INSTITUTE OF AGRICULTURAL
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Input-output flows and developmental implications for Polish agriculture

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THE POLISH AND THE EU AGRICULTURES 2020+
CHALLENGES, CHANCES, THREATS, PROPOSALS

Warsaw 2017

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The paper was prepared under the topic: **Sources of growth and the expected evolution of structures and the role of the agri-food sector until the year 2020 and beyond** in the task: *Functioning and the role of the agri-food in the national economy (model approach).*

Discussing selected issues referring to input-output analysis, identifying on this basis the role of Polish agribusiness sector in national economy and creating short- and mid-term projections about changes in these parts of input-output tables that concern Polish agriculture and food industry.

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Introduction

This monograph is the third one in the series that presents the results of the research carried out under Task 3. Functioning and the role of the agri-food in the national economy (model approach). This research task is part of a wider scientific research project carried out on topic "Sources of growth and the expected evolution of structures and the role of the agri-food sector until the year 2020 and beyond" which in turn is part of Multi-Annual Programme "The Polish and the EU agricultures 2020. Challenges, Chances, Threats and Proposals" implemented by the Institute of Agricultural and Food Economics - National Research Institute in 2015-2019.

The work carried out under the aforementioned task in 2017 focus on the problem of analysis of sectoral input-output flows to and from the broadly understood agribusiness sector and an innovative attempt to capture forecasts on Polish agriculture based on input-output tables. This is a further step in the research program that will eventually allow such a model approach to economic processes in the agri-food sector that help to indicate the most optimal mechanisms of state policy towards agriculture after 2020.

The research problem presented in this study is without doubts a very complex one. The topics of national and international input-output flows cover a broad spectrum of research on economic issues. Some of the numerous group of specific problems could unfortunately only be mentioned. One should emphasize, on the one hand, a high degree of generality of the conclusions drawn, and on the other hand, an innovative character of the analysis of sectoral input-output flows in such an approach that will allow to identify the most likely projections of changes inside and around the agri-food sector. The authors hope that the accent distribution selected in the work will allow the reader not only to capture the essence of the problem, but it will also be appropriately transparent and understandable, and the conclusions drawn from the analyzes will prove useful when considering the interaction between the state policy on the agri-food sector and the efficiency of this sector.

The study, resulting from the cooperation of three authors that are agricultural economists, is divided into five main chapters. Each of them is characterized by a certain autonomy of considerations, but only their combination fully reflects the authors' intentions regarding the subject of the main work.

The first part of the work is aimed at the multi-aspect approach to the importance of the agri-food sector in the national economy. It also allow to extract

processes that changes the importance of this sector over time. The second chapter is devoted to the theoretical and methodological basis for the use of input-output tables. It also contains basic information relating to the interaction of Polish agri-food sector with other sectors of the Polish economy. In the third part of the work projections of changes in input-output flows in the analyzed aspect were made on the basis of national input-output tables, as well as the similarities in the development processes of the Polish and German economies. The next chapter also presents projections of changes in input-output flows. What distinguishes these chapters devoted to projections is the research methodology and the source of the data used. The fourth chapter uses data contained in the WIOD (World Input Output Database) and panel analysis was used there to form the projections. The last part of the work deals with the previously presented research results on projections of changes in the size and structure of inter-branch flows in the context of development implications associated with the growth of Polish agriculture in the third decade of the 21st century.

1. The importance of agriculture in the economy

Due to the fact that a significant part of this monography is devoted to use of input-output tables, which have been discussed more broadly in the next chapter, the physiocrats' theory was approximated first. The economic board by François Quesnay is the main work of the physiocrats (around 1750-1790)[1], who recognized agriculture as the only source of wealth. According to the physiocrats, a pure (net) product was created only in this sector and it was the result of natural productivity of nature. Other sectors were considered as sterile (they did not create a net product), although they were necessary due to the maintenance of the circulation of resources in the economy. It was the first attempt to explain the basic relationships between global figures in the economy. By many economists, they are considered the predecessor of Wassilya Leontief's input-output table (1906-1999).

As a result, two approaches have so far prevailed regarding the relationship between the economic situation in agriculture and the economic situation in the economy. Proponents of theory William Stanley Jevons pointed out that cyclical changes in agriculture affect the development of macroeconomic values for the entire economy. Opponents argued that production and prices in agriculture are determined by the economic cycle. It should be emphasized that during the formulation of Jevons theory, the economy was largely based on agricultural production and all its fluctuations had a significant impact on changes in national income. It seems that the most accurate is the statement that there is a feedback relationship between agriculture and the economy, both agriculture affects the course of the economic cycle and the latter shapes the economic situation of the agricultural sector (Stępień 2011).

[1] Physiocrism is the first school of economic thinking, their leader was the royal doctor F. Quesnay (1694-1774). He isolated permanent capital in agriculture (cattle, machinery and equipment), which he defined as elemental inputs and working capital (wages and grain), called by him annual expenditures. The elemental inputs were decisive. Physiocrats recognized that only large, large-scale farming brings so-called clean product. They were active only in France, and their main slogan was: laissez-faire, laissez-passer. Polish physiocrats (Stanisław Staszic, Stroynowski brothers, Joachim Chreptowicz) strongly emphasized the importance of industrial production in development of agriculture, hence about the need to intensify agricultural production. Hieronim Stroynowski analyzed the expenditures in detail of an investment nature. He expressed the view that the height of a pure agricultural product depends on the productivity of agriculture. For S. Staszic, technical progress in England was a source of inspiration for the development of domestic agriculture [Łęczycki 2012].

In the opinion of Zegar (2012], agriculture has gained attention to an extent unlisted since the 1970s (the food crisis). This is due to the following reasons:

1. Unstable situation on agri-food markets;
2. Expected double growth in demand for agricultural products in the middle of this century (2050);
3. The role of agriculture in implementing the idea of sustainable development – multifunctionality of agriculture (for example biofuels, supplier of public goods);
4. Growing conviction that the paradigm of industrial agriculture is losing importance. The basic challenge for agricultural producers is meeting this growing demand while simultaneously reducing the pressure on the environment (Zegar 2014).

Modern agriculture is responsible for food security, which is treated particularly (the strategic sector, as well as the power industry or the defense industry). This is the first sector of the economy and at the same time a base for all agribusiness[2] and food economy (Poczta, Mrówczyńska-Kamińska 2004; Trzcińska 2015). It is a national raw material base for the food industry, whose share in the creation of the Polish Gross Domestic Product (GDP) is constantly increasing (Grzelak, Seremak-Bulge 2014; Ambroziak 2017). A similar approach to assessing the importance of agriculture can be noticed not only at the level of individual countries, but also larger forms of organization, such as the European Union (EU). We will return to this thread later in the paper (see subsidies from the Common Agricultural Policy).

You should also keep in mind the other functions of agriculture[3]. In addition to the superior function of food production (food security of the state) and being a raw material base for the food industry, it is also necessary to indicate the social function (working environment and place of residence of part of society) and spatial (agricultural landscape). It should also be added that this sector greatly interferes with the natural environment (Góral, Rembisz 2017). Rural areas in Poland have a positive greenhouse gas emission, they emit more than

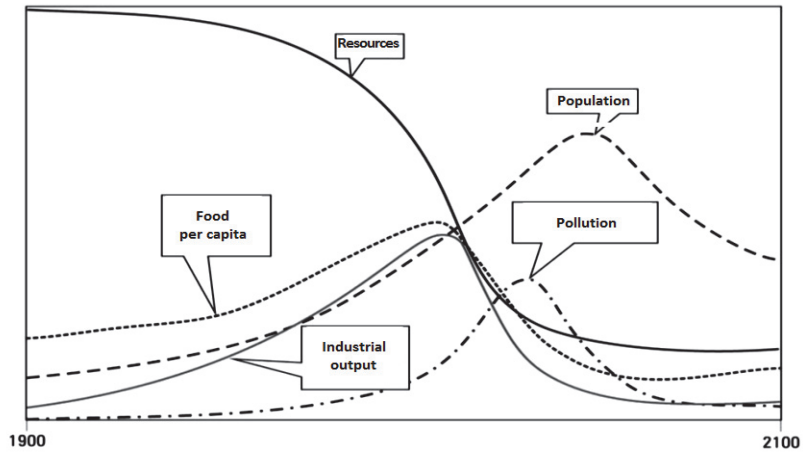
[2] The agri-food sector (agribusiness) is the largest subsystem of the national economy, as it employs around 3 million people and creates a dozen or so percent of GDP. In 2014, agri--food exports accounted for over 12% of total exports and were characterized by a high positive balance of turnover with foreign countries [Poczta 2014].

[3] Multifunctionality of agriculture and rural areas is increasingly appreciated by modern societies. This applies, for example, to the assumptions of the Kuznets environmental curve. The importance of multifunctionality of agriculture has influenced the positions of highly developed countries, and especially the EU, in terms of trade negotiations on the World Trade Organization forum [Wilkin 2013].

they consume, although there are opportunities to achieve the status of zero-emission rural areas. We should remember that in 2007 the EU set itself the goal of reducing greenhouse gas emissions (by at least 20% by 2020), and agriculture is the third sector in the EU in terms of emissions of these gases. Agriculture is also the main source of methane and nitrous oxide emissions, the thermal potential of which is significantly higher than that of carbon dioxide (Góral 2017).

The purpose of this chapter is showing the importance of the agricultural sector in the economy and outline future challenges to it. The importance of the sector is shown based on macroeconomic data. However, you should have in mind that with the emergence of further agricultural functions (it is multifunctionality), current macroeconomic data are supplemented with new information. It is mainly about the growing importance of agriculture in the provision of public goods for every country (KE 2010; Wilkin 2010; Kosior 2011; Zegar 2012). The problem of current and future challenges is presented in Chart 1.1.

Chart 1.1. A pessimistic concept of the economic development of the world taking into account the resource barrier according to the first report for the Roman Club

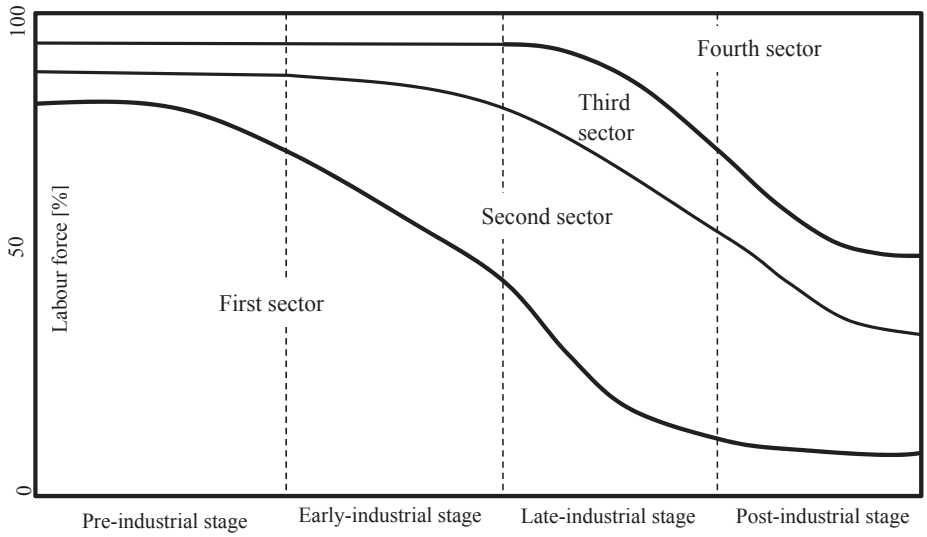


Source: (Granice wzrostu 1972).

The shrinking resources (arable land, drinking water, natural resources) are compared with the growing population (growing demand for food) and the progressive degradation of the natural environment. These processes are at the same time a reference to such concepts as determinism (climate, soil and food are the most important factors determining the development of societies) and geographic possibilism (balance between natural factors and social). Contemporary views on the relationship between a man and the natural environment are similar to those held by possibilists.

Returning to the assessment of the importance of this sector compared to others in the light of macroeconomic data, attention should be paid to participation in key figures describing the economy, namely: creation of gross domestic product (GDP)[4], employment, investments, savings, production assets as well as national and EU budgets (expenditure on agriculture in the form of subsidies, preferences and concessions). This paper focuses on the analysis of most of them. The determination of these relations largely explains the importance of the agricultural sector in the economy (Wilkin 2000; Zegar 2007). What is more, it also shows the image of the economy itself, its nature and stage of development. It is not only decreasing role of agriculture in creating GDP (which will be discussed later), but also a decreasing share in employment (chart 1.2).

Chart 1.2. Share of agriculture in employment



Source: (Kuciński 2015).

Undoubtedly, the development of the agricultural sector for the last nearly 30 years was influenced by two types of conditions resulting from: transformation of the economic and social system (after 1989) and integration with the European Union in 2004. After Poland's accession to the EU, the average annual production value in real terms was higher than the one from the previous period,

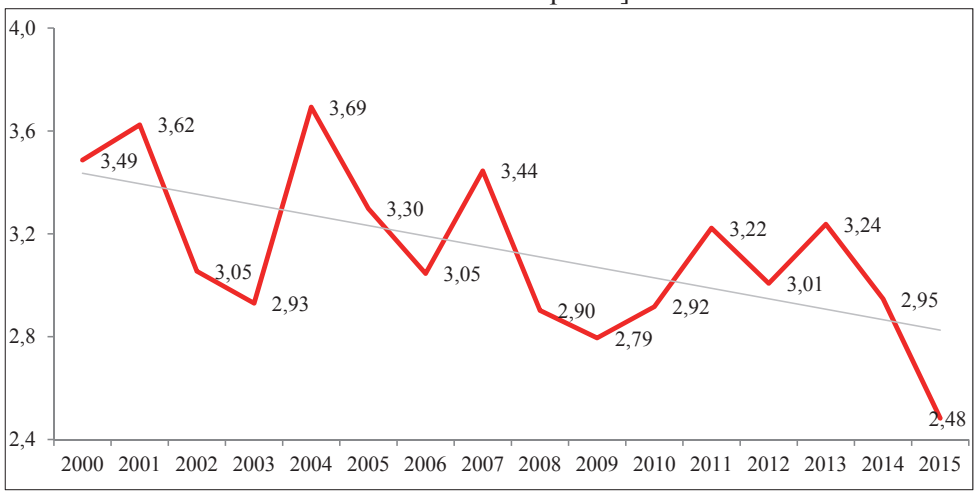
[4] GDP is the sum of added value. The value of final production generated in a given year from production factors in a given country, regardless of who owns the resources. More on the subject of estimation and GDP accounts can be found in the publication entitled *Estimation of the value of gross domestic product in Polish poviats* by D. Ciołek (2017).

and the average level of income of agricultural producers in real terms increased by nearly 150 percent (Poczta 2014).

1.1. Participation in the creation of gross domestic product

The importance of the sector in the economy can be demonstrated, among others, by its share in creating gross value added (GDP). Looking through the prism (GDP), it must be stated that agriculture is losing its importance over the years. This process is depicted in the following graph 1.3 and in table 1.1. Despite the strategic function (production of healthy food), this sector also creates the lowest value of GDP in comparison to other sectors (CSO 2017).

Chart 1.3. The percentage share of agriculture in generating GDP [estimated based on current prices]



Source: own calculations based on Central Statistical Office (CSO) data.

It is worth adding that countries where agriculture prevails in generating GDP and in employment are usually poorer and less developed ones. This does not mean that agriculture loses its entire role at a higher level of socio-economic development. According to Woś (2001): (...) "one cannot imagine a developed economy of any country without modern (in technical and social terms) agriculture".

Table 1.1. Gross value added (GVA) in agriculture [base prices, EUR million]

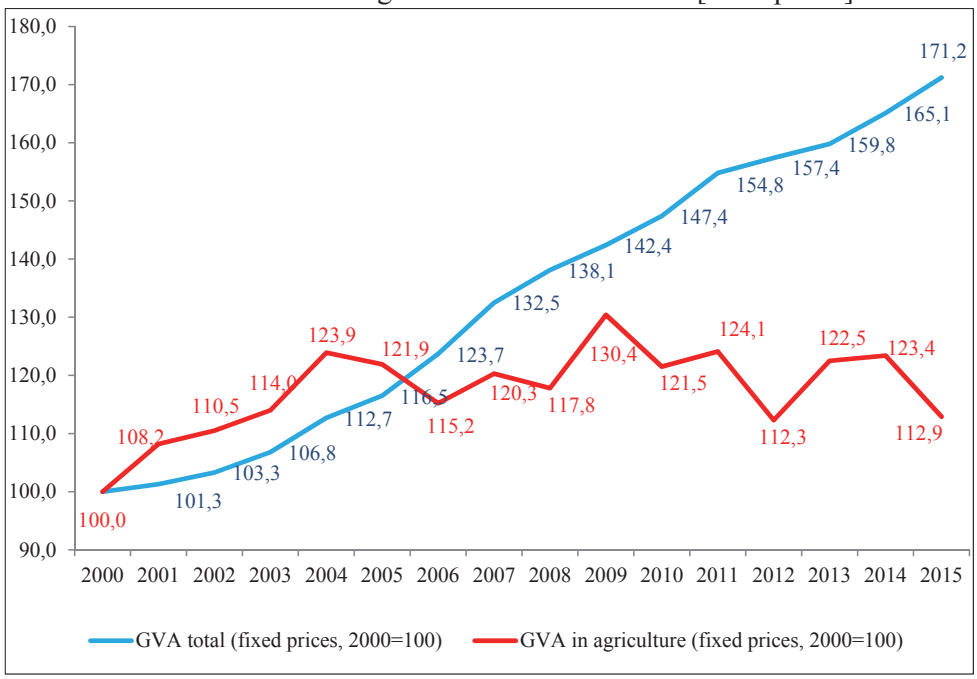
Year	2000	2005	2010	2015
WDB in agriculture	**4 665**	**6 092**	**8 236**	**7 857**

Source: EUROSTAT.

The decreasing importance of this sector is also illustrated in figure 1.4, where values in constant prices are given. It is worth noting that by analyzing in detail the input-output tables prepared for 2005 and 2010, it can be noted

that agriculture is losing in importance, while the food industry is gaining in it (Gorzelak 2010, 2011; Ambroziak 2017).

Chart 1.4. Share of agriculture in GDP creation [fixed prices]



Źródło: own calculations based on CSO.

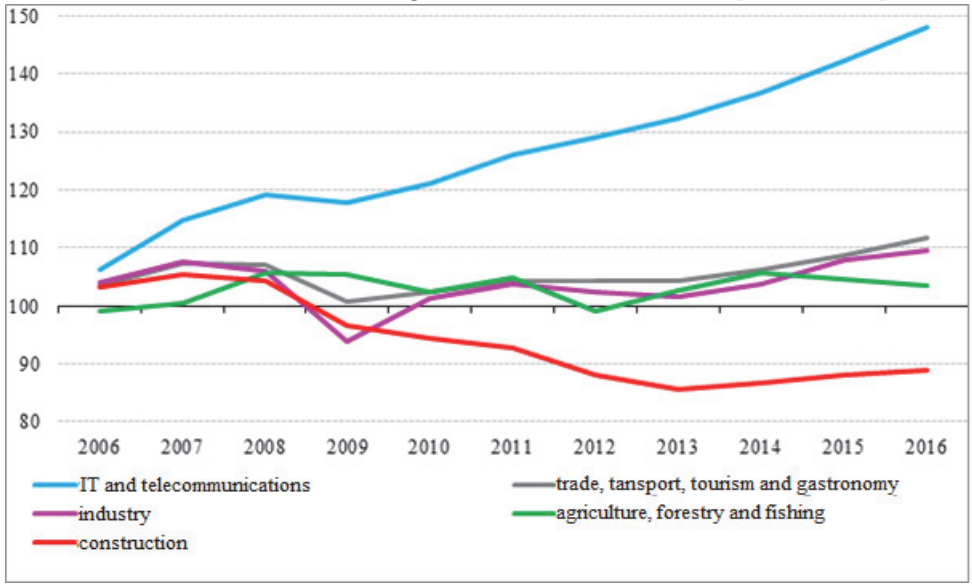
The developing food industry is beneficial for agriculture (it is pushing up the annual demand for agricultural production)[5]. However, the role of agriculture, despite these processes, remains important to the condition of agribusiness, regardless of latitude or longitude. This is evidenced by the high level of support for this agricultural sector in the most developed countries of the world. This is illustrated, inter alia, by the high level of support for agricultural producers (Producer Support Estimate - PSE) (Poczta-Wajda 2015, 2017).

These observations confirm the ongoing transformation process of the Polish economy. It is part of the classic course of the processes of transformation of economies in the world – starting from the large share and importance

[5] Agriculture is subordinated to the food industry, which shapes market conditions. The development of transnational corporations in the food industry causes that changes in the conditions of functioning of agribusiness entities developed by these corporations are now more important for the economic situation in agriculture than intervention systems created by states and their institutions [Kowalczyk 2010].

of agriculture, through the growing role of industry, to the transition to the economy based on services, knowledge and innovative technologies.

Chart 1.5. Real GDP changes in 2006-2016 in EU-28 [2005 = 100]



Source: Own elaboration based on Eurostat and CSO.

According to Mrówczyńska-Kamińska (2008), the decreasing importance of agriculture is the result of a faster pace of development of other sectors of the economy, which indicates evolution towards a modern structure of the national economy. It is difficult to indicate a developed economy, which is driven by agriculture. In fact, the opposite is true, highly developed countries are characterized by a high share of services, followed by industry (especially precision) in GDP creation and a negligible (1-2%) share of agriculture. Confirmation of these considerations is illustrated in chart 1.5 and table 1.2, which show the development trends of various sectors and the growing importance of services (IT and telecommunications) both within the EU and in the world.

Table 1.2. Gross value added in 2015 - comparative approach [in %]

Specification	Euro zone	USA	Japan	China
Agriculture, forestry and fishing	**1,6**	**1,1**	**1,1**	**8,6**
Industry and construction	**25,1**	**20,0**	**28,9**	**39,8**
Services	**73,4**	**78,9**	**70,0**	**51,6**

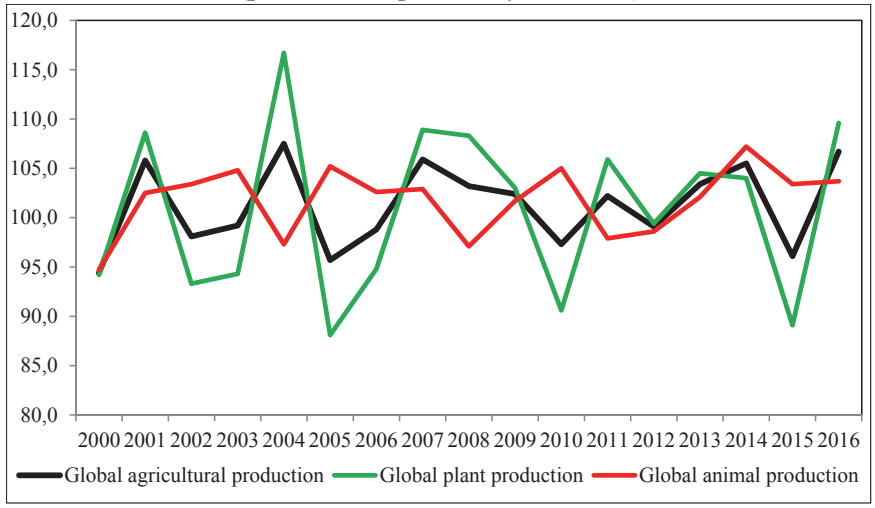
Source: (Eurostat, IMF, OECD 2016).

For example, in 2011 in the structure of the EU GDP, agriculture accounted for only 1.8 percent, while the industry accounted for 25.1 percent and services 73.1 percent. These processes testify to the modernization and develop-

ment of both the Polish, EU and global economy. They are justified in the theory of Simon Kuznets and Arthur Lewis. They enter simultaneously into the theory of development economics.

At the end of this part, changes in global production were also shown in Polish agriculture in the years 2000-2016, constituting 4-5 percent of the total output in the national economy (chart 1.6.).

Chart 1.6. Total agricultural production in 2000-2016
(prices in the previous year = 100)



Source: Own elaboration based on CSO.

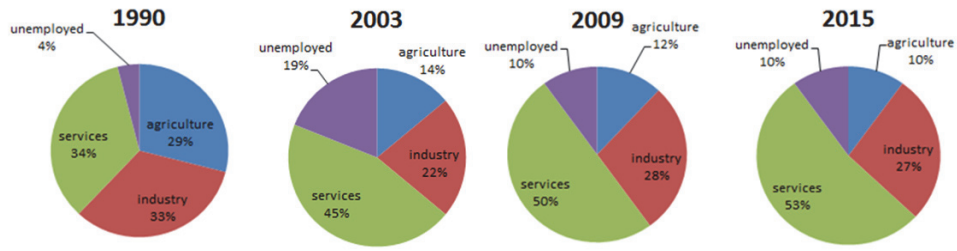
1.2. The share in employment and labor productivity in agriculture

Chart 1.7 shows changes in the employment structure, including changes in the number of employees in agriculture[6]. Currently only 10 percent of the total population is still active in agriculture (and at the same time 10 percent of the population living in rural areas). Rural areas (together with forestry) account for 93 percent of Poland's area and approx. 39 percent of Poland's population. At the same time, the character of rural areas changes. Their disagrarisation follows, or the process of limiting the impact of agriculture on the economy and farmers on society. This phenomenon has been present since the beginning of the 20th century, since its most common measures, the share of agriculture in generating GDP and the ratio of the population employed in agriculture to the

[6] The loss of employment in agriculture has many causes. The report *Polish Village 2016* shows that about 30 percent of foreign migrants are rural residents [Wilkin, Nużyńska 2016].

entire population, are systematically decreasing. More and more often they are only residential, tourist or recreational functions for people who work in the city.

Chart 1.7. Changes in the employment structure in Poland (1990-2015)



Source: Own elaboration based on CSO.

Disagrarisation has also been observed in Central Europe since the beginning of the 20th century, when the agricultural societies of the region began to slowly lose their agricultural character. This process definitely accelerated after 1990, which is indicated by the dynamics of the share of agriculture in generating GDP. As a measure of population agrarianity, the percentage of those employed in agriculture or those living from agriculture is also used (Halamska 2011). Data confirming a downward trend related to the share of the agricultural sector in total employment in the EU economy is presented in table 1.3.

Table 1.3. Tendencies of changes in the scope of work in Polish and EU agriculture (in AWU, 2005 = 100)

Specification	2000	2005	2010	2015
UE-27	**121**	**100**	**78**	**69**
UE-15	**113**	**100**	**87**	**78**
Poland	**108**	**100**	**83**	**84**

Source: Own elaboration based on Eurostat.

At the same time, there is a large regional variation, which is shown in chart 1.8 for data relating to Poland. In the eastern and south-eastern parts of Poland, a much larger part of the population is connected with agriculture and inhabits rural areas (table 1.4). This is followed by a clear regional diversification of labor productivity. The regions with high employment in agriculture, low level of technical work equipment and considerable agrarian fragmentation are characterized by a low level of labor productivity (Chart 1.9).

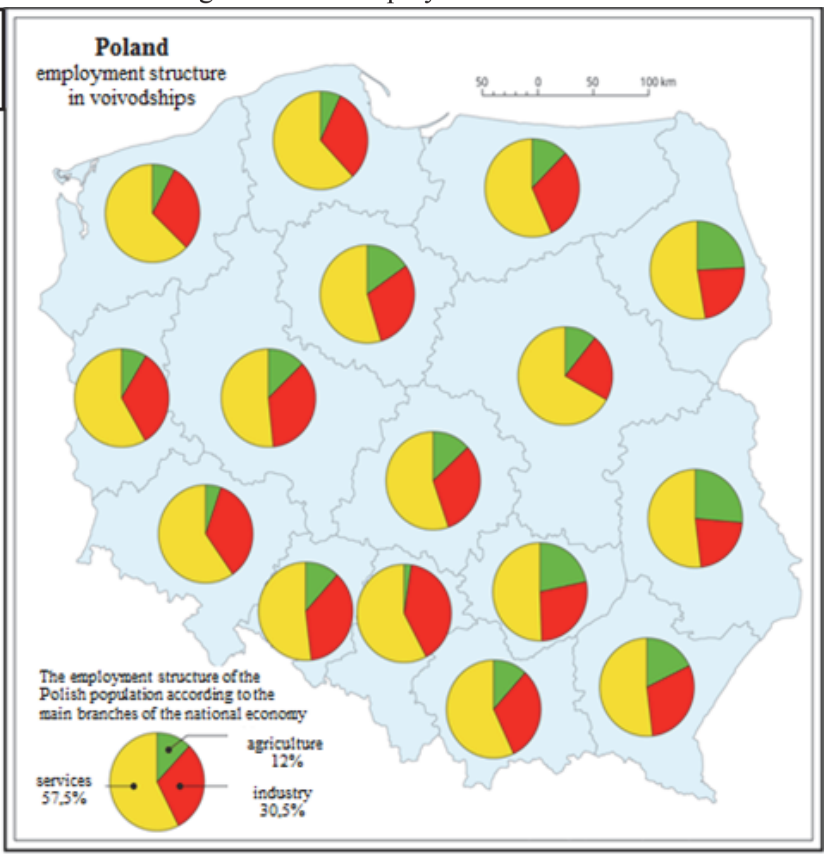
Table 1.4. Diversification of agriculture in voivodeship terms in 2015

Specification	Working in agriculture per 100 ha of UAA	Average size farms in ha
POLSKA	**16,1**	**10,49**
Dolnośląskie	**9,3**	**16,21**
Kujawsko-Pomorskie	**9,9**	**15,40**
Lubelskie	**21,2**	**7,58**
Lubuskie	**8,5**	**20,94**
Łódzkie	**18,3**	**7,62**
Małopolskie	**50,4**	**3,98**
Mazowieckie	**15,5**	**8,52**
Opolskie	**9,8**	**18,21**
Podkarpackie	**44,6**	**4,71**
Podlaskie	**11,8**	**12,13**
Pomorskie	**8,2**	**19,02**
Śląskie	**27,8**	**7,42**
Świętokrzyskie	**30,8**	**5,57**
Warmińsko-Mazurskie	**6,6**	**22,76**
Wielkopolskie	**12,0**	**13,43**
Zachodniopomorskie	**5,3**	**30,00**

Source: Own elaboration based on CSO, ARiMR.

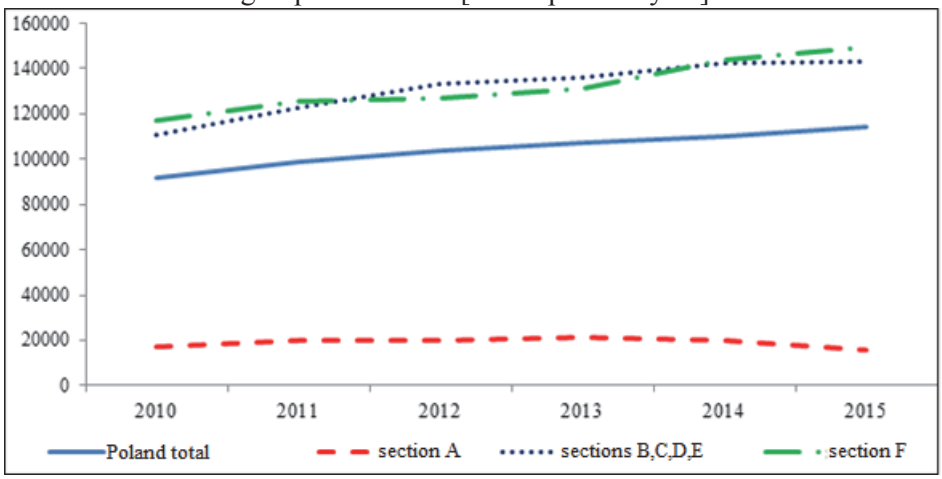
Chart 1.8. Regional data on the share of agriculture in employment in 2013

voivodeship	Agriculture [%]	Industry [%]	Services [%]
dolnośląskie	5,5	34,9	59,6
kujawsko-pomorskie	15,4	30,0	54,6
lubelskie	26,5	21,8	51,7
lubuskie	8,7	33,2	58,1
łódzkie	13,1	31,6	55,3
małopolskie	11,9	31,3	56,8
mazowieckie	11,0	22,2	66,8
opolskie	11,9	36,2	51,9
podkarpackie	17,9	30,4	51,7
podlaskie	24,3	23,0	52,7
pomorskie	7,0	31,0	62,0
śląskie	2,6	39,7	57,7
świętokrzyskie	21,8	27,8	50,4
warmińsko-mazurskie	12,7	30,8	56,5
wielkopolskie	13,0	35,5	51,5
zachodniopomorskie	8,0	29,2	62,8



Source: Own elaboration based on CSO.

Chart 1.9. Gross value added per working person (labor productivity) by section groups PKD 2007 [PLN / person / year]



Explanations regarding the PKD 2007 sections: section A - agriculture, forestry, fishing, hunting; sections B, C, D, E - industry; section F - construction.
Source: Own elaboration based on CSO.

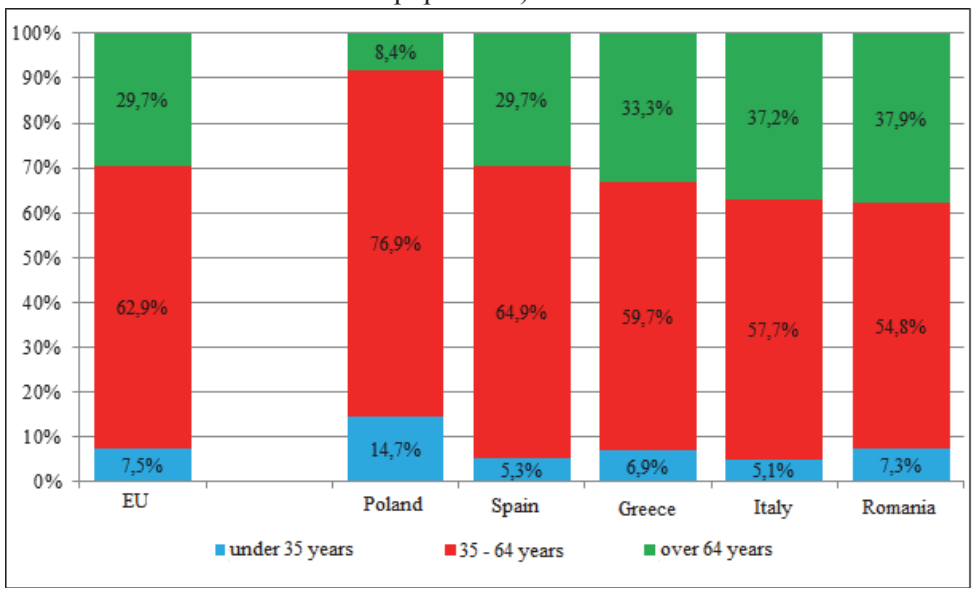
Agriculture in terms of labor productivity is significantly lower than other sectors. What is more, this unfavorable distance increases with time. From the models of Kuznets, Lewis, Schultz and Jorgenson, it can be concluded that agriculture may have less beneficial relationships in this respect (effects on labor inputs). In the light of the neoclassical regional theory of growth, it is assumed that differences in the development factors possessed by a given region are eliminated as a result of their interregional adaptation. Economic development requires people shift from the sector with lower productivity to the sector of high productivity in order to eliminate these differences. Greater inequalities lead to an increase in social transfers and distort the economy by reducing investment and decelerating economic growth. It was aptly described by Tomczak (2001), claiming that the state "cannot be highly developed if it uses a significant part of its potential and resources for food production".

Lower labor productivity in agriculture is affected by a number of reasons. For example, Polish agriculture in terms of valorization of agricultural production space occupies one of the last positions in Europe. Agricultural land in Poland is of poor quality, as the soil quality index is 0.82 on average. Very good and good soils account for only 11.5 percent of total farmland (Nowak 2011). The labor productivity of a farm is determined not only by the UAA per

employee[7], but also by the technical labor infrastructure (capital expenditure per employee). As a result, labor productivity in Polish agriculture accounts for only about 30% of the average level of labor productivity in agriculture in the EU-28 (Nurzyńska, Wilkin 2016; Góral, Rembisz 2017).

At the same time, the age structure of agricultural producers in Poland stands out exceptionally positively against the EU. The share of young farmers (under 35 years) is twice as high, and the share of the oldest (over 64 years) is almost four times lower than the total in EU countries (chart 1.10). Owner's age determines to a large extent the goals and strategies of action, as well as style unit management. A young agricultural producer usually uses more intensive investment activity and implements a more risky strategy (Sulewski 2007, 2009).

Chart 1.10. Share of individual age groups of farmers in the largest (according to farmers' population) EU countries



Źródło: Own elaboration based on SAEPR/FAPA.

[7] The growing number of larger farms testifies to the growing concentration of capital in agriculture. For example, in 2015 the number of farms with an area exceeding 50 ha doubled in relation to 2000 [Góral 2017; GUS 2017]. It also increases the relationship: land inputs to labor inputs.

1.3. The share in production assets and capital expenditures

The structure of agriculture is characterized by large fragmentation of farms. Only 30 percent of arable land is located on larger farms (over 50 ha), while in most EU countries this share is 80-90%. In recent years, the smallest farms have been experiencing a loss of 1-2 ha. The number of farms is increasing with an area of more than 30 ha, which are the suppliers of the majority of commodity production.

In 2015, in the total area of the country amounting to 31.3 million ha, agricultural holdings covered 16.3 million ha of land. The number of farms with arable land was 1,404 million. Their area structure is presented in table 1.5. Holdings having an area above 1 ha of agricultural land accounted for 1.382 million, including 1,203 million had a sown area. The average area of arable land of a farm was 10.35 ha. The largest number, 73% of the total number of agricultural holdings, was in the area group of 1-10 ha of arable land. They occupied 28.2 percent of the farm area. Holdings with more than 10 ha of agricultural land – 26.8% of the area of agricultural holdings. The number of farms with 1-3 ha of agricultural land is 446 thousand and they used only 5.8% of the area of farms (CSO 2017; ARiMR 2017).

Table 1.5. Area structure of farms in Poland [in %]

Years	Agricultural holdings with farmland area [%]								The average area of the agricultural holding	
	< 1 ha	1,01-1,99	2,00-4,99	5,00-9,99	10,00-14,99	15,00-19,99	20,00-49,99	> 50 ha	total [ha]	including UR
2010	**1,6**	**19,9**	**32,6**	**22,9**	**10,0**	**4,8**	**6,4**	**1,8**	**11,3**	**9,8**
2015	**2,0**	**18,0**	**32,2**	**22,9**	**10,3**	**5,1**	**7,2**	**2,3**	**11,6**	**10,3**

Source: Own elaboration based on CSO.

In parallel to changes in the area of farms, an increase in their productivity, degree of specialization and concentration of production (especially livestock production) in a smaller number of farms is also observed. These processes lead to an increase in the economic size of a significant part of commercial farms. However, it must be emphasized that irrational management of agricultural land is a threat to the future development of the sector. Disadvantages of agricultural

policy and spatial development policy contribute to this. In the years 2002-2014, the area of agricultural land decreased by 2.3 million ha.

Next, in table 1.6 the value and the degree of consumption of fixed assets are shown. In terms of the degree of consumption of fixed assets, the agricultural sector was the worst compared to other sectors of the economy.

Table 1.6. Gross and net value of fixed assets in Poland

Specification	2005	2010	2014	2015		
	Gross value [current registration prices, million PLN]				Value net	Degree of usage (%)
Overall in Poland	**1826907**	**2520940**	**3258955**	**3471801**	**1880228**	**45,8**
including: agriculture, forestry, hunting and fishing	**118191**	**131856**	**148585**	**151396**	**38319**	**73,7**

Source: Own elaboration based on CSO.

Analyzing the dynamics of changes based on fixed prices, the confirmation of this trend in table 1.7 was shown. Restoration of fixed assets in agriculture was slower than other sectors. Capital expenditures are still insufficient. They should be more substitutive to work inputs.

Table 1.7. Dynamics of gross value of fixed assets in Poland (constant prices)

Specification	2013	2014	2015	2015	
	previous year = 100			2005 = 100	2010 = 100
Overall in Poland	104,1	104,3	104,6	146,3	123,6
including: agriculture, forestry, hunting and fishing	**100,8**	**100,8**	**100,7**	**104,2**	**103,4**

Source: Own elaboration based on CSO.

This part analyzes the investment activity of the agricultural sector against the background of the entire economy (tables 1.8-1.9 and chart 1.11). Capital expenditures are financial or material outlays which aim is to create new fixed assets or improve existing objects of fixed assets, as well as expenditures on the so-called first investment equipment (CSO 2016).

Table 1.8. Investment expenditures [current prices, PLN million]

Specification	2005	2010	2014	2015	2005	2015
	mln zł				%	
Overall in Poland	**131055**	**217287**	**250776**	**271839**	**100,0**	**100,0**
including: agriculture, forestry, hunting and fishing	**2980**	**4282**	**6155**	**6084**	**2,3**	**2,3**
- agriculture and hunting	**2398**	**3716**	**5241**	**5304**	**1,9**	**2,0**
- forestry	**554**	**548**	**858**	**741**	**0,4**	**0,3**
- fishing	**27,5**	**18,3**	**56,3**	**38,8**	**0,0**	**0,0**

Źródło: opracowanie własne w oparciu o dane CSO.

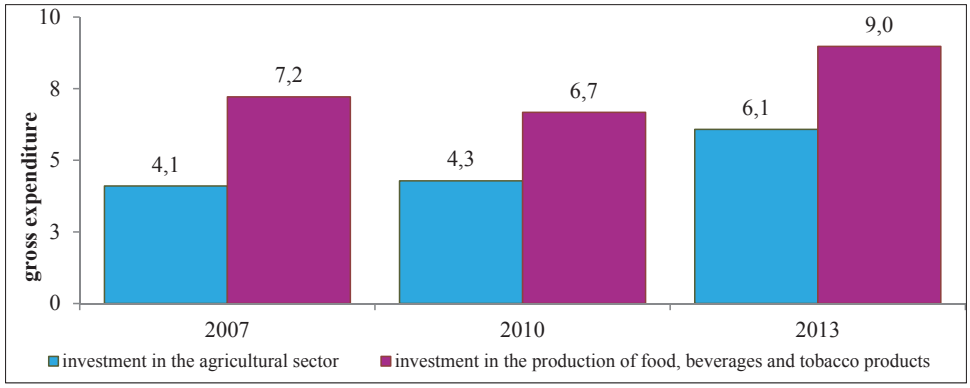
Table 1.9. Dynamics of investment outlays in Poland [fixed prices]

Specification	2013	2014	2015	2015	
	previous year = 100			2005 = 100	2010 = 100
Overall in Poland	**98,8**	**109,5**	**107,1**	**192,7**	**124,6**
including: agriculture, forestry, hunting and fishing	**106,6**	**102,2**	**99,3**	**181,5**	**141,1**
- agriculture and hunting	**109,3**	**108,0**	**101,8**	**195,0**	**141,2**
- forestry	**97,2**	**77,0**	**86,2**	**124,0**	**135,8**
- fishing	**91,1**	**99,3**	**69,8**	**137,8**	**215,0**

Source: Own elaboration based on CSO.

Table 1.8 shows that these outlays accounted for 2.3% of the total investment expenditure of the Polish economy in 2005 and 2015. This is an unsatisfactory share, especially in the context of the investment needs of this sector and the possibility of obtaining funds from EU funds (for example RDP 2014-2020).

Chart 1.11. Investment outlays and gross value of fixed assets in the agricultural and food processing sector in Poland [PLN bn/yr]



Source: Own elaboration based on CSO.

For a synthetic summary of the considerations regarding production assets and capital expenditures, table 1.10 is presented.

Table 1.10. Fixed assets and capital expenditures in agriculture and hunting

Years	Gross fixed capital formation (current prices registration, PLN billion)	Degree of consumption (%)	Net fixed assets (current prices registration, PLN billion)	Expenditures investment (current prices, PLN billion)
2005	**112,4 (7,6%)**	**71,1**	**30,5**	**2,4 (1,8%)**
2006	**114,7 (7,1%)**	**73,6**	**28,5**	**3,0 (1,9%)**
2007	**117,4 (6,8%)**	**74,9**	**28,4**	**3,6 (1,9%)**
2008	**119,7 (6,4%)**	**74,9**	**28,3**	**4,0 (1,8%)**
2009	**122,6 (6,2%)**	**77,3**	**27,8**	**3,7 (1,7%)**
2010	**124,3 (5,9%)**	**76,7**	**27,4**	**3,7 (1,7%)**
2011	**127,1 (5,6%)**	**76,8**	**28,0**	**4,3 (1,8%)**
2012	**130,4 (5,4%)**	**76,9**	**28,7**	**4,5 (1,9%)**
2013	**134,0 (5,2%)**	**76,7**	**29,8**	**4,9 (2,1%)**
2014	**137,4 (5,0%)**	**76,5**	**30,9**	**5,2 (2,1%)**

* values in brackets shows share of agriculture and hunting in the national economy.
Source: Own elaboration based on CSO.

1.4. The share in domestic and EU budget expenditures

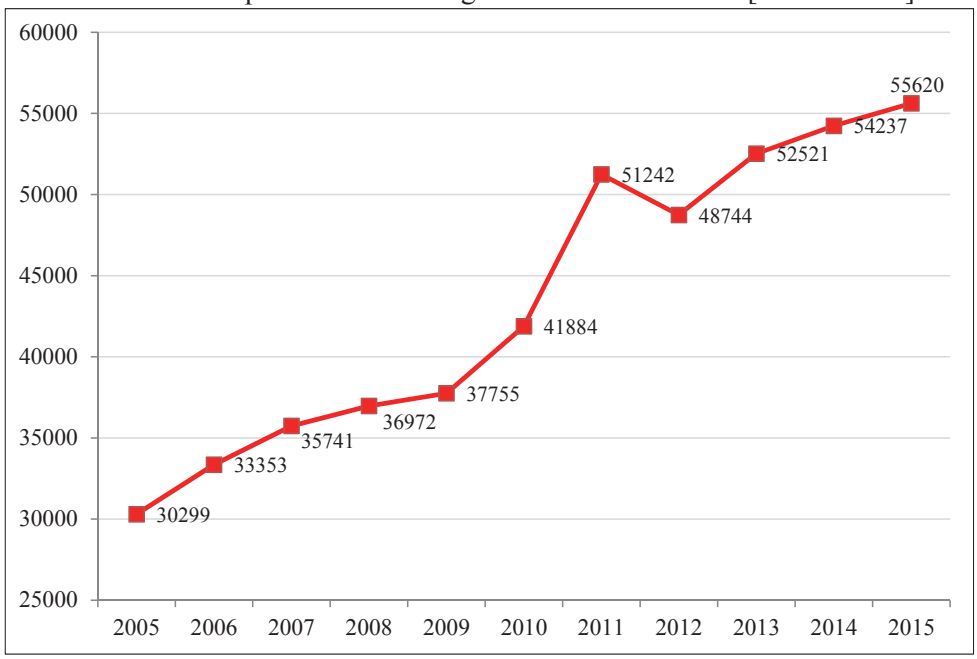
Agriculture has been treated in a privileged way since the beginning of the Community, which was reflected in the Treaty of Rome of 1957. However, the European Agriculture Model was defined much later, in Explanatory Memorandum of 1998 and Agenda 2000. The basic feature of this model is the attempt to reconcile the multifunctionality of agriculture while strengthening its competitiveness. It is based on the belief that the functioning of agriculture cannot be left solely to the regulatory power of the market, because in this case it would be impossible for agriculture to implement many useful functions (values) for the society, culture, economy and nature of the member countries (Wilkin 2007). The difficulty of including agriculture in the general theory of the markets results, according to J. Wilkin (2007), from the following conditions of agriculture:

- significant, although changing, bilateral relations between the agricultural economy and the natural environment and the related difficulties of taking into account these dependencies in the economic calculation;
- multifunctionality of agriculture, the importance of which is appreciated more and more commonly (some of these functions are difficult to quantify and pricing);
- stronger than in other sectors of the economy, social and cultural roots of agriculture are reflected in decisions made by farmers and their market behavior;
- the importance of agriculture for the country's food security.

When starting the analysis of the scale of external support for Polish agriculture, it should be emphasized that in the 1990s an exceptionally difficult period was recorded for this sector. State aid was withdrawn when other countries heavily subsidized their agricultural sectors. It should be noted that the history of the Agency for Restructuring and Modernization of Agriculture dates back to the 1990s, when the process of systemic transformation of the country required changes in the sphere of agriculture and the countryside. ARiMR was established in January 1994 (pursuant to the Act of 29.12.1993).

In the pre-accession period, spending on the agricultural sector was relatively low and amounted to about 2.5% of total state expenditure on an annual average. As a result, the PSE indicator at the time of Poland's accession to the EU was only 5-8%. It should be added that at present, the PSE indicator for the whole Community is around 20 per cent. After joining the EU, there was a sustained and real increase in budget expenditures on the agricultural sector (chart 1.12 and table 1.11).

Chart 1.12. Expenses on Polish agriculture in 2005-2015 [PLN million]



Source: Own elaboration based on MRiRW.

Table 1.11. Expenditure from the state budget by divisions

Specification	2005	2010	2013	2014	2015	2005	2010	2013	2014	2015
	in PLN million					in percent				
Overall	**208133**	**294894**	**321345**	**312520**	**331743**	**100**	**100**	**100**	**100**	**100**
including:										
Agriculture and hunting	**6220**	**10279**	**10014**	**8617**	**7857**	**3**	**3,5**	**3,1**	**2,8**	**2,4**
Forestry	**35**	**8,2**	**10,8**	**10,6**	**10**	**0**	**0**	**0**	**0**	**0**
Mining and quarrying	**943**	**876**	**548**	**639**	**933**	**0,5**	**0,3**	**0,2**	**0,2**	**0,3**
Industrial production	**990**	**826**	**1013**	**1258**	**1437**	**0,5**	**0,3**	**0,3**	**0,4**	**0,4**
Trade	**810**	**1072**	**609**	**646**	**1076**	**0,4**	**0,4**	**0,2**	**0,2**	**0,3**
Transport and communication	**4573**	**9082**	**8996**	**8774**	**10738**	**2,2**	**3,1**	**2,8**	**2,8**	**3,2**
Tourism	**40,5**	**43**	**45,5**	**43,5**	**45**	**0**	**0**	**0**	**0**	**0**
Housing economy	**1362**	**1443**	**2327**	**2369**	**2205**	**0,7**	**0,5**	**0,7**	**0,8**	**0,7**
Service activities	**774**	**881**	**1221**	**1235**	**1258**	**0,4**	**0,3**	**0,4**	**0,4**	**0,4**
Science	**2901**	**4200**	**4791**	**5002**	**5415**	**1,4**	**1,4**	**1,5**	**1,6**	**1,6**
Public administration	**8335**	**11545**	**12737**	**12641**	**12771**	**4**	**3,9**	**4**	**4**	**3,8**

Source: Own elaboration based on CSO.

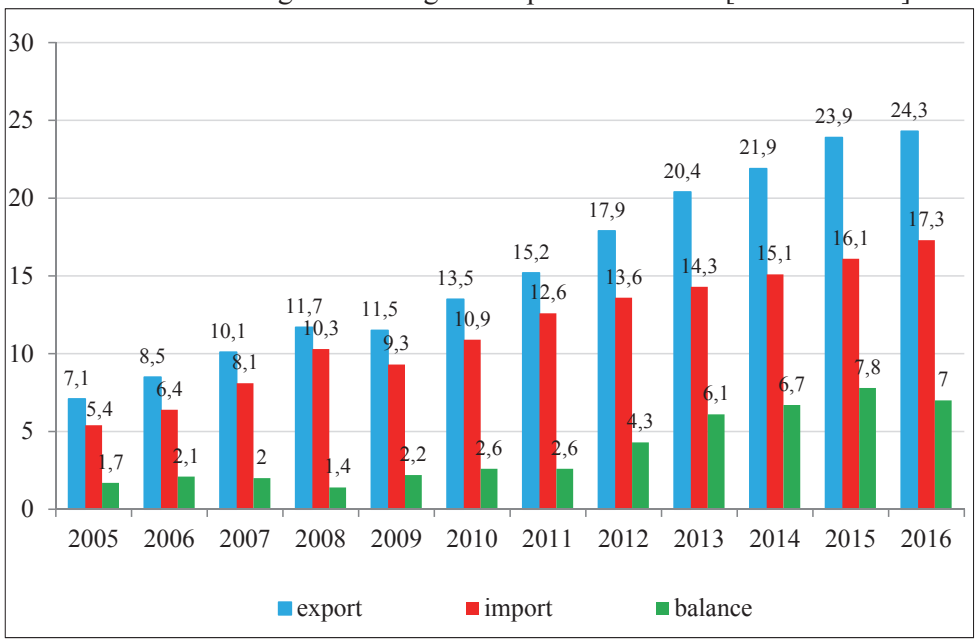
Currently, in the area of public spending, many items are allocated to support the agricultural sector. We include real and transfer expenses, direct and indirect expenses, current and investment expenses as well as expenditure on various levels of spending. The combination of all forms of financial assistance together with facilities in the tax system, social security system or pension system creates a comprehensive aid package for agriculture (Góral 2016, 2017). It should also be added that after Poland's accession to the EU in 2004, the average income level of an agricultural producer in Poland increased by 150% in real terms (Poczta 2014).

1.5. The share of agriculture in trade

The agri-food sector accounts for over 12% of Polish exports (chart 1.13). It is a sector which in recent years has been creating the addition (and steadily growing until 2015) balance in trade (Ambroziak 2017; CSO 2017), despite the difficulties resulting from the embargo of Russia[8] and other unforeseeable events.

[8] At the end of January 2014, Russia banned the import of live pigs and pork from the EU; in August 2014 – import of beef, veal and poultry meat, fish and crustaceans, dairy products, fruit and vegetables, meat and edible offal [KOWR 2017].

Chart 1.13. Foreign trade in agri-food products in total [in billion euro]

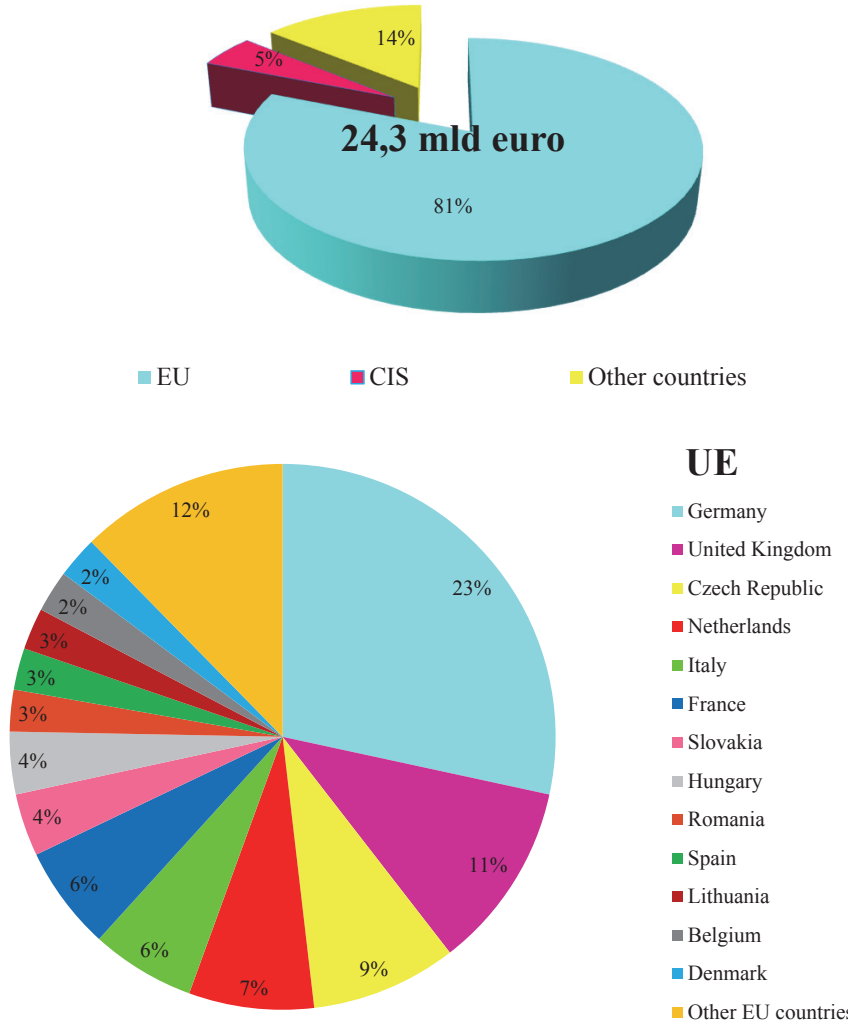


Source: Own elaboration based on KOWR.

In the export of agri-food products, the importance of cereal-flour products, meat and offal from poultry and confectionery products, whose share in export revenues in 2016 amounted to 9.0%, is gradually increasing. The products that in 2016 generated the largest export revenue were: meat and poultry offal (1 784 million euro), fish and processed products (1 709 million euro), chocolate products (1 429 million euro), bread (1 350 million), beef (1 176 million euro), meat products (951 million euro), pork (796 million euro), wheat (741 million euro), cheese and curd (625 million euro), fruit and vegetable juices (550 million euros) and cigarettes and cigars (1 778 million euros). In 2016, the total value of these products accounted for 53% of the value of agri-food exports (KOWR 2017).

Polish agri-food products are exported mainly to the EU market (chart 1.14). In comparison with 2015, the value of exports of these goods to European Union countries in 2016 increased slightly (by 0.9%) and amounted to EUR 19.8 billion. The share of Germany in the value of exports of agri-food products from Poland in 2016 amounted to 23% and was similar to the one quoted in 2015, the United Kingdom was in second place so far.

Chart 1.14. Geographical structure of Polish agri-food exports in 2016



Source: Own elaboration based on KOWR.

1.6. Summary

The agricultural sector in terms of quantity (macroeconomic data) is losing importance (its share in employment, production assets, and GDP is decreasing). On the other hand, it should be remembered that rural areas occupy about 93% of the area of the country and are the place of residence for about 40% of the population of Poland.

Table 1.12. Data on factors of production and size of agricultural production

Years	Total Agricultural land (UAA) [thousand ha]	Labor costs [thousand AWU]	Capital expenditures* [million euro]	The value of agricultural production** [million euro]
2000	**17 812**	**2 495**	**10 430**	**12 698**
2001	**17 788**	**2 524**	**10 438**	**13 348**
2002	**16 899**	**2 267**	**10 493**	**13 358**
2003	**16 169**	**2 279**	**10 348**	**13 190**
2004	**16 327**	**2 284**	**10 723**	**14 267**
2005	**15 906**	**2 292**	**10 313**	**13 995**
2006	**15 957**	**2 292**	**10 537**	**13 706**
2007	**16 177**	**2 299**	**10 709**	**14 837**
2008	**16 154**	**2 299**	**10 631**	**14 964**
2009	**15 608**	**2 214**	**10 712**	**15 454**
2010	**15 535**	**1 915**	**10 339**	**15 090**
2011	**15 134**	**1 915**	**10 813**	**15 405**
2012	**15 050**	**1 915**	**10 643**	**15 799**
2013	**14 609**	**1 937**	**10 850**	**15 971**
2014	**14 558**	**1 937**	**11 708**	**17 349**
2015	**14 545**	**1 937**	**11 860**	**16 670**

* Values are given in constant prices (2005 = 100). Intermediate consumption of Polish agriculture accounted for 5 percent of the same size in the EU-27 and 6 percent in the EU-15. The depreciation value is 3 per cent of the average depreciation value for agriculture in the EU-27 and 3-4 per cent for agriculture in the EU-15

** The values are given in the producer's constant prices (2005 = 100). These values throughout the entire analyzed period accounted for 5 percent of the value of production in the entire EU-27 and nearly 6 percent of this value in the entire EU-12. There is no tendency here. These relationships were constant over time.

Source: Own elaboration based on CSO, Eurostat.

An important issue that determines the functioning of farms is the scale of production (farmland area), the level of employment and labor productivity. There are close cause and effect relationships between these values. This statement was also supplemented with a synthetic table 1.12, which contains key information about the state of Polish agriculture. Supplementing the information contained therein, it is worth emphasizing that Poland ranks fourth in the EU in

terms of the size of farmland space (after France, Spain and Germany). Labor expenditures in Polish agriculture accounted for around 40 percent of analogous expenditures in the entire EU-15 and about 20 percent in the entire EU-27 in the period under consideration.

In the light of the presented data, it is possible to find slow, beneficial changes in the ratio of capital expenditure per hectare and the relation of labor inputs per hectare of farmland. We should strive to accelerate these changes and definitely improve labor productivity in agriculture.

Agriculture together with the food industry affect the state of the Polish economy (creating a total of about 7 percent of GDP). This impact is greater than in the case of the EU-15. From the McKinsey & Company report entitled "Poland 2025 – a new growth engine in Europe" shows that around 200 million EU citizens live within a radius of no more than 1000 km from Polish borders. This is a favorable location and at the same time a great opportunity that no other European state has. It gives the country the opportunity to be a European center for food production and food processing.

Similar observations result from the research of Rembisz and the analyses of Gruda (2013). In the opinion of the predicted increase in global demand for food is expected to lead to a significant increase in production in the perspective of 2050 (by about 70 percent) and an increase in exports of major Polish agricultural products. This shows the challenges for the agricultural sector for the next 20-30 years. The need for producing food and conducting agricultural production for non-food purposes (for example biofuels) seems to be a difficult task while respecting the state of the environment (less ecological aggression), shrinking agricultural land in the world, increasing soil degradation, annual desertification of land parts and climate change.

2. Analysis of development processes in agriculture at using input-output tables

The purpose of this chapter is assessing the position of the agricultural sector in Poland based on input-output tables. First, however, the idea and assumptions regarding the input-output tables were approximated.

Physiocracy has glorified the importance of agriculture in economic development. Quesnay's "Economic Table"[9] (1758)[10], which shows that wealth is created in agriculture, has become the basis for the development of the method of inter-branch flows. It is worth adding that the basis of classical economics (the law of diminishing revenues, Turgot) and the symbol of modern liberalism (laissez-faire) also derive from physiocracy. Agrarianism and co-operativism end up a positive approach to the importance of agriculture in the economy that reappeared in the economy of development.

F. Quesnay's "Economic Board" was the first attempt to explain and demonstrate the basic dependencies in the economy. Using the board he showed the flows of goods between agriculture (production class), non-agricultural sphere (sterile class) and owners (secular and spiritual power), as well as explained the principles of simple reproduction. Analyzing the flow, F. Quesnay showed the role of income distribution for economic growth. The work contained the first economic model ever invented and explicitly formulated. At the same time, he created the basis of the method of analysis of input-output flows, which were expressed in the concept of Walras[11] general equilibrium and in the formulation of Leontief's input-output flow table (Poczta, Mrówczyńska-Kamińska 2004).

Leontief developed the first tables of input-output flows in the early 1930s for the US economy based on data of 1919 and 1929. These tables, in a similar form, have been used to this day in statistical reporting of over 80 countries around the world, which significantly facilitates the analysis of macroeconomic activity (Gruszczyński, Podgórska 2004).

[9] The original title was: *Tableau èconomique.*

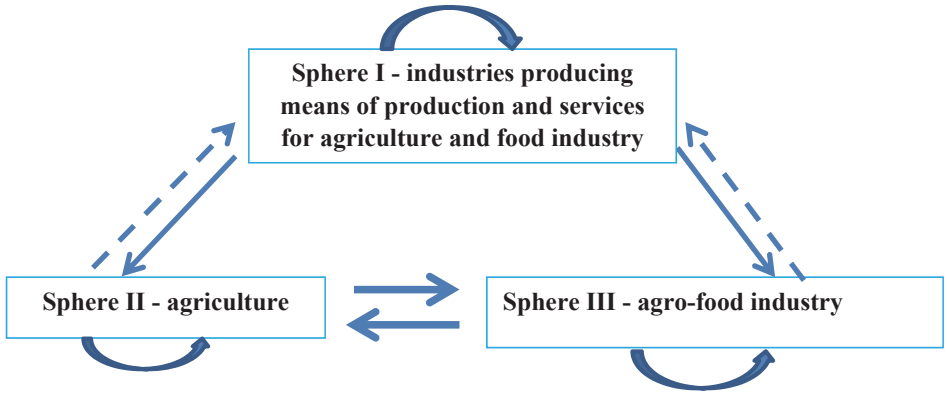
[10] The most outstanding representative of physiocracy, its creator and master was Francois Quesnay (1694-1774). The basis of the economic concept of the physiocrats is the pure product theory and the theory of exchange equivalence. It distinguishes the multiplication of wealth, its increase and the addition of the sum of wealth.

[11] Leon Walras presented his general equilibrium model at work entitled *Elements d'economie politique pure* (1874), the aim of which was to show that the free game of competition leads to the formation of a price system that ensures a balance between supply and demand in all markets and corresponds to the best possible allocation of resources.

The existence of product flows between branches creates a need for analysis of inputs and the results in the scale of individual branches, such as also the entire economy. The model allows to determine quantitative relationships between different sectors of production leading to overall economic balance. The interbranch flows through the analysis of the supplier-recipient or producer--consumer type concretize the idea of the functioning of the economic mechanism, its external links and dependencies.

In general, the national economy consists of many different branches related to each other. The products of some branches are consumed as expenditures by others, which would not be able to carry out production activities without them (Scheme 2.1). A good example here, it could be the agricultural sector (the first sector of the national economy[12]), without which the food industry and the whole agribusiness would not function efficiently. Agriculture, despite a negligible share in generating GDP, is the basis for the entire sphere of agribusiness and determines its strength to a large extent and competitiveness. The dynamically developing food industry in recent years is also determined by the level of development of Polish agriculture.

Scheme 2.1. Relationships between the spheres of the food economy



Source: (Mrówczyńska-Kamińska 2013).

[12] The national economy is divided into 5 sectors: (1) **the first**: agriculture, forestry, fisheries; (2) **the second**: mining, mining and processing industries and construction; (3) **third**: transport, communication, municipal and housing management and trade; (4) **fourth**: finance, insurance, marketing and advertising as well as real estate trading; (5) **fifth**: health protection, social welfare, education, research, tourism and recreation, state administration, justice, police and army [Trzcińska 2015]. There is also a traditional division into: (1) agriculture, forestry and fishing, (2) industry and construction, and (3) services. Basing in turn, 21 sections (from section A to section U) stand out for the classification of PKD 2007.

It is also worth adding that the share and importance of various branches of the economy in food production are explained by the agribusiness theory of Davies and Goldberg in 1957 (Davis, Goldberg 1957). Goldberg presented an input-output table based on Leontief's theory of input-output flows. Its model gives the opportunity to analyze complex economic systems and is based on the observation that the economy includes many production branches whose activities are interrelated. These connections result from the fact that the production of some branches is consumed as an outlay in other branches. The input-output model consists of four parts (quadrants, scheme 2.2). In the first part, the individual production phases are defined, specifying the intermediate sector demand (intermediate consumption matrix, highlighted in yellow in scheme 2.2). In the second quarter the final demand (green field) was reflected. The final demand is reported by an individual consumer, the state budget, as well as the investment sphere that purchases fixed assets and rotary. Part III presents macroeconomic effects created in specific sectors, from the income perspective (value added components – red field in scheme 2.2). Quarter IV of the array (blue) refers to the division of generated income (Czyżewski, Grzelak 2012). The model published by the Central Statistical Office does not contain the fourth quadrant.

In addition, other information can be included in the table, such as the value of imports, exports, taxes and added value broken down into individual branches. Meanwhile, information is provided in the regional variant of the table on the production and directions of its use by region.

Scheme 2.2. Quadrants of the input-output model

<table>
<tr><td colspan="3" rowspan="2"></td><td colspan="2">APPLICATION / DISPOSAL</td><td rowspan="2">Global production</td></tr>
<tr><td>Intermediate consumption</td><td>Final consumption</td></tr>
<tr><td rowspan="6">ORIGIN</td><td rowspan="4">branches</td><td>1</td><td rowspan="4">I quarter</td><td rowspan="4">II quarter</td><td rowspan="5"></td></tr>
<tr><td>2</td></tr>
<tr><td>…</td></tr>
<tr><td>n</td></tr>
<tr><td>import</td><td>n+1</td><td></td><td></td></tr>
<tr><td colspan="2">gross value added</td><td>III quarter</td><td>IV quarter</td></tr>
<tr><td colspan="3">Global production</td><td colspan="2"></td></tr>
</table>

Source: own elaboration based on (Ambroziak 2017).

2.1. Input-output methods in modelling economy

Analysis of input-output flows (also input and output analysis or input--output analysis) is a type of macroeconomic calculation that concerns the study of the state and structure of complex economic systems. The input-output table contains numerical data for a specific period (year)[13,14]. They show the image of the economy as an example of a system of connected vessels (Gruszczyński, Podgórska 2004).

This system is divided into *n* branches, to which the values of produced production and the ways of its use are assigned. These quantities are placed in a checker table, in which one row is assigned to one branch (manufacturer). However, the column shows the same branch as the recipient of products from other branches. The concept of branches can be broadly understood and can mean a sector, department or other part of the economic system.

Information is collected in the input-output method about the value of goods produced in the economy and their use. In addition, other relevant information may also be included, for example about the value of imports, exports, taxes and value added broken down by branch. In the regional variant of the table, information on production and directions of utilization by regions is placed.

The essence of the balance of input-output flows is the assumption that the national economy is an aggregate of resources and streams consisting of several interlinked systems. The input-output balance sheets are a statistical material that allows the inclusion of the social whole of the process production of ma-

[13] Information on inter-industry flows in Poland is published by the Central Statistical Office every 5 years. The last data concerns the year 2010 and it is included in the publication: "The balance of input-output flows at current base prices in 2010". This publication includes: (1) general methodological assumptions of input-output balances, (2) a balance of input-output flows at current basic prices in a 77x77 division, (3) a balance of input flows at current basic prices for domestic production in a 77x77 division, (4) matrix of the use of imported goods and services 77x77 sections. The input-output balance sheets at base prices for 2010 differ from the published balance sheet version of 2005 ("Intra-group balance in current base prices in 2005", GUS, Warsaw 2009). These differences result from methodological changes and revision of national accounts carried out in 2009-2013.

[14] The balance of input-output flows at basic prices published by the Central Statistical Office is in the form of a symmetric matrix in the product-by-product system. Three parts are distinguished in the balance sheet: I - intermediate consumption matrix, II - final demand matrix by components (consumption by households, non-commercial institutions and by government and local government institutions, gross expenditure on fixed assets, increase in inventories and assets of exceptional value, export fob), part III - gross value added matrix (costs related to employment, taxes on producers, less subsidies to producers, depreciation of fixed assets, net operating surplus, gross operating surplus).

terial goods and production costs (Poczta, Mrówczyńska-Kamińska 2004). These conjugated systems can be illustrated by means of scheme 2.1. It is not possible to show the image of the economy or economic processes without simplifications and certain assumptions. Every economic model is based on them. The model approach to the economy is circular movement (Ślusarczyk, Ślusarczyk 2011). Circular movement is a model of the economy showing in a simplified way the flows of monetary (financial) and material resources between the main categories of entities performing a role in the national economy and participating in the production and/or development of a domestic product. It is a model describing the flow of consumer goods and production factors, as well as the prices paid for them between the producer and the consumer. At this point, it is worth adding that the material circulation is referred to as the real economy, and the cash cycle is an unrealistic economy.

Producer and consumer play a dual role in circular motion (in the economy). The consumer is also the buyer of final goods and services, as well as the provider of own production factors. In turn, the producer is a buyer of services of production factors and a seller of final goods and consumer services. Mutual dependencies and relations between consumers and producers are shaped on the consumer goods and services market and on the factor of production market (Rembisz, Sielska 2015).

For the preparation of schemes 2.3 and 2.4, the following notation was adopted:

P - producer,

K - consumer,

C - consumption,

S - savings,

I - investments,

T - taxes (including: direct: T_B, T_d and indirect T_e),

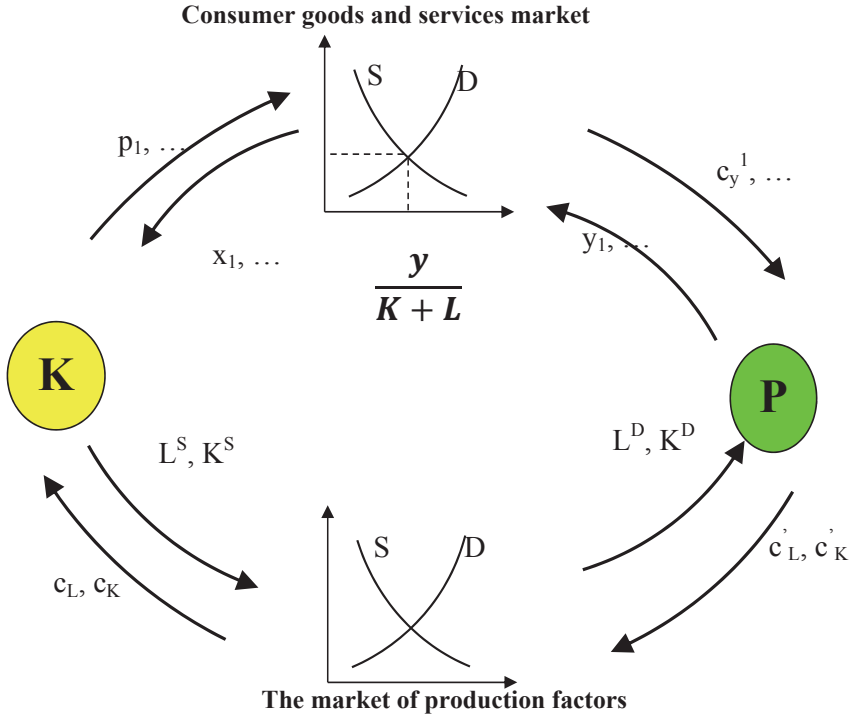
G - government spending,

B - state budget,

L - labor inputs (production factor),

K - capital expenditure (production factor).

Scheme 2.3. Basic relationships between the consumer and the producer

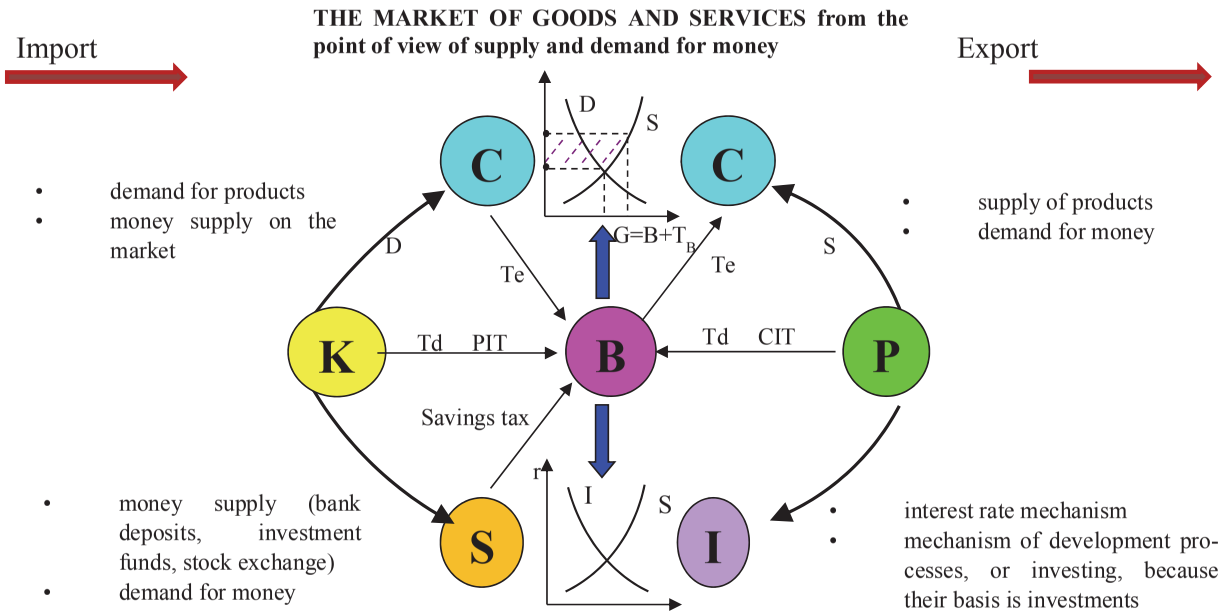


$x_1, \ldots$ - products and services purchased by the consumer,
$p_1, \ldots$ - prices paid by the consumer (demand prices),
$y_1, \ldots$ - products manufactured by the producer for sale to the consumer,
$c_y^1, \ldots$ - prices obtained by producers (supply prices),
L^S, K^S (L^D, K^D) - supply of labor factor, capital (demand for labor factor, capital),
c_L, c_K (c'_L, c'_K) - supply price of labor factor, capital (demand price of labor factor, capital).
Source: (Rembisz, Sielska 2015).

The above diagram shows the completeness of the circular movement between the consumer (K) and the producer (P). The consumer is the final purchaser of goods produced based on the services of factors which he provided to the producer at the beginning of the circular movement.

For the purposes of the analysis of the dependencies of scheme 2.4, add the following relations: C + S = C + I and S - I = T - G, in particular: S> I = T <G, which describes the macroeconomic balance in the context of the budget deficit.

Scheme 2.4. Circular flow in a typically macroeconomic approach (including savings and investments)



Source: developed based on: (Rembisz, Sielska 2015).

Among the issues to be explored by disaggregated branches of the economy and input-output tables, the following should be mentioned: energy and climate policy, environmental protection, foreign trade, tax or agricultural policy, as well as labor intensity analysis.

The economy is a system of connected vessels. The existence of product flows between sectors creates a need for input analysis and results on the scale of individual groups of enterprises and the entire economy. It is treated as a model for quantifying relationships between different sectors, leading to overall economic balance. Input-output type analysis based on the assumptions of the general equilibrium theory allows to evaluate the generated macroeconomic effects, the processes of budget redistribution, relationships between sectors and the environment, the impact of global processes (Tomaszewicz 1994; Czyżewski, Grzelak 2012). It also allows you to specify the scope of self-management or inter-sector links in the objective and dynamic system. When assessing the allocation of products in given sectors (especially consumption or accumulation), you can analyze their position in the economy. On the basis of the input--output flow table, it is also possible to examine the structure of direct and indirect current outlays, capital expenditures and determine the effectiveness of particular types of outlays. The product-absorbing factor (material intensity) serves this purpose. The most commonly used is the coefficient of direct material consumption, called the technical coefficient of production. It defines the relation of the value of goods consumed directly by the surveyed sector (group of enterprises) to the value of produced production. These coefficients are used to determine the effectiveness of particular sectors, their importance in shaping development processes in the economy (Czyżewski 2011).

Based on statistical data describing global production values by industry and intermediate consumption in each branch, an input-output matrix can be created. Elements of the matrix (xij) inform about the consumption of products of the j-th branch in the production process of the i-th branch. These elements are usually expressed in current basic prices and published in the form of input--output tables by the Central Statistical Office (CSO). In addition, these data can also be found in international databases, such as Eurostat or WIOD (World Input-Output Database)[15] (Boratyński 2015). It is worth noting here that international databases allow for analysis the so-called global value chains, extremely

[15] It contains time series of input-output tables and satellite accounts of approx. 40 countries included in a unified form (M.P. Timmer, 2012). The creation of WIOD, a unified, easily accessible database, was a breakthrough in the use of input-output methods, especially for the needs of multi-regional input-output tables.

important in the era of progressive globalization of production, especially the growing role of China in global value chains (concept of multiregional input-output tables).

2.2. Leontief's input-output flows – theoretical approach

Leontief published in 1941 a book entitled "The structure of the American economy", in which he presented his world-famous analysis method input-output flows (also known as input-output or model / input-output matrix). In its method Leontief describes how entrepreneurs buy and sell manufactured products. Too much output (called output) is the basic input (input) for the second production. Presenting these input-output exchanges using a dual input array (input-output) Leontief created a real model of the economy (scheme 2.5). Among the European economists, one should mention Stone (1960s[16]) – co-creator of the national accounts system. Among the Polish economists involved in the balance sheet of the national economy should be mentioned Lange, whose approach is a very good complement and complement the Leontief's approach. The importance of this method may also be demonstrated by the fact that in 1988 the International Input-Output Association was established, which is still in operation today[17,18].

Scheme 2.5. The input-output table on the example of four branches

Global production branches (X_i)	Intermediate flows (internal turnover, consumption indirect or indirect demand, x_{ij})	Final production (consumption, investments, inventory growth, exports; Y_i) *
X_1	$x_{11} + x_{12} + x_{13} + x_{14}$	Y_1
X_2	$x_{21} + x_{22} + x_{23} + x_{24}$	Y_2
X_3	$x_{31} + x_{32} + x_{33} + x_{34}$	Y_3
X_4	$x_{41} + x_{42} + x_{43} + x_{44}$	Y_4

* Final production is the surplus of the global production of a given branch over the production needs of all branches. Also referred to as final demand or final consumption.
Source: (Ślusarczyk, Ślusarczyk 2011).

The analysis of the above table (matrix) consists in looking at the entire economy through the prism of transactions taking place between its branches. It may be further developed after taking into account the depreciation of fixed assets used in a given sector j (Aj), wages in a given branch j (x0j) and profits (Zj)

[16] Macroeconomic models based on input-output tables (integrated – and CGE – Computable General Equilibrium) formulated at that time are used in general terms until today.
[17] Look: https://www.iioa.org/.
[18] For more on future applications, see E.Dietzenbacher et al., *Input-Output Analysis: the Next 25 Years*, Economic Systems Research, no. 25 (4), 2013.

generated by the j-th branch (scheme 2.6). In addition, you can show different approaches, once treat a given branch (sector) as a supplier of products and the second time – as a producer.

Scheme 2.6. An extensive Leontief input-output flow table based on four branches

Global production branches (X_i)	Indirect demand (x_{ij})	Final demand (Y_i)
X_1	$x_{11} + x_{12} + x_{13} + x_{14}$	Y_1
X_2	$x_{21} + x_{22} + x_{23} + x_{24}$	Y_2
X_3	$x_{31} + x_{32} + x_{33} + x_{34}$	Y_3
X_4	$x_{41} + x_{42} + x_{43} + x_{44}$	Y_4
Aj	A_1 A_2 A_3 A_4	
x_{0j}	x_{01} x_{02} x_{03} x_{04}	
Z_j	Z_1 Z_2 Z_3 Z_4	
X_j	X_1 X_2 X_3 X_4	

Source: developed based on: (Ślusarczyk, Ślusarczyk 2011 and Przybyliński 2012).

Indirect demand streams are presented in lines. Analyzing individual lines one can see how the production of a given branch was distributed among other branches and on its own self-supply. Indirect demand flows through streams to Part II, to final demand. The final consumer demand also includes non-productive investments: residential houses, public utility buildings, culture and art expenditure.

When we analyze input-output tables from the perspective of the supplier of products (horizontal shot-by line), we get the equation of division of the production of the i-th branch defining the purposes of consumption of the global output of a given branch (sector):

$$X_i = \sum_{j=1}^{n} x_{ij} + Y_i$$

where Y_i consists of consumption, investment, governmental and foreign demand (domestic demand and exports), and $\sum_{j=1}^{n} x_{ij}$ means indirect consumption for the needs of other branches, as well as self-supply of a given branch (consumption for example production of the first branch through other branches and itself: $x_{11} + x_{12} + x_{13} + x_{14}$). Final demand is the amount resulting from the adjustment of the value of the output of a given branch to flows to other branches (indirect demand). In general, it can be concluded that indirect demand together with final demand determine the purpose (distribution) of the production of a given branch.

When analyzing our example matrix of input-output flows (4 branches and for j = 1) from the producer's perspective (vertical approach – according to columns), we look at the sources of production costs and we distinguish here:

- material costs of j-th (here: j = 1) branches: $x_{11} + x_{21} + x_{31} + x_{41} + x_{n+1}$ (x_{n+1} means imported products) – these are costs of purchasing raw materials and materials used during production,
- material costs of j-th branch: $x_{11} + x_{21} + x_{31} + x_{41} + x_{n+1} + A_{n+2,1}$ – material costs including depreciation of fixed assets (depreciation of $A_{n+2.1}$ is also referred to as $x_{n+2.1}$),
- branch production costs: $x_{11} + x_{21} + x_{31} + x_{41} + x_{n+1} + A_{n+2,l} + x_{01}$ (for j = 1 and four branches) are material costs increased by wages.

Looking at the vertical approach (according to the columns) we can see the origin of the components of the global output of a given branch (share of various branches, share of imports, gross value added). Vertical analysis allows to determine the cost equation for a given branch j in the form:

$$X_j = \sum_{j=1}^{n} x_{ij} + A_j + x_{0j} + Z_j$$

In addition, a very useful value that we can derive from the above matrix positions is the added value also called pure j-th branch production (PC_j). It is defined as follows:

$$PC_j = X_j - \sum_{j=1}^{n} x_{ij} - A_j = x_{0j} + Z_j$$

On the other hand, increasing the value of PC_j by the value of depreciation allows to estimate the gross value added generated by branch j (WDB_j):

$$WDB_j = PC_j + A_j = x_{0j} + Z_j + A_j$$

In the context of the above relationships and description of the components of costs, a general form of input-output matrix can be proposed, where added value and other above values were taken into account (scheme 2.7).

Scheme 2.7. The general structure of the input-output flows

Branch number (j)	Intermediate consumption (x_{ij})	Final consumption (Y_i)	Global production of branches (X_i)
1	$x_{11} + x_{12} + \ldots + x_{1n}$	Y_1	X_1
2	$x_{21} + x_{22} + \ldots + x_{2n}$	Y_2	X_2
…	…	…	…
n	$x_{n1} + x_{n2} + \ldots + x_{nn}$	Y_n	X_n
Import (x_{n+1})	$x_{n+1,1}\ x_{n+1,2}\ \ldots\ x_{n+1,n}$		
WDB: $A_j = x_{n+2}$ x_{0j} Z_j	$A_{n+2,1}\ A_{n+2,2}\ \ldots\ A_{n+2,n}$ $x_{01}\ x_{02}\ \ldots\ x_{0n}$ $Z_1\ Z_2\ \ldots\ Z_n$	$\sum_i Y_i$ / $\sum_j WDB_j$	$\sum_i X_i$
Global production j-th branch	$X_1\ X_2\ \ldots\ X_n$	$\sum_j X_j$	

Source: developed based on: (Chrzanowski 2014; Ambroziak 2017).

The balance of a branch can, therefore, be summarized as follows:

$$X_i = \sum_{j=1}^{n} x_{ij} + Y_i = \sum_{j=0}^{n+2} x_{ji} + Z_i = X_i$$

where:

$$\sum_{j=0}^{n+2} x_{ji} + Z_i = X_i$$

is referred to as the cost equation for a given branch.

This means that the sum of the values of intermediate consumption and final consumption is balanced with the sum of production costs and profits (a breakdown of the division of production of a given branch with the equation of costs of this branch). In practice, it boils down to the fact that both green fields (scheme 2.7) should contain the same values.

As a result, you can also specify the **general equilibrium** conditions for the following form:

$$\sum_{i=1}^{n} X_i = \sum_{i=1}^{n} \left(\sum_{j=1}^{n} x_{ij} + Y_i\right) = \sum_{j=1}^{n} \left(\sum_{i=1}^{n} x_{ij} + x_{0j} + x_{n+1,j} + x_{n+2,j} + Z_j\right).$$

It means balancing in the level of intermediate and final consumption of all branches (sum of fields: yellow and orange in scheme 2.7) with production

costs and profits of all branches in vertical terms (sum of fields: yellow, blue and pink in scheme 3).

The basic coefficient calculated on the basis of data from such a matrix is the share of production of a given branch in the value of total production of the second branch. This share is in other words the coefficient of direct inputs or the technical coefficient. It informs about the direct impact of the demand for products of the j-branch on the demand for products of the i-branch (Chrzanowski 2014). This can be expressed in matrix form as:

$$X = AX + Y,$$

and:

$$X = (I - A)^{-1}Y,$$

where:

X – global production vector;
A – matrix of direct material inputs, direct material consumption (in other, a matrix of technical and financial coefficients, in other worlds costs);
Y – vector of final demand;
I – unit matrix with dimensions $n \times n$;
$(I - A)^{-1}$ – Leontief's inverse matrix marked with the symbol L (including the matrix of full inputs, the matrix of full material absorption coefficients or additional demand).

As a result, we can write the following equation:

$$X = LY$$

The Leontief matrix (I - A) transforms the global production vector (X) into the final production vector (Y).

The elements of the full input matrix are the coefficients of full outlays (in other: full material absorption coefficients) denoted by the symbol αij and:

$$\alpha_{ij} = \frac{\partial X_i}{\partial Y_j}$$

Vector literature in the literature:

$$Y = (I – A)X$$

it is sometimes called the final production vector (Czerwiński 1973).

And the square matrix (I - A) is determined by the Leontief matrix. It converts the output vector (X) into the final production vector (Y). By transforming the table, you can calculate the material consumption rates for the final production of a given branch, that is, synthetic performance indicators. The sum

of the inverted coefficients shows the cost of obtaining a usability unit, i.e. a usability product.

Moreover, on the basis of the analysis of the matrix of direct input factors, it is possible to predefine the areas of special cooperation between branches of the economy. Coefficients of direct expenditures and full outlays allow to diagnose areas of special connections between branches of the economy. Therefore, in order to investigate: "what would happen if domestic production were to be replaced entirely by imports?", the value of final demand for products of a given sector and the appropriate row of the matrix of direct material factors should be reset.

The Leontief model is a linear model, i.e. it is uniform and additive. The homogeneity of the model results in the fact that an even growth of global production in all sectors (for example by 5%) translates into an increase in the final production of these sectors by the same value (for example 5%). However, the additivity of the model allows forecasting – if the final production in various branches (sectors) increases, if the global production increases by a specific value (vector ΔX).

Finally, it should be added that the Leontief model can be used to formulate forecasts:

- I type – with information on global output X, or its changes, we forecast the volume of final Y production based on the model $X = LY$;
- mixed – in a situation where we have mixed information (about some elements of the matrix X and some elements of the matrix Y);
- II type – knowing the size of Y, we determine the value of X (we examine what global production in particular departments is needed for the economy to reach a certain level of final production in particular departments). For the purposes of type II forecasts, you can use the following solutions:
  - inverse model $L^{-1}Y = X$ for a non-personal matrix L;
  - if the elements of the L-1 matrix are marked as βij, then βij means the increase in global output in the branch and needed for a unitary increase in final production in branch j.

2.3. Basic sectoral interdependencies and the Leontief model in practical terms

Balance and distribution of global production in agriculture

The data on the CSO input-output tables shows that in 2000, the employment costs generated a volume of 7% of the value of global production (expressed in basic prices, Table 2.1). Material costs accounted for 63% of the val-

ue of global production (expressed in basic prices). Self-supply (products of agricultural origin) constituted, in turn, 42% of material costs. Industrial processing products are another 30%, while commercial services and repairs account for 18% of material costs. The same was true in 2005, i.e. employment costs also accounted for 7% of the value of global production. Material costs are another 52% of this value. The remaining items reached the same values as in 2000. In turn, in 2010 it is worth noting that employment costs decreased to around 5%. The largest part of material costs were agricultural products consumed in the entire production process (self-supply, approx. 35%) and food products (about 20%). Subsequently, there were chemical products (10%) and retail (6%) and transport (6%). Electricity accounted for 3% of material costs. These costs, on the other hand, gave over half of the value of output expressed in basic prices (57%).

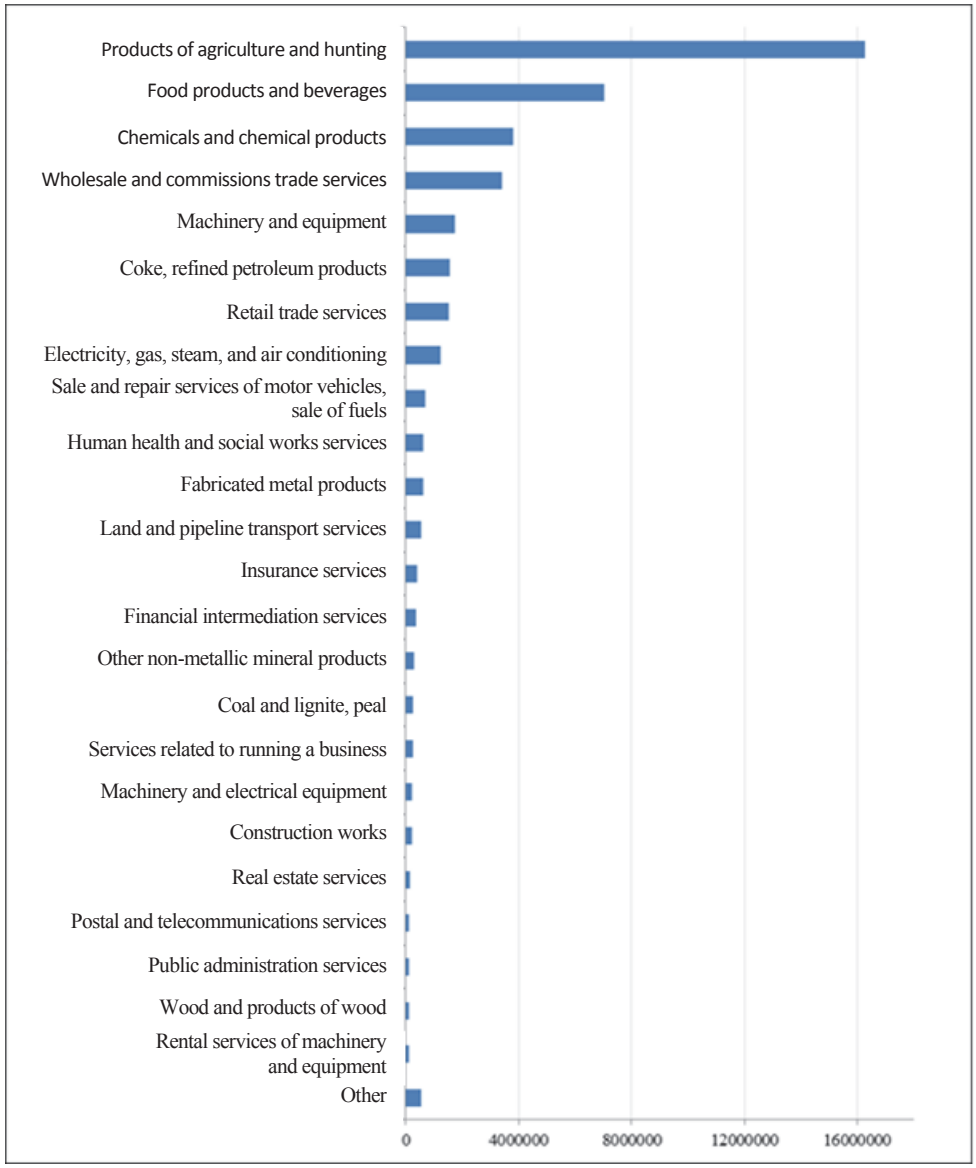
Table 2.1. The balance of global production in agriculture
[current base prices, thousands zloty]

Specification	2000	2005	2010
Material costs	**39 954 843**	**42 093 987**	**54 438 813**
Depreciation of fixed assets	**6 341 961**	**8 657 101**	**9 930 516**
Employment costs	**4 483 194**	**5 681 572**	**5 309 130**
…	**…**	**…**	**...**
Gross value added	**22 140 608**	**36 331 230**	**42 678 332**
Global production at basic prices	**63 419 610**	**80 655 357**	**99 860 390**

Source: development based on input-output tables from CSO.

The following chart 2.1 presents the origin of goods and services consumed in the production process on the example of 2005. Self-supply was the dominant value, which in terms of value accounted for 39% of all products and services consumed in the production process. Subsequently, food and beverages were found (17% of the value of all products). The value of chemicals and chemical products consumed amounted to PLN 3 798 695 thousand PLN and accounted for about 9% of the total consumed products. It is worth mentioning wholesale and commission trade services worth PLN 3 394 538 thousand PLN (and a share equal to 8%).

Chart 2.1. Structure of consumption of materials and services for agricultural production (so-called origin) in 2005 [current prices, thousand zloty]

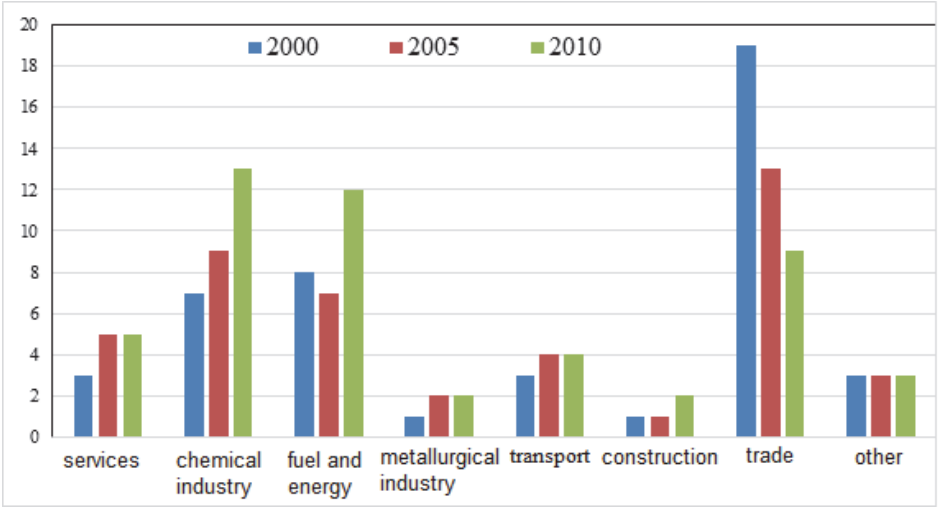


Source: prepared on the CSO data for 2005.

In chart 2.2, which is a direct reference to scheme 2.1, the structure of flows from the 1st sphere (from suppliers of means of production) to agriculture is shown. The growing trend in the chemical industry was clearly marked. The "fuel and energy" position is also important, while the share of trade decreases.

In 2010, the share of construction also doubled, which in 2000 and 2005 was at the same level. Fixed shares of such items as: services, transport and others.

Chart 2.2. Structure of material flows from the 1st sphere (suppliers of funds for production) for agriculture (in %)



Source: development based on input-output tables from CSO.

It is worth emphasizing that the significance of the first sphere is key and dominant in comparison to the others, as shown by the percentage shares in Table 2.2. It is also worth adding that a positive phenomenon was the growing share of the third sphere (recipients of agricultural products). The growing importance of the first and third sphere will be in the future, a manifestation of favorable changes in agriculture and confirmation of improvement in the level of its modernity. A good reference point here is EU-15 agriculture, as shown in Table 2.3.

Table 2.2. The size and structure of material supply of agriculture in Poland [in %]

Specification	2000	2005	2010
from the sphere I	**45,6**	**44,6**	**43,1**
from the sphere II	**42,4**	**38,6**	**33,4**
from the sphere III	**12,0**	**16,8**	**23,5**

Source: development based on input-output tables from CSO.

Then, ways of managing agricultural production are shown (table 2.4). Indirect demand (intermediate consumption) was the dominant part here. However, over the years, this share has been decreasing in favor of the growing share of final demand. A positive phenomenon is the abruptly growing value of exports (from PLN 1,839 thousand in 2000 to PLN 7,478 thousand in 2010). It is worth noting that the level of self-supply of agriculture remained stable, which

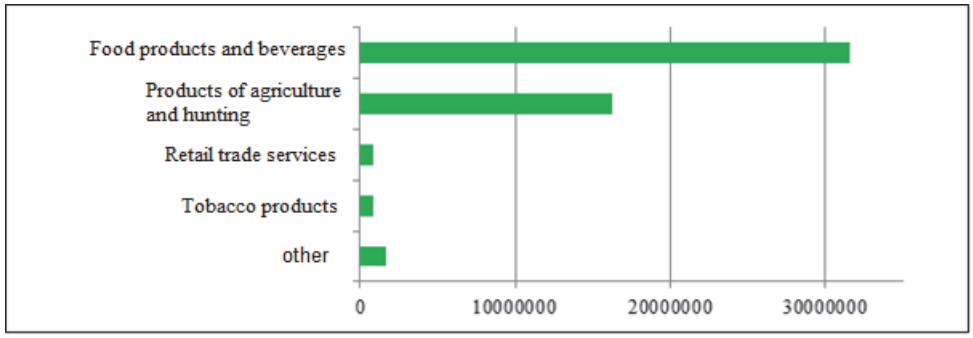
is not a positive phenomenon in the scale of the entire economy and it is not good to modernize the agricultural sector.

Table 2.3. The structure of input-output flows in Polish agriculture and EU-15 – comparison [in %]

Specification	Years	From the suppliers of the means of production - I sphere	From agriculture - II sphere	From the food industry - III sphere
Poland	2000	**47.6**	**39.7**	**12.6**
	2010	**43.1**	**33.4**	**23.6**
EU-15	2000	**53.5**	**25.6**	**20.8**
	2010	**56.3**	**23.1**	**20.5**

Source: development based on input-output tables from CSO and Eurostat, and (Figurek, Vasković, 2017).

Chart 2.3. Distribution of agricultural production as part of demand internal tax in 2005 [current prices, thousands zloty]



* In 2010, this distribution was similar.

Source: development based on input-output tables from CSO.

Table 2.4. Creating and distributing supply of agricultural products in Poland [basic current prices, thousand zloty]

Items		2000	2005	2010
Creation	Agricultural production	**57 723 (91,0%)**	**80 655 (91,8%)**	**99 860 (88,7%)**
	Import	**5 730 (9,0%)**	**7 207 (8,2%)**	**12 664 (11,3%)**
Supply		**63 453 (100,0%)**	**87 863 (100,0%)**	**112 525 (100,0%)**
Disposals – demand internal	Food and tobacco industry	**25 248 (39,8%)**	**32 425 (36,9%)**	**39 058 (34,7%)**
	Agriculture	**15 638 (24,6%)**	**16 257 (18,5%)**	**18 973 (16,9%)**
	Other industries	**3 018 (4,8%)**	**2 487 (2,8%)**	**3 824 (3,4%)**
	Demand for indirect treatment	**43 904 (69,2%)**	**51 169 (58,2%)**	**61 855 (55,0%)**
Disposals – final demand	Consumption	**18 854 (29,7%)**	**33 461 (38,1%)**	**42 451 (37,7%)**
	Export	**1 839 (2,9%)**	**4 467 (5,1%)**	**7 478 (6,6%)**
	Increase in inventories	**-1 173 (-1,8%)**	**-1 454 (-1,7)**	**658 (0,6%)**
	Gross fixed capital formation	**28 (0,0%)**	**219 (0,2%)**	**83 (0,1%)**
	Final purpose total	**19 549 (30,8%)**	**36 693 (41,8%)**	**50 670 (45,0%)**

Source: development based on input-output tables from CSO.

With reference to Table 2.4, the structure of intermediate demand (Scheme 2.3) and final demand (Table 2.5) is shown. The recipient of agricultural products is primarily the food industry. In this context, the strong, competitive position of the food industry, as well as its further development, is important. A positive process is the growing share of exports of both agricultural products and food products (Ambroziak 2017).

Table 2.5. Structure of final demand in 2005 and 2010
[current prices, thousand zloty]

Final demand				
Consumption			Accumulation	
by household	by non-commercial institutions	by institutions government and local government	expenditures gross on funds permanently	increase material means rotary and assets of exceptional value
2005				
32 141 121	**7 692**	**1 311 787**	**218 393**	**-1 453 771**
2010				
40 086 738	**9 621**	**2 354 595**	**83 056**	**657 951**

Source: development based on input-output tables from CSO.

Material intensity and import absorption coefficients

The ratios of input-output flows of tables 2.6-2.7 present the ratios describing inter-industry dependencies (factors of direct and full material intensity as well as direct and full import intensity of global production in agriculture and hunting).

The coefficients of direct material consumption allow to determine: if demand for production in particular departments changes, if global production in agriculture and hunting increases by a unit. On the other hand, coefficients of full material consumption inform how the production in particular departments will change, when final production (final demand) in agriculture will increase by a unit.

Table 2.6. Material consumption ratios of domestic output in agriculture and hunting in 2010

Specification	Coefficients of direct material absorption	Coefficients full material absorption
Agriculture and hunting products	**0,182**	**1,266**
Groceries	**0,098**	**0,153**
The retail trade	**0,035**	**0,055**
Wholesale trade	**0,035**	**0,069**
Chemicals, chemical products	**0,027**	**0,039**
Coke, refined petroleum products	**0,021**	**0,035**
Electricity, gas, steam and hot water	**0,018**	**0,037**
Land and pipeline transport	**0,009**	**0,029**
Insurance services	**0,007**	**0,010**
Financial services	**0,007**	**0,015**
Veterinary services	**0,006**	**0,008**
Finished metal products	**0,004**	**0,010**
Hard coal and lignite	**0,004**	**0,011**
Machines and equipment not elsewhere classified	**0,003**	**0,005**
Articles of other non-metallic raw materials	**0,003**	**0,007**
Repair, maintenance and installation services for machines and devices	**0,003**	**0,008**
Construction and construction works	**0,003**	**0,015**
Storage; postal and courier services	**0,002**	**0,012**
Wood and wood products	**0,001**	**0,003**
Services related to real estate market services	**0,001**	**0,007**
Public administration services	**0,001**	**0,003**
Legal and accounting services	**0,001**	**0,005**
Renting and leasing	**0,001**	**0,005**
Telecommunication services	**0,001**	**0,005**
Sale of motor vehicles, vehicle repairs	**0,001**	**0,003**
Water, treatment services and water supply	**0,001**	**0,002**
Rubber and plastic products	**0,001**	**0,005**
Architectural and engineering services	**0,001**	**0,003**

Source: development based on input-output tables from CSO for 2010.

Table 2.7. Coefficients of import intensity of domestic output in agriculture and hunting in 2010

Specification	Rates of direct import intensity	Coefficients of full import intensity
Agriculture and hunting products	**0,008**	**0,014**
Chemicals, chemical products	**0,027**	**0,049**
Crude oil and natural gas, metal ores, products mining, other	**0,000**	**0,027**
Groceries	**0,008**	**0,021**
Machines and equipment not elsewhere classified	**0,006**	**0,011**
Coke, refined petroleum products	**0,006**	**0,010**
Finished metal products	**0,002**	**0,005**
Rubber and plastic products	**0,001**	**0,004**
Metals	**0,000**	**0,003**
Paper and paper products	**0,000**	**0,003**
Electric equipment and non-electrical equipment, household equipment	**0,001**	**0,003**
Hard coal and lignite	**0,001**	**0,003**
Land and pipeline transport	**0,000**	**0,002**
Vehicles, trailers and semi-trailers	**0,000**	**0,002**
Computers, electronic and optical products	**0,000**	**0,002**
Fish and other fisheries products	**0,000**	**0,002**
Products from other non-metallic raw materials	**0,000**	**0,001**
Drugs and pharmaceutical products	**0,000**	**0,001**
Software services and consulting in the field of computer science	**0,000**	**0,001**
Legal and accounting services	**0,000**	**0,001**
Other professional, scientific and technical services	**0,000**	**0,001**
Financial services	**0,000**	**0,001**
Water and air transport	**0,000**	**0,001**
Management consultancy services	**0,000**	**0,001**
Wood and wood products	**0,000**	**0,001**

Source: development based on input-output tables from CSO for 2010.

On the other hand, import intensity rates indicate how much the demand for imports will increase in particular departments, if global production in the agriculture and hunting department increases by a unit. In the case of full import intensity, it is possible to verify – how will the demand for imports in individual departments change if the final production (final demand) in the agriculture and hunting increases by a unit. Table 2.7 shows that this department is not heavily dependent on imports.

2.4. Summary

Data analysis has enabled us to capture the direction of flows between agriculture and other sectors of the economy. It is clear that the internal flow structure is changing, although it is still not close to the level in agriculture of the EU-15. Internal marketing (self-supply) in agriculture is still too much. It should be emphasized that the Polish agricultural sector is undergoing transformation. However, the high agricultural potential results in relatively low macroeconomic efficiency (meaning in the economy), as discussed in the previous chapter. Modern agriculture is characterized by strong relations with other sectors of the economy and low self-sufficiency. It is, therefore, desirable to increase the importance of services and decrease the self-supply of agriculture. However, in order to achieve this, more capital expenditures are required resulting in the implementation of the latest production technologies and, above all, improvement of labor productivity in agriculture.

3. Projection of input-output flows in agribusiness in Poland after 2020

In the modern world, the priority of food production is very often undermined before the production of other consumer goods (Tomczak 2004 after Georgescu-Roegen 1985). However, man first appeared as *homo agricola*, before he became also *homo faber*. For many centuries agriculture, as Xenophon of Athens wrote, was "the mother and nanny of all other arts". The mother, because the earliest innovations arose in agriculture. The nanny, because agriculture was and still is the guardian of all other arts for the simple reason that as long as the symbolic Robinson and Friday could not feed on what only one of them collected, no one could devote all the time to any other purpose. If agriculture would not be able to develop to a level where it could feed both those who cultivate the land and those involved in other activities, humanity would continue in a state of barbarism (Tomczak 2004, Georgescu-Roegen 1985). In this, the sense and importance of food as a primary is revealed and the first human need. The level of food of the societies has always determined their size and power. It is even believed that the fate of nations depends on nutrition. Food is an elementary common good and is subject to constant concerns and treatments of every society for its possession in the right quantity and quality, as well as its proper nutritional value (Zalewski 1989).

For centuries, food has been delivered to man directly through agriculture, since it has been isolated as a form of social production. Nowadays, food is created in a complex organism called agribusiness, which is a branch of the economy, where goods are produced to meet the nutritional needs of human beings. As the founder of this concept points out, it covers all economic activities related to the production and processing of agricultural raw materials as well as production operations carried out on farms, as well as storage, processing and distribution of agricultural commodities and products that originated from them (Davis, Goldberg 1967).

Agribusiness in a classic form consists of three areas: an industry producing means of production and services for agriculture and agro-food industry (sphere I), agriculture (sphere II) and agri-food industry (sphere III). The internal structure of agribusiness changes as a result of progressive development processes. Farming plays the most important role in the pre-industrial economy. Along with the evolution towards the industrial economy, the share of agri-food processing and trade is growing, while the highest dynamics of growth is characterized by the share of industries producing means of production and services

for agriculture and the food industry. In the postindustrial economy, the share of agriculture in the entire agribusiness is still reduced, and the agri-food industry and trade take over the leading role (compared to the previous period, the share of the supply sector is also declining) (Poczta, Mrówczyńska-Kamińska 2004). The changes in the internal structure of agribusiness are accompanied by a decrease in the share of agribusiness in the entire national economy with a simultaneous increase in the value of production realized in this sector of the economy (Mundlak 2000). As the socio-economic development of the country shrinks relatively the agri-food sector, the number of people working in it decreases and the share of this sector in the gross domestic product is decreasing, however its economic and social importance for the development of the entire national economy increases.

Agriculture and agribusiness remain an important element of the national economy, it determines its development, but also increasingly depends on what is happening outside it, in other branches of the national economy (Woś 1979, Tomczak 2006). It can be stated that the essence of the agribusiness development mechanism is revealed in changes in the proportion between the entire national economy and this subsector and between individual agribusiness units – in its internal structure (Mrówczyńska-Kamińska 2012). From the point of view of the development of agribusiness, it is important in which place we are now and what are the prospects for the future. On the basis of the theoretical regularities of development of agribusiness, it can be stated that in the near future there will be changes in the Polish agri-food sector regarding the role and importance of this subsystem in the national economy.

3.1. Methods of making projections of input-output flows changes

The main objective of the research carried out in this sub-chapter is the projection of agribusiness development in Poland after 2020 based on input--output flows. The analysis will be carried out on the basis of the analogy method (similarities) and comparisons, which allow obtaining forecast information by transferring regularity from one phenomenon to another. The work uses comparisons and analogies regarding the regularity of agribusiness development in Poland on the basis of the situation in the German agri-food sector. The German economy was selected for comparisons due to geographical proximity, similarity of climatic and soil conditions, demographic and economic potential as well as traditions of economic, social and political connections. In Germany, there is a similar structure of production and consumption of food. Due to the much higher level of economic development in Germany, this comparison can be a premise allowing to formulate conclusions regarding the direction of devel-

opment of agriculture and entire agribusiness in Poland. Due to the fact that the assessment of the size of streams of funds flowing to the agri-food sector from other branches of the national economy is subjective, it can be attempted to objectify precisely through international comparisons.

Understanding world experience plays an important role in research on the agri-food sector, its transformations and development factors. in studies on the development of this sector, attention should be paid to international analyzes and comparisons, because experience of highly developed countries can be treated as an example of pragmatic behavior in economic and social development, and the practice of these countries should be directly relevant to solving problems occurring in agribusiness in a given country (Mrówczyńska-Kamińska, 2012).

In addition, Germany has one of the most modern agribusiness structures in terms of input-output flows and the involved production potential as well as production and income results. Therefore, it can be assumed that the situation in the German agri-food sector in terms of input-output flows in agribusiness and its role and importance in the national economy indicates the potential development directions of this subsystem in Poland.

As confirmation of the meaning of comparing the situation in German agribusiness to the development directions of this subsector in Poland in Table 3.1, the indicators describing the economic situation of the Polish and German economy in the years 2000-2016 are presented. It is generally assumed that in the modern global economy a big influence on the shaping of structural changes in the economies of individual countries they have macroeconomic conditions in which a given country operates. The processes of globalization and integration are also important (Czyżewski, Grzelak 2011, Pinstrup-Andersen 2002, Sobiecki 2007).

In the analyzed years, a relatively stable macroeconomic situation was observed in the analyzed countries both in Germany and in Poland. And to a much lesser extent, the Polish economy has been affected by the effects of crisis phenomena that were initiated in the global economy in 2008. In 2000, real GDP changes in Poland amounted to 4.3% compared to the previous year, while in Germany – 2.9%. After integration to the EU, a significant GDP growth rate was observed in Poland, which in 2007 was around 7.0%. After the economic crisis of 2008, there was a slowdown, but GDP changes continued to be positive. In Germany in the analyzed period a much slower economic growth rate was observed, however, it should be remembered that GDP in absolute terms is much higher there than in Poland. The higher pace of economic growth in Poland suggests that there is a chance to catch up with the German economy, including in terms of the situation in the agri-food sector.

Table 3.1. Overall economic situation in the Polish and German economy in years 2000-2016

Specification	Changes in GDP [in %]		GDP per capita [in euro]		Inflation HICP [previous year =100]		The unemployment rate [%]		Investments [participation in GDP in %]	
	Poland	Germany	Poland	Germany	Poland	Germany	Poland	Germany	Poland	Germany
2000	4,3	2,9	6400	29000	.	.	16,1	7,9	23,74	22,99
2001	.	.	6500	29400	5,3	1,9	18,3	7,8	20,48	21,68
2002	.	.	6700	29400	1,9	1,4	20	8,6	18,44	20,04
2003	.	.	6900	29200	0,7	1	19,8	9,7	18,17	19,51
2004	5,3	1,2	7300	29600	3,6	1,8	19,1	10,4	18,33	19,16
2005	3,5	0,7	7500	29800	2,2	1,9	17,9	11,2	18,89	19,07
2006	6,2	3,7	8000	31000	1,3	1,8	13,9	10,1	20,4	19,82
2007	7	3,3	8500	32100	2,6	2,3	9,6	8,5	22,46	20,12
2008	4,2	1,1	8900	32500	4,2	2,8	7,1	7,4	23,1	20,33
2009	2,8	-5,6	9200	30800	4	0,2	8,1	7,6	21,44	19,16
2010	3,6	4,1	9400	32100	2,7	1,2	9,7	7	20,28	19,44
2011	5	3,7	9900	33300	3,9	2,5	9,7	5,8	20,68	20,27
2012	1,6	0,5	10000	33400	3,7	2,1	10,1	5,4	19,79	20,11
2013	1,4	0,5	10200	33500	0,8	1,6	10,3	5,2	18,81	19,7
2014	3,3	1,9	10500	34000	0,1	0,8	9	5	19,74	20,00
2015	3,8	1,7	10900	34300	-0,7	0,1	7,5	4,6	20,07	19,85
2016	2,9	1,9	11200	34600	-0,2	0,4	6,2	4,1	.	20,04

Źródło: own elaboration based on Eurostat.

In Poland, to some extent, the stabilization of the pace of development was the use of European Union funds, also in agriculture. Throughout the whole period before and after integration, economic growth occurred, which, according to theories of economic development, may significantly contribute to positive changes in the scope of input-output flows and internal structure of agribusiness, as well as its share in the national economy in the future. The increase in GDP per capita is the effect of positive changes in the gross domestic product. In 2000, there were around 6.5 thousand euro GDP in Poland per capita, while in 2016 it was already over 11,000 euro (in the whole analyzed period, the growth rate was 1.7). In Germany in turn, GDP per capita increased at the rate of 1.18 and in 2016 amounted to 34.6 thousand euro.

As far as the unemployment rate is concerned, a negative relationship can be observed in relation to GDP growth both in Poland and in Germany In 2000, this rate in Poland was around 16%, to reach the level of 20.0% in 2004 in the first years of integration, and then decrease to 6.2% in 2016. In the years when the effects of the 2008 crisis were felt in Europe and in the world, in Poland the unemployment rate fell to 7.0% and was equal to the German economy in this respect. Another indicator characterizing the macroeconomic situation is the in-

flation rate. In the entire analyzed period, the inflation rate in Poland fluctuated around the set inflation target, with the exception of 2008 and 2011, when this indicator exceeded 4.0%. In general, after 2007, the phenomenon of increasing inflationary pressure appeared in Poland. In the last two years, deflation has been observed in Poland, while in Germany, a very low inflation rate. As far as it goes to the share of investment in GDP in Poland in the entire period considered, this indicator is at a very similar level as in Germany, which is a positive phenomenon.

In the next stage of research, to indicate the direction of agribusiness development in Poland after 2020 in the scope of input-output flows from domestic production and import as well as creation and distribution of supply of agricultural and food industry products together with production potential, production and income results, the most important thing is to present the processes of unification of Polish and German agribusiness sector in the scope of global production and gross value added. Than the development distance between Polish and German sector will be presented as well. The results of these calculations indicate the direction of changes in the Polish agri-food sector.

In order to achieve this objective, data from Poland-Germany's inter-bank balance sheets for 1995, 2000, 2005 and 2010 were used, published by Eurostat. Gross output and gross value added of agribusiness in Poland and Germany was calculated using the formula proposed by Woś (1979):

$$X_A = x_r + x_p + \sum_{i=1}^{n} x_i b_{ir} + \sum_{i=1}^{n} x_i b_{ip}$$

where:

X_A – global production of agribusiness,
x_r – global production of agriculture,
x_p – global production of food industry,
x_i – global production of i-divisions (branches) related to agriculture
and the food industry (i + 1, 2, ..., n, $n \neq r$, p), indirectly involved in the production of food,
b_{ir}– factor determining the flow of products and services of the i-th branch (s) to agriculture, expressed as a percentage of the intermediate demand of the i-th division (branches),
b_{ir} – factor determining the flow of products and services of the i-th department (branch) to the food industry, expressed as a percentage of the intermediate demand of the i-th department (branch).

This formula allows for the determination of global production and gross value added of agribusiness on the basis of input-output tables in those sectors of the economy that indirectly participate in the production of food (sphere I).

After determining the values characterizing agribusiness in Poland (country A, delayed) and Germany (country B, model), the process of becoming similar to agribusiness structures in Poland and Germany was started. According to the procedure proposed by Kukuła (2010), this analysis was carried out in five stages:

1. In the first stage, measures of the diversity of structures (model 1) between the analyzed countries in particular periods were determined. The values obtained as a result of calculations fall within the range of [0,1], if the values are closer to 0, the structures are less diversified. Additionally, when the sequence of structural differentiation measures is a growing (or quasi-growing) sequence, the structures are moving away. In the case of a constant (quasi constant) string, a constant distance between the structures is maintained, and when the sequence is decreasing (quasi-decreasing) the approaching structures are approaching each other. This means that the structure of the β object can reach the shape of the object structure α of the last observed period.

$$d_t = \frac{\sum_{i=1}^{k} |\alpha_{it} - \beta_{it}|}{2} \qquad (t = 0, \dots, n), (i = 1, \dots, k)$$

This stage allowed to determine how the distances separating the structures characterizing agribusiness in Poland and Germany change.

2. The second stage allowed to determine the value of the average speed of structural transformations v in dynamic terms (formula 2) for characteristics describing agribusiness in both countries. This velocity is the average value of chain measures showing the degree of transformation of a given structure from period to period. The increase in the value of this measure for a delayed country (β) accelerates the similarity of structures.

$$v = \frac{\sum_{t=1}^{n} \sum_{i=1}^{k} \left| \alpha_{it} - \alpha_{i(t-1)} \right|}{2n} \; (t = 0, \dots, n), (i = 1, \dots, k)$$

3. The next step was to determine the degree of monotonicity η of structural changes (formula 3). It allowed to assess whether the evolution of agribusiness structures maintains a relatively constant direction of change (this measure takes values from the range of [0,1], where decreasing the value of η to zero indicates that the structure is increasingly chaotically evolving, its components are growing once, and sometimes they are decreasing). A higher degree of monotonicity indicates the possibility of faster structure conformation.

$$\eta_m = \frac{v_{n,0}}{\sum_{t=1}^{n} v_{t,t-1}} \ (m = n)$$

4. The fourth stage is related to the determination of the value of the disturbance factor of the structure transformations (formula 4) resulting from the non-tonicity of the changes in the structure of the conforming country. This index is the inverse of the degree of monotonicity η of the structural changes of this country. It is a measure that makes it possible to adjust the length of the time gap dividing both structures by fluctuations in the shares of individual elements of structures that diverge from the development trend. If the structures are fully monotonic, the value of the z coefficient is 1. Decreasing the monotonicity causes an increase in the value of this meter.

$$z_m = \frac{1}{\eta_{nB}}$$

5. The last stage of the proceedings consisted in calculating the time distance l (formula 5), which divides the structures of both objects. It is the approximate time (number of periods) in which the structure of the delayed object reaches the state of the structure of the reference object from the nth (last) observation period (assuming that a constant direction and a similar rate of change are maintained).

$$l = \frac{zd_n}{v_B}$$

In the next stage of the research, in order to change the direction of agribusiness development in the scope of input-output flows in Poland, the first priority was to compare the size and structure of gross output and gross value added in agribusiness in 1995 to 2010. Then, the structures and the process of their becoming similar to the situation in Poland were compared in Germany.

3.2. Level of production and gross value added

Over the period under review, the value of global agribusiness production in the Polish economy has been systematically growing and in 2010 it reached the level of nearly EUR 97 billion (Table 3.2). It was almost three times more than 15 years earlier. However, compared to the German economy, Polish agribusiness generated much lower values of global production. In Germany, in 2010, the value of all production generated in this economic subsector amounted to over EUR 276 billion and was about 2.2 times higher than in 1995. Due to such large differences in absolute values of global production, a better measure reflecting changes in agribusiness is assessment of its internal structure.

In both countries covered by the study, the agri-food industry has the greatest importance in the structure of production of global agribusiness. In Germany, the share of sphere III did not undergo significant changes and amounted to around 56% during the entire period under consideration. In Poland, however, within 15 years the share of this sphere in creating global agribusiness has increased by over 3 pp and in 2010 it amounted to almost 51%. Sector with declining share Farming is creating the global agribusiness production. In the period covered by the study in Poland, the share of sphere II decreased by over 10 pp and in 2010 it amounted to 25.8%. In Germany, this reduction was less than 5 pp, and the contribution of this agribusiness aggregate to the creation of the discussed category in 2010 was 14.5%.

A greater decline in the share of agriculture in the creation of global agribusiness production in Poland is a beneficial phenomenon because it indicates the modernization of its internal structure. This direction of transformation is also evidenced by the faster growth rate of the sphere I in Poland than in Germany. In Poland in 2010, the sphere of the first agribusiness created almost 24% (over 7 pp more than in 1995) of the total output of this subsector of the economy, and in Germany it was nearly 30% (over 5 pp more than 15 years earlier). Nevertheless, German agribusiness is characterized by a much higher degree of modernity of the internal structure, and dynamic changes indicating the intensive development of this subsector have already occurred in this economy.

The regularities regarding the development of agribusiness can also be concluded on the basis of changes in its share in the creation of global production of the entire national economy. According to the regularities of the development of societies indicated by D. Bella, along with the development of the post-industrial society, the role of traditional sectors is weakening for the benefit of the industrial sector, and then for service sector or scientific research (Kociszewski 2010). Despite the increase in the nominal value of global agribusiness production in Poland and Germany, its share in generating the global production of these economies is decreasing (Table 3.2). In Germany, this reduction over the years 1995-2010 was just 1 pp however, it resulted from the low – about 6% of the agribusiness contribution to global production. In the Polish economy, this share fell from almost 21% in 1995 to just under 14% in 2010, which indicates positive changes favoring the development of modern agribusiness.

The faster pace of changes in the structure of Polish agribusiness also shows the decreasing distance between agribusiness structures in both countries in 1995 and 2010, and nearly twice the average rate of structural transformation

of agribusiness in Poland than in Germany. (Table 3.4). This is a good sign for the processes of approaching the structures of Polish agribusiness to German. Also, the quite high degree of monotony of the discussed structures indicates that disturbances appear rarely and a constant course of changes in evolving structures is maintained. All these elements (after taking into account the structural disruption factor of 1.165) allowed to determine the time lag that divides the structure of global agribusiness production in Poland from the structure of global agribusiness production in Germany. It is about 16 years (3,273 five-year periods), which means that with unchanged tendencies of structural transformations, the structure of global agribusiness production in Poland around 2026 will reach the level of the agribusiness structure in Germany in 2010.

The revenue-generating role of agribusiness can be seen through the prism of changes in gross value added. The added value corresponds to the difference between the market value of the effects of economic activity and the expenditure incurred on their production (Marcinkowska 2012). It expresses the production capacity of the used factors of production (Cyrek 2014). The analysis of the gross value added generation structure allows for comparison of countries with different generation potential and level of development.

Throughout the period covered by the study, gross value added of agribusiness in the countries covered by the study increased, and the more dynamic growth was characteristic of the Polish economy. In 2010, gross value added generated by all agribusiness in Poland amounted to nearly 30 billion euros, and in Germany it was more than twice higher and reached around 77 billion euros. The structure of creating this value varied significantly between the countries covered by the analysis. In Poland, a large share in gross value added is agriculture – nearly 40% in 2010. It is about 14 pp less than fifteen years earlier, however, in comparison with the German economy (less than 19% of the share of the second sphere in 2010) it indicates a less modern structure of agribusiness. With similar regularities it is more than twice lower than in agribusiness in Germany, 16% share of the supply sphere in creating gross value added. Only the share of industry in the internal structure of creating the discussed value was at a similar level in 2010 in both countries, however, the direction of its changes was different during the entire period considered. In Germany, this share in the years 1995-2010 was at the level of about 45-47%, while in Poland it increased by about 12 pp up to 44% in 2010. Analysis of changes in the structure of gross value added of agribusiness indicates a high degree of modernity in the structure of German agribusiness and positive changes in Poland. This is also confirmed by the changes in the share of agribusiness in generating national income. The

contribution of agribusiness to the creation of gross value added of the entire economy in Germany was low and continued to decrease (from 4.2% in 1995 to 3.4% in 2010). In the Polish economy, agribusiness in 2010 was responsible for the creation of about 9% of the total gross value added (by 5 pp less than in 1995).

As in the case of global production, changes in the importance of agribusiness in generating national income and in its internal structure indicate positive transformations taking place in Poland. However, the gap between the gross value added structures of agribusiness in Poland and Germany is larger (Table 3.4). The speed of structural transformation of the gross value added of agribusiness in Poland is higher than in Germany, which is a factor positively affecting the period of "reaching" this structure to the state in the model country. Unfortunately, this category in the case of Polish agribusiness is characterized by a lower degree of monotonicity than is the case in Germany (0.68 vs. 0.88), which indicates the possibility of interference in the desired direction of change. After taking into account the change distortion factor for the evolving structure, it was estimated that the structure of gross value added of agribusiness in Poland will reach the state of the German agribusiness structure in 2010 in about 22 years (4.47 5-year periods), in 2032.

Table 3.2. Value (million euros) and structure (in %) of global agribusiness production in Poland and Germany and its share in the production of the global national economy (in %)

Specification		1995				2000				2005				2010			
		I	II	III	total	I	II	III	total	I	II	III	total	I	II	III	total
Poland	a	**5 644**	**12 393**	**16 259**	**34 296**	**12 362**	**17 565**	**25 192**	**55 119**	**16 019**	**20 049**	**33 157**	**69 225**	**22 892**	**24 998**	**49 029**	**96 919**
	b	**4,2**	**8,7**	**7,7**	**20,6**	**2,4**	**5,3**	**6,6**	**14,3**	**2,3**	**4,3**	**5,0**	**11,7**	**3,2**	**3,5**	**6,9**	**13,6**
	c	**16,5**	**36,1**	**47,4**	**100,0**	**22,4**	**31,9**	**45,7**	**100,0**	**23,1**	**29,0**	**47,9**	**100,0**	**23,6**	**25,8**	**50,6**	**100,0**
Germany	a	**53 532**	**41 589**	**123 060**	**218 181**	**59 628**	**44 194**	**126 525**	**230 347**	**74 355**	**44 749**	**148 755**	**267 859**	**81 694**	**40 102**	**154 605**	**276 401**
	b	**1,5**	**1,4**	**4,0**	**6,9**	**1,5**	**1,3**	**3,5**	**6,4**	**1,6**	**1,1**	**3,4**	**6,1**	**1,7**	**0,9**	**3,3**	**5,9**
	c	**24,5**	**19,1**	**56,4**	**100,0**	**25,9**	**19,2**	**54,9**	**100,0**	**27,8**	**16,7**	**55,5**	**100,0**	**29,6**	**14,5**	**55,9**	**100,0**

a - million euros
b - Participation in the production of the global national economy (%)
c - Internal structure (%)
Source: own elaboration based on balance of input-output flows.

Table 3.3. Value (million euros) and structure (in %) of gross value added of agribusiness in Poland and Germany and its share in the production of the global national economy (in %)

Specification		1995				2000				2005				2010			
		I	II	III	total	I	II	III	total	I	II	III	total	I	II	III	total
Poland	a	**1 403**	**5 177**	**3 088**	**9 668**	**3 073**	**7 685**	**5 388**	**16 146**	**4 381**	**9 032**	**6 480**	**19 893**	**4 380**	**10 684**	**11 935**	**26 999**
	b	**2,3**	**8,0**	**3,8**	**14,0**	**1,3**	**4,9**	**3,3**	**9,5**	**1,5**	**4,3**	**2,7**	**8,5**	**1,4**	**3,4**	**3,8**	**8,6**
	c	**14,5**	**53,5**	**31,9**	**100,0**	**19,0**	**47,6**	**33,4**	**100,0**	**22,0**	**45,4**	**32,6**	**100,0**	**16,2**	**39,6**	**44,2**	**100,0**
Germany	a	**16 104**	**20 355**	**32 615**	**69 074**	**19 600**	**20 786**	**33 314**	**73 700**	**24 101**	**17 044**	**33 740**	**74 885**	**26 480**	**14 360**	**35 695**	**76 535**
	b	**0,8**	**1,3**	**2,1**	**4,2**	**1,0**	**1,3**	**2,0**	**4,3**	**1,0**	**0,9**	**1,7**	**3,7**	**1,2**	**0,6**	**1,6**	**3,4**
	c	**23,3**	**29,5**	**47,2**	**100,0**	**26,6**	**28,2**	**45,2**	**100,0**	**32,2**	**22,8**	**45,1**	**100,0**	**34,6**	**18,8**	**46,6**	**100,0**

a - million euros
b - Share in gross value added of the entire national economy (%)
c - Internal structure (%)
Source: own elaboration based on balance of input-output flows.

Table 3.4. The values of measures describing the diversity and approaching of agribusiness structures in Poland and Germany

Specification	Global production	Gross value added
The distance separating the agribusiness structures of Poland and Germany in 1995	**0,171**	**0,241**
The distance separating the agribusiness structures of Poland and Germany in 2010	**0,113**	**0,208**
The average speed of structural transformation of agribusiness in Poland	**0,040**	**0,069**
The average speed of structural transformation of agribusiness in Germany	**0,021**	**0,043**
The degree of monotonicity of structural changes in agribusiness in Poland	**0,859**	**0,679**
The degree of monotonicity of structural changes in agribusiness in Germany	**0,816**	**0,877**
Disturbance coefficient of structural changes	**1,165**	**1,472**
Time gap dividing the agribusiness structures of Poland and Germany (number of five-year periods)	**3,273**	**4,467**
The approximate year in which the structure of agribusiness in Poland will reach the state of the agribusiness structure in Germany from 2010	**2026**	**2032**

Source: Szuba-Barańska (2016).

To sum up this part, it should be pointed out that the changes are taking place in Polish agribusiness, they are consistent with the theoretical regularities of development of this subsector. The share of agriculture in the creation of global agribusiness values is decreasing, and the significance of spheres I and III is increasing. The share of output and gross value added generated in agribusiness also decreases in the whole national economy. Observed changes in the share of this subsector in the national economy and in its internal structure indicate a slow process of the evolution of agribusiness structures in Poland towards highly developed German agribusiness structures. It should be emphasized that this subsector in Poland is still one of the most important parts of the economy, and its contribution to the creation of national income is quite significant.

Based on the analysis of the similarity of Polish agribusiness structures to German, it can be stated that changes in agribusiness are proceeding in the expected and desired direction. At the same time, the research results indicate a clear direction of changes in input-output flows in the Polish agri-food sector. Before the state and direction of changes will be presented in inter-industry flows in Polish agribusiness, it is worth pointing out the differences in the level of production potential between Polish and German agribusiness.

The macroeconomic situation significantly determines changes in internal structures in individual subsystems of the national economy. Presented macroeconomic conditions in Poland in the context of the situation in Germany, there is a chance that important changes will take place in Poland in this regard. Table 3.5 presents the internal structure of agribusiness and participation in the national economy in terms of labor resources, gross value of fixed assets and capital expenditures. When comparing employment in agribusiness in Poland and Germany, we note that in Poland about 3.0 million people work in food production (more than 2.0 million people in agriculture alone), while in Germany about 1.0 million less (in agriculture only 0.56 million people). Taking into account these numbers, the internal structure of labor resources in Polish agribusiness is also presented less favorably than in Germany.

In Germany, those working in agriculture constitute about 30.0% of all food production employees, in Poland almost 70.0%. Significant differences also occur in the case of other agribusiness spheres. In the first sphere of agribusiness in Poland, only 15.0% of all employees in agribusiness work (in Germany – over 30.0%), and in the food industry in Poland 16.8%, and in German almost 40.0%. Employment is one of the basic indicators determining the size of work that society is devoting to food production. The size of employment in the food economy in Poland is determined by the very high employment in agriculture and this is one of the most difficult issues concerning Polish agriculture.

The situation in Germany sets the state to be sought in this regard. However, it is very difficult to achieve a condition in Poland that is characteristic of highly developed countries. It certainly will not happen in the near future, after 2020. According to the theory of structural economic development, in order to lead to a higher level of development, it is necessary to stimulate the shifting of surplus labor from agriculture to other non-agricultural activities. It is necessary to conduct structural changes in the economy consisting in the growth of the industrial and service sector. In Poland, there are changes in this area, however, these changes are very slow. In Poland, the share of employees in agribusiness in relation to the employed in the entire national economy is over 20.0% and has practically been unchanged for over 15 years. In turn, in Germany, it is just over 5.0%.

An element accelerating the process of diminishing the share of agribusiness in total employment in the national economy may be measures directed to agriculture under the Common Agricultural Policy of the EU. However, the substitution of live labor with capital is not a dynamic phenomenon. Usually it is achieved in intergenerational cross-section. Therefore, changes in this area should not be expected immediately, but in the further future.

Table 3.5. Projection of the size and structure of internal generation potential in agribusiness in Poland after 2020 against the background of the situation in Germany

Specification	Work resources				Gross value of fixed assets				Investment expenditures			
	Poland		Germany		Poland		Germany		Poland		Germany	
	thousand of people	%	thousand of people	%	billion of euros	%	billion of euros	%	million of euros	%	million of euros	%
An industry that produces inputs and services for agriculture and the food industry	**464,2**	**14,5**	**696,2**	**31,7**	**12,5**	**21,0**	**217,7**	**39,1**	**999,0**	**21,8**	**7723,7**	**40,3**
Agriculture	**2202,1**	**68,7**	**648**	**29,5**	**30,9**	**51,7**	**230,5**	**41,4**	**1011,9**	**22,1**	**6260,0**	**32,7**
Food industry	**539,4**	**16,8**	**852**	**38,8**	**16,2**	**27,2**	**108,9**	**19,5**	**2566,0**	**56,1**	**5170,0**	**27,0**
Total agribusiness	**3205,7**	**100**	**2196,2**	**100,0**	**59,7**	**100,0**	**557,1**	**100,0**	**4576,9**	**100,0**	**19153,7**	**100,0**
Participation in national economy	**x**	**20,2**	**x**	**5,4**	**x**	**12,2**	**x**	**5,0**	**x**	**8,8**	**x**	**4,7**

Source: Mrówczyńska-Kamińska(2015).

Another factor characterizing the situation in agribusiness is the gross value of fixed assets. Capital resources are of particular importance in the interrelations of individual agribusiness aggregates in the national economy. In the Polish agribusiness, agriculture has the highest value of fixed assets, about EUR 31.0 billion, which accounts for 52.0% of the total production potential concentrated in fixed assets of the food economy. In other areas, the value of this capital is much lower. In the food industry, EUR 16.2 billion – 27.0% of the total, and in the sphere of EUR 12.5 billion (21.0%). We notice significant differences with the German food economy. Although fixed assets accumulated in agriculture also constitute the highest share in the internal structure (41.4% – 230.5 billion euros), it is by over 10 pp less than in Poland. Comparable capital is accumulated in the first sphere (EUR 217.7 billion – 39.1% of the total). The remaining 19.5% of capital is involved in the food industry.

3.3. Material supply

In Poland in the near future both the internal structure and the value of accumulated capital should change in agribusiness. In accordance with the development of agribusiness, the role and share of the supply sphere in the assets involved in food production should increase in the first stage. In the next stage, the share of the food industry will increase, at the expense of reducing the share of agriculture. It is difficult to say when exactly the changes in agribusiness rela-

tions will take place in this area. Considering the fact that the increase in the value of fixed assets in Polish agribusiness is accelerating and structure changes occurred after 2004, when Polish agriculture was covered by EU funds and assuming further financing for the development of the Polish agri-food sector by EU funds, it can be assumed that the first symptoms of changes will follow the current financing program, after 2020. However, it will be a very difficult and slow process, as the value of fixed assets in Polish agriculture is characterized by a high degree of consumption (73.7%)[19].

After Poland's integration with the EU, there were slight changes in this area (in 2004, the rate of consumption of fixed assets in agriculture was 70.0%). These results indicate that despite the increase in assets in absolute terms, the degree of consumption has not changed. Such high consumption of fixed assets in this sphere of agribusiness means that on average, farms in Poland are not very modern and are equipped with outdated assets. The technical level of agriculture and indirectly the production of food are mainly determined by obsolete agricultural machinery and equipment. In this situation, about the production technique in the production of food, the level and pace of technical equipment of labor and modernization, agriculture is also determined by non-modern production techniques. This state of affairs is characterized indirectly by technologies existing in agriculture, and also indicates the need to expand the stream of fixed assets, not only to increase production resources in agriculture, but also to fundamentally renovate them and improve the technical efficiency of individual production processes. This diagnosis shows that there is still a large need in Poland to support agriculture with aid for investments.

Agrobusiness production assets in Poland constitute 12.2% of the total production resources of fixed assets in the entire national economy, while in Germany about 5.0%. These results indicate a high share of food producing industries in the overall wealth of the national economy. It should be remembered that rapid economic growth is a condition for decreasing this share after 2020 and then there is indeed a chance to reduce the share of agribusiness in the national economy.

An important factor that should contribute to changes in the situation of fixed assets in Polish agribusiness are capital expenditures. The modernization of the productive apparatus is one of the most important factors thanks to which the development of agribusiness takes place. In Poland, in the whole period after integration with the European Union, we note a positive situation regarding

[19] Rocznik Statystyczny RP 2016, GUS, Warsaw.

the internal structure of investments in Polish agribusiness (Mrówczyńska-Kamińska 2015). In the entire post-integration period, the share of agriculture in total agribusiness investment expenditures and the value of investments in the agricultural sector increased[20]. However, from the perspective of the German economy, the value of investment outlays in Poland is much lower. Currently, around 5.0 billion euros are invested in the entire agribusiness in Poland, and in Germany almost 4 times more (around 20 billion euros). Even with a very fast pace of economic growth, there is no chance to catch up with the German economy in the near future, around 2020. For this reason, after 2020, further financial resources from the European Union are needed, which will be helpful in modernizing the Polish agri-food sector. The volume of investment outlays is an opportunity to stop further decapitalization of fixed assets in the agri-food sector in the coming years. Especially in the group of commodity farms, which determine the production and competitive situation in the food economy, there is a need to modernize fixed assets.

In this process, CAP activities supporting investment in farms were still effective and necessary. It is worth pointing out that in Poland the share of investment expenditures in agribusiness in relation to investment expenditures in the entire national economy is almost 9.0, while in Germany it is lower by half. The share of investment expenditures in the food complex on the background of the national economy gives an exponent of the modernity of the structure of the food economy.

Summing up the comparison of the situation in the Polish and German food economy in terms of production potential and taking into account the results of research on the model structure in the two economies analyzed, it can be assumed that the food economy complex is an extremely important element of the national economy. No other branch or field of material production represents a potential equal to the food economy. In the nearest future, the share of agribusiness must decline in the national economy in Poland in terms of production potential and production and income results. The internal structure of agribusiness must also change in favor of the food industry and the supplying sector. These changes are possible due to financial flows from rich to poor countries, which is important from the point of view of the creators of this theory in catching up with highly developed countries, by countries with a lower level of socio-economic development. On the basis of this, it can be assumed that there is

[20] The effect of "net" investment after Poland's accession to the EU by 2011 can be estimated at PLN 11-12 billion (Czubak 2013), which should be understood that without support from CAP measures, investments made in agriculture would have been lower by this amount.

a chance to reach the state of agribusiness in Germany after 2020. High GDP growth and further CAP funding are still needed. Only for work resources, too big differences in absolute terms between Poland and the German economy indicate that in 2020 no rapid changes in this area should be expected.

Table 3.6. Projection of the size and structure of material supply in agribusiness in Poland after 2020 (millions of euros, %) compared to the situation in Germany

Specification	Agriculture				Food industry				Total agribusiness			
	Poland		Germany		Poland		Germany		Poland		Germany	
	million of euros	%	million of euros	%	million of euros	%	million of euros	%	million of euros	%	million of euros	%
From I sphere	**6227**	**45,7**	**18656**	**76,2**	**16665**	**44,8**	**63038**	**53,6**	**22892**	**45,0**	**81694**	**57,5**
Fuel and energy industry	**1258**	**9,2**	**2384**	**9,7**	**624**	**1,6**	**5388**	**4,6**	**1882**	**3,7**	**7772**	**5,5**
Metallurgical industry	**189**	**1,3**	**370**	**1,5**	**848**	**2,3**	**1149**	**1,0**	**1037**	**2,0**	**1519**	**1,1**
Electrical machinery industry	**39**	**0,3**	**38**	**0,2**	**31**	**0,1**	**114**	**0,1**	**70**	**0,1**	**152**	**0,1**
Transport industry	**261**	**1,9**	**830**	**3,4**	**206**	**0,6**	**601**	**0,5**	**467**	**0,9**	**1431**	**1,0**
Chemical industry	**1350**	**9,9**	**2077**	**8,5**	**478**	**1,3**	**1208**	**1,0**	**1828**	**3,6**	**3285**	**2,3**
Construction materials industry	**126**	**0,9**	**386**	**1,6**	**411**	**1,1**	**749**	**0,6**	**537**	**1,1**	**1135**	**0,8**
Other industries	**57**	**0,4**	**384**	**1,6**	**1753**	**4,7**	**5588**	**4,8**	**1810**	**3,6**	**5972**	**4,2**
Services	**801**	**5,9**	**7936**	**32,4**	**4129**	**11,1**	**23329**	**19,8**	**4930**	**9,7**	**31265**	**22,0**
Trade	**1784**	**13,1**	**3044**	**12,4**	**4343**	**11,7**	**17189**	**14,6**	**6127**	**12,0**	**20233**	**14,2**
Architecture	**63**	**0,5**	**806**	**3,3**	**100**	**0,3**	**952**	**0,8**	**163**	**0,3**	**1758**	**1,2**
Transport and communication	**298**	**2,2**	**329**	**1,3**	**3297**	**8,9**	**6547**	**5,6**	**3595**	**7,1**	**6876**	**4,8**
Forestry	**-**	**0,1**	**72**	**0,3**	**-**	**0,0**	**7**	**0,0**	**-**	**-**	**79**	**0,1**
Other branches	**1**	**0,0**	**0**	**0,0**	**445**	**1,2**	**217**	**0,2**	**446**	**0,9**	**217**	**0,2**
From II sphere	**4750**	**34,9**	**2474**	**10,01**	**9972**	**26,8**	**31469**	**26,8**	**14722**	**28,9**	**33943**	**23,9**
From III sphere	**2651**	**19,5**	**3354**	**13,7**	**10596**	**28,5**	**23121**	**19,7**	**13247**	**26,0**	**26475**	**18,6**
Total	**13628**	**100,0**	**24484**	**100,0**	**37233**	**100,0**	**117628**	**100,0**	**50861**	**100,0**	**142112**	**100,0**

Source: Mrówczyńska-Kamińska A. (2015).

Taking into account the approximate year in which the structure of global production generated in agribusiness in Poland will reach the state of the agribusiness structure in Germany from 2010, it can be assumed that in Poland only after 2026, the structure of input-output flows from domestic production and imports between individual spheres in agribusiness will approach the state of Germany from 2010. Table 3.6 presents projections of the volume and structure of material supply in Poland by analogy with the German economy.

The forces that dynamise the production of the agricultural sector come primarily from the outside and are the product of industry, while the means of agricultural production constitute one of the basic factors of the start-up of the food economy. On the one hand, agriculture is making more and more raw materials available, on the other hand, it is reporting an increasing demand for

means of production of industrial origin and all kinds of services. In the process of agricultural integration with the industry, the supply covering all production means and services is becoming more and more important.

The condition for a technical breakthrough in the food economy is a well--developed industry of means of production that allows the use of global technical innovations in all phases of food production (Woś, Zegar 1989). Developed industry significantly supports and modernizes the entire agri-food sector, transforming it into a specific branch of industry and activating its development. According to Woś and Zegar (1989) in the strategy of socio-economic development, the development of industry and agriculture should be complementary. From the point of view of the development of agribusiness, input-output flows between its various spheres are very important.

When comparing the situation in Poland with the German economy, it may be assumed that in the nearest future the relation in the material (raw material) supply of the agri-food sector will change. In Poland now in agriculture, self-supply is an important item (35.0% of the total), while the remaining part of intermediate consumption goes from the first and third spheres. In Poland, currently agriculture is treated mainly as a raw material department, because agriculture continues to be an "important supplier of the means of production". As a result of economic development in the production of agricultural raw materials, the share of sectors supplying agriculture should increase in the means of production and services (sphere I), at the expense of decreasing the share of agriculture. Taking into account the results of the approximation of agribusiness structures in Poland and Germany in the aspect of global production, it can be assumed that in Poland, around 2026, the structure in the field of input-output flows will become similar. Therefore, it can be assumed that in the near future agriculture will decrease the share of internal weirs, and the significance of the first sphere in flows to agriculture will increase significantly.

According to a study conducted by Mrówczyńska-Kamińska (2015), in Poland, since 1995, the share of the first sphere in material supply of Polish agriculture has increased by about 10.0 pp and in 2010 it amounted to 46.0%. This increase occurred at the expense of decreasing the share of internal turnover. It can be assumed that the increase in these values was significantly influenced by the inclusion of the Polish agricultural sector in the funds under the Common Agricultural Policy of the European Union. The increase in incomes, caused partly by transfers to agriculture, made it possible to shift from self-supply to the purchase of industrial means of production. This indicates that in Poland, in the next financial perspective after 2020, further financial resources are needed,

necessary to increase the link between agriculture and non-agricultural branches of the national economy.

First of all, those branches that have a significant share should be mentioned in flows to German agriculture. These are mainly all kinds of services, including bookkeeping services, machine rental and equipment, veterinary, related to financial consulting, insurance and business. Including Polish farmers with EU aid will probably increase the demand for all kinds of services. Annually, German services flow to German agriculture for over EUR 8.0 billion, and in Poland it is 10 times less (EUR 800 million). In Poland, among the most important branches that supplied agriculture with means of production intended for primary production, one should also mention the fuel-energy industry, chemical industry and the transport industry, from which agriculture contributed to 90.0% of all resources that came from the first sphere of agribusiness[21]. The most important meaning within this sphere of agribusiness is the fuel and energy industry in the material supply of agriculture[22]. These results indicate modernization of the machine park in Polish agriculture and, consequently, higher energy consumption on farms[23]. Undoubtedly, the impact on the increased flow of modern machines and farm equipment have EU funds (Czubak 2013)[24].

The consumption of electricity and liquid fuels is a real measure of the level of agricultural development at the current level of technology used in this sector of the national economy. These are the main sources of energy, applicable in almost all production processes. In Germany, also the products of the fuel and energy industry constitute a significant share in the flows to agriculture. Among numerous streams of current flowing from outside to Polish and German agriculture, one should also mention products of the chemical industry (mainly fertilizers). The share of this industry in the inflow to agriculture in both Poland and Germany is at the level of 8.5-9.0%.

These results indicate that the chemical industry is in a growing position in the material supply of agriculture, and the main causative factor is that this

[21] Own calculations based on table 6.
[22] Consumption of products and services of the fuel and energy industry includes consumption of coal and other solid fuels, electricity and liquid fuels.
[23] In 1995, the energy intensity of global production in agriculture amounted to 0.06, while currently it is at the level of 0.09.
[24] The results of the implementation of CAP funds for investment support indicate the purchase of primarily machinery and equipment. Among the purchased machines, tractors dominated. In dynamic terms, the significant increase in the number of tractors occurred after the introduction of activities from EU funds – the number of tractors in 2004 was 1,365 thousand, and in 2009 1,577 thousand (Czubak 2013).

sector is covered by financial aid from the European Union. This is also confirmed by over threefold increase in absolute values since 1995 of flows from the chemical industry (Mrówczyńska-Kamińska 2015). Already in the initial period of Poland's integration with the EU, an increase in the use of fertilizers and plant protection chemicals in Polish agriculture has been observed, and in the following years there was the ability to maintain this consumption at an increasing level. The share of the first sphere in the supply of agriculture should grow, because they are the branches supplying the food production process with modern means of production and increasing social labor productivity. It is also a determinant of structural changes and the level of modernity in the entire national economy.

In the case of flows from the food industry to agriculture in Poland, the share of these turnover will probably increase in the near future, which will be mainly related to the increased stream of products from the feed and disposal industry. The supply of mixed feeds is quite specific; in fact, we are dealing here with agricultural products after industrial processing. Analyzing the sold production of the feed and utilization industry, it can be concluded that the most important among products flowing from the third sphere to agriculture is fodder.

Analyzing, in turn, the current structure of input-output flows in the Polish and German food industry, we note that the material supply of the food industry may come from agriculture (mainly raw materials), from industries producing means of production and services and from the food industry itself (in this case mainly raw materials and semi-finished products as well as products ready consumed in other branches of the food industry). In Poland, the self-supply of the food industry and inflows from agriculture constitute the most important position of the third raw material supply, while the remaining part of intermediate consumption goes from the first sphere. In the near future, the share of inflows from the first sphere (mainly all kinds of services to the food industry) should increase in Poland. This is a correct trend, which is confirmed by the situation in German agri-food processing. In Germany, there is a decline in the share of agriculture in the supply of the agri-food industry, the importance of internal turnover remained stable, while the importance of the first sphere is growing. Due to the much higher level of social and economic development of Germany and significant industrialization of the country, individual values in the German food industry are several times higher than in Poland, but since 1995 there has been a reduction in the distance between the Polish and German food industry (Mrówczyńska-Kamińska 2010).

In 1995, inflows to the Polish food industry were 7.5 times lower than to German (respectively 11.9 and 90.9 billion euros), while in 2010 they were lower only 4 times (respectively 37.0 and 118.0 billion euros). Economic development contributes to the growing importance of sectors supplying agribusiness with means of production and services. The first sphere (industries producing means of production and services for agriculture as well as agri-food processing) is the source of dynamics and the motor force of the food economy complex. Determining its importance in the production of agricultural raw materials and ready-made food products is an important issue, because they are the branches supplying the production process of agricultural raw materials and ready food with modern means of production and services, contributing to the increase of social labor productivity. It can be assumed that the increase in the importance of the first sphere in the supply of the food industry in Poland has contributed to reducing the distance between Polish agri-food processing and German in terms of labor productivity, and this has determined the agribusiness relationships with other branches of the national economy. Among the most important branches within the first sphere, which supply both Polish and German food industry with means of production and services, one should mention the fuel and energy industry, other industries, transport and communication and the services sector. Outflows from these sectors in Poland account for over 73.0%, while in Germany 83.0% of all inflows to the agri-food industry from the first sphere of agribusiness.

In Germany, an important place in the supply of agri-food processing is occupied by services, primarily related to running a business (e.g. law, accounting, technical research and analysis, advertising, etc.), auxiliary services related to financial and insurance intermediation and related services with real estate. In Poland, compared to highly developed countries, the services sector does not have such a large impact on the development of the food industry. It must be remembered that a decisive factor in the growth of output in the entire agri-foodstuffs are industries that produce means of production and services for agriculture and the food industry (sphere one).

As agribusiness develops, the means of production and services should flow to the sector in a growing, richer, more varied assortment. Due to the progressive integration process of individual agribusiness domains with the national economy, the supply covering all the means of production from particular branches of the national economy is becoming more and more important, even the starting position. This is due to the fact that every increase in production in the food economy causes interdependence. On the one hand, agriculture and

agri-food industry offers more and more raw materials and ready-made food products, on the other hand it is reporting an increasing demand for means of production of industrial origin and all kinds of services. A well-developed industry of means of production and service sphere allow for the use of global technical innovations in all phases of production of agricultural raw materials and ready-made food according to the saying: "agriculture creates industry, and the growth of industry improves agriculture" (Staszic 1790), therefore, a very significant development of the agri-food sector in a given country is a developed, modernized industry, including agri-food industry. This dependence confirms the condition of the German food economy, where high industrialization of the country and very well developed agri-food industry led to very modern agribusiness structures.

All premises indicate that in 2020 the situation in Polish agribusiness in the field of input-output flows will not reach the state of highly developed countries, therefore it seems important to further stimulate the development of agriculture, food industry and all other industries producing means of production for agriculture and food industry in order to grow input-output relationships in the economy.

The material supply of agriculture comes from domestic production and imports. Table 3.7 presents the material supply of agriculture and food industry imported from Poland against the background of the German economy. In Poland, products from imports in intermediate consumption in agricultural production account for approximately 12.0%, and in Germany 19.0%. Analyzing in detail the share of imported products in each item making up intermediate consumption in agriculture, we note that in Poland the most was imported in relation to the total consumption of products of the electromechanical industry and means of transport. The share of imports within the products of the chemical industry remains at a high level in the supply of agriculture. On the other hand, in Germany, agricultural products (internal trade) and the food industry also constitute a major share in intermediate consumption. On the other hand, in the food industry, the share of imported products in materials supply in Poland amounted to 18%, while in Germany – 23%. These results indicate that the share of imported products in intermediate consumption in the agri-food sector should increase in the near future.

Table 3.7. Projection of the volume of material supply from imports in agriculture and the food industry, share in the general supply in Poland after 2020 (million euros, %) compared to the situation in Germany

Specification	Agriculture				Food industry			
	Poland		Germany		Poland		Germany	
	million of euros	% general supply from a particular branch NE	million of euros	% general supply from a particular branch NE	million of euros	% general supply from a particular branch NE	million of euros	% general supply from a particular branch NE
From I sphere	**1179**	**19**	**3577**	**19**	**2026**	**15**	**8264**	**13**
Fuel and energy industry	**172**	**14**	**727**	**31**	**57**	**4**	**1706**	**32**
Metallurgical industry	**65**	**37**	**128**	**35**	**231**	**46**	**442**	**39**
Electrical machinery industry	**27**	**70**	**16**	**42**	**18**	**66**	**42**	**37**
Transport industry	**171**	**65**	**388**	**47**	**110**	**67**	**118**	**20**
Chemical industry	**684**	**51**	**1386**	**67**	**301**	**72**	**791**	**66**
Construction materials industry	**17**	**14**	**79**	**21**	**77**	**28**	**201**	**27**
Other industries	**29**	**52**	**203**	**53**	**520**	**39**	**1545**	**28**
Services	**10**	**1**	**646**	**16**	**321**	**14**	**3353**	**20**
others	**3**	**9**	**4**	**4**	**389**	**85**	**66**	**50**
From II sphere	**197**	**4**	**399**	**16**	**963**	**10**	**11956**	**38**
From III sphere	**197**	**7**	**624**	**19**	**2879**	**29**	**7089**	**31**
Total	**1572**	**12**	**4600**	**19**	**5869**	**18**	**27309**	**23**

Source: Mrówczyńska-Kamińska A. (2015).

On the basis of the size of material supply of agriculture from abroad, it is possible to calculate import intensity indexes (value of products used directly by agriculture and the food industry, and imported products, related to the output of this sector). In Poland, this indicator in agriculture is 0.063 and in Germany 0.115. In the food industry in Poland 0.120 and in Germany 0.177[25]. Low import intensity rates in Poland indicate a smaller import significance in stimulating agricultural development. It also means limiting the influx of progress in Poland, i.e. new technologies decisive for the modernization of agriculture. In Poland, in the first period of Poland's integration with the EU, the first symptoms of integration in the scope of the volume of inflows from imports to agriculture and the food industry, primarily from branches forming the first sphere of agribusiness,

[25] Own calculations based on data from tables 6 and 7.

were noticed. There is a chance that after 2020 there will be an acceleration in the growth of import intensity indicators in Polish agribusiness.

Material flows from the first, second and third agribusiness spheres to agriculture and the food industry together constitute intermediate consumption in these sectors. In Poland, all values in absolute terms are at a much lower level than in Germany (Mrówczyńska-Kamińska 2015). In Poland, intermediate consumption in agriculture is around EUR 50.0 billion, and in Germany it is almost three times higher than EUR 150.0 billion. It allowed for the production of approximately 74.0 billion euros in global production in Poland and approximately 200.0 billion in Germany. As a result, gross value added in Poland amounted to about 24 billion euros, and in Germany it was twice as high: 50.0 billion euros. As for the gross operating surplus, it was at a similar level both in Poland and Germany (around EUR 12.0 billion). This is caused by the much higher employment costs of hired employees in German agriculture. It can be assumed that in Poland in the near future, when gross value added will increase, employment of hired workers in agriculture will also increase, which will entail an increase in costs related to employment. Analyzing the same values in the food industry, it should be noted that individual sizes are four times higher in Germany than in Poland (Mrówczyńska-Kamińska 2015). Gross value added in Germany was also much higher than in Poland. It can be assumed that this is due to higher prices of ready-made food products on the German market than Polish ones.

In the near future, if there is a price convergence between the Polish and German agri-food sectors, one should expect a reduction in the difference between income results in the Polish agri-food sector and highly developed countries. It certainly will not happen shortly after 2020. Such changes should be expected in the long term, around 2032, when Poland in the field of gross value added structure in agribusiness will reach the state of German agribusiness from 2010.

The effectiveness can be determined on the basis of the above values individual types of expenditures and macroeconomic efficiency of individual areas of the agri-food sector. The first one can be determined using, among others product-consumption (material intensity) ratios, asset intensity, and investment intensity (Mrówczyńska-Kamińska 2015). The most commonly used is the coefficient of direct material consumption, called the technical coefficient of production. It is calculated as the ratio of goods consumed directly by the studied branch to the value of produced global production. On the other hand, macroeconomic efficiency is understood as the share of gross value added in output or

as the ratio of final demand for food products to the value of streams supplying agriculture and the food industry (efficiency of input-output relations).

Table 3.8. Projection of the coefficient of direct material consumption and import intensity in agriculture and the food industry in Poland after 2020 (euro / euro) against the background of the situation in Germany

Specification	Direct material consumption			
	Agriculture		Food industry	
	Poland	Germany	Poland	Germany
From I sphere	**0,249**	**0,465**	**0,340**	**0,408**
Fuel and energy industry	**0,050**	**0,059**	**0,013**	**0,035**
Metallurgical industry	**0,008**	**0,009**	**0,017**	**0,007**
Electrical machinery industry	**0,002**	**0,001**	**0,001**	**0,001**
Transport industry	**0,010**	**0,021**	**0,004**	**0,004**
Chemical industry	**0,054**	**0,052**	**0,010**	**0,008**
Construction materials industry	**0,005**	**0,010**	**0,008**	**0,005**
Other industries	**0,002**	**0,010**	**0,036**	**0,036**
Services	**0,032**	**0,198**	**0,084**	**0,151**
Trade	**0,071**	**0,076**	**0,089**	**0,111**
Architecture	**0,003**	**0,020**	**0,002**	**0,006**
Transport and communication	**0,012**	**0,008**	**0,067**	**0,042**
Forestry	**x**	**0,002**	**x**	**x**
Other branches	**x**	**x**	**0,009**	**0,001**
From II sphere	**0,190**	**0,062**	**0,203**	**0,204**
From III sphere	**0,106**	**0,084**	**0,216**	**0,150**
Total	**0,545**	**0,611**	**0,759**	**0,761**

Source: Mrówczyńska-Kamińska A. (2015).

In Poland, the coefficient of direct material intensity is about 0.5 in agriculture, while in Germany it is 0.6. On the other hand, in the food industry this indicator was also shaped at a similar level of 0.7. The only difference in the size of these coefficients is in the case of individual departments included in the first sphere of agribusiness and inflows from agriculture and the food industry. On the basis of all the coefficients, it can be concluded that in the long-term perspective in Poland we are recording an improvement in the efficiency of expenditure utilization in the agri-food, which should be considered a positive trend. The efficiency improvement[26] in Poland, however, occurred at a much lower scale of production in the Polish agri-food sector than in Germany. Changes in these indicators may indicate an improvement in the position of agriculture and the food industry in the light of the input-output mechanism and a more rational use of inputs from other sectors.

[26] See Mrówczyńska-Kamińska 2015.

Further stimulating the development of agribusiness will probably be a factor accelerating positive changes in Poland. The first years after 2020 seem real. Changes in these indicators point to improving the position of agriculture in the light of the mechanism of input-output flows and a smaller transfer of the effects developed in agriculture to the non-agricultural environment. Some of these positive changes were stimulated by the implementation of EU agricultural policy mechanisms. The use of EU funds increased the supply of farms with raw materials from the agricultural environment, and what was important was related with more rational use of inputs from other sectors[27].

3.4. Output allocation

Agriculture and agri-food industry meet intermediate and final demand (Table 3.9). Demand of consumers and exporters, or final demand, which is one of the most important variables that determines the development of the entire food economy, as well as conditions for effective operation of individual entities on the market (Woś 1998). No part of the economy can develop if there is no demand for goods and services it generates. Also agribusiness, if it meets the demand barrier, loses its dynamism. In turn, the demand for food depends on the economic situation. Thus, the relationship between the demand for food and the development of agriculture and agribusiness is very strong and direct (Woś 1998).

From the point of view of understanding the input-output relations and determining the dependence of agri-food processing and agriculture on the entire national economy, along with material supply, it is important to analyze the structure of creating and distributing the entire supply of agri-food industry products and agriculture. As a result, we obtain an image, what elements determine the size of supply (the creation side) and what part of the supply is allocated to meet the intermediate and final demand (distribution). In Poland, the supply of products from both agriculture and the food industry is more than four times lower in absolute terms than in Germany, which is mainly due to the much lower level of economic development in Poland and the less developed agri-food sector. On the supply side, both the Polish and German agri-food sectors have the largest share in the production of ready-made food products.

[27] For more details see (Czubak, Sadowski, Wigier 2014).

Table 3.9. Projection of creating and distributing the supply of food industry products and agriculture in Poland in 2020 against the background of the situation in Germany (current prices, million euros)

Specification			Agriculture				Food industry			
			Poland		Germany		Poland		Niemcy	
			million euros	%	million euros	%	million euros	%	million euros	%
Creation	Production of the food industry		**24999**	**89**	**40102**	**62**	**49092**	**86**	**154605**	**78**
	Import		**3170**	**11**	**24623**	**38**	**8108**	**14**	**42969**	**22**
Supply of food industry products at purchasers prices			**28169**	**100**	**64725**	**100**	**57200**	**100**	**197574**	**100**
Disposals	Intermediate consumption	Food industry	**9973**	**35**	**31469**	**49**	**10596**	**19**	**23121**	**12**
		agriculture	**4750**	**17**	**2474**	**4**	**2651**	**5**	**3354**	**2**
		other branches	**762**	**3**	**3015**	**5**	**4061**	**17**	**21326**	**11**
		together, intermediate consumption	**15485**	**55**	**36958**	**57**	**17308**	**30**	**47801**	**24**
	Final demand	Consumption	**10627**	**38**	**15979**	**25**	**30147**	**53**	**111290**	**56**
		Export	**1872**	**7**	**7475**	**12**	**9489**	**17**	**42585**	**22**
		Increase in inventories	**165**	**1**	**4363**	**7**	**255**	**0**	**-4102**	**-2**
		Gross fixed capital formation	**21**	**0**	**-50**	**0**	**,**	**X**	**210**	**x**
		Total final demand (at purchaser's prices)	**12685**	**45**	**27767**	**43**	**39892**	**70**	**147773**	**76**

Source: (Mrówczyńska-Kamińska 2015).

In recent years, there has been a decline in the share of the sector's output in supply creation both in Poland and in Germany, mainly due to the increase in imports. In Poland, however, this share is still much lower than in the German economy (in Poland it is 11-14% in agriculture and food industry respectively, in Germany 38 and 22% respectively). In the near future, an increase in the share of imported products in the supply of the agri-food sector is expected in Poland (increase in the import intensity indicator, which has already been mentioned), which will result in greater stimulation of the Polish industry by imported products. This will mean an increase in the flow of progress in the Polish food economy, new technologies that decide about the modernization of agri-food processing and the entire agribusiness.

The prepared supply of food industry products is subject to distribution. Between the distribution of the supply of products in agriculture and the food industry there are significant differences both in Poland and in Germany. The supply of agri-food industry products was mainly intended for satisfying final demand, while agriculture for intermediate demand (as a raw material for further

processing). This is a general tendency that characterizes highly developed countries, where there are differences where the raw materials of agriculture are. Self-supply is still very important in Poland, while in Germany agriculture, apart from internal turnover, is also an important supplier of raw materials for other branches of the national economy, including mainly for the food industry. Thus, it is confirmed that in Germany agriculture is typically of a raw nature, while in Poland this process is just taking place and it can be assumed that this is the direction of development of the Polish agricultural sector.

Agriculture also satisfies the final demand, but recently the proportions of individual components of final demand have changed. The share of consumption is decreasing, and the importance of exports increases. A similar situation occurs in Germany. The connection of the food industry and agriculture with the rest of the world, next to the importing intensity of the sector, can be analyzed through the prism of changes in the share of exports of food industry products in the total or final demand for food products. This allows us to assess both changes in the external competitiveness of the food industry and its position in the food economy, if we take into account analogous indicators for agriculture[28]. In Poland and Germany, since 1995, the share of exports of food industry products in the total final demand at purchasers' prices has been increasing. In the case of agricultural products, there has also been an increase[29]. The analysis of detailed data shows that in Poland exports of both agricultural raw materials and ready-made food products are growing at the same pace, while in Germany the processing of agricultural products through food processing is growing faster. This shows the greater importance of global processes for the development of the agri-food sector in Germany than in Poland. It can be expected that after 2020, these processes will accelerate.

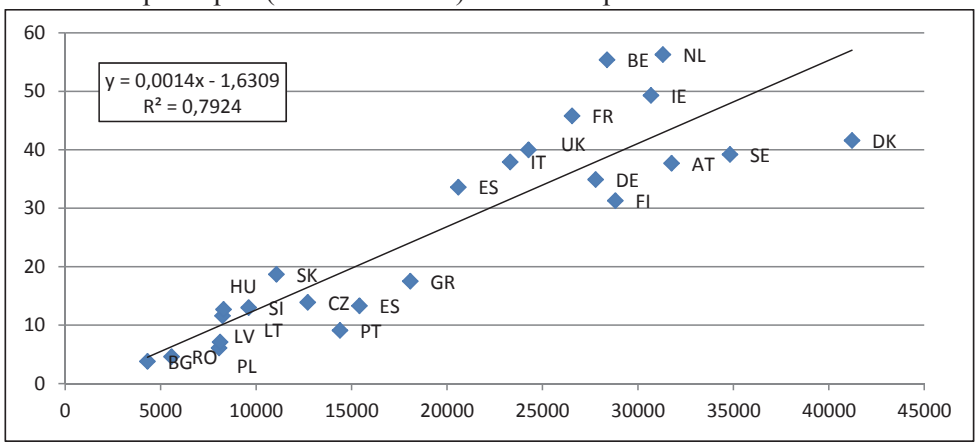
3.5. Summary

Summarizing the considerations regarding the projection of the state of agribusiness in Poland, in terms of input-output flows, the relationship between the level of labor productivity in agriculture and the entire agribusiness and the level of socio-economic development was calculated (Figures 3.1 and 3.2). These are the two most important economic indicators for the entire national economy, but also for agriculture and agribusiness. Thanks to this dependence,

[28] The point here is that, for example, reducing the share of exports in the total demand for agricultural products may be related to the increase in the degree of processing of agricultural products through food processing, which in this case should not be assessed negatively (Czyżewski, Grzelak 2009).
[29] See Mrówczyńska-Kamińska 2010 a, b.

the analyzed countries can be grouped according to economic development and the level of labor productivity in agriculture and agribusiness. The transition of agriculture from the lower stages to the higher levels determines conditions understood as development forces (external and internal).

Figure 3.1. Relationship between the level of work efficiency in agribusiness (in thousands of euros – y axis) and the Gross Domestic Product per capita (in euro – x axis) in the European Union in 2010



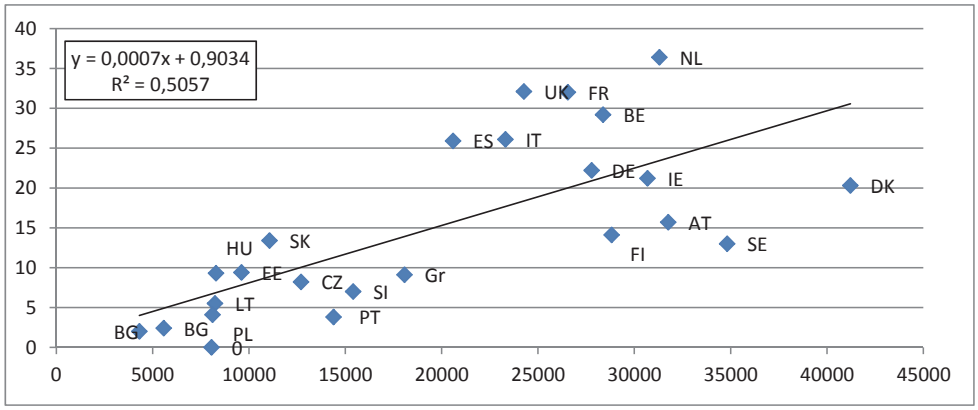
Source: Own calculations based on data from table 2 and data from the National Accounts tab, www.epp.eurostat.ec.europa.eu.

External factors include the level of economic development, the share of agriculture in total GDP, the level of food demand and the level of trade. In turn, internal factors include work productivity in agriculture (measured by gross value added per 1 employee), share of employed in agriculture in total employment, scale of production or size of farms. By choosing only some conditions, one can determine the direction and sequence of developmental regularities of farms (Tomczak 2004). From this point of view, it is the relationship between the level of labor productivity in the sector that is important to determine the path of agricultural and agribusiness development and the level of GDP per capita.

Analyzing the indicated dependence in the European Union, we can distinguish two groups of countries in which – on the one hand – the level of labor productivity in agriculture and agribusiness is low and also the level of GDP per capita is low. This group includes most of the countries that joined the EU after 2004, as well as Greece and Portugal. In line with the direction of development of world agriculture proposed by Tomczak (2004, 2006), these countries are at the beginning of the path of agricultural development and all agribusiness

(Figure 3.3). In turn, most of the EU-15 countries are at the final stage of agricultural development towards an agribusiness farm.

Figure 3.2. The relationship between the level of labor productivity in agriculture (in thousand of euros - ordinate) and the Gross Domestic Product per capita (in euro - abscissa) in the European Union in 2010

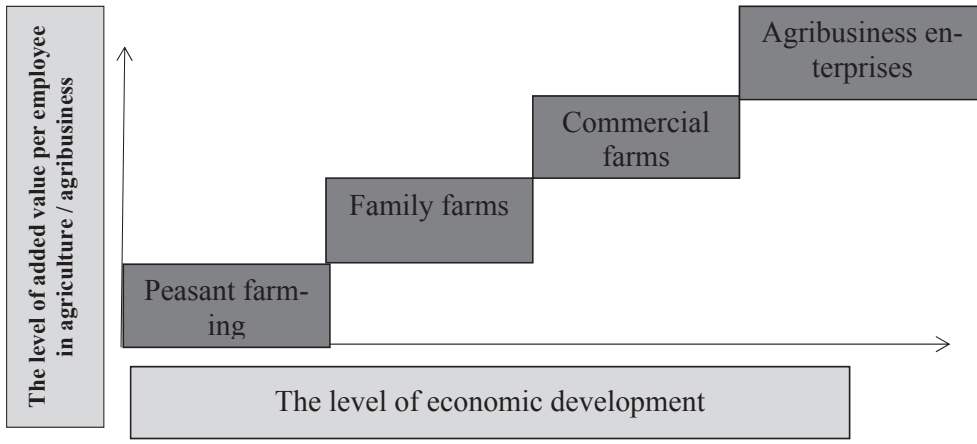


Source: Own calculations based on data from table 2 and from the National Accounts tab, www.epp.eurostat.ec.europa.eu.

These results confirm earlier analyzes that between countries with a lower level of socio-economic development and more developed countries (example of Poland and Germany presented above) there are very significant differences in the scope of agricultural development and the entire agribusiness. In the new Member States, peasant farming dominates in Poland, farmers have low incomes (AA and BB poverty zones according to Tomczak 2004, 2006), which is not conducive to the emergence of modern agribusiness. This type of agriculture occurs in countries with the lowest level of economic development, and the possibilities of transition to higher groups are associated with non-agricultural conditions. The delay of these processes is primarily due to the lower employment opportunities in non-agricultural activities, poor flow of technical progress, etc. occurring at every stage of development. One of the most important conditions for the transition to higher stages of agricultural development towards agribusiness is the need to reduce the number of people employed in agriculture and the number of farms and the constant need to achieve new relations of production potential and production and income results. This is a dependent process largely on the pace of economic development and other sectors of the national economy, which is why often the development of agriculture and the entire agribusiness is quite slow. In turn, in Western and Northern Europe (example Germany – zone DD and EE according to Tomczak 2004, 2006) is dominated by com-

modity farms fully connected with the market and agribusiness enterprises, very high level of labor productivity, low employment in agriculture as well as integration with industry and globalization of agricultural economy.

Figure 3.3. Model of global agriculture development



Source: Development based on Tomczak (2004).

It can be assumed that from the comparison of the agribusiness situation between Germany and Poland, the countries of the "old" EU-15 and the new member states show the path of agricultural development and all agribusiness for the latter. The condition for moving to higher stages of development and achieving specific goals is the higher level of economic development and the increase in efficiency. This is the path of change and constant evolution in the food production process. It is about the essence of the development process consisting of various stages, which is very important, consecutive in the right order. The level of development of the food sector plays an important role in the economic development of the country by combining production and consumption. Through the production of agriculture and the entire food sector supplies raw materials to other non-agricultural branches of the national economy, but also shapes demand from other modern sectors of the economy (input-output flows). On the consumption side, higher productivity in the agricultural sector and the entire agribusiness contributes to an increase in the income of the population, which creates a demand for industrial production. Overall, it contributes to economic growth and, as a result, to employment growth in non-agricultural sectors, which is also indicated by other research (see Dethier and Effenberger 2012). The development of agriculture and agribusiness may be the result of spontaneous economic processes, but through appropriate economic policies, these pro-

cesses may be supported. In economic policy, everything should be done to start agribusiness development processes manifested in increasing the links with the entire national economy, because this way guarantees success (Mrówczyńska-Kamińska 2015). The main goal of this road is above all the increase in efficiency for competitiveness.

From the point of view of the subject of the work, it seems very important to increase the productivity of work, which is the result and necessary condition for the development of the entire national economy and agribusiness. This is, in fact, a factor that allows the flow of excessive and unnecessary labor resources from agriculture to other branches of the economy, which affects the development of industrial production and services. The increase in labor productivity means not only an increase in the possibilities of agriculture and agribusiness to increase the supply of food to the domestic market and foreign markets, but also changes in the demand for these products. Increasing labor productivity in agriculture also contributes to the increasingly stronger process of social division of labor both in agriculture and in agribusiness, which contributes to ever higher input-output flows in agribusiness. All these issues in turn contribute to shaping the modern food sector in accordance with the agricultural development model proposed by Tomczak (2004).

Modern economics indicates that the countries of Central and Eastern Europe, including Poland, have two paths to develop agriculture and all agribusiness: either a conventional agri-food system dominated by industrial agriculture and large corporations of the food and trade industry (as in Western and Northern Europe countries), or a system based on more environmentally friendly agriculture, smaller processing companies and local markets (sustainable development). From the point of view of current problems occurring in the new EU member states (too many employees in agriculture, low agribusiness performance, agrarian fragmentation), the latter system can better fit this group of countries. However, the important problem is that the paradigm of sustainable development remains outside the mainstream of development economics, which may consolidate the backwardness of these countries (Zegar 2012). Situation in agriculture and agribusiness in the countries of Central and Eastern Europe is different than in the highly developed member states of the "old EU". In Poland and other countries that joined the EU after 2004, there is a period of leaving the agrarian society and moving towards an industrial and modern society.

There is still a long way to reach maturity in the sphere of food production. Therefore, the dilemma remains whether the new member states are to duplicate the path designated by the developed countries of Western and Northern

Europe (based primarily on the increase in labor productivity), or rather they should choose a completely different development path in the sphere of food production? Should the agribusiness structure change in favor of the industrial and service sector and should its share in the national economy decrease? Is the reduction of the share of agriculture in the agribusiness structure a natural phenomenon of the agricultural development process? What are the limits of structural change at all? It is difficult to answer all these questions unambiguously, because it is not known whether the presented way of development will lead Poland and the new member countries to the same place as today's highly developed European economies. Perhaps, according to the paradigm of sustainable development, these countries should follow a slightly different path, in which the share of the food sector in the national economy is larger than in the most developed economies of the EU and the world? However, should EU funds, which according to the neomodernization theory are to accelerate the changes, be sufficient for the less-developed countries to allow themselves to omit the developmental stages and start to implement the concept of sustainable development?

The main factor that supports the implementation of this concept is that the idea of sustainable development assumes the necessity of such development that meets the current needs, without depriving future generations of the possibility of satisfying their needs. The understanding of the development of Amartya Sen (Sen 2002)[30] can be combined with the sustainable society model, which points to the basic elements that make up a good life (like the concept of sustainable development), such as civil and political freedom, carbon emissions, quality of life, ethics in economic life, etc. According to him, society cannot be considered to be developed if all of its life needs are not met. Only the satisfaction of all needs causes that a person feels free and can fully use their potential. Whether the concept of sustainable development or the understanding of development as the freedom of Sen will be an alternative solution to neoliberal ideas for the development of agriculture and agribusiness, will probably prove to be in the future.

However, the open question remains whether the new member countries after 2020 will continue to duplicate the path designated by the developed countries of Western and Northern Europe, including Germany, based primarily on a large increase in labor productivity, or will they follow a completely different

[30] Although he was not a direct creator of the idea of sustainable development, his thoughts constitute an invaluable intellectual wealth to build the foundations of this idea (Płachciak 2010).

development path in the sphere of production food? It is difficult to answer this question unambiguously. It can only be said that both paths of development will be driven by labor productivity, while its growth rate will be definitely lower while maintaining the paradigm of sustainable development. It can be assumed that everything depends on how the CAP will be shaped after 2020. Will there be enough money in the new budget for the countries of Central and Eastern Europe, including Poland for modernization and thus increasing input-output flows between particular agribusiness domains that will stimulate labor productivity growth, or will the policy be directed at further promoting sustainable development. First of all, it depends on whether the size and structure of input-output flows in Polish agribusiness and all consequences resulting from it will change already in 2020 or changes should be expected in the long term.

4. Projection of changes in the structure of input-output flows and international experience

The previous chapter presents projections of changes in selected components of input-output tables relating to Polish agribusiness based on an analogy with the changes observed in Germany. In this chapter, the scope of observation has been widened. The basis for deciding on the direction of future changes in the structure of input-output flows concerning agriculture and agri-food processing in Poland are observations referring to the relationship between selected indicators of the level of economic development and intra-industry flows among a wide range of developing and highly developed countries. In contrast to the analysis contained in Chapter 3, this chapter focuses only on the structure of flows to and from the agricultural sector and the agri-food processing sector, not on absolute values.

The research in question would not be possible without a sufficiently wide database containing comparable input-output tables for a large number of countries and a sufficiently long time horizon. Such a database was finally completed and published in 2012. This is about the one created in the years 2009-2012 under 7. EU Framework Program WIOD (World Input-Output Database). This huge undertaking resulted in a unique database offering comparable data on input-output flows between 35 economy sections (in accordance with the ISIC Revision 4 classification[31]) in each of the 40 analyzed countries. Then, the analysis may include flows not only between individual branches within individual countries, but also flows of this kind between each branch within a given country, as well as internationally. This means that a very extensive flow network has been created, allowing for the capture of flows to and from the industry of interest in 1434 directions[32]. What is more, a uniform methodology for collecting, processing and presenting data enables the analysis to be carried out over time. The database contains results for the years 1995-2013.

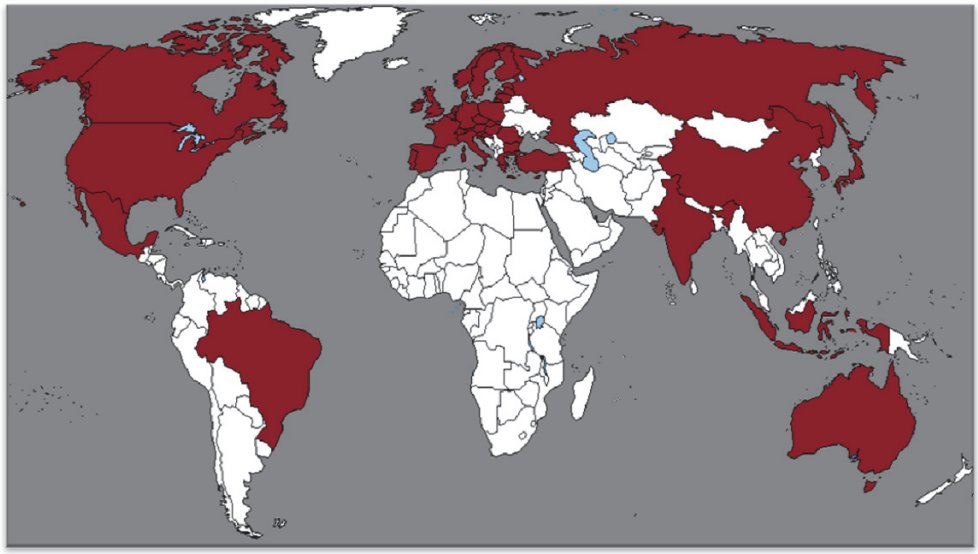
The success of the first version of the WIOD database measured, among others, by the interest of the scientific community and the number of publications presenting research results developed on the data contained in this database

[31] The ISIC abbreviation comes from the first words of the name International Standard Industrial Classification of All Economic Activities and means the unified statistical economic classification created in 2007 by the United Nations. On this classification is based on the scheme of the Polish Classification of Activities (PKD 2007). More information on ISIC Rev. 4 is available at https://unstats.un.org/unsd/cr/registry/isic-4.asp.

[32] This number is the product of 35 branches and 40 countries plus the model for the rest of the world minus 1.

was one of the most important reasons behind the creation of an updated and extended database of international input flows. In 2016, a newer version of the WIOD[33] database was released. It contains information relating to 56 branches for 43 countries and for the Rest of the World model.

Figure 4.1. Countries included in the WIOD database in 2016



Source: own elaboration based on (Timmer i inni 2016).

Among the 43 countries, the information contained in the WIOD database is 28 countries belonging to the EU, including Poland. In addition to the EU Member States, 15 major economies of the world have been distinguished[34], thanks to which the sum of GDP values of all 43 countries exceeds 85% of global GDP for each of the analyzed years. The geographical distribution of countries included in the WIOD database is shown in Figure 4.1.

[33] More information about the methodology of collecting and processing data and creating the database itself in [Timmer, Los, Stehrer, de Vries 2015; Dietzenbacher, Los, Stehrer, Timmer, de Vries 2013].

[34] The fifteen of these countries include: Australia, Brazil, China, India, Indonesia, Japan, South Korea, Canada, Mexico, Norway, Russia, Switzerland, Taiwan, Turkey and the USA.

Table 4.1. The structure of aggregate groups used in the analyzes conducted in Chapter 4

Aggregate group	Branch symbol	Branch name	Branch symbol	Branch name	Branch symbol	Branch name
Agriculture	A01	Agriculture				
Mining	A02	Forestry	A03	Fishing	B	Mining
Food industry	C10-C12	Food industry				
Clothing, paper	C13-C15	Clothing production	C16	Manufacture of wood products, cork, straw	C17	Paper production
	C18	Printing				
Energy resources	C19	Coke and refined petroleum products				
Fertilizers, chemicals	C20	Production of chemicals	C21	Production of pharmaceutical products		
Metals, electrics	C22	Manufacture of rubber and plastic products	C23	Production of other non-metallic mineral products	C24	Metal production
	C25	Manufacture of metal finished products without machinery and equipment	C26	Production of computers and electronic products	C27	Manufacture of electrical equipment
Machines, cars	C28	Other production of machinery and equipment	C29	Production of motor vehicles	C30	Production of other transport equipment
	C31-C32	Manufacture of furniture and other products	C33	Repair of machines and devices		
Energy, water	D35	Production and supply of electricity, gas, hot water	E36	Collection and delivery of water		
Architecture	F	Architecture				
Trade and car repair	G45	Trade and repair of motor vehicles				
Wholesale	G46	Wholesale trade outside of vehicles				
Detail	G47	Retail outside of vehicles				
Transport	H	Transport and storage	J	Information and communication		
Hotels	I	Accommodation and catering services				
Finances	K	Financial and insurance activities				
Services	L68	Real estate market service	M69-M70	Legal and accounting and accounting services	M71	Architecture and engineering, research and technical analysis
	M72	Research	M73	Advertising services and market research		
Veterinary	M74-M75	Veterinary and other services				
Rent	N	Administrative and support services activities				
Other	O84	Public administration and compulsory insurance	P85	Education	Q	Health care and social assistance
	R-S	Culture, entertainment and other services	T	Services within households	U	Extra-territorial organizations and teams

Source: own elaboration.

From the point of view of the considerations in the work, it is also important to locate the agricultural sector and the food industry in the branch structure separated in the WIOD database. Table 4.1 lists all the specified branches, as well as the method of aggregation of 56 branches to 20 groups. It should be noted that some aggregates include a large number of individual branches, as is the case for the aggregate group "Metals, electrics" or "Services". At the same time, single branches such as "Construction", "Wholesale trade" or "Retail trade" were also analyzed. The method of aggregation depended on the importance of individual branches in the structure of flows to and from agribusiness, whereby observations referring to the global scale, not only those from the Polish market were directed here. The branch of "Agriculture" and "Food industry" are of course the most important for the analyzes conducted in this chapter. In both cases no additional aggregations were made.

As already mentioned, the essence of the conducted analysis is to capture the relationship between the structure of the analyzed input-output flows and selected indicators of the level of economic development. Identifying this type of relationship will allow us to develop projections regarding future changes in the structure of branch flows, assuming that the Polish economy will develop in the coming years. It should be emphasized that only the direction of the relationship was determined. Due to the complexity of economic processes shaping the structure of branch flows and determining the diversity of these flows between individual countries, no attempt was made to determine the exact impact of economic development on the share of individual components in the structure of input-output flows. The focus was only on determining the sign with the coefficient in the estimated model, so as to determine whether economic development is associated with an increase or decrease in the importance of the analyzed type of flow. Operating on a hypothetical example of flows from the "Food Industry" to the group "Hotels", it was determined only if the increase in a given measure of economic development will cause an increase or decrease in the percentage share of this type of flow in the total distribution of the supply of "Food Industry".

An extremely important element of the research was the selection of appropriate measures of economic development. From among a number of available indicators, in the initial phase, six measures of economic development were chosen, such as: GDP per capita (in thousand of US dollars); value added per employee in agriculture (in dollars at constant prices in 2011); wheat yield (in kg per hectare); life expectancy (in years); share of employed persons in agriculture in total employment (in %); share of agricultural land in the area of the country (in %). The values of the first four measures increase with the progress

of economic development, while the last two – decrease. That is also how their values have progressed in recent decades in Poland. In the course of further analyzes, however, only two of them were used: GDP per capita and share of employees in agriculture. These measures created the strongest links with the variables analyzed, and moreover, they seem to best correspond in terms of content to what can be understood as a measure of economic development, and what can have a real impact on the change in the structure of input-output flows related to the food industry and agriculture in the first place.

The data from the WIOD database input-output tables were used for the analysis. For each country, the structure of flows directed to the Agriculture and Food Industry sectors was calculated by summing up all domestic and international flows. The same was done for the supply of these sectors. The calculations were carried out for each year from the period 2000-2014.

In the first step, the relationship between selected measures of economic development and the share of selected, major flows to or from agriculture or food industry for 2000 and 2014 was analyzed. In the case when there was a significant relationship between the share of such a flow and the selected metrics for state-level data, perform an estimation of the panel model that would confirm a positive or negative dependence for the entire analyzed period.

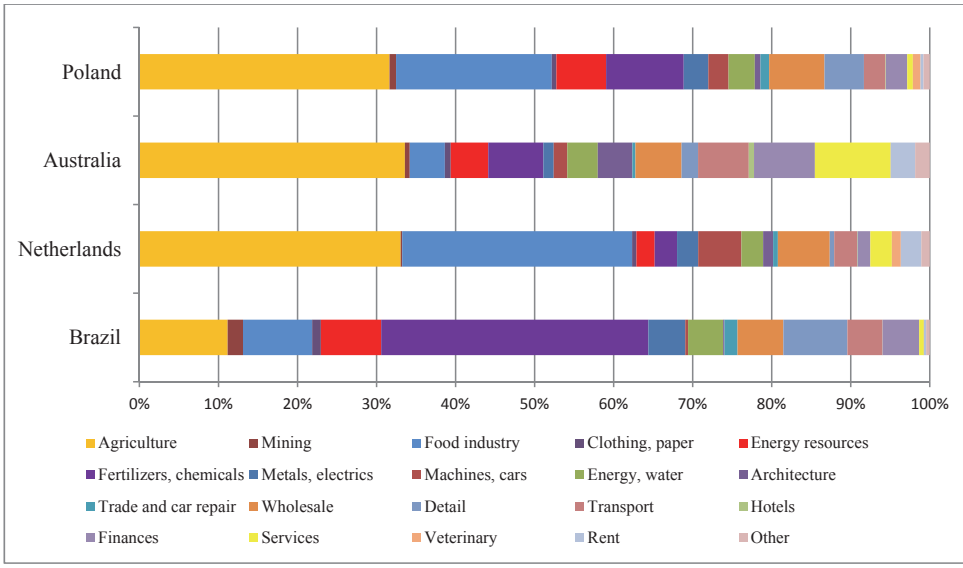
Three statistical tests were carried out to determine the appropriate model structure. The first of them is test F (Chow). Its purpose is to verify the hypothesis about the irrelevance of group effects. In the absence of rejection of the null hypothesis, it should be considered that there is no basis for using a panel model. As a complement to the F test, the Breucas-Pagan test is based on the Lagrange multiplier – designated in the tables as the B-P test – as part of which the hypothesis about the immateriality of group effects is also verified. The last test is carried out in order to select the right type of panel model. This is the Hausman test – indicated in the tables as the H test. Rejection of the null hypothesis in this test suggests that a model with predefined effects is more effective. There are no grounds to reject the null hypothesis means the recognition that the more appropriate model is the one with random effects.

The presentation of the research results was divided into four parts. The first one refers to flows directed to the agricultural sector. The next section presents the results of research relating to the structure of flows to the food industry. Next, the issue of distributing production generated in the agricultural sector will be taken up, and finally the structure of distributing production of the Food Industry.

4.1. Material supply of agriculture

Structure of flows of goods and services addressed to the agricultural sector is very complex one. The material supply of the agricultural sector refers to a wide variety of goods and services. The machinery used for agricultural production, energy, means of production are the result of the activity of units operating in virtually all branches of the national economy. In Chart 4.1. presents an example structure of material supply of agriculture in 2014 in four selected countries of the world.

Chart 4.1. Branch structure of agricultural sector supply in Australia, Brazil, the Netherlands and Poland in 2014



Źródło: own elaboration based on WIOD.

As one can see, the differences between countries can be significant. For example, the most important in terms of value source of flows directed to agriculture in Brazil are those originating from the chemical industry (including fertilizers, plant protection chemicals), while flows inside the agricultural sector or from the construction sector are relatively small. In turn, in the case of Dutch agriculture, the advantage of flows of goods and services originating from the agri-food processing sector (including fodder) and sectors from the "Machines and cars" group is noted. In Australian conditions, flows from the services sector play a very important role compared to other countries. It concerns both financial and insurance services (the "Finance" group), as well and law, accounting, engineering, etc. (the "Services" group).

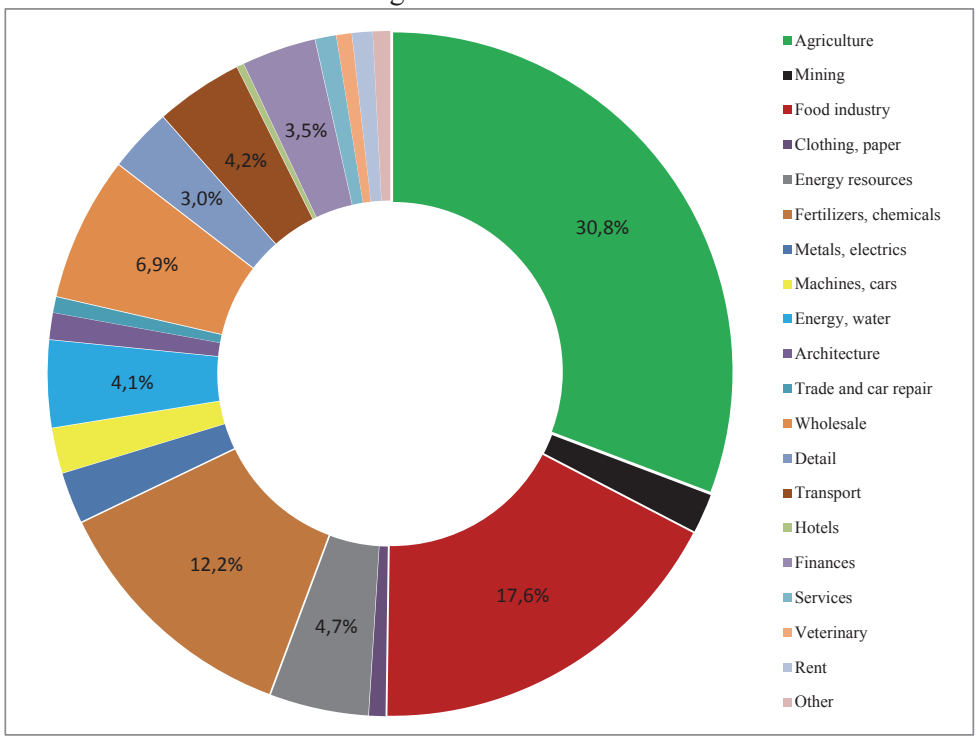
The structure of material supply of Polish agriculture is closest to that being the global average. This means that the largest value share in the structure of flows to the agricultural sector, there is self-supply and flows from the agri-food processing sector. The goods provided by the chemical industry, energy services rendered by entities dealing in wholesale trade, transport and finances, including insurance, also play a significant role. The branch structure of flows directed to the agricultural sector in global terms in 2014 is shown in Figure 4.2. It should be noted that only for nine of the twenty separate groups of the economy branches share in the total material supply of agriculture exceeds 3%. Share of the five most important groups, namely agriculture (30.8%), food industry (17.6%), fertilizers and chemicals (12.2%), wholesale (6.9%) and energy raw materials (4.7%), exceeds 72% in total. In the case of Polish agriculture, the share of flows from these five groups in 2014 amounted to 74.5%. In the years 2000-2014, the lowest share of these five groups in the branch structure of the supply of the Polish agricultural sector, it referred to 2003, when it amounted to 65.2% and 2006 (65.3%)[35].

This structure of material supply of the agricultural sector means that in the further part of the work only the most important components were analyzed. In particular, attention was paid to the relationship between the aforementioned measures of economic development and self-supply and flows to agriculture from the food, chemical or energy industry.

As mentioned in the methodological part of this chapter, in the first stage, the differences in the share of selected components of material supply of agriculture between particular countries were analyzed in the first (2000) and last (2014) year of the analysis year. So this is a static analysis.

[35] In 2011, this share was the highest and amounted to 75.1%.

Chart 4.2. Branch structure of material supply of the agricultural sector on global scale in 2014

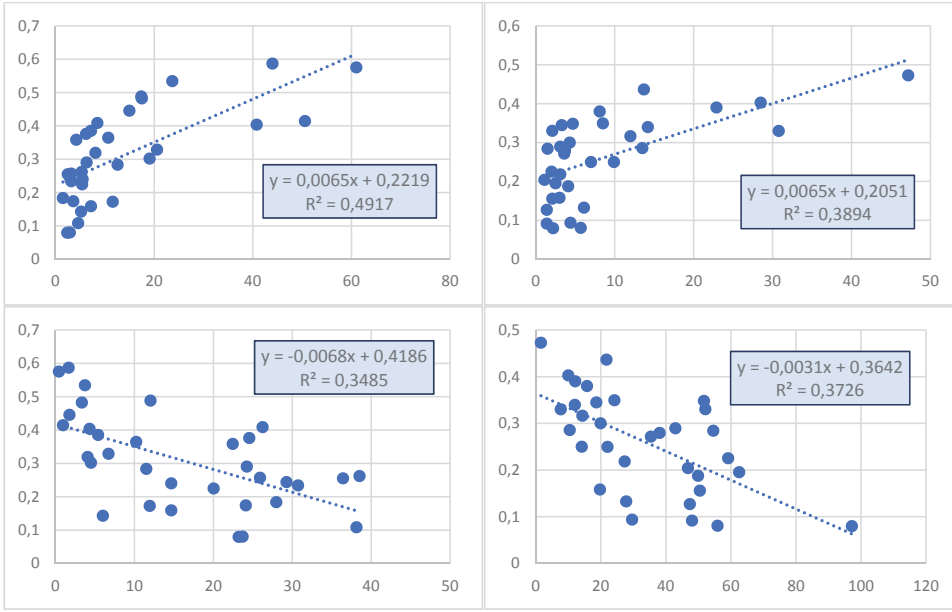


Source: own elaboration based on the database WIOD.

In the first step, an analysis was carried out referring to the most important component of the flows of products and services to agriculture, self-supply. In the course of the conducted research, it was observed that there are two clear relationships between the level of self-supply participation in the total flows to agriculture in the analyzed countries, and the indicators of economic development adopted for these countries in the work. The first one refers to the share of employed in agriculture in general employed, while the second one – up to GDP.

Both graphs are shown in Figure 4.3. The upper graphs refer to the dependence on employment in agriculture, while the lower ones refer to the relation with the size of GDP. Each point on the graph corresponds to one country. It can be observed that both in 2000 (both left graphs) and in 2014 (both right graphs), the greater the share of people working in agriculture in a given country, the higher was the share of self-supply in general flows to agriculture. Similarly, there is a negative dependence between the GDP per capita in a given country and the share of self-supply.

Chart 4.3. Relations between the share of self-supply in agriculture in total supply [in % - y axis] and the share of employed in agriculture [in % - x axis for upper charts] and the level of GDP per capita [in thousand USD – x axis for lower charts] in 2000 (left graphs) and 2014 (right graphs)



Source: own elaboration based on the database WIOD.

On the basis of a graphical analysis on the data from 2000 and 2014, it was also possible to have a dynamic relationship. To confirm these suspicions, a panel analysis was performed for the analyzed variables. Its results confirm the existence of a positive relationship between the share of self-supply in general flows directed to the agricultural sector in a given country and the share of people employed in agriculture, as well as the negative dependence in the case of GDP per capita for a given country. In the first step, based on the tests chapter described in the introduction, it was proved that the panel model is appropriate for describing this type of dependence. In the case of relations with persons employed in agriculture, it was shown that the optimal model is the one with random effects, while for the relationship with the level of GDP per capita – with determined effects.

Relations determined on the basis of panel models confirm the observations derived from the analysis of static relations. The results of the estimation are presented in Table 4.2. On the basis of the results, it can be predicted that with the increase of per capita GDP and the drop in the share of employees in agriculture, the share of self-supply in the total flows to agriculture will be re-

duced. The number of stars after the value of the explanatory factor coefficient means the degree of significance. Three stars means a statistically significant variable with a significance level of 0.01. Two stars are the significance level of 0.05, and one star is the level of 0.1. The same designations were also used in other tables of this type.

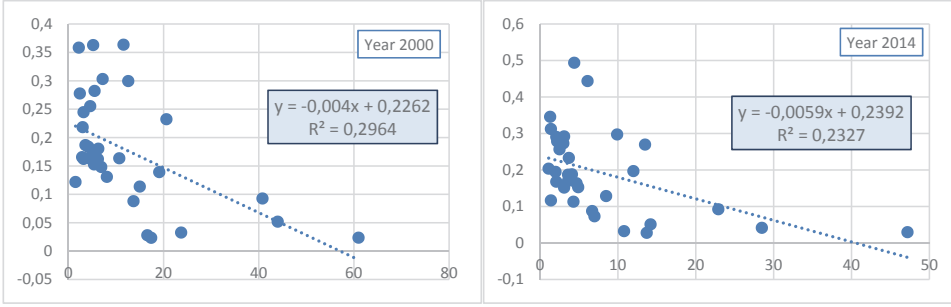
Table 4.2. Analysis results for relation between the share of self-supply in total supply and the analyzed indicators

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **GDP *per capita***	0,000	0,000	0,002	**-0,002 *****
Relation with: **Share of employed in agriculture**	0,000	0,000	0,931	**0,007 *****

Source: own elaboration based on the database WIOD.

Another observation concerns the level of share of flows from the food industry. On the basis of a comparison of the level of these flows and indicators of economic development for the analyzed countries in 2000 and 2014, it was noticed that there is a negative relationship between the share of flows from the food industry to agriculture and the percentage of employed in agriculture. Observed relations, which are graphically presented in Chart 4.4. they are not particularly clear and it is necessary to confirm their occurrence on the basis of a panel model.

Chart 4.4. Relations between the share of flows Food Industry → Agriculture in total material supply of agriculture [in % – y axis] and the share of agricultural employment [in % – x axis] in 2000 and 2014



Source: own elaboration based on WIOD.

The panel model, the key data of which is presented in table 4.3, confirmed the existence of a negative relationship between the growth in the share of employees in agriculture and the increase of flows from the food industry to agriculture. This means that along with economic development, flows from the food industry sector to agriculture are increasing.

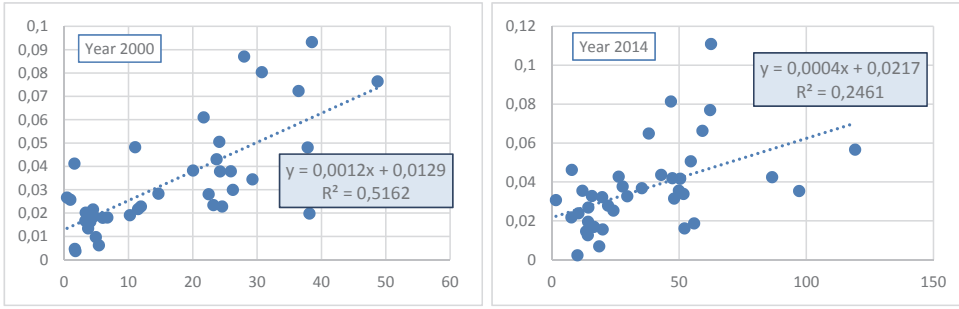
Table 4.3. Analysis of results for relation between the share of flows from Food Industry to Agriculture in total material supply and the share of agricultural employment

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **Share of employed in agriculture**	0,000	0,000	0,169	**-0,001** ***

Source: own elaboration based on WIOD.

From among a number of analyzed components of flows to the agricultural sector, only some showed a relation with the analyzed indicators of economic growth. Such components include, among others, cash flows of financial and insurance services. The static analysis for the first and last year of the analysis indicated the existence of a positive relationship between the share of flows from the financial sector and the level of GDP per capita, which is shown in Chart 4.5.

Chart 4.5. Relations between the share of flows Finances → Agriculture in total material supply of agriculture [in % – y axis] and the value of GDP per capita [in thousand USD % – x axis] in 2000 and 2014



Source: own elaboration based on WIOD.

Also the panel analysis indicated the existence of a positive relationship between economic growth in a given country and the increase in the significance of the value of services provided by financial and insurance institutions in general, the supply of the agriculture sector, as shown in Table 4.4.

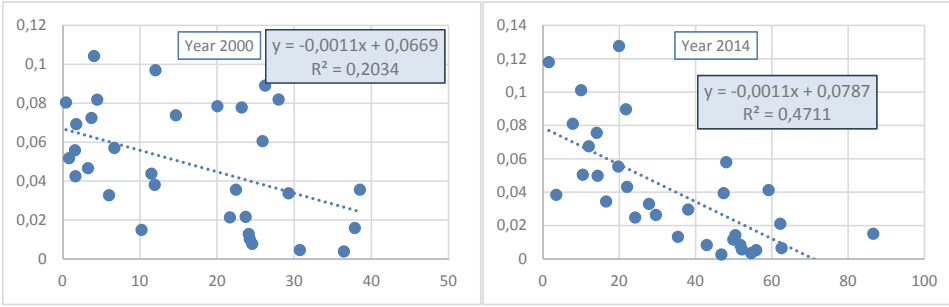
Table 4.4. Analysis results for relation between the share of flows Finances → Agriculture in total material supply of agriculture and the value of GDP per capita

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **GDP per capita**	0,000	0,000	0,000	**0,001** ***

Source: own elaboration based on WIOD.

There was also a negative relation between economic growth and the share of services provided by retail trade in the total value of flows directed to the agricultural sector. In the case of 2000 and 2014, the ratio for the countries studied was as shown in Chart 4.6.

Chart 4.6. Relations between the share of flows Retail → Agriculture in total material supply of agriculture [in % – y axis] and the value of GDP per capita [in thousand USD % – x axis] in 2000 and 2014



Source: own elaboration based on WIOD.

The results of the panel estimation presented in Table 4.5 confirm the existence of a negative relationship between the level of GDP per capita and the share of flows from retail to agriculture in general flows. This means that agricultural producers are less and less used with economic development from the services of retail units. Such a result suggests the existence of an inverse relationship for flows from the wholesale trade. However, this type of relationship could not be proven using the panel model for the relevant data.

Table 4.5. Analysis results for relation between the share of flows Retail → Agriculture in total material supply of agriculture and the value of GDP per capita

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **GDP per capita**	0,000	0,000	0,002	**-0,002 ***

Source: own elaboration based on WIOD.

Summarizing the results of research on the relationship between the structure of flows directed to the agricultural sector and economic development indicators, it should be noted that four such relationships have been proven. The total dependence of changes in the share of flows to agriculture from particular branches or groups of branches is presented in Table 4.6.

Table 4.6. The relationship between economic growth and share of flows to agriculture from selected branches

Used indicator	Participation in the entire material supply	Relation with economic growth
GDP per capita Share of employees in agriculture	Flows from Agriculture	Negative
Share of employees in agriculture	Flows from Food Industry	Positive
GDP per capita	Flows from Finances	Positive
GDP per capita	Flows from Retail	Negative

Source: own elaboration based on WIOD.

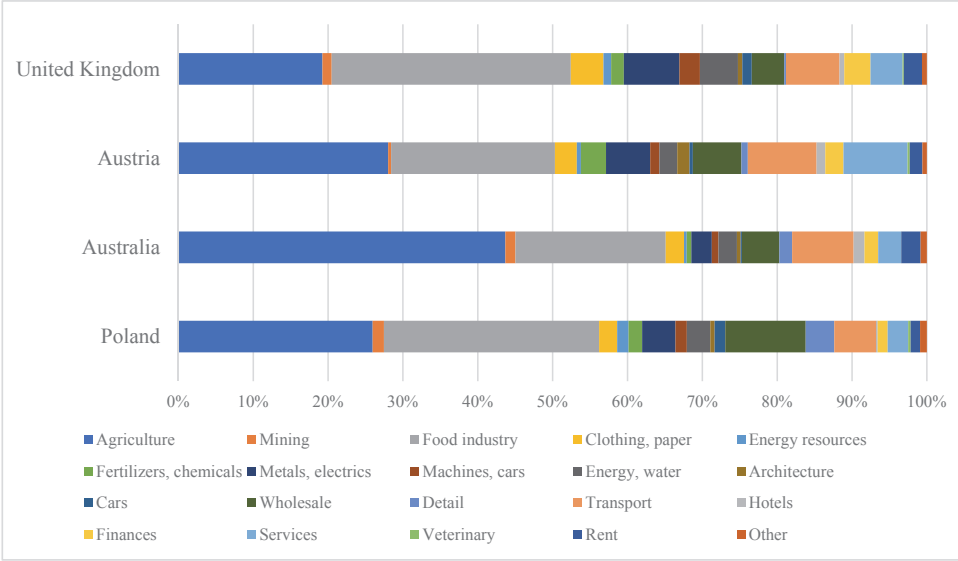
First of all, it was observed that with the economic growth – measured by the value of GDP per capita and the share of employees in agriculture – the share of self-supply in general flows towards the agricultural sector is falling. Economic development also makes a larger share the food sector is in the supply of agriculture. Probably this is due to the growing specialization of production. Holdings focusing on the production of a narrow group of products must make greater use of inputs purchased on the market. This applies in particular to livestock production.

What is more, it has been proved that with the development of the economy we are dealing with an increase in the share of financial and insurance services and a decrease in the share of services offered by retail trade in general flows directed to the agricultural sector. In the case of an increase in the share of the value of financial services, the increase in demand for agricultural insurance may play a significant role.

4.2. Material supply of food industry

The provision of the food sector is characterized, naturally, by a different structure from that which determined flows to the agricultural sector. Chart 4.7 presents the structure of flows of goods and services addressed to four selected countries. These countries were selected in terms of showing some similarities on the one hand, and differences between individual countries on the other.

Chart 4.7. Branch structure of material supply of food industry in the UK, Austria, Australia and Poland in 2014



Source: own elaboration based on WIOD.

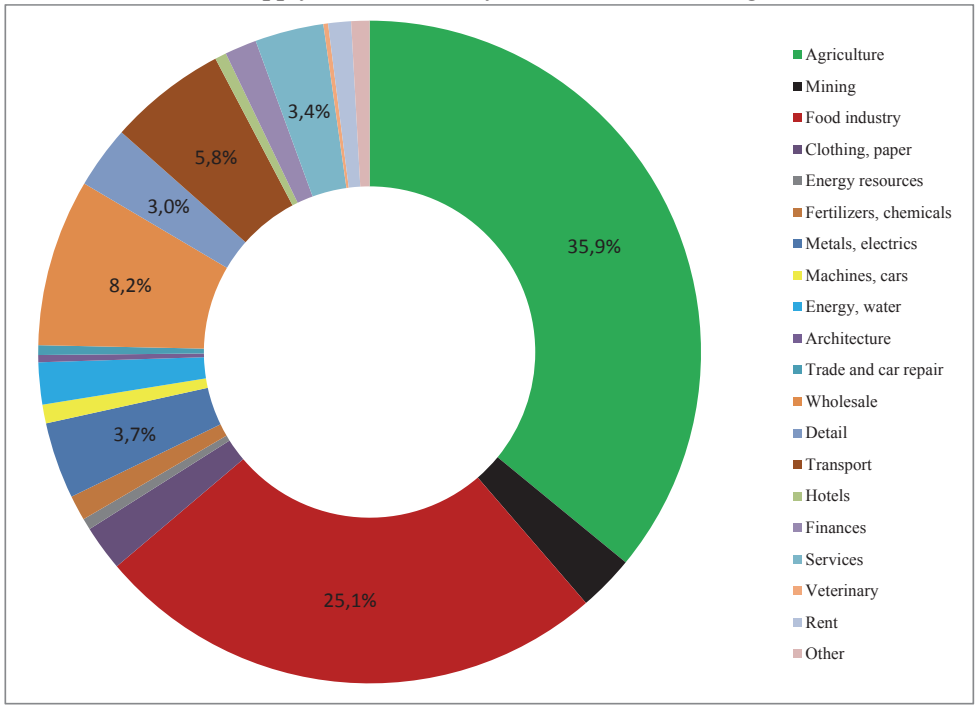
The sectors of agriculture and the food sector itself are included in the two sectors, from which the flows with the greatest share in the supply of the entire food sector are directed. Only in the case of several countries included in the WIOD database (including Luxembourg, Malta, Croatia), this share in 2014 was lower than 45%. In most cases, it ranged from 45 to 60%. The highest was for the Dutch food industry (70.2%). It is worth adding that in the aspect of the dominant role of agricultural flows and the food sector, 2014 was not exceptional.

Among the other branches of the economy, the most important - in the context of food industry supplies - includes wholesale trade, transport and services. Considering the supply structure of the food industry in the four countries highlighted in the chart, it is worth noting the low share of flows from the agricultural sector and the high share of food industry flows → the food industry, as well as the high share of the value of financial services flow in the case of the Great Britain. Austria, in turn, is characterized by a high share of transport services and those included in the scope of the aggregate Services in general supply of the food sector. In contrast, the Australian food industry is characterized by a high share of raw material flows from the agricultural sector.

The situation related to the Polish food sector to the largest extent corresponds to the global average referring to the material supply of the food industry. The detailed structure of this supply for 2014 is presented in Chart 4.8. We

can observe here the key importance of raw material flows from agriculture (35.9%) and processed goods from the food industry (25.1%). The services provided by wholesale and retail trade (in total 11.2%) play a significant role in the dominant role of the wholesale. Transport is responsible for 5.8% of all flows directed to the food industry. The next in order of importance flows are the result of goods and services offered by the following groups of branches: Metals, electrics – 3.7%; Services – 3.4%; Mining – 2.7%; Clothing, paper – 2.2%; Energy, water – 2%. Flows from the point of view of the share of the sectors of the economy in the entire material supply of the food sector are the subject of the analysis conducted later in the chapter.

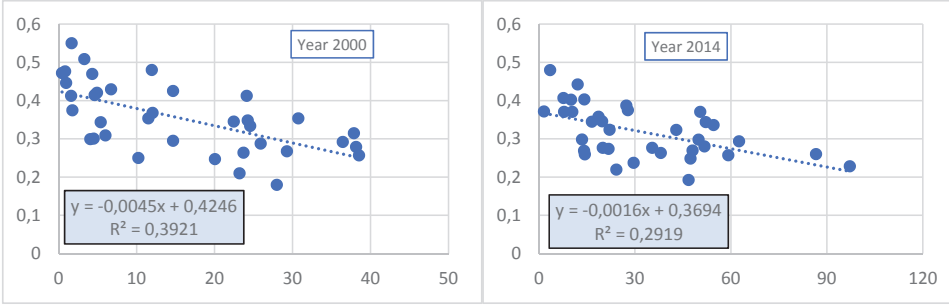
Chart 4.8. Material supply of food industry branch structure on a global scale in 2014



Source: own elaboration based on WIOD.

The analysis of the diversification of the share of flows from agriculture to the food industry sector showed that in the static approach for 2000 and 2014 there is a clear relationship between this share and the level of GDP per capita for a given country. This is shown in Chart 4.9.

Chart 4.9. Relations between the share of flows from Agriculture to Food Industry in total material supply of Food Industry [in % – y axis] and the value of GDP per capita [in thousand USD % – x axis] in 2000 and 2014



Source: own elaboration based on WIOD.

It is clear that in more developed economies, where the value of GDP per capita is a measure, the share of flows from agriculture to the food industry is generally lower. In the case of countries with lower GDP per capita, the share of flows from agriculture was on average around 45% in 2000 and around 40% in 2014. In order to investigate whether one could talk about a negative relation taking into account dynamic analysis, the panel model was estimated.

Table 4.7. Analysis results for relation between the share of flows from Agriculture to Food Industry in total material supply of Food Industry and the value of GDP per capita

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **GDP per capita**	0,000	0,000	0,028	**-0,001 *****

Source: own elaboration based on WIOD.

The most important results of the panel analysis are presented in Table 4.7. What is particularly important is the negative value of the explanatory factor ratio. This means that there is a negative relationship between economic growth and the decline in the share of agricultural flows in general flows to the food industry sector.

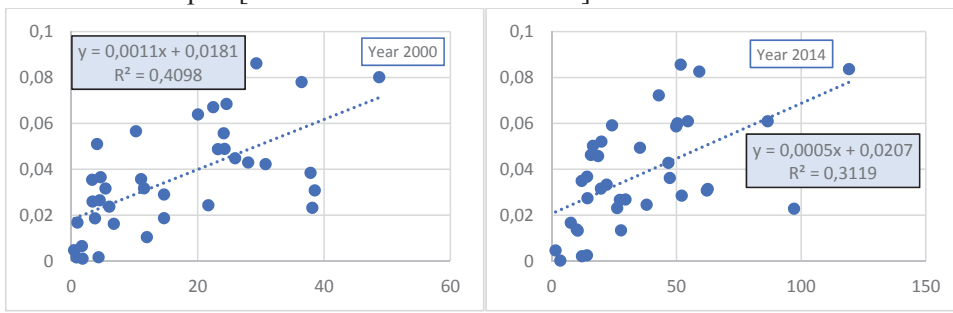
As mentioned before, the second most important type of flows were those directed from the food industry itself. However, unlike in the case of agricultural flows, no clear relationship was found with any of the analyzed measures of economic growth.

For this reason, it should be recognized that economic growth is not a significant variable conditioning changes in the importance of this type of flows in the material supply structure of the food industry sector. And the size of these flows in a given country is influenced by other variables not analyzed in this

study. Similarly, it was not possible to detect dependencies in the case of the share of flows from the Metals, electrics group. Despite some promising results based on static analysis, in the case of the flow of services provided by wholesale and retail trade, based on a panel analysis, it was not found that the change in the share of this type of flows may depend on the analyzed measures of economic growth.

Data analysis, on the other hand, allowed to capture dependencies relating to the share of flows from a group of branches collectively called Services. Flows recorded from this group include legal, accounting, marketing or research services. It was noted that the share of such flows in the total supply of the food sector is higher for those countries characterized by a higher level of GDP per capita, which is graphically presented in Chart 4.10.

Chart 4.10. Relations between the share of flows Services → Food Industry in total material supply of Food Industry [in % – y axis] and the value of GDP per capita [in thousand USD % – x axis] in 2000 and 2014



Source: own elaboration based on WIOD.

Panel analysis, the most important results of which are presented in Table 4.8, confirmed the existence of a positive relationship between the level of GDP per capita and the share of services flows → Food Industry. This means that with the economic growth one should expect an increase in the share of legal services, accounting, advertising and scientific research in the material supply of the Food Industry in general.

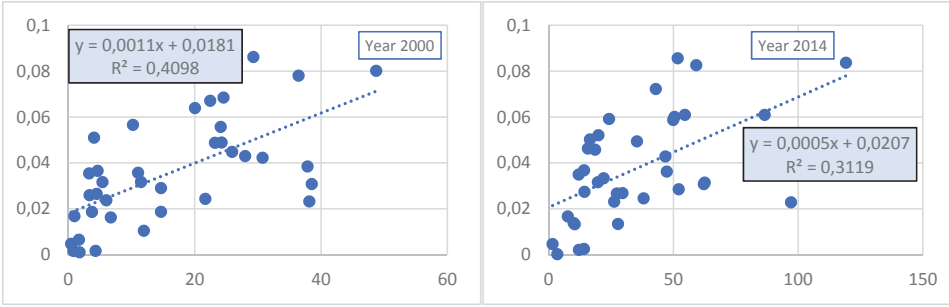
Table 4.8. Analysis results for relation between the share of flows Services → Food Industry in total material supply of Food Industry and the value of GDP per capita

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **GDP per capita**	0,000	0,000	0,001	**0,001 *****

Source: own elaboration based on WIOD.

The final type of flows, whose share changes in the overall supply of the Food Industry can be attributed to the economic growth are the flows of financial and insurance services. The results of data analysis for 2000 and 2014 are presented graphically in Figure 4.11. It can be seen that the role of this type of services is growing in those countries that have a higher level of GDP per capita.

Chart 4.11. Relations between the share of flows Finances → Food Industry in total material supply of Food Industry [in % – y axis] and the value of GDP per capita [in thousand USD % – x axis] in 2000 and 2014



Source: own elaboration based on WIOD.

The positive relation between the share of financial and insurance services and the level of GDP per capita was also confirmed on the basis of the panel model (Table 4.9). The exceptionally low value of the coefficient is the result of the relatively small role of this type of flows in the material supply of the Food Industry, but the expected direction of dependence has been demonstrated.

Table 4.9. Analysis results for relation between the share of flows Finances → Food Industry in total material supply of Food Industry and the value of GDP per capita

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **GDP per capita**	0,000	0,000	0,000	**0,0001 ***

Source: own elaboration based on WIOD.

Based on the calculations made, it can be concluded that economic growth is related to changes in the food industry's outlook structure in three ways, which are summarized in Table 4.10. First of all, the share of valuable agricultural raw materials in general supply will decrease Food Industry. This is, moreover, in line with the long-observed decreasing share of raw materials costs in the price of food products (Schluter et al., 1998).

Table 4.10. The relationship between economic growth and share of flows to the food industry from selected branches

Used indicator	Share in the entire material supply	Relation with economic growth
GDP per capita	Flows from agriculture	Negative
GDP per capita	Flows from the „Services" group	Positive
GDP per capita	Flows from the „Finance" group	Positive

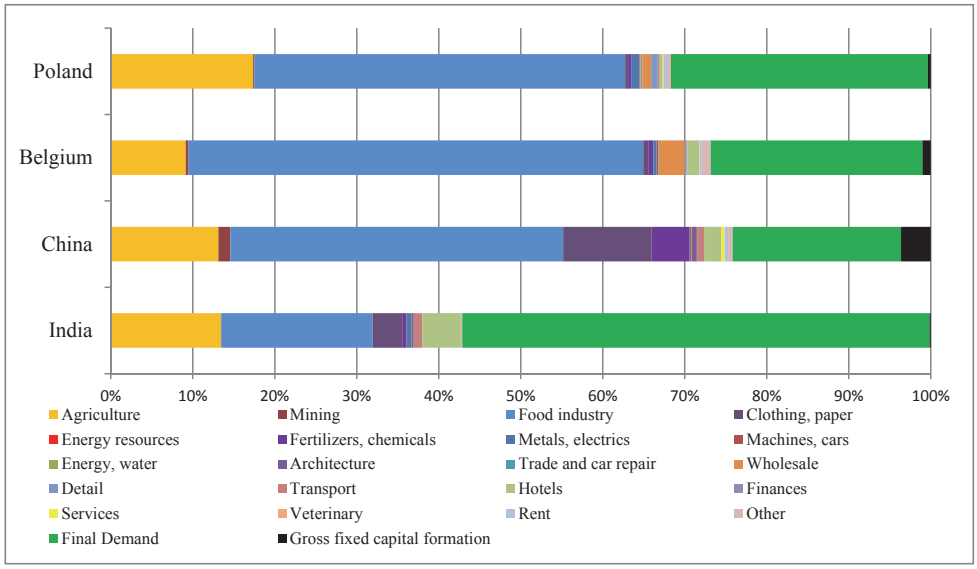
Source: own elaboration based on WIOD.

In addition, along with the economic development, the share of various types of services in the general supply of the Food Industry is growing. In the case of various types of services included in the "Services" group, there is an increase in the importance of, above all, legal and accounting services, as well as services related to advertising and market research. Like it took place in the case of the assessment of changes in the supply structure of agriculture, also in the case of the Food Industry, the share of financial and insurance services will grow.

4.3. Agricultural output allocation

As mentioned in previous chapters, products manufactured in the agricultural sector are directed to many different sectors of the economy. Their destiny can be varied, but the predominant role is of course food destiny. It is also mainly responsible for three key directions of flows, flows to the agriculture, food industry and final consumption in farms. The flows addressed to agriculture, the food industry and consumers are responsible for nearly 80% of the total distribution of the supply of the agricultural sector. In none of the analyzed countries, they were lower than 70% in 2014 (the smallest share in China – 73.79%). Among the other groups of branches, the following groups of branches: "Clothing, paper", "Hotels" and "Fertilizers, chemicals" still remain a significant recipient of goods produced in agriculture. The importance of flows directed to other branches of the economy is definitely lower.

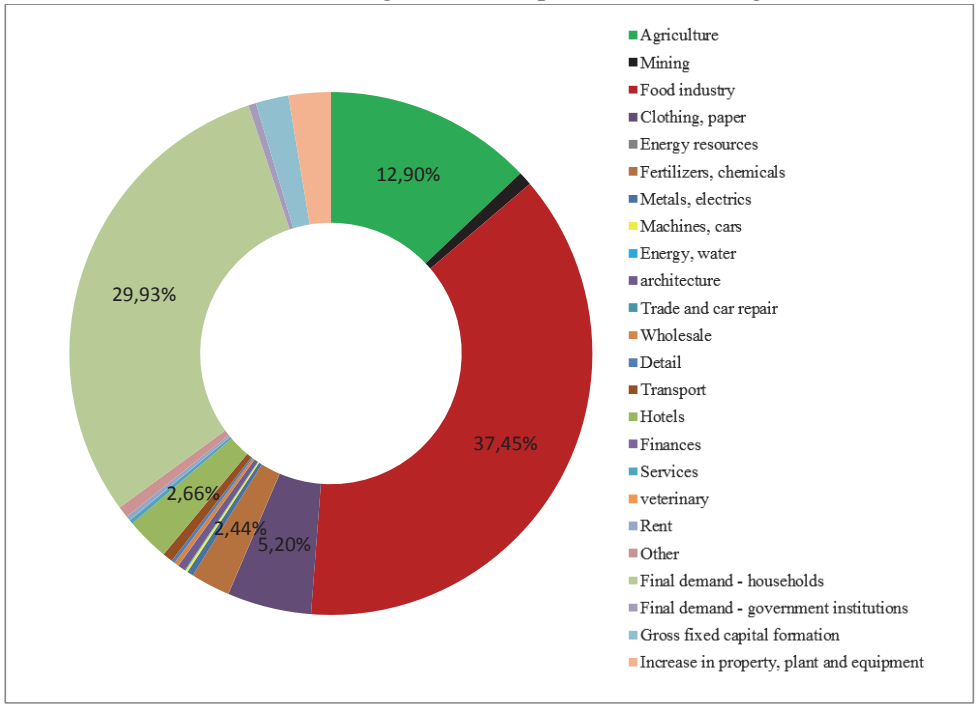
Chart 4.12. Branch structure of agricultural output allocation in Poland, Belgium, China and India in 2014



Source: own elaboration based on WIOD.

As in the case of material supply, there is a significant diversification of the distribution structure of supply between individual countries. To illustrate this statement, Chart 4.12 indicates the structure for agriculture in Poland and in three countries, each of which is characterized by a separate specificity. In the case of India, there is a high, over 50% share of flows from agriculture to final consumers. It is associated with a smaller share of flows directed to the Food Industry. On the other hand, China has a low share of flows to consumers, but a high share of the allocation of agriculture to non-food purposes, in particular to the group "Clothing, paper" (10.35%). On the other hand, in the case of Belgian agriculture, a significant difference in the structure of distribution of the supply of agriculture is the over 50% share of flows directed towards the food industry. In comparison to the three countries mentioned above, Poland is characterized by a structure of distributing the supply closest to that observed on a global scale, nevertheless, here we have clear derogations. One of them is a high, nearly 2% share of flows directed for consumption by government institutions. This means that on significantly larger scale than in other countries, agricultural products are transferred to aid programs.

Chart 4.13. Branch structure of agricultural output allocation on a global scale in 2014



Source: own elaboration based on WIOD.

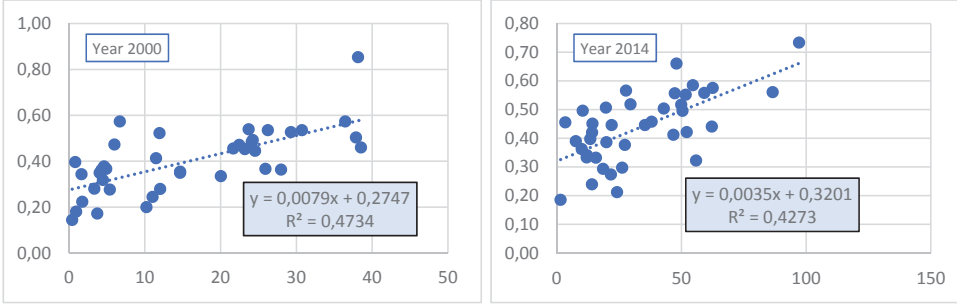
The distribution of agriculture supply in global terms is presented in Chart 4.13. On average, in 2014, the most important, in terms of value, direction of agricultural flows was the food industry. Nearly 30% of the supply of agriculture was directed directly to consumption in households. Less than 13% constituted self-supply of agriculture. Over 5% of the total distribution of the supply of agriculture went to the group of branches "Clothing, paper", which includes production of clothing, paper or straw products. Over 2.5% of supply goes to gastronomy ("Hotels" group), and a similar share is directed to the group "Fertilizers, chemicals". All of the above six directions for the allocation of supply, including gross fixed capital formation and the increase in tangible fixed assets, determine over 90% of the share of total flows from the agricultural sector. It was among these directions of allocation of the supply of agriculture that the relationship between the change in the share in the structure and measures of economic development was sought.

The first significant result of the research should be the lack of capturing the relationship between the share of flows related to the self-supply of this sector in the distribution of agriculture supply and the analyzed measures of economic growth. The same applies to flows to groups of branches "Clothing, pa-

per", "Fertilizers, chemicals" and "Hotels". Apparently, the influence of separate factors outside the analyzed ones is in these cases, significant enough that it does not allow to distinguish the impact of economic growth on the structure of the supply of the agriculture sector, on the basis of both static and panel analysis.

The dependence between the analyzed measures of economic development and the component of distribution of the supply of the agricultural sector was found for flows from agriculture to the food industry. As shown in Chart 4.14, there is a positive relation between the level of GDP per capita in a given country and the share of the supply flows of agriculture to the food industry. It seems quite clear both for the data for 2000 and 2014.

Chart 4.14. Relations between the share of flows from Agriculture to Food Industry in total agricultural output allocation [in % – y axis] and the value of GDP per capita [in thousand USD % – x axis] in 2000 and 2014



Source: own elaboration based on WIOD.

To confirm the assumptions about the existence of such a dependence, an analysis was carried out using a panel model. Based on the model with the determined effects a model was constructed for which the ratio referring to the explanatory variable is statistically significant and positive, as shown in Table 4.11. This means that we are indeed dealing with a strong positive dependency, on the basis of which forecasts can be made to increase the share of flows → Agriculture → Food Industry in the allocation of agricultural supply, assuming GDP growth in a given country.

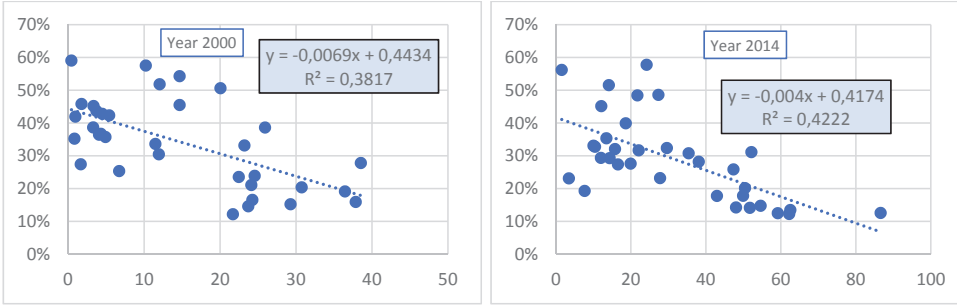
Table 4.11. Analysis results for relation between the share of flows from Agriculture to Food Industry in total agricultural output allocation and the value of GDP per capita

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **GDP per capita**	0,000	0,000	0,000	**0,005** ***

Source: own elaboration based on WIOD.

On the basis of data for the years 2000 and 2014, it was also possible to identify the relationship that occurs between the share of flows to final consumers and the level of GDP in a given country. Despite the considerable diversity of data for individual countries, there is a negative relationship between the analyzed indicators. As can be seen in chart 4.15, this relationship is definitely stronger for the year 2014 data.

Chart 4.15. Relations between the share of flows to final consumers in total agricultural output allocation [in % – y axis] and the value of GDP per capita [in thousand USD % – x axis] in 2000 and 2014



Source: own elaboration based on WIOD.

The negative relationship between economic growth and the share of flows directed to direct consumers was confirmed by panel analysis. Using the model with established effects, it was determined that the coefficient with variable GDP per capita explaining changes in the share of flows from agriculture to consumers is negative, as shown in Table 4.12.

Table 4.12. Analysis results for relation between the share of flows to final consumers in total agricultural output allocation and the value of GDP per capita

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **GDP per capita**	0,000	0,000	0,004	**-0,001 *****

Source: own elaboration based on WIOD.

In the case of the supply of agriculture, only two clear dependencies relating to the change in the structure of flows transferred from agriculture were captured, which are presented in table 4.13.

Table 4.13. The relationship between economic growth and the structure of agriculture output allocation

Used indicator	The share of the total output allocation	Relation with economic growth
GDP *per capita*	Flows to the food industry	Positive
GDP *per capita*	Flows to the final consumer	Negative

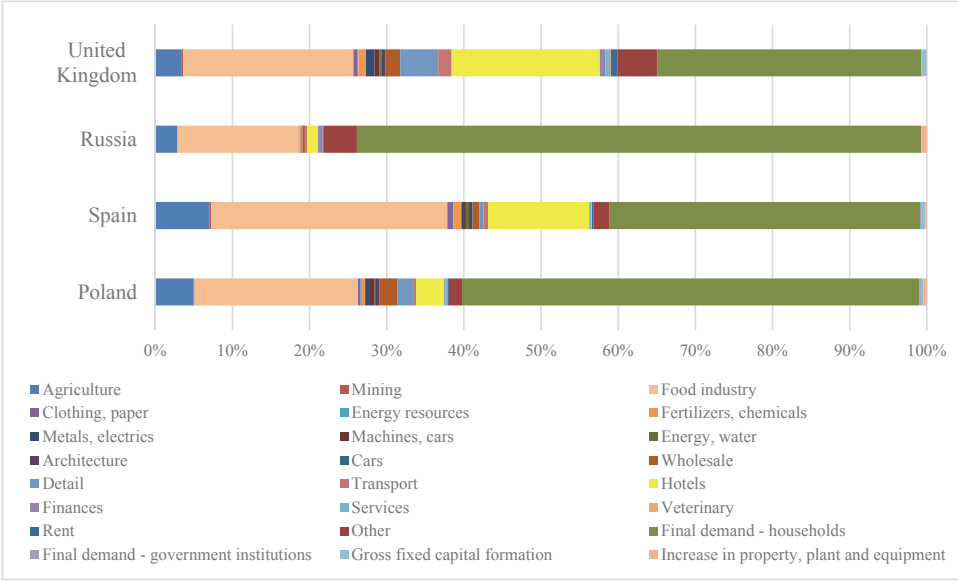
Source: own elaboration based on WIOD.

First of all, it was observed that with the growth of GDP per capita, the share of flows directed from the Food Industry increases, with the decrease in the share of flows to which final consumers are subject. One of the possible explanations for this process is the continuously observed increase in demand for processed food produced by Food Industry (Djupegot, Nenseth 2016).

4.4. Food industry output allocation

The last part of Chapter 4 is devoted to the distribution of the supply of the Food Industry. As will be shown below in graphic form, the main recipient of goods and services provided by the food industry are naturally final consumers. In addition to flows directed to households, which determine over 50% of total flows, also flows directed to Agriculture, the group of branches "Hotels" and also to the group "Others" play an important role. The importance of the last of these recipients is mainly determined by public aid provided by the state to the needy in the form of food and beverages. Of course, the self-supply of the Food Industry is also important.

Chart 4.16. Branch structure of food industry output allocation in United Kingdom, Austria, Australia, and Poland in 2014



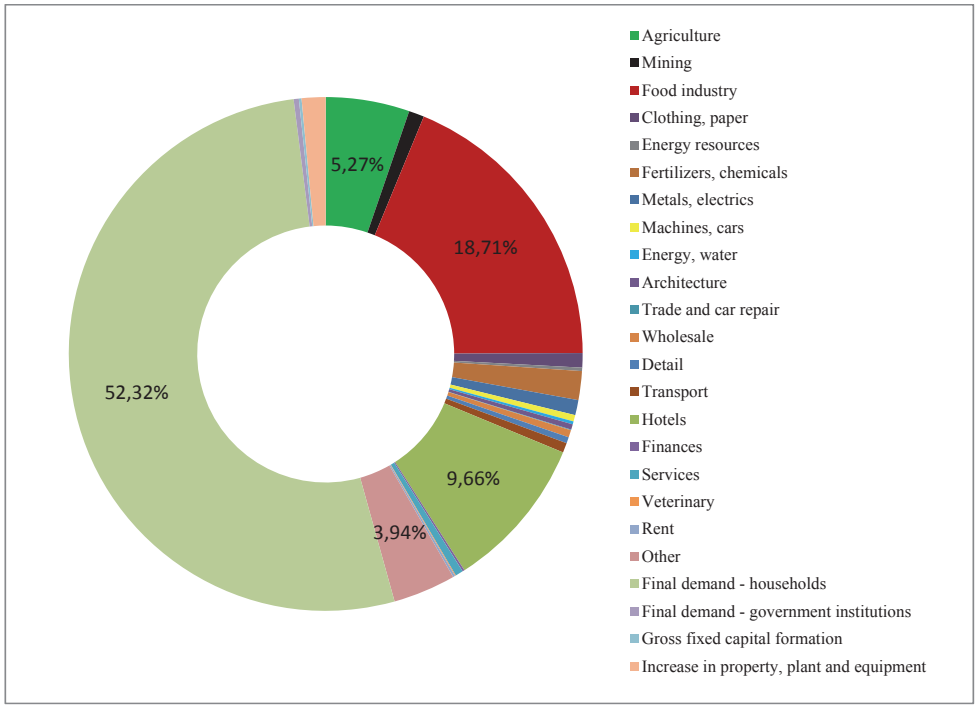
Source: own elaboration based on WIOD.

The structure of the Food Industry output allocation in individual countries differs significantly. On the example of four countries, including Poland, this is shown in Figure 4.16. The United Kingdom is an example of a state in which flows directed to gastronomy and tourism (19.2%) play an extremely im-

portant role in the overall structure. Russia, in turn, is distinguished by a very high share of flows directed to households (73.1%), and – similarly as in the case of the United Kingdom – to the "Other" group. In the case of Spain, both the flows to Agriculture and the self-supply of the analyzed branch play a large role in the structure of distribution of the supply of the Food Industry. In turn, Poland, despite the closest similarity to the average structure for all countries, is characterized by a low share of flows directed to the "Hotels" group (3.64%).

The global structure of distributing the supply of the Food Industry in 2014, shown in Figure 4.17. The share of flows directed to households accounted for 52.3% of all analyzed flows this year. Next in the hierarchy of significance were flows directed to the food industry (18.7%), the group "Hotels" (9.6%), Agriculture (5.3%) and the group "Other" (3.9%). In total, these five directions of distribution of the supply of the food industry determined about 90% of the value of all goods and services produced by the food industry.

Chart 4.17. Branch structure of food industry output allocation on a global scale in 2014



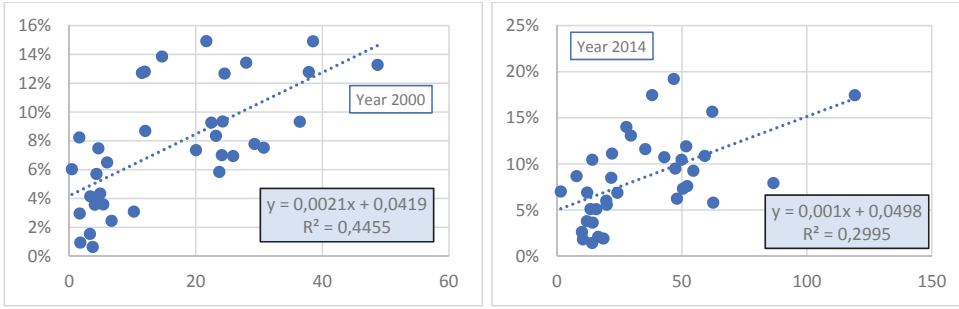
Source: own elaboration based on WIOD.

As in the case of the analysis of changes in the most important components of the supply of agriculture, also in the case of the analysis of the compo-

nents of the supply of the food industry, it was not possible in most cases to capture the relationship between the share of the tested components and measures of economic growth. It is worth noting that this concerns the participation of the self-supplying of the Food Industry in general allocation of this industry's supply. Also changes in the share of goods flows and services directed from the Food Industry to Agriculture and the "Other" group could not be linked to changes in the analyzed measures of economic growth.

Only in the case of the flow Food Industry → Hotels, it was possible to identify the nature of the relationship between the share of these flows in the total allocation of supply and the level of GDP per capita. In the case of static analysis operating on the data from 2000 and 2014, a positive relationship was found between the level of GDP per capita in a given country and the share of the examined flows. In Figure 4.18. the relationships for both studied periods are presented. It should be noted that for data from 2000, the analyzed relationship seems to be more pronounced.

Chart 4.18. Relations between the share of flows to Hotels sector in total output allocation of Food Industry [in % – y axis] and the value of GDP per capita [in thousand USD % – x axis] in 2000 and 2014



Source: own elaboration based on WIOD.

Based on the results of the panel analysis, some of which are presented in Table 4.14, it can be noted that there is a positive statistically significant relationship between the level of GDP and the share of directed flows from the Food Industry for gastronomy and tourism. Economic growth coincides with the increase in the importance of this type of flows.

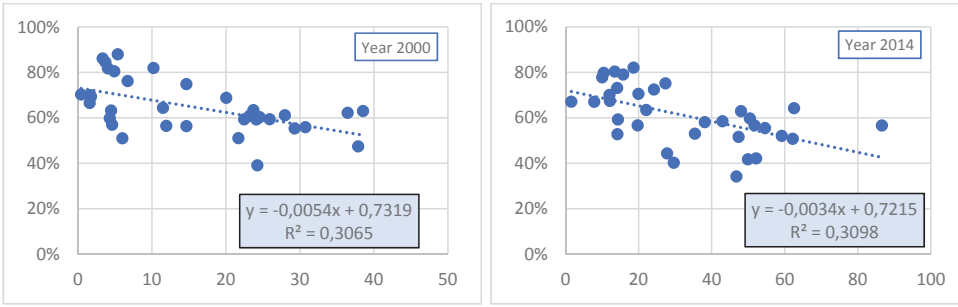
Table 4.14. Analysis results for relation between the share of flows to Hotels in total output allocation of Food Industry and the value of GDP per capita

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **GDP per capita**	0,000	0,000	0,000	**0,0002 *****

Source: own elaboration based on WIOD.

The inverse nature of the relationship combines the level of GDP per capita and the share of flows from the Food Industry to final consumers in households. Data for 2000 and 2014 indicate that the higher the level of per capita GDP in a given country, the lower the significance of flows directed towards households. This is shown in Chart 4.19.

Chart 4.19. Relations between the share of flows to final consumers in total Food Industry output allocation [in % – y axis] and the value of GDP per capita [in thousand USD % – x axis] in 2000 and 2014



Source: own elaboration based on WIOD.

Also on the basis of panel analysis and using a model with established effects, a negative nature of the relationship was observed that combined the share of flows to final consumers in general distribution of the supply of the food industry and the level of GDP per capita. This means that economic growth is associated with a decrease in the importance of flows directed to households, although it should be remembered that this decrease is not significant, and the share of such flows remains very high even among the most developed countries in the world.

Table 4.15. Analysis results for relation between the share of flows to final consumers in total output allocation of Food Industry and the value of GDP per capita

Specification	Test F (p-value)	Test B-P (p-value)	Test H (p-value)	Value of the coefficient of the explanatory variable in the panel model
Relation with: **GDP per capita**	0,002	0,000	0,001	**-0,001 *****

Source: own elaboration based on WIOD.

Similarly to the analysis of the distribution structure of the supply of agriculture, in the case of flows from the Food Industry only two statistically significant relations between the components of the total distribution of supply and the measures of economic growth were captured. The most important features of these relations are presented in Table 4.16.

Table 4.16. Relation between economic growth and structure of food industry output allocation

Used indicator	The share in the output allocation	Relation with economic growth
GDP per capita	Flows to the "Hotels" group	Positive
GDP per capita	Flows to the final consumer	Negative

Source: own elaboration based on WIOD.

First of all, the relationship between the level of GDP per capita was identified and the most important one, accounting for over half of the total supply, the one responsible for consumption in households. The analyzes allow us to believe that with the economic growth the role of these flows will be decreasing. Of course, they will still be of key importance to the Food Industry, but the decline will be noticeable. From among a number of alternative directions for the distribution of what previously went to the final consumer, flows addressed to the "Hotels" group occupy a special place. Therefore, tourism and gastronomy are becoming an increasingly important recipient of products produced not only in agriculture, but also in the Food Industry.

4.5. Summary

The results of the projection of changes in the structure of input-output flows presented in this chapter based on panel models using data for many countries from 2000-2014 largely overlap with those presented in the previous chapter and which were created using a different methodology.

As regards the material supply of the agricultural sector, it was established that with the economic development the role of flows from agriculture itself and from “Retail” will decrease, and the importance of flows from the “Food Industry” and the “Finances” group will grow. This is consistent with the observations formulated in the previous chapter referring to the growing demand of farms for means of production of industrial origin and services. For example, the growing level of production specialization in agriculture, an increasing proportion of feeds will come from outside the farm. On the other hand, the increase in flows related to services was confirmed only on the example of financial and insurance services due to the fact that the smallest share in the entire material supply was not analyzed, and this category still includes flows from the “Services” group.

In the case of material supply of the “Food Industry”, it has been proved that along with the economic development there will be a decline in the importance of flows related to raw material supplies from the agricultural sector. At the same time, the share of flows related to supply to the services industry will grow. The results of the panel analysis carried out using data from the WIOD database indicate the growing role of flows of various types of services.

This applies to both flows from the "Finance" group (financial and insurance services), as well as from the "Services" group, which includes legal, accounting, and engineering services and marketing, as well as relating to scientific research. This is in accordance with the results of the analysis carried out in the third chapter.

It is also worth mentioning the increase in foreign flows in the agribusiness material supply forecasted in the third chapter. Also on the basis of data contained in the WIOD database, a growing share of international flows can be noticed. Table 4.17 indicates the average share of domestic flows in total material supply for Agriculture and Food Industry. Only in the case of selected countries throughout the analyzed period there has been an increase in the value of the share of domestic flows. In the case of agriculture, significant growth occurred only in Indonesia and Spain, while in the remaining countries there was an increase in the share of material supplies from outside the domestic market. In particular, this applies to countries from the EU. The situation is similar in the case of the Food Industry, where apart from Spain, Cyprus, India, Indonesia and Russia, the share of flows from abroad increased.

Table 4.17. The average share of domestic material supply of Agriculture and Food industry in the years 2000-2002 and 2012-2014

Country	Agriculture		Food industry		Country	Agriculture		Food industry	
	2000-02	2012-14	2000-02	2012-14		2000-02	2012-14	2000-02	2012-14
Australia	92%	90%	94%	93%	India	96%	96%	95%	96%
Austria	80%	74%	81%	76%	Ireland	71%	43%	64%	32%
Belgium	71%	66%	75%	64%	Italy	86%	84%	90%	88%
Bulgaria	88%	75%	86%	80%	Japan	94%	89%	95%	91%
Brazil	86%	84%	95%	95%	Korea	87%	86%	89%	87%
Canada	86%	84%	90%	90%	Lithuania	73%	55%	78%	64%
Switzerland	83%	81%	87%	84%	Luxembourg	45%	37%	60%	42%
China	95%	95%	97%	97%	Latvia	68%	55%	78%	62%
Cyprus	73%	68%	76%	78%	Mexico	86%	78%	88%	83%
Czechia	84%	74%	90%	83%	Malta	68%	68%	69%	68%
Germany	84%	79%	86%	79%	Netherlands	74%	59%	73%	60%
Denmark	84%	72%	81%	67%	Norway	81%	76%	92%	87%
Spain	88%	89%	87%	89%	Poland	85%	80%	90%	86%
Estonia	69%	63%	74%	68%	Portugal	79%	76%	82%	78%
Finland	85%	76%	89%	82%	Romania	86%	85%	91%	89%
France	84%	80%	91%	88%	Russia	89%	86%	88%	94%
UK	83%	79%	87%	85%	Slovakia	79%	59%	83%	71%
Greece	84%	78%	90%	89%	Slovenia	67%	60%	80%	74%
Croatia	82%	79%	77%	75%	Sweden	80%	79%	86%	80%
Hungary	83%	72%	84%	75%	Turkey	89%	77%	93%	86%
Indonesia	82%	87%	89%	91%	USA	93%	90%	95%	94%

Source: own elaboration based on WIOD.

The increase in the importance of international flows also applies to the distribution of the supply of Agriculture and Food Industry, as presented in Table 4.18. In addition to Australia, China and the Netherlands, the importance of flows from the Agriculture sector outside the country is growing. This increase

is particularly high for EU countries. Of course, the highest in the case of countries that joined the EU in the analyzed period. I am talking here about Bulgaria, Hungary or Slovakia. In the case of the Food Industry, which traditionally is more open to international exchange, the foreign flows also increased in the analyzed period. It was particularly strong in the case of small EU countries.

Table 4.18. The average share of domestic distribution of Agriculture and Food Industry output in years 2000-2002 and 2012-2014

Country	Agriculture		Food industry		Country	Agriculture		Food industry	
	2000-02	2012-14	2000-02	2012-14		2000-02	2000-02	2012-14	2000-02
Australia	78%	80%	74%	77%	India	98%	96%	93%	91%
Austria	90%	83%	74%	56%	Ireland	87%	16%	18%	6%
Belgium	66%	63%	49%	42%	Italy	92%	90%	88%	79%
Bulgaria	96%	63%	97%	75%	Japan	100%	100%	99%	99%
Brazil	87%	79%	83%	82%	Korea	99%	99%	96%	93%
Canada	73%	68%	78%	80%	Lithuania	93%	47%	82%	54%
Switzerland	98%	98%	89%	73%	Luxembourg	77%	50%	72%	56%
China	98%	99%	94%	97%	Latvia	97%	58%	91%	52%
Cyprus	90%	86%	90%	97%	Mexico	92%	82%	96%	91%
Czechia	92%	81%	90%	63%	Malta	95%	89%	82%	72%
Germany	90%	80%	83%	69%	Netherlands	44%	52%	38%	46%
Denmark	72%	58%	47%	40%	Norway	98%	97%	77%	78%
Spain	82%	77%	87%	83%	Poland	96%	88%	89%	75%
Estonia	89%	77%	84%	55%	Portugal	97%	88%	93%	81%
Finland	92%	80%	89%	84%	Romania	95%	87%	97%	93%
France	87%	82%	83%	78%	Russia	95%	95%	99%	98%
UK	94%	92%	84%	83%	Slovakia	95%	73%	93%	80%
Greece	92%	88%	99%	97%	Slovenia	97%	83%	92%	83%
Croatia	95%	82%	81%	69%	Sweden	94%	87%	84%	74%
Hungary	90%	74%	81%	55%	Turkey	91%	90%	91%	85%
Indonesia	97%	97%	86%	82%	USA	91%	88%	95%	92%

Source: own elaboration based on WIOD.

As regards the structure of distribution of agribusiness supply, the analyzes carried out indicate that along with economic development there will be an increase in the importance of flows from Agriculture to the Food Industry with a simultaneous decline in the role of flows related to satisfying final demand. The decrease in the importance of flows directed directly to consumers will also apply to the distribution of the supply of the Food Industry. It is also forecasted that the significance of flows will increase, where the recipients of goods manufactured by the food industry will be entities operating within the "Hotels" group. These observations are also in accordance with the projections formulated in the third chapter.

5. Conclusions

Among various goals that the authors of this monograph guided, including the presentation of the importance of agribusiness for the Polish economy, demonstration of the method of creating input-output tables, or capturing economic relations in Polish agribusiness, the main aim is to make projections of changes in selected input-output flows related to agribusiness sector. The creation of this type of projection is undoubtedly a very ambitious task, which is due, on the one hand, to the limitations imposed by the specificity of employed data and, on the other hand, the innovative nature of conducted research. The precursory nature of this research causes also some limitations and imperfections of the results obtained. The authors of this monograph expect that the proposed methodology will be further improved by future economists addressing this issue.

Still, it should be remembered that as the title of the monograph indicates, the obtained projections were given a clearly defined character, which was reflected in the methodology, presentation and interpretation as well. Although the formulation of this projections is an important goal in itself, it also help to identify the development implications of Polish agriculture. Capturing development processes in agriculture by using research on changes in inter-branch flows, is considered by the authors particularly valuable due to its innovative nature. The most important elements of the changes in Polish agriculture, which will have to occur in the coming years, to make the estimated forecasts of changes in input--output flows become a fact, are presented below.

It should be also mentioned that set of developmental changes was deliberately limited. Those changes that relate to environmental or social factors what is formally a part of sustainable development was excluded from research analysis. This is mainly due to the nature of the data contained in the input-output tables. They concern real transactions that occur between participants of economic life. Meanwhile, sustainable development of agriculture in a nutshell is a model of development in which attempts are made to internalize external effects related to economic activity in rural areas (Howe 2005; Clock 2009; Rogall 2010). These types of changes are not detectable as part of published input-output tables.

It is also worth remembering that the projections specified in the work relate to changes in input-output flows both inside and in the environment of Polish agriculture. These projections concern all agribusiness, while the context of the analysed development implications formulated in the title of this monograph concerns only the agricultural sector. Hence, a series of projections present-

ed in previous sections refers to changes that occur outside of agriculture sector, since they decide about the importance of agriculture for the whole economy.

One of the most important effect of the further growth of the Polish economy is, for instance, the increase in the global value of agribusiness production. This concerns total value as well as individual components, as mentioned in Chapter 3. This means that in the coming years, the value of global agricultural production in Poland is expected to grow. Regardless of the projected growth, the importance of agriculture will be decreasing. This applies both to the role of agriculture in the entire national economy and – which seems more important from the point of view of the issues raised here – the role of agriculture in the agribusiness sector itself. The decreasing importance of agriculture in the national economy, measured both by the value of gross output and gross value added, is the result of naturally occurring development processes in every developed economy and changes in the structure of wealth creation. These processes however have no direct impact on changes taking place inside agriculture.

The shape of development processes in agriculture are determined by the forecasted changes in the decline in the importance of agriculture in the agribusiness sector. The projected increase in the importance of the agribusiness sector I and III, is associated, among other things, with the growth of the use of production means coming from outside the farm in the production of agricultural producers in Poland. This applies to fertilizers, feed and machinery and agricultural equipment. The increase in capital consumption, together with the stabilization of the level of land consumption, leads to relative decline in the importance of using labor in farms in the coming years (Balcerowicz-Szkutnik 2016). However, it should be remembered that the pace of changes in the labour use in the agricultural sector is to a large extent determined by the nature of the family model of farms operating in Poland. This means that the outflow of labor force from agriculture is hampered by much slower demographic changes in the families of farm owners. While the change in the importance of agriculture to the economy or other areas of agribusiness will occur relatively quickly, the pace of changes in the level of employment in agriculture will be much slower (Kamiński 2015, Szczukocka 2012). Returning to the issue of capital consumption growth, it is worth noting that it results not only from the projection specifying changes in the importance of particular agribusiness domains, but also from forecasted changes in the structure of material supply of agriculture.

Both in Chapter 3 and in Chapter 4, projections have been formulated regarding the decline in the role of agricultural self-supply in the entire material supply of this sector. It is a natural consequence of the development of the agri-

cultural sector, the evidence of which can be, for instance, the diversification of the structure of supplying farms of various economic size. For example, based on the analysis of the situation of households in the FADN (Farm Accountancy Data Network) database, it can be noted that the larger the holding and the larger the share of commodity production, the lower the share of self-supply. In the case of the smallest farms with an economic size below EUR 8,000, the share of internal consumption in total production exceeds 16%, while for the largest farms with an economic size exceeding EUR 100,000, this share fluctuates within 4% (Wyniki Standardowe 2015... , 2017). This is mainly due to the specialization of agricultural production. The highest share of consumption concerns, obviously, farms specializing in livestock production, however, even when grouping agricultural holdings by type of farming, a decline in share is observed along with an increase in the economic size of the farm (Wyniki Standardowe 2015... , 2017). Together with the development of the agricultural sector, farms similar to those currently the largest will increasingly eliminate the economically weaker ones from the market. As a consequence the average characteristics of all farms will be more similar to those currently characterized by the strongest agricultural producers.

Development of the agricultural sector will cause the growth of the importance of large agricultural producers, who use feed and fertilizers produced outside a farm. This in turn will increase the market demand for the means of production by the agricultural sector as a whole. The implication of these changes will also be the projected increase in the role of flows from food and chemical sector in the entire material supply of agricultural sector. This flows will be related to increased demand for feeding stuffs, and for fertilizers and plant protection products.

However, the projected increase in the use of capital in Polish agriculture mainly refers to purchased and possessed machinery and equipment. It is worth noting here that since the accession to the European Union and launching aid programs aimed at supporting transformations in Polish agriculture, an investment boom in the Polish countryside and an acceleration of the pace of modernization have been observed (Poczta et al. 2012). However, further development in Polish agriculture will need increased investment outlays. Especially that, as noted by Czubak (2012), in previous years, despite the observed increase in the value of investments, there was a drop in the gross and net value of assets owned as a result of the growing consumption of fixed assets. Similar observations were made by Grzelak (2013). Far from the optimal level of equipping farms with a modern machine park – together with a problematic area structure result-

ing in excessive agricultural employment – causes that Polish agriculture is characterized by very low, in particular compared to Western European countries, labor productivity (Gołaś, Kozera 2008; Kołodziejczak 2015). It is worth mentioning that an important problem in Poland is not the mere number of devices and machines, but rather their quality, and this is manifested, among others, by the high middle age of tractors (Wójcicki 2013) or combine harvesters (Muzalewski 2013).

The development of the agricultural sector will result in not only growing specialization in the type of agricultural production – which is a natural development process in agriculture (Ziętara 2014) – but also in the specialization on the production of agricultural raw material. The professionalization of the production of agricultural raw materials as well as the production of food in general requires specialization within the particular stages of preparation of food products for the final consumer. This means an increasingly clear demarcation between individual links in the food chain. Owners of farms will therefore become only suppliers of agricultural raw material, and all services related to further processing of food will be transferred to the food industry.

The increase in the importance of services offered to agricultural producers should be considered another development implication related to the forecasts made in the previous chapters. As in the case of large business entities, along with the development of units aiming at increasing competitiveness, the demand for outsourcing services increases (Malarewicz-Jakubów Tanajewska 2014), so in the case of agricultural producers there is an increase in the demand for professional services of various kinds. This is about both legal and accounting services, as well as those related to renting capital goods or labour force.

A special place among the types of services that demand on among farmers will be increased in next years are financial and insurance services. The increase in the demand for this type of services is associated on the one hand with the need to modernize farms, which requires the use of bank loans, and on the other with the observed increase in risk on farms. The consequence of the income risk rise is the increasing demand on insurance protection. It is already observed that the highest level of indebtedness concerns the largest farms (Gałecka, Pyra 2016). Similarly, in the case of agricultural insurance, the economic size of the farm is considered one of the determinants of the coverage of production by insurance protection (Kobus 2016). In addition to the objective evidence of increased demand for financial and insurance services, there are also those related to the policy. In recent years, many countries have introduced instruments to increase the demand for insurance of agricultural production, which

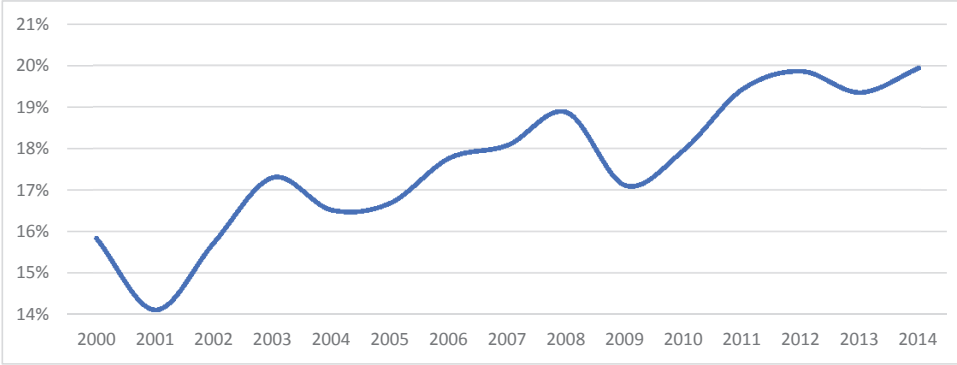
is related, among other things, to the fact that such support does not have to be subject to reduction under the Uruguay Round of WTO (Kemeny et al. 2014). Also in the European Union and in Poland there is a policy aimed at increasing the demand on agricultural insurance (Klimkowski 2013). In the coming years, this trend should not change, which will increase the importance of flows from the financial sector to agriculture.

As mentioned in Chapter IV, the importance of the flow of retail services will decrease. This is also related to the increase in the role of the largest agricultural producers in the future agricultural sector. Although it has not been demonstrated at the appropriate level of statistical significance, this will be related to the growing importance of services offered by wholesale trade. With the development of agriculture, retail will have more and more connections with wholesale trade or the food industry, and the importance of links with increasingly professional producers of agricultural raw materials will be reduced.

The above-mentioned increase in the demand for capital goods, means of production and various types of services will result in an increase in the material intensity of agricultural production. In this aspect, Polish agriculture will become more and more similar to agricultural sectors in Western European countries. In line with these changes, there will also be an increase in the demand for paid labour on farms in Poland. As in the case of other development implications of the forecasted changes in input flows, this will mean that the average entity representing the agricultural sector becomes similar to the current largest agricultural producers, where the labour force lease is a significant component of the total costs, and contract work definitely exceeds the share of the family labour in the whole of the labour force devoted to the production activity.

Completing the subject of material supply of agriculture, it is worth recalling that on the occasion of most processes related to changes in the structure of flows directed to the agricultural sector, there will be an increase in the share of foreign flows directed to agriculture. This trend has been observed for many years, and the increase in the share of flows from abroad to the domestic agricultural sector is shown in Chart 5.1.

Chart 5.1. The share of foreign flows in the total material supply of Polish agricultural sector in years 2000-2014 (in %)



Source: Own elaboration based on WIOD.

Over the analysed years, there was an increase in the share of flows directed from the old EU countries, in particular from the southern European countries and the United Kingdom, while the importance of flows from Russia and the Americas decreased. Throughout the analysed period, the country with the largest share in the total foreign material supply remained Germany, from which almost 1/4 of all flows were directed. When comparing national and foreign flows directed at Polish agriculture, it is worth noting that in the case of foreign material supplies, fertilizers, plant protection chemicals and machinery and equipment played very important role. This trend should be maintained in the following years, with regard to the increase in the importance of flows from abroad, as well as a large share of flows from chemicals and machinery and equipment sector.

Significant developmental implications related to Polish agriculture and forecasts based on changes in input-output flows also apply to probable changes in the allocation of the supply of the agricultural sector. At this point, one should notice the increase in flows from agriculture to the food industry and from the food industry to agriculture at a replacement for self-supply. This means that the Polish agricultural sector will become more and more similar to the sectors in highly developed countries. Polish agriculture will have an increasingly stronger raw material production character.

The growing intensification of transforming products made in agricultural sector into only raw material in the complicated food production process is also reflected in the decline in the importance of flows to the final consumer in the total distribution of agriculture supply. It is an element of economic development resulting in food consumers' "distancing" from agricultural producers. As

noted by Świetlik (2016), the process of declining household demand for simple, unprocessed food products has been underway for many years, with the simultaneous increase in demand for highly processed food, convenient to use and less time-consuming in terms of preparing meals.

However, while strengthening agriculture as the raw material sector means a decrease in the importance of flows to households, the food industry is not the only "beneficiary" of this decline. In the following years, the importance of the Accommodation and Catering Services branch as a recipient of products manufactured in agriculture will also grow. This is related to the trend of the growing demand for catering services observed for years. Over the last decade, there has been a nearly threefold increase in expenditure on nutrition in restaurants, cafes and bars (Świetlik 2015).

It is also worth remembering that, just as the share of the raw material purchased by the Polish food industry from abroad is increasing, the same is true for foreign demand for agricultural raw materials produced in Poland. On the one hand, this means "detachment" of the Polish food industry from the domestic raw material base, and on the other, the growing independence of the agricultural sector from the demand reported only by the domestic processing industry. These phenomena in the following years together with the development of globalization will take on the intensity.

A brief overview of the various types of development implications that the Polish agricultural sector will face in the coming years was presented above. These development implications were created on the basis of the results of the analysis referring to future changes in input-output flows within and around Polish agribusiness.

The conclusions drawn from the results of the research included in the study indicate that Polish agriculture after 2020 will continue the process of professionalization that has been observed for several years so far. Polish agricultural sector will become similar to agricultural sectors functioning in highly developed countries while maintaining a certain national specificity. In the national dimension, it will mean that large farms will play an increasingly important role. Even today they do not diverge in the condition of technical equipment or the organization of production from its counterparts in Germany or France. Gradual marginalization will apply to smaller, less organized farms, for which agricultural income are often the second source of income in the family. As long as the main trends of changes in the common agricultural policy are maintained, these farms will increasingly implement non-productive functions. Supply creation will go through the aforementioned large farms focusing on increasing pro-

duction capacities and ensuring technical and economic efficiency of the conducted production activity.

Finally, it is worth mentioning that the analysis carried out concerns the agricultural sector as a whole. Due to the characteristics of used input-output tables, it was not possible to discuss changes in specific types of farm production or specific types of agricultural raw materials. In this kind of data agricultural sector produce not specific kinds of agricultural raw materials but only specific value of total production, hence the conclusions based on input-output tables, although certainly true and useful, have a high degree of generality.

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