites into a one-stage CES nest, following the original specification by Melitz (2003).[6] These models do not distinguish the different roles of these two elasticities but jointly examine their impact with one elasticity of substitution. Our sensitivity analysis shows that these two elasticities could alter the welfare impact

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[6] They followed Melitz's original model with a single-nest CES specification partly for simplicity of the model and partly for examination of the welfare impact equivalence with respect to "trade elasticities" with CGE models, which was proposed by Arkolakis et al. (2012).

estimates in different directions and that the effect of one elasticity could be either larger or smaller than that of the other elasticity in our empirical setting.

5.   Concluding Remarks

We conducted a Brexit impact analysis using a state-of-the-art CGE model with firm heterogeneity, which evokes productivity changes from firm exit and loss of variety. The scope of our Brexit scenarios is limited to trade-related barriers disconnecting the UK from the remaining EU 27 members. In this sense, our impact estimates should be considered as lower-bound estimates. Even so, depending on the magnitude of an export fixed cost increase, the cost of Brexit could be as large as the savings of the EU budget contribution by the UK, which were considered to be the most important economic benefit of Brexit. This large impact originating from productivity changes with heterogeneous firms was not predicted by the earlier Brexit CGE studies without the Melitz feature.

Adding the omitted Brexit factors, the net negative impacts could be substantially larger. Needless to say, such possible economic losses might be found to be acceptable and reasonable by the UK voters as the cost of their sovereignty, free from regulations and bureaucracy by the European Commission. Nevertheless, their decision must be firmly based on accurate and comprehensive estimates of the costs and benefits of their policy options, not only for the Brexit referendum but also for future post-Brexit negotiations. Our analysis provides detailed simulation results at the sectoral level, unlike the earlier studies, which focused on aggregate indicators, probably for convenience and simplicity of presentation to the voters. Such omissions limit the benefits of analysis using multisectoral models such as CGE models. We demonstrated that the gains and losses would vary among sectors. Our results enable richer policy discussions for reshaping the future European economy under some form of bilateral treaties, such as FTA or customs union, between the UK and the EU27.

Our study, however, as mentioned above, focused on the trade-related factors associated with Brexit expected in the near future, not considering any dynamic factors, such as domestic investment and FDI, which drive the European economy in a long run. An extension involving dynamic analysis with FDI, à la Hosoe (2014) for goods producers and Tarr (2013) for service providers, would enable us to describe the deceleration of trade fragmentation in Europe and the resulting long-run cost of Brexit. We could also examine the impact of Brexit on immigration using the most recent GTAP Database, which contains detailed labor data.

Acknowledgements

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Appendix   Sensitivity Analysis

We conduct a sensitivity analysis by changing the values of the elasticity of substitution for the Armington CES function σ_i^{ARM} and that for the variety aggregation CES function σ_i^{MLZ}. Figure A.1 shows that a larger σ_i^{ARM} intensifies the changes of exports, the number of exporting firms, and output. Table A.1 shows that a 5% larger value of σ_i^{ARM} reduces welfare (i.e., larger negative impact of Brexit) by 5–20% for the UK, compared with the base case. In contrast, a change in the elasticity parameter increases welfare marginally for the EU27.

A smaller elasticity σ_i^{MLZ} gives a larger impact on exports, the number of exporting firms, and output (Figure A.2–A.3). When we employ a 5% larger/smaller elasticity value for σ_i^{MLZ}, we find a 10–15% better/20–30% worse welfare outcome (i.e., smaller/larger negative impact of Brexit) for the UK (Table A.1). This is because the elasticity of substitution among the varieties σ_i^{MLZ} is negatively linked with the markup rate and thus the intensity of imperfect competition and economies of scale. That is, the larger monopoly profits produced by a smaller elasticity in the status quo would be lost following Brexit. Therefore, the negative impact of Brexit for the UK would be exacerbated further. For the EU27, however, the effect of the alternative value of σ_i^{MLZ} does not show either a significant or clear tendency among these cases, except for the cases in Scenario 3.

Figure A.1: Impact of Brexit on the UK (left) and EU27 (right) with a 5% Larger Elasticity for σ_i^{ARM}
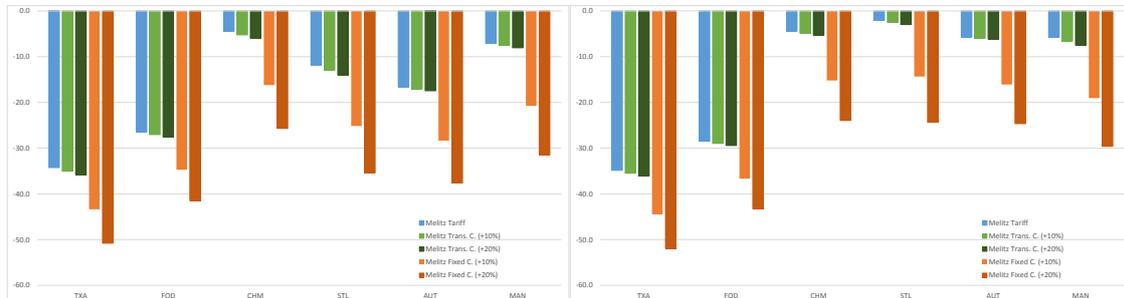
Output (change from the base, %)
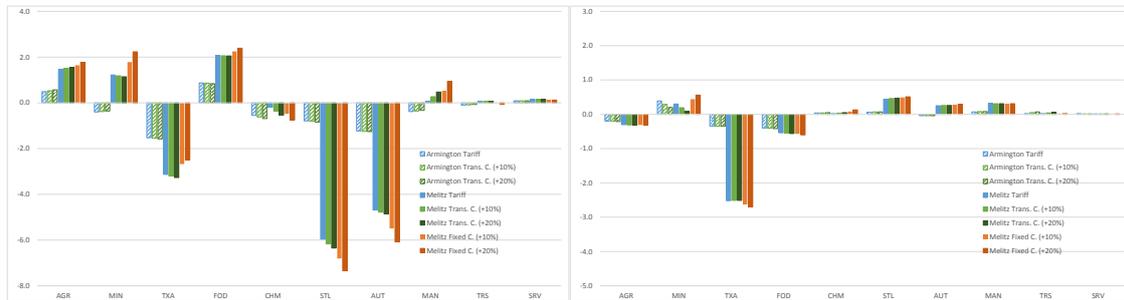
Bilateral Exports (change from the base, %)
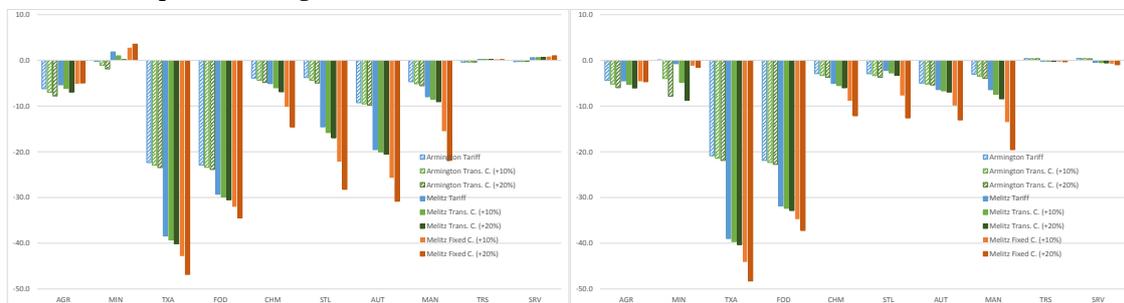
Number of Exporting Firms (change from the base, %)
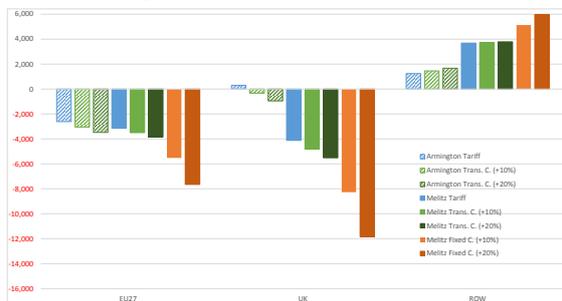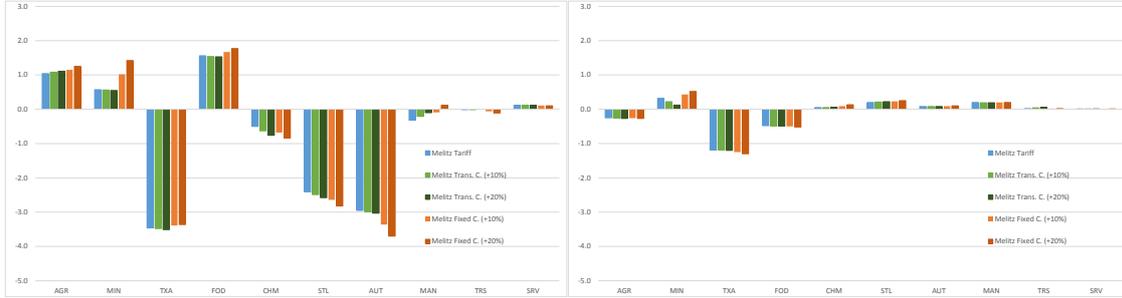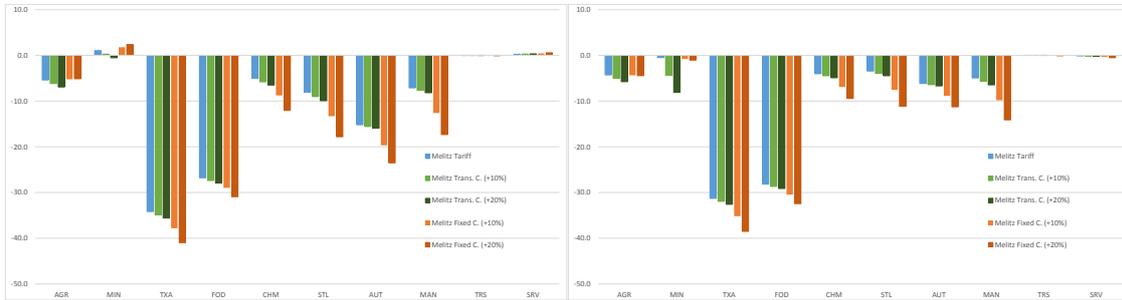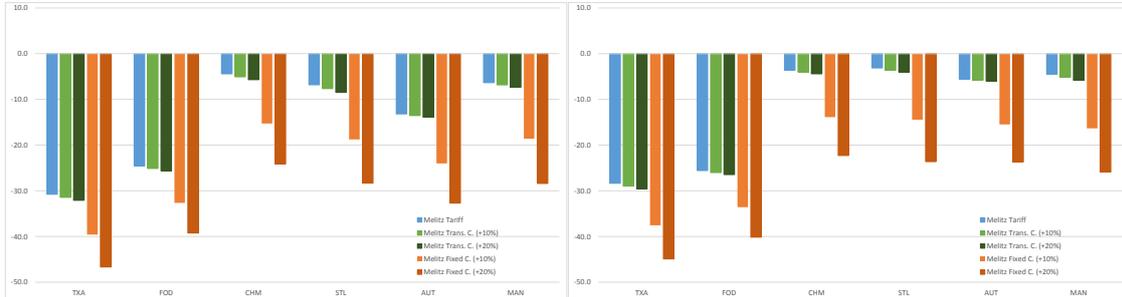

Welfare (equivalent variations, mil. USD)

Figure A.2: Impact of Brexit on the UK (left) and EU27 (right) with 5% Larger Elasticity for σ_i^{MLZ}

Output (change from the base, %)

Bilateral Exports (change from the base, %)

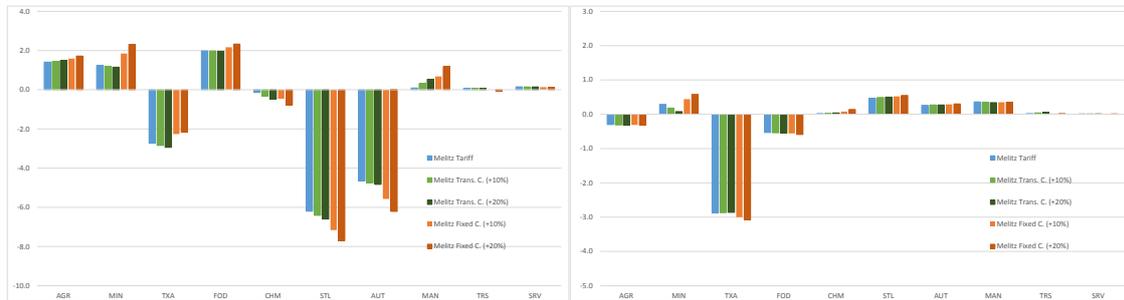Number of Exporting Firms (change from the base, %)
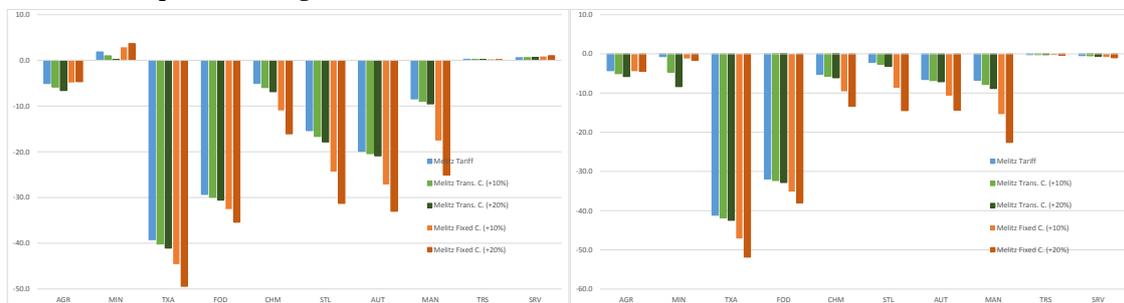

Welfare (equivalent variations, mil. USD)

Note: The simulation results with the Armington CGE model, which does not contain σ_i^{MLZ}, are the same as for the base case and thus are omitted.

Figure A.3: Impact of Brexit on the UK (left) and EU27 (right) with 5% Smaller Elasticity for σ_i^{MLZ}
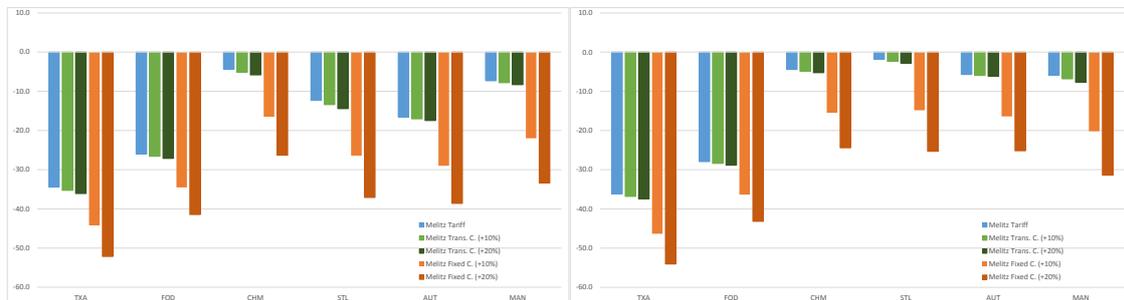
Output (change from the base, %)

Bilateral Exports (change from the base, %)

Number of Exporting Firms (change from the base, %)

Welfare (Equivalent variations, mil. USD)

Note: The simulation results with the Armington CGE model, which does not contain σ_i^{MLZ}, are the same as for the base case and thus are omitted.

Table A.1: Welfare Impact with Alternative Elasticity Values

(Equivalent variations, mil. USD)

	Armington Model			Melitz Model				
	Tariff	Trans. C. (+10%)	Trans. C. (+20%)	Tariff	Trans. C. (+10%)	Trans. C. (+20%)	Fixed C. (+10%)	Fixed C. (+20%)
UK								
Base	354	−279	−907	−3,350	−4,047	−4,735	−7,410	−10,948
σ^{ARM}+5%	299	−330	−955	−4,121	−4,824	−5,515	−8,270	−11,846
σ^{MLZ}+5%				−2,840	−3,539	−4,230	−6,269	−9,292
σ^{MLZ}−5%				−4,329	−5,024	−5,707	−9,129	−13,219
EU27								
Base	−2,638	−3,077	−3,512	−3,210	−3,575	−3,939	−5,602	−7,743
σ^{ARM}+5%	−2,613	−3,048	−3,479	−3,145	−3,495	−3,844	−5,521	−7,651
σ^{MLZ}+5%				−3,211	−3,583	−3,953	−5,235	−7,053
σ^{MLZ}−5%				−3,309	−3,663	−4,017	−6,098	−8,589
ROW								
Base	1,243	1,462	1,678	3,058	3,117	3,177	4,422	5,615
σ^{ARM}+5%	1,243	1,456	1,666	3,683	3,736	3,789	5,130	6,380
σ^{MLZ}+5%				2,717	2,789	2,861	3,836	4,827
σ^{MLZ}−5%				3,878	3,921	3,965	5,547	6,970