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Efficiency of the Labour Inputs on Commodity Farms in European Union Countries

Keywords: efficiency of labour factor; labour productivity; labour profitability; agriculture; European Union

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Abstract

Theoretical background: The concept of efficiency is widely used in many scientific disciplines and is defined depending on the context in which it is used. This concept is used in economics as a criterion for the assessment of business unit operations. The issue of efficiency in agriculture is extensively studied due to its crucial role in evaluating sector performance and policy implementation. The European Union prioritises measuring production factor use to address competitiveness, sustainability, climate change, and market challenges within the Common Agricultural Policy framework. A production factor utilisation

efficiency assessment is usually performed with the Total Factor Productivity. However, among all inputs, the efficiency of labour utilisation is particularly important.
Purpose of the article: This study aimed to determine the efficiency of labour input utilisation and its changes with respect to performance and effectiveness on farms in the EU member states in 2012–2021.
Research methods: The performance assessment was based on an analysis of a mean labour output measured by gross farm income per full-time employee. Effectiveness was also examined, and labour profitability was calculated as the income generated by a farm per full-time employee.
Main findings: The mean labour output and effectiveness on farms in EU member countries as determined for the years 2012–2021 varied. The mean labour output in the EU during the decade under study amounted to EUR 35,060. Denmark proved to be a significant leader in terms of labour output. Considerable differences were observed in labour utilisation performance between the old and new EU countries. The labour output index measured in most old member countries is above average. On the other hand, none of the countries that joined the EU in 2004 or later have achieved the EU average level of the indicator. A labour output increase was observed in all EU member countries during the 2012–2021 period, and its growth was the fastest among the newly admitted members. The mean labour profitability in an EU farm amounted to 14,270 EUR/AWU. Luxembourg, Belgium and the Netherlands were the countries with the highest profitability. A deterministic analysis of changes in both labour output and labour profitability shows that capital-intensive factors play a major role in their increases. The obtained results may be used in shaping EU agricultural policy, particularly in directing support towards investments that increase the technical equipment of labour and in continuing modernisation processes and structural transformations in farms, especially in the new EU member countries, as a condition for a sustained improvement in labour efficiency.

Introduction

"Efficiency" is one of the major and most important concepts in economics as it is linked inextricably to a shortage of resources. Their limited amount makes it impossible to satisfy all human needs, and, in consequence, it necessitates actions aimed at using the available resources in the most beneficial way.

The importance of the concept of efficiency in the modern world was conveyed properly by Kozuń-Cieślak (2013), who pointed out that efficiency "achieved an imperative status at every level of management (micro, meso, macro) and in each sector of the economy (private, public, non-profit)" (p. 13). It is for this reason that the precise meaning of "efficiency" usually arises from the context of an analysis (Coelli et al., 2005) or the area of application (Ziębicki, 2013). Holstein-Beck (1997) divided "efficiency" into six conceptual categories, which, in her opinion, make up its actual meaning. These include:

- output (in Emmerson's technical and economic approach);
- performance (in Pszczołowski's praxeological approach);
- competence (in Weber and Beckhard's organisational and bureaucratic approach);
- functionality (in McGregor, Price, and Lawless' humanistic approach);
- communicativeness (in Scanlan and Obuchowski's personality approach);
- morality (in an ecological approach).

An economic literature review shows that efficiency is a multidimensional concept, and lacks a clear definition (Kozuń-Cieślak, 2013; Murillo-Zamorano, 2004).

A number of efficiency categories exist, and their diversity arises mainly from a relationship with a specific economic current. According to Skrzypek (2012), this term can be defined in the following manner: "performance in action, positive outcome, profitability, productivity, output, effectiveness, purposefulness, rationality, economics or usefulness."

Based on the definition review, the authors concluded that efficiency can be regarded as equivalent to both performance and effectiveness and can be used to assess efficiency. The issue of efficiency in the agricultural sector has been the subject of numerous scientific studies in recent years (European Commission, 2024). This demonstrates its significant importance in assessing the performance of agriculture (Czyżewski et al., 2025). The European Union pays particular attention to improving agricultural efficiency. According to the European Commission, measuring the use of production factors in agriculture is a priority, not only for assessing the sector's competitiveness but also for assessing the implementation of the Common Agricultural Policy (CAP) objectives in the 2023–2027 perspective. Moreover, EU agriculture must contend with challenges associated, among others, with sustainable development, climate change, and the imperfect functioning of markets (Dinis, 2023; Gollin, 2023).

In the case of agricultural farms, this involves mainly the utilisation of production factors, i.e., labour, capital, and land, which, in agriculture, is not the only place where production takes place. Efficient management of production resources, including the labour force, is essential for the competitiveness of agriculture in the international markets (Baer-Nawrocka & Markiewicz, 2012). A production factor utilisation efficiency assessment is usually performed with the Total Factor Productivity (TFP). However, partial productivity measures can prove more useful than the comprehensive TFP index in some cases (Kijek et al., 2020; Suresh et al., 2021).

The aim of this study was to determine the efficiency of labour utilisation and its change rate in agriculture with respect to performance and effectiveness in agricultural farms in EU member countries during the period from 2012 to 2021. The impact of selected variables on changes in labour output and labour profitability dynamics was also analysed.

Literature review

Efficiency of labour input utilisation in agriculture is an object of occasional yet detailed studies. An assessment of resource or labour input utilisation efficiency is only one element of a broader evaluation of production factors in this sector (e.g., Marcysiak & Marcysiak, 2018). It is usually presented only in a productivity-oriented dimension (Adamopoulos et al., 2022; Blanco & Raurich, 2022; Błażejczyk-Majka & Kala, 2012; Kołodziejczak, 2025; Nowak, 2020; Nowak, 2022; Polyzos & Arabatzis, 2006). Meanwhile, an in-depth analysis of labour output in agriculture could provide valuable information on the potential for an efficiency improvement in this essential

economic sector. Importantly, the value of output per worker in non-agricultural countries is twice as high as in agriculture, and even higher in developing countries (Casselli, 2005; Gollin et al., 2014).

According to a review of the literature on labour efficiency in agriculture, it varies from one EU member country to another. The identified causes of this are believed to include the economic size of farms, the level of capital-labour ratio, production direction and production intensity (Baer-Nawrocka, 2017; Bereżnicka & Wicki, 2021; Komorowska, 2019; Kusz et al., 2022). The authors note, in particular, the significant differences between the countries which became EU members before 2004 and those which joined the EU after that year (Baráth & Fertő, 2014; Nowak & Kubik, 2019). According to Nowak and Kubik (2019), lower labour productivity in the countries that joined the EU after 2004 was caused mainly by insufficient application of modern technologies, which required the engagement of a substantial amount of capital. In consequence, an additional labour force had to be employed. This could be explained by a paper by Blanco and Raurich (2022), in which the authors suggest a link between economic development, changes in the structure of agriculture and its productivity. According to those authors, capital becomes increasingly available and cheap as the economy grows. This results in substantial production cost reduction in capital-intensive production types, more so than in labour-intensive ones. As a consequence, the price of labour-intensive agricultural products grows compared to capital-intensive products. If two products are imperfect substitutes, consumption and, consequently, production volume in labour-intensive production types decreases compared to the production volume in capital-intensive ones. This results in the structure of agriculture moving towards capital-intensive production types. Czyżewski and Staniszewski (2017) confirmed the claim that "labour output in agriculture can be improved by a change of the employment structure, which would involve increasing the share of production types where this factor is used more productively" (p. 36). Those authors saw a possibility of accelerating these changes in a proper policy oriented towards maintaining production and employment on farms where labour output is high.

Other authors have also dealt with important issues related to labour efficiency in agriculture. Cock et al. (2022) pointed out that labour output in agriculture is lower in countries with lower income than in the others. If the labour output does not improve, farmers will suffer poverty, and the food supply will be affected. In order to increase labour productivity, make rural areas wealthier and supply towns and cities with food, it is necessary to apply an approach based on innovation systems. Making higher-value products is essential to increasing the labour output when land is scarce.

A noteworthy paper on labour efficiency was published by Popescu et al. (2021). That study presented an analysis of labour output in EU countries and demonstrated that its level was affected by two key factors: gross farm income in this sector and labour input in agriculture expressed in AWU.[1] The authors claimed that EU mem-

[1] AWU – annual work unit. An AWU is equivalent to a worker employed on full time basis for one year.

ber countries could improve labour productivity by increasing production output, optimisation of indirect consumption, increasing gross farm income, and reducing labour input, but using exclusively highly qualified, conscious, responsible and usable labour force and by taking actions aimed at preventing climate changes (Popescu et al., 2021). That paper stressed the multidimensional nature of the approach to efficiency assessment while using indicators other than those applied in the current study. A study by Marcysiak and Marcysiak (2018) concerning the efficiency of resources (i.e., land, labour and capital) employed a similar approach using indicators of productivity (output) and profitability (effectiveness). Komorowska (2019) treated this idea in the same way, describing the efficiency of farms oriented towards animal production, where productivity indicators allow for assessing production efficiency and profitability indicators can be used to assess economic efficiency.

This literature review shows that the efficiency of labour input utilisation in agriculture is an important issue. One should emphasise its complexity, which allows for a multi-faceted approach. This study presents an in-depth analysis of the output and profitability indicators and a causal analysis identified countries where improvements in labour input utilisation efficiency, measured by labour profitability, were input effective and driven by intensive management practices (a greater impact of input-effective factors, i.e., productivity of fixed assets and production profitability on an increase in the synthetic labour profitability indicator). In contrast, it also highlights countries where these improvements were capital-intensive, primarily due to an increased capital-labour ratio, and where extensive nature of increase in labour profitability is a result of an increase in fixed asset value.

Research methods

Data for this study were sourced from the Farm Accountancy Data Network (FADN), focusing on farms engaged in commodity production within the European Union from 2012 to 2021. The study aimed to analyse two dimensions of efficiency: performance and effectiveness.

Performance in using the labour factor on farms is assessed by means of the labour output or productivity. According to Kusz and Misiak (2017), it is one of the major elements determining production efficiency in agriculture. Labour output on farms can be calculated with such variables as production value (Sobczyński, 2010), gross farm income (Nowak, 2022), net added value (Gołaś, 2010) and farm income (Mikołajczyk, 2011) per full-time farm employee (AWU). This study employed the labour output indicator measured as a ratio of gross farm income and labour input. According to Gołaś (2019), this ratio is of fundamental value in examining the issue of labour output in agriculture. The labour output indicator in the present study was determined by the following formula:

$$\frac{GFI}{AWU} = \frac{P}{FA} \times \frac{FA}{AWU} \times \frac{GFI}{P}$$

where:
GFI – gross farm income (SE410),
AWU – labour input expressed as the number of full-time employees (SE010),
P – income from sale expressed as the total production value (SE131),
FA – fixed assets (SE441).

This equation represents a dependence of labour output on three factors, including fixed asset productivity (P/FA), capital-labour ratio (FA/AWU) and gross farm income index (GFI/P). The share of these factors in labour output changes was calculated using the function method (Sierpińska & Jachna, 2004).

The effectiveness of labour input utilisation in efficiency analyses is assessed by means of labour profitability (Zakrzewska, 2010). This is a proper indicator for effectiveness assessment as agricultural farm accounting does not include profit. A farmer receives an agricultural income in return for engaging his own production factors. This is because estimating the cost of a farmer's labour on the farm is problematic. Analyses concerning agricultural farms (without comparing them to other economic sectors) involve calculating the profitability indicator, which is a ratio of farm income and the farmer's own labour input (Goraj & Mańko, 2009). An analysis of the labour profitability indicator was based on a distribution according to the formula:

$$\frac{FNI}{AWU} = \frac{P}{FA} \times \frac{FA}{AWU} \times \frac{FNI}{P}$$

where:
FNI – farm net income (SE420).

Labour profitability is presented as the product of three partial indicators, including fixed asset productivity, capital-labour ratio and production profitability. The scope of the impact of individual partial indicators on a change in synthetic labour profitability was established by the function method. This allowed for the identification of the nature of the agricultural growth in the EU member countries under study (i.e., whether it was intensive or extensive).

Results

Labour output is one of the basic measures that enable an analysis of labour utilisation efficiency from the management performance perspective. A labour output increase was observed in all EU member countries during the 2012–2021 period (Table 1). As data in Table 1 show, the mean labour output on farms in EU member countries in the years 2012–2021 varied.[2] The mean labour output in the EU during the decade under study, as measured by the gross farm income per one full-time employee in a farm, amounted to EUR 35,060. Denmark proved to be a significant leader in terms of labour output. This indicator was three times higher than the average for the EU, and it was 108,728 EUR/AWU for the years 2012–2021. High labour output was also observed in Luxembourg (80,583 EUR/AWU) and in the Netherlands (78,225 EUR/AWU). The lowest labour output was determined on farms in Romania and Croatia, with the mean indicator in question amounting to 9,195 EUR/AWU and 9,499 EUR/AWU, respectively. Efficiency on farms in Poland also proved to be low in terms of the performance in labour utilisation in agriculture. The labour output in Poland was three times lower than the EU average: 11,373 EUR/AWU.

Table 1. Gross farm income (EUR), total labour input (AWU) and labour output (EUR/AWU) on farms in EU countries, the mean and the dynamics of changes in the years 2012–2021

Specification	Gross farm income		Total labour input		Labour output	
	mean	dynamics	mean	dynamics	mean	dynamics
	EUR	%	AWU	%	EUR/AWU	%
Belgium	124 401	108.42	2.08	103.94	59 774	104.31
Bulgaria	44 117	335.80	2.73	117.67	15 751	285.37
Czechia	171 652	161.87	5.58	106.81	30 646	151.55
Denmark	220 812	150.16	2.02	146.39	108 728	102.58
Germany	133 701	127.64	2.28	102.22	58 655	124.86
Estonia	59 370	146.57	1.90	85.37	31 382	171.69
Ireland	38 267	129.95	1.17	95.83	32 853	135.60
Greece	17 660	108.23	1.08	93.10	16 306	116.25
Spain	48 786	199.78	1.60	129.79	30 135	153.93
France	105 201	113.42	2.06	100.97	51 083	112.33
Croatia	15 553	163.94	1.66	85.33	9 499	192.14
Italy	47 277	143.75	1.34	105.34	35 303	136.45
Cyprus	18 497	138.79	1.43	105.67	12 883	131.33
Latvia	33 766	146.09	2.01	94.17	16 882	155.13
Lithuania	26 054	147.14	1.65	86.78	15 941	169.55
Luxembourg	140 606	130.26	1.76	91.21	80 583	142.82
Hungary	44 675	161.15	1.60	103.16	27 778	156.21
Malta	17 623	139.66	1.39	97.89	12 793	142.68
Netherlands	231 924	134.05	2.96	112.95	78 225	118.68
Austria	58 164	157.82	1.53	118.44	37 899	133.25

[2] A large amplitude of the variable fluctuations and a classic coefficient of variation V(x) = 73% are a proof of strong differentiation of this attribute.

Specification	Gross farm income		Total labour input		Labour output	
	mean	dynamics	mean	dynamics	mean	dynamics
	EUR	%	AWU	%	EUR/AWU	%
Poland	18 219	142.09	1.61	88.37	11 373	160.79
Portugal	23 766	140.92	1.58	87.80	15 135	160.49
Romania	12 115	298.99	1.26	123.58	9 195	241.95
Slovenia	15 484	149.02	1.28	84.51	12 262	176.34
Slovakia	272 176	165.35	10.73	70.36	26 216	235.02
Finland	68 758	160.81	1.30	118.70	52 546	135.48
Sweden	88 226	140.48	1.55	118.88	56 792	118.17
EU27	77 668	145.73	2.19	97.23	35 060	133.33

Source: Authors' own study based on EU FADN.

Labour output is associated with gross farm income and labour input expressed as full-time employees AWU. Table 1 shows that the mean gross farm income generated in 2012–2021 in an EU farm amounted to EUR 77,668. The highest indicator was generated on farms in Slovakia (EUR 272,176), the Netherlands (EUR 231,924) and Denmark (EUR 220,812). The highest dynamics, due to the scale of the agricultural production, were determined in Bulgaria and Romania, where gross farm income increased in the years 2012–2021 by 236% and 199%, respectively. The worst effects for this indicator were determined in Romania (EUR 12,115) despite high growth dynamics. An analysis of data in Table 1 shows that the gross farm income increased in all EU countries during the decade under study, and the growth rate was higher than that of the labour input expressed as the number of full-time employees (AWU). Moreover, the labour output on farms in Estonia, Ireland, Greece, Croatia, Latvia, Lithuania, Luxembourg, Malta, Poland, Portugal, Slovenia and Slovakia grew faster than the gross farm income with a simultaneous decrease in labour input (AWU). This may prove an increase in the efficiency of the production potential utilisation (Zakrzewska, 2010). It is noteworthy that a majority of these countries joined the EU after 2004. Growth dynamics of gross farm income higher than labour output translated into an increase in labour input engaged (AWU).

Figure 1 shows a ranking of EU countries with respect to the mean labour output in 2012–2021. Considerable differences were observed in labour utilisation performance between the old and new EU countries. Labour output measured in most old member countries is above average. On the other hand, none of the countries that joined the EU in 2004 or later achieved even the EU average for this indicator.

Performance in labour utilisation measured by labour output grew the fastest in newly admitted countries. The highest growth dynamics for this indicator was determined on farms in Bulgaria (185% growth), Romania (142%) and Slovakia (135%). The smallest increase was observed in agriculture in old member countries, such as Denmark (growth by nearly 3%), where the mean indicator was found to be the highest, and Belgium (growth by 4%). Higher dynamics of labour output growth in countries where its lower values confirm the presence of beta convergence processes. They assume that the growth rate in countries with a lower initial income level is higher than

in rich countries, which, in consequence, leads to equalisation of income per capita in the group of economies under study (Baer-Nawrocka & Markiewicz, 2012).

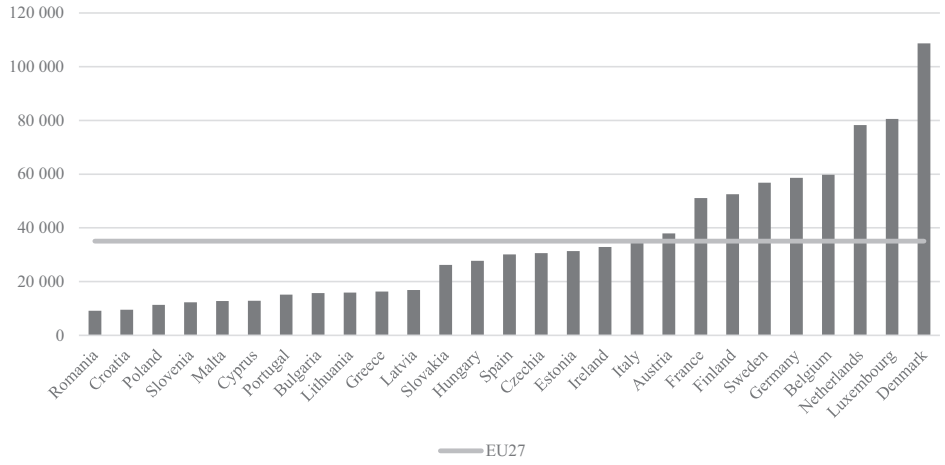

Figure 1. Ranking of EU member countries with respect to labour output on farms in EU member countries, mean for 2012–2021 (EUR/AWU)

Source: Authors' own study based on EU FADN.

According to the formula adopted in the current study, labour output is affected by three factors, including capital-labour ratio, fixed asset productivity and share of gross farm income in sale income. The capital-labour ratio is associated with an increase in property equipment and is an example of capital-intensive sources of labour output growth. Fixed asset productivity and share of gross farm income in sale income are, in turn, input-effective factors.

The data in Table 2 show that the capital-labour ratio spanned over a wide range (40 times), which demonstrates considerable differences in technical progress between EU member countries.[3] The capital-labour ratio ranged from approx. EUR 30,000 of the fixed asset value per full-time employee on farms in Romania and Bulgaria to over 1.2 million EUR/AWU in Denmark during the decade under study. An analysis of the mean capital-labour ratio shows the difference between the old and new EU member countries. As with labour output, none of the newly admitted countries reached the mean EU level of the capital-labour ratio. This indicator was found to increase in most of the member countries during the period under analysis. The largest growth in the property equipment per full-time employee during the 2012–2021 period was noted on farms in Slovakia and Estonia (by 136% and 113%, respectively). The capital-labour ratio was found to decrease only in four EU member

[3] Moreover, a classic coefficient of variation of V(x) = 111% is a proof of very strong differentiation of this attribute.

countries. These states include Cyprus (17% decrease), Spain (14%), Italy (10%) and Denmark (4%). The dynamics of the capital-labour ratio growth in Belgium, Germany, Estonia, Lithuania, Latvia, Hungary, the Netherlands, Slovenia and Slovakia exceeded that of labour output. This can mean that the labour output growth in these countries was accompanied by the substitution of human labour with capital.

A utilisation assessment for fixed assets at a farm's disposal is performed through measurement of their productivity. This indicator describes progress in fixed asset management, i.e., the effects of investment-free methods of increasing labour output, e.g. technical and organisational improvements. The highest efficiency of fixed asset utilisation during the period under study was determined on farms in Slovakia, where each 1 EUR of fixed assets engaged generated EUR 0.89 of total production. High fixed asset productivity was also determined in France (0.79) and Bulgaria (0.73). This indicator was found to be the lowest on farms in Ireland (0.08) and Slovenia (0.13).

Fixed asset productivity improved in most countries during the decade under study, with the largest growth observed in Spain (by 88%), Bulgaria (by 75%) and Cyprus (by 73%). This was found to decrease in 10 countries, with the largest decreases noted in Belgium (by 20%), Estonia (by 18%) and Latvia (by 17%). The decrease in the total fixed assets in all the countries was an effect of faster fixed asset growth compared with the total production growth dynamics. This may have been caused by an improvement in the farms' property equipment in these countries. The process of labour substitution with capital is also confirmed by the fact that a higher capital-labour ratio growth rate was observed in these countries compared with the labour output growth rate.

The causal analysis of the labour output changes shows that its growth in EU farms during the period under study was mainly caused by an increase in capital-labour ratio (66%) as well as by an increase in fixed asset productivity (22%) and an increase in a share of the gross farm income in total production value (2%) (Table 2). A higher share of capital-labour ratio in the output growth was observed in Belgium, Germany, France, Luxembourg, the Netherlands, Austria, Finland, Sweden, Estonia, Lithuania, Latvia, Hungary, Malta, Poland, Romania, Slovenia and Slovakia. A major part of the capital-intensive factor growth in these countries was associated with farms investing in property equipment. An increase in labour output was linked mainly to the improvement of fixed asset productivity in the other ten countries (Denmark, Ireland, Greece, Spain, Italy, Portugal, Bulgaria, Czechia, Croatia and Cyprus). This means that it was an effect of investment-free ways of improving the fixed asset utilisation efficiency.

Table 2. The impact of a change in capital-labour ratio, fixed asset productivity and gross farm income index on a change in labour output on farms in EU member countries in 2012–2021 (EUR/AWU)

Specification	Capital-labour ratio		Fixed asset productivity		Gross farm income index		Total change in labour output	Impact on labour output change		
	mean	dynamics	mean	dynamics	mean	dynamics		change in capital-labour ratio	change in fixed asset productivity	change in gross farm income index
Belgium	361 748	157.39	0.38	79.91	0.44	82.94	2 628	28 901	-14 324	-11 949
Bulgaria	31 362	124.98	0.73	174.74	0.68	130.67	17 819	3 850	9 367	4 602
Czechia	96 997	112.41	0.61	129.87	0.52	103.81	13 077	3 690	8 204	1 183
Denmark	1 215 667	96.47	0.21	108.82	0.42	97.71	3 193	-4 516	10 619	-2 910
Germany	371 566	129.99	0.33	97.48	0.48	98.54	13 946	16 488	-1 612	-931
Estonia	134 313	212.61	0.53	82.18	0.44	98.27	19 644	27 871	-7 559	-668
Ireland	759 317	114.97	0,08	140.73	0.51	83.81	10 938	5 063	12 336	-6 460
Greece	101 504	106.67	0.22	119.14	0.75	91.47	2 488	1 069	2 897	-1 479
Spain	141 253	85.55	0.34	188.02	0.63	95.70	12 255	-4 618	18 169	-1 295
France	130 192	112.36	0.79	105.63	0.50	94.65	6 640	6 658	3 129	-3 147
Croatia	83 388	120.05	0.18	140.05	0.61	114.28	6 053	1 700	3 108	1 245
Italy	224 121	89.97	0.24	143.74	0.66	105.52	10 720	-3 701	12 549	1 872
Cyprus	93 703	82.66	0.32	173.22	0.44	91.72	3 364	-2 429	6 892	-1 099
Latvia	64 002	190.31	0.53	83.06	0.50	98.14	7 629	11 335	-3 368	-338
Lithuania	55 438	184.77	0.48	91.58	0.60	100.20	9 759	11 405	-1 684	38
Luxembourg	638 227	134.93	0.20	113.86	0.62	92.96	28 585	24 041	10 464	-5 920
Hungary	85 757	183.64	0.60	85.36	0.55	99.66	13 590	18 711	-5 012	-109
Malta	144 605	134.91	0.23	112.96	0.38	93.62	4 215	3 552	1 454	-790
Netherlands	807 078	121.53	0.23	97.77	0.42	99.89	14 239	16 217	-1 885	-93
Austria	264 599	120.56	0.23	110.08	0.64	100.41	11 740	7 639	3 933	168
Poland	102 055	152.41	0.20	110.97	0.54	95.07	6 065	5 377	1 345	-657
Portugal	53 861	105.71	0.40	130.92	0.70	115.96	7 409	875	4 209	2 325
Romania	30 276	168.73	0.46	143.48	0.64	99.94	8 677	5 113	3 570	-6
Slovenia	166 198	183.08	0.13	87.89	0.56	109.59	6 915	7 401	-1 635	1 148
Slovakia	63 079	236.01	0.89	87.04	0.47	114.41	21 767	21 949	-3 798	3 616
Finland	336 025	130.23	0.28	109.55	0.55	94.96	16 925	14 722	5 107	-2 905
Sweden	572 397	117.83	0.25	93.79	0.41	106.93	10 679	10 500	-4 117	4 296
EU27	264 018	121.12	0.37	109.51	0.54	100.69	10 827	7 176	3 413	259

Source: Authors' own study based on EU FADN.

With respect to effectiveness, the efficiency of labour input utilisation was measured with labour profitability, which expresses the income generation capability of a farm. Labour profitability reflects the financial effect of activities as income per full-time employee.

Figure 2 shows the rankings of EU member countries with respect to the mean labour profitability in 2012–2021. The mean indicator for an EU farm was 14,270 EUR/AWU during the decade under study. It varied considerably[4] from one EU member state to another, but the differences were smaller compared with the mean level of labour output. The highest efficiency in terms of profitability was determined in Luxembourg, with EUR 31,289 per full-time employee in a farm, i.e., more than twice as much as the EU average. Equally high effectiveness of labour utilisation was found in Belgium and the Netherlands: 30,327 EUR/AWU and 27,936 EUR/AWU, respectively. Farms in Slovakia were characterised by the lowest efficiency with respect to the effectiveness of labour input utilisation, as they generated an income of EUR 2,783 per full-time employee in a farm, which accounts for merely 20% of the EU average. Labour profitability indicator amounted to 6,633 EUR/AWU in Poland, and it was more than twice as low as the EU average. This placed Polish agriculture 22nd among the member countries. As with labour output, there is a distinct border between the old and new member countries. The income per full-time employee in a farm in the new EU countries did not exceed 2/3 of the EU average. Farms in Hungary, with labour profitability slightly higher than the EU average (14,512 EUR/AWU), were the only exception. Labour profitability calculated for the old EU countries was high, which means that they were more efficient in terms of labour input utilisation. Among the old member countries, only Portugal, Greece, and Sweden were below the EU average.

Labour profitability is greatly affected both by capital-intensive factors (capital-labour ratio) and input-effective factors (fixed asset productivity, production profitability). As the data in Table 3 show, profitability growth in EU farms during the period under study was mainly caused by an increase in capital-labour ratio (60%) as well as by an increase in fixed asset productivity (26%) and improvements in production profitability (14%). A deterministic analysis of changes in labour profitability shows that capital-intensive factors play a major role in its increase. These are the results for Belgium, Germany, Estonia, France, Latvia, Lithuania, Luxembourg, Hungary, Malta, Austria, Poland, Romania, Slovenia and Finland. Labour profitability growth in other countries may be attributed to input-effective factors, with the greatest impact being a change in fixed asset productivity observed in Bulgaria, Czechia, Ireland, Greece, Spain, Italy, Cyprus, and Portugal. However, an increase in production profitability had the greatest impact on the improvement of labour profitability in Croatia, the Netherlands, Slovakia and Sweden. Improvement

[4] The classic coefficient of variance V(x) = 60% suggests strong differentiation of the attribute under study.

of both factors associated with intensive management, i.e., fixed asset productivity and production profitability, had approximately the same impact on improvement of management effectiveness as measured by the labour profitability indicator.

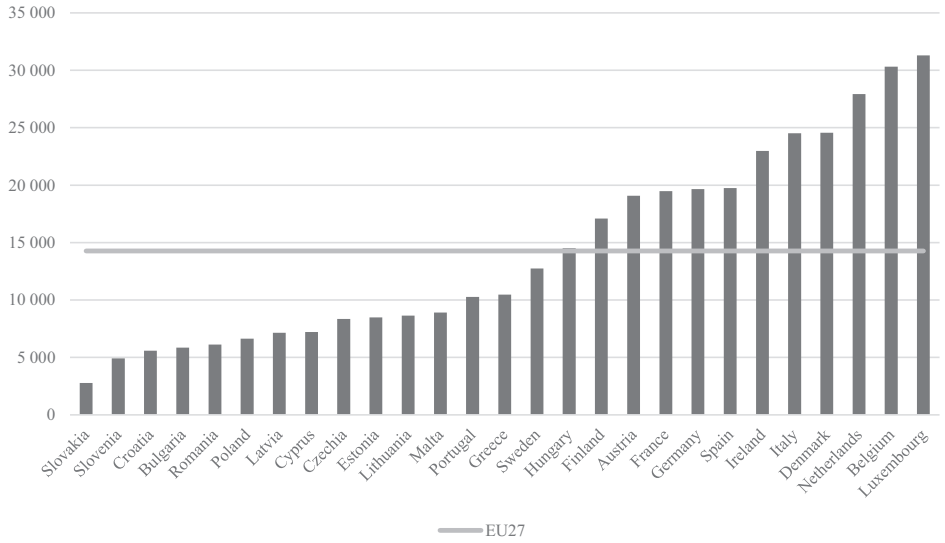

Figure 2. Ranking of EU member countries with respect to labour profitability on farms, mean values for the years 2012–2021 (EUR/AWU)

Source: Authors' own study based on EU FADN.

Table 3. The impact of a change in capital-labour ratio, fixed asset productivity and production profitability on a change in labour profitability on farms in EU member countries in 2012–2021 (EUR/AWU)

Specification	Total change in labour profitability	Impact on labour profitability change		
		change in capital-labour ratio	change in fixed asset productivity	change in production profitability
Belgium	4 226	15 593	-7 764	-3 603
Bulgaria	9 549	1 678	4 057	3 813
Czechia	1 438	1 014	2 261	-1 836
Denmark	5 042	-1 381	3 243	3 179
Germany	2 767	6 169	-602	-2 800
Estonia	2 590	11 385	-3 004	-5 791
Ireland	12 628	3 387	8 224	1 017
Greece	2 209	701	1 898	-390
Spain	7 302	-3 021	11 916	-1 592
France	4 417	2 987	1 404	27
Croatia	5 206	950	1 728	2 528
Italy	10 685	-2 540	8 565	4 661
Cyprus	3 211	-1 470	4 132	550
Latvia	1 762	4 891	-1 434	-1 695
Lithuania	4 208	6 985	-1 022	-1 754
Luxembourg	12 234	8 337	3 633	264

Specification	Total change in labour profitability	Impact on labour profitability change		
		change in capital-labour ratio	change in fixed asset productivity	change in production profitability
Hungary	8 389	9 839	-2 648	1 198
Malta	3 537	2 515	1 030	-8
Netherlands	14 247	6 125	-715	8 838
Austria	4 414	4 172	2 146	-1 905
Poland	4 178	3 463	867	-151
Portugal	5 214	596	2 864	1 755
Romania	5 800	3 523	2 459	-182
Slovenia	3 481	3 070	-683	1 094
Slovakia	7 919	1 863	-390	6 446
Finland	6 374	5 422	1 881	-929
Sweden	12 427	2 791	-1 106	10 742
EU27	6 128	3 668	1 590	869

Source: Authors' own study based on EU FADN.

Conclusions

This study has shown great differences between EU member countries in agricultural farm efficiency as measured by labour output and profitability. The level of performance was found to vary more than the effectiveness of labour input utilisation. The best performance during the decade under study was observed on farms in Denmark, whereas the lowest output was in Romania and Croatia. Meanwhile, the most efficient farms in terms of labour input utilisation effectiveness were in Luxembourg and Belgium, and those with the lowest profitability were in Slovakia.

The old EU member countries proved to be the most efficient, both in terms of labour output and profitability. On the other hand, the countries admitted to the EU in 2004 or later did not achieve the EU average level of these indicators. Despite their low level, both labour output and profitability grew faster in the newly admitted than in the old member countries. The dynamics of changes in labour output and profitability in most old member countries were lower than or fluctuated around the EU average, which may indicate difficulties in achieving further increases in labour utilisation efficiency.

Both measures of labour input utilisation in agriculture grew in all EU member countries during the decade under study. The labour output increase was mainly caused by an increase in the capital-labour ratio (66%) as well as by input-effective factors (34%), such as improvement of fixed asset productivity (32%) and an increase in the gross farm income share in total production value (2%). Further, an improvement in efficiency as measured by labour profitability was mainly caused by an increase in the capital-labour ratio (60%) as well as by fixed asset productivity increase (26%) and growing production profitability (14%). This indicates that the improvement of labour input utilisation efficiency in agriculture in the years 2012–2021 was caused mainly by an increase in the capital-labour ratio resulting from investments aimed at improving farm property equipment.

Despite the high dynamics of change, most new member countries were characterised by low efficiency of labour input utilisation in agriculture, and they were at the bottom of the rankings. Countries with high levels of mechanisation and modern agricultural technologies tend to achieve high labour output.

This study shows that it is necessary to continue the processes of structural changes and modernisation, as well as to model the EU agricultural policy in such a way as to reduce the distance between the new and old EU member countries, with the latter being characterised by high levels of mechanisation and modern technologies, thereby achieving higher efficiency, both in terms of performance and effectiveness of labour input utilisation in agriculture. Support programmes and subsidies can stimulate investments in modern technologies and cultivation methods, which will contribute to efficiency improvement. An increase in the share of gross farm income in the total production value and an increase in production profitability should also be important directions for further increases in labour efficiency in agriculture.

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