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Trade Implications of the Transatlantic Trade and Investment Partnership for Poland's Agri-Food Trade

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Abstract

The objective of the paper is to evaluate the implications of trade liberalization under the Transatlantic Trade and Investment Partnership (TTIP) for the Polish economy. We analyze the level of tariffs and non-tariff protection in the US and in the EU and identify products particularly "sensitive" from the point of view of TTIP liberalization. With the help of a partial equilibrium model, we simulate the trade implications of the TTIP for Poland's trade with the US at the detailed product level. We analyze trade creation and diversion effects of tariff elimination and partial removal of non-tariff barriers. We found that the TTIP can increase Poland's trade with the US by around 45 percent with a limited impact on its trade with the European Union (EU) members. Subsequent general equilibrium simulations show that trade diversion effects of the TTIP are substantial, while the welfare benefits of the agreement are limited.

Keywords: TTIP, tariff equivalents of NTMs, general equilibrium models, partial equilibrium models, agri-food sector, Poland

JEL Classification: C63, C68, F13, F14, F15, F17, F47, Q17

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1 Introduction

International trade flows play an important role in the promotion of economic growth of various countries (Frankel & Romer 1999). The Doha Development Agenda recognizes this fact (Gil-Pareja et al. 2019). Lower trade barriers, going together with declining transportation and communication costs (Hummels 2007), as well as the expansion of international production networks (Yi 2003, Cingolani et al. 2015), are commonly mentioned as the main reasons for an increase in trade flows, being a great booster to the economic growth. The new Doha round of the WTO multilateral negotiations was launched in 2001. This round, however, for many years has been at an impasse and is very unlikely to result in a new global agreement. Lack of progress in global negotiations has led to a growing number of initiatives aiming at regional trade liberalization agreements. The impact of selected trade agreements on exports from both developing and developed countries was investigated by Gil-Pareja et al. (2019).

The Transatlantic Trade and Investment Partnership (TTIP) can be considered as one of the most important initiatives in the area of regional trade liberalization. Although the TTIP talks are put on hold, and the prospects for a potential agreement seem slim under the current commercial policy of the US administration, the previous simulations of the TTIP implications (Fontagné et al. 2013, Francois et al. 2013, Bureau et al. 2015) suggest that macroeconomic gains should induce EU and US to strengthen cooperation, even if the conflicts of interest sometimes hinder it. Moreover, when looking both at the WTO forum and many regional initiatives (e.g., EU-MERCOSUR negotiations), it seems evident that there is nothing unusual in the fact that talks are periodically suspended. In this context, it is justified to ask a question concerning the status quo and possible outcomes of the TTIP agreement for the EU countries, the US, and the rest of the world.

The TTIP negotiations have been very complicated and finally have not been completed. The TTIP attracted the interest of many social groups, and non-governmental organizations (NGO's). The opposition against the TTIP has been relatively strong. In Europe, the liberalization of agricultural and food trade has been in the center of the debate. In this paper, we contribute to the discussion on the effects of the TTIP on the agri-food sector, as well as the debate on the broader welfare implications of the TTIP. It should be noted that so far, regional trade agreements have been more effective than the WTO in agricultural trade liberalization (Grant & Lambert 2009). Trade impacts of selected free trade agreements on agricultural trade of their members have been investigated by many researchers, for example by Lambert & McKoy (2009), Svatoš & Smutka (2009), Sun & Reed (2010), Hndi et al. (2016), Xiong (2017) or Altay (2018).

The preamble to the EU negotiating mandate within TTIP talks said that the "Agreement shall be composed of three key components: (a) market access, (b) regulatory issues and non-tariff barriers (NTBs), and (c) rules. All three components will be negotiated in parallel and as part of a single undertaking ensuring a balanced outcome between the elimination of duties, the elimination of unnecessary regulatory obstacles to trade, and an improvement in rules...". There was no separate section on agri-food trade in the EU Mandate, but this issue was one of the most difficult areas to negotiate.

According to the EU mandate, "the goal was to eliminate all duties on bilateral trade, with the shared objective of achieving a substantial elimination of tariffs upon entry into force and a phasing out of all but the most sensitive tariffs in a short time frame. In the course of negotiations, both Parties should have considered options for the treatment of the most sensitive products, including tariff rate quotas" (see The UE mandate, point 10, page 5). In the case of certain "sensitive" agricultural commodities, the timetable for liberalization of the customs might have been delayed, and tariff rate quotas could have been introduced on both sides. This approach has already been used when negotiating the other free trade agreements. As far as the CETA Agreement (between the EU and Canada) is concerned, the tariff quotas were introduced in the case of, e.g., bovine meat and chickens.

However, the main challenge in the agricultural negotiations is posed by the high levels of protective non-tariff measures (NTMs) rather than in the tariff levels themselves. In particular, it applies to the sanitary and phytosanitary (SPS) measures, designed in principle to protect the life and health of consumers, which can serve as means of protection (for more on technical trade barriers in agricultural trade, including these in the US/Europe trade, and the SPS standards see Roberts (1999), Swinbank (1999), Weyerbrock & Xia (2000)). The EU called for "cross-cutting disciplines on regulatory coherence and transparency for the development and implementation of efficient, cost-effective, and more compatible regulations for goods and services, including early consultations on significant regulations, use of impact assessments, evaluations, periodic review of existing regulatory measures and application of good regulatory practices" (see The UE mandate, point 25, page 12).

The main goal of the paper is to evaluate the likely trade and welfare implications of the TTIP agreement for Poland. We analyze the possible trade implications of the TTIP for Poland's agri-food trade with the US. We performed a detailed product-level analysis using a partial equilibrium model, as well as a more structural analysis using a general equilibrium model showing the welfare effects of the TTIP and the volume of sectoral adjustments.

The structure of this paper is as follows. In the subsequent section, we provide a review of the relevant empirical literature. Next, we discuss the level of tariff and non-tariff protection in the US and the EU and analyze the structure of bilateral agricultural trade between Poland and the US, focusing on sensitive products. The following two sections provide the results of partial and general equilibrium simulations. The last section concludes with a summary of the main findings on possible outcomes of negotiations for Poland.

2 Possible results of the TTIP implementation for the agri-food trade – literature review

The current literature devoted to the TTIP suggests that once the agreement is implemented, the agri-food trade between the EU and the US will grow faster than total trade due to a higher current level of protection for agri-food products relative to other goods. The studies available so far show a similar scale of expected effects of the TTIP.

According to Francois et al. (2013), liberalization that assumes the abolishment of all duties and an ambitious 25% reduction of *ad valorem* equivalents of non-tariff barriers is expected to bring a 15% increase in the export of agricultural products from the EU to the US and an increase of 45% in the export of processed foods. Simultaneously, the simulations show that EU imports of agricultural products from the US could increase by 22%, whereas the imports of processed foods could increase by 75%. Thus, the TTIP agreement could bring more benefit in agri-food trade to the US rather than to the EU. It is due to the differences in the initial level of tariff protection of the EU and US markets. If customs tariffs are abolished or at least reduced, the party which applied a lower degree of protection before the establishment of a preferential trade zone will probably benefit more from liberalization. We discuss the level of tariff protection in the EU and US agri-food trade in the next section of the paper.

Bureau et al. (2014), employing the general equilibrium model MIRAGE (*Modelling International Relationships in Applied General Equilibrium*) has shown that the effects of the TTIP might be more significant in agri-food trade in comparison to total trade flows and claimed that the US might benefit more than the EU from the liberalization (see also Francois et al., 2013). If the customs duties are entirely abolished, and non-tariff barriers in products and services are reduced by 25%, the EU exports of agri-food products to the US might increase by about 57%. In contrast, imports of food from the US might increase by over 116%. Fontagné et al. (2013) forecast even more dynamic changes in bilateral trade between the EU and the US.

The CEPR on behalf of the Polish Ministry of Economy investigated the overall consequences of the possible TTIP agreement for the Polish economy. As shown by the study, it is likely that the exports of agricultural products increase by as much as 179%, whereas the imports of processed food products rise by 99% (Ministry of Economy 2015). Similar results of simultaneous trade liberalization between the EU and the US were presented by Hagemejer (2015) who showed that Polish agricultural exports to the US could increase by as much as 100%, while the volume of food product exports could be higher by 59% with a considerably more substantial increase of imports from the US.

3 Tariff and non-tariff measures applied to the EU and the US agri-food trade

The Agreement on Agriculture of the Uruguay Round of the GATT/WTO achieved only limited success in improving access to agricultural markets, as customs duties in agri-food trade are higher than in the case of industrial goods (Ingco 1996, Tangermann 2001, Bureau et al. 2006). A similar situation is observed in the EU and the US agri-food trade. In 2014 (we refer to the year of 2014 to be consistent with both partial and general equilibrium simulations) the duty rate imposed by the EU countries on agricultural products was nearly 3-fold higher than the one on non-agricultural products (12.2% vs 4.2%). The rate on imports of agricultural products applied by the US was almost 2.5-fold lower than in the EU and amounted to 5.1%, while the rate on non-agricultural products was 3.2% (WTO, ITC, UNCTAD 2015, Pawlak 2016).

The general structure of tariff lines and the value of agri-food imports is presented

Table 1: Tariff lines (2014) and agri-food import values in the EU and the US (2013) by the MFN tariff rates (%)

Specification	Duty-free	(0; 5]	(5; 10]	(10; 15]	(15; 25]	(25; 50]	(50; 100]	> 100
				EU				
Structure of tariff lines	31.7	10.1	17.5	13.5	11.4	8.7	3.4	0.8
Structure of import values	46.1	11.9	13.3	7.3	7.3	3.1	4.9	6.0
				USA				
Structure of tariff lines	30.8	46.4	12.2	5.0	3.1	1.5	0.3	0.8
Structure of import values	39.6	35.1	14.9	2.9	1.9	4.8	0.0	0.6

Source: WTO, ITC, UNCTAD (2015).

in Table 1. It should be noted here that there were no duties on around 30% of all tariff lines in the EU and the US. These tariff lines covered over 46% of the EU imports and 40% of the US imports. In the US customs tariff there were more tariff lines with duty rates under 10%, while in the EU more tariff lines with duty rates of at least 50% were applied (cf. Pawlak 2016).

The MFN rates of tariffs according to the 2-digit HS classification are diversified (Table 2). In the EU the lowest duties were imposed on the import of products from other climate zones or on the land-intensive goods which were not produced in adequate amounts in the EU. In the US most products were protected by relatively low tariff rates, usually not exceeding 6%. Only in imports of tobacco and its substitutes, oil seeds, dairy produce and preparations of vegetables, fruit, or nuts the average ad valorem duty rates exceeded 10%. In more detailed this aspect is discussed by Pawlak (2016).

In addition to the elimination of customs duties, the reduction of non-tariff measures in trade between the EU and the US was an important issue under the TTIP negotiations. The estimates of tariff equivalents of NTMs differ across alternative studies. Bureau et al. (2014) estimated that NTMs in the EU are higher than those in the US nearly for all product groups. However, Fontagné et al. (2013) estimated that this is true only for some product groups. According to these studies, the highest NTM equivalents in the EU and the US are found in the case of meat, dairy produce, vegatables and fruits and processed food.

Table 2: The average MFN applied tariffs in agri-food trade of the EU and the US in 2014 (%)

HS code	EU	USA	HS code	EU	USA
01 – live animals	1.2	0.8	13 – lac; gums, resins and other vegetable saps and extracts	2.3	0.9
02 – meat and edible meat offal	5.1	4.2	14 – vegetable plaiting materials; vegetable products n.e.c	0.0	1.1
03 – fish and crustaceans, molluscs and other aquatic invertebrates	11.1	0.5	15 – animal or vegetable fats and oils and their cleavage products	5.4	3.5
04 – dairy produce	5.8	12.7	16 – preparations of meat, of fish or of crustaceans, molluscs or other aquatic invertebrates	17.9	3.1
05 – products of animal origin n.e.c	0.1	0.4	17 – sugars and sugar confectionery	6.8	6.2
06 – live trees and other plants	6.7	3.6	18 – cocoa and cocoa preparations	6.1	3.3
07 – edible vegetables	8.5	8.7	19 – preparations of cereals, flour, starch or milk	10.7	5.5
08 – edible fruit and nuts	6.4	3.4	20 – preparations of vegetables, fruit or nuts	17.5	10.2
09 – coffee, tea, maté and spices	2.3	0.3	21 – miscellaneous edible preparations	9.2	5.6
10 – cereals	2.2	1.5	22 – beverages, spirits and vinegar	3.9	1.8
11 – products of the milling industry	12.2	3.8	23 – residues and waste from the food industries; prepared animal fodder	0.8	0.6
12 – oil seeds and oleaginous fruits	1.2	13.1	24 – tobacco and manufactured tobacco substitutes	44.7	204.2

Source: own elaboration based on WTO (2017).

Considering relatively low levels of tariff protection in trade between the EU and the US, we expect that the reduction of customs duties will not strongly increase EU-US trade in agri-food products. However, due to a relatively high concentration of bilateral trade in selected product groups (see section "Agri-food trade flows between Poland and the US"), the liberalization of trade under the TTIP may lead to a significant trade expansion for some Polish agri-food industries such as meat, sugar, fruits and vegetable, wine or beverages and tobacco.

4 Estimation of non-tariff measures in the EU and US imports – methodology and results

In order to quantify the potential effects of trade liberalization within the framework of the TTIP we employed the standard gravity framework as proposed initially by Park (2002) and refined by Fontagné et al. (2011). This method is based on attributing the otherwise unexplained deviations of trade from benchmark trade flows to the effects of NTMs.

Following the above literature, we analyzed the difference in log values of actual and model-predicted import values from the i-th country to the j-th country. The difference between the total actual and predicted values of country imports may indicate the level of distortion to trade caused by the existence of trade barriers. However, the absolute differences should be normalized relative to a benchmark free-trade country case. As proposed by Fontagné et al. (2011), in a panel setting this boils down to comparing the fixed effect of the j-th country to that of the benchmark country (as the fixed effect is itself a time-invariant average residual) and the tariff equivalent t_j satisfies:

$$-\sigma \ln t_j = Fe_j - Fe_b \tag{1}$$

where Fe is the estimated importer-specific fixed effect for the j-th country and the b-th country respectively, and σ is the elasticity of substitution. Our estimations employ Comtrade data for the years 2009-2014 to account for the post-crisis slowdown of trade and a possible increase of NTMs. The trade data are merged with the effectively used tariffs (World Integrated Trade Solution UNCTAD TRAINS available through the World Bank Data Catalog), macroeconomic and demographic data (GDP and the population from the World Development Indicators database) and the standard gravity variables such as distance, contiguity, common colonial past, common language etc. (CEPII data by Mayer & Zignago (2011)). The estimations include importer and exporter fixed effects together with time dummies. The estimations are performed at a commodity level where the level of aggregation is defined by the Global Trade Analysis Project (GTAP) classification (see `https://www.gtap.agecon.purdue.edu/databases/v9/v9_sectors.asp` for a detailed industry breakdown). The elasticities of substitution that are used to calculate the tariff equivalents are also obtained from the GTAP database. The benchmark country for each estimation is the country with the highest value of the importer-specific fixed effect.

Examination of the estimation results included in Table 3 (detailed estimation results for each sector are available upon requests) show a considerable difference between the tariff level and NTM tariff equivalents. While tariffs as a rule are low and usually do not exceed 10 percent, the NTMs are higher and more heterogeneous. In general, the tariffs on raw agricultural products are lower than those on products of the food industry. In the EU, the highest tariffs are levied on milk and milk products, sugar and rice. The highest NTMs are present in sectors where trade is low in spite of

Table 3: Tariffs and NTM tariff equivalents in the EU and US agri-food imports

Sector	Import tariff		NTM tariff equivalent	
	EU	USA	EU	USA
Paddy rice	5.0	1.5	23.6	45.4
Wheat	0.0	1.8	18.3	53.0
Cereal grains n.e.c.	1.9	0.7	31.9	94.4
Vegetables, fruit, nuts	3.0	0.4	0.0	24.7
Oil seeds	0.0	0.0	0.0	46.4
Sugar cane, sugar beet	0.0	0.0	312.5	233.9
Plant-based fibers	0.0	0.0	62.6	126.5
Crops n.e.c.	9.4	2.0	6.1	5.3
Bovine cattle, sheep and goats, horses	0.1	2.8	84.0	103.8
Animal products n.e.c.	4.0	0.6	106.3	144.4
Raw milk	0.0	0.0	16.4	25.6
Wool, silk-worm cocoons	0.0	0.0	10.5	17.6
Bovine meat products	42.9	0.0	27.3	49.4
Meat products n.e.c.	4.5	2.2	26.9	41.8
Vegetable oils and fats	0.2	5.1	21.2	12.2
Dairy products	44.4	6.4	16.4	25.6
Processed rice	21.2	4.4	40.4	34.8
Sugar	31.8	0.2	47.9	20.1
Food products n.e.c.	10.1	4.6	41.2	16.6
Beverages and tobacco products	4.0	0.3	90.4	0.0

Source: import tariffs – GTAP database, NTM tariff equivalents – own estimates using gravity models.

the low tariffs. This in particular applies to raw agricultural products where tariff equivalents of NTMs may be of the order of 100 percent or higher. The differences between the EU and the USA are, at the same time, not systematic.

5 Agri-food trade flows between Poland and the US

The potential effects of agricultural trade liberalization to a large extent depend on existing levels of trade flows. The USA is not an important agri-food trade partner for Poland. Although the value of bilateral trade between Poland and the US rose by about 150% from 2007 to 2014, the share of the US in Poland's export of agri-food products reached only 1.3%, while the share of this country in the import's structure amounted to less than 1% (Eurostat 2017). The relatively low value of agri-food Polish-US trade flows results from a small complementarity of agriculture in these

countries (the same temperate zone).
The structure of agri-food trade between Poland and the US in 2014 is shown in Table 4. This trade was dominated by food preparations, beverages, spirits and vinegar, as well as tobacco and manufactured tobacco substitutes. These groups of products accounted for more than 60% of total exports to the US (171.5 million EUR) and 66% of imports from this country (89.5 million EUR). Polish exports to the US were dominated by preparations of meat or of fish (17% of total exports), spirits (12%), cocoa and cocoa preparations (9%), and preparations of vegetables, fruit or nuts (8%), including mainly fruit juices (4%). Fresh or chilled or frozen pork meat accounted to 20% of Poland's export of agri-food products to the US. Thus, Poland did not export to the US goods produced by basic food processing industries, agricultural raw materials and unprocessed products for final consumption, with the exception of fruit, vegetable preparations and preparations of pork meat.
In Table 4 we present "key products" (4-digit level of HS) in Polish exports to the US. These products have a large share in bilateral trade, while the level of ad valorem duties and NTM tariff equivalents applied in the US is high. Thus, it may be expected that the liberalization of bilateral exchange within the TTIP results in a relatively strong creation of Polish exports of fruit and vegetable preparations, pork meat, edible offal and preparations of pork meat. However, Polish producers and exporters will have to face the challenge of strong competition from US farmers, who produce at a larger scale and at lower costs of production.
The customs duties and/or NTM tariff equivalents applied to the US imports of live animals, fibrous plants, sugar cane or beet, dairy produce, and tobacco are much higher than import duties for meat products and processed horticultural products. Still, due to the small share of these products in the structure of export, no significant changes may be expected in the value of Polish agri-food export to the US after the abolishment of trade barriers under the TTIP.
Polish imports from the US were dominated by food preparations, beverages, spirits and vinegar, as well as tobacco and manufactured tobacco substitutes (accounting for about 66% of total food import from the US). The critical food preparations imported to Poland were residues and waste from the food industries as well as prepared animal fodder, including oil-cake and other solid residues resulting from the extraction of soybean oil (17% of total import in 2014), unmanufactured tobacco (13%), spirits (13%), as well as preparations of vegetables, fruit or nuts (8%). Moreover, fresh or chilled or frozen fish (14%) and edible fruit and nuts (mainly almonds, hazelnuts, walnuts, and dried fruit) were imported to Poland as well (9% – Table 4). It is worth mentioning that imports of tropical fruit, fresh or prepared or preserved, other fruit and nuts, some fish, and oil-cake resulting from the extraction of soybean oil met the considerable demand on the Polish market. Moreover, the EU markets for tobacco, preparations of fruit and vegetables, and fish are protected by relatively high customs duties and NTMs. The abolishment or even reduction of these tariff barriers may result in a further increase in import values. Some products such as live animals, in

Table 4: Agri-food trade between Poland and the US in 2014, including "key product groups" (in thousand EUR)

HS code	Export		Import		Balance	HS code	Export		Import		Balance
	thous. EUR	%	thous. EUR	%	thous. EUR		thous. EUR	%	thous. EUR	%	thous. EUR
01	350.7	0.1	176.5	0.1	174.2	14	0.0	0.0	21.4	0.0	−21.4
0105	x	x	152.4	x	x	15	819.0	0.3	1 190.7	0.9	−371.6
02	54 022.7	19.0	0.0	0.0	54 022.7	1517	588.6	0.2	x	x	x
0203	53 807.5	18.9	x	x	x	16	48 055.6	16.9	58.5	0.0	47 997.1
03	11 631.6	4.1	20 533.1	15.2	−8901.6	1604	x	x	58.5	0.0	x
0304	x	x	18 266.0	13.5	x	17	10 101.9	3.5	181.2	0.1	9 920.7
0305	6 079.5	2.1	x	x	x	1701	x	x	176.1	0.1	x
04	7 397.5	2.6	12.9	0.0	7 384.6	1703	3 711.2	x	x	x	x
0406	6 536.5	2.3	x	x	x	1704	6 259.9	2.2	x	x	x
05	6 104.4	2.1	1 476.3	1.1	4 628.0	18	24 234.8	8.5	8.9	0.0	24 226.0
06	625.7	0.2	181.7	0.1	444.0	19	13 643.4	4.8	62.9	0.0	13 580.5
07	8 451.2	3.0	289.4	0.2	8 161.8	1905	11 124.6	3.9	58.5		11 066.1
0710	4 712.7	1.7	x	x	x	20	22 493.6	7.9	10 609.6	7.8	11 884.0
08	2 663.1	0.9	12 325.6	9.1	−9662.5	2009	11 762.2	4.1	366.8	0.3	11 395.4
0802	x	x	6 990.9	5.2	x	21	11 862.3	4.2	14 069.8	10.4	−2207.5
0806	x	x	1 919.4	1.4	x	22	40 525.0	14.2	21 816.9	16.1	18 708.1
0811	2 366.5	0.8	x	x	x	2202	5 353.8	1.9	x	x	x
0813	x	x	3 324.5	2.5	x	2204	x	x	4 710.2	3.5	x
09	3 582.4	1.3	25.5	0.0	3 556.9	2208	x	x	17 001.8	12.6	x
10	12 086.0	4.2	795.4	0.6	11 290.6	23	495.3	0.2	25 389.9	18.8	−24894.6
1005	x	x	622.0	0.5	x	2304	x	x	23 597.7	17.4	x
11	4 351.5	1.5	43.1	0.0	4 308.5	2309	x	x	1 775.9	1.3	x
12	1 341.3	0.5	4 958.1	3.7	−3616.7	24	129.0	0.0	17 270.0	12.8	−17141.0
1202	x	x	3 039.9	2.2	x	2401	x	x	17 255.3	12.8	x
1209	x	x	1 656.7	1.2	x	Total	284 974.8	100.0	135 328.6	100.0	149 646.2
13	6.7	0.0	3 831.2	2.8	−3824.6						

HS codes: 0105 – live poultry; 0203 – meat of swine, fresh, chilled or frozen; 0304 – fish fillets and other fish meat, fresh, chilled or frozen; 0305 – fish, dried, salted or in brine; 0406 – cheese and curd; 0710 – vegetables, frozen; 0802 – other nuts, fresh or dried, whether or not shelled or peeled; 0806 – grapes, fresh or dried; 0811 – fruit and nuts, uncooked or cooked by steaming or boiling in water, frozen; 0813 – fruit, dried; 1005 – maize; 1202 – ground-nuts; 1209 – seeds, fruit and spores, of a kind used for sowing; 1517 – margarine; 1604 – prepared or preserved fish; 1701 – cane or beet sugar and chemically pure sucrose; 1703 – molasses; 1704 – sugar confectionery, not containing cocoa; 1905 – bread, pastry, cakes, biscuits and other bakers' wares; 2009 – fruit and vegetable juices; 2202 – waters; 2204 – wine of fresh grapes; 2208 – undenatured ethyl alcohol of an alcoholic strength by volume of less than 80% vol.; spirits, liqueurs and other spirituous beverages; 2304 – oil-cake and other solid residues, resulting from the extraction of soybean oil; 2309 – preparations of a kind used in animal feeding; 2401 – unmanufactured tobacco
Source: own calculations based on Eurostat (2017).

particular swine and poultry, edible offal and meat preparations of poultry or swine, and sugar beet and cane have relatively low shares in Poland's agri-food imports from the US. Nevertheless, they may be regarded as "key product groups", since they face high tariffs and NTMs barriers in imports to the EU countries. In imports of meat preparations, the EU also imposed high ad valorem duties. The elimination of all these trade barriers could result in a rapid increase in import, which can create a competitive threat to producers in Poland less concentrated and efficient than in the US.

6 Implications of trade liberalization based on partial equilibrium model (GSIM)

6.1 Model specification

In this section we present the effects of trade liberalization in agricultural trade using the SMART partial equilibrium model. The model is available at the WTO website (WITS Global Tariff Cuts Simulator) and is based on the GSIM (Global Simulation Model), elaborated theoretically by Francois & Hall (2009). The structure of the SMART (GSIM) model is discussed in detail in WTO (2012), basing on the paper by Jammes and Olarreaga (2005). This partial equilibrium model is grounded on the Armington (1969) assumption, that the varieties of a given product are differentiated by the country of origin. This is represented by a constant elasticity of substitution sub-utility function. The representative consumer in an importing country consumes a product being a bundle of different varieties, which are imperfect substitutes and are imported from various countries. A simple framework, described Jammes and Olarreaga (2005, a simpler version of the SMART and GSIM is presented in chapter 4 of WTO, 2012), is to assume a quasi-linear an additive utility function that is also additive on a composite numéraire good (n). In this case the structure of the utility function is:

$$U = \sum_g u_g(m_g) + n, \tag{2}$$

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 (2), taking into consideration the budget constraint, gives the equation (3):

$$\begin{aligned} m_{g,c} &= f\left(p^d_{g,c}; p^d_{g,w}\right) \quad \forall g, c \\ n &= y - \sum_c \sum_g p^d_{g,c} m_{g,c}, \end{aligned} \tag{3}$$

where $m_{g,c}$ are the imports of good g from country c, $p^d_{g,c}$ is the domestic price of imported variety g from country c, and $p^d_{g,w}$ 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 $p^w_{g,c}$ 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. Using the following definition of price elasticity of import demand:

$$\varepsilon_{g,c} = \frac{dm_{g,c}/m_{g,c}}{dp^d_{g,c}/p^d_{g,c}} < 0, \tag{4}$$

where $dm_{g,c}$ is the change in the demand for import of good g from country c, one can define the trade creation ($TC_{g,c}$) expressed in world prices as follows:

$$TC_{g,c} = p^w_{g,c} dm_{g,c} = p^w_{g,c}\varepsilon_{g,c}m_{g,c}\frac{dp^d_{g,c}}{p^d_{g,c}}. \tag{5}$$

From the definition of domestic price we get $dp^d_{g,c} = p^w_{g,c}dt_{g,c}$. Inserting it to (5), and assuming that $p^w_{g,c} = 1$, we get a simple formula of TC for calculations.

$$TC_{g,c} = p^w_{g,c}dm_{g,c} = p^w_{g,c}\varepsilon_{g,c}m_{g,c}\frac{dt_{g,c}}{(1+t_{g,c})} = \varepsilon_{g,c}m_{g,c}\frac{dt_{g,c}}{(1+t_{g,c})}. \tag{6}$$

If the tariff reduction from country c (like EU) is a preferential tariff reduction then imports of this good from other countries are going to be substituted away from imports, because they become relatively more expensive. Thus we can define the trade diversion. In order to measure it we have to define the elasticity of substitution, ($\sigma_{g,c,w}$) across imports of good g from country c and all other countries:

$$\sigma_{g,c,w} = \frac{d\left(\frac{m_{g,c}}{m_{g,w}}\right)\Big/\frac{m_{g,c}}{m_{g,w}}}{d\left(\frac{p^d_{g,c}}{p^d_{g,w}}\right)\Big/\frac{p^d_{g,c}}{p^d_{g,w}}} < 0. \tag{7}$$

Taking into account relative tariff changes, resulting from preferential tariff reductions, recalling the definition of trade diversion $dm_{g,c} = -dm_{g,w}$, and using previous relations we can define the trade diversion as (an addition constraint must be introduced since the trade diversion cannot be larger than the original imports of good g from other countries, not c):

$$TD_{g,c} = dm_{g,c} = \frac{m_{g,w}m_{g,c}}{m_{g,c}+m_{g,w}}\frac{dt_{g,c}}{(1+t_{g,c})}\sigma_{g,c,w}. \tag{8}$$

The simulated changes in the price of a given variety, resulting from changes of tariffs, 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, ($\sigma_{g,c,w}$) 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, i.e. one can run the simulations for every HS category separately.

We applied the SMART model to analyze the potential trade implications of the TTIP for Poland. In particular, we studied the implications of tariff eliminations and NTM reductions in the US for exports originating in Poland and other 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 US (*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.

In our simulations we used the standard supply elasticities provided by the SMART model. The elasticity of export equals to 99 (which can be understood as the exporting country being a price taker in the export market), while elasticities of import demand are different for a given (aggregate) good. On the other hand, we based Armington elasticities of demand on the GTAP database to assure compatibility with our general equilibrium simulations. 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 SMART model simulations were performed for "key" product groups identified in the previous section of the paper and are based on the 2014 trade flows and matched to relevant categories of the GTAP classification.

6.2 Empirical results

In Table 5 we present the results of simulations for total tariff elimination and the reduction of NTMs by 50 percent in comparison to the present level of tariff equivalents. The simulations are based on WITS/TRAINS data, covering trade flows in US dollars and based on applied tariff levels.

Taking into account the limitations of our analysis we can state that the expected export growth (42.8 million of US dollars) represents nearly 47% of analyzed Polish exports. This increase represents mostly trade diversion (30.7 million USD) and not trade creation (12.1 million USD). The trade diversion effect in this case means that Polish exports replace (due to lower US prices) goods from other countries, not benefiting from lower tariffs and NTM's. According to our simulations the largest

Table 5: Simulated increases in Polish exports to the US, resulting from tariff elimination and reductions of NTM equivalents by 50% (in thousand US dollars and percent), based on the US import data in 2014

2-digit HS group	Specific 4-digit HS group	Poland's exports to the US (thousands of USD)	Applied US tariff and NTMs tariff equivalent	Elimination of tariffs and reduction of NTMs tariff equivalents by 50%	Trade creation effect	Trade diversion effect	Total trade effect	Increase in exports (in percent)
02	0203	71 457.0	21.0	5.6	59 178.4	28 088.3	87 266.7	122.1
03	0305	8 198.6	46.0	20.5	1 079.7	2 865.5	3 945.1	48.1
04	0406	8 521.6	36.6	12.8	1 172.9	2 676.6	3 849.6	45.2
07	0710	6 516.2	35.7	12.3	3 140.6	3 926.9	7 067.5	108.5
08	0811	3 795.4	31.4	12.3	275.6	2 000.5	2 276.1	60.0
15	1517	873.2	19.9	6.1	502.1	649.9	1 152.0	131.9
17	1703	6 785.5	20.1	10.1	283.9	2 597.2	2 881.1	42.5
17	1704	1 917.1	25.2	8.3	93.1	918.4	1 011.5	52.8
19	1905	26 702.8	18.8	8.3	1 917.0	8 843.8	10 760.7	40.3
20	2009	20 877.8	16.6	8.3	796.4	3 211.2	4 007.6	19.2
22	2202	7 435.1	33.9	8.3	2 854.3	3 006.6	5 860.9	78.8
Total		91 623.3			12 115.7	30 696.5	42 812.1	46.7

HS codes: 0203 – meat of swine, fresh, chilled or frozen; 0305 – fish, dried, salted or in brine; 0406 – cheese and curd; 0710 – vegetables, frozen; 0811 – fruit and nuts, uncooked or cooked by steaming or boiling in water, frozen; 1517 – margarine; 1703 – molasses; 1704 – sugar confectionery, not containing cocoa; 1905 – bread, pastry, cakes, biscuits and other bakers' wares; 2009 – fruit and vegetable juices; 2202 – waters.
Source: own calculations performed in SMART and based on WITS/TRAINS databases (2015). The elasticities of substitution are based on Hertel et all. (2004).

export increases, exceeding 100%, may be expected in the case of meat of swine (HS 0203), vegetables (HS 0710), margarine and edible mixtures or preparations of animal or vegetable fats (HS 1517). The important increases, exceeding 50%, may also appear in the case of mineral water (HS 2202), fruit and nuts (HS 0811) and prepared or preserved fish (HS 1704). Thus, the simulated export gains may be significant, but they largely depend on the final outcome of negotiations on NTMs.

We also simulated changes in Polish imports from the United States and the results of these simulations are presented below in Table 6. The simulations were performed for 4-digit level "key" product groups identified in the previous section and are based on EU imports data for the year 2014. We simulated the complete elimination of import duties and a 50% reduction of tariff equivalents of NTMs. The NTM tariff equivalents were also calculated for aggregated GTAP products, while the simulations were conducted for 4-digit product groups.

Table 6: Simulated increases in Polish imports from the US, resulting from tariff elimination and reductions of NTM equivalents by 50% (in thousand US dollars and percent), based on the EU import data in 2014

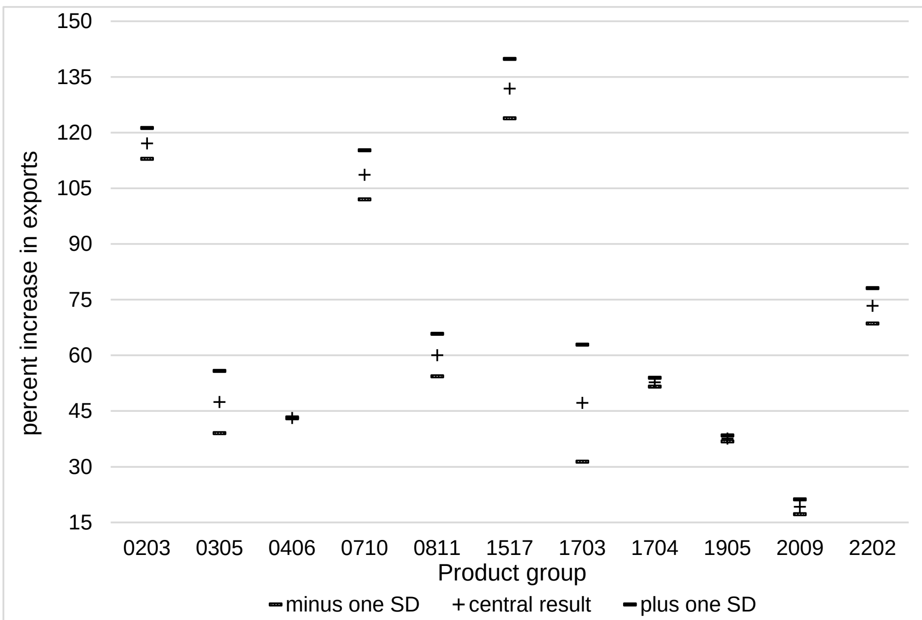
2-digit HS group	Specific 4-digit HS group	Poland's imports from the US (thousands of USD)	Applied EU tariff and NTMs tariff equivalent	Elimination of tariffs and reduction of NTMs tariff equivalents by 50%	Trade creation effect	Trade diversion effect	Total trade effect	Increase in imports (in percent)
01	0105	202	90.1	44.2	24	255	279	138.4
03	0304	45 742	21.9	5.3	6 534	14 682	21 216	46.4
08	0802	32 303	2.8	0.0	446	4 005	4 451	13.8
08	0806	3 310	3.6	0.0	57	421	478	14.4
08	0813	5 046	9.1	0.0	210	2 502	2 711	53.7
10	1005	934	31.8	15.9	56	317	373	40.0
12	1202	7 420	0.0	0.0	0	0	0	0.0
12	1209	2 529	0.0	0.0	0	0	0	0.0
15	1517	1 181	23.3	6.1	82	1 186	1 268	107.4
16	1604	103	20.5	5.2	7	35	42	40.3
17	1701	650	106.7	24.0	130	1 579	1 709	263.0
19	1905	332	31.8	15.9	56	317	373	112.4
22	2204	27 862	122.0	45.0	4 832	23 950	28 782	103.3
22	2208	29 884	90.0	45.0	3 539	16 603	20 142	67.4
24	2401	42 886	90.0	45.0	5 079	22 377	27 455	64.0
Total		238 637			21 052	88 228	109 281	45.8

HS codes: 0105 – live poultry; 0304 – fish fillets and other fish meat, fresh, chilled or frozen; 0802 – other nuts, fresh or dried, whether or not shelled or peeled; 0806 – grapes, fresh or dried; 0813 – fruit, dried; 1005 – maize; 1202 – ground-nuts; 1209 – seeds, fruit and spores, of a kind used for sowing; 1517 – margarine; 1604 – prepared or preserved fish; 1701 – cane or beet sugar and chemically pure sucrose; 1905 – bread, pastry, cakes, biscuits and other bakers' wares; 2204 – wine of fresh grapes; 2208 – undenatured ethyl alcohol of an alcoholic strength by volume of less than 80% vol.; spirits, liqueurs and other spirituous beverages; 2401 – unmanufactured tobacco
Source: own calculations performed in SMART and based on WITS/TRAINS databases (2015).

The results presented in Table 6 suggest that Polish imports could increase by 109.3 million USD, i.e. by 45.8% of Polish exports in 2014. We have to stress here that the simulated increases of imports results mainly form trade diversion (88.2 million USD), and to lesser extend from trade creation (21.0 million USD). The important increases exceeding 100% may be expected in the case of poultry (HS 0105), margarine and edible mixtures or preparations of animal or vegetable fats (HS 1517), bread, pastry, cakes, biscuits, other bakers' wares, (HS 1905) and wine (HS 2204). There will be no increase in the case of major imports of Poland, i.e. oil seeds and oleaginous fruits (HS 12), since the EU common external tariff (CET) is already close to zero. Thus, the simulated changes in imports may be important, but fully comparable to the simulated increases of Polish exports from the US. These results strongly depend on the outcome of final negotiations on NTM reductions.

We check the robustness of our simulations by modifying the exogenously given, from GTAP model, the elasticities of substitution ($\sigma_{g,c,w}$) across imports. The possible modifications in the elasticities of substitution – in line with the equation (8) – will change the level of Polish trade diversion are shown in Table 5. In the following graph we present the likely changes in the trade flows estimations, taking into account the upper and lower limits of elasticities, resulting from standard deviations of baseline elasticities of substitution.

Figure 1: Sensitivity analysis. Changes in Polish exports (in percent) resulting from the modification of the elasticities of substitution across import sources



Comment: To perform these additional simulations, we used the elasticities and standard deviations calculated by Hertel et al. (2004). (+1 and −1 standard deviation (SD) of elasticities).

The results of additional simulations presented in Figure 1 show that our baseline results, presented in Table 5, are fairly robust. The major differences are present in the case of HS 1703 (molasses). The other larger likely changes also appear in the cases of groups HS 0710 (vegetables, frozen), HS 0811 (fruit and nuts) and HS 1517 (margarine). For overall Polish exports, the possible changes resulting from modified

elasticities range from +4 to −4 percent.
The partial equilibrium simulations are easy to perform due to small data requirements. They allow us to analyze potential changes in trade flows for disaggregated product groups, but they do not demonstrate broader implications for the whole economy. These implications will be analyzed in the next section on the basis of general equilibrium simulations.

7 Computable general equilibrium simulation

7.1 Methodological remarks

The simulations were performed using the Global Trade Analysis Project (GTAP) model. The GTAP model, developed by the Center for Global Trade Analysis at Purdue University is a multi-region, multi-sector static (i.e. used for comparative statics) computable general equilibrium model. The documentation of the model is ample (see, e.g., Corong et al. 2017), and we will present only a general outline here focusing on the preference and technology structure and the management of final demand. It is based around the concept of regional household that allocates total regional income across private and public consumption expenditures as well as savings (through a Cobb-Douglas utility function) assuring constant shares of the three expenditure categories. Thanks to this way of modelling it is possible to conduct welfare analysis that takes into account public consumption and savings. It also solves the problem of modelling government savings/deficits in general equilibrium. However, this way the public consumption is unrelated to (non-existent) government budget constraint which limits the usefulness of the model for analysis of fiscal policy but on the other hand, facilitates dealing with analysis of welfare effects of tariff liberalization.
As is typical in CGE modelling, both preference structure and the structure of production is a nested concept allowing for flexible behavior of producer and consumer at various levels of aggregation. While the government consumption expenditure is allocated across different goods according to a Cobb-Douglas function, the top nest of private consumption preferences is governed by a *constant difference of elasticities* (CDE) utility function (see McDougall, 2003). These preferences allow for non-unitary income and price elasticities of demand for different types of goods. Demand generated by this top tier function is for a composite good that is composed of the domestically produced goods and an aggregate of imported goods (see later).
The GTAP model in the form employed in this paper relies on perfect competition assumptions, i.e. all agents are price takers in factor markets and given the constant returns to scale assumption this leads to zero profits in all production sectors. The zero profit-conditions explicitly link the output prices with the unit costs of production.
The production function is multi-level based on several constant elasticity of substitution (CES) aggregates. The top-tier output aggregate is a composite of

value-added and an aggregate of intermediate use. The value-added aggregate is a CES composite of capital, labor (high and low skilled) as well as land and natural resources. Land and natural resources are sector-specific, while labor and capital are mobile across sectors. Intermediate consumption is an aggregate of sectoral intermediate products with elasticity of substitution restricted to zero (Leontief). The sectoral intermediate products are composite goods of domestic production and composite imports.

Imports and domestic output are imperfect substitutes in regional final and intermediate consumption, as suggested by Armington (1969), as governed by CES function with a sector-specific elasticity of substitution ESUBD. Similarly, the import aggregate is composed of goods coming from different regions, which are imperfect substitutes to each other according to a lower-tier CES function with sector-specific elasticity of substitution ESUBM. While the elasticities in the GTAP database come from econometric estimation (Hertel et al. 2004), in our sensitivity test, we show that the choice of their levels even within the standard errors of that particular estimation has a rather significant impact on simulation results. Both final demand (private and government demand), as well as intermediate demand for imports, have the same parameters of substitution at both levels of aggregation.

The model is written in percentage changes – denoted by lower-case abbreviations of variables. For example, the intermediate import demand for composite imports are thus:

$$qfm_{c,a,s} = qfa_{c,a,s} - ESUBD_c \left(pfm_{c,a,s} - pf_{c,a,s}\right), \tag{9}$$

where qfm is percentage change of the composite intermediate import demand, pfm is the percentage change of price of imported composite and pf is the percentage change of price of a composite intermediate of domestic and imported goods (a corresponding CES price index) and c stands for the source industry, a stands for destination industry and s stands for destination region. Government consumption and private consumption demand for composite imports rely on respective demand aggregates and respective prices and the same elasticity and the demand functions have similar forms. They are denoted by qpm and qpm respectively. The percentage change of total composite import demand is $qim_{c,s}$ and the corresponding change of that aggregate CES prices index is denoted by $pim_{c,s}$. The percentage change of demand for imports by region r from region s are given by the right-handside of the following equation:

$$qxs_{c,r,s} = -ams_{c,r,s} + qim_{c,s} - ESUBM_c * [pms_{c,r,s} - ams_{c,r,s} - pim_{c,s}], \tag{10}$$

where $qxs_{c,r,s}$ are bilateral exports of c, $pms_{c,r,s}$ is the market price of c coming from region r to region s. Special attention should be given to a shift variable $ams_{c,r,s}$, the import-augmenting technical change that relates to the iceberg cost of trade idea, so that the reduction in NTMs does not bring a direct revenue benefit to any agent in the economy. When ams is shocked, the direct effect of that shock is connected with a decrease in the perceived price of imports and at the same time a direct increase

in the available quantity, so that the value of the import flow stays constant. The price decrease leads to an additional boost in demand (determined by the respective elasticity of substitution) and general equilibrium effects. We use this particular parameter to model changes in non-tariff measures in our simulations.
The GTAP model includes an explicit treatment of transportation margins by ways of a global transportation sector. A global transport sector purchases services from transport sectors of individual regions (imperfect substitutes) and supplies the aggregate transport services to accompany trade activities. This way, trade liberalization is indirectly linked to an increase in the transport services supplied by involved countries (for more details see Corong et al., 2017).
The simulation scenarios were the following:

tar – the tariff elimination scenario – it assumes that all tariffs in the bilateral EU-US trade are eliminated for all products. The tariff level on non-food goods is on average less than 2% and therefore effectively this scenario involves a change in tariffs of only agricultural products;

agr50 – this scenario assumes a complete elimination of tariffs and a 50% reduction of the initial NTMs on agricultural and food products in the bilateral EU-US trade;

all50 – this scenario assumes a complete elimination of tariffs and removal of 50% of all NTMs. The initial level of NTMs on non-food products and services is taken from a paper by Hagemejer & Śledziewska (2015), and it amounts to roughly 21% for manufacturing and 39% for services. This is the central scenario;

all100 – this scenario assumes a complete tariff and non-tariff barrier elimination in the bilateral EU-US trade.

We perform the simulations using the GTAP database version 9 and the reference year of 2011. The non-tariff measures are shocked using the GTAP *ams* parameter (see model description above). We use the standard general equilibrium short-run classical GTAP closure typically used for comparative statics. In this closure government and private consumption expenditure, as well as savings, are a fixed share of regional income; the supply of all production factors is fixed at the region level. All prices are flexible. All firms earn zero profits. Factors of production (except land and natural resources) are mobile within regions and subject to full employment. All tax rates are exogenous (budget of the regional household is balanced by the adjustment of aggregate consumption). The global savings are equal to global investment, which also means that at the regional trade deficit has to equal the net inflow of foreign investment while the trade balance is endogenous (investment is allocated internationally through a global bank that gathers the domestic savings based on the differences of the rate of return across regions, see Corong et al. 2017 for details). The (single) numeraire is the composite world price index of factor endowment. As in other perfect competition GE models, Walras law holds, and the choice of numeraire does not affect any of the real variables.

8 Simulation results

From a macro standpoint, the *tar* and the *agr50* effects point to a negligible impact on the involved economies (Table 7 and Table 8). While there is a minuscule effect on the exports of both the EU and the US, it does not exceed 1% of the initial volume. Both GDP and welfare (an equivalent variation measured as a percentage of GDP) are less than 0.1%. When liberalization of non-food products and services trade (*all50* and *all100*) are added to the picture, the macro results are similar to other studies investigating the impact of the TTIP. In the central *all50* scenario, the GDP boost is of the order of 0.4% in the EU-15 and the US and considerably less than that in the New Member States (NMS), including Poland. In the *all100* scenario, this effect is roughly doubled. The welfare effects point to an even stronger disparity between the EU-15 and the NMS. The difference is mainly due to the deterioration of the terms of trade in the NMS.

Table 7: Changes in GDP, welfare and terms of trade

Country/scenario	GDP				Welfare (% of GDP)				Terms of trade			
	tar	agr50	all50	all100	tar	agr50	all50	all100	tar	agr50	all50	al100
Poland	0.0	0.0	0.2	0.4	0.0	0.0	0.1	0.2	−0.1	−0.1	−0.2	−0.3
NMS	0.0	0.0	0.3	0.6	0.0	0.0	0.2	0.4	0.0	0.0	−0.1	−0.2
Germany	0.0	0.0	0.4	1.0	0.0	0.0	0.5	1.1	0.0	0.0	0.2	0.4
EU-14	0.0	0.0	0.4	1.0	0.0	0.0	0.5	1.1	0.0	0.0	0.2	0.4
USA	0.0	0.0	0.4	1.0	0.1	0.1	0.9	1.9	0.4	0.5	2.7	5.4
Rest of Europe	0.0	0.0	0.0	−0.1	0.0	0.0	−0.3	−0.6	0.0	0.0	−0.6	−1.3
Turkey	0.0	0.0	0.0	−0.1	0.0	0.0	−0.2	−0.3	−0.1	−0.1	−0.4	−0.8
Rest of America	0.0	0.0	0.0	−0.1	0.0	0.0	−0.3	−0.6	−0.1	−0.2	−1.1	−2.3
Asia	0.0	0.0	0.0	−0.1	0.0	0.0	−0.2	−0.5	−0.1	−0.1	−0.4	−0.9
Rest of the World	0.0	0.0	0.0	0.0	0.0	0.0	−0.2	−0.5	0.0	0.0	−0.5	−1.0

Source: own simulations performed in GTAP, NMS – New EU Member States excluding Poland, EU14 – EU15 excluding Germany.

The low initial bilateral importance in the US-EU trade is reflected in the small aggregate changes in imports and exports. Even in a scenario of a drastic reduction of NTMs the bilateral US-EU trade does not contribute to a large change in overall exports of the EU countries. On the part of the US, the scale of exports boost is at least twice as that of the EU. As far as imports are concerned, while trade with the US goes up, the EU-15-US trade is crowding out the NMS-EU-15 intra-EU trade, which together with the deterioration of the terms of trade in the NMS is even leading to a drop of aggregate imports (Poland, *all100* scenario).

Table 8: Changes in aggregate imports and exports

Country/scenario	Exports				Imports			
	tar	agr50	all50	all100	tar	agr50	all50	all100
Poland	0.1	0.1	0.6	1.2	0.0	0.0	−0.1	−0.1
NMS	0.1	0.2	0.5	1.0	0.0	0.1	0.1	0.2
Germany	0.3	0.4	1.3	2.6	0.3	0.4	1.8	3.5
EU-14	0.3	0.3	1.3	2.5	0.2	0.2	1.5	3.1
USA	0.6	0.6	3.3	7.0	1.4	1.6	9.6	19.9
Rest of Europe	0.0	0.1	0.5	1.1	−0.1	−0.1	−1.4	−2.9
Turkey	0.0	0.0	0.3	0.7	−0.1	−0.1	−0.8	−1.7
Rest of America	0.0	0.1	0.5	1.1	−0.3	−0.4	−2.7	−5.5
Asia	0.1	0.1	0.9	1.9	−0.1	−0.1	−0.9	−1.8
Rest of the World	0.0	0.0	0.3	0.7	−0.1	−0.1	−1.1	−2.3

Source: own simulations performed in GTAP, NMS – New EU Member States excluding Poland, EU14 – EU15 excluding Germany.

Table 9: Polish bilateral exports in agri-food sectors

Scenario	Sector	NMS		Germany		EU-14		USA	
		Change	Contrib.	Change	Contrib.	Change	Contrib.	Change	Contrib.
tar	Agriculture	0.2	0.0	−0.1	0.0	−0.6	−0.2	8.9	0.1
	Food	−1.0	−0.2	−3.4	−0.7	−2.3	−0.8	14.6	0.3
agr50	Agriculture	−0.3	0.0	−0.9	−0.3	−1.8	−0.5	49.6	0.3
	Food	−2.6	−0.6	−5.7	−1.3	−4.7	−1.6	54.6	1.2
all50	Agriculture	−0.2	0.0	−0.7	−0.2	−1.6	−0.4	48.7	0.3
	Food	−1.7	−0.4	−3.8	−0.8	−2.7	−0.9	61.4	1.3
all100	Agriculture	−0.8	−0.1	−1.7	−0.5	−3.0	−0.8	103.2	0.7
	Food	−2.6	−0.6	−4.1	−0.9	−3.1	−1.0	132.7	2.9

Source: own simulations performed in GTAP, NMS – New EU Member States excluding Poland, EU14 – EU15 excluding Germany. Changes in % and contribution in percentage points of overall change.

The remainder of the text focuses on Poland and more detailed results leading to the aggregate result above. We considered the geographical distribution of the change in agricultural and food products trade. While the changes of Polish exports to the US in food and agriculture are relatively large even in the first two scenarios, they are even greater in the scenarios involving liberalization of manufacturing and services. This results from the further deepening of the Polish comparative advantage in food and agriculture. However, the contribution of the change in trade with the US to the overall export change is small and together with the trade diversion and the drop of trade with other EU members, it all even leads to a small drop in overall food and agricultural exports (Table 9). The overall output in both agriculture and food is expected to slightly fall (Table 10).

Table 10: Aggregate export, import and output changes in Poland

Sector/scenario	Exports				Imports				Output			
	tar	agr50	all50	all100	tar	agr50	all50	all100	tar	agr50	all50	all100
Agriculture	−0.1	−0.5	−0.2	−0.2	−0.1	−0.2	−0.1	0.0	−0.3	−0.4	−0.2	−0.1
Food	−1.8	−2.9	−1.0	0.4	−0.1	0.1	−0.3	−0.5	−0.4	−0.7	−0.2	0.1
Forestry and fishing	0.0	−0.1	0.3	0.7	−0.3	−0.4	0.1	0.6	0.0	0.0	0.1	0.2
Mining	0.7	1.0	−2.3	−6.6	0.0	0.0	0.2	0.5	0.1	0.1	−0.3	−0.9
Manufacturing n.e.c.	0.2	0.3	0.7	1.2	0.0	0.0	−0.1	−0.2	0.1	0.2	0.1	0.2
Energy, water, gas	0.3	0.4	0.8	1.3	−0.2	−0.2	0.4	1.2	0.0	0.0	0.0	0.0
Services	0.3	0.4	1.1	2.0	−0.2	−0.2	−0.2	−0.3	0.0	0.0	0.0	0.0

Source: own simulations performed in GTAP.

Table 11: Detailed output changes in Poland by agri-food sectors

Sector/scenario	tar		agr50		all50		all100	
	%	pp.	%	pp.	%	pp.	%	pp.
Agriculture	**−0.3**		**−0.4**		**−0.2**		**−0.1**	
Wheat	−0.2	0.0	−0.5	0.0	−0.2	0.0	−0.3	0.0
Cereal grains n.e.c.	−0.3	0.0	−0.6	−0.1	−0.3	0.0	−0.1	0.0
Vegetables, fruit, nuts	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
Oil seeds	0.2	0.0	0.1	0.0	−0.1	0.0	−0.6	0.0
Sugar cane, sugar beet	−0.1	0.0	−0.2	0.0	−0.2	0.0	−0.3	0.0
Plant-based fibers	0.2	0.0	−0.5	0.0	−0.9	0.0	−2.2	0.0
Crops n.e.c.	−0.3	0.0	−0.5	0.0	−0.4	0.0	-0.7	−0.1
Bovine cattle, sheep and goats, horses	−5.0	−0.2	−7.9	−0.3	−6.9	−0.3	−8.9	−0.3
Animal products n.e.c.	0.1	0.0	0.2	0.1	0.5	0.1	1.2	0.3
Raw milk	−0.2	0.0	−0.2	0.0	0.0	0.0	0.2	0.0
Wool, silk-worm cocoons	0.4	0.0	0.6	0.0	−1.1	0.0	−3.3	0.0
Food	**−0.4**		**−0.7**		**−0.2**		**0.1**	
Bovine meat products	−5.9	−0.3	−8.9	−0.4	−7.8	−0.4	−9.8	−0.5
Meat products n.e.c.	0.0	0.0	0.3	0.1	0.7	0.2	1.8	0.5
Vegetable oils and fats	0.1	0.0	−0.4	0.0	−0.5	0.0	−1.4	0.0
Dairy products	−0.2	−0.1	−0.2	−0.1	0.0	0.0	0.2	0.1
Processed rice	−0.9	0.0	−2.1	0.0	−1.7	0.0	−2.8	0.0
Sugar	−0.1	0.0	−0.2	0.0	−0.2	0.0	−0.3	0.0
Food products n.e.c.	−0.2	−0.1	−0.6	−0.2	0.0	0.0	0.4	0.1
Beverages and tobacco products	0.0	0.0	−0.4	0.0	−0.1	0.0	0.0	0.0

Source: own simulations performed in GTAP. Changes in % and contribution in percentage points of overall change.

While the aggregate level changes are rather negligible, the commodity-level changes in output are sometimes substantial (the same applies to export changes. Detailed results of simulation are available upon requests). The largest drop in output in the agricultural product category is connected with the decrease in output of bovine cattle,

sheep and goats, and horses (Table 11). It also has the largest negative contribution to the overall output of agriculture across all the scenarios. That said, the other raw animals (pork and chicken in particular) are expected to increase output. This increase is not sufficient to outweigh the fall in other goods outputs. In the case of processed foods, the bovine meat products have the largest contribution to the fall of output in food products, while other meat products increase outputs. When considering the exports of bovine cattle and bovine meat, the fall is substantial, reaching 20% of overall exports.
In order to find out the sensitivity of our results to the choice of the crucial parameter – elasticity of substitution across varieties of goods in imports, we perform a systematic sensitivity analysis. We vary the standard GTAP substitution elasticities ESUBM and ESUBD for the agri-food sector according to a uniform distribution between the standard errors of the original estimates provided by Hertel et al. 2017. The procedure assumes that the distributions of the elasticities of substitution are uncorrelated. The standard deviations of the results in the endogenous variables are approximated by Gaussian quadrature (see Arndt, 1996). A systematic sensitivity tool is a part of the GEMPACK programming language suite.

Table 12: Systematic sensitivity analysis: selected results for Poland (*all50* scenario)

Sector	Output			Exports			Imports		
	Mean	SD	Mean/SD	Mean	SD	Mean/SD	Mean	SD	Mean/SD
Wheat	−0.2	0.1	0.3	−1.5	0.6	0.4	−0.2	0.2	1.1
Cereal grains n.e.c.	−0.3	0.1	0.4	−0.3	0.0	0.1	−0.3	0.1	0.3
Vegetables, fruit, nuts	0.1	0.0	0.1	0.1	0.0	0.4	−0.2	0.0	0.1
Oil seeds	−0.1	0.0	0.2	0.6	0.2	0.3	−0.1	0.0	0.3
Sugar cane, sugar beet	−0.2	0.1	0.5	7.9	1.9	0.2	0.8	0.2	0.3
Plant-based fibers	−0.9	0.2	0.2	−5.2	1.1	0.2	−0.1	0.0	0.2
Crops n.e.c.	−0.4	0.0	0.0	0.5	0.1	0.3	0.2	0.1	0.7
Bovine cattle, sheep and goats, horses	−6.9	1.7	0.2	−4.3	1.0	0.2	−7.4	1.8	0.2
Animal products n.e.c.	0.5	0.0	0.0	−0.4	0.1	0.2	0.7	0.0	0.0
Raw milk	0.0	0.0	17.0	3.7	0.8	0.2	0.4	0.1	0.4
Wool, silk-worm cocoons	−1.1	0.1	0.1	−2.2	0.2	0.1	0.0	0.0	0.3
Bovine meat products	−7.8	1.9	0.2	−18.6	4.4	0.2	1.4	0.7	0.5
Meat products n.e.c.	0.7	0.0	0.0	3.7	0.1	0.0	−1.3	0.0	0.0
Vegetable oils and fats	−0.5	0.0	0.1	−0.5	0.1	0.1	0.2	0.1	0.3
Dairy products	0.0	0.0	1.1	−0.8	0.4	0.5	0.1	0.1	1.1
Processed rice	−1.7	0.7	0.4	−3.6	1.1	0.3	1.0	0.5	0.6
Sugar	−0.2	0.1	0.5	−2.5	1.2	0.5	−0.2	0.0	0.2
Food products n.e.c.	0.0	0.0	1.0	0.5	0.0	0.0	−0.1	0.1	0.8
Beverages and tobacco products	−0.1	0.0	0.2	0.0	0.0	1.0	−0.3	0.0	0.1

Source: own calculations performed in GEMPACK suite.

The selected results of such a sensitivity are presented in Table 12. These results apply to the previously defined *all50* scenario. One has to keep in mind that the standard errors of the original elasticities of substitution can be large, e.g. 30-40% of the actual point estimate. Such changes in the elasticity of substitution do have a crucial impact on the results of the simulations, primarily through the adjustment of imports. The standard deviation of the import demand is rather large, in some cases rendering the sign of the actual import response somewhat uncertain (although with uni-directional change of trade barriers one could rather expect that the reaction will indeed be greater than zero). With much less uncertainty regarding the behavior of exports, the output changes in Poland are mainly driven by the changes in imports. While these variations have a negligible effect on the GDP of Poland and other macro aggregates, the standard deviation of the response of the land rental rates is of the order of magnitude close to the mean of the original effect of this scenario on that variable (12%). Therefore some caution is needed while interpreting the simulation results.

9 Concluding remarks

Agricultural issues were one of the most difficult areas in the TTIP negotiations and attracted the interest of many social groups and NGOs. It was due to the asymmetric level of protection in the agricultural markets of the EU and the US, associated with significant differences in the production potential of agriculture and food industry in these countries. Comparing the EU and the US, the rates of tariff barriers limiting access to the American agricultural market are on average 2.5-fold lower than in the EU. Moreover, the US provides less domestic support to agricultural production. The relatively high level of the EU protection for agricultural markets means that so far the producers in the EU and Poland has not faced a strong competitive pressure from the American agricultural sector.

The abolishment or reduction of customs duties and NTMs imposed by the US on agri-food imports probably will not lead to a strong creation of exports from Poland to that market. The partial equilibrium simulations indicate that Polish exports and imports in “key” products with the US could increase by about 46%, mainly due to the trade diversion effect. However, it may result in a significant improvement in the access to the Polish market for products from the US.

GTAP simulations show that in Poland the growth of both GDP and overall exports, resulting from the liberalization of mutual trade, would be insignificant and smaller than in the US. In the US an improvement of terms of trade would also be possible, while in Poland the terms of trade could deteriorate and then, after changes in relative prices, have a negative impact on imports. According to the adopted assumptions, an increase in exports of non-agricultural goods and services could be observed together with the decrease in the value of imports and exports of agri-food products. Contrary to the other main Poland’s trading partners, the growth of trade with the US could be expected; however, because of the negligible share of the US in the overall turnover their contribution to the dynamics of total exports and imports of agri-food products from/to Poland would remain insignificant. The conducted analysis confirmed that a possible liberalization of mutual trade could, however, be of considerable importance for such sectors of the Polish food industry as the meat industry, the sugar industry, the fruit and vegetables industry, the wine industry, as well as the tobacco industry. As a result of increased imports from the US, the competitive position of Polish manufactured tobacco substitutes, meat products and sugars in relation to the other EU markets might be weakening.

The study presented focuses on trade implications of the TTIP for Poland's agri-food sector. However, it should be taken into account that the competitive position of this sector of the economy is strongly affected not only by macroeconomic and institutional factors, but most of all by the potential for agri-food production reflected in the resources of basic production factors (land, labour, capital), ratios between them, as well as their productivity. Examining the simultaneous impacts of changes in trade policy and productivity changes in the agri-food sector would require additional research. Due to the changing consumer preferences, simulations assuming the respectively modified demand elasticities might also be performed. Investigation under two time frames, i.e. short- and long-term might deliver more specific knowledge about the future trade relations and competitiveness of agri-food sectors of the TTIP parties, including Poland. All those analyses would be crucial in the context of adjustments of directions of export specialisation with respect to the target markets.

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