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LABOUR PRODUCTIVITY VERSUS STRUCTURAL CHARACTERISTICS OF FARMS IN POLAND COMPARED TO OTHER EU COUNTRIES

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Purpose: The aim of this study was to assess labour productivity on farms in Poland against their structural characteristics and those of other EU Member States.
Design/methodology/approach: The research was carried out on the basis of Farm Accountancy Data Network (FADN EU) data from to 2013-2022, on which labour productivity indicators, relations between production factors, and correlations between productivity and selected structural characteristics were calculated.
Findings: Despite the high dynamics of change, labour productivity in Poland is one of the lowest among EU countries (21st place in 2022). The low level of labour productivity is accompanied by unfavorable structural characteristics of farms and inappropriate relationships between production factors. Research has shown a correlation between the level of labour productivity and the economic size and technical equipment of agricultural holdings.
Practical implications: The results of this research provide a clear indication of the continuation of the development path of agriculture in Poland related to the improvement of the agrarian structure.
Originality/value: The study is a contribution to the discussion on the relationship between the level of labour productivity and structural characteristics of farms.
Keywords: labour productivity, farms, structure of agriculture, Poland, European Union.
Category of the paper: Research paper.

1. Introduction

The concept of structural change and the problems associated with its study are not new phenomena. Their impact on the development of the economy and the social changes induced by them have caused constant interest among researchers in this phenomenon (Prokopiuk, Maksimczuk, 2015). Structural changes themselves are understood as permanent transformations occurring over a long period of time in the system of a certain whole (Syrquin, 2007), making it possible to understand and formulate the construction and description of the development of any economy or its individual sectors (Onufer, 2009).

Attempts to bridge the development disparities between EU member states by means of numerous economic policy instruments have been carried out in various areas of socio-economic life, including agriculture. In many member countries, there is a need to modernize the agricultural sector, including improving the efficiency and economic strength of farms through structural changes (Rzeszutko, 2017). The structure of agriculture is the result of many economic and historical processes taking place in agriculture and the environment (Biernat-Jarka, 2017). In Poland, the most important role in these transformations was played by systemic transformation, followed by accession to the EU and the inclusion of agriculture in the instruments of the Common Agricultural Policy (CAP) (Bański, 2018; Wicki, 2019, p. 286). The consequences of these processes were changes in the indicators characterizing the macroeconomic importance of agriculture (the declining share of agriculture in total employment and gross value added), as well as in the size, structure, and profitability of farms (Wawrzyniak, 2017, p. 50; Szabo et al., 2018; Badach et al., 2023; Strojny, 2020, p. 62). According to Wawrzyniak (2017, p. 50), it is possible to derive a relationship between the length of the impact of CAP financial instruments and the average size of farms. Regarding the situation of Polish agriculture, many researchers point to the still unfavorable structure of farms as a reason for the low efficiency of the sector (Biernat-Jarka, 2017; Badach et al., 2023). It is also mentioned as one of the key factors shaping the level of competitiveness of agriculture (Nowak, 2020), especially in the long term (European Commission, 2008, p. 7; Guth, Smędzik-Ambroży, 2020). Therefore, this area requires further research, especially since the literature review indicates a relatively low level of labour productivity of Polish farms in relation to other EU member states (Ancans, 2023, p. 126). An additional argument for undertaking research in this area is that the available scientific studies usually focus only on one of the structural characteristics, i.e. area size (Biernat-Jarka, 2017) or economic size (Wicki, 2019; Nowak, 2020). However, there is a lack of analyses that examine the structural characteristics of farms in the context of labour productivity. Considering this, the purpose of this study was to assess labour productivity on farms and compare it with their structural characteristics in Poland and other EU member states.

2. Research methods

Assessments of labour productivity and structural characteristics of farms were made based on the Farm Accountancy Data Network (FADN) Public Database (2024) from to 2013-2022. This is the only database for which information is collected according to uniform rules, and the farms form a statistically representative sample of commodity farms operating within the European Union (Pawłowska-Tyszko et al., 2023, p. 10). The FADN observation field included commodity farms. The individual variables selected for analysis were assigned symbols according to FADN methodology.

This study was conducted in two stages. In the first stage, labour productivity indicators were calculated as the ratio of the value of output (SE131) to the number of full-time employees (AWU - Annual Work Unit) (SE010), as well as the dynamics of change and the average annual rate of change of this indicator in 2013-2022, according to the following formula (Pułaska-Turyna, 2011):

$$\bar{T} = \sqrt[n-1]{\prod_{i=2}^{n} \frac{y_i}{y_{i-1}}} - 1 \quad (1)$$

where:

$\bar{T}$ – average rate of change of a phenomenon over time,

Π – is the multiplication,

y – the observed magnitude of the phenomenon,

y_i – i_{th} expression of the time series,

$i = 1,2, \ldots, n$, $\frac{y_i}{y_{i-1}}$ – index with a variable base (base is the previous year).

The second stage of the research concerned the analysis of the structural characteristics of farms and the confrontation of these characteristics with the level of labour productivity in individual EU member states. The following farm characteristics were included in this study:

- average agricultural area (ha) on the farm (SE025),
- average farm economic size (SE005),
- technical armament of labour as the ratio of fixed assets (SE441) to full-time employees (SE010),
- number of working people (SE010) per 100 hectares of agricultural land (SE025).

The scope of the study included 27 EU member states, with a focus on Poland.

3. Results

Poland ranked 21st among EU member states in terms of labour productivity in 2022. One fully employed person produced an average output of 40500.7 euros per year. This means that this indicator reached only 51.4% of the average indicator for the 27 EU countries. In 2013, Poland's position improved slightly (promotion from 23rd to 21st place), and the ratio of the value of the labour productivity index to the EU average increased by more than 10 percentage points (Table 1). Among other member countries, the highest labour productivity is observed in Denmark and the Netherlands (373.3 thousand euros/AWU and 266.8 thousand euros/AWU, respectively). Productivity exceeding 200 thousand euros/AWU in 2022 was also marked by Luxembourg and Sweden, followed by Belgium, Finland, Germany, and France occupied the next places. At the other end of the ranking with the lowest labour factor productivity were countries such as Portugal, Slovenia, Romania, Greece and Croatia.

Table 1.
Labour productivity on farms in EU member states 2013-2022

Specification	Labour productivity (EUR/AWU)			Ranking in 2022
	2013	2022	średnia 2013-2022	
EU-27	43802.0	78866.5	54614.8	-
Denmark	269831.8	373273	265068.6	1
Netherlands	186183.5	266833.1	196918.5	2
Luxembourg	112993.4	212627.1	141644.4	3
Sweden	139767.8	211920	146105.1	4
Belgium	129036.8	199303.2	142361.5	5
Finland	83857.3	151767.8	102206.6	6
Germany	121558.0	150918.7	125325.8	7
France	96759.8	140852.2	106253.7	8
Estonia	57479.5	139957.6	78645.6	9
Ireland	57163.9	110203.4	70282.1	10
Czechia	50678.4	97830.3	63455.7	11
Austria	53181.7	95863.8	63801.6	12
Slovakia	39612.4	93160.5	60611.6	13
Hungary	43103.8	81794.0	54563.1	14
Italy	44914.7	65951.1	55360.6	15
Latvia	27954.1	58063.1	36690.3	16
Lithuania	22242.9	57286.3	29886.3	17
Spain	38488.3	57215.3	49789.4	18
Bulgaria	16256.4	45990.6	25735.4	19
Malta	29496.5	42499.3	35500.1	20
Poland	**17766.5**	**40500.7**	**23251.3**	**21**
Cyprus	27104.5	36687.8	30885.2	22
Portugal	18723.1	29795.7	22690.5	23
Slovenia	16550.0	28206.7	22762.7	24
Romania	9911.8	26116.0	16041.7	25
Greece	20265.7	25670.4	22454.9	26
Croatia	12524.5	21058	16254.2	27

Source: Own elaboration based on FADN EU data.

From 2013 to 2022, agricultural labour productivity steadily increased in all member states. However, in most of the countries newly admitted to the EU (in 2004 and later), both the dynamics in 2022 relative to 2013 and the average annual rate of change were higher than those in Western European countries. This can be explained by the low initial level of agricultural labour productivity in these member states. Their accession to the EU has promoted growth. In Western European member states, on the other hand, the situation varied. For example, in Finland, Ireland or Austria, the growth dynamics were among the highest among the countries of the so-called "old EU-14". Ancans (2023) reached similar conclusions. In Poland, the growth rate of labour productivity in the studied period reached 228%, and the average annual rate of change reached 8% (Fig. 1). In contrast, the leaders in terms of the growth rate of the productivity indicator under study were Bulgaria and Romania, with dynamics of 282.9% and 263.5%, respectively. Among the old EU members, the lowest labour productivity growth was recorded in Germany; however, it was still more than five times higher in 2022 than in Poland.

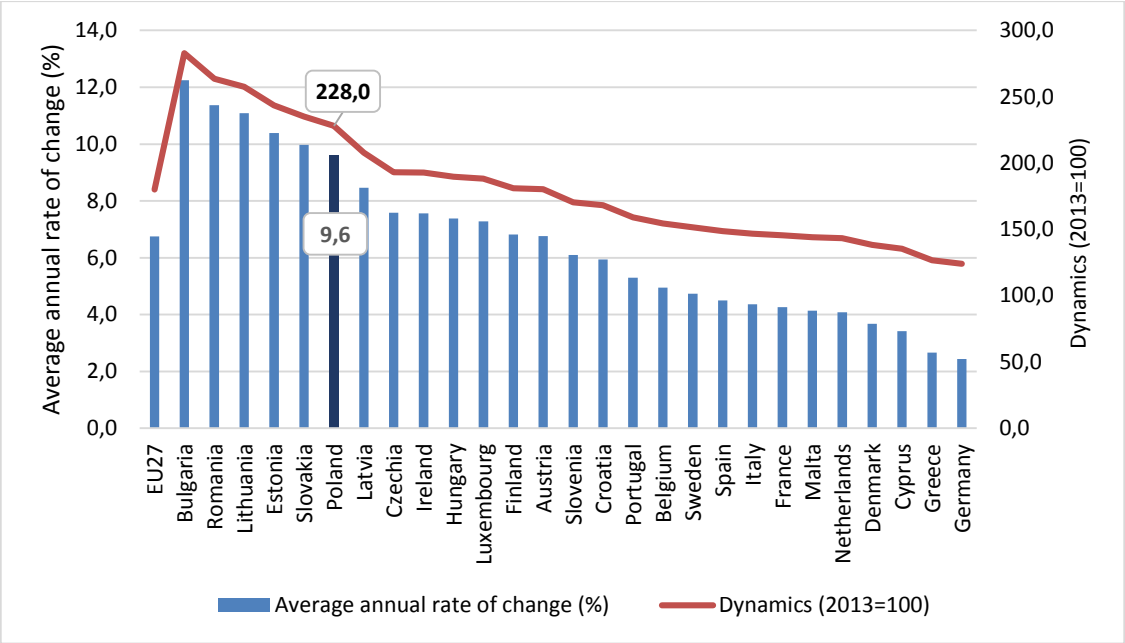


Figure 1. Dynamics and average annual rate of change in labour productivity on farms in EU member states 2013-2022.

Source: Own elaboration based on FADN EU data.

The next stage of the research was to determine the level of labour productivity in the selected structural characteristics of farms. Table 2 shows the relationship between labour and land resources and capital and labour resources. Countries were ordered in descending order based on the average value of fixed assets per 1 AWU in 2013-2022. Malta, Cyprus, Croatia, Greece, and Slovenia are among the countries with the highest land endowment in labour expressed in terms of the number of employed per 100 ha of utilised agricultural area (UAA) are Malta, Cyprus, Croatia, Greece and Slovenia. In Poland, this indicator is much higher than the EU average, although it has decreased from 9 to 7.1 people per 100 hectares between 2013 and 2022. The average value of the technical armament of labour in the period under review, which is the ratio of fixed assets to the number of employees, placed Poland 17th among the member countries with an indicator below the EU average. Denmark, the Netherlands, and Ireland remained the leaders in this regard, while Romania and Bulgaria ranked last.

Table 2.
Relationships between production factors on farms in EU member states 2013-2022

Specification	AWU per 100 ha UAA			Fixed assets per 1 AWU (EUR 1 000/AWU)		
	2013	2022	2013-2022	2013	2022	2013-2022
EU-27	4.9	4.1	4.4	151.3	198.8	172.9
Denmark	1.8	1.6	1.7	1216	1252.7	1213.7
Netherlands	7.5	7.7	7.7	770.9	972.3	831.5
Ireland	2.4	2.5	2.4	717.5	805.4	770.5
Luxembourg	2.2	1.8	2	563.5	774.7	660.9
Sweden	1.4	1.5	1.5	479.8	679.7	592.4
Germany	2.5	2.2	2.4	339.3	417.8	381.2
Belgium	4	4.1	4	313.7	438.1	377.6

Cont. table 2.

Finland	2.1	1.9	1.9	295.6	374.7	344.6
Austria	4.3	4.4	4.8	249.9	332.5	273.2
Italy	7.6	5.9	6.3	237.4	214.5	222.1
Slovenia	13.1	10.5	11.8	127.2	223.1	176.3
Malta	53.4	46.2	49.3	131.2	175.6	149.8
Estonia	1.5	1.1	1.3	100.9	214.8	146.8
Spain	3.3	4.2	3.7	147	126.2	139.1
France	2.4	2.2	2.3	128.1	146.4	132.3
Poland	**9.0**	**7.1**	**7.8**	**85.6**	**126.9**	**106.9**
Greece	11	10.4	10.7	96.5	96.7	102.1
Czechia	2.9	2.4	2.6	109.6	131.1	99.8
Cyprus	14.9	13.2	13.3	108.6	90.2	92.3
Hungary	3.2	3.1	3.2	70.5	132.8	92.2
Croatia	11.7	9.8	10.5	73.9	88.8	84.9
Slovakia	2.5	2.0	2.3	37.8	91.2	68.8
Latvia	3.0	2.5	2.8	48.2	87.3	68.4
Lithuania	3.6	3.0	3.2	42.4	78.6	59.1
Portugal	6.1	5.4	6.4	54.2	60.0	54.3
Bulgaria	6.4	3.7	4.7	18.8	47.9	32.8
Romania	12.8	5.7	8.9	23.4	39.6	32.1

Source: Own elaboration based on FADN EU data.

Table 3 shows the average economic size and farm area. Countries are listed in descending order of their economic size. The average value of standard farm production in the EU was 94,500 euros in 2022 and averaged 82,000 euros in 2013-2022. Farms in the Netherlands, Denmark, and Slovakia have the highest economic potential, reaching 614.8%, 607.2%, and 417.5% of the EU average economic size in 2022, respectively. Poland is one of the countries with both low economic size of farms and a relatively small area of agricultural land. In 2013-2022, only Slovenia, Croatia, Greece, and Romania had a lower average economic potential for farms than Poland, and six countries (Cyprus, Malta, Slovenia, Croatia, Greece, and Romania) had a lower area of farms.

Table 3.

Average area of agricultural land and economic size of farms in EU countries in 2013-2022

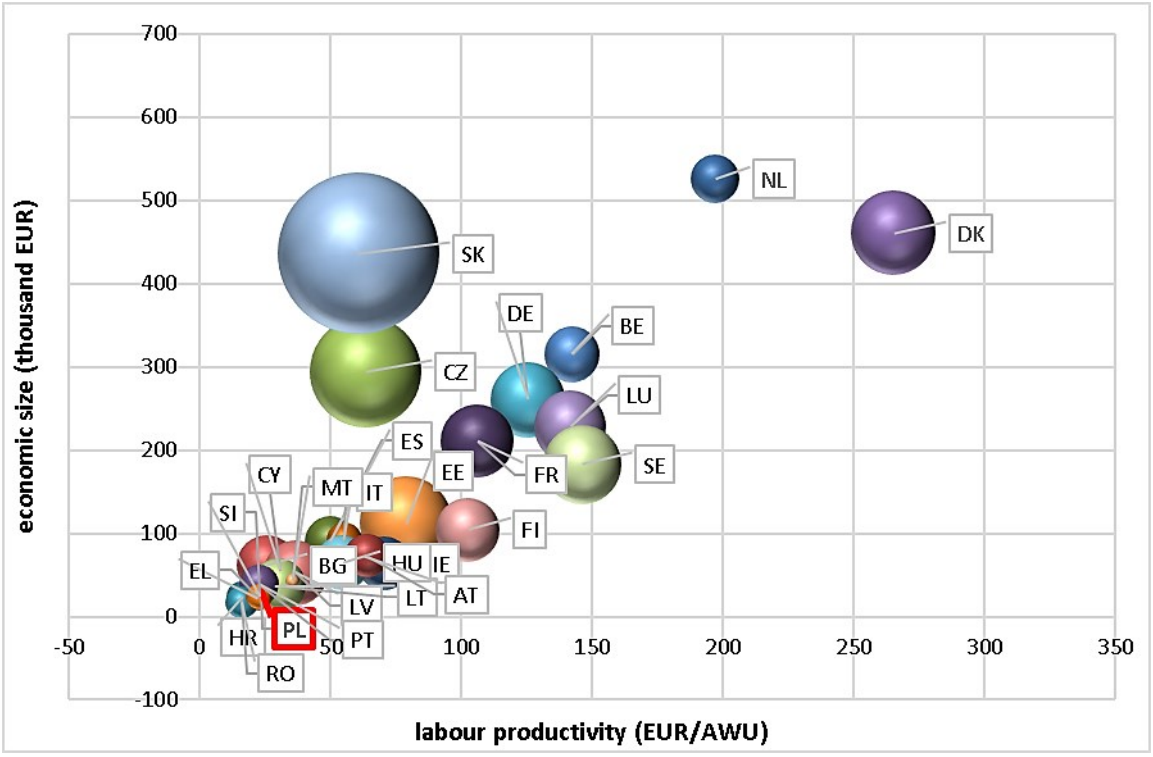
Specification	Utilised agricultural area (ha)			Economic size (thousand euro)		
	2013	2022	2013-2022	2013	2022	2013-2022
EU-27	30.5	40.4	35.9	61.0	94.5	82.0
Netherlands	36.5	41.2	39.0	417.5	581.0	525.6
Denmark	97.9	152.1	122.9	357.4	573.8	460.8
Slovakia	550.9	409.5	452.2	460.9	394.5	436.2
Belgium	51.0	53.1	52.5	296.7	321.5	314.9
Czechia	202.0	254.3	213.4	245.7	351.5	294.6
Germany	88.9	103.4	95.5	234.6	276.9	260.4
Luxembourg	82.9	96.0	88.2	192.9	238.8	227.8
France	86.4	94.1	90.3	180.5	225.3	210.8
Sweden	102.8	104.4	104.7	149.5	197.9	182.5
Estonia	137.0	150.9	144.7	91.6	124.5	113
Finland	57.7	78.3	69.1	82.3	121.4	104.1
Italy	17.0	23.6	21.5	66.0	99.4	92.0
Spain	41.0	44.1	44.2	58.9	107.1	89.3
Austria	32.7	33.7	32.3	56.8	83.4	72.8
Hungary	48.7	52.8	49.7	53.9	73.7	64.9

Cont. table 3.

Ireland	49.5	45.7	48.3	49.0	73.1	64.0
Bulgaria	37.9	75.9	62.2	33.2	75.6	61.7
Cyprus	8.9	11.1	10.8	37.8	66.3	55.0
Latvia	69.1	73.6	70.8	40.1	59.0	52.4
Malta	2.7	3.0	2.8	37.4	54.8	43.6
Portugal	26.4	25.8	24.3	34.2	40.6	38.7
Lithuania	48.6	51.4	50.6	28.7	43.4	36.4
Poland	**18.8**	**21.3**	**20.4**	**27.7**	**36.9**	**33.7**
Slovenia	10.6	11.5	10.7	22	26.8	24.1
Croatia	15.7	16.0	15.6	23.6	24.2	23.7
Greece	9.8	10.4	10.1	20.7	25.5	22.4
Romania	9.3	26.3	17.2	9.8	25.3	17.3

Source: Own elaboration based on FADN EU data.

To better illustrate the relationship between the level of labour productivity of farms and their structural characteristics, a graph showing the position of each member country according to the value of the labour productivity index and the average economic size of farms is developed. The size of the sphere represents the average area of agricultural land of farms in 2013-2022.



Note: Country abbreviations: BE - Belgium, BG - Bulgaria, CZ - Czechia, DK - Denmark, DE - Germany, EE - Estonia, IE - Ireland, EL - Greece, ES - Spain, FR - France, HR - Croatia, IT - Italy, CY - Cyprus, LV - Latvia, LT - Lithuania, LU - Luxembourg, HU - Hungary, MT - Malta, NL - Netherlands, AT - Austria, PL - Poland, PT - Portugal, RO - Romania, SI - Slovenia, SK - Slovakia, FI - Finland, SE - Sweden. The agricultural area of the farm is the size of the sphere.

Figure 2. Distribution of EU countries according to labour productivity, economic size and agricultural area of farms from 2013 to 2022.

Source: Own elaboration based on FADN EU data.

It can be seen that the Netherlands and Denmark achieved the highest level of labour productivity with a very high level of economic size and, in the case of Denmark, also high UAA. At the other extreme are countries with very low labour productivity, economic size, and UR area. This group includes Poland, Romania, Croatia, Greece, Portugal, Slovenia, Bulgaria, Lithuania, Latvia, Cyprus, and Malta, most of which joined the EU in 2004 or later. It is noteworthy that Slovakia and the Czech Republic are characterized by economically strong and large-area farms, but still achieve fairly low labour productivity, although higher than that of the previously mentioned countries.

The next step of the analysis was to examine the correlation between labour productivity (X1) and the structural characteristics of farms: UAA (X2), economic size (X3), value of fixed assets per AWU(X4), and number of fully employed persons (AWU) per 100 hectares of UAA (X5). Table 4 presents the correlation matrix between the variables mentioned above. This shows that there is a strong correlation between the level of labour productivity and the economic size and technical labour equipment of farms. There is a weak correlation between labour productivity and the area of agricultural land and the armament of land for labour. This should be explained, among other things, by the fact that some farms small in area can carry out intensive production and achieve high efficiency in the factors of production involved, such as vegetable farms. It should also be added that in accordance with the current methodology, the smallest farms, below the standard production threshold adopted by each country, were not included in the FADN sample.

Table 4.
Correlation matrix between labour productivity and structural characteristics of farms

Variable	Mean	Standard deviation	*X1*	*X2*	*X3*	*X4*	*X5*
X1	74242.5	61540.1	1.000	0.211	**0.812**	**0.879**	-0.295
X2	72.8	89.8	0.211	1.000	**0.589**	0.025	-0.332
X3	145.3	147.2	**0.812**	**0.589**	1.000	**0.611**	-0.272
X4	270.6	296.5	**0.879**	0.025	**0.611**	1.000	-0.196
X5	6.7	9.2	-0.295	-0.332	-0.272	-0.196	1.000

Source: Own elaboration based on FADN EU data.

4. Discussion

Agriculture in many new EU member states, including Poland, is characterized by a relatively low level of labour productivity (Bilenko, 2022). A study by Smędzik-Ambroży et al. (2019) shows that agriculture in Poland, compared to EU countries, was characterized in 2004-2017 by the lowest competitive capacity as a result of resource productivity. The analysis of labour productivity and structural characteristics of farms conducted in this study showed that there have been changes in the agriculture of member countries between 2013 and 2022.

This has also been confirmed by other studies. Neuenfeldt et al. (2019, p. 714) note that the European Union's agriculture has undergone significant structural changes in recent decades. The most visible and significant changes are reflected in the decreasing number of farms, increase in farm size, and specialization of production. The area structure of farms in EU countries varies significantly. Babiak (2010, p. 90) explains that in addition to natural conditions, these differences depend on the advancement of the process of structural transformation in each country. According to Peng et al. (2024, p. 11), agriculture in the European Union is struggling to find the optimum farm size, with some CAP support measures encouraging family farming and others prompting an increase in the scale of farming, which promotes consolidation processes. According to the study, in Poland, the average farm size is one of the lowest among the EU member states, although it shows an upward trend. According to Pawlak and Poczta (2025, p. 4), one cannot expect a remarkable stimulating effect of CAP on structural changes in Polish agriculture in the short term. Given the slow pace of structural changes, they will continue in the coming years. In the discussion supporting the existence of small farms within the framework of state agricultural policy, one can distinguish extreme views on the subject. Some point to the necessity of eliminating small farms so that their resources can be used more efficiently by more developmental farms, while others point to the need to sustain them to reduce poverty (Davidova et al., 2009) or achieve sustainable development goals (Adder, 2017).

Research has shown that low labour productivity remains a problem in Polish agriculture. The efficiency of production factors, including the labour factor of Polish farms in 2010-2013 was analyzed by Orłowska (2014). She showed that the economically larger a farm, the higher its productivity of land, labour, and capital (except for very large farms). Wicki (2019) arrived at a similar conclusion, pointing out that the economic size of farms is one of the most important factors affecting productivity. This characteristic determines not only the growth of labour productivity but also the ability to invest, introduce technical progress, and achieve both internal and external economies of scale. Structural transformations aimed at concentrating processes in agriculture are justified. Peng et al. (2024) emphasize that increasing the quality of human capital in the agricultural sector can help increase agricultural labour productivity and ultimately income. Based on an analysis of FADN data, Takács (2013), showed that labor productivity has a strong positive relationship with net farm value-added, which has a decisive impact on farm performance. Ancans (2023) showed that labour productivity in agriculture was low in almost all Eastern European member states, with the exception of the Czech Republic and Slovakia. He explained the relatively high productivity in these countries based on the average farm size. Forgacs (2020), on the other hand, found that the productivity of land and labour depends largely on the specialization of farms. The research presented in this paper showed a relatively lower growth rate of labour productivity in most old EU member states. Similar conclusions were reached by Jarka (2017), who explained the low growth dynamics in Germany and the Netherlands by the fact that these countries have perhaps reached a maximum level of labour productivity that will be difficult to exceed under unchanged conditions.

5. Conclusions

This study contributes to the discussion on the relationship between the level of labour productivity and the structural characteristics of farms. The research results show Poland's unfavorable situation in terms of labour productivity, although its growth dynamics was one of the highest among EU countries. A low level of labour productivity is accompanied by unfavorable structural characteristics of farms, inappropriate relations between production factors, and a high level of employment. Poland is a country where the number of people employed in the agricultural sector is one of the highest among the Member States. According to Eurostat data, in 2022, Polish agriculture employed 8.5% of the total workforce, with only three countries (Bulgaria, Romania, and Greece) having a higher percentage. Although there have been structural changes in agriculture in Poland over the years under study, their pace is still too low. In addition, the research showed a correlation between the level of labour productivity, the economic size and technical equipment of farm labour. This is a clear indication of the continuation of the development path of agriculture in Poland related to the improvement of the agrarian structure, which remains related to the increase in the economic size of farms. Further changes are also required in the relations between the production factors, especially between land and labour, and labour and capital.

This study is not without its limitations, as it does not consider all structural characteristics of farms. Farms in Poland are diverse, not only in terms of area and economic size but also in terms of production direction or level of mechanization. Hence, it is reasonable to conduct further analysis of labour productivity for more homogeneous groups, separated, for example, based on economic size or agricultural type (specialization).

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