

Analysis of dairy farm assets in the Visegrad Group based on the Farm Accountancy Data Network 2015-2022 data

A tejtermelő gazdaságok vagyoni helyzetének vizsgálata a visegrádi csoport országaiban a 2015-2022 években a Tesztüzemi Információs Rendszer adatai alapján

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ABSTRACT

This study aims to investigate the milk production of the Visegrad countries (V4), to answer the question, of what differences and similarities characterize the asset structure of the dairy farms of these countries. Based on the Farm Accountancy Data Network (FADN), the size and the structure of the fixed assets, as well as the use of subsidies for investments is analyzed. The study focuses on differences and similarities in the stock of current assets, as well as the structure of liabilities. Based on the structure of assets Czech Republic and Slovakia show more similarities. Based on the results characteristics of Hungarian dairy farms are closer to the EU average, while the characteristics of Polish farms are determined by their small economic size. Due to their small size, they minimise liabilities, Polish dairy farms are characterized by a dominance of family labour. In Poland the most typical type of fixed assets is land. The tendency of the number of dairy cows and the structure of the other three countries' assets are not significantly different from each other. Within fixed assets, breeding livestock represent a greater weight, and within current assets, non-agricultural current assets.

Keywords: milk production, efficiency, structure of assets, debt ratio, Visegrad Group

ÖSSZEFOGLALÁS

A kutatás a visegrádi országok tejtermelésére fókuszál, arra keresve a választ, hogy milyen különbségek és hasonlóságok jellemzik a tejtermelő gazdaságok vagyoni szerkezetét az egyes országokban. A vizsgálat a Tesztüzemi Információs Rendszer (FADN) adataira építve elemzi a befektetett eszközök nagyságát, szerkezetét, valamint a beruházásokhoz kapcsolódó támogatások igénybevételét. Kiemeli a forgóeszközök állományában megjelenő hasonlóságokat és különbségeket, valamint elemzi a kötelezettségek összetételét. Az eredmények alapján megállapítható, hogy a vagyon szerkezete alapján Csehország és Szlovákia mutat nagyobb hasonlóságot. Magyarország tejjgazdaságainak jellemzői inkább az Unió átlaghoz közelebbiek, míg a lengyel gazdaságok jellemzőit a kis ökonómiai méret határozza meg. A lengyel tejjgazdaságokra a családi munkaerő túlsúlya jellemző. A kis méretből adóan az idegen forrásokat nem használják. Legjellemzőbb tartósan lekötött eszközük a föld. A másik három ország esetében a tejelő tehénállomány számának alakulása és a vagyoni összetétel nem különbözik jelentősen. A befektetett eszközökön belül a tenyésztőállatok képviselnek nagyobb súlyt, a nem tartós eszközökön belül pedig a nem mezőgazdasági forgóeszközök.

Kulcsszavak: tejtermelés, hatékonyság, eszköz szerkezet, eladósodottsági mutató, Visegrádi országok

INTRODUCTION

Recently, the dairy sector has undergone a significant structural transformation, the size of farms has increased and advanced agricultural production systems have spread (Poczta et al. 2020; Galica, 2023). The increase in world milk production was caused by the growth in demand associated with the growth of the world's population and the rise in living standards, modern animal feeding, and the development in technology (Von Keyserlingk et al., 2009; Parzonko et al., 2023). The dairy market has many players on the producer side, which results in significant competition. The economic environment is continuously changing and market players need to respond by introducing innovative technologies (European Commission, 2015). Producers want a competitive advantage, so they increase their production and invest in ways that improve the technical efficiency and income generation of their dairy farms (Spička and Smutka, 2014).

Developments in genetics, feeding and herd management resulted in an increase in milk yield and, in this connection, a decrease in the numbers of farms and cows in many countries. These changes affected the dairy sector of the EU countries to a different extent and given the policy changes within the European Union, the size of the dairy herd is expected to increase in many European countries. Increased herd size and specialization within the farm can bring efficiency improvements, which is now essential for survival. (Nehring et al. 2016; Marquer, 2013; Krpalkova et al., 2016). The high labour and capital intensity and the relatively low profitability of the invested capital of this line of agricultural production deter especially young farmers from continuing and developing (Parzonko et al., 2023).

Dairy farms in the old EU member states have higher milk yields than in other parts of the EU (European Commission, 2019). This is due to their natural characteristics and different social, economic and regulatory conditions (Spička and Smutka, 2014; Skarżyńska, 2017). The financial and economic situation of these farms also differs significantly from that of other EU countries (Guth, 2017).

The EU exports milk around the world as the main exporter globally and as the second largest producer of milk in the world (Bórawski et al., 2020, Jongeneel et al. 2023). The EU's main milk producers are old EU member states – Germany, France, the Netherlands and Italy – and, Poland, which together account for around 70% of total EU milk production. While Poland is the third largest milk producer, its milk yield per cow is one of the smallest in the EU (Bórawski and Dunn, 2015; European Commission, 2019; Parzonko et al., 2023). Only a few countries in the EU with high production potential have a decisive influence on the market (Skarżyńska, 2017). In Germany, France and Italy, the number of dairy farms has recently decreased, while the average herd size has remained stable (European Commission, 2019). Requena-i-Mora and Barbeta-Viñas (2024) studied the relationship between farm size and farm economic performance, and they found that smaller farms were more economically profitable. But including the imputed family labour in the profit margins, most farms made a loss, that is farms sustained themselves through self-exploitation by relying on unpaid labour from family members.

The CAP provides a stable solution for dairy farms, responsible for the agricultural production increase, thus ensuring the independence of food production in the EU and stimulating the process of restructuring the dairy sector (with the improvement of milk quality, pre-accession support investments, export development, increase in milk prices). (Augustyńska-Grzymek et al., 2015; Bórawski and Dunn, 2015) Rising prices in the dairy sector could lead to inflation. A fall in prices can lead to farmers becoming indebted, which in the long term leads to unemployment (Perrot et al; 2007). Support for the sector aims to support incomes, improve food security, increase competitiveness, protect the environment and natural resources, and improve technology (Ubrežiová, 2005). As one of the types of CAP non-repayable aid subsidies on investment can drive the process of agricultural and farm modernization and restructuring (Fertő et al., 2021). However, investments improve production efficiency, increase concentration and the scale of production, and reduce labour shortages

(Bórawski and Dunn, 2015; Ubrežiová, 2005). In addition, dairy farmers need investments in green and digital technologies to respond to policy changes and societal expectations (Fertő et al., 2021).

Since the end of the milk quota (1 April 2015), the supply and price of milk are regulated by the market, so all milk producers, processors and countries have to continuously seek competitive advantages in the internal and EU market, as well as outside.

Dairy farms in the EU countries are quite diverse in terms of the scale and intensity of milk production, while the farm structure of farms in Poland is characterized by a significant number of holdings with a relatively small production scale, regarding milk production, land size and capital resources dairy farms of Czechia are the biggest in Central and Eastern Europe (Parzonko et al., 2023).

V4 countries share mutual historical heritage since under strong influence of the Soviet Union after the II World War significant social and agricultural uniformity was among them. Despite the similarities, at the beginning of the transformation period their starting positions varied greatly, thanks to which the policy and agriculture of these countries varies (Augustyńska-Grzymek et al., 2015)

The aim of this study is to present an overview of the milk production in the Visegrad countries of the period between 2015-2022 (at the time of calculations, this was the latest available data from FADN), looking for an answer to what differences and similarities characterize the production of the V4 countries' milk producers and the asset structure of dairy farms since the end of the milk quota. A comparative analysis of the dairy farms of the Visegrad countries fills a gap in the literature.

Czech Republic

Due to the transformation of the Czech economy and the Czech Republic's accession to the European Union, since the 1990s the Czech dairy sector has undergone significant institutional and structural changes, which significantly affected the performance, structure and size of the dairy sector (Zakova Kroupova, 2016).

The majority of the large state-owned agricultural enterprises that dominated Czech agriculture were completely privatized and transformed into business partnerships after 1991. Thanks to this, the dairy farms of Czechia are the biggest in Central and Eastern Europe (Parzonko et al., 2023).

The development of the dairy sector in the Czech Republic is significantly influenced by the situation of the dairy market in the European Union. Low milk prices are forcing producers to reduce costs and increase production efficiency. Large farms are exploiting economies of scale to produce at lower cost.

Some of the 35 industrial dairies are owned by foreign companies. There are no cooperative dairies, so there is no personal link between the processor and producer. The farms also supply milk to dairies near the Czech-German border. Despite the very low milk prices, investments are being made in barns with 400 to 500 places, where animal welfare conditions are a priority. Dairy enterprises account for 9.2% of all agricultural enterprises and more than 10% of total agricultural production (Durilová, 2021). Sustainable production systems and animal welfare are very important for Czech consumers. Milk is an important export for the country. Exports of milk and dairy products account for 41% of milk production in terms of milk equivalent, while imports account for 34.7%.

Slovakia

The Slovak dairy industry has recently undergone significant changes. At the end of the 1990s, milk producers' organizations were spontaneously created at the initiative of farmers, in response to ensuring fair market conditions for milk producers. The majority of milk is offered to the market by farms that have a greater concentration of arable land, and are also oriented towards cattle breeding (Simo et al., 2016).

The quality of milk and dairy products, technological equipment and work efficiency have improved. The involvement of foreign capital in Slovak dairy enterprises has improved the quality of products and increased the quantity of raw materials processed. Foreign investors

choose Slovakia because of its cheaper labour, energy and inputs compared to the EU average and the limited supply of dairy products (Ubrežiová, 2005).

Investment in the Slovak agricultural sector has declined in recent years, although the country's share of gross value added is high compared to the EU average. Since EU accession in 2004, the stock of outstanding loans has increased significantly. There are three main drivers of investment by Slovak farmers: expanding the size of enterprises, modernizing agricultural enterprises and improving production standards. The dairy and cattle sectors account for 19% of agricultural production.

Poland

The dairy sector, with dairy cow's husbandry and milk production, is one of the most important branches of agricultural production, which is a source of income for many farms in Poland (Augustyńska-Grzymek et al., 2015; Wilczyński et al., 2020).

The rural community strongly resisted the establishment of state farms, despite attempts by state authorities to impede the development of small family farms between 1945 and 1989. Changes and subsequent transformations after 1991 Poland's accession to the EU did not fundamentally change the existing economic structure. Polish farms, including farms specializing in breeding cattle and milk production, are still among the smallest in the EU. Changes after 1991 and transformations after Poland's accession to the EU did not fundamentally change the existing economic structure, so Polish farms are still among the smallest in the EU (Parzonko et al., 2023).

At the same time the country's accession to the structures of the European Union radically changed the operation of the entire dairy sector. Huge progress has been made in meeting EU requirements, during which productivity has also improved, although the gap between the Polish market and the largest EU milk producers is still significant (Augustyńska-Grzymek et al., 2015). One of the greatest problems of the Polish dairy sector is fragmented milk production with a great share

of the small farms within the structure of dairy farms (Augustyńska-Grzymek et al., 2015). Zietara et al. (2024) analyzed the relationship between the scale of milk production and the factors of efficiency, and they found that milk production is highly uncompetitive for smaller farms, because their income is too small to cover the extremely high opportunity cost of labour. Meanwhile, Wilczyński et al. (2020) found that the average efficiency in the groups of the smallest and largest farms was at a similar, high level in Poland.

Polish dairy farms have a high share of own and family labour, a low concentration of livestock and low output. In recent years, the number of farms has decreased, while their size and livestock numbers have increased, which has contributed to improved profitability (Kowalska et al.; 2019), and a group of voivodships specialized in milk production was developed at the regional level, so the increase in concentration of the milk production and processing is visible (Szajner, 2017).

Poland has the lowest operating costs per ton; partly thanks to this, it is one of the EU member states with the highest margin (Jongeneel et al. 2023). Despite the reduction in the number of dairy animals, the quantity of milk produced has increased. In the period 2000-2017, the number of cows decreased by 29%, while milk yields increased by 62% (Kowalska et al.; 2019). The increase in milk production is due to the result of investments in the improvement of production technology and changes in nutritional practices (Augustyńska-Grzymek et al., 2015).

Improving competitiveness requires an increase in livestock concentration and genetic improvement (Wierzejski et al. 2020). Accession to the EU has been a major advantage for Polish agriculture. Farmers received financial resources to restructure their farms. The first support was the Special Accession Programme for Agricultural and Rural Development (SAPARD), which benefited 12.36 thousand farmers. Under the SOP programme, they received investment subsidies, with priority given to dairy farms (Zalewski et al.; 2022). So large investment inputs accompanied the processes of the growth in concentration of milk production, the effect

of which was improved technical and economic efficiency (Szajner, 2017). The criteria for assessing applications were: the age of the farmer, education, farm size or level of milk production (Zalewski et al.; 2022). After Austria (23.4%) young farmers are the most common in Poland (21.0%) (Jongeneel et al. 2023).

Hungary

In Hungary, milk production reached its maximum (2,880 million kg) in 1988, 90% of which was purchased by the state and cooperative dairy industry (MIOPB, 2013). During the economic transformation accompanying the change of regime, the ownership relations changed. The lowest point of production was in 1995. In 1999, due to the change in subsidies and credit policy, dairy farms were able to attract more capital, thus achieving significant development (Gesztzi and Borbély, 2005).

At the time of EU accession (2004), the actual production was 1,900 million kg, which decreased further in the years following accession, while raw milk exports increased (Popp et al., 2010). The first half of 2004 was characterized by a decrease in the price of milk, and as a result of accession, prices began to slowly increase (Vágó, 2005). In 2009, the dairy crisis required agricultural government measures, which meant bringing forward the payment of quota-based support (Pogány et al., 2011).

In Hungary's agriculture in general, a structural change can be observed: in addition to the decline of small farms - mostly self-sufficient, producing as a complementary activity - the number of viable commodity farms is increasing, which can provide work for an increasing number of workers (Varga, 2019). Developments in the livestock sector have been aimed at improving the competitiveness of the sector and the efficiency of energy use. Investments have been made in animal health, animal housing, animal feed, new buildings and machinery for handling and storing the products or feed and crops produced (Vulcz, 2017).

According to Kapronczai (2016), there was and still is a problem in Hungarian agriculture not with the mass of investment subsidies, but with the efficiency and

structure of their use. As a consequence of the increase in subsidies available for agricultural machinery investment or the expansion of subsidy opportunities, machinery distributors have increased the price of machinery. Thus, part of the subsidy is not used in the sector but by the machinery distributors. Between 2010 and 2015, the largest investments were in machinery and real estate, followed closely by investments in livestock. The high share of machinery investment in this period was the economic consequence of economic policy decisions and internal automatisms. These two types of investment were influenced by the development opportunities announced. Farmers will not invest in high-value real estate without subsidies and external funding. Investment in real estate was also reduced by the fall in livestock numbers. Significant improvements have been made, with only a small decrease in housing capacity, which has increased compared to the turn of the millennium (Kapronczai, 2016). Profitability in dairy production averaged above 15% in 2011-2014, but due to price declines, profitability in 2015 relative to production value decreased dramatically (Kapronczai, 2016).

Fertő et al. (2021) presented the development of Hungarian dairy farm investments and analyzed the investment behavior to investigate the effect of state interventions with CAP investment subsidies on dairy farms as dairy farmers use a large amount of capital on asset-specific investment. According to their results in Hungary, state investment subsidies helped dairy farms to overcome their investment-related financial difficulties. Any reform of the CAP instruments that involves a reduction in subsidies may limit the investments of dairy farms and increase the exit of dairy farms, not only in Hungary but in EU agriculture.

Augustyńska-Grzymek et al. (2015) investigated the farms' production effectiveness indexes (milk yield, value of production per dairy cow; labour input (AWU) per dairy cow, production per AWU; capital productivity index - value of production per 100 euro of assets) and found that the values were better in Hungary than Poland in 2012 based on FADN data. Among the new EU member states Slovakia, the Czech Republic, and Hungary had the

highest income per AWU in 2018, but they had the lowest margin in the EU, thanks to their high operating costs due to their relatively low level of specialization (European Union, 2021; Jongeneel et al. 2023). In Hungary, the share of milk production from specialized farms is 76%, while in Czechia it is 64% (the Slovak share is only a little bit higher, 67%), which is actually lower compared to the Polish (88%) and the EU's (93%) share (Jongeneel et al. 2023).

MATERIALS AND METHODS

The aim of this study is to present the production, potential and economic situation of milk producers in the V4 countries from 2015 – since the end of the milk quota. The analysis is based on data collected and processed in the FADN.

The sample for which FADN data is available is representative of most farms (of an appropriate economic size) in each country, which jointly account for at least 90% of total standard output, therefore FADN data is presented as average figures for farms in each country (European Union, 2021). The type of farming covered by this study (code 45 in the FADN grouping scheme) includes farms where dairy cows account for more than 75% of ruminants kept on the farm (Poczta et al., 2020). Data was collected in 2015–2022 (at the time of calculations, this was the most recent data available in the FADN). Descriptive methods were used to reach conclusions.

The differences in production potential are related to factors which include different historical and natural conditions and the level of economic development of a country (Poczta et al., 2020). This study presents not only the indicators of the farms' production potential (e.g. natural resources, available machinery and technical equipment, and owned labour resources and their ratios) but also the indicators of productivity (output per dairy cow, output per 1 AWU, output per 100 Euro assets). Augustyńska-Grzymek et al. (2015) used these indicators to assess the productivity of Hungarian and Polish dairy farms.

The purpose of economic analysis is to examine the effectiveness and efficiency of the development and management activities of the farms. The assets of the farms are the elements necessary for its operation and for achieving the corporate goal. Its composition varies from company to company.

The increase in the ratio of fixed assets can be considered positive if investments have been made that are justified by the quantitative or qualitative improvement of future production. At the same time, fixed costs of production will have to be taken into account to a greater extent in the future. An increase in the ratio of current assets can be viewed positively if it results from the acquisition of assets that improve the flexibility and adaptability of the enterprise in production and in terms of external environmental demands.

The equity and liabilities used to finance the assets of the enterprise are classified into two groups: the group of own resources (equity) and the group of external resources (liabilities). The debt ratio (debt-to-asset) and the equity ratio (equity-to-asset) measure of how much of farms' assets are owned by investors and how much of farms' assets are leveraged. If the debt ratio is around 30%, it is considered favorable, the maximum acceptable level is 50% (Bíró et al., 2007; Paár et al., 2021).

The research also seeks to identify differences and similarities in the asset structure of dairy farms in these countries and investigate the debt ratio (debt-to-asset) and the equity ratio (equity-to-asset) of farms.

RESULTS AND DISCUSSION

While the number of dairy cows per farm increased in the Czech Republic, Slovakia and Poland, the opposite trend in Hungary developed in the period 2015-2017. After a steady decrease, there was a slight increase in Hungary in 2018, after which the number of dairy cows per farm decreased again. In the Czech Republic and Slovakia, the tendency in the number of dairy cows is fluctuating. For the former, it increased during the examined period, for the latter, it decreased, thanks to which the Czech Republic is now the first among the Visegrad countries

considering the number of cows per farm. Only in Poland, the tendency is stable with a slight increase.

The structure of farms varies considerably (Table 1). In the Czech Republic and Slovakia, the concentration of the number of cows is typical, well above the EU27 average. Denmark comes first (223.5 LU/farm in 2022), followed by the Czech Republic and Slovakia. The Hungarian economic size of farms is the closest to the EU average. The economic size of farms is above the EU27 average in the Czech Republic and Slovakia (close to each other) and well below average in Poland. A similar tendency to the number of cows can be seen in terms of economic size. For this reason, an increase in economic size can be observed in Poland, which is accompanied by an increase in the number of cows per farm. The reason for this is the pursuit of scale efficiency and better development opportunities. In Slovakia, a decrease in economic size, agricultural area and number of cows per farm can be observed. The opposite trend is characteristic of the Czech Republic, so by the end of the period it is ahead of Slovakia in terms of economic size and dairy cows' number per farm.

In terms of total utilized agricultural area, which provides the possibility of fodder production, the largest farms in the EU are in Slovakia, the Czech Republic and Estonia. The size of the arable land per farm in these countries was (in the former order) 238.2 ha, 264.9 ha and 210.3 ha in 2022.

Although Slovak labour use decreased significantly during the examined period, it is still the highest in the EU. Poland uses the least labour; however, Poland has the highest use of family labour due to the dominance of small family farms in the dairy sector. In the Czech Republic and Slovakia, large-scale dairy farming is dominant and therefore the proportion of family labour is the lowest. In addition, Hungary has the smallest unpaid labour unit of farms in the EU (Estonia's indicator is similarly low, with 0.77 AWU in 2022).

To evaluate the effectiveness of dairy farms, the ratios of the output and the input (productivity index), the value of production per dairy cow and the value of production

per labour input can be assessed. These indexes (Table 2) are the highest in the Czech Republic (the former exceeds the EU27 average, similar to Slovakia). In terms of labour productivity, Hungary is only slightly behind Czechia, but compared to the EU27 average, the value of all four countries is significantly lower. Considering the input/input ratios, the least labour input is used in Hungary to supply 10 animal units, but even this is higher than the EU average. Poland has the highest crop area per livestock unit, however, the Visegrád countries also lag behind the EU27 average in terms of this indicator.

The Czech Republic leads the Visegrad countries in terms of milk yield closely ahead of Hungary. The Estonian and Danish milk yield is the highest in the EU (over 10,000 kg/cow). Slovakia is close to the EU27 average and Poland is below average. Small family farms are less able to exploit the genetic potential and the potential of more advanced technology than large-scale systems. In the Czech Republic, Slovakia, and Hungary, specialization is relatively low compared to the EU28 average (93% in 2018). Regarding the production structure, the predominance of dairy production is typical in smaller farms, 80-86% in Poland and 68-80% in Hungary. For the larger Czech and Slovak dairy farmers, the production structure is more diversified, with milk production accounting for between 45% and 68% of total output (European Union, 2021).

Due to the large economic size of both countries, Slovak dairy farms had the highest assets in the Visegrad Group until 2017 (Table 3), and Czech farmers were only slightly behind them. From 2018, the assets per farm in the Czech Republic started to increase, in 2022 only Denmark and the Netherlands overtook it in the EU (with an asset value of around 4-5 million). By 2022, Hungarian dairy farmers had on average nearly 29% of the assets of Czech farms, Pole 15%, and Slovak 58%.

Looking at the asset structure, total fixed assets account for more than half of the assets in all four countries. This figure is 58-64% in Hungary, 62-69% in Slovakia, 67-71% in the Czech Republic and the highest in Poland at 84-91%.

Table 1. Characteristics of dairy farms (2015-2022)

Year	Economic size (1,000 €)	Total Utilised Agricultural Area (ha)	Cattle dairy cows (LU ¹)	Total labour input (AWU ²)	Unpaid labour input (AWU)	Milk yield cattle dairy cows (kg/cow)
	(SE005 ³)	(SE025)	(SE086)	(SE010)	(SE015)	(SE126)
Hungary						
2015	179	99.7	53.6	4.15	0.85	7,237
2016	163	85.4	50.3	3.61	0.88	7,121
2017	136	71.0	42.2	3.20	0.90	7,547
2018	243	104.3	75.1	5.13	0.91	8,159
2019	207	74.3	66.3	4.36	1.07	7,926
2020	200	86.8	61.8	4.17	0.85	8,034
2021	193	83.2	58.9	4.17	0.87	8,055
2022	181	84.5	55.6	3.67	0.76	8,480
Czech Republic						
2015	589	363.7	136.6	13.70	1.56	7,233
2016	622	384.1	143.8	14.23	1.52	7,293
2017	611	364.9	145.8	14.03	1.58	7,858
2018	692	411.6	149.5	15.07	1.34	7,998
2019	660	397.8	141.0	13.65	1.36	8,007
2020	697	425.4	149.0	14.22	1.27	8,116
2021	747	448.2	161.9	14.45	1.26	8,287
2022	692	428.8	150.4	13.35	1.20	8,519
Slovakia						
2015	636	749.2	154.3	22.02	0.90	5,796
2016	720	810.4	175.8	22.33	0.85	6,359
2017	759	812.9	184.7	21.51	0.66	6,850
2018	597	578.0	149.1	17.60	0.86	6,581
2019	610	608.8	151.4	17.51	0.94	6,890
2020	628	595.4	157.6	17.16	0.83	7,429
2021	543	571.0	131.7	15.43	0.91	6,935
2022	542	558.0	134.2	14.74	0.89	7,063
Poland						
2015	46	22.9	17.7	1.84	1.79	5,465
2016	44	22.1	16.9	1.76	1.71	5,630
2017	48	23.5	18.5	1.86	1.81	5,868
2018	57	26.5	20.4	1.87	1.77	6,190
2019	58	26.6	20.9	1.86	1.76	6,324
2020	58	25.9	20.9	1.83	1.74	6,424
2021	57	24.8	20.9	1.83	1.76	6,291
2022	60	25.8	21.6	1.87	1.75	6,513
EU27						
2015	104	35.1	30.9	1.66	1.40	7,007
2022	135	45.3	40.1	1.94	1.54	7,323

¹ Livestock Unit, ² Annual Work Units, ³ for standard variable details see FADN (2024)

Source: FADN data

Table 2. The indexes of production efficiency (2015-2022)

	Value of production per		Labour intensity AWU/10LU	Stocking density (LU/ha)
	Dairy cows (1,000 €/LU)	Labour input (1,000 €/AWU)		
Hungary	3.24	46.15	0.70	0.68
Czechia	4.50	47.13	0.96	0.37
Slovakia	4.06	34.22	1.19	0.24
Poland	2.71	29.05	0.94	0.80
EU27	3.39	71.19	0.48	1.59

Source: Own calculation based on EU FADN data

The changes in the value of both buildings, machinery and breeding livestock have fluctuated over the period under study. There are successive increases and decreases. These trends vary from country to country.

Similar tendencies can be observed in all three asset groups of Hungarian dairy farmers. A steady decline in the first three years, followed by a slight increase in 2018 and a decline in the last years. If we look at the subsidies on investment received during this period, the highest amount was in 2015 (€ 2,698 per farm), with no subsidy received in 2016-17. In 2018 Hungarian dairy farmers received € 100/farm and in 2019 they will receive € 433/farm, and in 2022, they could already receive support of € 1,721/farm for the development of fixed assets, which manifested itself in the increase of machinery.

In the Czech Republic, the above asset items have changed at different rates than in Hungary. There was an increase in the first three years, then a decrease and a slight increase again in the last year. The level of support for development was much higher than in Hungary: € 19,872 per farm in 2015, with no subsidy received in 2016, € 14,741 in 2017, € 16,885 in 2018 and € 20,749 in 2019. The highest amount (€ 23,828) was in 2020, but it was also much higher in 2022 (€ 14,018) than the other Visegrad countries.

As the total asset, the stock of machinery for Slovak dairy farmers decreased by the end of the examined period. The most critical year for the stock of breeding

animals was 2018. Slovak farmers received less support than those in the Czech Republic, with just over € 11,500 in 2015-16, but this fell to € 2,972 in 2017-18, and no subsidy in 2021. In Poland, the amount of received subsidies was much more balanced, which was available every year and fluctuated between € 549 and € 422. Due to the relatively small share of subsidies in farm net income milk production is less dependent on such type of support (Augustyńska-Grzymek et al., 2015).

The trend in changes in assets can be clearly seen in the evolution of gross investments on fixed assets. The value of net investment on fixed assets is positive only in the Czech Republic over the period under review. From the decline in 2019, it has been decreasing year by year, returning to the 2015 level by 2022. There have been significant improvements in buildings, machinery and breeding livestock. Technological change, environmental protection and raising the level of animal welfare may require investment aimed at improving the capital stock of dairy farms, so one of the main areas of subsidies is the use of renewable energy sources, environmental protection and organic farming (Bórawski and Dunn, 2015; Bórawski et al., 2020; Fertő et al., 2021). Of the four countries surveyed, farmers in the Czech Republic received the highest value of subsidies.

Hungarian farmers were unable to develop their fixed assets between 2015-2017, and Slovak and Polish farmers in 2015-2016, and 2020.

Table 3. The fixed assets structure of dairy farms

Year	Total assets (€)	Total fixed assets (€)	Land, permanent crops & quotas (€)	Buildings (€)	Machinery and equipment (€)	Breeding livestock (€)	Gross investment on fixed assets (€)	Net Investment on fixed assets (€)
	(SE436)	(SE441)	(SE446)	(SE450)	(SE455)	(SE460)	(SE516)	(SE521)
Hungary								
2015	409,000	263,711	35,902	111,342	56,172	60,262	11,169	-5,899
2016	361,994	234,698	34,692	94,645	52,192	52,955	8,740	-4,636
2017	325,553	205,483	36,086	78,645	44,943	45,631	7,933	-3,536
2018	594,771	375,573	42,958	155,400	90,768	86,182	30,622	4,321
2019	503,635	312,245	41,337	124,930	72,825	72,826	21,945	1,002
2020	510,100	310,667	41,165	128,276	73,341	67,746	27,262	7,031
2021	573 890	365,619	61,082	144,369	97,866	62,212	45,058	22,564
2022	621,262	365,639	71 ,741	131,885	104,023	57,849	50,676	29,914
Czech Republic								
2015	1,298,604	926,037	136,743	431,648	226,828	130,286	91,939	9,212
2016	1,446,232	1,025,143	168,828	484,832	235,097	135,862	112,499	23,090
2017	1,552,713	1,076,510	201,292	495,560	240,129	138,897	113,355	26,034
2018	1,817,126	1,281,244	255,925	573,448	295,268	156,049	155,470	50,846
2019	1,727,884	1,211,458	250,368	549,993	258,611	151,677	127,472	28,313
2020	1,901,824	1,315,931	293,331	584,933	279,897	157,183	129,800	23,370
2021	2,099,780	1,441,022	323,019	659,947	285,353	172,207	136,666	22,461
2022	2,147,552	1,451,582	323,261	645,013	302,618	180,529	126,193	9,185
Slovakia								
2015	1,427,666	957,342	57,884	577,028	171,652	104,259	5,766	-1,290
2016	1,700,619	1,166,889	90,283	674,085	234,150	122,235	4,878	-1,693
2017	1,778,086	1,192,723	120,160	664,164	233,722	137,136	8,760	1,468
2018	1,396,053	974,073	95,561	532,142	189,883	103,953	9,626	1,637
2019	1,618,071	1,086,415	134,275	557,180	240,289	105,102	8,636	414
2020	1,835,873	1,142,623	158,329	586,398	241,158	104,843	7,981	-193
2021	1,269,990	829,874	78,792	423,810	153,196	105,154	9,044	1,106
2022	1,250,666	805,270	72,673	383,087	143,782	123,313	10,009	1,718
Poland								
2015	241,045	221,153	110,382	48,650	45,195	16,849	5,487	-1,257
2016	229,210	207,854	106,782	45,351	39,811	15,860	4,585	-1,619
2017	256,279	230,959	117,458	49,811	45,172	18,460	8,539	1,684
2018	283,105	253,424	127,691	54,656	49,988	21,029	9,085	1,490
2019	289,772	258,635	130,827	55,446	50,542	21,716	8,192	442
2020	282,902	251,665	126,948	52,987	50,516	21,108	7,598	-98
2021	284,681	249,662	125,453	50,963	51,496	21,680	8,784	1,209
2022	317,834	267,782	135,522	52,925	53,760	25,492	9,893	1,938
EU27								
2015	459,791	388,454	221,763	78,753	50,760	34,812	17,124	3,075
2022	747,903	589,433	354,565	104,159	75,885	52,396	28,155	8,357

Source: FADN data

The amortization charged was higher than the value of the investments in these years, i.e. it was not able to replace the assets that were worn out. In the case of Hungarian dairy farmers, net investments have the highest negative value, one of the reasons for this is the lack of investment subsidies and the capital deficit. In the case of Poland, the improvements are aimed at increasing the economic size (Augustyńska-Grzymek et al., 2015; Szajner, 2017). Net investment was lowest in Slovak farms, where investment was highest, but still not enough to replace obsolete assets. Simo et al. (2017) highlight that through the system of national subsidies and other economic instruments, the Slovak Ministry of Agriculture and Rural Development must revitalize the breeding of cows with marketable milk production, to finish the overall decline of the milk sector. For Slovak farmers, in addition to subsidies, the low borrowing rates on loans introduced in 2015 will help them finance their investments.

Poland also shows the largest divergence from the other Visegrad countries in the composition of fixed assets, meanwhile, it is the closest to the EU27 fixed assets' structure (Table 4). Half of the fixed assets are land. Buildings and machinery account for almost the same 21% and 20% respectively, while livestock only 8%. In Slovakia, buildings are more than half of the value of fixed assets, the share of machinery is similar to the other countries' (and thus to Poland), and the share of livestock is only 3% higher than in Poland, and 2% lower than in the Czech Republic. The asset structure of Hungarian and Czech dairy farmers shows greater similarities. Buildings are the largest share, but they do not reach 50%. The share of machinery is nearly the same (20-24%) while breeding animals represent a larger share (21%) of fixed assets for Hungarian farmers than in the other Visegrad countries. The composition of the assets shows that the Polish dairy farmers have the lowest technical endowment, with

Table 4. The share (%) of the fixed assets' components (2015-2022)

	Land, permanent crops & quotas	Buildings	Machinery and equipment	Breeding livestock
Hungary	15	40	24	21
Czechia	19	46	22	13
Slovakia	10	54	20	11
Poland	51	21	20	8
EU27	59	19	13	9

Source: own calculation

Table 5. The indexes of production efficiency from an asset perspective, 2015-2022

	Value of production per 1,000 Euro assets	Fixed assets-to-labour ratio (€'000/AWU)	Fixed assets-to-land ratio (€'000/ha)
Hungary	0.39	74.93	3.55
Czechia	0.39	86.39	3.00
Slovakia	0.41	55.45	1.56
Poland	0.20	131.77	9.79
EU27	0.22	274.26	11.75

Source: Own calculation based on EU FADN data

Table 6. The current assets' structure of dairy farms

Year	Total current assets (€) (SE465)	Non-breeding livestock (€) (SE470)	Stock of agricultural products (€) (SE475)	Other circulating capital (€) (SE480)	Inventories (€) (SE476)
Hungary					
2015	145,289	23,812	29,262	92,215	41,713
2016	127,296	19,986	27,722	79,588	39,439
2017	120,070	16,472	23,539	80,059	36,042
2018	219,198	33,460	40,992	144,746	65,023
2019	191,390	28,913	31,005	131,471	49,342
2020	199,433	25,593	28,275	145,565	42,245
2021	208,271	25,249	23,469	159,553	43,781
2022	255,623	28,511	24,116	202,995	44,691
Czech Republic					
2015	372,567	66,912	52,742	252,913	127,743
2016	421,089	69,054	56,752	295,282	152,890
2017	476,203	75,194	62,584	338,425	166,545
2018	535,883	82,845	64,679	388,359	187,327
2019	516,426	81,553	65,258	369,615	195,689
2020	585,893	83,659	70,301	431,933	207,922
2021	658,758	96,214	76,009	486,536	243,871
2022	695,970	98,747	98,788	498,435	279,562
Slovakia					
2015	470,324	95,583	37,684	337,057	193,726
2016	533,730	90,291	53,193	390,246	242,723
2017	585,363	82,652	49,029	453,682	260,163
2018	421,980	63,677	36,509	321,795	202,652
2019	531,656	78,919	43,178	409,560	242,265
2020	693,250	76,952	49,787	566,511	278,929
2021	440,116	76,420	42,170	321,527	189,048
2022	445,395	66,801	44,701	333,894	200,556
Poland					
2015	19,892	6,888	6,723	6,281	7,989
2016	21,357	6,677	6,769	7,910	8,452
2017	25,321	7,899	8,295	9,127	10,077
2018	29,681	9,412	8,963	11,305	11,649
2019	31,137	9,365	9,775	11,997	12,513
2020	31,237	8,927	9,916	12,395	12,130
2021	35,019	9,992	11,706	13,321	14,819
2022	50,052	11,689	18,258	20,105	24,344
EU27					
2015	71,336	13,037	6,805	51,495	13,126
2022	158,470	18,687	15,346	124,437	40,179

Source: FADN data

land dominating the asset structure, while in the Czech Republic, Hungary and Slovakia, buildings dominate.

In terms of the capital productivity index (value of production per 1,000 Euro assets), Poland is the closest to the EU27 average. Hungary, the Czech Republic and Slovakia perform similarly, well above the EU27 average. The ratio of fixed assets per labour unit and agricultural area for all four countries is below the EU27 average. Regarding the Visegrad countries, it can be stated that Poland is the closest to the EU27 average. Poland is the closest to the EU27 average, especially in terms of the fixed assets-to-land ratio, since it has the highest proportion of land to fixed assets.

Slovak and Czech farmers had the highest total current assets (Table 6), with current assets per livestock unit ranging from € 2,900 to € 3,600/LU. Hungarian farmers are the worst off in the Visegrad Group, with only the last year reaching € 1,000/LU. Polish dairy farmers' current assets increase steadily from 1,005 €/LU to 1,400 €/LU. Except for Slovakia, the countries showed an increase in current assets, Poland during the entire examined period, while the Czech Republic and Hungary from 2019. The current assets of Slovak farms show fluctuating changes. The decline will be greater in 2018 and 2021, which occurred in all four groups of current assets.

Non-breeding animals include young animals and fattening animals. Their value has fluctuated, determined mainly by animal breeding technology, culling and reproduction biology (Bórawski and Dunn, 2015; Bórawski et al., 2020). In addition to feed, the stock of agricultural

products includes various raw materials for production and goods. Hungarian, Czech and Polish farmers have kept this stock of current assets at a relatively high level, higher than the EU27 average. Other current assets include cash and assets that can be liquidated within one year.

Looking at the structure of current assets (Table 7), the most significant differences are found between Polish dairy farmers to the other Visegrad countries. The proportions of the three main elements can be considered almost the same. For dairy farms in the other three countries, the share of non-breeding livestock ranged between 14 and 16%. There are greater differences in the proportion of stock of agricultural products. Slovak farmers had the lowest (9%) and Hungarian farmers the highest (16%) proportion of agricultural stocks, due to different feeding technologies and the production of larger quantities of forage. The share of other current assets was highest in Slovakia (76%), indicating the existence of a high level of cash and accounts receivable. Slovakia is nearly the same as the EU27 current assets' structure.

The size of the liability stock varied hectically for each country (Table 8). In the Czech Republic and Hungary, a significant increase was observed towards the end of the period under review (this increase is typical for both long-term and short-term loans.). In Hungary and Slovakia, farmers preferred short-term loans. From 2019 Polish and Slovak dairy farmers have reduced their long-term loans.

Table 7. The share of the current assets' components (%), 2015-2022

	Non-breeding livestock	Stock of agricultural products	Other circulating capital	Inventories
Hungary	14	16	70	26
Czechia	16	13	71	36
Slovakia	15	9	76	44
Poland	30	33	37	41
EU27	16	9	75	20

Source: own calculation

Table 8. The structure of dairy farms' liabilities

Year	Total liabilities (€) (SE485)	Long & medium-term loans (€) (SE490)	Short-term loans (€) (SE495)	Net worth (€) (SE501)	Average farm capital (€) (SE510)
Hungary					
2015	96,414	38,491	57,923	312,586	377,895
2016	79,403	32,398	47,005	282,591	321,583
2017	57,685	17,079	40,606	267,867	287,182
2018	123,982	42,361	81,620	470,789	535,356
2019	95,785	34,547	61,237	407,850	454,236
2020	96,577	44,729	51,848	413,523	445,513
2021	144,255	62,857	81,399	429,635	476,687
2022	152,117	55,533	96,585	469,145	485,372
Czech Republic					
2015	479,944	315,564	164,379	818,660	1,167,990
2016	541,190	366,146	175,044	905,042	1,263,108
2017	539,538	362,375	177,163	1,013,174	1,333,562
2018	690,687	468,798	221,890	1,126,439	1,557,676
2019	597,815	389,506	208,310	1,130,069	1,469,164
2020	729,376	458,048	271,328	1,172,448	1,600,023
2021	655,733	431,879	223,854	1,444,048	1,758,081
2022	714,312	428,343	285,969	1,433,240	1,783,795
Slovakia					
2015	396,930	76,962	319,968	230,827	142,091
2016	570,500	143,742	426,758	220,844	130,431
2017	549,304	151,320	397,984	246,174	147,148
2018	482,576	175,833	306,744	268,082	164,910
2019	707,093	222,646	484,447	275,510	169,009
2020	798,648	206,712	591,935	271,451	166,503
2021	433,189	89,581	343,608	273,805	165,458
2022	480,780	81,022	399,758	307,587	183,094
Poland					
2015	12,677	9,919	2,758	228,368	138,500
2016	11,121	8,533	2,588	218,089	126,006
2017	13,382	10,159	3,223	242,897	142,178
2018	17,710	13,143	4,567	265,395	160,420
2019	16,921	12,049	4,872	272,851	163,828
2020	14,640	10,694	3,947	268,262	160,555
2021	13,228	9,500	3,727	271,453	161,382
2022	12,176	7,930	4,246	305,658	179,223
EU27					
2015	111,716	96,210	15,506	348,074	248,415
2022	153,503	129,154	24,348	594,400	414,786

Source: FADN data

Net worth, which shows the value of assets without external liabilities, has also fluctuated but increased slightly in all four countries from 2015 to 2022.

Looking at the structure of liabilities and the debt ratio (Table 9), the Czech and Slovak farmers were the most indebted. In these countries, the foreign liabilities ratio was 36 of assets. Polish farmers had the lowest debt burden (5%).

Table 9. The share of the liabilities' components (%) and debt ratio, 2015-2022

	Long & medium-term loans	Short-term loans	Debt ratio	Equity ratio
Hungary	38	62	21	79
Czechia	65	35	36	64
Slovakia	25	75	36	64
Poland	73	27	5	95
EU27	84	16	23	77

Source: own calculation

In addition to the lack of land consolidation and low profitability, it was the small amount of loans that limited investments in dairy farms in Poland. Small dairy farms had difficulty accessing capital, and development opportunities were limited. Small dairy farms are often supported by dairies that provide loans to farmers to help the farms develop quickly (Bórawski et al., 2020).

The proportion of debt to liabilities also shows a different picture. The Czech Republic and Poland had a higher share of long & medium-term loans (65-73%), suggesting a higher use of development loans. Hungarian and Slovak farmers tended to have more short-term debt proportion.

CONCLUSIONS

While European dairy farms differ greatly, according to the results of Poczta et al. (2020), five different types of dairy farms (EU countries) can be identified based on the economic situation, with the Czech Republic, Hungary, Slovakia (and Estonia) in one cluster, and Poland

in another. Nevertheless, there are many differences between countries within the same cluster. Investigating the milk production of the Visegrad countries, the following conclusions can be made.

In the Czech Republic and Slovakia, the concentration of the number of cows is typical, well above the EU27 average. In Slovakia, a decrease in economic size, agricultural area and number of cows per farm can be observed. The opposite trend is characteristic of the Czech Republic, so by the end of the period it is ahead of Slovakia in terms of economic size and dairy cows' number per farm. Poczta et al. (2020) highlights, that the farms of these Central and Eastern European countries (including Hungary) have large resources of productive inputs because as a result of the collectivization processes, large-scale commercial farms with large agricultural areas were established, a significant part of which, despite the large number of changes of ownership, retain their original form, and old operating methods. The Hungarian economic size is the closest to the EU average. The size of the total utilized agricultural area, which provide the possibility of fodder production, is adjusted to the economic size.

Augustyńska-Grzymek et al. (2015) investigated and compared the farms' production effectiveness indexes of Hungary and Poland after accession to the EU from 2004 and 2012. Although milk yield has increased, and labour productivity has decreased in both countries since then, Hungarian farms are still about 30% better than Polish farms in terms of average milk yield per cow, and Hungarian farms continue to be characterized by better labour productivity. Hungary uses the least labour per animal unit among the Visegrad countries. Although Slovak labour use decreased significantly during the examined period, it is still the highest in the EU. The number of employees of Polish dairy farms also differs significantly from the other examined countries. Poland uses the least labour; however, Poland has the highest use of family labour. While large-scale production remained in the Czech Republic and Slovakia, small herd concentration (around 20 cows) is typical in Poland.

Considering the assets of dairy farms, Poland shows a different picture compared to the other countries. The fixed assets represented a significant proportion of total assets. While this share is around 90% in Poland, in the other Visegrad countries it is below 70% (in Hungary only 60-65%). In Hungary, the Czech Republic and Slovakia, the most significant element of fixed assets is livestock buildings, while in Poland it is land. Poland also differs from the other countries in terms of the structure of current assets, the ratio of non-breeding livestock, stocks of agricultural products and other circulating capital is almost 1/3-1/3-1/3, while in the other three countries, the ratio of non-agricultural current assets is above 60-70%.

Examining the liabilities, the result is similar in that Poland shows a different picture, Polish farmers were the least indebted. According to the literature, a debt ratio of around 30% is considered favorable, with a maximum acceptable level of 50%. All Visegrad countries have ratios that meet this standard, although there may be farms with higher ratios in individual countries. In addition, while short-term loans are typical in Slovakia and Hungary, long-term liabilities are typical in the Czech Republic and Poland.

Overall, it can be said that considering the asset structure the Czech and Slovak farmers show the most similarities due to their common past. The Polish dairy farms show the biggest differences both in terms of the number and the tendency of livestock, as well as in the structure of assets, the reason for which is that the Polish dairy farm is mostly based on small family farms. One of the main milk producers in the EU, but with characteristics that are different not only from the other Visegrad countries but also from the other largest milk producers in the EU.

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