Agricultural exports to the UK after the Brexit. Simulations for sensitive products of four Visegrad countries*

Maria Dunin-Wąsowicz

European Movement Forum

Jan Hagemejer[#]

University of Warsaw and CASE Center for Social and Economic Research

Jan Michałek

University of Warsaw

Karolina Pawlak

Poznań University of Life Sciences

Abstract:

We use a partial equilibrium model to analyze the implications of Brexit for agricultural exports of Visegrad four (V-4) countries (Czechia, Hungary, Poland and Slovakia). Our scenario is based on the outcome of the negotiations, ie. the Soft Brexit with FTA and no specific commitments on non-tariff measures (NTMs). We simulate the increase of NTMs, resulting from a possible divergence of regulatory standards and the increase of border costs, differentiated by agricultural sectors. We base our simulations on actual tariff data, and NTMs equivalents, which were estimated using an econometric model for trade off the EU. Moreover we apply the disaggregated import elasticities for UK 6-digit agricultural products.

We identify the 4-digit "sensitive" agricultural product groups for individual V-4 countries. These products have a large share in exports of individual countries and face a significant increase in NTMs tariff equivalents and border costs. The pattern of "sensitive" products is quite different among individual V-4 countries. In the case of Poland the export structure is diversified and covers 18 "sensitive" groups, while for the other three countries exports are much more concentrated narrowly defined product categories. We analyze trade creation and diversion effects of NTM's and border costs changes. The simulations reveal that exports of V-4 countries to the UK could decrease by up to 20 percent in the case of selected sensitive products.

Keywords: partial equilibrium modelling, international agricultural trade, Brexit, trade policy

* The authors would like to acknowledge the financial support of the Polish National Science Center, grant number UMO-2018/31/B/HS4/01855. The views presented are those of the authors and not necessarily the institutions they represent. The authors also would like to thank Jacek Szyszka for outstanding research assistance.

[#] Corresponding author. email: j.hagemejer[at]uw.edu,pl

Introduction

In this paper we analyze the implications of Brexit Agreement for agricultural exports of four Visegrad (V-4) countries (Czechia, Hungary, Poland and Slovakia). For this purpose we perform simulations using a partial equilibrium model. Our simulation scenario is based on the outcome of the Brexit negotiations concluded with the Brexit Agreement (Trade and Cooperation Agreement) in December 2020, i.e. we assume the existence Free Trade Agreement, but with no specific commitments regarding non-tariff measures (NTMs). Moreover, we assume a substantial increase of border costs.

We simulate the increase of NTMs, resulting from a possible divergence of regulatory standards and the increase of border costs, differentiated by agricultural sectors. In this study we use tariff equivalents of NTM's estimated separately using a gravity model and GTAP bilateral trade data. In those simulations we also rely on disaggregated import elasticities for UK 6-digit agricultural products.

In our study we identify the 4-digit "sensitive" agricultural product groups for individual V-4 countries. These products have a large share (more than 0.5%) in exports of individual countries and face a significant increase in NTMs tariff equivalents and border costs. The pattern of "sensitive" products is quite different among individual V-4 countries. In the case of Poland the export structure is quite dispersed and covers 18 "sensitive" groups, while for the other three countries the exports are much more concentrated within two-three 4-digit groups of the HS trade classification. We perform simulations for 6-digit HS groups and aggregate them to 4-digit HS groups. We analyze trade creation and diversion effects resulting from the increase of NTM's and border costs. The short-run simulations reveal that exports of V-4 countries to the UK could decrease up to 20 percent on the case of some sensitive products.

The paper is organized as follows. In the first part, we present the major provisions of Brexit Agreement referring to agricultural trade. In the second part, we provide a brief literature review. Third part presents the agricultural trade profile of V-4 countries, exporting their products to the UK. In the fourth part we briefly describe the structure of SMART model, used in our simulations. Fifth, we present and discuss the results of our simulations. The last section concludes.

The Brexit agreement

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 concluded in November 2018. The Political Declaration issued at that time 2018, setting out the framework for the future bilateral relationship was very optimistic and described future deep integration agreement. However it did not materialize.

Both parties signed the Withdrawal Agreement in November 2019[2]. The EU and the UK had jointly agreed on a transition period, which lasted until 31 December 2020. 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 Due to the political tensions between EU and UK as well as within UK Parliament, the option of a "very soft" Brexit agreement was excluded. In the very last moment, on 24 December 2020 the EU and the UK reached the Trade and Cooperation Agreement[3].

The UK was 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[4]. British market is a very important for the majority of the EU members. In the case of Poland, exports of agricultural products to the UK are especially important. On the other hand, Polish market is of great importance for British exporters of beverages and tobacco, motor car vehicles, processed food and machinery.

The new Trade and Cooperation Agreement sets up the Free Trade Area between the EU and the UK. It means that all goods traded between the EU and UK will not be subject to the tariffs or quotas. However, there is no specific agreement on NTMs. Thus it is impossible to call the new Agreement as a very "soft" one.

The EU and British firms will face additional regulatory requirements that will make exports of goods more costly and burdensome. In particular there are new rules of origin. The EU and UK firms will have to certify the origin of their exports to qualify for tariff-free access to the other market. There are limits on what proportion of goods can be assembled from parts and components made in the third countries to qualify for tariff-free access. There are also additional testing and certification requirements. But there is no automatic mutual recognition, which means that UK and the EU regulatory bodies will not be able to certify products for sale in the EU and the UK; which is potentially a big obstacle to bilateral trade.

---

[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] AGREEMENT on the withdrawal of the United Kingdom of Great Britain and Northern Ireland from the European Union and the European Atomic Energy Community (2019/C 384 I/01).

[3] The European Commission: Brussels, 25.12.2020 COM(2020) 857 final Annex).

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

In the agricultural sector, trade between the two sides will benefit from the zero-tariff, and no quotas. However, the lack of an equivalence agreement on phyto-sanitary rules means the exporters will face new barriers at the border. There will be additional border checks. The EU and UK agri-food consignments will have to have health certificates and undergo sanitary and phyto-sanitary controls at member states' border inspection posts.

The EU and UK will be able to maintain their own sanitary standards (SPS) going forward. While currently the EU and UK regulations are compatible due to EU-driven harmonization, in the longer perspective the SPS standards of the EU and UK can diverge. This process can substantially increase the non-tariff barriers (NTMs) between two partners. The agricultural products from the EU entering the UK will be subject to checks and phyto-sanitary controls.

Thus, the Brexit agreement increased significantly the trading costs between UK, Poland and other EU members in all goods, and especially in the agricultural sector. It may have important negative consequences for agricultural exports of Visegrad countries to the United Kingdom.

Literature review

A great deal of previous research has demonstrated that the Brexit would cause perturbations in the UK's agricultural trade relationships with the EU and with the Visegrad countries specifically. These variations were identified by the studies with the use of both general equilibrium (GE) and partial equilibrium (PE) models, as well as by these ones deploying a descriptive approach. No matter what type of investigation was applied, the examined scenarios of the Brexit were ranging from a WTO-type, Hard Brexit relationship in which the UK and EU trade on Most Favoured Nation terms, to an arrangement closer to an FTA.

As research so far has shown, the FTA scenario is expected to result the least adverse post-Brexit effects in the area of agriculture. In the case of studies with using the GE models such relatively positive implications in the agri-food sector especially for the UK and not for the EU once applying the FTA option have been shown *inter alia* by Felbermayr (2018) and the IMF (2018). In particular, the IMF noted that UK's agri-food firms could see future profits, possibly reflecting a substitution towards domestically produced goods.

In turn, studies using PE models have shown that under the FTA option their agricultural producer prices could somewhat change. This applies to van Berkum et al. (2016) employed of the AGMEMOD and Davis et al. (2017) and Choi et al. (2021), who use the FAPRI-UK model.

According to Davis et al. (2017) the prices would slightly rise for commodities, in which the UK is a net importer (e.g. beef or cheese) and fall a little for commodities in which it is a net exporter (e.g. barley). Upon Choi et al. (2021) the meat and dairy products' prices will increase.

The FTA option is also more advantageous than the other options for some EU's agricultural markets. Van Berkum et al. (2018), while applying the AGMEMOD model to look at the Dutch agri-sector, found out that under this scenario its export to the UK and to the rest of the world would not be affected much as the changes in export prices would be relatively small. According to Donnelan and Hanrahan (2016), who use the FAPRI model, the volume of the Irish agri-trade might be relatively unhindered in the case of the FTA option, though the cost of doing business with the UK would increase.

The impact of Brexit on agri-sector in Visegrad countries remains not sufficiently explained so far. It was only shown that the case of WTO option can cause severe consequences (Vasary 2018, Zawojska 2019), including higher domestic prices especially for bovine, pork and dairy products.

The structure of EU-UK agri-food trade

Leaving the EU is likely to have significant implications for the agricultural sector and agri-food trade both in the UK and the rest of the EU countries, including V-4 countries. Agri-food products have always held an important position in V-4 countries foreign trade structure. Agri-food export share in the total Czech and Slovak commodity exports amounted to around 4-5% in 2007-2019, while in Hungary it reached 7-10%. In Poland it was even higher and the value of agri-food exports contributed in 10-13% to the total value of Polish commodity exports (Figure 1). The importance of agri-food products in total Polish exports has been constantly rising since the financial crisis of 2008-2009.

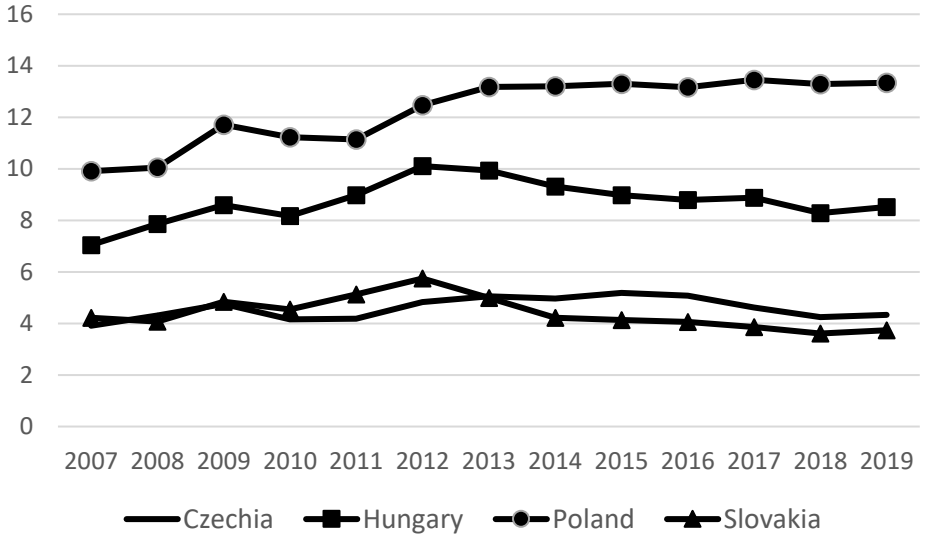
Since V-4 countries joined the EU, the UK has been gaining importance as an export destination. In the years 2007-2019 the value of agri-food exports from Poland to the UK increased almost 4 times and reached around 3.1 billion USD. In consequence, the UK became Poland's second largest export partner after Germany, and the share of the UK in the structure of the total export of agri-food products from Poland amounted to nearly 9% (Comext-Eurostat 2021). It is worth noting that Poland was a net exporter of agri-food products to the UK during the period under consideration. In 2019 agri-food exports from Poland to the UK were almost 17 times higher than imports. The surplus has also been growing over time – by 4.5 times since 2007 (Table 1). Positive and rising trade balance was also observed in the agri-food trade of the

rest of V-4 countries, however, the values of trade surplus were significantly lower when compared to Poland, even accounting for differences of in the country size. The 2019 exports values in other V4 countries were between 40 million USD in Slovakia and 126.5 million USD in Hungary. The relatively high value of agri-food exports from Poland to the UK was chiefly caused by the size of the UK market and consumers' purchasing power, relatively small distance to the target market, similar way of doing business, as well as high recognition of Polish agri-food products in the UK, as well as high absorption of these goods among migrants from Poland.

Agri-food exports from Poland to the UK was not only higher in values, but also much more diversified than from the rest of V-4 countries. At the 4-digit HS product level top 5 agri-food products exported from Poland to the UK were: meat and edible offal of poultry; prepared or preserved meat; chocolate and other food preparations containing cocoa; cigarettes and bread, pastry, cakes, biscuits and other bakers' wares (Table 2). In 2019 these products made around 47% total agri-food exports to the UK. Meat preparation and chocolate along with sugar confectionery, various food preparations and preparations used in animal feeding were mostly exported from Czechia, Hungary and Slovakia. An important item exported from Czechia to the UK was beer (10% of total exports), while in Slovak export cheese and curd was of key importance (35% of total exports). In 2019 top 5 agri-food products exported from Czechia, Hungary and Slovakia to the UK constituted 92%, 94% and 99% total exports, respectively.

It is expected that the strength of the trade effects under Brexit will be proportional to the increase in non-tariff barriers and trade costs, which are higher in trade in animal origin products. Due to the relatively high trade share and level of market protection, the biggest drop in the export of agri-food products from all V-4 countries to the UK may be experienced in case of dairy products, meat preparations, preparations used in animal feeding and chocolate. It is worth stressing that this observation is in line with the assessment of the impacts of Brexit on Dutch and Danish agri-food trade flows submitted by Yu et al. (2017), Bellora et al. (2017) or van Berkum et al. (2018).

Figure 1. Shares of agri-food products in total commodity exports from V-4 countries in 2007-2019 (%)



Source: authors' own elaboration based on Comext-Eurostat (2021).

Table 1. Agri-food trade between V-4 countries and the UK in 2007 and 2019 (million USD)

Country	Exports			Imports			Trade balance		
	2007	2019		2007	2019		2007	2019	
	million USD		2007=100	million USD		2007=100	million USD		2007=100
Czechia	122.0	114.4	93.8	72.5	58.3	80.4	49.5	56.1	113.4
Hungary	120.3	126.5	105.2	55.2	26.1	47.2	65.0	100.4	154.4
Poland	828.4	3 072.4	370.9	201.8	182.2	90.3	626.6	2 890.2	461.3
Slovakia	39.2	40.6	103.5	28.4	7.3	25.6	10.9	33.4	306.5

Source: authors' own elaboration based on UN Comtrade Database (2021).

Table 2. Top 5 agri-food products exported from V-4 countries to the UK in 2019

Czechia			**Hungary**		
HS code	Million USD	Share in total agri-food exports (%)	HS code	Million USD	Share in total agri-food exports (%)
1704	58.2	50.9	2309	50.2	39.7
2106	15.7	13.7	1602	34.2	27.1
2203	11.7	10.2	2106	15.6	12.3
1806	11.1	9.7	1806	11.3	8.9
2309	8.2	7.1	1704	7.6	6.0
Poland			**Slovakia**		
HS code	Million USD	Share in total agri-food exports (%)	HS code	Million USD	Share in total agri-food exports (%)
0207	394.4	12.8	1806	17.1	42.0
1602	350.4	11.4	0406	14.4	35.4
1806	293.7	9.6	1704	4.4	10.9
2402	212.4	6.9	2106	3.9	9.7

1905	181.4	5.9	1602	0.3	0.7

HS codes: 0207 – meat and edible offal of poultry; 0406 – cheese and curd; 1602 – prepared or preserved meat, meat offal or blood; 1704 – sugar confectionery, not containing cocoa; 1806 – chocolate and other food preparations containing cocoa; 1905 – bread, pastry, cakes, biscuits, other bakers' wares; 2106 – food preparations, n.e.c.; 2203 – beer; 2309 – preparations of a kind used in animal feeding; 2402 – cigars, cheroots, cigarillos and cigarettes
Source: authors' own elaboration based on UN Comtrade Database (2021).

The analyzed scenario

In our study we analyze a scenario, which reflects the conservative outcome of Brexit negotiations. We assumed no changes in the level of bilateral tariff levels resulting from signing the Free Trade Agreement covering all products, including agricultural ones. We also assumed that there are no changes in UK tariff levels towards the third countries, i.e., the UK maintains all the previously signed free-trade areas. We assumed that the UK applies the same tariffs of the EU Common Agricultural Policy (CAP) towards all countries in the world. Moreover, in our simulations we keep the tariff preferences within the Generalized System of Preferences (GSP) towards the developing countries unchanged. The same applies to tariffs towards the members of the European Economic Area (EEA) and Switzerland. Of course, in the longer run the UK can sign new agreements liberalizing trade with other countries, and in particular with the US and/or Australia. In the past, the UK Government frequently complained about high level of tariffs within the CAP policy. Therefore in the future it can also lower level of its external non-discriminatory (MFN) protection towards the WTO members, which is likely to exacerbate the adverse effects of Brexit on UK's trade with the EU members.

In our analysis we assumed that the changes in the level of British trade protection result from the changes in the tariff equivalents of non-tariff measures. The Brexit agreement has no provisions regarding continuation of CAP regarding application of common sanitary and phyto-sanitary (SPS) standards. In the Brexit agreement there is only a general reference to the WTO SPS agreement, which calls for international cooperation and refers to the Codex Alimentarius standards. Thus, we assumed that EU and UK SPS standards can diverge. The divergent SPS standards and other technical regulations regarding accession to the market, will create the additional barriers, i.e. costs that exporters will have to face. In our analysis we assumed that the level of external of NTM protection in the UK agricultural sector will increase by 25% of the difference in the level of estimated NTM protection in the intra-EU trade and the external NTM tariff equivalents of the EU. This assumption is in line with the idea that while the regulations and standards are going to slightly diverge, due to cultural, economic and

geographical proximity this divergence will be limited and the UK technical and sanitary requirements will be still closer to the EU ones than to those employed by the third countries.

The NTM tariff equivalents were estimated using gravity model methodology. We used the GTAP data as a source of bilateral trade data for a panel of two time periods, i.e. 2011 and 2014. Data on standard gravity macro variables come from World Development Indicators and the time-invariant gravity variables (i.e. distances, contiguity, common language, colonial ties) comes from CEPII geo-dist database. 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 *ceteris paribus* an approximate percentage deviation in trade between that country and a reference country. One should choose the reference country to be the most liberal country in the sample, i.e. having the highest reporter-level fixed effect. When we obtain the average fixed effects for all countries we 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 NTMs. The details of our estimations of NTM tariff equivalents are presented in Hagemejer et al. (2021) who do it for all the merchandise and service trade flows and we follow the same methodology for the agricultural sectors as defined by the GTAP database. The results of the estimations of NTM tariff equivalents are presented in the appendix (Table 8).

Moreover, we also simulate the implications of the fact that the British economy quits the Single European Market. This fact will increase the border costs for exporters. By now the exporters have to meet additional formal requirements, fill additional administrative forms, and the TIR trucks are subject of border control, frequently requiring a couple of hours. These additional formalities involve additional costs, which can be especially high in the case of animal products. Therefore, we assume that the border costs after Brexit increase by 2 percent on average and by 5 percent in the case of animal products. We combine both changes, reflecting the increase of NTM tariff equivalents and increase of border costs, in one simulation for sensitive products.

Specification of the model

In our study we studied the effects of Brexit in agricultural trade using the GSIM partial equilibrium model elaborated by Francois & Hall (2009). The detailed structure of the GSIM

model is presented in Jammes and Olarreaga (2005). This partial equilibrium model is grounded on the Armington (1969) assumption, with a constant elasticity of substitution sub-utility function. The representative consumer in an importing country consumes a product being a bundle of different varieties, imported from various countries. Jammes and Olarreaga (2005), describe a simpler version of the SMART model and assume a quasi-linear an additive utility function that is also additive on a composite numéraire good (n). The aggregate consumer utility function in an importing country is:

$$U = \sum_g u_g(m_g) + n \tag{1}$$

where n is the consumption of the composite numéraire good, m_g is the consumption of imported aggregate good (existing in many varieties from different countries) of good g, and u_g is the constant-elasticity of substitution sub-utility of good g. The maximization of utility function (1), taking into consideration the budget constraint, gives the equation (2):

$$m_{g,c} = f\left(p^d_{g,c}; p^d_{g,w}\right), \forall g, c \tag{2}$$
$$n = y - \sum_c \sum_g p^d_{g,c} m_{g,c},$$

where $m_{g,c}$ are the imports of good g from country c, $p_{g,c}^d$ is the domestic price of imported variety g from country c, and $p_{g,w}^d$ is the domestic price of good g imported from all countries with the exception of c, and y is the national income. The consumption of the composite and numéraire good, absorbs all income effects. In the open economy the domestic price is given by: $p^d_{g,c} = p^w_{g,c}(1 + t_{g,c})$, where the $p_{g,c}^w$ is the world price of good g imported from country c, and $t_{g,c}$ is the ad valorem tariff imposed on good g from country c. Then one can define the trade creation ($TC_{g,c}$) effect expressed in world prices as follows:

$$TC_{g,c} = p^w_{g,c} dm_{g,c} = p^w_{g,c} \varepsilon_{g,c} m_{g,c} \frac{dp^d_{g,c}}{p^d_{g,c}}. \tag{3}$$

where $\varepsilon_{g,c}$ is the price elasticity of import demand and $dm_{g,c}$ is the change in the demand for import of good g from country c. Using the definition of domestic price ($dp^d_{g,c} = p^w_{g,c} dt_{g,c}$) and inserting it to (3), and assuming that $p^w_{g,c} = 1$, we get a formula of TC for calculations.

$$TC_{g,c} = p^w_{g,c} dm_{g,c} = p^w_{g,c} \varepsilon_{g,c} m_{g,c} \frac{dt_{g,c}}{(1+t_{g,c})} = \varepsilon_{g,c} m_{g,c} \frac{dt_{g,c}}{(1+t_{g,c})}. \tag{4}$$

If the (non)tariff equivalent change from country c (like UK) is equivalent a non-preferential tariff increase then imports of this good from other countries are going to substitute away

imports from customs union partners (EU), because they become relatively more expensive. We can also define the trade diversion effect.

Taking into account relative tariff changes, resulting from (non)tariff measures increases, and recalling the definition of trade diversion $dm_{g,c} = -dm_{g,w}$, we can define the trade diversion as[5]:

$$TD_{g,c} = dm_{g,c} = \frac{m_{g,w}m_{g,c}}{m_{g,c}+m_{g,w}} \frac{dt_{g,c}}{(1+t_{g,c})} \sigma_{g,c,w} \quad (5)$$

where $(\sigma_{g,c,w})$ is the elasticity of substitution, across imports of good *g* from country *c* and all other countries.

The simulated changes in the price of a given variety, resulting from changes of tariffs (or non-tariff equivalents), affect the price index and the structure of consumption of different varieties. Thus, by using exogenously given elasticities of export supply, the import demand elasticity and the elasticity of substitution, across imports, it is possible to simulate changes in the trade flows of a given good in many "country specific" varieties. The model considers only the effects of a given policy in the given market and does not account for the other economic interactions. This relatively simple partial equilibrium model makes it possible to simulate the effects of changes in tariffs and non-tariff equivalents at a high level of disaggregation.

We applied the GSIM model to analyze the potential trade implications of the Brexit for Visegrad countries. We studied the implications of non-tariff increases in the British imports originating in the EU countries. We analyzed changes in import prices of goods imported from the EU (*own price effect*) and changes in exports of non-EU countries to the UK (*cross price effects*) under the assumption of exogenous world prices. The own price effects and the cross-price effect correspond to trade creation and trade diversion effects, respectively. The increase of British NTM-measures reduces the imports from the EU countries (negative trade creation) and leads to the substation of imports from the EU by imports from third countries (negative trade diversion for the EU countries).

In our simulations we used the standard supply elasticities provided by the GSIM model in the version published on the World Bank's WITS database. The elasticity of export equals is infinite (which means setting it to 99). This assures that the exporting country being a price taker in the export market, while elasticities of import demand are different for a given HS6 good and each importing country. These elasticities can be downloaded from the World Bank website and essentially they are the update of the elasticities provided in Kee, Nicita and

[5] An additional constraint must be introduced since the trade diversion cannot be larger than the original imports of good g from other countries, not c.

Olarreaga (2008). On the other hand, we based Armington elasticities of demand on the GTAP database. Finally, the NTM tariff equivalents were based on gravity estimations, presented in an earlier section of this study. The main drawback of this approach is that the NTM tariff equivalents were calculated for broad groups of products within the GTAP classification, while the simulations were performed for more disaggregated 4-digit product groups. The GSIM model simulations were performed for "sensitive" product groups identified in the previous section of the paper and are based on the 2020 trade flows and matched to relevant categories of the GTAP classification.

Simulation results

In order to streamline our analysis we focus our attention on the most sensitive products, exports of which can be mostly affected by the Brexit. We defined them as being subject of high level of external Single European Market protection (over 30%) and contributing significantly (over 0.5%) to the overall exports to the UK of analyzed countries.

Trade shares presented in Table 2 are one out of three basic ways to look for products which appear to be most sensitive to the changes in trade costs. It is also possible to use market protection level or trade shares along with market protection level to identify sensitive products. When taking into account the level of tariff protection of the EU market, we can see that the highest MFN applied rates (weighted average, incl. AVE) are imposed on dairy products, sugar, meat and edible meat offal, including beef, and manufactured tobacco and tobacco substitutes (WITS-TRAINS 2021). However, it should be noted here that in agri-food trade NTMs are even more serious obstacle to trade development than tariffs and they should also be included into the investigation. That is why, the most comprehensive way for identifying sensitive products is to simultaneously employ trade shares and market protection rates covering both tariffs and non-tariff barriers to trade. Taking this approach, we can conclude that the UK market for beef and dairy products is characterized by the highest level of protection. In this case, the overall level of market protection ranged from 77% for cheese and curd to over 116% for frozen beef. It was slightly lower in the trade of tobacco products, and in the exchange of pork, poultry and some fruit and vegetables it ranged from over 42% to 50% (Table 3). Considering both criteria in parallel and assuming over 0.5% share in exports and over 30% overall level of market protection, meat and edible offal, especially beef, poultry, dairy products, certain fruits and vegetables, fish products, chocolate, mineral waters and fruit juices, as well as preparations used in animal feeding may turn out to be particularly sensitive to the decline in exports from Poland to the UK (Figure 2 upper panel). In 2019 those 18 sensitive tariff lines made more than

60% total agri-food exports from Poland to the UK. The same criteria applied to the agri-food exports from the rest of V-4 countries showed that only a few products such as cheese and curd, meat preparations, chocolate and preparations used in animal feeding (CZ, HU) and sugar (CZ) should be considered sensitive ones (Figure 2 bottom panel). These agri-food items were responsible for around 24% (CZ) or 80% (HU, SK) total agri-food exports to the UK.

The 4-digit tariff groups revealing the highest overall level of protection are shown in Table 3, while the level of border costs after Brexit, which we assumed for the identified "sensitive" agri-food products in the partial equilibrium simulation are given in Tables 4 and 5.

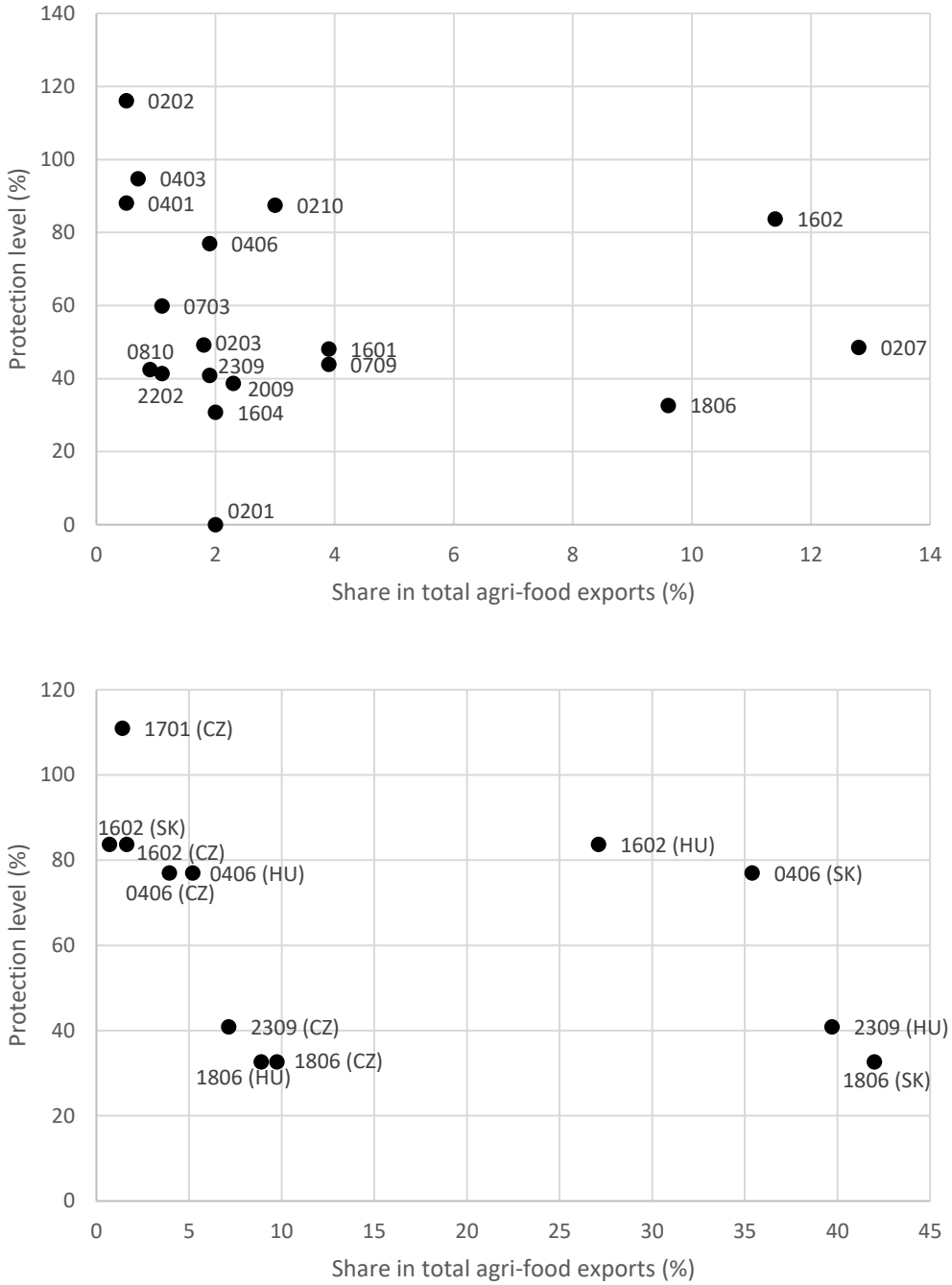
Table 3. Four-digit tariff groups facing the highest level of tariff and NTMs external protection

Four-digit tariff group	MFN tariff	NTMs tariff equivalents	Overall level of protection
Meat of bovine animals; frozen	73.80	42.32	116.12
Milk and cream; concentrated	67.76	40.00	107.76
Meat of bovine animals; fresh or chilled	60.43	42.32	102.75
Buttermilk, curdled milk and cream, yoghurt, kephir, fermented or acidified milk or cream	55.04	39.67	94.71
Milk and cream; not concentrated	48.43	39.67	88.10
Meat and edible meat offal; salted, in brine, dried or smoked	61.12	26.40	87.52
Prepared or preserved meat, meat offal or blood	57.29	26.40	83.69
Cheese and curd	37.33	39.67	77.00
Manufactured tobacco and manufactured tobacco substitutes n.e.c.[a]	42.79	30.55	73.34
Onions, shallots, garlic, leeks and other alliaceous vegetables	24.44	35.48	59.92
Cigars, cheroots, cigarillos and cigarettes[a]	28.69	30.55	59.24
Edible offal of bovine animals, swine, sheep, goats, horses, asses, mules or hinnies; fresh, chilled or frozen	13.83	42.32	56.15
Meat of swine; fresh, chilled or frozen	22.81	26.40	49.21
Meat and edible offal of poultry; fresh, chilled or frozen	22.17	26.40	48.57
Sausages and similar products of meat, meat offal or blood	21.77	26.40	48.17
Vegetables; n.e.c. fresh or chilled	8.44	35.48	43.92
Fruit, fresh; n.e.c.	7.05	35.48	42.53

Note: a – we excluded these tariff groups from further analysis as we assume that food industry covers manufacture of food products (NACE C10) and beverages (NACE C11)

Source: authors' own elaboration based on WITS-TRAINS (2021) and estimations of tariff equivalents of NTMs by Hagemejer et al. (2021).

Figure 2. "Sensitive" agri-food products in the exports from V-4 countries to the UK in 2019 (by export shares and market protection rates)



HS codes: 0201 – meat of bovine animals; fresh or chilled; 0202 – meat of bovine animals; frozen; 0203 – meat of swine; fresh, chilled or frozen; 0207 – meat and edible offal of poultry; 0210 – meat and edible meat offal; salted, in brine, dried or smoked; 0403 – buttermilk, curdled milk and cream, yoghurt, kephir, fermented or acidified milk or cream; 0401 – milk and cream; 0406 – cheese and curd; 0703 – onions, shallots, garlic, leeks and other alliaceous vegetables; 0709 – vegetables, n.e.c.; 0810 – fresh fruit, n.e.c.; 1601 – sausages and similar products of meat, meat offal or blood; 1602 – prepared or preserved meat, meat offal or blood; 1604 – prepared or preserved fish; 1701 – cane or beet sugar; 1806 – chocolate and other food preparations containing cocoa; 2009 – fruit juices and vegetable juices; 2202 – waters; 2309 – preparations of a kind used in animal feeding
Notes: upper panel refers to Polish agri-food exports, while bottom panel refers to the Czech (CZ), Hungarian (HU) and Slovak (SK) agri-food exports
Source: authors' own elaboration based on Comext-Eurostat (2021).

Table 4. Border costs by "sensitive" product groups for Polish exports of agricultural products to the UK

HS4 Code	Commodity	Border costs (%)
0201	Meat of bovine animals; fresh or chilled	5
0202	Meat of bovine animals; frozen	5
0203	Meat of swine; fresh, chilled or frozen	5
0207	Meat and edible offal of poultry; of the poultry of heading no. 0105, (i.e. fowls of the species Gallus domesticus), fresh, chilled or frozen	5
0210	Meat and edible meat offal; salted, in brine, dried or smoked; edible flours and meals of meat or meat offal	5
0401	Milk and cream; not concentrated, not containing added sugar or other sweetening matter	5
0403	Buttermilk, curdled milk and cream, yoghurt, kephir, fermented or acidified milk or cream, whether or not concentrated, containing added sugar, sweetening matter, flavoured or added fruit or cocoa	5
0406	Cheese and curd	5
0703	Onions, shallots, garlic, leeks and other alliaceous vegetables; fresh or chilled	2
0709	Vegetables; n.e.c. in chapter 07, fresh or chilled	2
0810	Fruit, fresh; n.e.c. in chapter 08	2
1601	Sausages and similar products of meat, meat offal or blood; food preparations based on these products	5
1602	Prepared or preserved meat, meat offal or blood	5
1604	Prepared or preserved fish; caviar and caviar substitutes prepared from fish eggs	5
1806	Chocolate and other food preparations containing cocoa	2
2009	Fruit juices (including grape must) and vegetable juices, unfermented, not containing added spirit; whether or not containing added sugar or other sweetening matter	2
2202	Waters, including mineral and aerated waters, containing added sugar or sweetening matter, flavoured; other non-alcoholic beverages, not including fruit or vegetable juices of heading no. 2009	2
2309	Preparations of a kind used in animal feeding	2
2402	Cigars, cheroots, cigarillos and cigarettes; of tobacco or of tobacco substitutes	2
2403	Manufactured tobacco and manufactured tobacco substitutes n.e.c; homogenised or reconstituted tobacco; tobacco extracts and essences	2

Source: authors' own elaboration.

Table 5. Border costs by "sensitive" product groups for Czech, Hungarian and Slovak exports of agricultural products to the UK

HS4 Code	Commodity	Border costs (%)
0406	Cheese and curd	5
1602	Prepared or preserved meat, meat offal or blood	5
1701	Cane or beet sugar and chemically pure sucrose, in solid form	2
1704	Sugar confectionery (including white chocolate), not containing cocoa	2
1806	Chocolate and other food preparations containing cocoa	2
2106	Food preparations not elsewhere specified or included	2
2203	Beer made from malt	2

2309	Preparations of a kind used in animal feeding	2

Source: authors' own elaboration.

We can observe that Polish structure of "sensitive" agricultural exports to the UK is fairly differentiated and covers eighteen 4-digit commodity groups. Many of them are crude plant and animal products facing quite high level of protection. This situation reflects the large potential of Polish agriculture.

On the other hand, the structure of other three Visegrad countries is much more concentrated. In some cases the countries specialize in one or two 4-digit commodity groups. like cheese (0406) and chocolate (1806) in the case of Slovakia or preparations of a kind used in animal feeding (2309) and prepared or preserved meat (1602) in the case of Hungary.

Having selected the "sensitive" products we performed the simulations for all sensitive products for four Visegrad countries. The results of the simulations short-run for Poland's exports of agricultural product to the UK are shown in Table 6.

Table 6. The simulation of trade flows changes in Poland's exports of "sensitive" products to the UK

Commodity group	4-digit HS code	NTMs tariff equivalent	Exports (thousand US$)	Trade creation effect	Trade diversion effect	Total trade effect	Percentage change
Meat and meat products	0201	42.3	79 373	-11 107	-1 196	-12 304	-15.5
	0202	42.3	13 356	-1 498	-320	-1 818	-13.6
	0203	26.4	49 468	-4 878	-37	-4 915	-9.9
	0207	26.4	377 851	-34 983	-3 344	-38 326	-10.1
	0210	26.4	5 219	-866	-326	-1 192	-22.8
Dairy products	0401	39.7	6 939	-959	0	-959	-13.8
	0403	39.7	16 598	-2 280	-2	-2 282	-13.7
	0406	39.7	56 036	-6 946	-56	-7 002	-12.5
Vegetables	0703	35.5	25 164	-7 800	-946	-8 746	-34.8
	0709	35.5	108 894	-13 964	-200	-14 164	-13.0
Fruits	0810	35.5	24 286	-22 641	-65	-22 706	-93.5
Preparations of meat	1601	26.4	56 368	-8 741	-50	-8 791	-15.6
	1602	26.4	1 758	-73	0	-73	-4.2
	1604	8.5	53 992	-5 294	-812	-6 106	-11.3
Cocoa and cocoa preparations	1806	8.5	295 783	-13 498	-1 115	-14 612	-4.9
Fruit juices	2009	8.5	70 190	-1 741	-1 359	-3 100	-4.4
Mineral waters	2202	30.6	24 840	-1 576	-193	-1 769	-7.1
Prepared animal fodder	2309	8.5	45 403	-3 098	-707	-3 806	-8.4
Total			1 311 518	-14 1943	-10 728	-152 671	-11.6

Source: authors' own simulations.

The results of simulation for Poland show that exports of this country to the UK will be reduced as a consequence of negative trade creation (Polish products are becoming more expensive because of higher NTMs and border costs) and negative trade diversion, since they become relatively more expensive in comparison to products imported from third countries.

The negative trade creation effect is about thirteen time stronger in relation to trade diversion effect. It probably means that there are no simple alternatives for products imported from Poland and other EU members. According to theses estimations the strongest relative decreases in Polish exports would be observed in the case of fruits, n.e.c. (0810), onions, shallots (0703) and meat and edible meat offal (0210). The overall reduction of Polish exports of sensitive agricultural products will be close to 152.7 million of US$, i.e. reduced by about 11.6%.

The results of the simulations short-run for Czech, Hungarian and Slovak exports of agricultural product to the UK are shown in Table 7. Relative changes in prices of agri-food products exported from these countries to the UK will result in negative trade diversion effect, while increase in trade costs covering both higher NTMs and border costs will induce a negative trade creation effect. Similarly to Poland's case total trade effect will be determined by trade creation effect rather than by trade diversion. An only exemption from that regularity includes sugars and sugar confectionery exported from Czechia to the UK. This is also one of the most affected products under the Brexit conditions. Moreover, relatively high decreases in exports from the rest of V-4 countries would be noted in the case of cheese and curd (0406). Chocolate (1806), preparations of a kind used in animal feeding (2309) or meat preparations (1602) might be less affected by the changes in trade policy rules. Czechia, Hungary and Slovakia are less important trading partners for the UK than Poland.

Since the values of exports of those countries and the UK are much lower, the possible trade effects are proportionally lower as well. The overall reduction of exports of sensitive agricultural products will probably reach around 9.5 million of US$, i.e. about 15 times less in comparison to Poland. The reduction in exports of Czechia, Hungary and Slovakia in relative terms will also be much lower and close to 8% (and equal to 14.3% in case of Poland).

Table 7. The simulation of trade flows changes in the Czech, Hungarian and Slovak exports of "sensitive" products to the UK

Commodity group	4-digit HS code	NTBs tariff equivalent	Exports (thousand US$)	Trade creation effect	Trade diversion effect	Total trade effect	Percentage change
Czechia							
Dairy products	0406	39.7	3 728	-480	-6	-486	-13.0
Preparations of meat	1602	26.4	44	-2	0	-2	-4.2
Sugars and sugar confectionery	1701	32.7	1 973	-129	-222	-350	-17.8
Cocoa and cocoa preparations	1806	8.5	9 927	-544	-47	-591	-6.0
Prepared animal fodder	2309	8.5	6 129	-320	-95	-415	-6.8
Total			21 801	-1 475	-275	-1 750	-8,0
Hungary							
Dairy products	0406	39.7	1 164	-153	-2	-155	-13.3
Preparations of meat	1602	26.4	14	-1	0	-1	-4.2
Cocoa and cocoa preparations	1806	8.5	12 073	-671	-49	-720	-6.0
Prepared animal fodder	2309	8.5	39 780	-2 455	-618	-3 072	-7.7
Total			53 013	-3 280	-669	-3 948	-7.4
Slovakia							
Dairy products	0406	39.7	20 505	-2 806	-49	-2 855	-13.9
Preparations of meat	1602	26.4	54	-2	0	-2	-4.2
Cocoa and cocoa preparations	1806	8.5	22 185	-780	-97	-877	-4.0
Total			42 744	-3 588	-146	-3 734	-8.7

Source: authors' own simulations.

Conclusions

In our paper we analyzed the implications of Brexit for agricultural exports of four Visegrad (V-4) countries. Our scenario is based on the outcome of the negotiations, with FTA between the EU and the UK, but with no specific commitments on NTMs. We simulate a 25% increase in NTMs, resulting from a possible divergence of regulatory standards and an increase in border costs, differentiated by agricultural sectors.

In our simulation we used the partial equilibrium model (SMART). The Armington elasticities of demand used in the model were based on the GTAP database. In our simulations we used actual tariff data, and NTMs equivalents were estimated on the basis gravity model.

We identified the 4-digit "sensitive" agricultural product groups for individual V-4 countries. These products have a large share in exports of individual countries (over 0.5%) and face a significant increase in NTMs tariff equivalents and border costs. The pattern of "sensitive" products is different among individual V-4 countries. In the case of Poland the export structure is diversified and covers 18 "sensitive" groups, while for the other three countries exports are much more concentrated narrowly defined product categories. We analyzed trade creation and diversion effects of NTMs and border costs changes.

The simulations reveal that exports of sensitive groups of V-4 countries to the UK could decrease by up to 20 percent in the case of selected sensitive products. The exports of Polish sensitive products can be reduced by 152.7 million US$ or by 11.6%. Since the values of exports of other three countries and the UK are much lower, the possible trade effects are proportionally lower as well. The overall reduction of exports of sensitive agricultural products will probably reach around 9.5 million of US$, i.e. about 16 times less in comparison to Poland. The reduction in exports of Czechia, Hungary and Slovakia in relative terms will also be much lower and close to 8%.

This results provide a rough estimate of the scale of the drop in trade in sensitive agricultural products between the V-4 countries and the UK. While the macroeconomic importance of this changes is not significant as agriculture and food sectors have a limited contribution to GDPs of each of the economies involved, for the producers of the sensitive goods these losses of exports are sizeable. However, these results should be interpreted with caution. First, the results of our simulations are sensitive to the choice of import demand and imports substitution elasticities, as well as to the estimates of non-tariff barriers. Therefore these results could rather be treated as stylized facts than actual projections. Second, the size of the shock to NTMs is also subject to uncertainty. The actual changes in trade flows will depend a lot on whether the UK and EU SPS standards will diverge and the extent of regulatory cooperation in the longer term and the resulting level of non-tariff measures.

Bilbliography

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).

Armington P. (1969): A Theory of Demand for Products Distinguished by Place of Production. *Staff Papers – International Monetary Fund* 16(1), 159-177.

Bellora C., Emlinger C., Fouré J., Guimbard H. (2017): Research for AGRI Committee – EU-UK agricultural trade: state of play and possible impacts of Brexit. European Parliament, Policy Department for Structural and Cohesion Policies, Brussels.

Choi H.S., Jansson T., Matthews A., Mittenzwei K. (2021): European Agriculture after Brexit: Does Anyone Benefit from the Divorce? Journal of Agricultural Economics, 72(1), 3-24.

Comext-Eurostat (2021): http://epp.eurostat.ec.europa.eu/newxtweb/, access: 17.07.2021.

Davis J., Feng S., Patton M., Binfield J. (2017): Agreements on UK Agriculture: Sector Analyses using the FAPRI-UK Model. August, p. 1-37.

Dhingra, S. et al. (2017): The Costs and Benefits of Leaving the EU: Trade Effects, Economic Policy. Great Britain, October 2017, p. 653-691.

Donnelan T., Hanrahan K. (2016): Brexit. Potential Implications for the Irish Agri-Food Sector. FAPRI-Ireland Partnership, April, p. 1-73.

Felbermayr G., Gröschl J., Steininger M. (2018): Quantifying Brexit: From Ex Post to Ex Ante Using Structural Gravity. Cesifo Working Paper No. 7357, November 2018, p. 3-54.

Hagemejer J. , Dunin-Wąsowicz M., Michałek J.J., Szyszka J. (2021): Trade-related effects of Brexit. Implications for Central and Eastern Europe. Faculty of Economic Sciences, University of Warsaw, Working paper

HM Government (2018): EU Exit: Long-Term Economic Analysis. Cm 9742, November 2018, p. 2-90.

IMF (2018): United Kingdom. Country Report No. 18/316. November, p. 1-90.

Jammes O., Olarreaga M. (2005): Explaining SMART and GSIM. The World Bank, available at: http://wits.worldbank.org/witsweb/download/docs/ explaining_smart_and_gsim.pdf.

Kee, H.L., Nicita A., Olarreaga M. (2008): Import Demand Elasticities and Trade Distortions. The Review of Economics and Statistics, 90(4), 666-682.

Trade and Cooperation Agreement Between the European Union and the European Atomic Energy Community, of the one part, and the United Kingdom of Great Britain and Northern Ireland, of the other Part (The European Commission: Brussels, 25.12.2020 COM(2020) 857 final Annex)

UN Comtrade Database (2021): https://comtrade.un.org/data/, access: 17.07.2021.

Van Berkum S., Jongeneel R.A., van Leeuwen M. (2018). Brexit's Agri-trade Impacts on the Netherlands. EuroChoices, 17(2), 38-46.

Van Berkum S., Jongeneel R.A., van Leeuwen M.G.A., Terluin I.J. (2018): Exploring the impacts of two Brexit scenarios on Dutch agricultural trade flows. Report 2018-026. Wageningen Economic Research, Wageningen.

Van Berkum S., Jongeneel R.A., Vrolijk H.C.J., van Leeuwen M.G.A., Jager J.H. (2016): Implications of a UK exit from the EU for British agriculture. Study for the National Farmers' Union (NFU), Warwickshire, UK. LEI, Wageningen.

Vasary M. (2019): Impact of Brexit on the trade of Hungarian agricultural and food products. In: 17th Wellmann International Scientific Conference, Május 8., Hódemzővásárhely, p. 1-8.

WITS-TRAINS (2021): https://wits.worldbank.org/default.aspx, access: 17.05.2021.

Yu W., Elleby C., Lind K.M.H., Thomsen M.N. (2017): Modeling the potential impacts of two BREXIT scenarios on the Danish agricultural sectors. IFRO Report No. 260. Department of Food and Resource Economics, University of Copenhagen, Copenhagen.

Zawojska A. (2019): Brexit implications for agri-food trade between Poland and the UK. Annals of the Polish Association of Agricultural and Agribusiness Economists, XXI(4), 589-599.

Appendix

Table 8. Estimated NTM tariff equivalents

Product name	NTM tariff equivalent		
	Extra-EU	Intra-EU	Difference
Paddy rice	20.9	0.0	20.9
Wheat	50.9	16.5	34.4
Cereal grains n.e.c.	102.5	28.3	74.3
Vegetables, fruit, nuts	35.5	0.0	35.5
Oil seeds	37.8	0.0	37.8
Sugar cane, sugar beet	0.0	0.0	0.0
Plant-based fibers	53.3	47.5	5.8
Crops n.e.c.	20.4	10.5	9.9
Bovine cattle, sheep and goat	53.2	35.8	17.4
Animal products n.e.c.	49.8	13.4	36.5
Wool, silk-worm cocoons	0.0	0.0	0.0
Forestry	47.8	28.2	19.7
Fishing	62.3	2.4	59.8
Minerals n.e.c.	100.3	61.6	38.7
Bovine meat products	42.5	0.2	42.3
Meat products n.e.c.	31.4	5.0	26.4
Vegetable oils and fats	32.2	18.3	13.8
Dairy products	56.9	17.2	39.7
Processed rice	49.1	0.0	49.1
Sugar	32.7	0.0	32.7
Food products n.e.c.	31.2	22.8	8.5

Source: own estimations using GTAP data.