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# Challenges and Trends in Agricultural Employment: The Case of Hungary

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## Abstract

The agriculture and food industry faces many challenges, including a shortage of skilled and seasonal workers, low productivity, and a demographic shift towards an ageing agricultural population. The agricultural productivity and efficiency of Central and Eastern European countries, including Hungary, are relatively low compared to that of Western Europe. This study explores the complex landscape of agricultural employment in Hungary by analysing its situation and challenges that are in line with international standards. Using national- and company-level data, the study applies an analytical framework comprising descriptive statistics and a non-parametric Kruskal-Wallis test to explore patterns and trends in the sector's performance. In Hungary, more than 70% of farm managers are over 45 years old. Furthermore, despite the increase in the number of people with an agricultural education, around 150,000 farms still rely on experience-based management. We identify statistically verifiable and notable differences in the investigated indicators (sales revenue in proportion to number of employees, wage efficiency, personnel expenses per capita, assets value per capita) according to the founding period (pre-1989, 1989-2004, post-2004). The study concludes by arguing for generational change, better agricultural education and emphasis on the concentration of skills and capital within families as a sustainable solution, thereby addressing the complex challenges of the agricultural labour market and creating flexibility in the sector by attracting younger and educated people.

## Keywords

Agricultural employment, rural employment labour, migrant labour, employment problems, labour productivity, efficiency, Kruskal-Wallis tests, Hungary.

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## Introduction

In recent years, climate change, the fourth industrial revolution, and the growing middle class globally have posed increasingly greater challenges for agriculture and the food industry (Iglesias et al., 2012; Prisecaru, 2016; Wheeler and Von Braun, 2013). These challenges have appeared simultaneously on the market and with regard to technology. It is a market-related problem that in EU countries and, more narrowly, Central and Eastern European (CEE) ones, the development and productivity of the food industry exceeds that in Hungary (Bozsik and Magda, 2018; Fogarasi, 2007; Latruffe et al., 2012). A completely new technological environment is expected to be decisive in the coming years. At the same time, agriculture and the food industry play a significant role in CEE and the Hungarian economy for historical reasons and due to geographical location (Harangi-Rákos and Szabó, 2013; Ritter, 2004).

Despite their decreasing number, family farms are still crucial elements of agricultural employment in many developed countries (Klikocka et al., 2021; Smędzik-Ambroży et al., 2021). In Western and Northern Europe, the average size of farms is increasing due to greater efficiency pressure on modern farms (Hubert, 2018; Rye et al., 2018). Along with the increase in farm size, non-family employment also appears in the agricultural industry, especially in Central and Eastern Europe, although the number of family members working on family farms is decreasing (they prefer to work in other sectors of the economy). Family labour can be more

favourably replaced using seasonal workers than workers with permanent contracts (e.g., income tax is more favourable with short-term contracts; several programs support seasonal work) (Alarcón, 2021; Darpeix et al., 2014). In the case of Central and Eastern Europe, several studies (Biernat-Jarka, 2015; Dries and Swinnen, 2002; Górny and Kaczmarczyk, 2018; Labrianidis and Sykas, 2009) have highlighted that, due to structural change, the number of farms of less than five hectares (mainly family farms) has decreased to the greatest extent, as size significantly influences productivity. In turn, the number of immigrant seasonal workers is increasing in agriculture, including in Poland. During the high season, 80-90% of the workforce employed on Polish farms are immigrant workers, mainly from Ukraine (Górny and Kaczmarczyk, 2018). The proportion of migrant workers in agriculture is also rising in Greece; the primary reason is the movement of young people and women from the agricultural sector to other, more profitable sectors (Papadopoulos et al., 2021). In the case of Romanian agriculture (Mateoc-Sîrb et al., 2014; Tocco et al., 2012), the presence of a Western European agricultural model cannot yet be observed since agriculture accounts for a very large share of GDP and family farms are dominant and employ a significant amount of people. However, as in all European countries, in Romania young and skilled people are more likely to leave agriculture.

One primary means of increasing labour productivity is reducing the labour cost associated with creating agricultural products. For this, the use of new equipment and new technologies is essential, which may affect the workforce. Therefore, the development of human capital is essential in agriculture as well (Babenko and Vasilyeva, 2017). American farmers report that the recent wave of mechanisation and digitisation will reduce the use of migrant labour in agriculture (Carolan, 2020, D'Antoni et al., 2012), while according to German farmers, it will take a long time for machines to completely replace migrant workers (Prause, 2021). The rapid development of technology and smart agriculture and the collection and processing of an incredible amount of data require different knowledge and skills from agricultural workers than before. One of the most essential means of managing this change is education, which, however, must also adapt to this challenge (e.g., practice-oriented or dual training). Having professionals with the right knowledge and experience has become crucial. At the same time, it should also be noted that the education of the agricultural workforce is generally lower than in other sectors (Dries and Swinnen, 2002; Górny and Kaczmarczyk, 2018), and members of the highly educated workforce often do not spend a long time in the agricultural sector, instead looking for job opportunities in non-agricultural sectors (Bousmah and Grenier, 2022, Tocco et al., 2012, Unay-Gailhard and Bojnec, 2019).

As in other sectors, important goals include increasing profits and productivity. The need to increase productivity is further reinforced by the generally widely observed labour shortage in developed countries. Agricultural investment, innovation and capital per employee are directly correlated with agricultural gross domestic product per employee, highlighting the importance of investing in raising labour productivity (Herrendorf and Schoellman, 2015). In addition, decreases in labour due to technological developments require increasing employees' level of education (Babenko and Vasilyeva, 2017). However, the productivity of agricultural land grows more slowly than the increase in labour force, and growth in agricultural productivity lags behind that of input-producing sectors, which is especially true for smaller producers (Kołodziejczak, 2020). As a result, it is necessary to concentrate production, optimise the production structure, develop technology, and support young people in starting agricultural activities (Kuznets and Murphy, 1966; Duarte and Restuccia, 2010).

Kijek et al. (2020) examined the EU Member States based on agricultural productivity. The authors constructed three groups: countries with low- (the new Member States, except for Cyprus, Malta, and Slovenia), medium- (Greece, Italy, Portugal, Spain, and Cyprus, Malta, and Slovenia) and high- (the remaining old Member States) productivity. In the first two groups (low and medium), the values gradually converged within the groups, while the differences increased within the third group (high productivity), i.e., economic and structural conditions are very important from this point of view. The role of agriculture and the food industry is more significant in the new Member States of the EU than in the old ones, but the opportunities for employment growth are limited in the case of both groups of countries (Donnellan and Hanrahan, 2017). Another regional difference is that the role of the food industry in gross added value is typically greater in the old Member States, while the share of agriculture is more significant in the new Member States.

Hungary's transition from a centrally planned economy to a market-oriented one in the 1990s brought forth challenges and opportunities regarding the efficiency of agricultural employment. The agricultural workforce in Hungary has experienced a steady decline, primarily due to modernisation and structural changes in the sector. The level of education and skills among Hungarian agricultural workers is integral to employment efficiency (Mészáros and Szabó, 2014). The mechanisation and adoption of modern agricultural technologies have significantly enhanced labour efficiency (Schmitz and Moss, 2015). Sectoral productivity, capital accumulation, and total factor productivity contribute to sectoral performance, especially in key areas of the sector (Yasmin et al., 2019). Efficiency analyses of agriculture in Central and Eastern Europe, and mainly in Hungary, show less efficiency and less labour productivity in comparison to the EU-15 (Nowak et al., 2015; Đokić et al., 2022), and a decreasing trend over time (Kočišová, 2015). Different specialisation patterns and policy measures (e.g., subsidies) in the Central and Eastern European countries contribute to filling this gap (Górny and Kaczmarczyk, 2018; Csaki and Jambor, 2019).

Overall, the efficiency of agricultural employment in Hungary and other countries is influenced by a combination of the following factors: structural changes, education level, adoption of technology, investment, and government policies, each playing a significant role in shaping the productivity and competitiveness of the sector. In recent years, the listed problems have not been solved due to the fragmentation of the production structure of Hungarian agriculture, the ageing farming community, urbanisation and the migration of the rural population, the relatively low agricultural incomes, and the spread of the coronavirus pandemic along with the Russian-Ukrainian conflict. The purpose of the present study is to assess the situation and challenges of Hungarian agricultural employment in line with international standards and to provide relevant policy recommendations concerning the new challenges of agricultural employment and the education system. In this paper, the authors address the following questions: (1) How is agricultural employment developing in Hungary and? (2) What are the main trends in agricultural employment? (23) What challenges does Hungarian agricultural employment face? (34) What are the differences between companies operating in Hungarian agriculture in terms of time of foundation? We answer these questions in the Results and Discussion section. Finally, the last section provides conclusions and policy implications, notes limitations, and suggests future research based on the article.

## Materials and methods

In this chapter, we describe the structure of the database selected and the methodological approaches used for the analysis. First, the Hungarian agricultural employment situation is analysed based on national data from the Hungarian Central Statistical Office (HCSO). More specifically, descriptive statistics are calculated, with the help of the Excel and SPSS softwares, for the period from 2011 to 2020. However, this 9-year period was selected for the examination of the national data, since company-level data were available for three years (2011, 2015, 2020) obtained from OPTEN Informatics Ltd. In the first part of the paper (see Results and Discussion), the distribution of people employed in Hungary by economic sector, the number of Hungarian agricultural employees, the gender and age distribution of Hungarian agriculture, and the education level of farm managers were investigated. In this part, we seek to answer the following research questions: How is agricultural employment developing in Hungary and what are the main trends in agricultural employment? What challenges does Hungarian agricultural employment face?

We also used a company-level database containing 23,414 observations referring to various Hungarian agricultural enterprises. This firm-level data comes from OPTEN Informatics Ltd., which provides company data and information services. The OPTEN database contains the following variables about the companies: (1) name, (2) headquarters, (3) number of locations, (4) main activity, (5) headcount data, (6) location according to county, (7) net sales revenue, (8) equity, (9) personnel expenses, (10) assets, (11) year of foundation, and (12) the year the financial report was prepared.

Table 1 provides comprehensive details of the accounting data received from OPTEN, expressed in nominal prices for the examined enterprises. The indicators in this series relate directly and indirectly to the balance sheet, through the profit after tax. These indicators show a significant dispersion, reflecting the variability within the data. In order to deal with this variability and to achieve a more accurate representation,

| Accounting data (thousands of HUF) | Mean (Standard deviation) [5% trimmed mean] (median) | | |
|---|---|---|---|
| | 2011 | 2015 | 2020 |
| Net revenue | 609,814 (3,579,851) [226,993] (90,713) | 615,641 (3,904,126) [214,551] (84,675) | 715,060 (4,860,263) [232,726] (91,368) |
| Personnel expenses | 52,292 (234,960) [21,372] (9,305) | 57,524 (296,722) [22,307] (10,018) | 67,246 (380,480) [26,593] (12,457) |
| Assets | 582,415 (2,272,136) [287,529) (114,388) | 629,476 (2,495,063) [301,197] (109,886) | 794,104 (3,700,645) [353,081] (131,318) |
| Owners' equity | 288,074 (1,039,840) [148,433] (45,589) | 334,334 (1,149,360) [168,898] (49,786) | 428,493 (1,582,843) [207,170] (67,374) |

Source: Author's composition based on Opten (2023)

Table 1: Accounting data of the examined agricultural enterprises.

a 5% reduced average has been calculated by excluding the extreme values at the beginning and at the end of the data series. This adjustment results in a significantly corrected and refined comparison that provides insights, similar to the median.

In the second part of the article (see Results and Discussion ), the main emphasis is on presenting the basic characteristics of the companies (e.g., distribution of investigated enterprises by county or agricultural sector, the number of employees), as well as conducting a variance analysis for some accounting indicators (sales revenue in proportion to number of employees, wage efficiency, personnel expenses per capita, value of assets per capita) according to the founding period. Three years (2011, 2015, 2020) have been analysed, due to the data collection and transfer of OPTEN, highlighting the differences between the periods.

Descriptive statistics and non-parametric Kruskal-Wallis tests, in the case of the company data received from OPTEN, were applied using Excel and SPSS software. The Kruskal-Wallis test is used to determine whether there is a significant difference between three or more groups when the conditions of normal distribution are not met and the variances between independent samples are unequal. The Kruskal-Wallis test works by ranking data and then comparing the sum of the data ranks between groups. If there is no difference between the groups, then the differences between the statistical values calculated as the sum of the rankings of each group are random (Ostertagova et al., 2014, Breslow, 1970). In this paper, with the help of the Kruskal-Wallis test, a statistically significant (at the 5% level) difference was investigated in the above mentioned indicators in line with year of foundation (pre-1989, 1989-2004, post-2004). These periods and years were chosen because Hungary had a political and economic system change in 1989 and the country became the member of the European Union in 2004. Kruskal-Wallis test was used to answer the research question of 'What are the differences between companies operating in Hungarian agriculture in terms of time of foundation?'.

## Results and discussion

### The situation of Hungarian agricultural employment - based on national data

In Hungary, the democratic transformations that occurred in 1989-1990 fundamentally changed the organisation of the economy and society, accompanied by the appearance and permanence of unemployment. On the one hand, the number of economically inactive people increased; on the other hand, production fell. The economic activity of the population decreased due to the closure and transformation of various companies and (production) cooperatives. According to Halmos (2006), nearly one and a half million jobs were lost between 1989 and 1992, and the number of employed people continued to decrease until 1997. After the regime change, the structure of employment was radically transformed; the weight of the classical production sectors decreased, while the role of the service sector increased. This transformation resulted in a substantial reduction in the number of workers in agriculture.

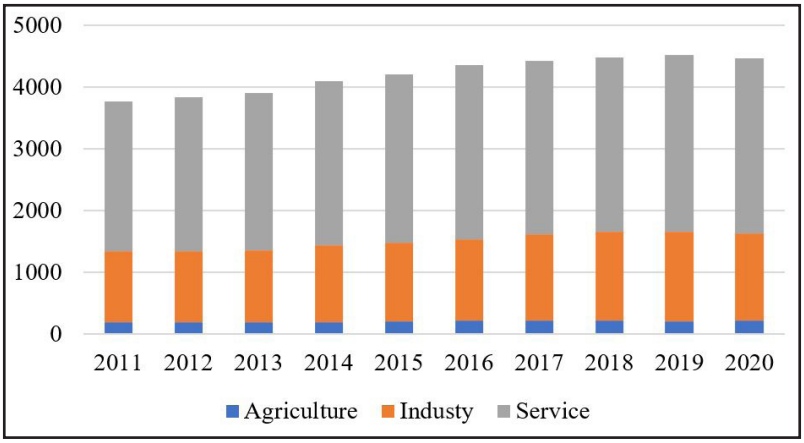
Using the data of the Hungarian Central Statistical

Office (HCSO), we sought to find out the trends in agricultural employment in Hungary between 2011 and 2020. The proportion was nearly two-thirds, approximately 30% in the industrial sector, and only 4.74% in the agricultural industry (Figure 1). The number of people employed in the agricultural sector has increased from 186,5 thousand in 2011 to 213,9 thousand in 2020, indicating the important role of the sector in the labour mark. However, the share of agricultural employment in total employment has slightly decreased from 4.78% in 2011 to 4.65% in 2020, indicating an expansion in other sectors. Based on Avincz et al. (2002), the number of people living from agriculture, or those connected to it at some level, may be much higher than in the official statistics. The share of the agricultural workforce in the EU varies across Member States, with a generally decreasing trend due to factors such as ageing and rural-to-urban migration, particularly among the younger generation seeking higher-paying employment (Popescu et al., 2021). In general, a small share of agricultural employment is a feature of European countries (Garrone et al., 2019, Megyesiova, 2021). Empirical evidence on the impact of subsidies on agricultural employment is mixed, with some studies showing positive effects (Breustedt and Glauben, 2007, Olper et al., 2014), while others find no or negative effects (Berlinschi et al., 2014). However, the CAP-related budgetary cost of maintaining jobs in agriculture is very high (Garrone et al., 2019).

Observing the distribution of employment by area, most people work in the Northern and Southern Great Plains and Southern Transdanubia (Table 2). The latter two regions are classically rural areas where the share of agriculture in GDP is the highest. After the regime change, relations between settlements were also transformed. Due to urbanisation, the labour force began to flow from rural (mainly agricultural) areas to towns. This process has affected the proportion of agricultural employees in villages and small towns since larger ones attract workforce from neighbouring settlements. As a result, most inhabitants do not participate in local production (Weber, 2014).

In addition to changes at national level, the data were used to examine how agricultural employment has changed at regional level. Regionally, agriculture is significant in all regions of Hungary except Budapest, where agricultural employment is lowest, but increased slightly from 3.1 thousand in 2011 to 4.5 thousand in 2020. In Central Hungary, the number of agricultural employees remained stable, but their share decreased. In Central Transdanubia region, the number of employees increased but their share decreased slightly. In Western Transdanubia, the number of employees remained stable but its share decreased, indicating a declining role of agriculture.

In South Transdanubia, fluctuations in the number of agricultural workers were observed. In Northern Hungary, the share of agricultural workers decreased, despite fluctuations in the number of employees. The Northern Great Plain showed a steady increase in both the number and the share of agricultural workers, highlighting the growing importance of agriculture in this region. The Southern Plain has also seen a steady increase in the number of agricultural employees, maintaining its dominant role in the region's labour market. The latter two regions are classically rural areas where the share of agriculture in GDP




Source: Author's composition based on HCSO (2023) data

Figure 1: Distribution of people employed in Hungary by economic sector (thousands of people).

is the highest. After the regime change in 1989-1990, relations between settlements were also transformed. Due to urbanisation, the labour force began to migrate from rural (mainly agricultural) areas to towns. This process has affected the proportion of agricultural employees in villages and small towns since larger ones attract workforce from neighbouring settlements. As a result, most inhabitants do not participate in local agricultural production processes (Weber, 2014).

Overall, the increase in the number of agricultural workers points to the continued importance and stability of the agricultural sector in the different regions of Hungary, despite a slight decline in its share of total employment. This may indicate a diversification of the economy, with other industries developing alongside agriculture.

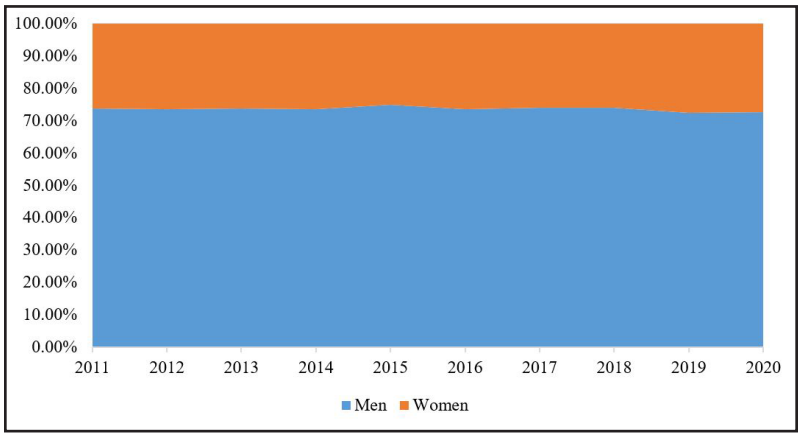
In Hungary, there have been no significant changes in terms of gender since men have always been disproportionately represented in agriculture due to the predominantly physical nature of the industry (Figure 2). In 2010 and 2011, after a continuous decrease, the proportion of men started to increase again and reached 76%. Since 2015, the proportion of men compared to women has continuously decreased; in 2020, 26.5% of the employed were women. It is clear from the literature that women are engaged in monotonous, less appreciated and less profitable agricultural activities (de Castro et al., 2020; Cortignani et al., 2020).

In addition to changes at national level, the data were used to examine how agricultural employment has changed at regional level. The age structure of agriculture (Figure 3) is very different from that of other sectors, as the proportion of the older age group is outstanding. While in 2011 and 2015, 55-64-year-olds were in the majority, by 2020, the over-65s accounted for 35% of managers of agricultural enterprises. Twenty-seven per cent of managers are between the ages of 60 and 69, but the age group between 70 and 75 also accounts for a significant 10%. Overall, more

| Regions | 2011 | | 2015 | | 2020 | |
|---|---|---|---|---|---|---|
| | Agriculture, thousand people | Share | Agriculture, thousand people | Share | Agriculture, thousand people | Share |
| Budapest | 3.1 | 0.41% | 3,7 | 0.44% | 4.5 | 0.51% |
| Central Hungary | 12.6 | 2.48% | 12.5 | 2.22% | 13 | 2.02% |
| Central Transdanubia | 19.6 | 4.26% | 23.1 | 4.61% | 22.8 | 4.39% |
| Western Transdanubia | 23.6 | 5.56% | 23.5 | 5.07% | 23.7 | 4.76% |
| Southern Transdanubia | 25.6 | 7.59% | 30.2 | 8.17% | 28.6 | 7.64% |
| Northern Hungary | 17.1 | 4.24% | 20.5 | 4.43% | 18.5 | 3.83% |
| Northern Great Plain | 38.5 | 7.35% | 43.1 | 7.14% | 48.7 | 7.59% |
| Southern Great Plain | 47.6 | 9.63% | 50.1 | 9.28% | 54.2 | 9.59% |
| Total | 186.5 | 4.78% | 205.3 | 4.74% | 213.9 | 4.65% |

Source: Author's composition based on HCSO (2023)

Table 2: Number of domestic employees in Hungary by region (2011, 2015, 2020).




Source: Author's composition based on HCSO (2023)

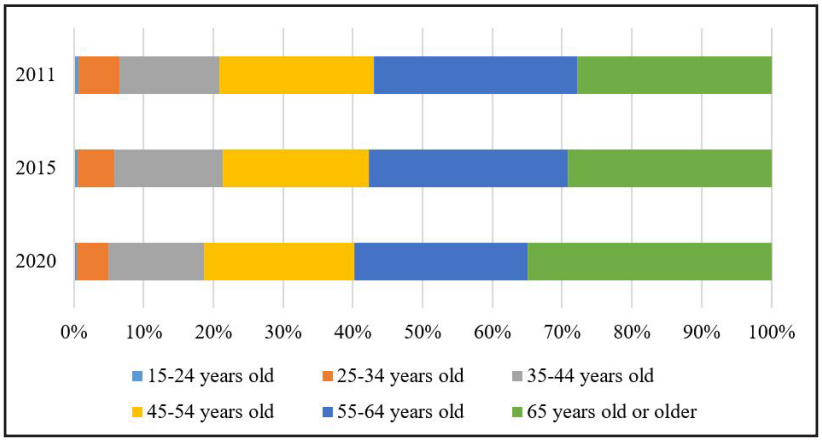
Figure 2: Gender distribution in Hungarian agriculture.

than 80% of farm leaders are between 45 and 74 years old in 2020. Demographic challenges pose a significant social obstacle for family farms, which is particularly evident concerning the issue of ageing managers, as predominantly observed in developed nations. Approximately one-third of family farm managers in the European Union are 65 or older, with notable percentages observed in specific countries such as Portugal (50%), Romania (44%), Cyprus (43%), and Italy (40%). Young farm managers (under 40) accounted for only about 10% of all managers (Eurostat, 2019). Overall, the increase in the share of the older generation and the decrease in the share of the younger generation indicate that the agricultural sector is a highly ageing. The ageing workforce is leading to structural changes in the agricultural sector, and concerns are being raised about its negative impact on the food economy. However, it should be noted that the survey is intended to show the manager of the farm. It is possible that a part of the younger generation is also active on family farms, but they are not participating in the management of farms. Younger farmers are associated with more efficient production practices (Leonard et al., 2017). Additionally, Potter and Lobley (1992) highlight that old age is linked to the transition from intensive to extensive production and the potential disappearance of family farms, especially when the successor is unknown. The challenge of ageing and inter-generational succession in the EU may impact the sustainability of family farming and rural areas.

Regarding the education of people employed in agriculture, only 5.5% of workers in 1990, 7.2% in 1996, and almost 7.7% in 2001 had completed higher education (Avincz et al., 2002). Among those managing farms, by 2020 (compared to 2011), the proportion without agricultural training or education had decreased by nearly 20% (Figure 4). Although the number of managers with agricultural qualifications has increased, there are approximately 150,000 farms that are managed based on experience alone. The education level of the agricultural workforce is generally lower than in other sectors (Dries and Swinnen, 2002, Górny and Kaczmarczyk, 2018), and members of the highly educated workforce typically do not stay long in the agricultural sector, largely for financial reasons (Tocco et al., 2012, Bousmah and Grenier, 2022).

The intensive mechanisation, automation, and robotisation that can also be observed in agriculture make it increasingly necessary to employ a workforce with new types of knowledge. Instead of manual workers, there is a growing need for specialists who can handle and service machines, which requires the development of other skills through education and technology-oriented training (Carolan, 2020). Operating constantly developing agricultural technology requires higher level qualifications (Putićová and Mezera, 2008). Additionally, education and various forms of training have a vital role to play in the employment of the workforce this frees up (Marinoudi et al., 2019).

Today, the younger generation has access to more learning and educational opportunities, which significantly impacts generational change. Farrell et al. (2021) observed that young individuals who leave farming for educational pursuits have the option to return, especially, if they receive subsidies or central support in agricultural areas of interest, such as organic farming. According

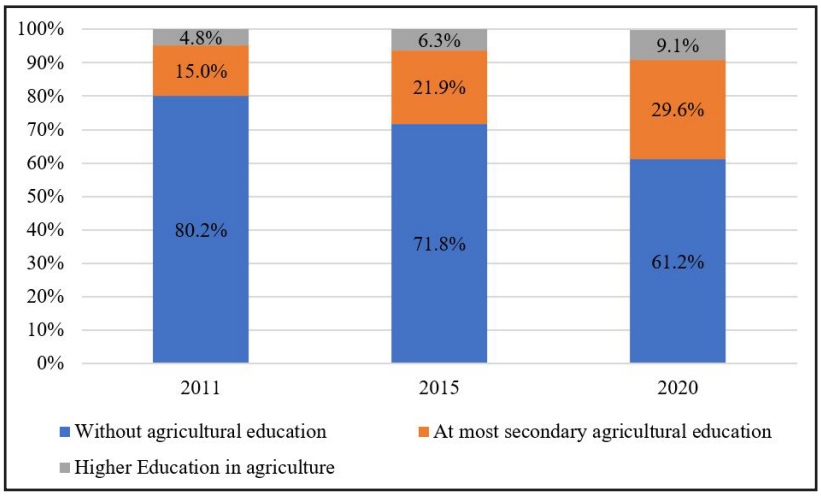



Source: Author's composition based on HCSO (2023)

Figure 3: Age distribution of farm managers in agricultural enterprises.

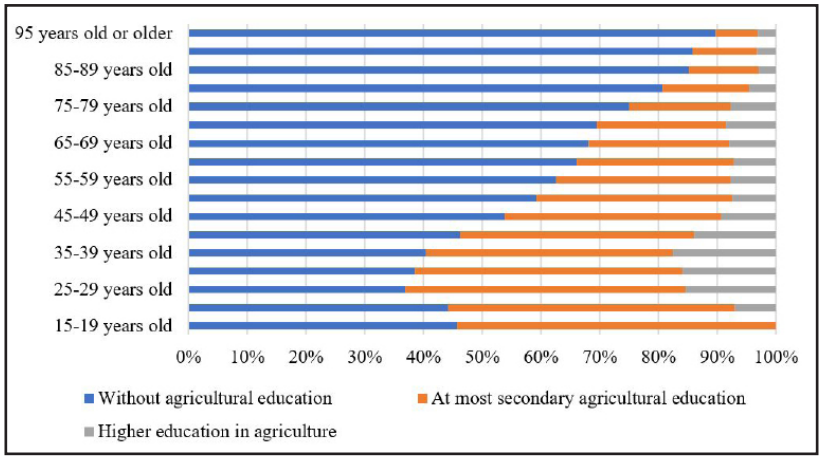
to Popa and Turek Rahoveanu (2021), education plays a crucial role in the decision to start or continue farming, with highly educated young farmers more likely to seek investment and farm establishment support. Popescu (2021) found a link between productivity and farmers' education, concluding that young people are keen to enhance their knowledge to improve their skills. Various studies have highlighted the increasing skill levels of farmers and the role of education in generational change and rural development (Elahi et al., 2022; Osterhoudt, 2018).In addition, Heider et al. (2021) identified the lack of modernization and development as another barrier to generational change. Chiswell and Lobley (2018) noted that older farmers often struggle to delegate farm management tasks, whilemodernization and digitalization offer solutions, as digitalizing administrative tasks allows young people to be more involved in daily farm operations. The adoption of innovative practices, precision agriculture, Agriculture 4.0 (or 5.0), and more sustainable farming methods can encourage the younger generation to take over farms and improve farm viability (Farrell et al. 2021). Modernization can enhance working conditions in agriculture and make the sector more appealing to young people. Research consistently shows that young people are more inclined to modernize the agricultural economy, with financial support being a critical factor (Karttunen et al., 2016; Widiyanti et al., 2018).

Comparison of the distribution according to age and education shows that more younger people have completed higher education (between 25-44 years), and the older a manager is, the greater the probability that they will not have completed agricultural education (Figure 5). According to Karácsony (2010), the low level of education of those employed in agriculture has hindered




Source: Author's composition based on HCSO (2023)

Figure 4: Distribution of farm managers by education.




Source: Author's composition based on HCSO (2023)

Figure 5: Age distribution of farm managers by education and age, 2020.

the development opportunities of Hungary's agriculture. Despite the increase in professional qualifications, today, middle-aged farmers who do not have a professional qualification (or other work experience outside of agriculture) have quite limited options and, if possible, want to continue farming until their retirement. In contrast, if members of the younger, more educated generation decide not to continue agricultural production, the structure of the agricultural workforce may undergo a significant transformation. This process is hindering the necessary restructuring processes in several Central and Eastern European countries (Ritter, 2018).

## The situation of Hungarian agricultural employment based on company data

The distribution of the examined enterprises by county is shown in Table 3. In the analysed sample, the largest proportion of enterprises were based in Pest, Bács-Kiskun and Hajdú-Bihar counties and Budapest. In contrast, the smallest proportion is located in Nógrád, Komárom-Esztergom, Fejér and Heves counties.

| **County** | **2011** | **2015** | **2020** |
|---|---|---|---|
| | **Distribution (%)** | | |
| Bács-Kiskun | 9.80 | 9.47 | 8.91 |
| Baranya | 4.93 | 5.43 | 5.72 |
| Békés | 6.66 | 5.81 | 5.55 |
| Borsod-Abaúj-Zemplén | 4.94 | 5.28 | 5.26 |
| Budapest | 6.08 | 7.46 | 7.89 |
| Csongrád | 4.35 | 4.35 | 4.55 |
| Fejér | 2.52 | 2.49 | 2.73 |
| Győr-Moson-Sopron | 5.14 | 4.89 | 4.71 |
| Hajdú-Bihar | 7.91 | 7.36 | 7.32 |
| Heves | 2.62 | 2.58 | 2.36 |
| Jász-Nagykun-Szolnok | 5.14 | 4.98 | 5.17 |
| Komárom-Esztergom | 2.37 | 2.27 | 2.18 |
| Nógrád | 1.23 | 1.06 | 1.05 |
| Pest | 12.91 | 12.70 | 12.59 |
| Somogy | 4.87 | 4.90 | 5.13 |
| Szabolcs-Szatmár-Bereg | 4.99 | 4.92 | 4.98 |
| Tolna | 3.49 | 3.70 | 3.87 |
| Vas | 3.31 | 3.15 | 2.98 |
| Veszprém | 3.74 | 3.80 | 3.86 |
| Zala | 2.97 | 3.40 | 3.19 |
| No data | 0.03 | 0.00 | 0.00 |

Note: Counties with the largest proportion of agricultural businesses are shown in bold. Counties with the smallest proportion of businesses are shown in italics.
Source: Author's composition based on OPTEN (2023)

Table 3: Distribution of enterprises by county in Hungary.

Table 4 provides descriptive statistics about the number of employees and the year of establishment of the companies. Regarding the number of employed people, the standard deviation is notable, which indicates that the degree of heterogeneity in the sample is high. A decrease in the number of employed people was typical during the analysed period, while in terms of the year of foundation, enterprises established after 1989 dominate. Market-based companies established after the regime change clearly operate and perform better than non-market-based companies established before 1989 (Martin, 2002).

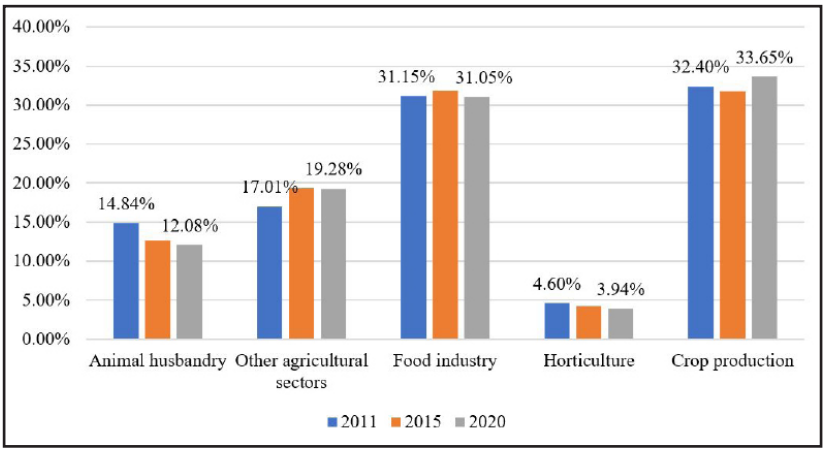
| | **Mean (standard deviation)** | | |
|---|---|---|---|
| | **2011** | **2015** | **2020** |
| Number of employees | 23.99 (79.95) | 19.77 (70.44) | 17.40 (70.55) |
| **Year of establishment** | **Distribution (%)** | | |
| | **2011** | **2015** | **2020** |
| -1989 | 2.89 | 1.6 | 1.26 |
| 1989-2004 | 77.2 | 59.7 | 49.36 |
| 2004- | 19.91 | 38.7 | 49.38 |

Source: Author's composition based on Opten (2023)

Table 4: Descriptive statistics of Hungarian agricultural companies in the sample.

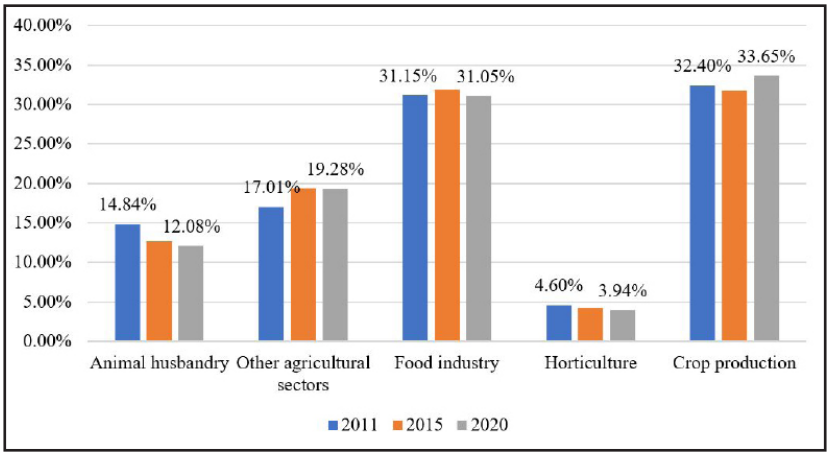
The distribution of the investigated enterprises according to sector is illustrated in Figure 6. The proportion of enterprises in crop production and the food industry is the largest, and those in the horticultural sector the smallest in the analysed sample.

In terms of the number of employees by sector, crop production does not stand out significantly (Figure 7), which shows that this sector is not overly labour-intensive, and mechanisation is present to a high degree.




Source: Author's composition based on Opten (2023)

Figure 6: Distribution of investigated enterprises by agricultural sector in Hungary.




Source: Author's composition based on Opten (2023)

Figure 7: Development of number of employees by sector in Hungary.

### Variance analysis based on period of establishment

In the next stage of our analysis, we investigated whether there is a statistically verifiable (significant at the 5% level) difference in the indicators (sales revenue in proportion to number of employees, wage efficiency, personnel expenses per capita, and assets value per capita) according to the founding period (-1989, 1989-2004, 2004-).

A significant difference at the 5% level was found between the period of foundation and sales revenue in relation to number of employees for the three years (Table 5). There are significant differences in revenue per employee by the year of establishment, highlighting how economic and political changes have affected business productivity over time. Enterprises established between 1989 and 2004 had consistently higher turnover per employee than those established before 1989 and after 2004. In 2011, enterprises established between 1989 and 2004 performed better in terms of turnover per employee, significantly outperforming enterprises established before 1989 and after 2004. This period benefited from the immediate effects of market reforms following the collapse of socialism and integration into the European Union, which boosted business growth through an inflow of resources and modernisation efforts.

The trend of outstanding performance of the 1989-2004 cohort continued in 2015. These enterprises maintained their leading position in terms of turnover per employee, underlining the lasting benefits of the various support programmes initiated during and after economic restructuring and EU accession. The ranking scores of companies from this period remained significantly higher than those of companies established in the other periods, confirming the idea that the initial reforms and support programmes have had a long-lasting positive impact

| Category | Test statistics | Average rank value | Test statistics (pairwise comparison) | Period of comparison |
|---|---|---|---|---|
| **2011** | | | | |
| -1989 | 8.65* | 2307.82 | -1.37 | (-1989) – (2004-) |
| 1989-2004 | | 2647.31 | -1.98 | (-1989) – (1989-2004) |
| 2004- | | 2544.26 | 2.34 | (2004-) – (1989-2004) |
| **2015** | | | | |
| -1989 | 34.98* | 3066.90 | -2.2 | (-1989) – (2004-) |
| 1989-2004 | | 3727.53 | **-3.63*** | **(-1989) – (1989-2004)** |
| 2004- | | 3470.54 | **5.03*** | **(2004-) – (1989-2004)** |
| **2020** | | | | |
| -1989 | 22.15* | 3318.04 | **-4.17*** | **(-1989) – (2004-)** |
| 1989-2004 | | 4132.81 | **-4.64*** | **(-1989) – (1989-2004)** |
| 2004- | | 4059.64 | 1.34 | (2004-) – (1989-2004) |

Note: *Significant at the 5% level.
Source: Author's composition based on Opten (2023)

Table 5: Variance analysis: period of establishment of companies in relation to sales revenue in proportion to number of employees.

on the productivity of companies.

By 2020, the dominance of firms from 1989-2004 in terms of turnover per employee has been maintained, although the gap between them and firms established in other periods has started to narrow. In particular, enterprises born before 1989 showed the most significant improvement in their turnover per employee. This improvement is probably due to the extensive restructuring and investments made in the previous decades, which allowed these older companies to catch up with more recently established companies.

The improved performance of enterprises created between 1989 and 2004 can be attributed to several key factors. Market reforms following the collapse of socialism created a more favourable business environment, while the inflow of EU funds provided financial support for growth and modernisation. These firms were able to take advantage of these benefits, resulting in higher productivity levels. In contrast, companies established before 1989 had to undergo significant restructuring to adapt to new market conditions, which initially hampered their productivity.

In addition, the creation of larger farms in the period 1989-2004 also contributed to the better performance of enterprises from this period. Although smaller farms, which are more prevalent in Hungary, have achieved faster growth rates, they remain generally less productive than their larger counterparts. This differentiation between smaller and larger farms further explains the differences in turnover per employee between different periods. Overall, the results show how historical economic and political changes have had a long-lasting impact on business productivity, with the period 1989-2004 proving to be a particularly favourable for business creation and growth.

What are the key factors driving the differences in wage efficiency among Hungarian enterprises founded in different periods? The analysis in Table 6 shows significant differences in wage efficiency between different categories of companies, at the 5% significance level. Enterprises established before 1989 have significantly lower wage efficiency than those established after 1989. In 2011, data showed that the wage efficiency of firms established before 1989 was significantly lower compared to those established later, while firms established after 1989 were more efficient in their use of labour costs. This trend continued in 2020, where pre-1989 enterprises show the lowest wage efficiency. In contrast, enterprises born between 1989 and 2004 showed the highest efficiency, closely followed by those which born after 2004. The lower wage efficiency observed in pre-1989 enterprises underlines the long-term impact of socialist economic policy, which often prioritised employment over productivity. In contrast, post-1989 born enterprises benefited from market-driven incentives and EU support, leading to more efficient practices and better use of labour costs. However, despite these improvements, overall wage efficiency in Hungarian agriculture remains significantly below Western European standards. On average, a Hungarian

| Category | Test statistics | Average rank value | Test statistics (pairwise comparison) | Period of comparison |
|---|---|---|---|---|
| **2011** | | | | |
| -1989 | 12.97* | 1857.07 | **-3.56*** | **(-1989) – (2004-)** |
| 1989-2004 | | 2623.89 | **-3.40*** | **(-1989) – (1989-2004)** |
| 2004- | | 2664.81 | -0.94 | (2004-) – (1989-2004) |
| **2015** | | | | |
| -1989 | 26.97* | 2462.37 | **-5.10*** | **(-1989) – (2004-)** |
| 1989-2004 | | 3645.48 | **-5.19*** | **(-1989) – (1989-2004)** |
| 2004- | | 3630.42 | 0.30 | (2004-) – (1989-2004) |
| **2020** | | | | |
| -1989 | 53.47* | 2679.21 | **-7.10*** | **(-1989) – (2004-)** |
| 1989-2004 | | 4109.55 | **-6.47*** | **(-1989) – (1989-2004)** |
| 2004- | | 4260.63 | **-2.78*** | **(2004-) – (1989-2004)** |

Note: *Significant at the 5% level.
Source: Author's composition based on Opten (2023)

Table 6: Variance analysis: founding period of companies in relation to wage efficiency.

farm worker produces roughly half as much as his or her Western European counterpart. Despite the major events of the past decades and Hungary's accession to the EU, this trend does not show any significant improvement, as detailed by Csáki and Jámbor (2018). The persistence of this gap highlights the continuing challenges in achieving parity with productivity levels in Western Europe, indicating that further reforms and support are needed to improve the efficiency and productivity of Hungarian agriculture.

Per capita personnel expenditure shows the average expenditure on staff, reflecting the level of investment in human resources. How do different periods of establishment influence per capita personnel expenditure among Hungarian enterprises, and what factors contribute to the varying levels of investment in human capital across these periods? Table 7 shows significant differences between enterprises created in different periods. Enterprises created after 1989 had higher per capita personnel expenditure in 2011 than those created before, and the average ranking values suggest that enterprises created after 1989 put more emphasis on investment in human resources. This trend was maintained in 2015, with enterprises created after 1989 continuing to have higher per capita personnel expenditure, reflecting efforts to improve the quality and productivity of their workforce. By 2020, the pattern remained consistent, with per capita personnel expenditure being highest for enterprises created after 2004, followed by enterprises created between 1989 and 2004, and lowest for enterprises created before 1989.

The higher per capita personnel costs of enterprises after 1989 reflect a strategic shift towards investment in human capital, driven by the need to remain competitive in a more market-oriented and technologically advanced agricultural sector. These enterprises are likely to take advantage of market incentives and potential EU support to increase their labour skills and productivity. In contrast, older enterprises, established before 1989, are often constrained by legacy structures and have limited access to capital, resulting in lower investment in labour. Their lack of investment in human capital may prevent them from competing effectively with more modern, better financed enterprises. The general trend underlines the importance of investing in human capital to increase productivity and competitiveness in the agricultural sector, especially, in adapting to today's market and technological demands.

In the following paragraph, we seek to answer the question: What factors have influenced the differences in per capita asset values among Hungarian enterprises founded in different periods, and How have historical and economic contexts shaped the capital investment patterns and modernisation efforts in these enterprises?

The value of assets per capita, which serves as an indicator of capital intensity, shows significant differences between enterprises founded in different periods, as detailed in Table 8. In 2011, enterprises founded between 1989 and 2004 had a higher value of assets per capita compared to enterprises founded before 1989 and after 2004, indicating a concerted effort towards modernisation and capital investment

| Category | Test statistics | Average rank value | Test statistics (pairwise comparison) | Period of comparison |
|---|---|---|---|---|
| **2011** | | | | |
| -1989 | 10.08* | 2081.65 | **-3.17*** | **(-1989) – (2004-)** |
| 1989-2004 | | 2605.95 | **-3.06*** | **(-1989) – (1989-2004)** |
| 2004- | | 2630.50 | -0.56 | (2004-) – (1989-2004) |
| **2015** | | | | |
| -1989 | 24.13* | 2866.39 | **-3.75*** | **(-1989) – (2004-)** |
| 1989-2004 | | 3681.85 | **-4.48*** | **(-1989) – (1989-2004)** |
| 2004- | | 3555.45 | **2.47*** | **(2004-) – (1989-2004)** |
| **2020** | | | | |
| -1989 | 10.72* | 3542.33 | **-3.00*** | **(-1989) – (2004-)** |
| 1989-2004 | | 4116.76 | **-3.26*** | **(-1989) – (1989-2004)** |
| 2004- | | 4076.55 | 0.70 | (2004-) – (1989-2004) |

Note: *Significant at the 5% level.
Source: Author's composition based on Opten (2023)

Table 7: Variance analysis: period of establishment of companies in relation to personnel expenses per capita.

| Category | Test statistics | Average rank value | Test statistics (pairwise comparison) | Period of comparison |
|---|---|---|---|---|
| **2011** | | | | |
| -1989 | 100.93* | 2462.46 | 0.81 | (-1989) – (2004-) |
| 1989-2004 | | 2763.47 | **10.01*** | **(-1989) – (1989-2004)** |
| 2004- | | 2323.14 | -1.76 | (2004-) – (1989-2004) |
| **2015** | | | | |
| -1989 | 170.10* | 3671.23 | **2.54*** | **(-1989) – (2004-)** |
| 1989-2004 | | 3871.18 | **13.04*** | **(-1989) – (1989-2004)** |
| 2004- | | 3204.83 | -1.10 | (2004-) – (1989-2004) |
| **2020** | | | | |
| -1989 | 79.16* | 3916.87 | 0.74 | (-1989) – (2004-) |
| 1989-2004 | | 4269.39 | **8.84*** | **(-1989) – (1989-2004)** |
| 2004- | | 3784.79 | -2.01 | (2004-) – (1989-2004) |

Note: *Significant at the 5% level.
Source: Author's composition based on Opten (2023)

Table 8. Variance analysis: period of establishment of companies in relation to value of assets per capita

during this transitional period. This trend continued in 2015 and 2020, with enterprises from the 1989-2004 period consistently maintaining the highest per capita asset values. This sustained advantage can be attributed to the significant investments made during Hungary's transition from planned economy to a market economy and accession to the European Union, which provided substantial financial support and incentives for infrastructure development and modernization initiatives. However, pre-1989 enterprises struggled with inherited structural weaknesses and limited resources for substantial capital investment, resulting in relatively lower per capita asset values. Meanwhile, post-2004 enterprises, despite their relative newness and potential flexibility, have not yet reached the same level of capital intensity, probably due to a more competitive financing environment and changing market dynamics. These results underscore the profound impact of the historical and economic context on the capital investment patterns of Hungarian agriculture, highlighting the critical role of targeted investment in promoting modernisation and enhancing competitiveness.

In 2022, agricultural income, measured according to the income of deflated factors per annual work unit (AWU) expressed as an index, increased by 12.5% compared to 2021. This rise was driven by a higher factor income (+10.3%) achieved with less total agricultural labour input, which decreased by -1.9%. Across the EU, many Member

States recorded increased or unchanged income per AWU, with notable rises for several key agricultural producers. Conversely, the sharpest declines were observed in Romania (-26.0%), Portugal (-11.7%), Malta (-8.7%), and Lithuania (-8.0%). Overall, agricultural income per AWU for the EU in 2022 continued its upward trend since 2009, reflecting both a steady factor income and, notably in 2022, a sharp increase (Eurostat, 2023).

## Recommendations and policy implications

Overall, the labour shortage observed in the agricultural and food industry is not a unique phenomenon, as these sectors face challenges similar to other sectors of the economy (Causa et al., 2022; Bollérot, 2002). In the agricultural sectors where the demand for manual labour is greater (e.g., the fruit or vegetable sector or animal husbandry), the lack of skilled or even career-starting labour is more pronounced. The wage demands of newly graduated applicants with no experience are unrealistic, even for those applying for simpler jobs. The supply of skilled labour (e.g., workers who know and can use precision technology, plant protection methods, or animal health specialists) is constantly decreasing. At the same time, the operation of modern machines requires an increasingly higher level of training (Erickson et al., 2018). A significant proportion of the older generation of workers does not know how to learn or does not want to finance the transition to modern technologies. **Technological development and digitisation and its impact on transformation can make the entire sector much more attractive to labour market participants.** However, attracting young people to the sector cannot be considered easy in other countries either (Som et al., 2018).

Companies attempt to overcome the problem of a lack of suitably qualified and experienced workforce by choosing from those less qualified and inexperienced during the selection process and then bringing employees up to the required professional level with the help of internal training since their education is usually not adequate in many cases (Carolan, 2020). **Greater emphasis should be placed on teaching skills that are often sought after (e.g., GIS, laboratory tests, the use of different software).** However, rapid technological development can be observed in the sector, and constantly staying up to date is an unrealistic expectation for secondary or higher education. Mid-year or summer internships are essential for acquiring the necessary practical knowledge, which training should not be allowed to deteriorate but be systematically organised under the supervision of the state or business chambers. At individual companies, participants of mandatory internships can represent a labour supply. There are already good examples of industry-university cooperation and dual training in many countries (Ankrah and Omar, 2015), including in Hungary (e.g., cooperation between Audi and István Széchenyi University in Győr). However, there should be many more such initiatives modelled on very well-functioning dual training.

Continuous generational change can be observed, and fluctuation is constantly present in the sector (Borda et al., 2023). At the same time, the career path model lacks harmony with the limitations associated with natural ageing processes and the performance of activities, for example. In many cases, exploiting retired people's professional and life experiences and transferring these to appropriate groups is not even called for. With retirement, significant accumulated experiential knowledge leaves companies and sectors. Another aspect of generational change concerns management. A significant number of domestically owned agricultural companies and food manufacturers are under family control. They typically started their independent activities in the years after the regime change, and the generation that is about to retire will not followed by the next generation within the family (in many cases, grandchildren take over the company directly from grandparents). In such cases, the issue of succession is difficult, and the involvement of an external manager can be critical. However, in some countries, generational change is already a well-established practice; successors must first prove themselves at other companies and play a leading role elsewhere, and only then can they come ‘home’ to work on the family farm or business. Furthermore, the return of young individuals after education to farming hinges on the availability of subsidies and central support. The attraction of advanced agricultural technologies, such as drones and milking robots, positively impacts the younger generation’s interest (Guerra, 2018, Farrell et al., 2021).

By encouraging generational change, the appropriate expertise and capital can be concentrated within families in the long term. **The government must consciously address**

**generational change and ensure that the sector is an attractive alternative for young people in the long term. Hungarian agricultural policy should encourage the creation of the size of farms capable of supporting single families by consolidating agricultural areas and reducing fragmentation**. Ownership structure strongly limits the possibilities of use (e.g., modern machines with high-performance capacity cannot be used everywhere). However, precision and environmentally friendly technologies are gaining ground, and it would be worthwhile strongly pursuing this direction of development. By properly using subsidies and investing in the future, an economy can become competitive in the long term. A complete review of systems based on subsidies is needed to reduce the effects of distorting competition (Berlinschi et al., 2014).

## Conclusion

Based on the results and the literature, it can be seen that Hungarian agriculture does not differ significantly from the agriculture of other Central and Eastern European countries. Agriculture lags behind other sectors in terms of employment and proportional GDP. The Hungarian agricultural society can be considered an ageing society, however, it can be seen as a positive issue that the small number of young people who are entering into the sector have a higher overall education level, and thus better abilities and skills. In the past ten years, the proportion of total employees working in the sector without agricultural employment decreased by 20 percentage points. Despite that the number of managers with agricultural education has increased, they still manage approximately 150,000 farms in Hungary based on their experience. The number of employees in the Hungarian agricultural enterprises is constantly decreasing, in 2011 an average agricultural enterprise employed 24 people, while in 2020 it employed 17 people, with median values of 3-8 people. Along every dimension, enterprises founded before 1989 have significantly lower efficiency and productivity than those founded after (mainly founded after the EU accession of Hungary in 2004). Moreover, most Hungarian agricultural enterprises are lagging behind the majority of Western European companies in terms of labour, territorial and wage productivity.

Overall, the tasks facing the agricultural and food industry labour market are multifaceted. On the one hand, work in the sector must be made attractive to young people by providing role models and career advice guidance and developing educational programmes. As a result of technological development, there is a need for highly practice-oriented training courses that respond to rapidly changing needs. In addition, it is necessary to provide adequate and competitive wages to those who choose a career in the competitive agriculture and food industry. The effects of the pandemic and the Ukrainian-Russian crisis are only exacerbating the employment-policy (and agricultural-policy)-related problems listed above. The crises of recent years have shown that countries with a fundamentally competitive agriculture and food industry remain the most resistant. As Csáki and Jámbor (2018) also showed, those countries that are sufficiently brave and quick enough to implement agricultural and employment policy reforms are more successful in the long term than their neighbours who focus on short-term benefits.

A limitation of this research is that Hungarian employment was examined only between 2011 and 2020 due to the availability of company data. Hungarian agricultural employment was explored before the 2010$^{s}$ with the help of the literature and secondary sources. It would also be worth examining how agricultural employment developed after 2020, when significant economic and political changes took place in the world, including in the states of Central and Eastern Europe.

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