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SCIENTIFIC ARTICLE

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Do short food supply chains impact on efficiency of farms? Evidence from Poland and Czechia

ABSTRACT

Short food supply chains (SFSCs) are a model promoted among farmers in many countries. This model is popularised as an opportunity to increase the economic efficiency. However, the research results found in the literature are ambiguous. This study therefore aims to assess the impact of participation in short food supply chains on the productivity and efficiency of farms. Poland and the Czech Republic are taken as examples of countries with a contrasting agrarian structure and different size classes of farms are investigated. Primary data come from semi-structured face-to-face interviews conducted among 375 producers divided into two groups – participating and not participating in SFSCs. The indices of productivity and non-parametric data envelopment analysis (DEA) were applied to assess differences in efficiency for two groups mentioned above. It was demonstrated that in Poland small farms participating in SFSC achieve higher production efficiency than farms not participating in SFSC.

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Introduction

The dominant position of large retail chains and global agri-food corporations – often resulting from extensive horizontal and vertical integration – has significantly weakened the bargaining power of farmers in conventional food value chains. In many agricultural sectors, such as seed production or food retail, a small number of international actors control key stages of the supply chain. This concentration of power leads to the separation of producers from consumers and marginalises farmers in the process of value creation. The length and complexity of traditional supply chains – with multiple intermediaries – further dilute the economic benefits for primary producers, who often receive only a small share of the final product value. As a result, farms have limited influence over the pricing of their raw materials or products, while most of the added value is appropriated by dominant intermediaries, including processors and retailers. According to transaction cost theory (Williamson, 1979), long and fragmented chains increase coordination and monitoring costs, and favour large, vertically integrated firms capable of managing these costs – leaving smaller farms at a disadvantage. In response to these structural inefficiencies and power imbalances, short food supply chains (SFSCs), also known as alternative food networks, have emerged as a viable model to re-embed food production in local contexts (Darlot *et al.,* 2016). SFSCs reduce the distance – both physical and relational – between producers and consumers, promote local economic development, and enhance the social embeddedness of food systems (Demartini *et al.,* 2017; Mundler and Jean-Gagnon, 2020). By limiting the number of intermediaries, they reduce transaction costs and allow farmers to retain a greater share of the added value, improving their economic resilience and restoring their role in the food system. Consequently, SFSCs represent not only a response to global market pressures but also a pathway toward more sustainable and equitable agri-food systems.

There is no universal definition of short food supply chains. Various typologies and classifications of SFSCs have been presented in literature (Darlot *et al.*, 2016; Matysik-Pejas *et al.*, 2017), and some of them are also reflected in legislation (Matysik-Pejas *et al.*, 2017). SFSCs are defined in Article 2 of Regulation (EU) No 1305/2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD), which came into force with the reformed Common Agricultural Policy 2014-2020. According to this regulation, SFSCs

are defined as 'a supply chain involving a limited number of economic operators, committed to cooperation, local economic development and close geographical and social relations between producers, processors and consumers'. Participation in SFSCs appears to be an appealing instrument for increasing the competitiveness of farms in the agri-food market. The attractiveness of this sales model is evidenced, for example, by the fact that in 2015, 15% of EU farms sold more than half of their production directly to consumers (European Parliament, 2016). However, from the farmers' perspective, involvement in SFSCs entails both benefits and costs (Bauman *et al.*, 2019; Mancini *et al.*, 2019; Mundler and Jean-Gagnon, 2020).

Short food supply chains support sustainable development of agriculture and rural areas in the economic, social and environmental context (Michalský and Hooda, 2015). SFSC farms utilise land in ways that prioritises sustainability and community engagement. They often implement organic farming practices, enhancing soil health and biodiversity, which can lead to improved crop resilience (Tiwari, 2021). They also strive to use local and/or raw ingredients to emphasise the quality, freshness and healthiness of the prepared meals (Torok *et al.,* 2022). For smallholder producers, SFSCs reduce the uncertainty and risk associated with economic processes and allow for future income flows to be planned with greater predictability. Consequently, they can limit the farm's vulnerability and increase the farm's resilience to negative external factors. The shortening of supply chains enables the producers to adapt to crisis conditions (Berti and Mulligan, 2016). Moreover, as SFSCs are less integrated into international markets on the output side and are more oriented toward local production, they may be less affected by international trade disruptions such as pandemic crisis or broken supply chains (Van Hoyweghen *et al.,* 2021). The local nature of SFSCs also allows for the reduction of transaction costs in farm operations, including costs related to finding buyers, negotiating prices, and transportation (Collison *et al.,* 2019).

However, SFSCs are not without drawbacks. They may pose challenges for consumers, such as limited product variety, dependence on local production, and issues related to seasonality, which can affect both availability and prices (Kawecka and Gębarowski, 2015). SFSCs often require rapid and frequent deliveries, leading to increased transportation costs and logistical complexities. Many producers find that the demands of SFSCs, including flexibility and time commitments, can outweigh the economic benefits, resulting in lower profitability (Rucabado-Palomar and Cuéllar-Padilla, 2020). Producers engaged in SFSCs often face challenges such as lower labour productivity in production tasks, high workload due to multiple roles, and low net earnings despite significant effort. These factors can hinder both financial sustainability and overall farm viability (Mundler and Jean-Gagnon, 2020).

In our research, we aim to evaluate the impact of participation in SFSCs on the productivity and efficiency of farms in two countries with different agrarian structure. To the best of our knowledge, a research gap exists in this area. Studies that have attempted to assess the influence of "short" selling on the economic performance of farms are few, and their findings are inconclusive or ambiguous. For example, Chiaverina *et al.* (2021) found that farms participating in SFSCs were more likely to report higher incomes compared to farms selling through intermediaries. Raftowicz *et al.* (2024), based on a literature review, stated that short food supply chains support the sustainable development of rural areas but often conflict with farm economic efficiency, as price competition tend to favour longer supply chains. Filippini *et al.* (2023), on the other hand, underlined that the efficiency of SFSC remains a subject of debate, requiring further investigation into their economic benefits. These cases justify the need for additional research in this area.

Taking the above into account, the main aim of our study is to assess the impact of participation in short food supply chains on the productivity and efficiency of farms. Poland and the Czech Republic are taken as examples of countries with contrasting agrarian structures. A comparative analysis of two countries with different land structures make it possible to determine whether the impact of participation in SFSCs on farm efficiency is independent of, or dependent on, a country's agrarian structure. These dependencies are also examined across different farm size classes.

The paper is structured as follows: the next section presents spatial scope of the study and dataset used. Section 3 describes the methods applied. The following section presents the results of the productivity and efficiency analysis for farms participating and not participating in SFSCs in Poland and Czechia. Finally, the paper ends with a discussion and conclusions.

Territorial scope and data set

The selection of Poland and the Czech Republic for this study stems from a research project carried out by the authors. The project aims to investigate the impact of the post-pandemic economic crisis on the functioning of short food supply chains. The two countries covered by the study - Poland and the Czech Republic - differ significantly in terms of farm size structure. The Czech Republic has the largest agricultural farms in the EU, with an average utilised agricultural area (UAA) of approximately 130 hectares, whereas Poland is characterised by a predominance of small farms, with an average UAA of around 11 hectares.

Nearly 90% of farms in Poland have less than 20 hectares of UAA, compared to 55% in the Czech Republic. At the same time, farms with more than 100 hectares of UAA account for 1.1% of all farms in Poland and 17.3% in the Czech Republic (Eurostat, 2020). There is also a substantial difference in the total number of farms - 1.3 million in Poland versus 29,000 in the Czech Republic – as well as in production and added value per farm, which are approximately ten times higher in the Czech Republic. Moreover, the more intensive use of capital by Czech farms results in approximately four times lower labour input per unit of capital.

The differences in agrarian structure and the use production resources result from divergent approaches to land management during the systemic transformation processes

that took place in both post-communist countries. In Poland, land previously managed by the State Agricultural Farms was mostly transferred to another state agency (currently the National Support Centre for Agriculture) and subsequently leased to individual farms by this institution. In contrast, in the Czech Republic, agricultural land was allocated primarily to large cooperatives and state-owned enterprises (often transformed into companies), which continue to constitute the core production base of Czech agriculture (Stacherzak *et al.*, 2019).

Currently, more than 80% of agricultural land in the Czech Republic is held by farms exceeding 1000 hectares of UAA, compared to 23% in Poland. The structural divergence between the two countries' agricultural sector is also influenced by socio-demographic and political factors. In Poland, these conditions continue to support the quasi-social nature of many farms (Soliwoda *et al.*, 2017).

Primary data were collected through qualitative research based on semi-structured interviews conducted with representatives of agricultural enterprises and individual farmers, both involved and not involved in short food supply chains (SFSCs). The selection of respondents followed a purposive-random sampling strategy, combining snowball sampling with expert selection, based on the knowledge and experience of the research team members. These experts had in-depth knowledge of the regional context and maintained direct contacts with relevant stakeholders. This approach allowed for the inclusion of a heterogeneous sample of entities varying in size, legal form, production orientation, and degree of integration into local markets.

In each country, 200 farms were selected and divided into two groups: those participating in short food supply chains (SFSC farms) and those not participating (non-SFSC farms). After eliminating incomplete and incorrect responses, the final sample consisted of 375 farms - 192 in Poland (85 of SFSC farms and 103 of non-SFSC-farms) and 183 in the Czech Republic (107 and 80, respectively) (data available at https://doi.org/10.18150/7RSDKB). The research was conducted in 2023 and 2024.

The interviews were guided by a pre-defined interview protocol that encompassed thematic areas such as organisational structure, production systems, economic performance, and distribution strategies. Example questions includes: *What is the average daily working time on the farm (in hours)? Which systems do you use to sell your products? What percentage of your production (including on-farm processed agricultural products) is sold through each channel (e.g., direct farm sales, neighbourhood sales, bazaar and market sales, delivery to consumers' households, own retail shop, box system, delivery to external units such as local retail shops, restaurants, bars, educational institutions, hospitals)? What is the estimated value of the farm buildings, machinery, and equipment (in the event of a hypothetical sale)? What is the total annual value of agricultural production (including processed products)? What is the total agricultural land area (in hectares), including leased land?*

The semi-structured format allowed for a combination of standardised questions and open-ended segments, enabling in-depth exploration of context-specific issues. All interviews were conducted in person, with the informed consent of respondents, and subsequently transcribed into textual form. The resulting data were systematically entered into a respondent database, which includes basic characteristics of the entities as well as coded outputs from the interviews.

The main advantages of the chosen methodology include the flexibility of data collection, allowing adaptation to individual case specifics; the high validity of data resulting from direct interaction with respondents; and the potential for mixed-methods analysis. However, certain limitations must also be acknowledged, such as the limited representativeness of the sample due to the non-probability selection method, the time and resource intensity required to conduct and process the interviews, and the potential for selection bias stemming from the reliance on personal networks during respondent recruitment.

The average farm size in the research sample was 20.48 hectares of UAA for Poland and 286.0 hectares for the Czech Republic. These figures highlight significant differences in the agrarian structure of the two countries.

In terms of the farm specialisation, mixed farms – those combining animal production and crop production – were the most common in both Poland and the Czech Republic (30.3% in Poland and 28.1% in Czechia). In Poland, these were followed by farms specialising in pigs (11.4%) and cereal production (10.3%), whereas in the Czech Republic, cereal production (21.1%) and wine production (13.0%) were the next common specialisations. Overall, it can be concluded that livestock-oriented farms were more prevalent among Polish farms compared to those in the Czech Republic.

Methods

Data Envelopment Analysis (DEA) as method for calculating efficiency in research

The use of productive resources determines the outcomes of manufacturing activities, including agriculture. As early as the time of W. Petty, land and labour were considered as the primary factors of national wealth. Commodity prices are determined by the remuneration of production factors – namely labour, land and capital – which forms the basis of Smith's doctrine. This approach was later developed by J. B. Say, who acknowledge the value-creating roles of capital and land, thereby rejecting theories based solely on labour. This also applies to agricultural products. In lines with these theories, resources determine the value of production. Efficiency, in turn, describes how effectively a company transforms resource inputs into production outputs. Measuring efficiency is essential for assessing a company's economic performance and for comparing its level of efficiency with that of other entities.

DEA (Data Envelopment Analysis) and SFA (Stochastic Frontier Analysis) are two the most important methods for measuring the efficiency of units (e.g. farms, companies), but they differ in their approaches and underlying assumptions. SFA is parametric method, which means it requires specifying a particular functional form of the production function (e.g. Cobb-Douglas). As a parametric technique, it

relies on strict statistical assumptions, such as the normality of the error term distribution and equality of variance (homoscedasticity). If these assumptions are violated, the result may be biased, and in such cases, non-parametric methods may be more appropriate (see also Lambarraa-Lehnhardt *et al.,* 2022). DEA, on the other hand, is a non-parametric method that does not require specifying a production function or meeting strict statistical assumptions. It uses linear programming to construct an 'efficiency frontier' based on observed input-output data. DEA evaluates the relative efficiency of units without assuming a predefined functional form (Engebretsen and Na, 2023; Kang and Kim, 2018). In our study, the data did not follow a normal distribution, as confirmed by the Shapiro–Wilk test. Moreover, the purpose of the analysis was to compare the efficiency of farms participating in SFSCs with those not participating in the SFSCs. These factors justified the use of the DEA method in the analysis.

The DEA method was proposed by Charnes, Cooper and Rhodes in 1978 in the form of the so-called CCR model (Charnes *et al.*, 1978). It is an extension of Farrell's (1957) seminal work on the estimation of technical efficiency. DEA is used to measure the relative efficiency of selected units (e.g., farms) in cases where multiple inputs are used simultaneously to produce multiple outputs. This method enables the calculation of synthetic technical efficiency scores of the examined entities, ranging from 0 to 1, where a higher score indicates the higher technical efficiency (Coelli *et al.*, 2005). This is a major advantage over commonly used partial efficiency indicators, such as fixed asset efficiency, land productivity, or labour productivity.

Another important advantage of DEA in agricultural efficiency analysis is its ability to handle inputs and outputs with different units of measurement. In practice, units are rarely described by just one input and one output, and input and output values are not always expressed in monetary terms. DEA overcomes this challenge by defining relative efficiency as the ratio of the weighted sum of outputs to the weighted sum of inputs. This relative efficiency is calculated within a specific set of units (in our case, farms). The ability to use heterogeneous inputs and outputs expressed in different units is one of DEA's greatest strengths, and this is the reason why it was applied in our analysis.

Research design

In the first stage of the analysis, land, capital, and labour inputs and their productivity were compared between farms participating in SFSCs and those not participating, across two countries simultaneously. The study defined SFSC-participating farms as those employing the following distribution methods: direct on-farm sales, neighbourhood sales, sales at bazaars and markets, home delivery to consumers, own retail outlets, delivery to external entities (such as local shops, restaurants, bars, educational institutions, or hospitals), and box schemes. Farm owners were asked what percentage of their production was sold through these channels. However, the analysis did not differentiate between the specific SFSC channels used. To be classified as participating in SFSCs, a farm had to sell at least 51% of its agricultural production through the aforementioned channels. The production value included both raw and processed goods.

In Poland, as many as 91.49% of farms that declared using various SFSC channels sold 100% of their production via these channels. The remaining farms sold, on average, 88% of their production through SFSCs. In the Czech Republic, the proportion of farms that sold their products exclusively through the aforementioned SFSC channels was lower than in Poland—58.70%. The remaining SFSC-participating farms sold, on average, 83% of their output via SFSC channels. In both Poland and the Czech Republic, direct sales from the farm and neighbourhood sales were by far the most common distribution method, followed by market or bazaar sales. It is also worth noting that in Poland, the farm with the lowest share of SFSC channel sales among those classified as SFSC participants still sold 60% of its production through these channels. The same minimum share was recorded in the Czech Republic—60%. Therefore, it can be concluded that the sample of farms classified as participating in SFSCs in both countries consisted of farms in which SFSC sales clearly predominated.

Table 1: Description of variables used in the study

Variables	Description
Agricultural production	Total agricultural production per year (PLN or CZK); includes both raw and processed agricultural products
Land	Total utilised agricultural area (UAA in hectares); includes both owned and leased agricultural land
Capital	Average annual expenditures on chemical fertilisers (PLN or CZK respectively) + Average annual expenditures on plant protection products (PLN or CZK) + Value of buildings, machinery, tools, etc. (PLN or CZK)
Labour	Total work performed on own farm (related to agriculture) in hours per year = Farmer's agricultural work + Partner's agricultural work + Other family members' work related to agricultural activities

Source: Own elaboration

To determine differences in input productivity between Polish and Czech farms, productivity indicators for Czech farms were expressed in both CZK and PLN. The exchange rate used for the conversion was that of 20 February 2025, i.e., 1 CZK=0.17 PLN. Table 1 provides a detailed description of the variables used in the study. The selection of input and output variables used to measure efficiency was based on a review of previous studies in which authors assessed efficiency in the agricultural sector. For example, Čechura *et al.* (2014) used labour (measured in AWU[1]), land (measured as total utilised agricultural area), and capital (measured as capital depreciation) as input variables to assess the technical efficiency of farms in EU countries. The output variable in their research was the total agricultural production of the farm. The output consisted of the value of pig production, while the inputs variables included labour, buildings and

[1] Annual work unit (AWU) represents full-time equivalent employment, calculated as the total hours worked divided by the average annual hours worked in full-time jobs in the country. One AWU corresponds to the work performed by one person engaged full-time on an agricultural holding. For reference, 1 AWU = 1,800 hours (Eurostat, 2025).

variable inputs (defined as the sum of feed costs—mainly concentrates—and veterinary services). Identical output and input variables to those used in our study were employed by Syp and Osuch (2018) where they used total farm output (in PLN) as the output variable, and the following as inputs: utilised land (in hectares), labour (in hours), intermediate consumptions, and total assets (in PLN).

Because the inputs and outputs were measured in different units (hectares, PLN, hours), and the range of their values varied widely, variable normalisation was applied. The min–max normalisation method was used (see Formula 1), which scaled each variable to a common range between 0 and 1.

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$$x\ norm = \frac{x - x\ min}{x\ max - x\ min} \quad (1)$$

where:
x norm – normalised value
x – original value
x min – minimum value in the data set
x max – maximum value in the data set

The productivity indicators used are partial, attributing all production to a single input (land, capital, or labour), which constitutes a significant simplification of reality. Therefore, in our analysis, we employed the Data Envelopment Analysis (DEA) method to assess the relationship between output and all inputs involved in production. Farm efficiency – separately for Poland and Czechia – was evaluated using input-oriented DEA models with variable returns to scale (VRS). To determine the optimal production technology for the farms, we applied the following formula (Cooper *et al.,* 2007):

$$P\ (x,y) = \{\ x_j \Rightarrow X\lambda_j, y_j \Leftarrow Y\lambda_j, \lambda_j \Rightarrow 0,\ \textstyle\sum_{j=1}^{n} \lambda_j = 1\} \quad (2)$$

where:

P (x,y) – set of production capabilities in the farm samples under study,
x_j – input vector m (labour in hours, land in ha of UAA, total assets in PLN or CZK) on the j-th farm;
X – input matrix (labour in hours, land in ha of UAA, total assets in PLN or CZK) sized (n*m) for all n farms;
y_j – output vector s (agricultural production in PLN or CZK) on the j-th farm;
Y – output matrix (agricultural production in PLN or CZK) sized (n*m) for all n farms;
λ_j – weights, which are the coefficients of the linear combination.

The construction of the production capacities set separately for Polish and Czech farms allowed us to measure the distance between the best-performing farms – representing optimal technology – and the remaining farms. This relationship is reflected by the following formula:

$$E(x_j, y_j) = \min\ \{\theta : \theta x_j,\ x_j\ \in P\ (x,y)\} \quad (3)$$

where:
$E\ (x_j, y_j)$ – function of distance between the point characterising the technology of j-th farm and the optimum technology (envelope);
θ – efficiency coefficient of the j-th farm;
$P\ (x, y), x_j, y_j,$ – as in formula 1.

The calculated technical efficiency indicators express how effectively land, capital, and labour inputs are transformed into final output, measured as total agricultural production. Technical efficiency scores estimated using the DEA method range from 0 to 1 and indicate the extent to which a given farm should proportionally reduce its inputs (i.e., land, labour, and capital) without changing its output (agricultural production), in order to achieve full efficiency (i.e., a score of 1).

In the next stage, farms were divided into four land-size classes separately for Poland and the Czech Republic. The classification was based on quartiles calculated independently for each country (Poland and the Czech Republic), ensuring that each class contained a similar number of farms. Subsequently, we compared the efficiency indicators for farms participating and not participating in SFSCs, both across the entire samples from Poland and the Czech Republic and within each land-size class. This approach allowed us to analyse the relationship between farm size and efficiency of SFSC farms and non-SFSC farms in two countries with different agrarian structure. It is worth noting that in Poland, the minimum and maximum farm size in the sample ranged from 1 to 75 hectares, whereas in the Czech Republic they ranged from 1 to 5,000 hectares. It highlights the significant differences in agrarian structures between the two countries (see section Territorial scope and data set). The land-sized classes for Poland and the Czech Republic are presented in Table 2.

Table 2: Farm area classes* for Poland and Czechia

Size class	Area range (ha of UAA) and number of farms (in brackets)	
	Poland	Czech Republic
Small	1–10 (52)	1–15 (45)
Medium-small	11–15 (46)	16–60 (46)
Medium	16–25 (48)	61–200 (46)
Big	26–75 (46)	201–5,000 (46)

* The classes were established to ensure that each contained a similar number of farms.
Source: Own elaboration

Since the survey samples in Poland and the Czech Republic did not meet the assumption of normality and equality of variances, a non-parametric Mann-Whitney U test was used to assess the significance of differences between the means

of the two independent samples, i.e., SFSC-farms and non-SFSC-farms, and farms across different area classes. STATA software was applied for the calculation.

Results

Inputs and their productivity in farms participating and not participating in SFSCs

We compared the size of inputs and production outcomes between farms participating in short food supply chains and those that do not. In both Poland and Czechia, the average values of agricultural production, capital, and land inputs were lower among SFSC-participating farms. Conversely, labour inputs were higher in SFSC-participating farms. However, statistically significant differences were found only for land and capital inputs (Table 3). This suggests that SFSC-farms operate on smaller areas of agricultural land and utilise lower capital inputs—differences that are statistically significant.

Next, partial productivity indicators were calculated. The data presented in Table 4 reveal significant differences in the types of agricultural intensification between the two countries. In the Czech Republic, both SFSC and non-SFSC farms exhibited higher labour productivity. In contrast, Polish farms demonstrated higher capital productivity. This suggests that agriculture in the Czech Republic is more capital-intensive – requiring substantially higher capital inputs – while being less labour-intensive compared to Poland.

Our research findings are consistent with broader structural trends in European agriculture. Poland is among the EU countries with the highest share of employment in agriculture—more than twice the EU average. At the same time, it ranks among the EU countries with the lowest labour productivity in the sector. In contrast, Czechia is one of the EU countries with the lowest proportion of people employed in agriculture (Ossowska and Janiszewska, 2018). According to Eurostat (2025), in 2022, 8.4% of Poland's total workforce was employed in agriculture. Meanwhile, in 2019, only 2.3% of the economically active population in Czechia worked in agriculture and forestry (Vaishar and Šťastná, 2020). These figures reflect two distinct models of agricultural development: the Czech Republic's model is oriented toward industrial farming, characterised by large-scale operations and high capital investment in machinery and infrastructure. In contrast, Poland's agriculture remains dominated by small-scale, family-run farms (Soliwoda *et al.,* 2017). In general, family farms attach greater importance to the efficiency of labor allocation, while large agricultural corporations focus on improving the efficiency of agricultural capital allocation (Dong, 2023). These structural differences were also confirmed by the results of our study.

In the case of land productivity, SFSC-farms in the Czech Republic recorded higher values, whereas in Poland, non-SFSC farms achieved better results. Thus, the cross-country comparison for this variable yields ambiguous conclusions. However, when comparing SFSC and non-SFSC farms within each country, land productivity was significantly higher among SFSC-farms – this difference was statistically significant in both Poland and Czechia. Labour productivity, on the other hand, was higher in non-SFSC farms, although the difference reached statistical significance only in the Czech Republic. Conversely, capital productivity was higher among SFSC-farms, but this difference was not statistically significant.

The observed differences in efficiency in favour of farms participating in short food supply chains (SFSCs) may stem from the specific economic model underpinning SFSCs, which supports local economies by reducing transportation costs and fostering direct sales – factors that can enhance the profitability of participating farmers (Petropoulou and Paschou, 2022). As highlighted by numerous researchers, co-creation is a key feature of the SFSC model. According to Thomson *et al.* (2023), co-creation within SFSCs involves a transformation of the selling and buying process, whereby participants – including consumers – become "co-producers," actively engaging in the design, planning, retailing, and

Table 3: Inputs and production value for SFSC and non-SFSC farms in Poland and Czechia

Participation in SFSCs	Inputs			Output
	Land (ha of UAA)	Labour (hours)	Capital (PLN)	Agricultural production (PLN)
	Poland			
Yes	14***	5,743	839,278**	209,356
No	20	5,302	1,007,012	225,296
p-value	<0.001	0.210	0.009	0.356
	Czech Republic			
Yes	220***	5,686	6,2196, 405*	2,127,993
No	372	4,286	8,110,819	3,640,011
p-value	<0.001	0.114	0.018	0.102

Note: Significant at: ***p < 0.001; **p < 0.05; *p < 0.10
* The exchange rate used for currency conversion was 1 CZK = 0.17 PLN, based on the rate from 20 February 2025.
Source: Own elaboration based on own survey

Table 4: Productivity of SFSC and non-SFSC farms in Poland and Czechia

Participation in SFSCs	Output per 1 unit of input (productivity)		
	Agricultural production to land (PLN/ha of UAA)	Agricultural production to labour (PLN/1 hour of work)	Agricultural production to capital (PLN/PLN)
	Poland		
Yes	24,973.21**	41.85	2.26
No	13,524.60	60.70	0.29
p-value	0.002	0.158	0.223
			Czech Republic
Yes	8,402.74***	547.63*	0.08
No	12,475.70	961.72	0.06
p-value	<0.001	0.013	0.825

Note: Significant at: ***p < 0.001; **p < 0.05; *p < 0.10
* The exchange rate used for currency conversion was 1 CZK = 0.17 PLN, based on the rate from 20 February 2025.
Source: Own elaboration based on own survey

Table 5: DEA efficiency of SFSC and non-SFSC farms by farm size class in Poland and Czechia (including share of SFSC and non-SFSC farms, %)

Area class:	Poland			Czech Republic		
	DEA efficiency indicators and participation in SFSC (yes/no)					
	Yes	No	p-value	Yes	No	p-value
Small	0.280* (65%)	0.200 (35%)	0.078	0.443 (80%)	0.251 (20%)	0.138
Medium-Small	0.151 (41%)	0.135 (59%)	0.89	0.221 (61%)	0.146 (39%)	0.919 (54%)
Medium	0.379 (42%)	0.300 (58%)	0.727	0.218 (46%)	0.200	0.242
Big	0.130 (26%)	0.218 (74%)	0.826	0.181 (39%)	0.137 (61%)	0.558
Total	0,445*** (44%)	0,310 (56%)	0,002	0.310 (56%)	0.220 (44%)	0.147

Note: Significant at: ***p < 0.001; **p < 0.05; *p < 0.10
Source: Own elaboration based on own survey

collaborative creation of outcomes. Similarly, Umaran *et al.* (2022) emphasise that SFSC participants often engage in the joint definition and planning of services and outputs.

SFSCs represent innovative food systems – such as farmers' markets, on-farm sales, food box delivery schemes, online sales, and pick-your-own arrangements – that are open to collaboration and inclusive of a diverse range of actors, including consumers, retailers, market organisers, and producers (Charatsari *et al.,* 2019). This collaborative nature of SFSCs contributes to increased profitability through co-creation. Moreover, the shortening of food supply chains, as an alternative food practice, aligns with the concept of a "quality turn" (Goodman *et al.,* 2012). This shift reflects a movement away from rigid quality criteria such as price, standards, and trademarks toward softer quality attributes rooted in trust, community, and tradition. These processes collectively contribute to cost reduction and improved efficiency among farms participating in SFSCs.

Efficiency of SFSC and non-SFSC farms and by farm size classes

This section presents the DEA (Data Envelopment Analysis) efficiency results for farms in Poland and the Czech Republic. In both countries, the average efficiency scores were higher for farms participating in short food supply chains (SFSCs) compared to those that were non-participating. However, this difference was statistically significant only in the case of Poland (Table 5). When the analysis was disaggregated by farm size classes, statistically significant differences were observed only among small farms in Poland – defined as those with an area between 1 and 9 hectares.

Additionally, the results indicate that the share of farms participating in SFSCs declined as farm size increased in both countries. This suggests that farmers in both Poland and the Czech Republic tend to view participation in short supply chains as more suitable for smaller farms, likely due to the perceived potential for improving their economic performance. In this context, the decision of small-scale farmers in Poland to engage in SFSCs can be considered economically rational.

Discussion

The work of Chiaverina *et al.* (2021), based on a review of 48 studies examining the impact of SFSCs on farm productivity, found that approximately 54% reported a positive effect on farm economic performance, while 46% observed no effect or, in some cases, a negative impact. In our study, a positive impact of participation in SFSCs was evident primarily among the smallest farms in Poland. For larger farms – those with 11 hectares or more – the relationship was not statistically significant. These results clearly indicate that the beneficial effect of participation in short food supply chains on economic outcomes, measured here by efficiency, is most pronounced for the smallest farms in Poland. Thus, our findings demonstrate that the impact of participation in SFSCs on the efficiency of the smallest farms is influenced by the agrarian area structure. A positive effect was observed in Poland – a country with a highly fragmented agrarian structure – while no such effect was found in the Czech Republic, which has the largest average farm size among all EU member states. For reference, the average farm size in the EU is 12 hectares, with the Czech Republic averaging 152 hectares, and Romania and Cyprus having the smallest farms, averaging just 3 hectares (Popescu, 2013). These differences suggest that the structure of land ownership and farm size plays a crucial role in shaping the relationship between participation in SFSCs and farm economic performance. Therefore, any general assessment of the economic impact of SFSC participation must consider national variations in agrarian structure.

The results of our study can also be compared with findings from other countries. For instance, Cesaro *et al.* (2020) reported a positive relationship between participation in SFSCs and economic performance in countries such as Greece, Slovenia, and Croatia. Notably, these countries – like Poland – are characterised by an agrarian structure dominated by small farms. By focusing on local markets, SFSCs can help mitigate inefficiencies associated with land fragmentation and contribute to the ecological and economic sustainability of farming practices. However, small-scale farmers often face significant challenges, including high transaction costs and production risks, which require cooper-

ative solutions. By fostering collaboration among producers and other stakeholders, SFSCs have the potential to enhance the competitiveness of small farms. This is particularly important for improving efficiency in the agricultural sector in countries with fragmented agrarian structures.

Dries *et al*. (2004) argue that effective participation in long food supply chains requires advanced production knowledge, access to specialised technical equipment, and adherence to private standards imposed by large agribusinesses. These requirements are often difficult for small farms to meet, making participation in SFSCs a more accessible and appealing alternative. Within long supply chains, small-scale producers typically have little or no influence over pricing, with the majority of added value captured by intermediaries. In contrast, short food supply chains offer farmers greater control over pricing and reduce their vulnerability to market volatility. As noted by Berti and Mulligan (2016), SFSCs offer a degree of protection against the negative economic consequences of market volatility, which are often experienced in conventional, intermediary-dominated food supply chains.

Our results align with the findings of Chiaverina *et al*. (2021), who emphasised that farming systems differ across countries and continents, and these structural differences influence the economic performance of farms participating in SFSCs. This highlights the importance of carefully selecting countries for analysis, as the national context may significantly shape the outcomes. Another key factor influencing research results is the duration of the study. Farmers entering SFSCs typically require several years to achieve profitability, as participation involves initial investments and the gradual development of a stable customer base (Dono *et al.,* 2022). According to Chiffoleau and Dourian (2020), farms engaged in short food supply chains can attain higher incomes than those relying solely on long chains, but this advantage tends to materialise only after 5–7 years of participation. Consequently, studies based on short-term data may underestimate the potential benefits of SFSCs. Our findings should therefore be treated as preliminary, and broader generalisations will require longitudinal research extending beyond a single year.

It is also important to note that other researchers, such as Enthoven and Van den Broeck (2021), based on an extensive literature review covering studies from Europe and North America, found that most analyses examined the economic performance of farms that sold at least a portion of their production through SFSCs. However, these studies often lacked direct comparisons with farms that did not participate in short supply chains. As a result, it remains difficult to accurately assess the economic differences between SFSC and non-SFSC farms or to isolate the effect of SFSC participation on farm performance. Our study addresses this gap by directly comparing the two groups, thereby contributing valuable insights to the literature on the economic impacts of SFSCs.

Conclusions

Small farms, measured by area size, tend to achieve higher land productivity and production efficiency through participation in SFSCs in countries with a fragmented agrarian structure, such as Greece, Slovenia, Croatia, and Poland. Therefore, the perspective commonly presented in the literature – that the SFSC model primarily targets smaller farms – should be viewed positively. It enables producers to improve their efficiency alongside conventional, long supply chains that dominate the food market. This dynamic is expected to enhance farm efficiency in countries with fragmented land ownership, thereby contributing to the increased competitiveness of agriculture in these regions.

As noted, SFSCs are closely linked to traditional, local products. Supporting initiatives within the framework of the EU Common Agricultural Policy (CAP) that promote local food, foster cooperation between consumers and producers, and encourage the formation of cooperatives and producer associations can significantly contribute to the expansion of the SFSC model. Such support is likely to enhance the efficiency of smaller farms in rural areas, especially in countries where family farming predominates. Collaboration among stakeholders can be further strengthened through industry meetings, training sessions, exhibitions, and the creation of networking opportunities. By backing these initiatives, EU agricultural policy can facilitate broader adoption of the SFSC model among small-scale farms.

Additionally, local leaders engaged in SFSCs can play a crucial role in promoting this business model within rural communities. By setting a positive example, they can encourage other farmers to adopt the SFSC approach. Financial support for farm visits and meetings with these pioneering farmers – targeted at those interested in joining SFSCs – should be considered under the EU Common Agricultural Policy. Ultimately, fostering participation in SFSCs through such initiatives may enhance the efficiency of smaller, family-owned farms across the EU, aligning with the EU's sustainable development goals.

Institutional support for SFSCs is further justified by the environmental and social benefits for local economy associated with this model. Environmentally, SFSCs contribute to lower greenhouse gas emissions due to shorter transportation distances, reduced packaging, and limited storage requirements. Socially, they promote increased trust between consumers and producers and help preserve and popularise local food traditions and cultural practices, thereby strengthening regional economies.

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