AgEcon SEARCH
RESEARCH IN AGRICULTURAL & APPLIED ECONOMICS

The World's Largest Open Access Agricultural & Applied Economics Digital Library

This document is discoverable and free to researchers across the globe due to the work of AgEcon Search.

Help ensure our sustainability.

Give to AgEcon Search

AgEcon Search
http://ageconsearch.umn.edu
aesearch@umn.edu

*Papers downloaded from **AgEcon Search** may be used for non-commercial purposes and personal study only. No other use, including posting to another Internet site, is permitted without permission from the copyright owner (not AgEcon Search), or as allowed under the provisions of Fair Use, U.S. Copyright Act, Title 17 U.S.C.*

No endorsement of AgEcon Search or its fundraising activities by the author(s) of the following work or their employer(s) is intended or implied.

Global Trade Analysis Project
https://www.gtap.agecon.purdue.edu/

This paper is from the
GTAP Annual Conference on Global Economic Analysis
https://www.gtap.agecon.purdue.edu/events/conferences/default.asp

A computable general equilibrium analysis of Brexit: Barriers to trade and immigration restrictions

Gabriela Ortiz Valverde and María C. Latorre

Abstract

This paper estimates the economic effects of different types of restrictions on trade and immigration in the UK after Brexit. Regarding trade restrictions, we focus on the increase of tariffs and NTBs with respect to the EU. We also analyze a scenario in which the UK removes all tariffs on its trade to all its trading partners. Concerning immigration, we run a 5-year cumulative annual reduction in net migrants by 87.000 workers following OECD estimations.

The study is conducted using a 21-sector, 5-region (UK, REU, US, China, ROW) Computable General Equilibrium (CGE) Model, which allows us to estimate the impact on GDP, Welfare, wages and capital remuneration, together with sectoral output and trade flows.

Our estimates suggest that Brexit would negatively affect the UK much more than the EU. Welfare reductions would be between -0.38% and -1.94% for the UK; while they would be between -0.03% and -0.17% in the EU. This is because the EU is a crucial trade partner for the UK, which cannot be easily substituted through trade with other regions in the world. Restrictions to migrants would bring about additional reductions in the range between -0.55% and -0.35% of GDP, depending on whether they affect skilled or unskilled workers, respectively.

Keywords: Non-tariffs barriers (NTBs), Ad valorem equivalents (AVEs), Computable general equilibrium (CGE), Most favored nation (MFN) tariff, Migration.

JEL codes: C68, F14, F15, F17

1. Introduction.

The United Kingdom's withdrawal from the European Union (EU) has raised concerns about its potential impact on the living standards in both regions. The exit of UK from the EU single market will necessarily lead to restrictions in trade and migration between UK and the EU. According to the majority of economic studies this will reduce trade, production and welfare (see Busch and Matthes, 2016; Latorre et al., 2018, Fernández-Pacheco et al., 2018 for reviews).

In this paper, we evaluate the impact of Brexit along two dimensions: barriers to trade and restrictions to migration. Most of the previous studies have focused on trade (e.g., Minford et al., 2016; Booth et al., 2015; Ottaviano et al., 2014; Aichele and Felbermayr, 2015; Dhingra et al. 2016; 2017). Other studies concentrate on the effects of migration and capital movement in the UK, however, they do not include trade (e.g., Oxford Economics, 2016; Dustman and Frattini, 2014 and Di Giovanni et al., 2015). By contrast, Ciuriak et al. (2015) and Latorre et al. (2017) include trade and foreign direct investment (FDI) but not immigration. Finally, Arriola et al. (2016), Jafari and Britz (2016), and PwC (2016) include trade and migration (among other elements) as we do.

In comparison to Arriola et al. (2016) and PwC (2016), our study provides results not only for macroeconomic aggregates but also the impact across 21 sectors in the UK economy. Moreover, unlike Arriola et al. (2016), we analyze the impact of Brexit in trade and migration in turn. This allows us to identify their contribution in isolation. Unlike PwC (2016) which assumes that the entry of skilled workers would increase due to a small liberalization in visa requirements in the UK, we estimate the foregone benefit of restrictions on both skilled and unskilled workers separately. Our approach takes into account the conditions agreed between the UK and EU in the recent joint agreement of December 8, 2017. This agreement did not specify any preferential condition for skilled workers.

We also run a scenario in which the UK eliminates all tariffs with respect to all its trading partners. This setting has received less attention in the literature. Only Dhingra et al. (2016) and Minford (2016) estimate it. Interestingly, while Dhingra et al. (2016) obtain that its impact is nearly negligible, Minford et al. (2016) argue that UK would experience a 4% rise in welfare. In other words, according to Minford et al. (2016) the rise of trade with other

regions would by far compensate the losses of trade with the EU under WTO conditions. Their estimates have been criticized because they assume that UK's prices of manufactures and agricultural goods would fall by 10% after Brexit and that trade flows would respond disproportionately heavily to trade costs (for more details, see Sampson et al., 2016 and Latorre et al., 2017). Compared to the rather stylized analysis of Dhingra et al. (2016) we offer a detailed assessment of its impact for a rich set of micro and macroeconomic variables.

We analyze the impact of trade and migration restrictions using a multi-sector, multi-region transparent and replicable Computable General Equilibrium (CGE) model. CGE models have the ability to capture the interactions between sectors, households, firms and the government (PwC, 2016). They use production functions which describe the requirements on intermediates and factors to produce a unit of output in each sector and the inter-sectoral input-output linkages, which reflect the different sources of intermediates in goods and services. They also include a utility function, which describes the preferences of all consumers in the economy, as well as, taxes and government transfers to other agents of the economy. In addition they have equations describing national accounts identities, which have to be fulfilled together with the microeconomic optimization behavior of firms and households. In other words, this type of models integrates micro and macroeconomic dimensions to offer a complete description of the economy and, therefore, a coherent framework to assess the economic impact of different policies.

The rest of the paper is organized as follows. The next section explains the model and the simulations. Section 3 describes the data used for our approach. In the results section, we depict the macro and microeconomic quantitative effects of Brexit. That leads to the final section, in which we present some concluding remarks. An Appendix closes the paper with a sensitivity analysis.

2. The Model and simulations.

There are several ways through which the UK's exit from the European Union could result in economic impacts. In this paper we focus on two dimensions; trade and migration. In both, restrictive policies could imply negative effects in production and labor markets and hence

in the economy as a whole. Migrants and companies play an important role in the supply and the demand of the economy. Migrants are workers and consumers, they are distributed across different sectors and consume domestic and imported goods, while, companies demand intermediates and factors of production (labor, land, and capital), and supply goods and services. Due to the interactions between migrants and companies and the simultaneous effects of trade and migration policies in the economy as a whole, we use a general equilibrium analysis to capture their potential impact.

The study is conducted by means of a well-known Computable General Equilibrium (CGE model, namely, the one of the Global Trade Analysis Project (GTAP). A detailed explanation of the model is available in the book of Hertel (1997) and has been updated in McDougall (2000). A more succinct explanation, including model equations can be found in Zhou and Latorre (2014a; 2014b). The standard GTAP model is a multi-region and multisector model, with a climate of perfect competition such as the one of Ottaviano et al. (2014) and Dhingra et al. (2017). We disaggregate the data in 21 sectors, 5 regions (UK, EU, US, China, and ROW), and 4 factors (skilled and unskilled labor, land, and capital). We assume that factor endowments are fixed. Moreover, in the function of production capital and land are introduced as sector specific, while labor is considered fully mobile across sectors within the economy. This implies that capital and land can only be used in a particular sector and cannot move across sectors. Therefore, changes in production can only be obtained by changes in labor demand[1].

In a sense, we derive even larger impacts than Dhingra et al (2017) do. Comparing our welfare results with theirs, for a hard Brexit our reductions are of -1.94% while they obtain a -2.66%. However, in the further welfare decomposition shown in table 4 (p.671)[2] we see that the most important contribution to their overall total welfare impact (-2.60%) is the absence of future EU integration (-1.61%), which even supposes the joint contribution of NTBs and Tariffs (-1.31% and -0.13%, respectively)[3]. Our welfare reduction after a soft

[1] These assumptions are appropriate for short-run estimations.
[2] To the best of our knowledge this table was not in the working paper version of the paper.
[3] The authors explain that their decomposition do not add up to the total -2.66% because they are performing "three different counterfactual exercise (per scenario) instead of one".

Brexit for the UK (-0.91%) is also larger than the impact of the increase in NTBs they obtain (-0.53%).

Our results are also in line with the ones from the literature one we decompose totals from other papers into the elements that are comparable with the ones of our model. For example, Jafari and Britz (2017) obtain in a Melitz framework an impact on GDP from NTBs and tariffs of -1.08% and -0.29%, respectively. This would be only slightly larger than our joint -1.14% impact on GDP (composed of a -0.15% reduction due to tariffs and the rest being explained by NTBs -0.99%).

Arkolakis et al. (2012) argue that within Armington, Krugman and Melitz models, the size of welfare gains is the same (even when the number of sources of gains from trade varies across models). In addition, Arkolakis et al. (2012) argue that welfare predictions in these trade models depend on only two sufficient statistics, the share of expenditure on domestic goods and the trade elasticity[4].

However, this welfare equivalence is sensitive to model assumptions and the type of trade policy instrument that is used in quantifying the economic effect of a shock.[5]

According to Balistreri and Tarr (2016)[6], the inclusion of intermediate input trade alters the welfare conclusions (even in one-sector and one-factor model). Moreover, they find that adding multiple sectors magnify the differences in the welfare predictions across models. Arkolakis et al. (2012) also acknowledge that the equivalence may not hold once the model has multiple factors of production.

Regarding trade, we simulate four scenarios, namely, zero tariffs, very soft, soft, and hard Brexit. With zero tariffs, we assume that the UK and the EU continue to enjoy a free trade agreement, this means that Brexit does not lead to any change in tariffs barriers between both regions. In addition, we assume that the UK unilaterally removes all its tariffs on imports from the rest of its trade partners. In the very soft and soft Brexit, we consider that the UK

[4] The share of expenditure on domestic goods is equal to one minus the import penetration ratio, while trade elasticity is the elasticity of imports with respect to variable trade costs.

[5] See Akgul (2017), for an extensive analysis of the effects (on welfare equivalence across models) of relaxing the model assumptions.

[6] Balistreri and Tarr (2016) show how relaxing the assumptions across Armington, Krugman and Melitz models result in different welfare predictions.

and the EU remain tariffs at zero and apply an increase of NTBs between both regions by 10% and 25%, respectively. Finally, "Hard Brexit" has two sub-scenarios. First, we increase import tariffs between the UK and the EU to the MFN level, and second, we assume a 50% rise in their bilateral NTBs. These scenarios are based on the approach of Ottaviano et al. (2014) and Dhingra et al. (2016, 2017).[7] Modelling a disintegration process such as Brexit is a rather uncommon exercise given that in the last decades we have been analyzing the effects of globalization[8] (e.g., Ortiz and Latorre, 2017; Latorre and Yonezawa, 2018). However, the logic is analogous just the opposite, in one case barriers to trade go down and in the other they increase.

While economist have a lot of experience in analyzing tariffs, modelling NTBs is more complicated.[9] Both, MFN tariffs and NTBs increase the costs of foreign trade. However, the latter, do not provide revenues to governments, and the wedge between the world and domestic price may reflect economic rents for importers and exporters and also trade inefficiencies. Because NTBs will reduce competition from foreign firms, this will allow other firms to increase their prices and rents. In addition, if the NTBs create red tape or other unjustified bureaucratic processes, they cause a waste of resources. To simulate the rents and inefficiencies attributed to NTBs, we rely on the estimations of Ecorys (2009)[10] which quantified the ad valorem tariff equivalents[11] (AVEs of NTBs). They found that 60% of the

[7] They consider that the UK will face a share of the NTBs that EU applies to the US and run a soft and hard Brexit scenario with no unilateral tariff removal. Moreover, in the case in which the UK was not be able to negotiate a new trade agreement with the EU (hard Brexit), trade between both regions would be governed by WTO rules.

[8] Some exceptions include the reduction in FDI inflows to China during the crisis (Hosoe and Latorre, 2016) and disinvestments by foreign multinationals (Gómez-Plana and Latorre, 2014).

[9] NTBs are any measure different to tariffs that may be an obstruction to international trade. They comprise regulations, requirements and rules that impose how to manufacture, handle or advertise a good, the amount of a specific product that can be sold in a market, licenses or any specific sanitary certifications, among others. Because they are usually expressed as norms and rules, contrasting with the percentages costs associated to tariffs, it is difficult to quantify the costs they involve.

[10] Ecorys (2009) relied on literature reviews, business surveys, gravity models and extensive consultations with regulators and businesses to calculate the ad valorem equivalents (AVEs) of the NTBs perceived by U.S. and EU firms across a wide variety of products. Because Ecorys (2009) did not provide values for Agriculture, other manufacturing and other services we take them from Latorre and Yonezawa (20018).

[11] The most straightforward way to model an NTB is to treat it as "tariff equivalent" (i.e., as an ad valorem equivalent, AVE). This is because NTBs increases the costs of importing goods and therefore they can be modeled similarly to tariffs with the nuances explained above.

NTBs would bring about efficiency losses, while 40% would generates rents. Additionally, they estimated that 2/3 of the rents were earned by importers and 1/3 by exporters.

Regarding migration, we extend our previous analysis of Brexit (Ortiz and Latorre, 2017b) by differentiating workers with respect to skill levels (skilled vs unskilled).

According to Wall Street Journal (2018) there are signs emerging that the Brexit vote may have already significantly slowed the influx of foreign workers. The decline reflects both fewer EU citizens arriving in the country and more leaving.

Most of the uncertainty that has surrounded the immigration policy that the UK would apply during the retreat period has been diminished with the last 8 December 2017 "joint report" between the UK and the EU[12]. Previous proposals showed more restrictive migration policies (for more details see Ortiz and Latorre, 2017b).

It is going to be relatively easy for EU citizens who have arrived to UK before 29 March 2019 to obtain "settled status"[13]. These EU citizens will be able to accumulate a 5 year residence period who will grant them the settled status. This holds even if they have to apply for temporary residence after March 2021 (once the transition period has ended) in order to accumulate these 5 years. By contrast, those EU citizens who arrive to the UK after 29 March 2019, would be subject to different migration conditions, which are still in negotiation.

Under this conditions it seems the UK will not generate a massive exit of immigrants. This is because most EU citizens arrived to the UK before or during the crisis (i.e., between 2008 and 2015). Thus, they will easily meet the conditions to apply for settled status.

Thus, we run an upper bound OECD scenario, following Arriola et al. (2016) OECD study. They estimate that the maximum possible reduction in migration flows would be of 116.000 persons per year. We follow their approach and interpret it as the maximum possible impact.

[12] This "joint report" is a summary of the process made in the first phase of negotiations toward the "Withdrawal Agreement". Both parties have committed on some issues such as EU citizens' rights. However, the negotiations are not completed and the implementations of such commitments will depend on the successful talks in the second phase (for an extended explanation see The Independent, 2017)

[13] "Settled status" means that foreign citizens are free to live in UK, having access to public funds and services and can apply for British citizenship. In other words, EU citizens with settled status will have the same access after Brexit as they currently do to healthcare, pensions and other benefits in the UK (Guidance Status in GOV.UK.website, 2018).

The OECD simulates three scenarios, optimistic, central and pessimistic in which the annual net migration into the UK will decline by 56.000, 84.000 and 116.000 persons per year. They also assume that 75% of the immigrants (independently of the scenario) would have been in the labor force. This assumption is consistent with evidence of the participation of recent EU immigration inflows (Arriola et al., 2016). Applying this 75% to the maximum number of migrants (116.000) we obtain the 87.000 reduction in the number of workers per year. We accumulate this reduction in the inflow of workers throughout five years. This would be equivalent to a 1.45% of the amount of employment in 2015 (the latest year for which we have data). We apply the 1.45% increase in to skilled and unskilled workers in turn. We model two extreme assumptions (i.e., that all migrants are skilled or that all of them are unskilled) because we do not know the figures. In addition, the 1.45% is run as a reduction in labor remuneration which is a common approach since CGE do not model the exact number of workers but rather measures them as efficiency units (e.g., Latorre, 2016).

Our scenarios are summarized in table 1. The percentage increases in NTBs are with respect to the barriers estimated by Ecorys (2009). The exact values for the barriers we run appear in table 2, which shows the NTBs and MFN tariffs for every sector in the UK and the EU. Columns 2 and 3 show the NTBs under a very soft and a soft scenario of Brexit. Columns 4 and 5 show the NTBs and MFN tariffs with a hard Brexit scenario, the three dimensions bars suggest that NTBs would guide the bulk of Brexit's impact on trade. Additionally, we can see in column 6, that the most protected sectors are agriculture, other primary and food; and to a lesser extend; textiles, motor vehicles, other transport, business services, and chemicals. Therefore, the UK's exit from the EU would potentially harm these sectors more than others.

[Table 1

As we mentioned above, we attempt to analyze the impact of Brexit through trade and migration. Table 2 depicts all the scenarios that will be considered in this approach.

[Table 2

3. Data.

The database for micro and macroeconomic variables and the model's input-output framework come from the latest version of the GTAP 9 dataset for 2011 (Aguiar et al., 2015). Table 3 shows the share of each sector in total production, exports and imports. The first set of columns at the right of the table shows data for the UK, while the second set of columns corresponds to information for the EU.

In both regions, the weight of services in total production is well beyond 60%, while their share is much smaller in trade. This reflects a worldwide trend, in which manufacturing goods account 80% of total trade, despite their much lower share in production (e.g., Latorre et al., 2018).

[Table 3

Other services, business services, construction, and chemicals are the most important sectors in UK's total production, with a share of 35.42%, 13.07%, 5.91% and 5.68%, respectively. In the three former sectors a large percentage of production goes to the domestic market (i.e., as intermediates, investment, private or public consumption). That means a drop in domestic demand would imply an important fall in their total production. By contrast, the increase in foreign trade costs that Brexit will imply would diminish UK's total production of manufactures that export and import an important share of their total output (e.g., motor vehicles, chemicals, textiles, and other primary).

Table 4 shows the bilateral trade flows of UK with the EU, United States, China, and the rest of the world. According to the data, the most important destinations of UK exports are EU and ROW, which account for 51.73% and 32.58% of its total exports, respectively. Regarding, the origin of UK's imports, 49.41% come from the EU and 32.85% from ROW. Consequently, the increase on barriers to trade between the EU and UK will affect very important shares of UK's trade. By contrast, the EU sells (buys) 54.23% (53.82%) of its total exports (imports) within the EU and only 3.47% (5.75%) in the UK.

[Table 4

Migration policies would affect more intensively those sectors with the largest labor shares. Except for other primary most sectors are labor intensive. Hence, the latter could be more affected by a migration decline.

4. Main Results.

4.1 Macroeconomic results.

4.1.1 International trade policy impacts on GDP, welfare and factors remuneration.

Table 5 shows the evolution of GDP, welfare (measured as Hicks equivalent variation), wages and capital remuneration under all scenarios. The results reflect an aggregation of all of the sectoral outcomes that will be analyzed below. Being able to come up with results across sectors and regions shows why a CGE model is said to be consistent at the micro- and macro-economic level (for more details see Latorre, 2012; 2013). We present the results for five regions. Interestingly the impact of Brexit seems confined to the two regions directly involved in it, while for the rest the effect would be negligible.

[Table 5.

Tariffs' elimination in the UK would lead to a tiny increase of its GDP by 0.04%. However, the UK would face small reductions in welfare and factors' remuneration. Concerning the welfare loss, after the increase of imported goods coming from third countries the UK reduces its trade with the EU. Because the EU is a very efficient partner this is a trade diversion effect

which reduces welfare in the UK. EU´s factors of production would also lose slightly after UK´s tariffs elimination.

We will see below that aggregate production would experience a tiny increase (0.05%). However, UK' industries that employ more than 50% of total labor and capital would reduce their production, which explains the downward pressure on wages and capital rents.

Under the very soft and soft Brexit, UK would experience a decrease in GDP, welfare, wages, and capital remuneration. The decline in GDP seems to be explained by the reduction of total production, due to the drop in output of industries such as motor vehicles, other primary, electronics, construction and other services. Some of them reduce their exports and face a reduction in domestic demand. This affects negatively their outcomes. On the other hand, these industries employ 59.70% of the UK's workforce. As a consequence, there is a decrease in wages and private consumption. Increased trade barriers lead to a reduction of imports, allowing local firms to supply these goods and compete with imports. However, the increasing competitiveness of local industries is due to the emergence of tariffs and non-tariffs restrictions and not to a real efficiency improvement.

Welfare drops by -0.38% and -0.91%, because, as we mentioned above, both NTBs and import tariffs reduce competition from other firms and allow inefficient firms to increase their prices. Furthermore, NTBs create red tape or other unjustified bureaucratic processes. Thus, they cause a waste of resources.

The negative effects of Brexit would be larger if the UK and the EU increase NTBs, by more than in the soft Brexit and also includes MFN tariffs. This is what happens in the hard Brexit in which the UK would experience a GDP decrease of -1.14%. Interestingly, our results are close to the ones of Ciuriak et al. (2015). Their Brexit scenario which is the more similar to our hard Brexit yields a -1.39% reduction in GDP in the UK, and a -0.14% for EU. On the other hand, their Brefta scenario, the closest to our soft version yields a -0.66% reduction for the UK and a -0.07% for EU. With respect to the EU, the region would face negative effects in GDP, welfare, wages, and capital remuneration, too. However, the impact is considerably lower than in the UK.

4.1.2 Impacts of the UK' migration policy on GDP, welfare and factors remuneration.

Unlike our previous approach (Ortiz and Latorre, 2017b), in this paper, we describe the impact of a reduction in migration taking into account skilled and unskilled labor. Therefore, table 5 depicts two potential results under OECD pessimistic scenario (see columns 6 and 7).

Under the most pessimistic OECD scenario, the GDP and welfare gains we derive from the increase in workers, would be foregone if the UK bans the entry of EU workers. This means, that the UK would face a potential GDP loss between -0.35% and -0.56% (i.e., of US$ -8,485.43 and US$ -13,570.76 million, respectively), depending a whether we apply the reduction in migration to skilled or unskilled migrants.

The exit of skilled (unskilled) workforce brings about a wage improvement for those skilled (unskilled) workers who remain in the UK. The fall in workers of a particular labor category leads to a decline in the supply of that labor category and consequently to an increase of its remuneration. However, the other labor category and capital becomes relatively more abundant and their remuneration falls.

To sum up, restrictions on migrants' entry in the UK would considerably intensify the negative impact of Brexit after some years. The potential loss is nearly double if the workers who go back to the EU are skilled than if they are unskilled.

4.2 Microeconomic results.

4.2.1 International trade policy impacts on production and trade flows.

Table 6 presents the evolution in production, exports and imports. On the top of the table, there are three blocks of columns, which depict the aggregate impact on those variables for the five regions of the model[14]. Below appear the details by sector in the UK. Each block of columns shows the results under three possible scenarios zero tariffs, hard Brexit, and OECD pessimistic. In the latter, we again display the outcomes by factors skill separately. We

[14] For the UK and the EU we also present the results for bilateral trade.

concentrate in these scenarios because they grasp the essence of the sector adjustment and in order to keep the tables unmanageable[15].

[Table 6

The elimination of tariffs in the UK would generate a tiny increase in total production (0.05%), with small rises in overall exports and imports (by 1.47% and 1.12%, respectively). While the EU would remain nearly unaffected.

Agriculture, food, textiles and motor vehicles are the sectors whit the largest tariffs. Therefore, removing tariffs in the UK would imply that domestic firms in these sectors could face a higher increase in competition than the rest of sectors and hence could reduce their production. Notice that, zero tariffs lead to a lower cost of imported goods and hence consumers and producers in the UK would have access to cheaper final and intermediate imported goods. Zero tariffs would push up UK´s imports on agriculture, food, textiles and motors vehicles by 0.53%, 6.06%, 8.49% and 0.63%, respectively. As we can see, production in three former sectors would fall while motor vehicles would be positively affected (-0.36%, -0.84%, -3.44% and 0.75%). This is because of the latter exports more than 50% of its total production, while the other sectors sell a larger share of their total production in the domestic market.

Looking at the detail on bilateral data we see that removing tariffs in the UK would lead to an increase of its exports with third regions (1.72%). However, imports coming from the EU would fall (-33.20%). This is because, contrasting to goods coming from other UK partners, imported goods coming from the EU do not experience any reduction in terms of tariffs. In other words, with zero UK tariffs, EU goods would face same conditions they currently enjoy.

[15] Results for the rest of scenarios are available upon request.

As we can see, UK would divert its imports from the EU by substituting them with imports from the third regions. This trade diversion would bring about a substitution from more-efficient trade partners to other less-efficient.

Turning to the bilateral trade data of the EU, we observe that EU's imports coming from third regions would fall (-0.38%). This could be due to the fact that the UK's market would be more attractive than the European, once UK's tariffs barriers have been eliminated.

On the other hand, the simultaneous increase of NTBs and tariffs (Hard Brexit) leads to a fall in UK's total production by -0.71%, due to the reduction of production in construction, other services, electronics, motor vehicles, textiles, chemicals, and other primary. The drop in the production of the latter five sectors would be related to the share of their total production that is sold abroad (mainly in the EU market). The existence of NTBs leads to an export decrease to the EU and hence a decrease in total production. By contrast, the fall in other services would be related to the behavior of domestic demand. This is because on average 31% of their total production is used as intermediates in the industries which would experience a production decline. On the other hand, construction would be affected because of a fall in aggregate investment after Brexit.

Although UK increases exports to third regions by 14.59%, this increase cannot compensate the fall in exports to the EU (-28.74%). In other words, the increase of UK's exports to other regions would be limited by the existence of tariffs and NTBs in these markets and the importance of the European market for UK's exports. In general, most sectors which sell a greater share of their total exports to the EU (e.g. agriculture, other primary, food, textiles, motor vehicles, etc.) would face larger trade barriers costs losing their previous preferential conditions.

Regarding the EU, it faces slight drops in its total production, exports, and imports (-0.04%, -0.40%, and -0.96%, respectively). Even though the EU faces the same increase of NTBs as the UK, the effect of these trade barriers would be smaller due to the low weight of the UK market in EU' exports and imports.

On the other hand, the EU would increase its intra-EU trade to compensate its export loses with the UK (under the same preferential trade conditions). Intra-EU trade would experience

a rise of 1.96% (which is equivalent to US$63, 239.39 in absolute terms). By contrast the total bilateral exports to the rest of trade partners (U.S., China and ROW) would rise by 2.14% (i.e., US$49,464.52). However, that increase is not enough, to compensate the fall in trade with the UK by-33.2% (i.e., US$-137, 229.93) and overall EU trade would still decline, although very slightly (by -0.40%, which is equivalent to US$ -24,596.02).

In terms of imports, both UK and EU face a decline in their aggregate imports. In the case of the UK, hard Brexit leads to a reduction of imports coming from the EU (-33.20%), while the bilateral imports from the rest of its trading partners increase by 8.86%.

By contrast, the EU would experience a tiny decrease (-0.38%) in its imports coming from third regions. The adjustment suggests that EU would replace its imports coming from the UK and from third regions with intra-EU trade, due to the existence of trade barriers between the EU and UK, USA, China, and ROW.

To sum up, if the UK unilaterally removes all its tariffs and continues to enjoy the current zero tariffs with the EU, UK production and trade would remain nearly unaffected. These results are in line with the ones derived by Dhingra et al. (2016) and are different than the very positive ones of Minford et al., (2016). By contrast, if a hard Brexit comes into force, the aggregate exports and imports in both regions would experience a drop, contracting total production. Motor vehicles would be one of the most affected sectors in UK, due to the emergence of trade costs, while construction would be affected by the adjustment of investment. Moreover, as we noted, the impact of Brexit would be larger in the UK than in the EU.

4.2.2 Impacts of UK' migration policy on production and trade flows.

Most sectors in the UK employ skilled workers more intensively than unskilled ones[16]. In addition, most industries in the UK are labor-intensive (with the exception of other primary). According to the Rybczynski theorem (1955), a change in the endowment of one factor leads

[16] Recall that our measures within the CGE model are based on labor remuneration which is calculated multiplying the number of workers by their wages. We obtain that most sectors are skilled intensive due to the high wages.

to an absolute increase in the production of the good that uses that factor intensively, while the goods that do not use it intensively would face an absolute decrease in their production. This implies that a decline in the number of workers would lead to a large fall across most sectors with the exception of other primary goods.

As we can note, a reduction in the number of workers would imply a potential loss in aggregate production, exports, and imports in the UK indistinctly of labor category. Unlike the impact on other-primary (in which production would remain nearly unaffected), most of the sectors in the UK would face a loss in their total production. In addition, the effects of an immigration restriction would be most harmful when workers who go back the EU are skilled. UK's production would face a loss of -0.58% if the number of skilled workers falls versus a -0.37% reduction if the entire decrease in the number of worker is applied to unskilled ones.

5. Conclusions.

In this paper, we have estimated the quantitative impact of Brexit by means of a CGE model. In particular, we have investigated how the emergence of MFN tariffs, NTBs, an unilateral removal of UK' tariffs, as well as restrictions to migration affect a broad set of micro and macroeconomic variables in the UK, the EU, the U.S., China and the rest of the world.

Our joint estimate of MFN tariffs and NTBs suggests that, if a hard Brexit comes into force, the UK would face a decrease in GDP (-1.14%), welfare (-1.94%), and capital rents (-4.77%). In the case of wages results would depend on whether Brexit affects more skilled or unskilled workers. In any case, the fall in wages would be between -4.26% and -4.60%, with losses being larger when affected workers are skilled.

If the UK eliminates all tariffs with respect to all its trading partners it will not be able to compensate the above mentioned losses. Running this scenario in isolation its GDP remains nearly unaffected. This result contrasts to the one of Minford et al. (2016), who derived a positive impact for Brexit based on such a policy.

The immigration issue has played an important role in the discussions previous to the referendum. After the joint agreement between the UK and EU of December 8 (2017), scenarios of massive deportation can be ruled out. Instead, reductions in the number of future migrants going to UK should be expected as a result of tighter controls which are still to be agreed upon. We show that restrictions on migration accumulated through five years do, however, have an impact. Fewer workers in the UK imply a potential foregone benefit, especially, if these workers are skilled. Hence, less restrictive immigration policies which guarantee the entry of qualified workforce could help to mitigate the bad outcomes arising from trade restrictions. But, inevitably, the UK retreat from the EU market will be harmful.

The number of industries that would be negatively affected would depend on the level of trade barriers that would emerge after Brexit. With zero tariffs, sectors like agriculture, food and textiles would face production falls. Tariffs' elimination increases the entry of more imported goods from other regions consequently pushing up competition in the domestic market.

On the other hand, the emergence of barriers to trade (MFN tariffs and NTBs) would mainly affect the exports of the manufacturing industry. And as a consequence, production in several industries fall (e.g. textiles, other primary, chemicals, motor vehicles, and electronics). Motor vehicles would be one of the most affected sectors with a drop of -7.7% in its output.

Even though, estimates of migration and trade barriers allow us to have a clearer vision of the potential effects of Brexit, future extensions including foreign direct investment and multinationals role would enrich the present analysis. We believe, however, that other elements considered in other studies like uncertainty (HM Treasury, 2016; Arriola et al., 2016; PWC, 2016) have so far failed to materialize and its negative impact may have been overstated.

References.

Aguiar, A. Narayanan, B. and McDougall, Ro. (2016), "An Overview of the GTAP 9 Data Base", Journal of Global Economic Analysis, Vol 1. No.1, pp.181-208.

Aichele, R., Felbermayr, G., Petersen, T., and Schoof, U. (2015), "Brexit- potential economic consequences if the UK exits the EU", Policy Brief #2015/05, Future Social Market Economy, Bertelsmann Stiftung.

Akgul, Z. (2017), "One Model to rule them all? The importance of firm heterogeneity in CGE modeling of the gains from trade", Working paper series, Centre for Global Trade Analysis, Purdue University and U.S. International Trade Commission.

Arkolakis, C. Costinot, A. amd Rodríguez-Plana, A. (2012), "New trade models, Same old gains?", *American Economic Review*, No.102, v.1, pp 94-130.

Arriola, C. Flaig, D. Fournier, JM. Fulop, G. and Van Tongere, F. (2016), "The economic consequences of Brexit: A taxing decision", OECD Economic Policy Paper, No.16, April 2016.

Hertel, T.W., and Tsigas, M.E. (1997). "Structure of GTAP", Global Trade Analysis: Modelling and Applications, Cambridge University Press.

Balistreri, E.J., and Tarr, D. (2016). "Comparison of Welfare Results from Trade Liberalization in the Armington, Krugman and Melitz Models: Impacts with features of real economies", *19th Annual Conference on Global Economic Analysis*, Washington DC, USA.

Booth, S. Howarth, Ch. Persson, M. Ruparel, R. and Swidlicki, P. (2015), "What if? The consequences, challenges and opportunities facing Britain outside EU", Report 03/2015. London: Open Europe.

Busch, B., and Matthes, J. (2016), "Brexit- The Economic Impact A Meta-Analysis", IW Report 10/2016, Cologne Institute for Economic Research.

Costinot, A., and Rodríguez-Clare, A. (2013). "Trade Theory with Numbers: Quantifying the Consequences of Globalization," CEPR Discussion Papers 9398, C.E.P.R. Discussion Papers.

Ciuriak, D., and Xiao, J., with Ciuriak, N., Dadkhah, A., Lysenko, D., and Narayanan, B. (2015), "The Trade-related Impact of a UK exit from the EU Single Market", Research Paper, Ciuriak Consulting INC, April.

Dhingra, S., Ottaviano, G. I., Sampson, T., and Van Reenen, J. (2016), "The consequences of Brexit for UK trade and living standards", Centre for Economic Performance (CEP), London School of Economics and Political Science (LSE).

Dhingra, S., Huang, H., Ottaviano, G.I, Pessoa, J.P., Sampson, T. and Van Reenen, J. (2017), "The Costs and Benefits of Leaving the EU: Trade Effects", Economic Policy, vol. 32, Número: 92, pp. 651-705.

Di Giovanni, J., Levchenko, A., and Ortega, F. (2015), "A global view of cross-border migration", Journal of the European Economic Association, Vol.13 No.1, pp. 168-202.

Dustman, C., and Frattini, T. (2014), "The fiscal effects of immigration to the UK", The Economic Journal, Vol.124, pp 593-643.

Ecorys (2009), "Non-Tariff Measures in EU-US Trade and Investment- An Economic Analysis", Final report OJ 2007/S 180-219493, European Commission, Diretorate-General Trade.

Fernández-Pacheco, C., Lopez, J.L. and Latorre, M.C. (2018) "Multinationals' effects: A nearly unexplored aspect of Brexit" forthcoming in Journal of International Trade Law and Policy.

Gómez-Plana, A.G., and Latorre, M.C., (2014), "When multinationals leave: A CGE analysis of divestments", Economics-The Open Access Open-Assessment E-Journal, vol. 8, pp. 1-41. Available at: http://www.economics-ejournal.org/economics/journalarticles/2014-6

GOV.UK website (2017),"Joint report from the negotiators of the European Union and the United Kingdom Government on progress during phase 1 of negotiations under Article 50 TEU on the United Kingdom's orderly withdrawal from the European Union", 8 December, 2017. Retrieved from: https://www.gov.uk/government/publications/joint-report-on-progress-during-phase-1-of-negotiations-under-article-50-teu-on-the-uks-orderly-withdrawal-from-the-eu

GOV.UK, website (2018) "Guidance: Status of EU citizens in the UK: what you need to know", Published 7 April 2017 (Last updated 11 January 2018). Retrieved from: https://www.gov.uk/guidance/status-of-eu-nationals-in-the-uk-what-you-need-to-know

Jafari, Y. and Britz, W. (2017). "Brexit- and economy-wide Impact Assessment looking into trade, immigration and Foreign Direct Investment", presented in the 20th Annual Conference on Global Economic Analysis, West Lafayette, Indiana USA, June 7-9.

Latorre, M.C. (2012), "Industry restructuring in transition after the arrival of multinationals: A general equilibrium analysis with firm-type costs' differences", Post-communist economies, Vol.24, pp. 441-463.

Latorre, M.C. (2013), "On the differential behaviour of national and multinational firms: A within and across sectors approach", The World Economy, Vol.36, pp. 1245-1372.

Latorre, M.C. (2016), "A CGE analysis of the impact of foreign investment and tariff reform on female and male workers in Tanzania", *World Development,* vol.77, pp.346-366.

Latorre, M.C. and Hosoe, N., (2016) "The role of Japanese FDI in China", *Journal of Policy Modeling,* vol.38, p. 226-241.

Latorre, M.C., Olekseyuk, Z. and Yonezawa, H. (2017), "Trade and FDI-related impacts of Brexit: A world-wide perspective", paper presented at the 20th Annual Conference on Global Economic Analysis, West Lafayette, Indiana, USA, June 7-9, 2017

Latorre, M.C. and Yonezawa, H. (2017a), "Stopped TTIP? Its potential impact on the world and the role of neglected FDI", Forthcoming Economic Modelling.

Latorre, M.C. and Yonezawa, H. (2017b). "A general equilibrium analysis of FDI growth in Chinese services' sectors", China Economic Review, wol.47, pp.172-188.

Latorre, M.C., Olekseyuk, Z. and Yonezawa, H. (2018) "Taking back control or losing it? An analysis of the possible economic impact of Brexit", Mimeo.

Mc Dougall, R.A. (2000), "A New Regional Household Demand System for GTAP", Working Paper No.14, Purdue University West Lafayette, IN: Global Trade Analysis Project (GTAP). Retrieved from: https://www.gtap.agecon.purdue.edu/resources/res_display.asp?RecordID=404

Minford, P., S. Gupta, V. Le, V. Mahambare and Y. Xu. (2016). "Should Britain leave the EU? An economic Analysis of a troubled Relationship", second edition, IEA.

Ottaviano, G., Pessoa, J.P., Sampson, T., and van Reenen, J.M. (2014), "Brexit or Fixit? The Trade and Welfare Effects of Leaving the European Union", Forthcoming in Economic Policy

Ortiz, G. and Latorre, M.C. (2017a), "No trans-pacific partnership? Good or bad for Mexico?", *Journal of International Trade Law and Policy*, vol. 16 Issue: 2, pp.106-123.

Ortiz, G. and Latorre, M.C. (2017b), "Economic Impact of Potential Migration Policies in the UK after Brexit", Mimeo.

Oxford Economics. (2016), "Assessing the economic implications of Brexit Executive Summary".

PwC. (2016), "Leaving the EU: Implications for the UK economy", PricewaterhouseCoopers (PwC) report commissioned by The Confederation of British Industry (CBI).

Rybczynski, T. (1995). "Factor Endowment and Relative Commodity Prices", Economica, Vol.22 No.88, pp. 336-341.

Sampson, T., Dhingra, S., Ottaviano, G. and Van Reenen, J. (2016). "How 'Economists for Brexit' manage to defy the laws of gravity", VOXeu, available at: http://voxeu.org/article/how-economists-brexit-manage-defy-laws-gravity

The Independent, (2017) "The Brexit deal is not legally binding- but politically, it's a different story altogether", December, 12. Retrieved from: https://www.independent.co.uk/voices/brexit-deal-european-union-eu27-withdrawal-bill-8-december-is-it-binding-a8105936.html

UNCTAD trade analysis information system (TRAINS) database. http://wits.worldbank.org/WITS/WITS/Default-A.aspx?Page=Default

United Nations Conference on Trade and Development. (2005), "Methodologies, Classifications, Quantification and Development Impacts of Non-Tariff Barriers", United Nations, Geneva.

Wall Street Journal (Online), “How a Migration Wave Drove Brexit and Why it is Now Receding , in 8 Charts; Britons’ concerns over immigration were a prime factor in their vote to leave the EU; now migrants are leaving, with mixed results for the U.K. economy”, New York, U.S., 8 January 2018.

Zhou, J. and Latorre, M.C. (2014a), “How does FDI influence the triangular trade pattern among China, East Asia and the U.S.? A CGE analysis of the sector of Electronics in China”, *Economic Modelling*, vol. 44, Supplement, pp. S77–S88.

Zhou, J. and Latorre, M.C. (2014b) “The impact of FDI on the production networks between China and East Asia and the role of the U.S. and ROW as final markets”, *Global Economic Review: Perspectives on East Asian Economies and Industries*, vol. 43, pp. 285-314.

Table 1 Trade and Migration Scenarios under Brexit

Trade Scenarios	Conditions	
Zero Tariff	Unilateral tariffs' elimination in UK (including zero tariffs on EU products).	
Very Soft Brexit	10% NTBs increase and zero tariffs between UK and EU	
Soft Brexit	25% NTBs increase and zero tariffs between UK and EU	
Hard Brexit	50% NTBs increase and MFN tariff increase (WTO rules) between UK and EU27.	
Migration Scenarios	**Percentage**	**Number of workers**
OECD (2016) scenario	-1.45%	435,000 (i.e., 87,000 x 5)

Source: Author's elaboration

Table 2. Non tariff barriers and MFN tariff under Brexit

Sectors	Very Soft Brexit	Soft Brexit	Hard Brexit				
	NTBs to Trade	NTBs to Trade	NTBs to Trade	MFN tariff		Total	
	In EU and UK	In EU and UK	In EU and UK	In EU	In UK	In EU	In UK
Agriculture	5.7	14.2	28.4	10.2	10.8	38.6	39.2
Other primary	5.7	14.2	28.4	0.0	0.1	28.4	28.5
Food	5.7	14.2	28.4	19.8	22.0	48.2	50.4
Textiles	1.9	4.8	9.6	10.0	9.5	19.6	19.1
Wood and Paper	1.1	2.8	5.7	0.5	1.0	6.2	6.7
Chemicals	1.4	3.4	6.8	2.8	2.7	9.6	9.5
Metals	1.2	3.0	6.0	1.9	2.0	7.9	8.0
Motor vehicles	2.6	6.4	12.8	8.0	8.8	20.8	21.6
Other transport	1.9	4.7	9.4	1.7	1.6	11.1	11.0
Electronics	1.3	3.2	6.4	0.9	1.5	7.3	7.9
Other machinery	0.0	0.0	0.0	1.7	1.8	1.7	1.8
Other manufactures	1.1	2.8	5.7	2.6	2.2	8.3	7.9
Construction	0.5	1.2	2.3			2.3	2.3
Water transport	0.8	2.0	4.0			4.0	4.0
Air transport	0.2	0.5	1.0			1.0	1.0
Communications	1.2	2.9	5.9			5.9	5.9
Finance	1.1	2.8	5.7			5.7	5.7
Insurance	1.1	2.7	5.4			5.4	5.4
Business services	1.5	3.7	7.5			7.5	7.5
Personal services	0.4	1.1	2.2			2.2	2.2
Other services	0.4	1.1	2.2			2.2	2.2

Source: Ecorys (2009) and Latorre et al. (2017).

Table 3 Initial data: UK and EU production, exports and imports by sector

Sector	United Kingdom			European Union		
	Share in Total Output	Share in Total Exports	Share in Total Imports	Share in Total Output	Share in Total Exports	Share in Total Imports
Agriculture	0,8	0,8	2,1	1,6	1,4	2,4
Other primary	1,3	3,9	7,0	0,5	0,9	17,3
Food	3,6	4,2	6,1	4,6	5,1	3,1
Textiles	1,0	1,9	5,3	1,7	2,9	5,7
Wood and Paper	2,2	2,0	3,5	2,7	3,2	1,7
Chemicals	5,7	18,5	14,9	7,5	18,2	15,3
Metals	2,2	6,2	9,9	3,9	6,8	5,5
Motor vehicles	1,9	7,5	8,6	3,2	9,8	3,4
Other transport	1,2	4,0	2,9	1,0	3,5	2,9
Electronics	0,8	3,3	5,1	1,2	3,6	6,9
Other machinery	3,1	12,1	10,8	5,5	18,9	10,3
Other manufactures	1,5	2,4	3,3	2,0	2,7	2,4
Construction	5,9	0,4	0,3	6,5	1,2	0,7
Water transport	0,9	0,5	0,6	0,8	1,1	0,8
Air transport	1,0	3,0	2,8	0,7	2,8	2,0
Communications	2,3	0,8	1,0	1,8	0,5	0,8
Finance	3,6	5,9	2,2	3,0	0,9	2,4
Insurance	1,9	1,4	0,3	1,0	1,0	0,4
Business services	13,1	14,0	5,7	11,3	6,6	7,6
Personal services	2,9	1,7	1,5	2,4	1,4	1,2
Other services	35,4	5,4	6,3	28,0	7,6	7,0
Manufatures	25,2	66,9	79,4	35,5	76,9	76,9
Services	74,8	33,1	20,6	64,5	23,1	23,1
Total	100	100	100	100	100	100

Source: Author' estimations based on GTAP 9 data base.

Table 4 Initial data: UK Bilateral exports and imports

Sector	Exports to					Imports from				
	EU27	US	China	ROW	TOTAL	EU27	US	China	ROW	TOTAL
Agriculture	75,9	3,6	5,4	15,1	100,0	49,3	4,0	1,8	44,9	100,0
Other primary	72,9	4,6	0,1	22,5	100,0	11,9	1,5	0,1	86,5	100,0
Food	61,8	9,1	1,0	28,2	100,0	75,2	3,0	1,6	20,3	100,0
Textiles	66,2	5,0	2,1	26,7	100,0	33,3	1,7	25,6	39,5	100,0
Wood and Paper	54,0	9,5	7,1	29,4	100,0	63,4	7,4	14,0	15,1	100,0
Chemicals	58,8	14,5	2,1	24,7	100,0	58,5	10,4	3,9	27,3	100,0
Metals	46,3	7,2	5,2	41,3	100,0	35,8	17,0	4,1	43,1	100,0
Motor vehicles	53,2	9,7	7,9	29,1	100,0	84,6	1,6	1,1	12,7	100,0
Other transport	36,6	16,3	1,8	45,3	100,0	38,2	32,2	2,5	27,1	100,0
Electronics	63,0	6,8	2,4	27,7	100,0	44,4	7,9	26,1	21,6	100,0
Other machinery	40,1	15,0	4,7	40,2	100,0	56,3	13,3	9,9	20,5	100,0
Other manufactures	42,0	15,6	1,1	41,3	100,0	38,8	17,7	21,3	22,2	100,0
Construction	42,5	2,6	0,7	54,2	100,0	39,1	2,7	10,5	47,7	100,0
Water transport	46,6	1,4	0,2	51,8	100,0	60,6	2,8	0,9	35,7	100,0
Air transport	41,8	17,0	0,5	40,7	100,0	55,7	9,9	0,3	34,1	100,0
Communications	65,7	6,8	0,3	27,2	100,0	48,0	13,6	1,7	36,7	100,0
Finance	42,6	24,5	1,0	31,8	100,0	32,2	33,5	0,2	34,0	100,0
Insurance	22,3	44,0	1,7	32,0	100,0	53,3	20,5	1,4	24,9	100,0
Business services	60,8	4,7	2,1	32,4	100,0	40,7	12,3	3,6	43,4	100,0
Personal services	52,4	10,9	0,8	35,9	100,0	48,8	25,4	1,1	24,7	100,0
Other services	40,6	21,5	2,1	35,8	100,0	46,4	17,9	1,9	33,7	100,0
Manufacturing	53,2	11,6	3,5	31,7	100,0	51,2	9,4	7,9	31,5	100,0
Services	49,6	15,0	1,5	33,9	100,0	44,8	17,0	2,0	36,2	100,0
Total	51,7	13,0	2,7	32,6	100,0	49,4	11,5	6,2	32,9	100,0

Source: Authors' estimations based on GTAP 9 data base.

Table 5 Macroeconomic impact of Brexit in the UK.

GDP	Zero Tariff	Very Soft Brexit	Soft Brexit	Hard Brexit Tariffs	Hard Brexit	OECD (pessimistic)	
						Skilled	Unskilled
EU27	0,00	-0,03	-0,07	-0,01	-0,14	0,00	0,00
UK	0,04	-0,20	-0,49	-0,15	-1,14	-0,56	-0,35
United States	0,00	0,00	0,00	0,00	0,00	0,00	0,00
China	0,01	0,00	0,00	0,01	0,01	0,00	0,00
ROW	0,00	0,00	0,01	0,00	0,02	0,00	0,00

Welfare as a percentage of Bechmark GDP	Zero Tariff	Very Soft Brexit	Soft Brexit	Hard Brexit Tariffs	Hard Brexit	OECD (pessimistic)	
						Skilled	Unskilled
EU27	-0,02	-0,03	-0,07	-0,03	-0,17	0,00	0,00
UK	-0,06	-0,38	-0,91	-0,28	-1,94	-0,55	-0,34
United States	0,01	0,00	0,01	0,01	0,03	0,00	0,00
China	0,04	0,00	0,01	0,02	0,04	0,01	0,00
ROW	0,01	0,02	0,04	0,01	0,07	0,00	0,00
TOTAL	0,00	-0,01	-0,03	-0,01	-0,06	-0,02	-0,01

Capital remuneration (Average percentage change)	Zero Tariff	Very Soft Brexit	Soft Brexit	Hard Brexit Tariffs	Hard Brexit Total	OECD (pessimistic)	
						Skilled	Unskilled
EU27	-0,12	-0,11	-0,25	-0,22	-0,60	-0,01	0,00
UK	-0,31	-1,03	-2,32	-1,63	-4,77	-0,43	-0,24
United States	0,05	0,07	0,15	0,10	0,36	0,00	0,00
China	0,10	0,04	0,10	0,09	0,25	0,01	0,01
ROW	0,03	0,06	0,14	0,10	0,33	0,00	0,00

Wages (Percentage change)		Zero Tariff	Very Soft Brexit	Soft Brexit	Hard Brexit Tariffs	Hard Brexit	OECD (pessimistic)	
							Skilled	Unskilled
EU27	Skilled	-0,12	-0,09	-0,21	-0,17	-0,54	0,00	0,00
	Unskilled	-0,13	-0,10	-0,24	-0,20	-0,61	0,00	0,00
UK	Skilled	-0,30	-0,83	-1,96	-0,95	-4,26	0,70	-0,23
	Unskilled	-0,32	-0,91	-2,12	-1,06	-4,60	-0,44	0,86

Source: Author's estimations

Table 6 Effects of Brexit in Total Production, Exports and Imports in the United Kingdom by industy (percentage change)

	Aggregate Production				Aggregate Exports				Aggregate Imports			
	Zero tariff	Hard Brexit	OECD (pessimistic)		Zero tariff	Hard Brexit	OECD (Pessimistic)		Zero Tariff	Hard Brexit	OECD (pessimistic)	
			Skilled	Unskilled			Skilled	Unskilled			Skilled	Unskilled
UK	0,05	-0,71	-0,58	-0,37	1,47	-7,31	-0,22	-0,09	1,12	-13,49	-0,54	-0,35
to or from EU					*1,38*	*-28,74*	*-0,21*	*-0,08*	*-3,91*	*-33,20*	*-0,54*	*-0,34*
to or from Third Regions					*1,72*	*14,59*	*-0,25*	*-0,11*	*5,38*	*8,86*	*-0,54*	*-0,35*
EU27	-0,01	-0,04	0,00	0,00	-0,001	-0,40	-0,03	-0,02	-0,07	-0,96	0,00	0,00
to or from EU27					*0,105*	*1,96*	*0,01*	*0,01*	*0,11*	*1,96*	*0,01*	*0,01*
to or from UK					*-3,910*	*-33,20*	*-0,54*	*-0,34*	*1,38*	*-28,74*	*-0,21*	*-0,08*
to or from Third Regions					*0,531*	*2,14*	*0,01*	*0,01*	*-0,47*	*-0,38*	*0,01*	*0,00*
United States	0,01	0,01	0,00	0,00	0,00	0,00	-0,05	-0,04	0,09	0,09	0,01	0,01
China	0,00	0,00	0,00	0,00	0,08	0,08	-0,03	-0,02	0,16	0,16	0,01	0,01
Rest of the World	0,00	0,00	0,00	0,00	0,02	0,02	0,00	0,00	0,04	0,04	-0,01	0,00

Table 6 Effects of Brexit in Total Production, Exports and Imports in the United Kingdom by industy (percentage change)

Sectors	Production in UK				Exports in UK				Imports in UK			
	Zero Tariff	Hard Brexit	OECD (pessimistic)		Zero Tariff	Hard Brexit	OECD (pessimistic)		Zero Tariff	Hard Brexit	OECD (pessimistic)	
			Skilled	Unskilled			Skilled	Unskilled			Skilled	Unskilled
Agriculture	-0,36	0,96	-0,14	-0,23	3,74	-59,18	0,78	0,02	0,53	-16,69	-0,47	-0,18
Other primary	0,01	-0,07	-0,01	0,00	-0,25	-35,92	0,50	0,34	0,21	-16,51	-0,60	-0,39
Food	-0,84	0,98	-0,45	-0,29	3,33	-52,41	-0,06	-0,08	6,06	-41,01	-0,48	-0,28
Textiles	-3,44	-1,72	-0,70	-0,43	8,95	-38,22	-0,58	-0,36	8,49	-13,52	-0,44	-0,26
Wood and paper	0,16	2,95	-0,60	-0,39	1,47	-3,64	-0,29	-0,25	-0,13	-13,41	-0,51	-0,31
Chemicals	0,26	-1,74	-0,42	-0,27	1,19	-13,28	-0,21	-0,13	0,64	-12,87	-0,48	-0,31
Metals	0,75	0,04	-0,67	-0,45	2,30	-9,27	-0,48	-0,31	1,01	-6,76	-0,54	-0,36
Motor vehicles	0,71	-7,79	-0,57	-0,36	1,95	-33,30	-0,35	-0,21	0,63	-25,01	-0,60	-0,39
Other transport	0,69	1,60	-0,65	-0,40	2,47	-6,66	-0,50	-0,28	1,43	-14,24	-0,51	-0,35
Electronics	0,78	-1,76	-0,52	-0,34	2,40	-13,88	-0,27	-0,15	0,75	-10,99	-0,66	-0,47
Other machinery	0,78	4,44	-0,63	-0,42	2,21	7,54	-0,42	-0,25	0,92	-8,26	-0,60	-0,43
Other manufactures	0,03	0,19	-0,60	-0,39	2,22	-3,92	-0,24	-0,14	1,12	-13,32	-0,58	-0,38
Construction	0,16	-5,42	-0,75	-0,58	0,87	15,57	0,85	-0,21	-0,30	-15,30	-1,20	-0,47
Water transport	0,40	2,51	-0,12	-0,15	0,41	2,27	-0,07	-0,12	0,03	-2,87	-0,31	-0,20
Air transport	0,47	2,88	-0,31	-0,27	0,80	4,74	-0,07	-0,17	-0,34	-3,44	-0,54	-0,30
Communications	0,11	1,11	-0,44	-0,35	0,79	-0,36	0,26	-0,27	-0,40	-9,30	-0,65	-0,21
Finance	0,26	1,95	-0,46	-0,19	0,58	2,03	-0,22	0,00	-0,22	-6,12	-0,44	-0,29
Insurance	0,01	0,99	-0,57	-0,29	0,85	7,63	-0,23	0,03	-0,53	-10,37	-0,50	-0,36
Business services	0,18	0,44	-0,56	-0,25	0,68	-0,77	-0,36	0,23	-0,35	-10,68	-0,43	-0,46
Personal services	0,01	0,87	-0,39	-0,50	0,99	9,00	0,56	-0,57	-0,59	-7,85	-0,78	-0,19
Other services	-0,12	-0,06	-0,60	-0,38	1,20	10,42	-0,08	-0,12	-0,72	-8,56	-0,56	-0,32

Source: Author's estimations

Appendix.

Sensitivity Analysis.

In order to evaluate the robustness of our model we perform a sensitivity analysis of the results obtained across our four simulations (i.e., zero tariffs, soft Brexit, hard Brexit and OECD migration scenarios). Following Harrison et al. (1993) and Latorre and Hosoe (2016) run an unconditional systematic sensitivity analysis. This consist of re-running the four scenarios mentioned above, but changing the values of three crucial elasticities: the elasticity of substitution between labor and capital, the Armington substitution between imports and domestic goods among regions and the Armington substitution among imports by origin. Each elasticity have been varied, one by one, while keeping the rest fixed at their initial level. To simplify, this analysis focuses on the effects for GDP, only. The results are displayed in Table 1A.

As we can see, the results are robust to changes in the value of the elasticity of substitution between labor and capital. This elasticity reflects how easy it is to substitute these factors in the production of different sectors in an economy.

On the other hand, the Armington substitution between imported varieties and domestic goods reveals the feasibility with which consumers and producers can choose between imported varieties and domestic goods, while the Armington substitution among imports by origin shows how easy it is to change the source of the imported varieties. As we can see, in those scenarios in which we assume the increase of barriers to trade (soft and hard Brexit), larger values in both elasticities lead to lower GDP losses in the UK. In the same line, the GDP gains in UK would be very slightly larger under the zero tariff scenario. In other words, the feasibility with consumers and producers can substitute goods would enhance the GDP gains under a trade liberalization process and would reduce the losses by restrictions to trade. This is because with larger values of these elasticities the UK can move easily substitute the trade lost with the EU with imports from other regions or with domestic production.

Overall, the results suggest that our previous results are very robust to different elasticities specifications.

Table 1.A								
			GDP					
			Zero Tariffs	Soft	Hard Tariffs	Hard Total	OECD skilled	OECD unskilled
Reference		EU27	0.00	-0.07	-0.01	-0.14	0.00	0.00
		GBR	0.04	-0.49	-0.15	-1.14	0.56	0.35
		USA	0.00	0.00	0.00	0.00	0.00	0.00
		CHN	0.01	0.00	0.01	0.01	0.00	0.00
		ROW	0.00	0.01	0.00	0.02	0.00	0.00
A) Elasticity of substitution between labor and capital	Half	EU27	0.00	-0.07	-0.01	-0.14	0.00	0.00
		GBR	0.04	-0.49	-0.14	-1.13	0.56	0.35
		USA	0.00	0.00	0.00	0.00	0.00	0.00
		CHN	0.01	0.00	0.01	0.01	0.00	0.00
		ROW	0.00	0.01	0.00	0.02	0.00	0.00
	Double	EU27	0.00	-0.07	-0.01	-0.14	0.00	0.00
		GBR	0.04	-0.49	-0.16	-1.14	0.56	0.35
		USA	0.00	0.00	0.00	0.00	0.00	0.00
		CHN	0.01	0.00	0.01	0.01	0.00	0.00
		ROW	0.00	0.01	0.00	0.02	0.00	0.00
B) Elasticity of substitution between imports and domestic production (Armington)	Half	EU27	-0.01	-0.07	-0.01	-0.14	0.00	0.00
		GBR	0.05	-0.52	-0.17	-1.24	0.56	0.35
		USA	0.00	0.00	0.00	0.00	0.00	0.00
		CHN	0.01	0.00	0.01	0.01	0.00	0.00
		ROW	0.00	0.01	0.00	0.02	0.00	0.00
	Double	EU27	0.00	-0.07	-0.02	-0.14	0.00	0.00
		GBR	0.03	-0.45	-0.14	-1.01	0.56	0.35
		USA	0.00	0.00	0.00	0.00	0.00	0.00
		CHN	0.02	0.00	0.01	0.01	0.00	0.00
		ROW	0.00	0.01	0.00	0.01	0.00	0.00
C) Elasticity of subtitution between regional allocation of imports	Half	EU27	0.00	-0.07	-0.01	-0.16	0.00	0.00
		GBR	0.01	-0.51	-0.11	-1.18	0.56	0.35
		USA	0.00	0.00	0.00	0.00	0.00	0.00
		CHN	0.01	0.00	0.00	0.01	0.00	0.00
		ROW	0.00	0.01	0.00	0.01	0.00	0.00
	Double	EU27	-0.01	-0.06	-0.02	-0.13	0.00	0.00
		GBR	0.06	-0.46	-0.18	-1.11	0.56	0.35
		USA	0.00	0.00	0.00	0.00	0.00	0.00
		CHN	0.02	0.00	0.01	0.01	0.00	0.00
		ROW	0.00	0.01	0.00	0.02	0.00	0.00

Source: Author's estimations.