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

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Abstract: We use a global computable general equilibrium (CGE) model to analyze several scenarios of Brexit to assess it on the EU New Member States (NMS) to complement the literature exist. Our scenarios are based on expected outcomes of the 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 is based on actual tariff data, the latter are estimated using an econometric model for both merchandise trade and services. Our results show the macroeconomic effects of Brexit are mild with a slight decline of NMS GDP of roughly 0.4 % even in the case of a Hard Brexit. 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

JEL codes: F17, F10, F13

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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 (WA) 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]. According to declaration mentioned, the new FTA should be of an unprecedented nature: no tariffs and no quotas across all goods, including agricultural and fisheries products[3]. In June 2019 Prime Minister Theresa May resigned, and then in July Boris Johnson was elected as her successor. The Johnson's administration reopened negotiations on the withdrawal agreement in August 2019, while declared that the so called "Irish backstop"—accepted by the May's government—must be removed from the WA, which the EU said it wouldn't accept.

In the absence of the reconciled positions of both parties, The United Kingdom left the European Union on 31 January 2020. Since this date, the UK became officially a third country to the EU and hence no longer can participate in EU decision-making. The EU and the UK have, however, jointly agreed on a transition period, which lasted until 31 December 2020. Until then, the business was "as usual" for citizens and businesses in both the EU and the UK. The EU law still applied to the United Kingdom until the end of the transition period. If transition period would end with no agreement, the EU-UK trading relationship would default to World Trade Organization (WTO) rules.

Due to the political tensions between EU and UK as well as within UK Parliament, the option of a "very soft" agreement and similar to the Norwegian one[4], was excluded. Despite the difficulties, the Draft text of the Agreement on the new Partnership between EU and UK was presented in March 2020 by the EU. It contained guidelines for the negotiations, in

[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] 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.
[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).

particular it included the set of possible scenarios of the future UK-EU trade relationship. The two extreme versions of negotiations' options are listed below:

- The most optimistic scenario assumed a Free Trade Area (FTA) covering all goods and majority of services. The optimistic scenario the FTA covers most services sectors, such as telecommunication services or business services. But, as in any FTA negotiated by the EU, exceptions are allowed. For instance, the EU normally excludes audiovisual services. Even in the best (most liberal) FTA, trade relations can be more complicated or tougher compared to the frictionless trade enabled by the EU's Single Market. In principle, rules of origin and customs formalities are to be applied by any FTA. All imports would then need to comply with the rules of the importing party and shall be the subject to regulatory checks and controls for safety, health and other public policy purposes[5]. Considering the rules mentioned, such an agreement would lead to a limited increase of EU-UK trade costs.
- In the most pessimistic scenario, there would be no FTA agreement by the end of transition period. In this scenario, the EU would apply "Most Favored Nation (MFN) tariffs" to the UK. On the other hand, the UK would 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 could not expect preferential treatment. In this case the EU law, including systematic controls, would fully apply to imported food, animals and plants without exceptions or equivalency. High EU level of SPS and TBT regulations become an important non-tariff measure. The relations would be built on existing multilateral instruments (WTO), such as Codex Alimentarius or International Plant Protection Convention recommendations and requirements.

In our analysis we formulated several scenarios of likely outcomes of Brexit negotiations. They represent various versions of negotiations outcomes from very Soft to Hard Brexit scenarios. Some of them could have large economic implications for parties involved in the short-to-long run.

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[6]. 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

[5] 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.
[6] Intensive trade flows between UK and EU27 are in line with predictions of gravity models.

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 is 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 from Poland.

On the other hand, Polish market is of great importance 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 increased drastically the trading costs between UK, Poland and other EU members, then it would have important negative consequences for both United Kingdom and EU27.

The goal of this paper is to analyze what was the impact of various Brexit scenarios on trade, production and welfare of the NMS economies with a focus on Poland. We employed a global computable general equilibrium (CGE) model serving the short-to-long run settings to analyze two set of scenarios, which considered both tariff and non-tariff barriers. These scenarios were based on the range of several possible outcomes of the Brexit negotiations, a detailed analysis of tariffs as well as own estimation of non-tariff barriers.

Our study fills the gap with respect to the studies that analyzed trade-related impact of Brexit on NMS countries. The results of our simulation 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 should be very small. They also indicate that the short run Hard Brexit scenarios roughly double effects of the Soft ones. Long-term effects of Brexit could lead to overall drop in investment.

The rest of the paper is organized as follows. Section two presents UK-UE trade profile. 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 % 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)

	UK trade		EU countries trade	
Merchandise trade				
Country	**Share of imports**	**Share of exports**	**Share of imports**	**Share of exports**
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: UN Comtrade 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 as follows: 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. Further, UK is also more competitive in exports of most of manufacturing goods to Ireland. On the services side, UK has RCA's in such sectors as 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.

	RCAs of UK in trade to EU									
sector	POL	CZE	SVK	HUN	rNMS	IRL	FRA	NLD	DEU	rEU14
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 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 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, Brexit is modelled as an increase in trade costs. The main impact is expected in the UK's economy, but there are sizeable differences in the size of that 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 7% or even 9.4-9.5% (Dinghra et al. 2016 and Ottaviano et al. 2014 respectively) in 10 years. Under very specific scenarios (Booth et al. 2015), which generally include the arrangements with the EU concerning FTAs with third countries the UK economy, the UK's economy may see a rise of GDP, for example by 0.75%.

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). 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. In persuance of all studies, Ireland can bear the largest cost after the UK. The expected declines of the Irish GDP range from 2.6% in the case of hard scenario to 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 as follows: Netherlands, Belgium, Denmark, Hungary, Czech Republic, Sweden, Germany and Poland.

Detailed investigation on the effects of Brexit on international trade of Poland or NMS in general 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 NMS 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 NMS is simulated by a model by Felbermayr, G. *et al.* (2015). In applying the gravity model, they show that a drop of their GDP can reach up to 1.82% till 2025. According to this study, the Czech Republic, as one of NMS, can be affected to gratest 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 NMS vary between -0.089 and -0.23 of GDP in the long run (table 8).

The presented above trade-related Brexit scenarios assume changes in tariff barriers (TBs) and non-tariff barriers (NTBs) to trade in goods and services. 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-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 **S:** FTA	MFN 0%	based on selected studies based on selected studies	**H:** UK's trade to EU: -56% **S:** UK's trade to EU: -30 ÷ -46%
Erken *et al.* (2016)	**H:** WTO **S:** FTA	MFN 0%	rise by ⅔ of EU-US NTBs raise by 45% of EU-US trade	**H:** UK's exports to EU: -19% **S:** UK's exports to EU: -6 ÷ -10%
Ebell & Warren (2016)	**H:** WTO **S:** FTA	5% na	based on selected studies based on selected studies	**H:** UK's trade to EU: -20.7 ÷ -29.2% **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 **S:** TAs w/third coun.	na na	na na	**H:** UK VAX: up to -18% **S:** UK VAX: up to -13.08%
Dinghra *et al.* (2017)	**H:** WTO **S:** EEA	MFN 0%	8.3% 2.8%	**H:** UK-EU exports: -43% UK-EU imports: -38% **S:** UK-EU exports: -25% UK-EU imports: -22%
Oberhofer & Pfaffermayr (2017)	**H:** WTO **S:** FTA	MFN na	na no NTBs	**H:** UK-EU exports: -29.4 ÷ -35.5% **S:** UK-EU exports: -13.2 ÷ -16.3%
HM Treasury (2016)	**H:** WTO **S:** EEA	MFN 0%	na na	**H:** UK's overall trade: -17 ÷ -24% **S:** UK's overall trade: by -9%
Lawless & Morgenroth (2016)	**H:** WTO **S:** na	eff. rates:11÷25% na	na na	**H:** UK's exports to EU: by -22% **S:** na
Felbermayr *et al.* (2015)	**H:** UK's isolation **S:** Soft exit	MFN 0%	restored NTBs: no data as above	**H:** UK exports to EU: -14 ÷ -21% **S:** UK exports to EU: -4 ÷ -6%
Ottaviano *et al.* (2014)	**H:** Pessimistic **S:** Optimistic	7% 0%	rise by ⅔ of EU-US NTBs rise by ¼ of EU-US NTBs	**H:** UK's overall trade: by -12,6 % **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) **S:** FTA	MFN 0%	gravity EU/UK coefficient South Korea coefficient	**H:** UK's overall exports: -4.33 ÷ -12.36% UK's overall imports: -3.37 ÷ -11.22% **S:** UK's overall exports: -12.36% UK's overall imports: -11.22%
HM Treasury (2018)	**H:** WTO **S:** FTA	agrigoods: 20% manf. goods: 3% 0%	average f/count. on non-preferential WTO terms goods: 0÷1%; services: 2÷10%	**H:** UK-EU total trade: -42÷-32% **S:** UK-EU total trade: -9 ÷ -3%
Kierzenkowski *et al.* (2016)	**H:** WTO **S:** FTA	EU MFN rel. free with EU	restricted access to SM na	**H:** UK's overall trade: -10 ÷ -20% **S:** UK's exports to ROW: -10 ÷ -15%
Rojas-Romagosa (2016)	**H:** WTO **S:** FTA	MFN 0%	average: 12.9 % average: 6.4%	**H:** UK's trade to EU: -51.3% **S:** UK's trade to EU: -31%

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 tool 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[7].

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 good is an imperfect substitute to imports and each imports, which are coming from each source are imperfect substitutes to each other, ie. the so-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

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

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) come 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 8.

Table 8. 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, it is assumed 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, two scenarios 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[8].

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 9.

[8] 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).

Table 9. 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

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 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 .

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).

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 % 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 10. 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 % 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% of GDP.

Turning to long term effects of Brexit, due to overall drop in investment (detailed results shown in Table 14 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% of GDP, ie. with Soft Brexit amounting to a fall in GDP by 0.2% and Hard Brexit – to a fall of 0.4% of GDP. The effects for the UK are between 1.0 % and 2.1% of GDP[9].

Table 4. 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 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 12). One may also take a look on the changes in the aggregate bilateral trade flows (these are presented in Table 14 and Table 15).

[9] 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.

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% 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% depending on a scenario. Similar adjustments are found in others NMS.

Table 5 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 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%. 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% in Poland and slightly less in others 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 13. 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% 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 others 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% 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% 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% 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% of GDP, ie. with Soft Brexit amounting to a fall in GDP by 0.2% and Hard Brexit – to a fall of 0.4% of GDP. The effects for the UK are much more significant and range between 1.0% and 2.1% 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% 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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Annex 1. Additional tables

Table 6. 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 7. 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 16. Changes in bilateral imports.

		Destination									
	Source	PL	CZ	SK	HU	DE	FR	NL	IR	rNMS	rEU14
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 17. Changes in output – selected short run scenarios

	Soft Brexit A					Hard Brexit B				
	PL	CZ	SK	HU	rNM	PL	CZ	SK	HU	rNM
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

sMachinery 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 18. Overall changes in output – long run scenarios

	Soft Brexit A LR					Hard Brexit B LR				
	PL	CZ	SK	HU	rNM	PL	CZ	SK	HU	rNM
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

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