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# ECONOMIC PERFORMANCE OF SECTORS ALONG THE FOOD SUPPLY CHAIN – COMPARATIVE STUDY OF THE EUROPEAN UNION COUNTRIES

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**ABSTRACT**

The study presents analysis of supply chains for agricultural products in EU countries. Supply chains are sets of interrelated production and trade economic activities, carried out in a specific sequence. In the agri-food sector, the chains encompass activities carried out at the farm level and then continued during primary and secondary processing and distribution to final recipients. The aim of the article is to analyze diversity of economic results and changes in labour productivity dynamics in individual sectors of the supply chain in the EU member states in years from 2008 till 2016. The findings have shown that economic results of individual sectors in the supply chain of food products differ substantially both along the supply chain and between individual EU countries.

**Key words:** supply chains, food sector, economic results

## INTRODUCTION

Development of agriculture and the food sector in the modern world results from both imminent economic processes and the domestic agricultural policy being implemented, taking into account the local conditions, as well as the global trends that determine the place of the agricultural sector in economy of individual countries, its significance and directions of changes [Kowalski et al. 2011]. The food sector in the EU as a whole is facing serious challenges due to changes in economic and non-economic conditions. These include lifestyle changes, global food consumption growth, decreasing area of land for production, increased demand for alternative non-food uses of agricultural raw materials [Moreira 2011, Handayati et al. 2015, EC 2017], as well as – equally important – a change in the approach of the society to the consequences of functioning of the food system in relation to environmental issues, expressed by the "sustainable development" concept [Schmitt et al. 2014]. Assessment of sustainability of the food sector must take into account many economic, environmental and social aspects [Wijnands and Ondersteijn 2006]. In order to face these challenges, the food chain must undergo innovations with regard to improvement of processes and their adaptation to the changing demands of customers [Juchniewicz 2009, Urban 2009, Lewandowska 2014, Moragues-Faus et al. 2017].

One of the significant areas of assessment of competitiveness and sustainability of the food sector is measurement of economic results [Latruffe 2010]. It encompasses comparisons of economic sectors over time, in relation to other branches, as well as international comparisons. Such analyses are significant not only from the scientific point of view – they are also of key importance for development of the economic

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policy. Assessment of alternative policies includes comparison of the present economic results and the possible effects of implementation of alternative solutions [Christensen and Jorgenson 1973].

Research on competitiveness and economic development is usually focused on a country as the analyzed unit, as well as the national conditions and policies as the driving forces behind this development. Nevertheless, for a long time, focus has been placed on differences in economic results in individual regions, countries and between countries [Porter 2003]. This suggests that many significant factors determining economic results can be found at the regional level, as well as in international comparisons. Extensive literature is available on regional economic development [Scott 2000, Hanson 2001, Kołodziejczak 2008, Baer-Nawrocka and Markiewicz 2012]. On the other hand, researchers are less eager to deal with issues of measure of economic results of sectors in supply chains on the global scene.

The purpose of this study is to examine the facts and relations occurring in the supply chain. Using the EU economy as the example, assessment of differences between individual countries was made with regard to significance of the food sector in national economy. The measure of added value and number of employees was applied in this regard. Moreover, the study includes an assessment of differences in dynamics of development of the food chain in individual countries on the basis of labor productivity. Differences in labor productivity between the supply chain sectors in individual countries have also been examined.

## RESEARCH METOD AND DATA SOURCE

The study is an attempt to asses results achieved by production and trade sectors in the food supply chain. The set of data for the EU countries and the basic sectors of the food supply chain (agriculture, food sector, wholesale trade in agricultural and food products and retail trade) was used to determine the basic facts of functioning of supply chains in the international context, taking into account the labor productivity dynamics of individual sectors. Labor productivity is often mentioned as a measure of competitiveness [Latruffe 2010, Szczepaniak 2014], and the European Commission regards it to be the most reliable measure of competitiveness over the long-term perspective [EC 2008, 2014]. The relation of added value in prices of production resources to the number of employees was used as the measure of labor productivity in the food industry and the retail and wholesale trade in food. In the EU statistics, this measure is expressed in thousands of EUR per employed person [EC 2018].

Moreover, the study includes assessment of significance of food supply chains in economy of individual EU member states. The later was based on analysis of the share in added value and employment, as well as assessment of importance of food in consumption expenditures of households. The basic sources of data used in the study were Eurostat data and literature on the subject.

## THE STRUCTURE AND SIGNIFICANCE OF THE FOOD SUPPLY CHAIN IN THE EUROPEAN UNION

The food supply chain encompasses various products and companies that operate on different markets [Szymanowski 2008, Gołębiewski 2010]. The food supply chain combines three major sectors: agriculture, food and distribution (wholesale and retail) – Figure 1. The basic agricultural products go through many processing and distribution phases to be sold to consumers as final food products. The presented model of the food supply chain indicates the main links and interactions between them in the food production and distribution process. Due to great diversity of food supply channels, existing in practice, the model applied has been simplified. The first sector taken into account in the food supply chain is the agricultural sector. As agricultural commodities include very different products, the distribution channels of this sector are equally diversified. The agricultural sector companies sell their products to the food and fodder sectors. Obviously, they can also deliver the final food products directly to retail sellers and end consumers and supply markets for alternative uses of biomass (such as the biofuel and biomaterial production sector), which are significant components of the developing bio-economy.

The food sector encompasses many diverse types of processing activity. These include refining plants (sugar production), milling (cereals), washing, cutting, drying or freezing (fruit and vegetables), as well as slaughter

and cutting of meat (livestock). These processes end in emergence of various products, which are packaged and sent to clients (distributors, catering). Other important aspects of activity of food producers include market and marketing research, as well as research and development works [Firlej 2008]. The distribution sector (particularly retail trade) is also the main sales market for food products, which exerts direct impact on end consumers through marketing activity as the last link in the supply chain. Supplies of products from processing to retail trade may take place directly or through the agency of specialist wholesalers.

Relations between individual links and entities in the supply chain include the contractual, as well as the technical aspects. Contractual links, in general, refer to interactions between the buyer and the seller and they depend on the relative market power of individual companies [Goodhue 2011]. From the technical perspective, transfer of products encompasses many activities that generate additional economic costs (transport, storage and logistics) [Rutkowski 2004, Klepacki and Wicki 2014, Klepacki 2016]. Moreover, functioning of the food supply chains is influenced by many external factors, such as legislation, state policy or macroeconomic conditions. One should also bear in mind such factors as accessibility of natural resources, environmental conditions, social and technical factors. Sectors that belong to the food supply chain also interact with

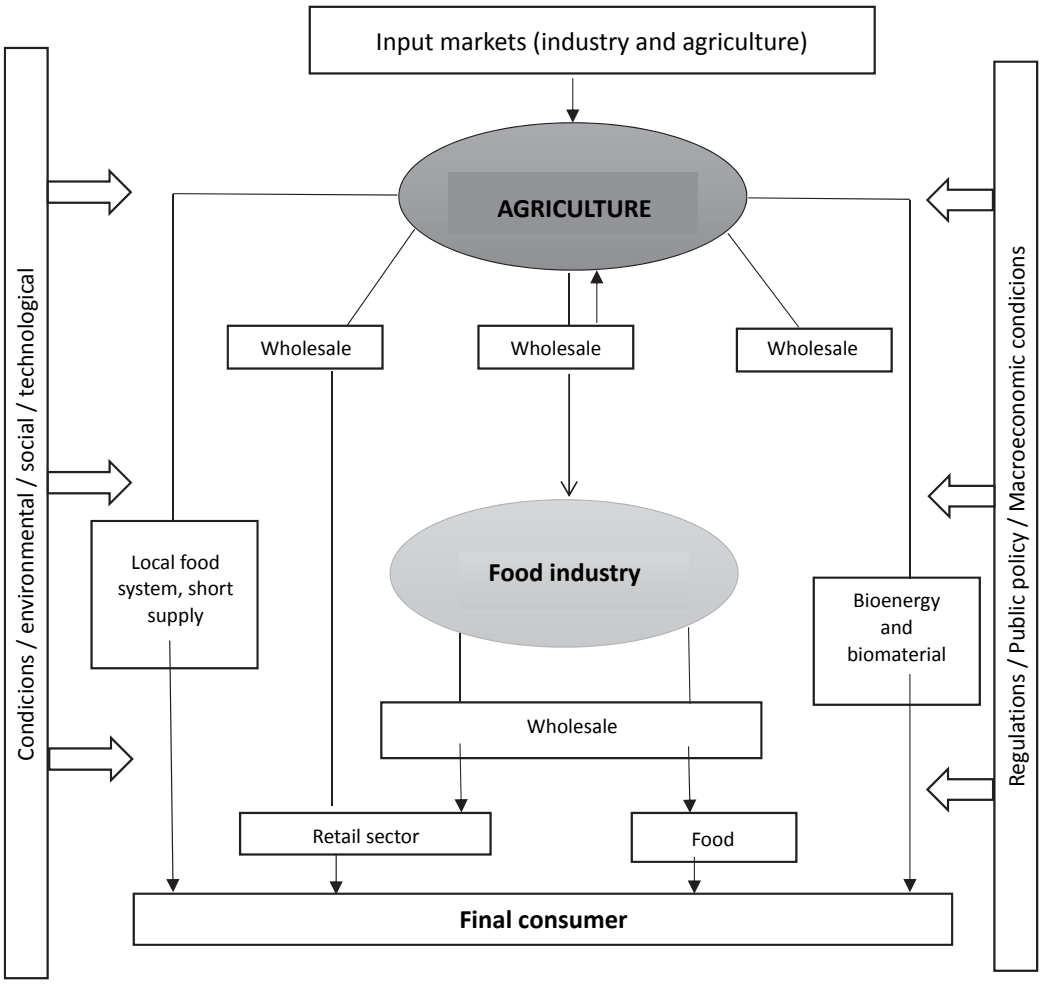


**Fig. 1.** Structure food supply chain in terms of bioeconomy

Source: Own elaboration.

**Table 1.** Sector shares in total valued added and total employment in 2016 (%)

| Specification | Value added, gross | | | | | Persons employed – number | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | agriculture, forestry and fishing | manufacture of food products; beverages and tobacco products | wholesale of agricultural and food products | retail sale of food, beverages and tobacco | total agricultural and food | agriculture, forestry and fishing | manufacture of food products and beverages | wholesale of agricultural raw materials, food, beverages and tobacco | retail sale of food, beverages and tobacco in specialised stores | total agricultural and food |
| European Union | 1.5 | 2.1 | 0.9 | 1.4 | 5.9 | 4.5 | 2.0 | 1.0 | 3.1 | 10.6 |
| Belgium | 0.7 | 2.2 | 0.9 | 1.4 | 5.1 | 1.3 | 2.1 | 0.9 | 2.7 | 7.0 |
| Bulgaria | 4.7 | 2.8 | 1.6 | 1.5 | 10.6 | 18.0 | 2.7 | 1.5 | 3.3 | 25.6 |
| Czechia | 2.3 | 2.3 | 0.7 | 1.4 | 6.7 | 3.1 | 2.2 | 0.7 | 3.1 | 9.1 |
| Denmark | 1.1 | 1.7 | 1.0 | 0.1 | 4.0 | 2.4 | 1.9 | 0.9 | 0.4 | 5.7 |
| Germany | 0.7 | 1.7 | 0.8 | 1.1 | 4.4 | 1.4 | 2.0 | 0.8 | 2.9 | 7.2 |
| Estonia | 2.4 | 2.1 | 1.1 | 1.5 | 7.1 | 3.9 | 2.4 | 1.1 | 3.3 | 10.7 |
| Ireland | 1.0 | 3.5 | 1.0 | 1.3 | 6.9 | 5.5 | 2.3 | 1.3 | 4.3 | 13.4 |
| Greece | 4.1 | 3.6 | 1.0 | 1.1 | 9.8 | 11.3 | 2.8 | 1.6 | 3.9 | 19.6 |
| Spain | 3.0 | 2.8 | 1.4 | 1.7 | 8.8 | 4.0 | 2.0 | 2.0 | 3.6 | 11.7 |
| France | 1.6 | 2.3 | 0.8 | 1.4 | 6.1 | 2.7 | 2.3 | 0.8 | 2.7 | 8.5 |
| Croatia | 3.8 | 3.9 | 0.6 | 2.3 | 10.6 | 7.5 | 3.8 | 0.7 | 4.0 | 16.0 |
| Italy | 2.1 | 1.8 | 0.7 | 1.3 | 6.0 | 3.7 | 1.8 | 0.9 | 2.7 | 9.1 |
| Cyprus | 2.2 | 1.8 | 1.3 | 2.1 | 7.4 | 4.0 | 3.2 | 1.7 | 3.5 | 12.4 |
| Latvia | 3.7 | 2.5 | 1.0 | 1.8 | 9.0 | 7.6 | 2.7 | 1.2 | 4.2 | 15.8 |
| Lithuania | 3.4 | 4.1 | 1.4 | 1.4 | 10.3 | 8.0 | 3.1 | 1.3 | 4.0 | 16.4 |
| Luxembourg | 0.2 | 0.6 | 1.7 | 1.0 | 3.5 | 0.9 | 1.4 | n.d. | 2.3 | n.d. |
| Hungary | 4.6 | 2.2 | 1.0 | 1.7 | 9.5 | 6.0 | 2.4 | 1.0 | 3.2 | 12.6 |
| Malta | 1.4 | 1.6 | 1.2 | 1.6 | 5.7 | 1.5 | 1.9 | n.d. | 3.0 | n.d. |
| Netherlands | 2.0 | 2.4 | 1.8 | 1.2 | 7.4 | 2.2 | 1.5 | 1.3 | 4.0 | 9.0 |
| Austria | 1.2 | 1.8 | 1.1 | 1.4 | 5.6 | 4.0 | 1.9 | 1.1 | 3.0 | 10.0 |
| Poland | 2.7 | 3.5 | 0.9 | 1.3 | 8.3 | 10.6 | 2.6 | 0.9 | 2.9 | 16.9 |
| Portugal | 2.2 | 2.5 | 1.2 | 1.6 | 7.5 | 9.5 | 2.4 | 1.3 | 3.4 | 16.6 |
| Romania | 4.5 | 4.9 | 1.2 | 1.4 | 12.0 | 23.8 | 2.2 | 1.0 | 2.7 | 29.7 |
| Slovenia | 2.2 | 1.5 | 0.4 | 1.7 | 5.9 | 7.7 | 1.8 | 0.4 | 2.7 | 12.6 |
| Slovakia | 3.7 | 1.4 | 0.4 | 0.8 | 6.4 | 3.1 | 1.7 | 0.6 | 1.8 | 7.2 |
| Finland | 2.8 | 1.4 | 0.5 | 1.4 | 6.1 | 4.2 | 1.5 | 0.5 | 2.5 | 8.7 |
| Sweden | 1.3 | 1.2 | 0.8 | 1.1 | 4.4 | 2.1 | 1.3 | 0.9 | 2.4 | 6.6 |
| United Kingdom | 0.7 | 1.5 | 0.7 | 1.7 | 4.7 | 1.3 | 1.6 | 0.8 | 3.6 | 7.2 |

Source: own calculations based on EC [2018].

other sectors of economy, both as purchasers and as suppliers of raw materials and means of production.

Sectors that make up the food supply chain – agriculture, food industry and food distribution and retail trade – in total represent around 6% of added value of the EU and 10.6% of employment in the EU (Table 1). The share of the food sector, beverage production and wholesale and retail trade in food products is usually higher in the new than in the EU-15 countries. The highest shares of the food sector in national economy in year 2016 was recorded in Romania, Croatia, Bulgaria and Lithuania (above 10%), and the lowest – in Luxembourg, Denmark, Sweden, Germany, Great Britain – below 5%. The share of added value of agriculture was the lowest in Luxembourg (0.2%). It was the highest in such countries as: Bulgaria, Hungary, Romania and Greece – from 4.1% to 4.7%. The share of added value in the food industry was particularly high in Romania, Lithuania and Croatia. Among the EU member states, the wholesale trade sector recorded the highest share in total added value in such countries as: the Netherlands, Luxembourg, Bulgaria.

The highest share of food sector in total employment was the highest in Romania and Bulgaria (above 25%). It was the lowest in Denmark and Sweden. Farming activity in Europe hires about 4.5% of all employees in national economy, and the food sector – around 2%. About 3% of all employees in the EU worked in the food product distribution sectors. The share of employment in the food industry and wholesale was higher in the new member states.

The economic importance of the food supply chain can also be measured by analyzing the share of food expenses in total household expenditures. On the food market, consumers act as sovereign entities, independently shaping the demand level and structure (expenditures and consumption) for food products and services. The demand results from the needs, financial capabilities, consumption patterns and lifestyle. Consumption patterns have developed over many years, and they are determined by economic factors, technological progress, political situation, environmental issues, as well as social and cultural conditions [UNEP 2016].

Significant conditions that determine demand for food are mainly economic factors including prices and income levels, which are decisive for economic accessibility of food [Gulbicka and Kwasek 2006]. The basic principle, observed as the consumer income increases, is the tendency to reduce the share of food expenditures in total expenditures. On the average, in 2016, the EU households spent about 12.2% of their expenditure funds on food and beverages (Fig. 2).

This share is usually reduced along with growth of GDP per capita and vice versa. Therefore, the share of food expenditures was usually higher in the new member states, and lower in the EU-15 countries.

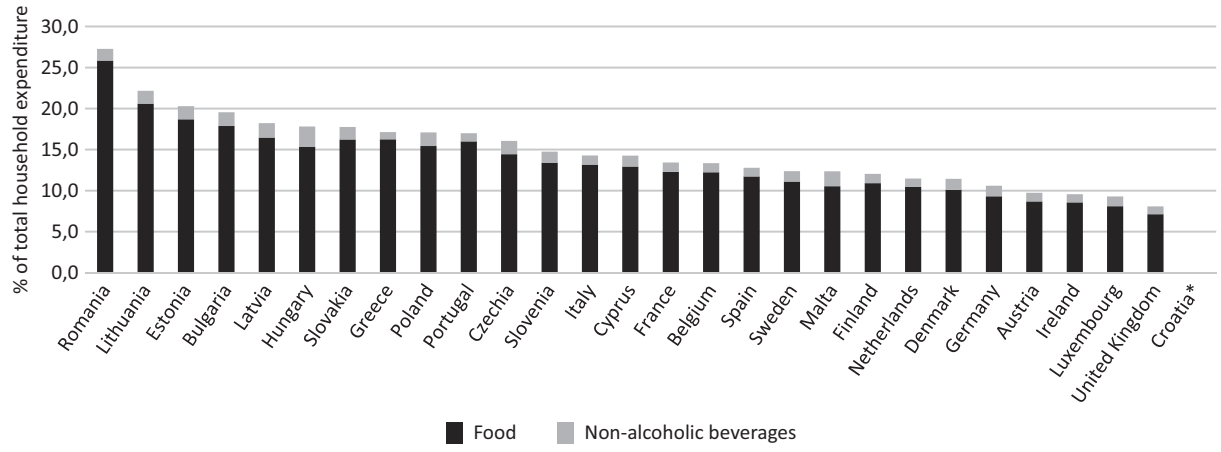


**Fig. 2.** The share of food and beverage purchases in total household expenditures in the EU in 2016

Source: Own calculation based on EC [2018].

## DIFFERENCES IN LABOR PRODUCTIVITY IN THE SUPPLY CHAIN BETWEEN THE EUROPEAN UNION MEMBER STATES

Diversity of labor productivity is one of the basic measures of economic results achieved in economic sectors. On the basis of Eurostat data, changes in labor productivity in the EU were analyzed in six sectors, identified in the food product supply chain, including two production sectors (agriculture, forestry and fishing; manufacture of food products) and four distribution sectors (wholesale of agricultural raw materials and live animals; wholesale of food, beverages and tobacco; retail sale in non-specialized stores with food, beverages or tobacco predominating; retail sale of food, beverages and tobacco in specialized stores).

Labor productivity measured as the relation of added value to number of employed was diversified in 2016 in individual sectors of the supply chain in the EU (Table 2).

The highest indicators were recorded in wholesale trade in food products. Both in trade in agricultural raw materials and in wholesale trade in food products, labor productivity exceeded EUR 50 thousand per employed person. Labor productivity in the food processing industry was only slightly lower (about EUR 46 thousand per employed person). On the other hand, labor productivity was much lower in retail trade sectors, where slightly higher indicators were recorded in non-specialized trade with food predominating. The lowest level of labor productivity was recorded in the agriculture sector – EUR 19.2 thousand per employed person. Average labor productivity in agriculture in years 2008–2016 increased by EUR 3.6 thousand per employed person, and its average annual rate reached 2.6%, representing the highest indicator in the food supply chain. Detailed data on differentiation of the rate of growth of labor productivity in individual EU has been presented in Figure 1 in the Annex. Among the EU-15, the highest rate of growth of labor productivity was recorded in Ireland and Denmark, and among the new EU – in Malta, Croatia and Poland.

The average annual rate of growth of labor productivity in the labor industry amounted to 2.3%, in the sector of wholesale trade in agricultural products – slightly above 2%, in trade in food products it amounted to 2.43%, and in non-specialized retail trade – 2.4%. In all of the analyzed sectors, there were substantial differences in the pace of growth of labor productivity between individual countries (Figs. 3–8).

**Table 2.** Differences in labor productivity in the food product supply chain sectors in the EU

| Specification | Apparent labour productivity (gross value added per person employed) | | | | | Growth rate apparent labour productivity in 2008–2016 (%) | | |
|---|---|---|---|---|---|---|---|---|
| | UE-28 total | min | max | *SE* | *CV* (%) | | | |
| | EUR thousand | | | | | UE 28 total | min | max |
| Agriculture, forestry and fishing | 19.2 | 3.1 | 64.2 | 16.3 | 84.6 | 2.59 | –0.91 | 7.00 |
| Manufacture of food products | 46.0 | 7.6 | 162.0 | 33.0 | 71.8 | 2.33 | –3.69 | 7.19 |
| Wholesale of agricultural raw materials and live animals | 52.0 | 18.9 | 94.1 | 20.3 | 39.1 | 2.04 | –10.67 | 14.45 |
| Wholesale of food, beverages and tobacco | 53.0 | 18.7 | 198.2 | 41.0 | 77.4 | 2.43 | –2.89 | 7.25 |
| Retail sale in non-specialised stores with food, beverages or tobacco predominating | 27.0 | 9.3 | 52.9 | 12.2 | 45.3 | 2.38 | –2.59 | 8.27 |
| Retail sale of food, beverages and tobacco in specialised stores | 20.0 | 2.0 | 44.6 | 12.3 | 61.6 | 0.00 | –7.48 | 6.80 |

Source: Own calculation based on (EC, 2018)

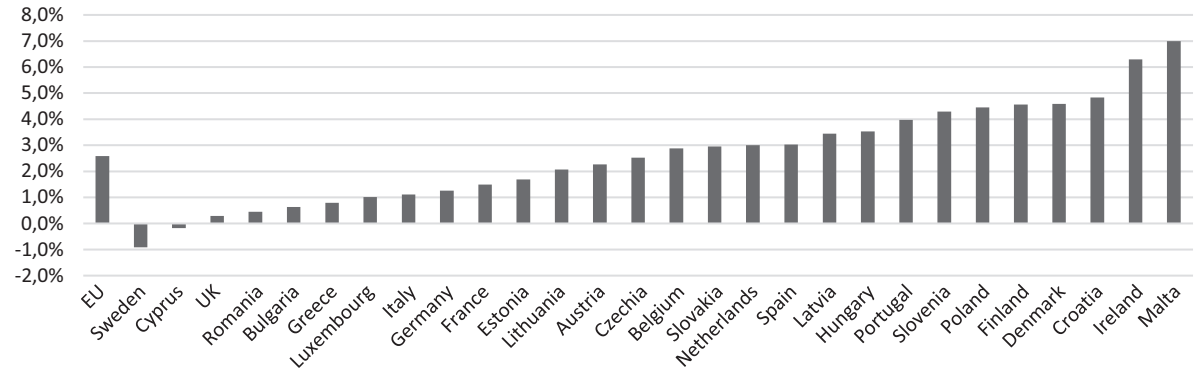


**Fig. 3.** Average annual growth rate for labor productivity in sector agriculture, forestry and fishing in years 2008–2016
Source: Own calculation based on EC [2018].

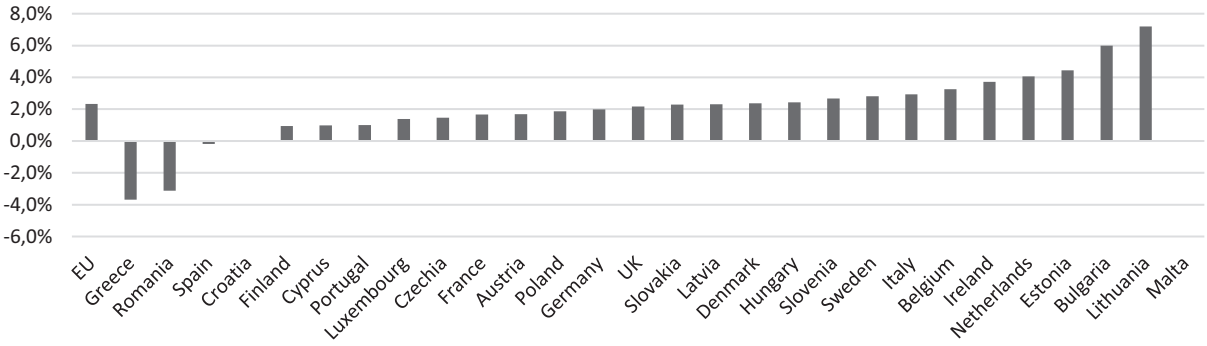


**Fig. 4.** Average annual growth rate for labor productivity in sector manufacture of food products in years 2008–2016
Source: Own calculation based on EC [2018].

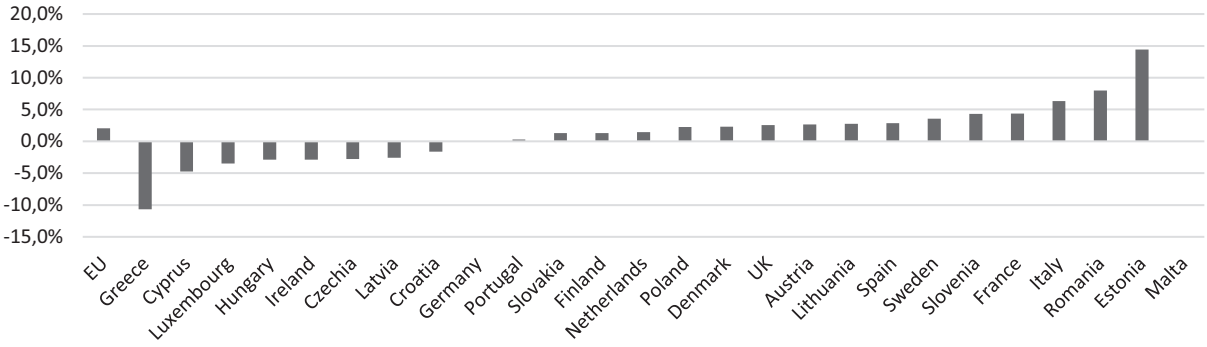


**Fig. 5.** Average annual growth rate for labor productivity in sector wholesale of agricultural raw materials and live animals in years 2008–2016
Source: Own calculation based on EC [2018].

In the food industry, the highest labor productivity growth was recorded in Lithuania and Bulgaria. On the other hand, decrease in productivity was recorded in Greece, Romania and Spain. In retail and wholesale trade, the group of countries that recorded the lowest labor productivity growth in this period included Estonia and Romania (wholesale trade in agricultural raw materials), Luxembourg and Estonia (wholesale trade

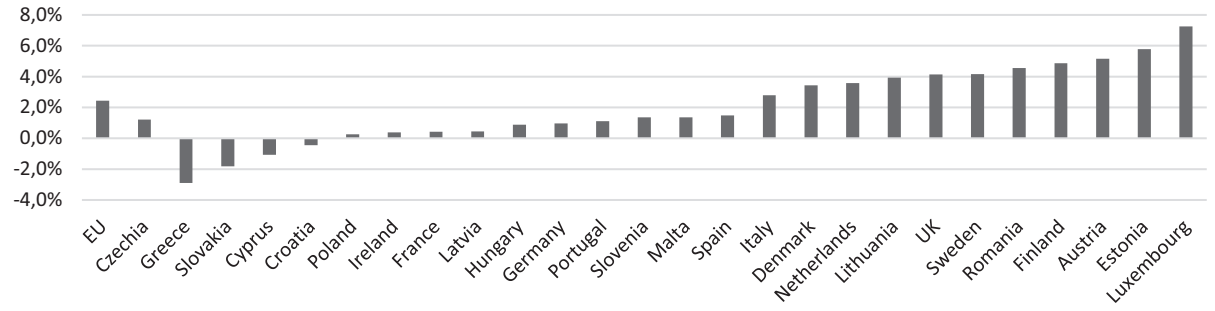


**Fig. 6.** Average annual growth rate for labor productivity in sector wholesale of food, beverages and tobacco in years 2008–2016

Source: Own calculation based on EC [2018].

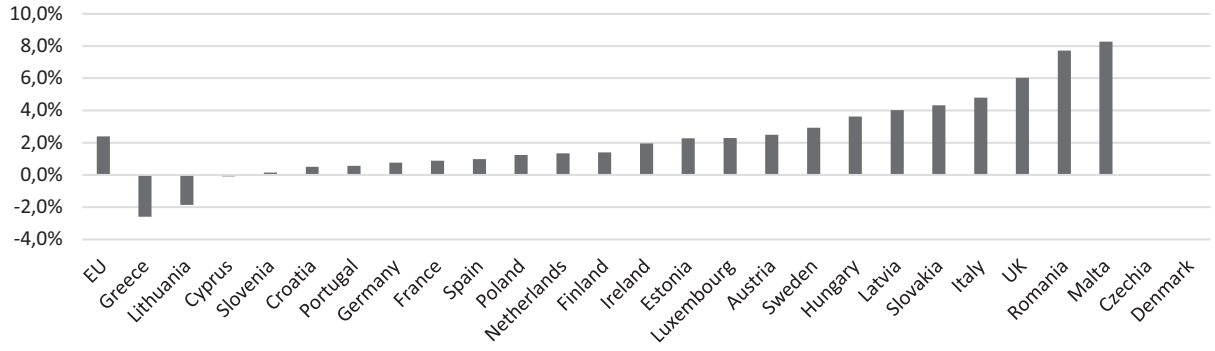


**Fig. 7.** Average annual growth rate for labor productivity in sector retail sale in non-specialised stores with food, beverages or tobacco predominating in years 2008–2016

Source: Own calculation based on EC [2018].

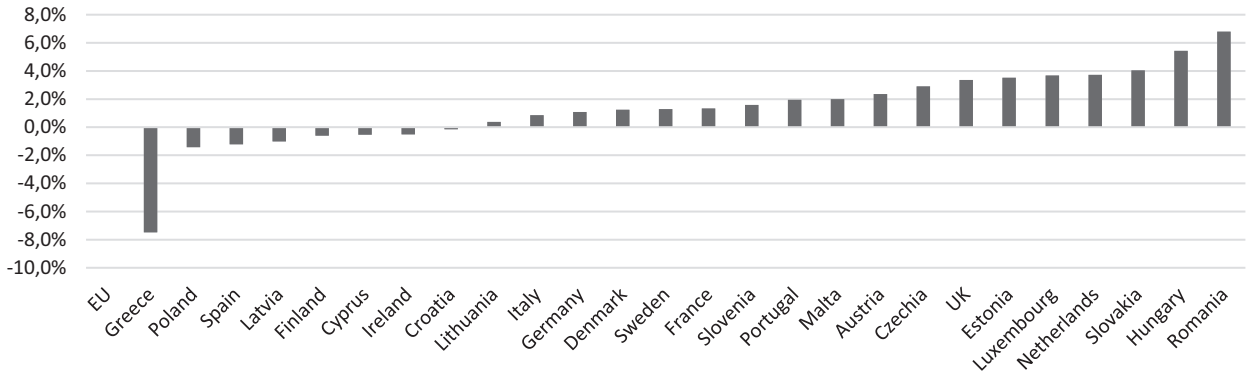


**Fig. 8.** Average annual growth rate for labor productivity in sector retail sale of food, beverages and tobacco in specialised stores in years 2008–2016

Source: Own calculation based on EC [2018].

in food products), Malta and Romania (non-specialized retail trade) and Romania and Hungary (specialized retail trade). The potential causes of these differences included: intensity of use of IT and communication technologies, differences in intensity of competition, differences in legislative frames and the labor market policy. Increase in labor productivity in the analyzed sectors of the food supply chain was in general higher in the new member states. This reflects to a great extent the effects of catching up and the lower preliminary productivity levels. The existing differences may suggest the potential for further labor productivity improvement in the EU food supply chain.

## CONCLUSIONS

The analyses conducted indicate that the highest share of the food sector in national economy is recorded in the "new" EU member states. The presented comparison of significance of the food supply chain for economy of individual EU leads to conclusion that labor productivity is greatly diversified among the EU countries. Countries, which acceded to the EU after year 2004, differ greatly from the states of Western Europe in terms of labor productivity. The EU-15 countries achieved a much higher level of labor productivity. This fact was associated, among other things, with a higher share of employment in the food sector in the new EU (even above 25% in Romania and Bulgaria).

Such diversity could also be observed in individual sectors of the supply chain. Dominant in terms of the productivity level was the sector of wholesale trade in food products, as well as food processing. Productivity in these sectors reached almost EUR 50 thousand per employed person. Retail trade recorded a lower level of productivity. Nevertheless, labor productivity was the lowest in the agriculture sector. The differences were often quite substantial. The difference between agriculture and wholesale trade was more than 2.5 times in favor of wholesale trade.

On the basis of the analyses conducted, it can be stated that, on the average, in the European Union, a tendency of growth in labor productivity was recorded in all sectors of the food supply chain. Nevertheless, some countries recorded a decrease in this regard.

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## WYNIKI EKONOMICZNE SEKTORÓW W ŁAŃCUCHU DOSTAW ŻYWNOŚCI – BADANIA PORÓWNAWCZE KRAJÓW UNII EUROPEJSKIEJ

### STRESZCZENIE

Opracowanie przedstawia analizę łańcuchów dostaw produktów rolnych w krajach UE. Łańcuchy dostaw stanowią zbiory powiązanych ze sobą, realizowanych w określonej sekwencji działań gospodarczych produkcyjnych i handlowych. W sektorze rolno-żywnościowym łańcuchy obejmują działania, które realizowane są na poziomie gospodarstwa rolnego, a następnie są kontynuowane w trakcie przetwórstwa pierwotnego, wtórnego oraz dystrybucji do finalnych odbiorców. Dokonano analizy zróżnicowania wyników ekonomicznych oraz zmian w dynamice produktywności pracy w poszczególnych sektorach łańcucha dostaw w krajach UE w latach 2008–2016. Badania wykazały, że wyniki ekonomiczne poszczególnych sektorów łańcucha dostaw artykułów żywnościowych różnią się znacznie zarówno wzdłuż łańcucha dostaw, jak i między poszczególnymi krajami UE.

**Słowa kluczowe:** łańcuchy dostaw, sektor żywnościowy, wyniki ekonomiczne