Trade-related effects of Brexit. Implications for Central and Eastern Europe

Jan Hagemejer[*,#], Maria Dunin-Wąsowicz[‡], Jan J. Michałek[*], Jacek Szyszka[*]

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Abstract

We use a global computable general equilibrium model to analyze several scenarios of Brexit. We mainly focus on the impact of Brexit on the New Member States of the EU to complement the existing literature on Brexit. Our scenarios are based on two reasonable expectations on the outcome of the process of negotiations, ie. the Soft Brexit with a limited FTA and a Hard Brexit governed by WTO MFN rules. The shocks imposed on the CGE model include modifications of both tariff and non-tariff barriers. While the former are based on actual tariff data, the latter are estimated using an econometric model for both merchandise trade and services. Our results show that in spite of the UK being one of the most important trading partners for many of the NMS, Poland in particular, the macroeconomic effects of Brexit are mild, even in the case of a Hard Brexit. In the most pessimistic scenario of a Hard Brexit, in the long run they amount to a fall of GDP of roughly 0.4 percent. However, there are some sectors that may experience somewhat significant drops in output, in particular the food sector and some other manufacturing export-oriented sectors.

Keywords: CGE modelling, international trade, Brexit, trade policy

As Brexit negotiations concluded on the 24th of December, this poster's content is based on simulations following the results of the negotiations. The paper contains an earlier version of the simulations taking into account various Hard and Soft Brexit scenarios and will be updated soon.

[*]University of Warsaw, Faculty of Economic Sciences
[‡]Warsaw School of Economics
[#]CASE – Center for Social and Economic Research

1 Introduction

Following the referendum on 23 June 2016, the United Kingdom (UK) voted to leave the European Union (EU). The UK formally requested the exit from the EU in March 2017 and several weeks later it initiated a process of negotiations with the EU-27 on the withdrawal agreement and on the future economic relationship, at a later date[1]. The Brexit withdrawal agreement was finally concluded in November 2018 with the release of the withdrawal agreement. The political declaration, issued in November 2018, setting out the framework for the future relationship between the EU and the UK was very optimistic and described future deep integration agreement[2]. But in June 2019 Prime Minister Theresa May resigned, and in July Boris Johnson was elected as her successor. The Johnson's administration reopened negotiations on the withdrawal agreement in August 2019, but declared a pre-condition that the so called "Irish backstop" must be eliminated, which the EU said it wouldn't accept.

The United Kingdom left the European Union on 31 January 2020. In accordance with the Withdrawal Agreement[3], it is now officially a third country to the EU and hence no longer participates in EU decision-making. The EU and the UK have, however, jointly agreed on a transition period, which will last until 31 December 2020. Until then, it will be business "as usual" for citizens and businesses in both the EU and the UK. The EU law still applies to the United Kingdom until the end of the transition period.

At present (April 2020) trade negotiations between the 27 EU member states (EU27) and the UK have begun. The deadline for the UK to formally request an extension to the Brexit Transition Period is 30 June 2020. If the UK chooses not to request an extension by this date, the transition period will end in December 2020. If the UK and EU27 can get a free trade agreement agreed and ratified by this date, then the UK and EU will start a new trading relationship in time for January 2021. But if there is no agreement in time, then the transition period will end, and the EU - UK trading relationship will default to World Trade Organization (WTO) rules.

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[1] The Directives for the negotiation for the withdrawal Agreement were given by the EU Council of European Union in the document: XT 21016/17 ADD 1 REV 2 , dated 22 May 2017.
[2] Council of the European Union: doc. BXT 111 CO EUR-PREP 54, Brussels, 22 November 2018.
[3] AGREEMENT on the withdrawal of the United Kingdom of Great Britain and Northern Ireland from the European Union and the European Atomic Energy Community (Official Journal of the European Union: 2019/C 384 I/01)

What are the likely options for future trade UK-EU trade relations at present? The political tensions between EU and UK and within UK Parliament excluded a chance for a "very soft" agreement, similar to the Norwegian one[4].

The Draft text of the Agreement on the new Partnership between EU and UK was presented on 18 March 2020 by the EU. Is sets the framework for the negotiations. Now, the most optimistic scenario assumes a Free Trade Area (FTA) covering all goods and majority of services. According to the announced Political Declaration, the new FTA should be of an unprecedented nature: no tariffs and no quotas across all goods, including agricultural and fisheries products.[5] In the optimistic scenario the FTA should cover most services sectors, such as telecommunication services or business services. But, as in any FTA negotiated by the EU, there will be exceptions: for instance, the EU normally excludes audiovisual services. Even the best FTA, trade relations will be different compared to the frictionless trade enabled by the EU's Single Market. In an FTA rules of origin and customs formalities will apply; all imports will need to comply with the rules of the importing party and will be subject to regulatory checks and controls for safety, health and other public policy purposes[6]. In order to limit the increase of EU-UK trade costs the EU foresees the "customs cooperation including customs checks and controls and the envisaged partnership should aim at facilitating legitimate trade by making use of available facilitative arrangements and technologies."

In the pessimistic scenario there will be no FTA agreement in place by the end of transition period. In this scenario, the EU will apply "Most Favored Nation (MFN) tariffs" to the UK. The UK will treat the imports from the EU in the similar way. Under the WTO (MFN) clause, benefits given to one trading partner need to be extended also to others. Therefore, without an FTA economic agents in EU and UK cannot expect preferential treatment. In this case the EU law, including systematic controls, will fully apply to imported food, animals and plants without exceptions or equivalency. High EU level SPS standards will be safeguarded. The relations will be built on existing multilateral instruments (WTO), such as Codex Alimentarius or International Plant Protection Convention recommendations and requirements.

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[4] The Norwegian (or Swiss) scenarios, assuming the UK membership in the Single Europe Market (SEM), has been analyzed in early empirical studies (e.g. Van Reenen).
[5] Draft text of the Agreement on the New Partnership with the United Kingdom ; Origin: European Commission, Task Force for Relations with the United Kingdom 18 March 2020 see: UKTF (2020) 14.
[6] More details are provided in the document of European Commission: Questions & Answers on the draft negotiating directives for a new partnership with the United Kingdom, Brussels, 3 February 2020.

Brexit is likely to have large economic implications for both UK and EU economies, in both the short and long-run. However, the scale of these effects remains unknown as they depend on the final from of Brexit, and knowledge of the post-Brexit UK economic environment.

The UK is the second largest economy in the EU by GDP. It has very intense trade relations with the rest of the EU27, and is its main "external" trading partners[7]. The British economy's specialization in the financial sector makes it an important element of the European financial system. It also attracts many European workers and many British citizens live in other European countries. Thus, the British economy occupies an important place in EU commercial and financial relations.

The implications of Brexit will be important for many developed EU members states from Western Europe. The economic and financial relation with UK are crucial for Ireland. They are also very important for Netherlands, Germany, France or Nordic countries. The potential importance of Brexit for the New Member States (NMS) of the EU varies with the individual countries involvement in economic relations with the UK and for some countries, these are quite significant. For example, for Poland, the British economy is the third main trade partner. Polish exports to the UK are concentrated in some important industrial sectors, such as wood products and paper products, metals, electronic equipment as well as transport equipment. The British market is also very important for Polish exports of processed food and beverages and tobacco. Moreover, UK market is also significant for Poland's exports of business, communication and transport services, while imports of financial and business services are also non-negligible. Finally, large British market attracted about 1.5 million of workers form Poland.

On the other hand Polish market is important for British exporters of beverages and tobacco, motor car vehicles, processed food and machinery. In some sectors both countries intensively participate in the same global value chains. Thus, if Brexit, will increase drastically the trading costs between UK Poland and other EU members then it can have important negative consequences for both United Kingdom and EU27.

The goal of this paper is to analyze possible trade, production and welfare implications of various Brexit scenarios on the NMS economies with a focus on Poland. We employ a global computable general equilibrium model in both short and long-run setting to analyse a set of scenarios covering both tariff and non-tariff barriers. These scenarios are based on the range of several possible outcomes of the Brexit negotiations and a detailed analysis of tariffs and own estimation of non-tariff barriers.

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[7] Intensive trade flows between UK and EU27 are in line with predictions of gravity models.

This paper is organized as follows. Section two covers some descriptive statistics of the EU-UK international trade in goods and services. Section three surveys the up-to-date literature on the outcomes of Brexit focusing on the analyzed scenarios and the range of results. Section four presents our methodology: the model, the method of estimation of non-trade barriers and our simulation scenarios. Section five presents the results of the simulations. Last section concludes.

2   UK – EU trade profile

Before we turn to the analysis of the Brexit scenarios, we look at the structure of UK-EU trade. Both bilateral importance of the trading countries and the sectoral trade pattern will have an impact on the structure of the response of the analysed economies to Brexit-related shocks. Table 1 presents the shares of total UK merchandise and services trade with the particular EU members and shares of the EU member trade of goods and services with the UK in their total trade. Obviously, the bilateral importance of EU to the UK is very different to the importance of UK to the EU. The UK-EU trade represents about 50% of total UK merchandise trade and over 40% of total UK trade in services. Major trade partners are (in the order of decreasing importance): Germany, Netherlands, France and Ireland. The contribution of NMS (including Poland) is very small.

As a proportion of EU countries trade, UK, on the other hand is, not surprisingly, much less important. There are also certain asymmetries. As far as merchandise trade is concerned, UK is a destination for 6.7 percent of EU's exports while only 2.4 EUs imports come from the UK. In trade in services this pattern is reversed, ie. UK is an important exporter of services to the EU (7% of overall EU service imports) and relatively less important destination of EU services. Looking at individual countries, Ireland stands out as an important UK's partner, both in goods and services, while the EU-14 including Ireland, France, Germany and the Netherlands are also highly dependent on imports of services from the UK. As far as the NMS are concerned, the bilateral involvement of the NMS both in goods and services is lower than in the EU-14 with Poland having the highest shares both in imports and exports among the analysed countries.

Table 1 Importance of trade relations between UK and EU, 2018 (Merchandise trade), 2018 (Services)

Country	UK trade		EU countries trade	
	Share of imports	Share of exports	Share of imports	Share of exports
		Merchandise trade		
Poland	2.2	1.5	1.2	6.3
Czechia	1.2	0.9	1.0	4.6
Slovakia	0.5	0.3	0.6	3.8
Hungary	0.6	0.5	0.9	3.2
rNMS	1.1	1.3	2.1	3.4
Ireland	2.8	5.1	10.5	9.4
France	5.6	5.7	1.9	6.5
Netherlands	8.5	6.7	2.9	11.2
Germany	14.1	9.1	1.6	6.5
rEU14	17.6	16.1	3.4	6.4
Overall	54.1	47.1	2.4	6.7
		Services		
Country	Share of imports	Share of exports	Share of imports	Share of exports
Poland	1.4	0.8	7.6	5.3
Czechia	0.4	0.3	5.0	3.7
Slovakia	0.2	0.1	3.7	4.1
Hungary	0.4	0.2	4.7	3.6
rNMS	1.6	0.8	0.9	0.8
Ireland	4.2	4.8	8.7	5.0
France	8.1	5.9	8.8	7.1
Netherlands	3.8	6.0	9.7	4.0
Germany	5.9	6.8	7.4	4.4
rEU14	21.0	14.1	8.0	6.3
Overall	47.1	40.0	7.0	4.6

Source: UNComtrade trade database; OECD Trade in services by partner economy data (EBOPS 2010);

UK trade: EU country/region share in total UK trade; EU trade: UK share in total trade;

We study the sectoral structure of bilateral trade by calculating the revealed comparative advantage indices. In Table 2, we present the RCA's of the EU countries/regions in their exports to the UK. As far as the NMS is concerned, Poland has more sectors with RCAs than the remaining NMS, which is a natural consequence of larger size, less openness and more diversification than elsewhere. Sectors in which Poland has comparative advantages are: food and beverages, wood and paper, minerals, metals, electronic equipment (manufacturing sectors) and construction, trade, accommodation and food service, land transport (part of transport nec), warehousing, communication, real estate, business and recreational services, human health and social work (services sectors). Other NMS (in particular Czechia, Slovakia and

Hungary) show RCAs in motor vehicles and metal products as well as electronic equipment, while the structure of service export overlaps to a large extent with that of Poland. The remaining NMS (in particular Bulgaria and Romania) exhibit additional RCAs in agriculture, food sector, textiles and wearing apparel.

There are only few manufacturing sectors where the UK has RCA's in exports to (majority of) EU countries (Table 3). These industries are: food and beverages, paper products, chemicals and motor vehicles. Two sectors stand out. UK has huge relative comparative advantage in exports to the EU within the beverages and tobacco sector; UK is also more competitive in exports of most of manufacturing goods to Ireland. On the services side, UK has RCA's in: communication, financial Services and business Services.

Table 2 Revealed comparative advantage indices of EU countries in trade to UK.

	RCAs of EU countries in trade to UK									
sector	POL	CZE	SVK	HUN	rNMS	IRL	FRA	NLD	DEU	rEU14
Agriculture	0.6	0.0	0.0	0.1	1.8	2.0	0.9	1.9	0.3	1.1
Fishing	0.3	0.1	0.0	0.0	3.5	1.9	0.3	1.2	0.1	1.8
Mining	0.0	0.1	0.0	0.0	0.1	0.6	0.1	2.0	0.2	1.8
Food	1.7	0.2	0.3	0.7	0.6	3.3	1.1	1.1	0.6	0.9
Bvrges & Tobacco	1.2	0.1	0.0	0.6	0.6	1.3	2.8	0.7	0.4	1.1
Textiles	0.7	0.6	0.4	0.5	1.6	0.5	0.8	1.1	0.7	1.5
Wearing apparel	0.5	0.5	0.0	0.1	3.6	0.4	1.4	0.8	0.6	1.4
Leather	0.4	0.7	0.1	0.1	0.2	0.2	1.9	1.1	0.6	1.3
Wood	3.6	0.5	1.4	0.6	7.6	1.0	0.4	0.2	0.6	1.3
Paper, Publishing	1.1	0.7	1.0	0.7	0.3	0.6	0.8	0.6	0.8	1.5
Fuels	0.4	0.0	0.0	0.0	0.9	0.8	0.7	2.4	0.1	1.4
Chemicals	0.1	0.3	0.1	0.6	0.5	1.2	1.5	1.2	1.0	0.9
Pharmaceuticals	0.7	0.2	0.1	0.5	0.5	2.2	0.8	1.8	0.7	1.0
Rubber & Plastics	1.4	1.5	1.6	1.8	1.2	0.9	1.0	0.5	1.3	0.9
Non-metalic minerals	1.4	1.2	1.0	1.6	1.5	1.2	1.3	0.5	0.9	1.1
Steel	0.5	1.6	0.4	0.1	0.8	0.5	0.9	0.9	0.7	1.5
Metals nec.	1.7	0.1	0.1	1.1	0.6	0.4	0.7	0.3	1.6	1.0
Metal products	1.1	1.2	1.7	0.4	1.0	0.6	0.6	0.4	1.0	1.5
Motor vehicles & parts	0.8	1.2	2.3	1.0	0.7	0.1	0.7	0.3	1.7	1.0
Transport Eq. n.e.c.	0.4	0.5	0.0	0.2	0.3	0.1	2.3	0.5	1.5	0.8
Electronics & opticals	1.6	3.1	2.4	3.5	0.5	1.0	0.6	2.3	0.5	0.4
Electrical Equipment	2.0	1.8	1.3	2.1	2.5	0.8	0.9	0.6	1.6	0.9
Machinery and eq. nec	1.0	1.4	0.9	1.7	1.3	0.7	0.9	0.8	1.2	0.9
Mnfcs nec	0.8	2.1	0.1	0.3	0.3	0.6	3.1	0.4	0.7	1.0
Energy	0.1	0.5	0.6	0.4	1.3	0.2	5.1	1.7	0.1	0.4
Construction	2.1	0.3	0.7	0.4	0.7	0.1	1.6	2.1	1.6	0.7
Trade	1.1	0.9	0.9	1.0	1.1	0.5	1.6	0.7	0.5	1.2
Accommodation &Food	1.1	1.0	0.9	1.0	1.1	0.4	1.6	0.6	0.5	1.2
Transport nec	1.9	1.6	1.7	0.9	1.9	0.4	1.6	0.8	0.3	1.2
Water transport	0.4	0.0	0.1	0.1	2.0	0.2	1.6	1.0	0.3	1.3
Air transport	0.5	0.7	0.6	1.5	1.1	1.3	0.9	0.9	1.4	0.8
Warehousing and support	1.4	1.1	1.1	1.1	1.6	0.6	1.2	0.7	0.8	1.1
Communication	1.1	1.6	1.4	1.0	1.2	1.1	0.9	1.4	1.1	0.9
Financial services nec	0.5	0.3	0.5	0.4	0.4	1.4	0.3	0.2	1.0	1.3
Insurance	0.5	0.6	0.5	0.4	0.4	2.5	1.4	0.5	1.0	0.7
Real estate activities	1.5	3.8	1.9	0.8	0.7	0.8	1.5	1.0	0.7	1.0
Business services nec	1.1	0.9	1.0	1.0	0.7	1.5	0.6	1.5	1.3	0.8
Recreational and oth.	1.1	1.4	1.7	2.3	1.0	0.2	1.6	0.8	0.5	1.1
Public administration	0.8	0.5	0.7	0.7	0.7	0.4	1.0	1.0	1.3	1.0
Education	0.6	0.4	0.7	0.6	0.7	0.4	0.8	1.0	1.5	1.0
Human health, social work	1.1	0.9	1.0	1.2	1.1	0.5	1.8	0.6	0.6	1.1

Source: own calculation using UNComtrade trade database (2018) and GTAP database (2014).

EU RCAs are relative to total EU27 exports to UK.

Table 3 Revealed comparative advantage indices of the UK in trade to EU countries.

sector	POL	CZE	SVK	HUN	rNMS	IRL	FRA	NLD	DEU	rEU14
	RCAs of UK in trade to EU									
Agriculture	0.3	0.4	0.9	2.2	0.2	1.3	0.3	0.2	0.1	0.2
Fishing	0.7	0.2	0.1	1.0	0.5	2.5	3.7	1.6	0.8	0.4
Mining	0.4	0.0	0.0	0.0	0.1	1.5	0.1	1.5	0.4	0.3
Food	1.9	2.5	1.5	2.0	1.0	2.4	1.4	1.0	1.2	1.0
Bvrges & Tobacco	6.4	3.4	3.2	3.9	4.8	1.9	5.4	3.0	3.2	3.8
Textiles	0.8	1.2	0.9	1.5	2.2	1.0	0.4	0.5	0.5	0.5
Wearing apparel	0.2	0.2	0.1	0.4	0.6	0.8	0.2	0.4	0.3	0.3
Leather	0.5	0.6	0.0	0.3	1.0	1.3	0.3	0.9	0.4	0.5
Wood	0.2	0.6	0.5	0.5	0.2	1.3	0.5	0.4	0.5	0.4
Paper, Publishing	2.5	3.6	5.0	2.2	1.3	2.3	2.1	1.5	1.9	1.4
Fuels	0.2	1.1	3.1	1.6	1.1	2.2	0.5	2.1	0.7	1.3
Chemicals	2.3	2.4	3.1	2.6	1.5	1.1	2.3	1.7	2.0	1.8
Pharmaceuticals	3.7	3.7	3.8	2.5	2.0	0.6	1.8	2.3	1.1	1.3
Rubber & Plastics	2.0	1.7	2.8	1.5	1.2	1.4	2.0	1.4	1.5	1.6
Non-metalic minerals	0.9	1.4	1.3	0.6	0.7	1.6	0.9	0.8	1.0	1.1
Steel	0.5	0.9	1.3	0.8	0.3	1.9	1.9	1.4	1.3	1.0
Metals nec	0.6	1.6	5.2	1.0	0.4	1.3	1.1	0.3	1.6	0.8
Metal products	1.0	1.2	1.8	0.8	0.8	1.7	1.0	1.4	0.8	0.9
Motor vehicles & parts	2.9	1.3	1.5	1.8	1.7	1.3	1.6	2.3	2.0	2.5
Transport Eq. nec	0.6	0.4	0.1	3.6	0.3	0.0	1.9	0.5	2.6	1.0
Electronics & opticals	0.5	0.7	0.2	0.8	1.8	0.6	0.5	0.4	0.6	1.3
Electronic Equipment	0.5	0.8	1.1	0.4	1.0	1.2	0.6	0.6	0.7	0.9
Machinery and eq. nec	1.1	1.1	1.0	0.8	1.6	1.0	1.0	0.7	0.9	1.3
Mnfcs nec	0.6	1.1	5.1	2.3	1.9	1.0	0.6	0.7	0.5	0.7
Energy	0.3	0.5	0.5	0.1	0.2	0.8	0.2	0.3	0.2	0.2
Construction	0.2	0.1	0.2	0.1	0.2	0.2	0.5	0.4	0.3	0.2
Trade	0.9	0.6	0.4	0.5	0.9	0.3	0.6	0.4	0.5	0.4
Accommodation&Food	1.1	0.8	0.9	1.0	1.0	0.3	0.9	0.8	0.8	0.7
Transport nec	0.3	0.2	0.1	0.1	0.3	0.6	0.3	0.3	0.2	0.2
Water transport	0.8	0.6	0.8	0.6	0.7	1.2	0.8	0.7	0.3	0.4
Air transport	0.9	0.9	0.7	0.6	0.8	1.4	0.6	0.7	0.5	0.7
Warehousing and support	0.9	1.2	0.5	0.5	0.8	0.9	1.0	0.8	0.5	0.8
Communication	1.5	1.0	1.3	1.5	1.8	1.9	2.0	1.6	1.7	1.3
Financial services nec	2.3	2.4	3.2	2.8	2.4	2.0	1.6	1.3	3.6	2.1
Insurance	1.0	1.0	2.0	1.0	1.7	1.1	0.7	0.8	1.2	1.0
Real estate activities	1.3	0.9	1.1	1.1	1.4	1.4	0.9	1.0	0.9	0.9
Business services nec	1.5	1.2	1.1	1.2	1.3	1.1	1.8	1.5	1.6	1.2
Recreational and oth.	1.0	0.6	1.2	1.6	1.2	1.0	1.0	0.7	0.8	0.7
Public Administration	0.4	0.3	0.4	0.4	0.5	0.5	0.3	0.3	0.3	0.3
Education	0.4	0.4	0.5	0.4	0.4	0.5	0.3	0.3	0.3	0.3
Human health, social work	0.4	0.3	0.4	0.3	0.5	0.4	0.2	0.3	0.2	0.2

Source: own calculation using UNComtrade trade database (2018) and GTAP database (2014).

UK RCAs are relative to total UK exports to RoW.

3   Review of literature

Below, we provide a brief review of twenty one studies related to the trade effects of Brexit. We briefly summarize the results as well as compare the simulation scenarios. The up-to date literature on Brexit generally uses four broad classes of quantitative trade models (term due to Bekkers 2017).: Computational General Equilibrium (CGE) models, Gravity models (GM), Global Econometric models (GEM) as well as Hybrid models (HM), where the latter combines elements of the first three models. These models differ in their structure and assumptions, ie. CGE models rely on a complicated structure of international and intersectoral linkages together with a large set of elasticities, the gravity models are simpler in their behavioral assumptions but intstead rely largely on panel data to identify the required parameters within the econometric model, while GEM models focus more on time series dynamics while using mostly aggregated macroeconomic data.

 In general, in the case of Brexit trade costs' the different models arrived at range of findings. However, according to most reviewed simulations Brexit will harm the UK's economy, but there are sizeable differences in the expected impact. For example, the most pessimistic results concerning UK exports to the EU predict its drop even by 56% against the Remain scenario (Hantzsche, A. et al. 2018), while total imports from the EU is to be lowered by between 22% to 38% depending on which estimates is considered. Further, increase in trade costs can lead to a reduction of UK GDP level from ca 1% (Ciuriak et al. 2017) to even 9.4-9.5% (Dinghra et al. 2016 and Ottaviano et al. 2014 respectively) in 10 years. Under very specific scenarios that include that generally include the arrangements with the EU concerning FTAs with third countries the UK economy may see a rise of GDP, for example by 0.75% of in a study by Booth et al. 2015.

The level of the EU GDP is expected to generally decrease as a result of Brexit. The cost of Brexit could range from 0.029% (Booth et al. 2015) to 0.8% (Rojas-Romagosa 2016). For example Dinghra et all (2017) predict that in the short run the GDP in UK wil decrease by 2.7% under hard Brexit scenario and by 1.3% under the soft one. The second most affected country is Ireland; 2.6% decline in the case of hard scenario and by 1.1% decline under soft one. The percentage declines for other EU members are much smaller. The relevant figures for hard Brexit range between 0.7 to 0.25 in the case of hard Brexit and the most affected

countries are: Netherlands, Belgium, Denmark, Hungary, Czech Republic, Sweden, Germany and Poland. Majority of other studies predict that in long run the UK GDP can decline by 7 to 9 percent[8].

Detailed investigation on the effects of Brexit on international trade of Poland or the Central and Eastern European Countries in general (CEECs)[9] are not available, but some simulations of macro effects are. According to Rojas-Romagosa, H. 2016 the level of Poland's GDP could be lower by 0.4% to 0.6% in 2030 , while the loss of CEECs GDP may reach 3%, which represents five times the loss of the EU's GDP that sought by this scenario. Further, Hungary could face the highest reduction of the level of GDP amounts to 0.9% in WTO scenario or 0.6% in FTA scenario, since its openness to the UK (understood as a ratio as exports plus import as a share of GDP) amounts to 2.4%.

An adverse impact of Brexit on CEECs is simulated by a model by Felbermayr, G. *et al.* (2015). They show a drop of their GDP of CEECs can be up to 1.82% till 2025. According to this study, of the analyzed CEECs the Czech Republic is affected a largest extent with a change in real income ranging between -0.35% under hard scenario and -0.12% in case of the soft option. Two other analyses (Ciuriak, G. *et al.* 2017 and Booth, S. *et al.* 2015) show in this context more optimistic, though still negative, estimates proving that the costs of the Brexit for the CEECs range between -0.089 and -0.23 of GDP in the long run (table 8). The trade-related scenarios assume changes in tariff barriers (TBs) and non-tariff barriers (NTBs) to trade in goods and services as resulting from Brexit. In the case of TBs, one can distinguish two standard scenarios and several intermediate ones. Standard options assume that TBs can remain at the level of 0% in the case of UK remaining in the Single Market (SM) or that they rise slightly above 3%, when exporters would be a subject to the EU's common external tariffs under the WTO, for the case of the UK leaving the EU without a trade agreement. In this case however, the post-Brexit level of TBs may significantly exceed the standard EU MFN rate level. According to the studies analyzed, the effective tariff rates can vary from ca 4% to 11%, when assuming the variations across countries in tariff rates applied to products (HS classification) for all tradable goods (Berthou *et al.* 2019, Ciuriak *et al.* 2017, Lawless 2016 or Ottaviano *et al.* 2014).

There are several approaches to the treatment of NTBs. They can, however, be classified into two specific categories by virtue of the quantitative approach applied (Francois 2013). The one defined as a bottom-

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[8] See: Dinghra et all. (2016), HM Treasury (2016) or Kierzenkowski (2016). Erken et. all (2017) predict that the UK GDP will drop by 18%.

[9] The block of the Central and Eastern European Countries is understood here as a bloc of seven countries consisted of Poland, Czech Rp., Slovakia, Hungary, Lithuania, Latvia and Estonia.

up, is based on data which are attributable to fractions or percentages (known as micro-data or partitive data) of estimated changes in NTBs level, while the second refers to the empirical evidence of different FTAs in the past (e.g. EU-Norway, EU-Turkey or other). Hence, the bottom-up approach assumes that trade of the UK with the EU, when considering its trade with the EU after Brexit–can be subject to some fraction or percentage of the reducible NTBs, that is the fraction of the trade cost that could in principle be eliminated (or increased) by policy action of the referenced state (such as the third countries outside the EU, for example the US). The weighted average of the sectoral reducible NTBs can be calculated using total UK-EU trade in each sector as weights and the subset of sectors. In the case of Brexit, some studies suggest that the costs of NTBs can rise by 25% and 75% of the reducible costs faced by the USA in trade relation with the EU (Dinghra *et al.* 2017) or by ¼ and ⅔ of NTBs between the EU-US as well as 45% of the rate of EU-US trade (Erken *et al.* 2016).

The top-down approach implies that the *ad valorem* equivalent of increasing NTBs can be inferred from gravity estimations as applied for example by Hantzsche *et al.* (2018), or Rojas-Romagosa (2016). Thus, Hantzsche, A. *et al.* assumes that Brexit will create NTBs, the opposite effect to the European integration process, or to the effect of average FTA in the past. According to this study, the potential elevated level of the post-Brexit NTBs mirrors, in general, the scope of their decline during the period of UK's membership in the EU. At the same time, it is expected that these post-Brexit NTBs can be higher than they are currently between the EU and Norway or between the EU and Switzerland. According to Rojas-Romagosa, H., *ad valorem* equivalents of the post-Brexit NTBs amount to 12.9 concerning the trade in goods and services, if the UK decides to leave the EU on the WTO conditions and 6.4 for both types of trade, should the UK conclude a trade agreement with the EU.

Based on the differences in the simulated TBs and NTBs increases found in the up-to date literature, one can identify the following Brexit scenarios: No-Deal scenario, a few limited agreements or comprehensive/deep FTA understood usually as a Soft scenario. These scenarios are defined as follows:

1. Hard, No Deal Brexit or WTO option, which assumes that both parties will be applying MFN tariffs to each other that can also be combined with trade liberalization with the third countries providing a slightly softer option (Felbermayr *et al.* 2018; Brakman *et al.* 2017 or HM Treasury 2018), ie:
   - the Anglosphere, sometimes identified with the Global Britain policy option, envisages closer trade relations, such as free trade agreements with other English-speaking countries, including the US, Canada, Australia and New Zealand;

- Unilateral Free Trade (TFT) solution assumes that UK unilaterally abolishes all tariffs on imported goods (from the EU and all other countries), whilst it will face EU MFN tariffs for goods sold to the EU;

2. Several FTA scenarios, which imply that both parties conclude a comprehensive trade deal, which reduces tariffs on goods exchanged between the UK and EU well below EU's current MFN rates. These include:

- a free trade deal between the EU and three of the European Free Trade Association (EFTA) members (Norway, Iceland and Lichtenstein, Switzerland decided to stay out) allowing for tariff-free access to the EU's Single Market and gives right to control own external trade policy;

- a free trade agreement (FTA) with the EU similar to the agreement with Switzerland;

- a customs union with the EU outside the framework of the EU treaties and institutions called as Turkish solution;

- A comprehensive/deep FTA;

Below we present a summary of the main findings of selected analysed papers.

Table 4. Brexit impact on trade, computable equilibrium models (CGE): short (2yr's) to long-term (2030)

Authors/Year	Main scenarios			Main findings
	Hard v. Soft	Tariffs	NTBs	
Ciuriak *et al.* (2017)	**H:** WTO **S:** EEA (SM effect)	schock na	as faced by EU firms in Canada no NTBs f/goods	**H:** UK's exports to ROW: -6.75% UK's imports to ROW: -7.53% **S:** UK's exports to ROW: up to -6.63% UK's imports to ROW: up to -7.34%
Kee & Nicita (2016)	**H:** WTO (2 yr's) **S:** na	EU MFN	based on Bown, Kee, Nicita, (2016)	**H:** UK's goods exports: -2% **S:** na
PWC (2016)	**H:** WTO **S:** UK-EU FTA	EU MFN 0% f/goods	rise by ⅔ of UK-EU NTBs rise by ¼ of UK-EU NTBs	**H:** UK's overall trade: -2.1% GDP **S:** UK's overall trade: -0.5% GDP
Booth *et al.* (2015)	**H:** WTO **S:** UK-EU FTA	MFN EU-EFTA	as faced by EU in Canada no NTBs f/goods	**H:** TBs & NTBs: -2.79 % of GDP **S:** NTBs: -1.03 % of GDP
CEPR (2013)	**H:** WTO **S:** UK-EU FTA	MFN na	as faced by US to access SM as faced by US under TTIP+ROOs	**H:** TBs & NTBs: -1.77 % of GDP **S:** NTBs: -1.24 % of GDP

Table 5. Brexit impact on trade, global econometric models (GEM): medium (5 yr's) to long-term (2030)

Authors/Year	Main scenarios			Main findings (in %)
	Hard v. Soft	Tariffs	NTBs	
Berthou *et al.* (2019)	**H:** WTO, Q1 2019 **S:** na	4.2 ÷ 5.3%	na na	**H:** UK's overall trade: -30% **S:** na
Cambridge Econometrics (2018)	**H:** WTO **S:** EEA	MFN 0%	based on Berden *et al.* (2009, 2013) no new NTBs	**H:** UK's exports to ROW: -2.3% UK's imports to ROW: -4.6% **S:** UK's exports to ROW: -0.4 ÷ -0.6% UK's imports to ROW: -1.5 ÷ -2.3%

Hantzsche *et al.* (2018)	**H:** WTO	MFN	based on selected studies	**H:** UK's trade to EU: -56%
	S: FTA	0%	based on selected studies	**S:** UK's trade to EU: -30 ÷ -46%
Erken *et al.* (2016)	**H:** WTO	MFN	rise by ⅔ of EU-US NTBs	**H:** UK's exports to EU: -19%
	S: FTA	0%	raise by 45% of EU-US trade	**S:** UK's exports to EU: -6 ÷ **-10%**
Ebell & Warren (2016)	**H:** WTO	5%	based on selected studies	**H:** UK's trade to EU: -20.7 ÷ -29.2%
	S: FTA	na	based on selected studies	**S:** UK's trade to EU: -10.5 ÷ **-17.5%**

Table 6. Brexit impact on trade, gravity models (GM): long term (2030)

Authors/Year	Main scenarios			Main findings (losses)
	Hard v. Soft	**Tariffs**	**NTBs**	
Brakman *et al.* (2017)	**H:** WTO	na	na	**H:** UK VAX: up to -18%
	S: TAs w/third coun.	na	na	**S:** UK VAX: up to -13.08%
Dinghra *et al.* (2017)	**H:** WTO	MFN	8.3%	**H:** UK-EU exports: -43% UK-EU imports: -38%
	S: EEA	0%	2.8%	**S:** UK-EU exports: -25% UK-EU imports: -22%
Oberhofer & Pfaffermayr (2017)	**H:** WTO	MFN	na	**H:** UK-EU exports: -29.4 ÷ **-35.5%**
	S: FTA	na	no NTBs	**S:** UK-EU exports: -13.2 ÷ **-16.3%**
HM Treasury (2016)	**H:** WTO	MFN	na	**H:** UK's overall trade: -17 ÷ -24%
	S: EEA	0%	na	**S:** UK's overall trade: by -9%
Lawless & Morgenroth (2016)	**H:** WTO	eff. rates:11÷25%	na	**H:** UK's exports to EU: by -22%
	S: na	na	na	**S:** na
Felbermayr *et al.* (2015)	**H:** UK's isolation	MFN	restored NTBs: no data	**H:** UK exports to EU: -14 ÷ -21%
	S: Soft exit	0%	as above	**S:** UK exports to EU: -4 ÷ -6%
Ottaviano *et al.* (2014)	**H:** Pessimistic	7%	rise by ⅔ of EU-US NTBs	**H:** UK's overall trade: by -12,6 %
	S: Optimistic	0%	rise by ¼ of EU-US NTBs	**S:** UK's overall trade: by -9 %

Table 7. Brexit impact on trade, hybrid models (HM): long term (2030)

Authors/Year	Main scenarios			Main findings (losses)
	Hard v. Soft	**Tariffs**	**NTBs**	
Felbermayr *et al.* (2018)	**H:** WTO (2014)	MFN	gravity EU/UK coefficient	**H:** UK's overall exports: -4.33 ÷ **-12.36%** UK's overall imports: -3.37 ÷ **-11.22%**
	S: FTA	0%	South Korea coefficient	**S:** UK's overall exports: -12.36% UK's overall imports: -11.22%
HM Treasury (2018)	**H:** WTO	agrigoods: 20% manf. goods: 3%	average f/count. on non-preferential WTO terms	**H:** UK-EU total trade: -42÷-32%
	S: FTA	0%	goods: 0÷1%; services: 2÷10%	**S:** UK-EU total trade: -9 ÷ -3%
Kierzenkowski *et al.* (2016)	**H:** WTO	EU MFN	restricted access to SM	**H:** UK's overall trade: -10 ÷ **-20%**
	S: FTA	rel. free with EU	na	**S:** UK's exports to ROW: -10 ÷ -15%
Rojas-Romagosa (2016)	**H:** WTO	MFN	average: 12.9 %	**H:** UK's trade to EU: -51.3%
	S: FTA	0%	average: 6.4%	**S:** UK's trade to EU: -31%

Table 4 Brexit impact on trade, computable equilibrium models (CGE): short (2yr's), medium (5 yr's) to long-term (2030)

Authors/Year	Main scenarios	Main findings
Ciuriak, D. *et al.*, 2017	**Hard:** WTO rules **Soft**: EEA membership	**Hard:** loss of UK's total exports to ROW: 6.75% loss of UK's total imports to ROW: 7.53% **Soft:** loss of UK's total exports to ROW: 1.72÷6.63% loss of UK's total imports to ROW: 2.20÷7.34%
Kee, H.L. & Nicita, A. (2016)	**Hard:** EU MFN rules (2 yr's) **Soft:** na	**Hard:** loss of UK's goods exports: 2% **Soft:** na
PWC (2016)	**Hard:** WTO rules, (baseline: UK in EU) **Soft:** UK-EU FTA	**Hard:** loss of UK's overall trade: 2.1% GDP **Soft:** loss of UK's overall trade: 0.5% GDP
Booth, S. *et al.* (2015)	**Hard:** WTO rules **Soft:** UK-EU FTA	**Hard:** cost of TBs & NTBs: 2.79 % of GDP **Soft:** cost of NTBs: 1.03 % of GDP
CEPR (2013)	**Hard:** WTO rules **Soft:** UK-EU FTA	**Hard:** cost of TBs & NTBs: 1.77 % of GDP **Soft:** cost of NTBs: 1.24 % of GDP

Table 5 Brexit impact on trade, global econometric models (GEM): medium (5 yr's) to long-term (2030)

Authors/Year	Main scenarios	Main findings
Berthou, A. *et al.* (2019)	**Hard:** WTO rules (baseline: Q1 2019) **Soft:** na	**Hard:** loss of UK's overall trade: 30% **Soft:** na
Cambridge Econometrics (2018)	**Hard:** WTO rules (baseline: SM + CU) **Soft**: EEA membership (Turkey, Norway)	**Hard:** loss of UK's total exports to ROW: 2.3% loss of UK's total imports to ROW: 4.6% **Soft:** loss of UK's total exports to ROW: 0.4÷0.6% loss of UK's total imports to ROW: 1.5÷2.3%
Hantzsche, A. *et al.* (2018)	**Hard:** WTO rules (baseline: UK in the EU) **Soft:** TAs with third countries	**Hard:** loss of UK's total trade to EU: 56% **Soft:** loss of UK's total trade to EU: 30÷46%
Erken, H. *et al.* (2016)	**Hard:** EU MFN rules (baseline: as above) **Soft:** UK-EU FTA	**Hard:** loss of UK's total exports to EU: 19% **Soft:** loss of UK's total exports to EU: 6÷10%
Ebell, M.I. & Warren, J. (2016)	**Hard:** TBs: rise by 5% (baseline: as above) **Soft:** UK-EU FTA (Norway, Switzerland)	**Hard:** loss of UK's total trade to EU: 20.7÷29.2% **Soft:** loss of UK's total trade to EU: 10.5÷17.5%

Table 6 Brexit impact on trade, gravity models (GM): long term (2030)

Authors/Year	Main scenarios	Main findings
Brakman, A. *et al.* (2017)	**Hard:** WTO rules **Soft:** TAs with third countries	**Hard:** loss of UK VAX: by 18% **Soft:** loss of UK VAX: by 13.08%
Dinghra, S. *et al.* (2017)	**Hard:** WTO rules **Soft**: EEA membership	**Hard:** loss of UK-EU exports: 43%; imports: 38% **Soft:** loss of UK-EU exports: 25%; imports: 22%
Oberhofer, H. & Pfaffermayr, M. (2017)	**Hard:** WTO rules **Soft:** TAs with third countries	**Hard:** loss of UK-EU exports: 29.4÷35.5% **Soft:** loss of UK-EU exports: 13.2÷16.3%
HM Treasury (2016)	**Hard:** WTO rules or 3 specific BAs (baseline: WTO membership) **Soft:** EEA membership	**Hard:** loss of UK's overall trade: 17÷24% **Soft:** loss of UK's overall trade: by 9%
Lawless, M. & Morgenroth, E.L. (2016)	**Hard:** WTO rules **Soft:** na	**Hard:** loss of UK's exports to EU: by 22% **Soft:** na
Felbermayr et al. (2015)	**Hard:** Isolation of the UK **Soft:** Soft exit	**Hard:** loss of UK exports to EU: 14÷21% **Soft:** loss of UK exports to EU: 4÷6%
Ottaviano, G.I.P *et al.* (2014)	**Hard:** Pessimistic **Soft:** Optimistic	**Hard:** loss of overall trade of UK: by 12,6 % **Soft:** loss of overall trade of UK: by 9 %

Table 7 Brexit impact on trade, hybrid models (HM): long term (2030)

Authors/Year	Main scenarios	Main findings
Felbermayr, G. *et al.* (2018)	**Hard:** WTO rules (baseline: 2014) **Soft:** Ambitious EU-UK FTA	**Hard:** loss of UK's total exports: 4.33÷12.36% loss of UK's total imports: 3.37÷11.22% **Soft:** loss of UK's total exports: 12.36% loss of UK's total imports: 11.22%
Kierzenkowski, R. *et al.* (2016)	**Hard:** WTO rules **Soft:** EU-UK FTA	**Hard:** loss of UK's overall trade: 10÷20% **Soft:** loss of UK's total exports to ROW: 10÷15%
Rojas-Romagosa, H. (2016)	**Hard:** WTO rules **Soft:** UK-EU FTA	**Hard:** loss of UK's total trade to EU: 51.3% **Soft:** loss of UK's total trade to EU: 31%

Table 8 Brexit impact on GDP/real GDP in UK, EU 27, Poland & CEEC, long-term (2030)

Authors/Year	Model	Main scenarios : Hard v. Soft	Findings (losses), in %			
			UK	**EU 27**	**Poland**	**CEEC**
Ciuriak *et al.* (2017)	CGE	**H:** WTO **S:** EEA	**H:** -2.54 **S:** -0,967	**H:** -0.237 **S:** -0.109	**H:** -0.236 **S:** -0.093	**H:** -0.23 **S:** -0.087
Rojas-Romagosa (2016)	CGE	**H:** WTO **S:** UK-EU FTA	**H:** -4.1 **S:** -3.4	**H:** -0.8 **S:** -0.6	**H:** -0.6 **S:** -0.4	**H:** -3 **S:** -2.4
Booth *et al.* (2015)	CGE	**H:** WTO **S:** UK-EU FTA	**H:** -2.759 **S:** -1.03	**H:** -0.335 **S:** -0.12	**H:** -0.281 **S:** -0.10	**H:** -0.260 **S:** -0.09
Felbermayr *et al.* (2015)*	Gravity	**H:** WTO **S:** EU-UK FTA (Norway, Switzerland)	**H:** -2.98 **S:** -0.64	**H:** -0.36 **S**: -0.10	**H:** -0.24 **S**: -0.07	**H:** -1.82 **S**: -0.62

Note: in case of IV.Felbermayr *et al.* (2015) the real GDP is calculated; long-term is assumed as 2025

4 Methodology

4.1 Simulation model

The core tool we use to evaluate the effects of trade liberalization is the GTAP global computable general equilibrium model and a global database developed by the Global Trade Analysis Project at Purdue University. We employ version 10 of the GTAP database released in late 2019 with the latest base year of 2014. This version of the database provides a more detailed sectoral classification than the previous edition and has information on 65 sectors in 141 regions (with 121 individual country data). This data includes information on the production volume, sales both domestic and international, intermediate use and primary factor use. It also contains information about bilateral trade between countries in both goods and services. For the purpose of this paper, we have created an aggregated database covering 21 countries/regions and 40 sectors (we joint the very detailed agricultural and food sectors into two aggregate sectors as well as created the country/regional division with a focus on Europe and its major trading partners).

The GTAP framework is a commonly used framework for trade policy analysis. The structure of the model is relatively simple and follows the logic of a neo-classical static computable general equilibrium model with perfect competition while allowing for a large range of policy related simulations – it includes a variety of tax, subsidy and other policy instruments[10].

The central economic agent in the GTAP model is the regional household that maximizes the regional utility subject to regional income constraints. This regional household takes all the expenditure decisions within the region's economy, by is choosing the levels of private consumption, government expenditures and savings. The decision making process of the household is multi-level, ie. it involves maximization of a nested utility structure. In the top nest the private consumption, public consumption and overall regional savings are aggregated using a Cobb-Douglas function leading to constant shares of consumption and spending in total expenditure. Private consumption demand is governed by a Constant Difference of Elasticity preferences to account for the non-homothetic nature of consumption demand, ie. it allows for non-unitary price and income elasticities of demand and therefore variable shares of goods and services in total consumer expenditure. Government consumption is, on the other hand, a Cobb-Douglas composite. For each consumption type, domestically produced variety of goods is an imperfect substitute to imports and each imports coming from each source are imperfect substitutes to each other, ie. the so-

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[10]For a complete description of the model consult Hertel, Tsigas (1997).

called Armington assumption. The allocation of expenditure across domestic/imported goods and across sources of imports follows the constant elasticity of substitution aggregator.

Firms produce using intermediate goods and primary factors purchased from the regional household. The sources of primary factors are purely domestic – it is assumed that the factors are strictly immobile internationally and mobile within a region (with exception of land and natural resources). The intermediate goods can be either domestically produced and imported. Factor markets are perfectly competitive.

4.2 Non-tariff barriers

All our simulation scenarios (see later in this section) involve increases in tariff and non-tariff barriers. Tariff levels are freely available both at the most favored nation (MFN) and effectively applied levels from the TRAINS/WITS database and this serves as the basis for the structure of the shocks imposed on the model. However, while NTBs estimates are available both for goods and services in several papers including (Dean et al. (2009), Berden et al. (2009, 2013), Fontagne et al. (2013), Egger et al. (2015), they are scattered, ie. are done for outdated data, different time periods, different sectoral classification. We decided to provide our own estimates using a gravity framework to provide full compatibility with the GTAP framework.

We use GTAP data as a source of bilateral trade data for a panel of two time periods, ie. 2011 and 2014. Data on standard gravity macro variables (ie. GDP and population) comes from World Development Indicators and the time-invariant gravity variables (ie. distances, contiguity, common language, colonial ties) comes from CEPII geo-dist database.

We loosely follow Fontagne, Guillin and Mitaritonna (2011) and obtain tariff equivalents of NTBs from a gravity model of the form:

$$imports_{ijt}^s = a_0^s + a_1^s GDP_{it} + a_2^s GDP_{jt} + a_3^s POP_{it} + a_4^s POP_{jt} + a_5^s DIST_{ij} + a_6^s CONT_{ij} + a_7^s LANG_{ij}$$

$$+ a_8^s COL_{ij} + a_9^s EU_{ijt} + Fe_i^s + Fe_j^s + u_{ijt}^s$$

where all level variables are expressed in natural logarithms, i refers to reporter, j refers to partner country, t is the time period and s is the good/service category of the GTAP classification, *imports* refers to bilateral imports, *GDP* to gross domestic product in partner and reporter country in current USD, *POP* to level of population, *DIST* to distance between capitals, *CONT* – contiguity, *LANG* – common language, *COL* – *common colonial past*. In the above equation EU_{ijt} is a dummy variable that takes a value of 1 when

both countries are members of the EU and zero otherwise and *Fe* refer to reporter and partner fixed effects. The last term in the above equation is the error term.

The estimates of reporter-level fixed effects provide an average level of imports of a particular reporter when all the other gravity variables are accounted for. Therefore a difference between country *i* fixed effect and some reference country fixed effect provide *caeteris paribus* an approximate percentage deviation in trade between that country and a reference country. One could choose the reference country to be the most liberal country in the sample, ie. having the highest reporter-level fixed effect.

Given that the time-invariant Armington elasticity provides a link between a percentage change in price of a particular variety and a change in import demand, the deviation of trade between a country *i* and a reference country is linked to a level of hypothetical tariff that would restrict the level of trade through the following equation:

$$-\sigma^s \ln t_i^s = Fe_i^s - Fe_{ref}^s$$

We obtain the average fixed effects for all countries, select the reference country for each sector and compute the average differences between the reporter fixed effects of the EU countries and those of the reference country. Then, using GTAP sectoral Armington elasticity, we recover the t_i^s – the tariff equivalent of NTBs. While this tariff equivalent refers to the tariff equivalent of NTBs in trade of the EU with the third countries, we still need to obtain the level of NTBs in the Single Market. This is obtained by the use of the EU dummy which provides the average boost in trade that is due to both reporter and partner taking part in the Single Market, and therefore through the use of the Armington elasticity, we obtain the percentage difference between the internal and external EU NTBs. If the EU average reporter fixed effect plus the EU dummy is larger than the initial reference country reporter fixed effect, therefore the internal EU NTBs are lower than that of the reference country and therefore EU becomes the reference country with zero NTBs. The estimated NTBs along with the applied and MFN external tariffs for the EU are given in Table 9.

Table 9 EU external tariff and estimated tariff equivalents of NTBs

	Applied Tariff	MFN Tariff	NTB Intra EU	NTB Extra EU
Agriculture	2.31	4.76	0.0	26.9
Fishing	1.78	3.19	20.5	43.5
Mining	0.00	0.00	6.1	11.7
Food	11.27	16.74	0.0	19.9
Beverages & Tobacco	5.62	7.98	0.0	31.2
Textiles	4.39	7.59	1.1	8.8
Wearing Apparel	6.33	11.37	0.0	15.3
Leather	7.74	9.25	0.0	13.8
Wood	1.54	2.01	1.0	10.7
Paper, Publishing	0.04	0.09	6.9	18.7
Fuels	1.43	1.77	19.2	27.1
Chemicals	3.13	4.45	7.7	19.0
Pharmaceuticals	0.31	0.57	0.0	13.8
Rubber & Plastics	3.33	4.71	8.2	16.3
Non-metalic minerals	3.16	4.10	6.5	12.7
Steel	0.30	0.63	33.8	47.8
Metals nec	1.03	1.90	32.1	44.9
Metal products	2.03	2.63	8.0	11.5
Electronics and opticals	0.86	1.12	8.1	14.3
Electrical equipment	1.77	2.39	8.5	11.1
Machinery and equipment nec	1.02	1.33	14.6	15.5
Motor vehicles and parts	3.94	7.30	0.0	11.4
Transport equipment nec	1.59	1.86	8.8	6.3
Manufactures nec	0.96	1.13	9.6	15.3
Energy			0.4	7.5
Construction			29.0	37.1
Trade			32.9	39.0
Accommodation and Food			34.9	39.2
Transport nec			36.8	44.4
Water transport			9.7	10.6
Air transport			6.4	11.2
Warehousing and support			32.2	37.1
Communication			25.5	31.2
Financial services nec			46.2	55.0
Insurance			58.1	65.8
Real estate activities			28.5	33.6
Business services nec			21.8	26.7
Recreational and oth.			30.5	32.9
Public Administration			25.4	34.5
Education			15.0	22.2
Human health, social work			10.8	16.9

Tariffs are tariffs weighted averaged across all extra-EU partners for 2014. NTBs from gravity model estimations.

4.3 Simulation scenarios

In our study we analyze several scenarios reflecting likely outcomes of Brexit negotiations. In our opinion, they reflect reasonable and realistic assumptions on the outcomes of the negotiation process. First, we exclude the possibility of very soft Brexit, i.e. participation of the UK in the EEA. Therefore, we assume that in each scenario border costs will increase by 2.5%, reflecting additional burden related to border controls, customs administration, controls of sanitary requirements and other costs of non-participation in the EEA. Second, we assume that agriculture is a very sensitive sector in Brexit negotiations, since the UK always complained about high level of Common Agricultural Policy protection. Thus, we assume that in the Soft Brexit C, there is no FTA agreement on agricultural products and EU tariffs raise to MFN level, while in Hard Brexit A the UK cuts its external tariffs by half with respect to the EU MFN level. Moreover, we assume that the level of NTB protection in agricultural products increases gradually, when we switch from Soft to Hard Brexit. Third, we assume that the tariffs on non-agricultural products, which are relatively low, can be easily eliminated within the FTA between EU and UK and stay at MFN levels only in the case of Hard Brexit. The level of tariff equivalents of NTB's will increase in the case of Hard Brexit. Fourth, we assumed that the tariff equivalents of NTBs will increase in the case of services, since we believe that service sectors will be burdened by some barriers even under the FTA agreement in the case of soft Brexit. The NTBs in the services sectors will significantly increase in the case of Hard Brexit, since the scope of WTO services' liberalization (within the GATS) is fairly limited. Fifth, in the Soft Brexit A scenario we assume that the external trade relations of the UK remain unchanged, i.e. we do not analyze possible future FTA agreements to be concluded by the UK with other countries. In all other scenarios we assume that UK applies external MFN tariffs to all other countries with which the EU has preferential trade agreements[11].

Basing on the above assumptions we propose three versions of Soft Brexit scenarios and two of the Hard Brexit. A brief description of each scenarios is presented in the Table 10. The Soft Brexit A scenario is the most liberal. We assume full FTA covering all products and assume that the level of tariff equivalents of NTBs remains unchanged, ie. will remain and the intra-EU level. In the case of Hard Brexit B the difference is small; we assume that the UK applies MFN external tariffs to all countries with which the UE has preferential agreements and vice versa. In the case of Hard Brexit C in addition we assume that the

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[11] This assumption means that the UK tariffs increase in relations with other countries, which can be questionable in terms of the WTO commitments (Article II and XXIV).

sensitive agricultural sector is excluded from the FTA agreement (like in many FTA of the EU with third countries) and scope of services' trade liberalization is limited.

The hard Brexit scenarios are based on the assumption that the UK leaves the EU27 without an FTA agreement. In the more liberal Hard Brexit A scenario we assume that the UK applies MFN external tariffs to all its partners, including EU27 countries. The level of external protection of NTM's does increase, but the UK cuts the tariffs on agricultural products by 50%, since British politicians are convinced that the EU level of protection is too high, and the country imports large quantities of agricultural products from various origins. In the case of Hard Brexit B the UK keeps the level of MFN agricultural tariffs unchanged (i.e. equal to the common external tariff of the EU) and the level of NTB's in this sector is only slightly less restrictive (75%), in comparison to the high level of protection of the CAP. The summary of basic assumption of five scenarios is presented in Table 10.

The tariff shocks imposed on the model are based on the differences between internal zero EU tariffs and MFN tariffs for 2014 (the base year for GTAP database) for intra-EU trade and on the differences between the effectively applied tariffs between the EU and the rest of the world and the MFN tariffs in the case of UK trade with the rest of the world. We use the initial levels of tariffs present in the GTAP database and impose a shock to the power of tariff (1+tariff) that correspond to our intended tariff increase. The shocks to NTBs are imposed through the trade shift parameter corresponding to the iceberg cost of trade in the GTAP model (ie. an increase in price and a corresponding decrease of the delivered quantity of the imported goods).

Table 10 Brexit scenarios – from least restrictive to most restrictive

Scenario	Agriculture & food	Manufacturing	Services
Soft Brexit A (full FTA + UK tariffs vs RoW stay intact including preferential agreements of EU)	Zero tariffs, Internal EU NTBs, + border costs 2.5% in UK-EU trade	Zero tariffs, Internal EU NTBs, + border costs 2.5% in UK-EU trade	25% of external EU NTBs, + border costs 2.5% in UK-EU trade
Soft Brexit B (full FTA + UK sets EU MFN tariff on RoW)	Zero tariffs with EU, MFN UK external tariffs. Internal EU NTBs, + border costs 2.5% in UK-EU trade	Zero tariffs with EU, MFN UK external tariffs. Internal EU NTBs, + border costs 2.5% in UK-EU trade	25% of external EU NTBs, + border costs 2.5% in UK-EU trade
Soft Brexit C (partial FTA excluding agriculture and limited FTA on services)	MFN tariffs, NTBs: 50% of external level, + border costs 2.5% in UK-EU trade	Zero tariffs. MFN external tariffs. Internal EU NTBs, + border costs 2.5% in UK-EU trade	50% of external EU NTBs , + border costs 2.5% in UK-EU trade
Hard Brexit A (with external merchandise trade liberalization)	EU: MFN tariffs, UK: 50% of the EU MFN across all partners, NTBs: 50% of external level, + border costs 2.5% in UK-EU trade	MFN tariffs, UK: 50% of the EU MFN NTBs: 25% of external level, + border costs 2.5% in UK-EU trade	100% of external EU NTBs, + border costs 2.5% in UK-EU trade
Hard Brexit B	MFN EU tariffs, NTBs: 75% of external level + border costs 2.5% in UK-EU trade	MFN EU tariffs, NTBs: 25% of external level, + border costs 2.5% in UK-EU trade	100% of external EU NTBs, + border costs 2.5% in UK-EU trade

5 Results

We begin with aggregated macro results that provide the reader with the overall scale of effects of different scenarios and the likely distribution of the effects across the analyzed countries. Overall, the soft Brexit scenarios lead to very mild macroeconomic effects of a drop in GDPs of analyzed countries of less than 0.1 percent of GDP in the short run. In particular, from the point of view of the NMS there is not much of a difference at the macro level between Soft Brexit A and Soft Brexit B with a slightly larger effect of the Soft Brexit C. Among the NMS Czechia and Hungary stand out with a roughly 40% larger drop in GDP than in the case of Poland, which is due mainly to higher export intensity and smaller size of those economies. The effect on the GDP of the main trading partner of the NMS – Germany is of similar size. In-line with other studies, Netherlands is slightly more affected than other EU countries. The shock in the UK is of a much higher magnitude and so is the one in Ireland which on top of it being highly connected to the UK, it is also a much smaller economy than that of the UK. The effects for the non-EU countries are negligible.

Table 11 Simulated changes in GDP

	SoftA	SoftB	SoftC	HardA	HardB	SoftA LR	HardB LR
Poland	-0.05	-0.05	-0.07	-0.11	-0.11	-0.15	-0.36
Czechia	-0.07	-0.07	-0.08	-0.15	-0.14	-0.23	-0.42
Slovakia	-0.04	-0.04	-0.05	-0.08	-0.08	-0.12	-0.21
Hungary	-0.07	-0.07	-0.09	-0.14	-0.14	-0.15	-0.30
Germany	-0.06	-0.06	-0.07	-0.12	-0.12	-0.12	-0.26
France	-0.05	-0.05	-0.07	-0.11	-0.11	-0.09	-0.20
Netherlands	-0.10	-0.09	-0.13	-0.22	-0.23	-0.30	-0.76
Ireland	-0.55	-0.55	-0.78	-1.29	-1.34	-2.40	-8.74
Rest of NMS	-0.06	-0.06	-0.08	-0.13	-0.14	-0.17	-0.36
Rest of EU-14	-0.07	-0.07	-0.09	-0.16	-0.16	-0.16	-0.36
UK	-0.49	-0.54	-0.73	-1.09	-1.25	-1.01	-2.14
Rest of Europe	0.01	0.00	0.00	0.02	0.02	0.05	0.08
Russia, Belarus, Ukraine	0.00	0.00	0.00	0.01	0.01	0.02	0.05
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.01
Rest of N. America	0.00	0.00	0.00	0.01	0.01	0.01	0.02
China	0.01	0.01	0.01	0.02	0.02	0.01	0.04
India	0.00	0.00	0.00	0.01	0.01	0.01	0.06
Rest of Asia	0.00	0.00	0.00	0.01	0.00	0.01	0.03
South America	0.00	0.00	0.00	0.01	0.01	0.01	0.03
MENA	0.00	0.00	0.00	0.00	0.00	0.03	0.03
ROW	0.00	0.00	0.00	0.01	0.01	0.14	-0.08

Source: own simulation

Hard Brexit scenarios lead to results roughly twice as large in the short run as those of the Soft Brexit. For the NMS they are, however, rather moderate with the effect on Poland at -0.11 percent of GDP and again,

roughly 40% more, ie. -0.14-0.15 of GDP for Czechia and Hungary. For Germany and France the shock is of similar magnitude as that of Poland, while the effects for the UK and Ireland both exceed 1 percent of GDP.

Turning to long term effects of Brexit, due to overall drop in investment (detailed results shown in Table 15 in the Appendix) as an immediate effect of increasing trade barriers, the capital stock falls leading to a magnification of the effects observed in the short term scenarios. In particular, in the NMS the difference in the expected results between Soft and Hard Brexit is 0.2 percent of GDP, ie. with Soft Brexit amounting to a fall in GDP by 0.2 percent and Hard Brexit – to a fall of 0.4 percent of GDP. The effects for the UK are between 1.0 and 2.1 percent of GDP[12].

Table 12 Simulated changes in welfare

	SoftA	SoftB	SoftC	HardA	HardB	SoftA LR	HardB LR
Poland	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	-0.4
Czechia	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.4
Slovakia	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.2
Hungary	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2
Germany	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2
France	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2
Netherlands	-0.1	-0.1	-0.2	-0.3	-0.3	-0.2	-0.7
Ireland	-0.6	-0.5	-0.9	-1.3	-1.5	-1.5	-5.4
Rest of NMS	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.3
Rest of EU-14	-0.1	-0.1	-0.1	-0.2	-0.2	-0.1	-0.3
UK	-0.8	-0.9	-1.1	-1.9	-2.0	-1.0	-2.2
Rest of Europe	0.1	0.1	0.1	0.2	0.2	0.1	0.1
Rus., Bel., Ukr.	0.0	0.0	0.0	0.1	0.1	0.0	0.1
USA	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Rest of N. America	0.0	0.0	0.0	0.0	0.0	0.0	0.0
China	0.0	0.0	0.0	0.1	0.1	0.0	0.1
India	0.0	0.0	0.0	0.1	0.1	0.0	0.1
Rest of Asia	0.0	0.0	0.0	0.0	0.0	0.0	0.0
South America	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MENA	0.0	0.0	0.0	0.1	0.1	0.0	0.0
ROW	0.0	0.0	0.0	0.1	0.1	0.1	0.0

Source: equivalent variation as % of GDP

As far as welfare results are concerned they largely follow the changes in GDP. The slight differences for the NMS and the EU-14 members stem from the adjustments in terms of trade. In particular Poland, Germany, France, Netherlands and the UK experience a slight decrease of the TOT while smaller countries

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[12] One can question the validity of results for Ireland, which result from a small size of the economy and high degree of openness, high involvement in trade with the UK, in particular in intermediate and investment goods. In order to check for the sensitivity of results to those large shocks in Ireland, we softened the shock in Ireland by a factor of 50% to find that the drop in GDP in the UK was reduced by less than 0.1 of GDP and for the remaining countries the difference between the simulation results were negligible.

such as Czechia, Slovakia, Hungary and Ireland experience an improvement in the TOT, leading to milder negative welfare effects.

The moderate effects on the aggregate output stem from relatively mild effects on the overall exports ranging from -0.1 to 0.5 in the NMS and slightly larger in the EU countries as it reflects moderate shares of the UK in bilateral trade of those economies. On the other hand, the effects on trade of the UK (and to a smaller extent in Ireland) is larger by more than an order of magnitude (Table 13). One may also take a look on the changes in the aggregate bilateral trade flows (these are presented in

Table 16 and Table 17). The simulated drop in trade between Poland and the UK ranges from 9.3 in the case of Polish exports in the Soft Brexit A scenario to 30.3 percent in the Hard Brexit B scenario in the short run (with the long-run versions of these scenarios showing similar magnitude of trade changes) and a slightly softer response of imports. An increase in intra-EU trade compensates some of that drop, ie. in Poland exports to the EU increase by 0.5 to 1.5 percent depending on a scenario. Similar adjustments are found in other NMS.

Table 13 Overall changes in international trade

	SoftA	SoftB	SoftC	HardA	HardB	SoftA LR	HardB LR
				Exports			
Poland	-0.1	0.0	-0.1	-0.2	-0.3	-0.2	-0.5
Czechia	0.0	0.0	0.0	0.0	0.0	-0.2	-0.3
Slovakia	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Hungary	0.0	0.0	0.0	0.1	0.1	-0.1	-0.1
Germany	-0.1	-0.1	-0.1	-0.4	-0.4	-0.2	-0.6
France	-0.1	-0.1	-0.2	-0.4	-0.4	-0.2	-0.5
Netherlands	-0.2	-0.1	-0.4	-0.6	-0.7	-0.4	-1.2
Ireland	-0.2	-0.1	-1.1	-1.5	-1.8	-2.0	-8.8
Rest of NMS	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.3
Rest of EU-14	-0.1	0.0	-0.1	-0.3	-0.3	-0.2	-0.6
UK	-3.2	-4.1	-5.6	-9.0	-10.9	-2.8	-9.6
				Imports			
Poland	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.5
Czechia	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.3
Slovakia	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1
Hungary	0.0	0.0	0.0	0.0	0.0	-0.1	-0.2
Germany	0.0	0.0	-0.1	-0.2	-0.2	-0.2	-0.5
France	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.4
Netherlands	-0.1	-0.1	-0.1	-0.3	-0.3	-0.4	-1.0
Ireland	-0.1	-0.1	-0.6	-0.8	-0.9	-2.3	-9.3
rNMS	0.0	0.0	0.0	-0.1	-0.1	-0.1	-0.3
rEU15	0.0	0.0	0.0	-0.2	-0.2	-0.2	-0.5
UK	0.2	-0.4	-1.8	-1.1	-3.1	-2.4	-9.6

Source: own simulation. Total trade (merchandise + services trade)

Given that our scenarios cover the whole range of productive and services sectors, the changes in outputs are not concentrated in selected sectors (the results are shown in Table 18 in the Appendix A1). Moreover,

general equilibrium effects and relative differences in imposed protectionism show a differentiated sectoral response. While in soft Brexit, the output changes in the NMS are rather mild and almost less than 0.5 percent. Looking at the sectoral patterns, there is a slight increase in the output of the automotive sector, partially replacing the imports from the UK, output of the chemical and pharmaceutical sectors. As far as the fall in the output is concerned, these are mostly observed in manufactures nec (which covers *inter alia* manufacturing of furniture, an important export sector of Poland), the wood sector, electronic and optical equipment and manufactured food (which is the largest sector of manufacturing in Poland). However, while these observed changes are very small, in the Hard Brexit scenarios they are considerably amplified, in particular in the long run. For example the food sector is expected to reduce output by 1 percent in Poland and slightly less in other NMS. Other sectors where output falls include the wood sector, paper and publishing, the mineral sector, electronics and optical products as well as manufactures nec. These changes are mostly concentrated in manufacturing with a much smaller impact on Brexit in services. There is a slight increase in output of financial services as well as the other transport sector (covering mainly the road transport) and the business services nec sector.

Table 14 Changes in real wages

	PL	CZ	SK	HU	DE	FR	NL	IR	rNMS	rEU14	UK
					Soft Brexit A						
Land	0.0	0.0	-0.1	0.0	0.0	0.2	0.0	-9.2	0.1	0.1	6.2
Unskilled labor	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	-0.2	-0.9	-0.1	-0.1	-1.0
Skilled labor	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.8	-0.1	-0.1	-0.8
Capital	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	-0.1	-0.5	-0.1	-0.1	-1.0
Natural Resources	0.7	0.8	0.5	0.6	0.9	0.8	0.3	-1.4	0.5	0.5	1.0
					Hard Brexit B						
Land	-1.4	-0.9	-0.9	-0.5	-2.4	-1.8	-6.7	-63.9	0.0	-2.8	28.6
Unskilled labor	-0.2	-0.3	-0.1	-0.2	-0.2	-0.3	-0.6	-3.2	-0.2	-0.3	-3.2
Skilled labor	-0.2	-0.2	-0.1	-0.2	-0.2	-0.2	-0.5	-3.1	-0.3	-0.3	-2.8
Capital	-0.3	-0.2	-0.1	-0.2	-0.2	-0.2	-0.4	-2.1	-0.2	-0.3	-3.3
Natural Resources	2.1	1.9	1.5	1.6	2.1	3.9	1.9	-5.9	1.3	1.9	4.3

Source: own simulation.

Differences in sectoral response translate to changes in real wages of factors of production. In Soft Brexit scenarios these changes are rather mild with the exception of the increase in the rents from natural resources (resulting from the increase in the output of the mining sectors). In Hard Brexit scenarios, where agriculture in the NMS is adversely affected by increased trading barriers, land rents visibly fall. There are no significant differences in wage changes across different labor types and capital for most analyzed countries and these changes are not large, at least compared to changes of land rents. On the other hand, the degree of adjustment in the UK is significantly larger, with land rents increasing by as much as 29 percent in the case of the Hard Brexit.

6 Conclusions

In this paper we analyze the impact of Brexit on the New Member States of the EU, with special attention devoted to Poland and other NMS. We investigated two classes of scenarios. Three versions of the Soft Brexit, with FTA covering majority of goods and services, and a two versions Hard Brexit, governed by WTO MFN rules. We used a CGE model (GTAP) and analyzed the shocks resulting from modifications of both tariff and non-tariff barriers. The benchmark line model was based on actual tariff data, while the tariff equivalents of non-tariff barriers, are estimated basing on an econometric model.

Our results show that in spite of the UK being one of the most important trading partners for many of the NMS, Poland in particular, the short run macroeconomic effects of Soft Brexit are very small. A drop in GDPs of analyzed countries is of less than 0.1 percent of GDP in the short run. In the case of NMS there is not major difference between there versions of Soft Brexit. Among the NMS Czechia and Hungary stand out with a roughly 40% larger drop in GDP in comparison to Poland.

The short run Hard Brexit scenarios roughly double effects of the Soft Brexit scenarios. For the NMS they are moderate with the effect on Poland at -0.11 percent of GDP and roughly 40% more, ie. -0.14-0.15 of GDP for Czechia and Hungary. For Germany and France the shock is of similar magnitude as that of Poland, while the effects for the UK and Ireland are much more significant; both exceed 1 percent of respective GDPs.

The long term effects of Brexit will lead to overall drop in investment. The capital stock falls leading to a magnification of the effects of the short term scenarios. In particular, in the case of NMS the difference in the expected results between Soft and Hard Brexit is 0.2 percent of GDP, ie. with Soft Brexit amounting to a fall in GDP by 0.2 percent and Hard Brexit – to a fall of 0.4 percent of GDP. The effects for the UK are much more significant and range between 1.0 and 2.1 percent of GDP.

The reduction of EU27-UK trade flows will lead to drops in sectoral outputs, especially in some export-oriented sectors. The drops in output are magnified in the case of Hard Brexit scenarios. In the case of Poland the simulated falls in the output are mostly observed in manufactures nec (which covers *inter alia* manufacturing of furniture), the wood sector, electronic and optical equipment and manufactured food (which is the largest sector of manufacturing in Poland). For example, the output of Poland's food sector can be reduced by 1 percent in the case of Hard Brexit. There is a slight increase in output of financial

services as well as the other transport sector (covering mainly the road transport) and the business services nec sector.

Even if the impact of Hard Brexit is not overly destructive, the policy makers in the NMS should support a relatively liberal scenario of Brexit negotiations, i.e. the conclusion of a comprehensive FTA, covering the majority of sectors. On the other hand they should devote some attention to the sectors in which the drop in the outputs can be significant in the case of Hard Brexit.

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A1 Additional tables

Table 15 Simulated changes in investment

	PL	CZ	SK	HU	DE	FR	NL	IR	rNMS	rEU14	UK
SoftA	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.3	-1.7	0.0	-0.1	-3.5
SoftB	0.0	0.0	0.1	0.0	-0.1	-0.1	-0.2	-1.5	0.0	0.0	-3.9
SoftC	-0.1	0.0	0.1	0.0	-0.1	-0.2	-0.4	-2.6	0.0	-0.1	-4.4
HardA	-0.1	0.0	0.2	0.0	-0.3	-0.3	-0.7	-4.7	-0.1	-0.2	-8.2
HardB	-0.1	0.0	0.2	0.0	-0.3	-0.3	-0.8	-5.0	0.0	-0.2	-9.2
SoftA LR	-0.2	-0.2	-0.1	-0.2	-0.1	-0.1	-0.3	-3.3	-0.2	-0.2	-1.2
HardB LR	-0.4	-0.4	-0.2	-0.3	-0.3	-0.2	-0.9	-13.2	-0.4	-0.4	-2.3

Source: own simulation investment change in percent of capital stock. For long-run scenarios – long run change in capital stock.

Table 16 Changes in bilateral exports

		Source									
	Destination	PL	CZ	SK	HU	DE	FR	NL	IR	rNMS	rEU14
Soft A	UK	-9.3	-9.7	-9.1	-9.7	-8.1	-8.4	-9.2	-8.8	-9.6	-8.7
	EU	0.5	0.4	0.4	0.4	0.6	0.7	0.7	1.1	0.4	0.6
	ROW	0.6	0.5	0.4	0.4	0.6	0.6	0.7	0.8	0.4	0.5
Soft B	UK	-8.3	-8.9	-8.1	-8.8	-7.2	-7.4	-7.7	-7.7	-8.1	-7.6
	EU	0.5	0.4	0.3	0.4	0.5	0.6	0.6	1.0	0.4	0.5
	ROW	0.5	0.4	0.3	0.3	0.5	0.5	0.5	0.7	0.3	0.4
Soft C	UK	-15.3	-10.5	-9.8	-12.4	-10.0	-12.4	-17.7	-19.8	-11.6	-12.5
	EU	0.9	0.5	0.4	0.5	0.7	1.0	1.5	1.9	0.5	0.8
	ROW	1.0	0.6	0.5	0.6	0.7	1.0	1.3	1.5	0.5	0.8
Hard A	UK	-27.2	-23.9	-23.3	-24.6	-23.1	-24.3	-28.8	-28.3	-25.7	-25.1
	EU	1.6	1.2	1.0	1.0	1.6	2.0	2.3	3.0	1.1	1.7
	ROW	1.5	1.2	0.8	1.0	1.4	1.7	2.0	2.3	0.9	1.4
Hard B	UK	-30.3	-25.8	-25.4	-26.6	-25.5	-26.7	-32.3	-31.5	-27.3	-27.3
	EU	1.8	1.2	1.1	1.1	1.7	2.1	2.6	3.2	1.1	1.8
	ROW	1.8	1.3	1.0	1.1	1.6	1.9	2.3	2.6	1.1	1.6
Soft A LR	UK	-9.0	-9.4	-8.7	-9.3	-7.8	-8.1	-9.1	-10.1	-9.2	-8.4
	EU	0.4	0.3	0.3	0.3	0.5	0.6	0.4	-1.2	0.3	0.5
	ROW	0.4	0.2	0.2	0.2	0.3	0.4	0.3	-1.5	0.2	0.3
Hard B LR	UK	-29.3	-24.6	-24.2	-25.4	-24.3	-25.5	-31.9	-35.7	-26.2	-26.2
	EU	1.5	1.0	1.0	0.9	1.5	1.8	1.8	-6.0	0.9	1.5
	ROW	1.2	0.7	0.6	0.6	1.1	1.2	1.3	-6.1	0.7	1.1

Source: own simulation. Total trade (merchandise + services trade)

Table 17 Changes in bilateral imports

	Source	PL	CZ	SK	HU	DE	FR	NL	IR	rNMS	rEU14
						Destination					
Soft A	UK	-7.2	-7.6	-7.8	-6.9	-7.7	-7.0	-6.6	-4.9	-6.9	-6.8
	EU	0.5	0.4	0.3	0.4	0.6	0.6	0.6	1.6	0.5	0.6
	ROW	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.1	0.6	-0.3	-0.1
Soft B	UK	-6.5	-6.7	-7.0	-6.1	-6.9	-6.2	-5.8	-4.2	-6.1	-6.1
	EU	0.4	0.4	0.3	0.4	0.6	0.5	0.6	1.5	0.4	0.6
	ROW	-0.2	-0.3	-0.2	-0.2	-0.1	-0.1	-0.1	0.6	-0.2	-0.1
Soft C	UK	-10.6	-9.3	-9.0	-8.6	-9.3	-10.4	-11.1	-12.4	-9.7	-8.6
	EU	0.6	0.6	0.4	0.6	0.9	0.8	0.9	3.6	0.7	0.8
	ROW	-0.4	-0.5	-0.4	-0.4	-0.3	-0.3	-0.2	0.9	-0.3	-0.2
Hard A	UK	-23.4	-21.4	-21.7	-18.1	-20.3	-19.2	-20.6	-19.5	-21.1	-19.9
	EU	1.4	1.3	0.9	1.3	1.7	1.5	1.9	6.2	1.3	1.7
	ROW	-0.8	-0.9	-0.9	-0.9	-0.6	-0.7	-0.4	1.6	-0.7	-0.5
Hard B	UK	-25.5	-23.3	-23.4	-19.8	-22.0	-21.1	-22.3	-21.8	-22.9	-21.5
	EU	1.5	1.4	0.9	1.3	1.8	1.6	2.0	6.7	1.5	1.9
	ROW	-0.9	-1.0	-0.9	-0.9	-0.7	-0.7	-0.5	1.7	-0.7	-0.5
Soft A LR	UK	-9.9	-10.4	-10.4	-9.6	-10.1	-9.4	-8.9	-8.2	-9.5	-9.1
	EU	0.3	0.3	0.2	0.3	0.4	0.5	0.4	0.1	0.3	0.4
	ROW	-0.1	-0.1	-0.2	-0.1	0.1	0.1	0.0	-0.6	-0.1	0.1
Hard B LR	UK	-31.0	-29.3	-28.8	-25.7	-27.0	-26.3	-27.0	-30.8	-28.3	-26.4
	EU	1.1	1.0	0.6	1.0	1.3	1.4	1.3	-0.4	1.1	1.3
	ROW	-0.4	-0.4	-0.4	-0.4	0.0	0.0	-0.2	-4.3	-0.3	0.1

Source: own simulation. Total trade (merchandise + services trade)

Table 18 Changes in output – selected short run scenarios

	Soft Brexit A					Hard Brexit B				
	PL	CZ	SK	HU	rNMS	PL	CZ	SK	HU	rNMS
Agriculture	0.0	0.0	0.0	0.0	0.0	-0.2	-0.1	-0.1	0.0	0.0
Fishing	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.1	0.2	0.0
Mining	0.1	0.1	0.2	0.1	0.1	0.3	0.3	0.5	0.3	0.3
Food	-0.1	0.0	-0.1	-0.1	0.0	-1.0	-0.4	-0.7	-0.8	0.0
Beverages & Tobacco	0.0	0.0	0.0	0.0	0.0	0.4	-0.2	0.0	0.1	0.4
Textiles	0.2	0.1	0.0	0.1	0.1	0.7	-0.2	0.1	0.3	0.1
Wearing Apparel	0.4	-0.3	0.5	-0.1	-0.4	1.2	-2.0	1.8	-0.9	-2.2
Leather	0.4	-0.4	0.4	0.4	0.5	1.0	-3.1	1.3	1.2	1.3
Wood	-0.2	0.1	-0.1	-0.1	-0.3	-0.6	0.0	-0.3	-0.2	-0.8
Paper, Publishing	0.0	0.0	-0.3	0.0	0.0	0.0	-0.3	-0.9	-0.2	0.0
Fuels	-0.1	0.0	0.0	0.0	-0.1	-0.2	0.1	0.1	0.1	-0.3
Chemicals	0.2	0.3	0.3	0.2	0.2	0.7	0.8	1.1	0.6	0.6
Pharmaceuticals	0.3	0.3	0.2	0.1	0.1	0.8	0.5	0.3	0.2	0.2
Rubber & Plastics	0.0	0.0	0.0	-0.1	0.0	0.1	-0.1	0.0	-0.3	0.0
Non-metalic minerals	-0.1	0.0	-0.1	-0.1	0.0	-0.3	-0.2	-0.4	-0.4	0.0
Steel	0.2	0.1	0.2	0.2	0.3	0.7	0.3	0.4	0.4	0.8
Metals nec	-0.1	0.2	0.3	0.0	0.3	0.0	0.7	1.1	0.3	1.0
Metal products	0.1	0.1	-0.2	0.1	0.0	0.3	0.1	-0.5	0.2	-0.1
Electronics and opticals	-0.4	-0.5	-0.4	-0.5	0.3	-0.4	-0.7	-0.8	-0.8	0.8
Electrical equipment	-0.2	0.0	0.1	0.0	0.1	-0.1	0.1	0.1	0.0	0.2
Machinery and equipment nec	0.1	-0.1	0.1	0.0	0.2	0.4	-0.2	0.0	-0.2	0.4
Motor vehicles and parts	0.3	0.3	0.2	0.3	0.4	1.0	1.0	0.6	1.3	1.3
Transport equipment nec	0.4	0.2	0.4	-0.2	0.3	1.1	0.1	0.3	-0.4	0.5
Manufactures nec	-0.2	-0.2	-0.2	0.0	-0.1	-0.3	-0.4	-0.6	0.0	-0.2
Energy	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.1
Construction	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Trade	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Accommodation and Food	0.0	0.0	0.0	-0.1	-0.1	-0.1	0.0	0.0	-0.1	-0.1
Transport nec	0.2	0.1	0.1	0.0	0.0	0.4	0.4	0.2	0.1	0.1
Water transport	0.2	0.0	0.0	-0.5	-0.2	0.7	0.1	0.1	-0.6	-0.2
Air transport	0.0	-0.1	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.1	-0.2
Warehousing and support	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
Communication	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1
Financial services nec	0.0	0.2	0.1	0.0	0.1	0.1	0.4	0.3	0.1	0.2
Insurance	0.0	0.0	0.0	-0.1	0.1	0.0	0.1	0.0	-0.1	0.1
Real estate activities	0.0	-0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
Business services nec	0.1	0.1	0.0	0.1	0.0	0.1	0.1	0.0	0.1	0.0
Recreational and oth.	0.0	-0.1	0.0	0.0	-0.1	0.0	-0.1	-0.1	-0.1	-0.2
Public Administration	0.0	0.0	0.0	0.0	-0.1	0.0	0.0	0.0	0.0	-0.1
Education	0.0	0.0	0.0	0.0	-0.1	0.1	0.1	0.0	0.0	-0.2
Human health, social work	0.0	-0.1	0.0	0.0	0.0	-0.1	-0.1	0.0	-0.1	-0.1

Table 19 Overall changes in output – long run scenarios

	Soft Brexit A LR					Hard Brexit B LR				
	PL	CZ	SK	HU	rNMS	PL	CZ	SK	HU	rNMS
Agriculture	0.0	0.0	0.0	0.0	0.0	-0.3	-0.2	-0.2	-0.1	0.0
Fishing	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	0.0	0.0	-0.2
Mining	0.1	0.0	0.1	0.0	0.0	0.2	0.1	0.3	0.1	0.1
Food	-0.1	-0.1	-0.2	-0.1	-0.1	-1.2	-0.6	-0.8	-0.8	-0.2
Beverages & Tobacco	0.0	-0.1	-0.1	-0.1	0.0	0.2	-0.3	0.0	0.1	0.2
Textiles	0.0	-0.1	-0.1	0.0	-0.1	0.2	-0.6	-0.1	0.0	-0.3
Wearing Apparel	0.2	-0.5	0.3	-0.2	-0.6	0.7	-2.4	1.5	-1.3	-2.7
Leather	0.2	-0.6	0.2	0.2	0.3	0.4	-3.4	0.9	0.7	0.7
Wood	-0.4	-0.1	-0.2	-0.2	-0.4	-0.9	-0.3	-0.4	-0.5	-1.2
Paper, Publishing	-0.1	-0.1	-0.2	-0.1	0.0	-0.2	-0.4	-0.7	-0.3	-0.1
Fuels	-0.1	-0.1	0.0	0.0	-0.2	-0.4	-0.1	0.0	0.0	-0.4
Chemicals	0.2	0.2	0.4	0.2	0.2	0.6	1.0	1.5	0.9	0.7
Pharmaceuticals	0.5	0.4	0.6	0.3	0.3	1.7	1.6	1.8	1.1	1.2
Rubber & Plastics	-0.1	-0.1	0.0	-0.1	-0.1	-0.1	-0.4	0.0	-0.4	-0.1
Non-metalic minerals	-0.2	-0.2	-0.2	-0.2	-0.1	-0.6	-0.5	-0.5	-0.6	-0.3
Steel	0.1	0.0	0.1	0.1	0.1	0.3	-0.1	0.2	0.2	0.4
Metals nec	-0.4	-0.1	0.1	-0.2	0.0	-0.6	0.2	0.8	-0.2	0.4
Metal products	-0.1	-0.1	-0.3	0.0	-0.1	-0.1	-0.2	-0.7	-0.1	-0.3
Electronics and opticals	-0.6	-0.7	-0.5	-0.6	0.0	-0.9	-1.3	-1.0	-1.2	0.1
Electrical equipment	-0.4	-0.2	-0.1	-0.3	-0.1	-0.6	-0.4	-0.2	-0.5	-0.2
Machinery and equipment nec	0.0	-0.2	0.0	-0.2	0.1	0.1	-0.5	-0.1	-0.5	0.0
Motor vehicles and parts	0.2	0.2	0.2	0.2	0.2	0.8	0.8	0.5	1.0	1.0
Transport equipment nec	0.3	-0.1	0.3	-0.3	0.1	0.8	-0.2	0.3	-0.4	0.2
Manufactures nec	-0.3	-0.3	-0.3	-0.1	-0.2	-0.5	-0.6	-0.6	-0.2	-0.4
Energy	-0.1	-0.2	-0.1	-0.1	-0.1	-0.2	-0.3	-0.1	-0.1	-0.2
Construction	-0.2	-0.2	-0.1	-0.1	-0.2	-0.4	-0.4	-0.2	-0.3	-0.3
Trade	-0.1	-0.2	-0.1	-0.1	-0.1	-0.3	-0.3	-0.2	-0.3	-0.3
Accommodation and Food	-0.2	-0.2	-0.1	-0.1	-0.2	-0.4	-0.3	-0.2	-0.3	-0.4
Transport nec	0.1	0.1	0.0	0.0	-0.1	0.3	0.2	0.1	0.0	-0.1
Water transport	0.1	-0.1	-0.1	-0.6	-0.3	0.4	-0.2	0.0	-0.8	-0.4
Air transport	-0.1	-0.2	-0.1	-0.1	-0.2	-0.4	-0.4	-0.3	-0.3	-0.4
Warehousing and support	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.3	-0.2	-0.3	-0.3
Communication	-0.1	-0.2	-0.1	-0.1	-0.1	-0.2	-0.3	-0.2	-0.1	-0.2
Financial services nec	-0.1	0.0	0.1	0.0	0.0	-0.1	0.2	0.3	0.0	0.0
Insurance	-0.1	-0.1	-0.1	-0.1	0.0	-0.2	-0.2	-0.1	-0.2	0.0
Real estate activities	-0.1	-0.2	-0.1	-0.1	-0.2	-0.3	-0.4	-0.2	-0.2	-0.3
Business services nec	0.0	-0.1	-0.1	0.0	-0.1	-0.1	-0.2	-0.1	-0.1	-0.2
Recreational and oth.	-0.1	-0.2	-0.1	-0.1	-0.2	-0.2	-0.4	-0.2	-0.2	-0.4
Public Administration	-0.1	-0.2	-0.1	-0.1	-0.1	-0.2	-0.3	-0.2	-0.2	-0.3
Education	-0.1	-0.1	-0.1	-0.1	-0.2	-0.1	-0.1	-0.1	-0.1	-0.3
Human health, social work	-0.1	-0.2	-0.1	-0.1	-0.1	-0.2	-0.4	-0.1	-0.2	-0.3