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The Effects of Investment Support on Performance of Farms: The Case of Application of the Rural Development Programme in Slovakia

The paper estimates the firm level impact of the Common Agricultural Policy (CAP) investment subsidies on gross value added, profits, employment, and productivity of farms in Slovakia, and evaluates the effectiveness of support provided through the Rural Development Programme. We employ a Propensity Score Matching Difference-in-Differences econometric approach on a database of commercial farms for the period 2006-2015. The results of this paper show that the farm investment support stimulated growth of gross value added, farm profits, and employment in the agricultural sector, while it reduced labour productivity. Investment support helped to maintain rural jobs, which occurred partly at the expense of labour productivity. The paper stresses high deadweight costs of investment support within the CAP, which should be considered when planning and implementing new CAP interventions.

Keywords: CAP, investment support, PSM estimator, Slovakia

JEL classifications: Q18, Q12, C21, O13, H25.

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Introduction

One of the objectives of the Common Agricultural Policy (CAP) of the European Union (EU) is to support the competitiveness of farms and their restructuring. In the programming period 2007–2013, 11 billion EUR of the EU budget was devoted to the support of competitiveness through investment into agricultural production and food processing. Investment support to farms and processing companies from Rural Development Programmes (RDP) of the EU continued in the programming period 2014–2020 and similar support has been allocated in the current period of 2023–2027. Similarly, the recovery plan for Europe also aims to allocate a substantial amount in the sector to address the adverse economic and social effects caused by the coronavirus pandemic.

Investment support is coupled to agricultural production, whereas the majority of farm subsidies within the EU's CAP are decoupled from production. Decoupled subsidies include mainly direct payments that are allocated per hectare of agricultural land. Investment support is project-based. Farmers submit investment projects for financing within specific calls for projects. Less than 15 percent of direct payments are still linked to agricultural production and are distributed based on cultivation of a specific commodity or rearing specific farm animals – they are coupled subsidies.

Investment support stimulates farm investment and the adoption of productivity-enhancing modern technology (FAO, 2011). The European Commission explicitly mentions in its proposal for the post-2013 CAP the challenge of food security and the EU's goal to support long-term food supply potential and meet the growing world food demand (European Commission, 2012; Rizov *et al.*, 2012).

Investment support remains an important objective of the CAP in the current programming period 2023–2027 (European Commission, 2023). Supporting agricultural productivity is one of the nine's main objectives and one of the three's economic objectives of the CAP, the other two being supporting incomes of farmers and strengthening the position of farmers in the supply chains. In the case of Slovakia, the Slovak strategic plan for the CAP 2023 – 2027 stresses the importance of increasing productivity of Slovak farms and the whole value chain and SWOT analysis accompanying the Strategic plan considers improvement of productivity one of the most important objectives of the Strategic Plan of the Common Agricultural Policy in Slovakia.

It is therefore important and relevant for taxpayers, policymakers, and analysts to evaluate the effects and efficiency of such support not only in Slovakia, which is a primary objective of our analysis, but also in other EU countries. The main goal of this paper is to evaluate the impact of investment support to farms provided within Rural Development Programme in the programming period 2007-2013 in Slovakia. Specifically, we analyse the impact of investment support on gross value added of farms, labour employment, labour productivity, and profit. Our null hypothesis is that investment support increases productivity of farms, gross value added, profits, and employment.

There is growing literature attempting to estimate the performance of the RDP support in general (e.g., Arata and

Sckokai, 2016; Bakucs *et al.*, 2019; Kuhfuss and Subervie, 2018; Mack *et al.*, 2018; Pufahl and Weiss, 2009; Udagawa *et al.*, 2014) and investment support (e.g., Bartova and Hurnakova, 2016; Desjeux *et al.*, 2014; Kirchweger *et al.*, 2015; Kirchweger and Kantelhardt, 2015; Medonos *et al.*, 2012; Michalek *et al.*, 2016; Olper et al., 2014; Petrick and Zier, 2011). Specifically, for Slovakia, Michalek (2009) evaluated the impact of investment support to farms in early years of Slovakia's membership in the EU (2004–2006). The results are likely to have been strongly affected by the period of the analysis, which was characterised by a rapid adjustment of the economy and agricultural sector to EU policies and institutions due to the EU accession. This article evaluates the RDP programming period of 2007–2013 when the Slovak economy and the agricultural sector in particular had already adjusted to EU membership. Slovakia fully participated in EU policies, including the RDP, for the whole programming period.

The results for Slovakia are especially relevant because (a) agricultural production in Slovakia is dominated by large farms and therefore differs from the structure of farms observed in other countries where family farms prevail[1], and (b) Slovak farms, like farms in all countries of Central and Eastern Europe, are technologically less advanced than those in the Western countries of the EU and investment support helps them to close the technological gap (Pokrivcak *et al.*, 2019).

Our results therefore provide evidence on the effect of investment subsidies on market-oriented large farms, which normally do not have problems obtaining credit from banks. This contrasts with the effect of investment subsidies on small family farms that suffer from credit constraint. Furthermore, our results shed some light on EU investment support to farms in Central and Eastern Europe where institutions, including financial institutions as well as regulatory capacity of the state, are lagging behind those in the more advanced countries of the EU. Moreover, the advantage on focusing specifically on a country case study instead of covering several countries or all EU is that the implementation details of each RDP measure – including the investment support (e.g., eligibility criteria, size of the support) – usually varies between member states. Given such variations in RDP implementation, a more desirable approach is to perform estimations for each regional unit (Michalek *et al.*, 2020).

Literature review

Government is significantly involved in EU agriculture. Annually, the EU spends around 50 billion EUR on support for rural areas, environmental public goods, agricultural incomes and production subsidies. According to the European Commission (the EU's executive branch) agricultural policies are crucial to support the incomes of farmers and to sustain rural communities by creating jobs and preventing outward-migration from rural areas (European Commission, 2012). In the new Common Agricultural Policy post-2020, the European Commission further stresses the important role of agricultural subsidies in fostering jobs in rural areas, improving incomes and productivity of farms and attracting new people in agricultural sector (European Commission, 2023).

The main rationale for agricultural policies is to correct market failure by supporting provision of public goods and coping with economic externalities of agricultural production. Furthermore, agricultural policies are used to eliminate imperfections in rural financial and insurance markets so as to enhance agricultural productivity (Blancard *et al.*, 2006; Ciaian and Swinnen, 2009; Hennessy, 1998; Roche and McQuinn, 2004). There is overwhelming evidence that rural credit markets are imperfect and lead to significant credit constraint of farms. Agricultural subsidies help to relax credit constraint either by directly providing investment funds for farms or indirectly by increasing farms' profitability and collateral (Ciaian *et al.*, 2010). Imperfect insurance markets hinder investment in riskier activities that have high return if there are no insurance policies available for farmers (Hennessy, 1998; Roche and McQuinn, 2004).

Improving the competitiveness of the agricultural sector is one of the key priorities of the CAP. One of the main CAP instruments used to promote the agricultural competitiveness is through the farm investment support granted under the Rural Development Programme (European Commission, 2012; European Union, 2013). Several studies attempted to investigate whether the CAP, the farm investment support in particular, contributes towards this objective.

Agricultural subsidies have important impacts on agricultural markets. Besides affecting farmers' income, studies have shown that agricultural subsidies distort input and output markets and thus alter the rents of other agents active in the agricultural sector (for example consumers or input suppliers). The impact of agricultural subsidies on distribution of income depends heavily on the type of subsidies, structure of markets and the existence of market imperfections (Alston and James, 2002; de Gorter and Meilke, 1989; Gardner, 1983; Guyomard *et al*., 2004; Salhofer, 1996; Ciaian and Swinnen, 2009). Studies also evaluate, among other aspects, the impacts of subsidies on the environment and agricultural public goods (e.g. van Beers and van den Bergh, 2001; Khanna *et al.*, 2002) or productivity and market distortions (e.g. Chau and de Gorter, 2005; Goodwin and Mishra, 2006; Sckokai and Moro, 2006).

In general, investment support is expected to stimulate on-firm investments on supported firms which can be translated into an improvement in their performance, particularly when farms have constrained access to credit. If farms are not credit constrained then the support is expected to lead to deadweight effects as farms are expected to carry out investments that they would do even in the absence of the support (Brandsma *et al.*, 2013; Michalek *et al.*, 2016, 2020). Further, the impact of the investment support might be reflected by reducing the capital cost that is expected to induce the substitution of capital for labour, and thus supported firms might become more capital intensive (Daly *et al.*, 1993; Michalek *et al.*, 2020).

According to Rizov *et al.* (2013), there are two opposed views on the agricultural subsidies in the context of the Common Agricultural Policy of the European Union. The Euro-

[1] Large farms also dominate in the Czech Republic and play important roles in Bulgaria and Baltic countries.

pean Commission stresses the role of agricultural subsidies in fostering jobs in rural areas, improving incomes and productivity of farms and attracting new people in agricultural sector (European Commission, 2023). Agricultural policies are crucial to support incomes of farmers and to sustain rural communities by creating jobs and preventing out-migration from rural areas (European Commission, 2012).

On the other hand, agricultural subsidies have been criticised for distorting agricultural markets and labour allocation in the economy by constraining or preventing structural change that is essential for economic growth and development (Johnson, 1973; Gardner, 1992; OECD, 2008). With respect to agricultural employment, some studies do indeed find a positive impact of subsidies on agricultural employment (Breustedt and Glauben, 2007; Olper *et al.*, 2014), but others find no or mixed impacts (Barkley and Flinchbaugh, 1990; Petrick and Zier, 2011) and yet others find a negative impact (Berlinschi *et al.*, 2014).

Regarding the farm investment support, the literature finds mixed results. Several studies found mostly positive effects of investment subsidies on various farm indicators such as gross added value, farm profitability, productivity, and income level (e.g., Kirchweger and Kantelhardt, 2015; Salvioni and Sciulli, 2011; Medonos *et al.*, 2012; Spicka and Krause, 2013). Other studies, however, found zero or negative impact of the RDP investment support, for example, on labour employment or efficiency and productivity (e.g., Salvioni and Sciulli, 2011; Gabe and Kraybill, 2002; Beason and Weinstein, 1996; Lee, 1996; Bagella and Becchetti, 1998; Harris and Robinson, 2004; Bernini and Pellegrini, 2011; Olper *et al*., 2014, Musliu, 2020).

The extent of government involvement in the agricultural production is difficult to explain through recourse to the market failure argument, though. Economic theory states that agricultural policies significantly distort incentives and reduce productivity (Johnson, 1973; OECD, 2008) by changing relative prices of outputs and inputs, increasing, or decreasing income of farmers, increasing, or reducing risks of agricultural production, and changing farm structure (size of farms, exit or entry of farms) (OECD, 2024). Many agricultural policies involve a combination of effects. For example, investment grants applied in the EU increase the income of farmers, reduce risk, and affect exit and entry of farms.

There are different types of subsidies and their effects, therefore, also differ. For example, subsidies to less favoured areas generally subsidise farms that cultivate less productive land and therefore these types of subsidies keep inefficient farms in production which reduces efficiency (Latruffe and Desjeux, 2016). Similarly, agri-environmental subsidies compensate farmers for imposition of additional environmental constraint on use of inputs. However, one study suggests that the empirical evidence is not clear-cut (Lakner, 2009), while others find no or a positive effect (Mary, 2013; Dudu and Kristkova, 2017). Investments in human and physical capital may be productivity enhancing and cost-reducing, as improved knowledge of efficient farming practices can lead to better use of technology and land (Boulanger and Philippidis, 2015; Dudu and Kristkova, 2017). There is related literature analysing the impact of different types of CAP subsidies (e.g., direct payments, RDP) on productivity of farms. Depending on the type of subsidy and institutional factors (e.g., the presence of farm credit constraint), theoretical papers suggest that agricultural subsidies may have either positive or negative impact on farm productivity (e.g., Rizov *et al*., 2012; Hennessy, 1998; Ciaian and Swinnen, 2009). For example, Latruffe *et al.* (2009) find a negative impact of CAP subsidies that are linked to production on managerial efficiency of French farms.

Agricultural subsidies might reduce productivity by introducing technical and allocative inefficiency. This occurs when farmers invest in supported activities that might be less productive and over-invest in subsidised inputs. Agricultural subsidies also reduce incentives to minimise costs and create soft budget constraint that leads to inefficiency and lower productivity growth (Alston and James, 2002; Rizov *et al.*, 2013; Leibenstein, 1966; Minviel and Latruffe, 2017; Kornai, 1998).

Cechura (2012) asserts that the most important factors which determine both technical efficiency and TFP are the factors connected with institutional and economic changes, in particular a dramatic increase in the imports of meat and increasing subsidies. Lakner (2009) shows that the agri-environmental and investment subsidies have negative effects on the technical efficiency of organic dairy farms in Germany, while Zhu and Oude Lansink (2010) discover a negative impact of subsidies linked to production on technical efficiency of crop farms in Germany, the Netherlands and Sweden. By analogy, Zhu *et al.* (2012) find that production subsidies and input subsidies negatively impact technical efficiency of dairy farms in Germany and the Netherlands. In the specific case of Slovakia, Michalek (2009) estimated that the effect of the SAPARD programme, granted to farmers before the EU accession, had a negligible or negative impact on farm profits and gross value added, while the estimated effect on the agricultural employment was slightly positive.

On the other hand, productivity is increased when agricultural policies solve rural credit or insurance imperfections, provide public goods and cope with negative externalities (Blancard et al., 2006; Ciaian and Swinnen, 2009, Hennessy, 1998; Roche and McQuinn, 2004). The estimates of Bartova and Hurnakova (2016) show a positive net effect of the RDP 2007-2013 investment support on farm performance in Slovakia.

Overall, with respect to agricultural employment, the literature states both positive and negative effects of subsidies. Positive effects result from higher incomes which keep farmers in agriculture rather than moving to other sectors of the economy. Negative effects of agricultural subsidies on employment result traditionally from substitution of labour by capital. Subsidies also relax credit constraint which leads to structural change towards less farms of bigger sizes. Higher income due to subsidies, however, indirectly leads to reduction of employment because farmers use enhanced income to invest in skills and education which allows them to find jobs outside of agriculture (Goetz and Debertin, 1996, 2001; Barkley and Flinchbaugh, 1990; Ciaian *et al.*, 2010; Berlinschi *et al.*, 2014). Indirect negative effects on employment might outweigh positive effects and therefore the net effect is a matter of empirical estimation (Garrone *et* *al.*, 2019). Garrone *et al.* (2019) estimated econometrically using detailed EU-wide panel data for 2015 regions of the EU collected within Clearance Audit Trail System that CAP subsidies are costly in the European Union. One saved job in the agricultural sector costs taxpayers 324 000 EUR annually, which is 27 000 EUR monthly.

Farm investment support in Slovakia

In this paper we cover the Measure 121 – modernisation of farms – (referred to as investment support) granted under the Rural Development Programme 2007–2013. The objective of this measure was to increase competitiveness of agricultural farms through better utilisation of the factors of production and the application of new technologies and innovations. The support was targeted towards the reduction of production costs, improvement of labour conditions, increasing the number of farms with modern buildings, new technologies and equipment saving energy, as well as towards introducing or expanding the use of information and communication technology (RDP Slovakia 2007–2013).

Investment support was implemented by 7 calls for proposals realised between 2008 and 2015. Project evaluation criteria of individual calls gave preference to projects that:

- led to expansion of modern and competitive crop production including production of fruits and vegetables with higher value added;
- contributed to modernisation of animal production;
- led to expansion of direct sale of production to consumers;
- directed investment to specific locations (less developed regions);
- targeted investment to specific segments and types of farms;
- invested in certain sizes of projects.

Overall, 2,173 projects were supported through this measure by the end of 2015 with a total amount of 490.9 million EUR. Regarding the number of farms, 1,498 farms were supported, of which 445 were natural persons. Around 55% of all supported projects were realised in animal production, while 26.65% were in crop production. In animal production, projects supported mainly cattle, while in crop production, cereals sector was supported. Regarding type of supported investments, 271 million EUR (55%) of grants was used on financing capital investment, while 219.4 million EUR (45%) was used on financing investment into buildings.

Materials and methods

Econometric Approach

We analyse the impact of investment support to farms (treatment) on their performance as measured by the average treatment on the treated (ATT) a widely applied method in the literature for counterfactual impact analysis of policies (e.g., Hoken and Su, 2015; Michalek *et al.*, 2016; Michalek *et al.*, 2018). We estimate the average difference in outcome variables (e.g., farm productivity, employment, value added or profits), Y, of farms that had received support (D=1) and those that had not received investment support (D=0). The causal effect of investment support is the difference between the potential outcome of farms with investment support (treated farms), Y_1, and the potential outcome of farms without investment support (untreated farms), Y_0: $Y_1 - Y_0$. The expected value of potential outcome of farms without investment support is not directly observed. To use non-supported farms as a control group would result in a selection bias, because the selection in or out of the investment support scheme is not random, implying that means of Y_0 for farms with investment support (D=1) and Y_0 for those without investment support (D=0) may differ systematically, even in the absence of the support programme (Heckman and Robb, 1985; Heckman, 1997; Smith, 2000; Smith and Todd, 2005). In the RDP farms self-select to apply for the investment grant which makes the selection bias particularly relevant. To deal with the selection bias, we define the average treatment on the treated (ATT) conditional on the probability distribution of observed covariates:

$$\mathrm{ATT}(Z) = E(Y_1 - Y_0 | X = Z, P(Z) = p, D = 1) \quad (1)$$

where X is a set of variables representing the pre-exposure attributes (covariates) of farms, Z is a subset of X representing a set of observable covariates, P is a probability distribution of observed covariance Z. However, the estimation of ATT is difficult due to high dimensionality of the conditioning problem.

According to Rosenbaum and Rubin (1983), the dimensionality of the conditioning problem can be significantly reduced by implementing matching methods using balancing scores b(Z) such as propensity score. For random variables Y and Z and for discrete variable D, the propensity score is defined as the conditional probability of receiving the treatment (i.e., receiving investment support) given pre-treatment characteristics, $Z: p(Z) = \Pr(D = 1|Z) = E(D|Z)$. Rosenbaum and Rubin (1983) show that if treatment is random conditional on Z, it is also random conditional on $p(Z)$:

$$E[D|Y,\Pr(D = 1|Z)] = E[E(D|Y, Z|Y,\Pr(D = 1|Y)] \quad (2)$$

so that $E(D|Y,Z) = E(D|Z) = Pr(D = 1|Z)$, which implies that $E[D|Y, \Pr(D = 1)|Z)] = E[D|Pr(D = 1|Z)]$, where $Pr(D = 1|Z)$ is a propensity score. This implies that, when outcomes are *independent of receiving treatment* conditional on Z, they are also *independent of treatment* conditional on the propensity score, $Pr(D = 1|Z)$. Hence, the conditional independence remains valid, if we use the propensity score $p(Z)$ instead of covariates Z or X.

Estimating a conditional participation probability by employing a parametric method, such as *probit* or *logit*, or *semi-parametrically* reduces dimensionality of the matching problem substantially to one dimension only, i.e., univariate propensity score. An important feature of this method is that after individuals have been matched, the unmatched comparison individuals can be easily separated out and are not directly used in the estimation of treatment effects.

The Propensity Score Matching (PSM) estimator for the ATT can be written as:

$$\tau^{\mathrm{PSM}} = E[p(Z)|D=1][E(Y_1|D=1, p(Z)] - \\ - [E(Y_0|D=0, p(Z)] \quad (3)$$

which corresponds to the mean difference in outcomes over the common support, appropriately weighted by the propensity score distribution of PO members (Caliendo and Kopeinig, 2008).

Difference-in-Differences PSM estimator

While the PSM can be applied to control for selection bias on observables at the beginning of the programme, a combination of the PSM with Difference-in-Differences (DID) methods (conditional DID estimator) allows for controlling of selection bias in both observables and unobservables (e.g., Heckman *et al.*, 1997; Bratberg *et al.*, 2002; Smith and Todd, 2005). The PSM-DID measures the impact of receiving investment support by using differences between comparable treated farms (D=1) and control group (non-treated) (D=0) in the period before, t', and after, t, the investment support implementation:

$$\text{PSM-DID} = \{\textstyle\sum_i [Y_{\mathrm{it}}|(D=1) - Y_{\mathrm{it}}|(D=0)] - \\ - \textstyle\sum_i [Y_{\mathrm{it'}}|(D=1) - Y_{\mathrm{it'}}|(D=0)]\}/n \quad (4)$$

where $Y_{\mathrm{it}}|(D=1) - Y_{\mathrm{it}}|(D=0)$ is the difference in mean outcomes between i with investment support and i *matched* non-investment support farm *after* the access to investment support, and $Y_{\mathrm{it'}}|(D=1) - Y_{\mathrm{it'}}|(D=0)$ is the difference in the mean outcome between i with investment support and i *matched* with no investment support in *prior* period to the programme implementation.

The PSM-DID estimator thus eliminates differences in the initial conditions (observable heterogeneity) and differences between both groups (receivers and non-receivers) of farms. The first difference in the PSM-DID estimator, which is the change over time within farms, eliminates the influence of time-invariant unobserved individual heterogeneity. The second difference, between receivers of investment support and control group, eliminates general changes common to all farms (receivers and non-receivers) (Michalek *et al.*, 2018).

Data

In this paper we use the individual economic, financial and accountancy data of farms obtained from Informačné listy (Information Letters) of the Ministry of Agriculture and Rural Development of the Slovak Republic. The database contains detailed accountancy data for commercial farms. This data was merged with the database of the Agricultural Paying Agency of the Slovak Republic which contains data on projects supported from Rural Development Programme 2007–2013.

We use data for 2006 and 2015. The choice of the data for 2006 and 2015 is determined by the timing of the application of the investment support as part of the RDP. This paper analyses the impact of the RDP support granted during the financial period 2007-2013 which was extended to 2014 due to the delayed adoption of the new CAP reform for the period 2014-2020. The data we employ in this paper covers one year before the start of the investment support (2006) and one year after the end of the support (2015). This allows us to evaluate the impact of investment support during the period 2007-2014. Further, the farm database allows us to identify farms with and without investment support granted in the period 2007-2014.

We consider four outcome variables, Y: farm gross value added (GVA), farm profits, farm employment and labour productivity (GVA per annual work unit, AWU). The purpose of including these variables is to capture both the revenue side and the input side of the farm performance.

Results and discussion

Table 1A (in appendix) provides data on how PSM balances the farms with investment support from RDP and those from the control group. Balancing reduced the difference between the treated farms and non-treated farms in observable covariates. Further, after matching the differences are no longer statistically significant, suggesting that matching reduced the bias associated with observable covariates. These results suggest that matching reduced the differences between treated farms and non-treated farms between 80% and 99% for the relevant covariates that are statistically significant before matching.

The tests of joint significance of covariates show that the likelihood ratio test was statistically significant before matching and insignificant after matching. The pseudo-R2 was reduced after matching by a factor greater than 3 relative to its value before matching. The matching reduced the overall bias by more than 94%. These tests show that the differences in the covariate means were eliminated between the treated farms and the control group (Table 2A).

Figure 1 plots the density-distribution of propensity scores for supported farms (treated farms) and the control non-treated group. Overall, the visual examination of Figure 1 suggests that the distributions of the propensity scores for treated and the control groups are more similar (and therefore highly comparable) after matching.

The estimated impacts of the investment support on gross value added and profit are reported in Table 1. The results show that the farm investment support had a positive but rather low effect on GVA per farm between 2007 and 2015. Due to investment support, the GVA increased on average by 31 025 EUR. While GVA of supported farms increased on average by 14 038 EUR, the GVA of non-supported firms decreased by 16 987 EUR. Using this estimated effects alongside considering 1,498 of farms that received the investment support, the investment support granted within the Rural Development Programme of Slovakia led to the aggregate increase of GVA by 46.5 mil EUR. The efficiency of the investment support − measured by the ratio of the average effect of investment support on farm GVA (31 025 EUR) and the average support per farm (302 877 EUR) − was 9.76 EUR or investment support needed for increase of GVA by 1 EUR.

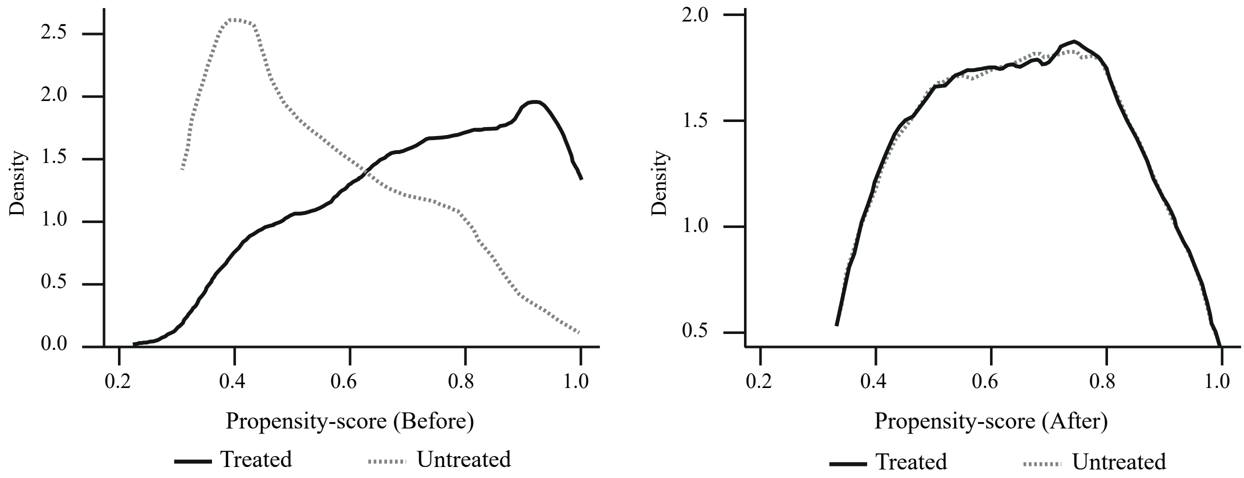

Figure 1: Distribution of propensity scores for supported farms (treated farms) and the control non-treated group before and after PSM balancing.

Source: own composition

Table 1: Effects of Investment Support on Gross Value Added and Profit.

	Estimated Effects of farm investment support		
	GVA per farm	**Profit per farm before taxation**	**Profit per farm from operations**
Effect of the investment support per farm	+31 025€	+20 908€	+17 893€
% change			
Treated	+15.3%	+210%	+50.5%
Non-treated	-10.2%	-464%	-85%
Change			
Treated	+14 038€	-7 458€	-10 941€
Non-treated	-16 987€	-28 367€	-28 834€
Efficiency of investment support	9.76 € of support for growth of GVA by 1€	14.49 € of support for growth of profit before taxation by 1€	25.61 € of support for growth of profit from operations by 1€

Source: own composition

Further, the results in Table 1 show that between 2007 and 2015 the profits of both supported and non-supported farms declined. Supported farms experienced a lower decline in profits than non-supported farms[2]. Thus, the investment support caused an increase of profit by 20 908 EUR per farm and profit from operations by 17 893 EUR. In terms of the efficiency indicator, one EURO of the investment support increased farm profit before taxation and profit from operations by 14.5 EUR and 25.6 EUR, respectively. These results are also presented in Figure 2.

Between 2007 and 2015 employment declined at both supported and non-supported farms. Decline of employment at supported farms was lower (12.3 AWU) than at non-supported farms (15 AWU). Thus, in aggregate the farm investment support increased (preserved) employment by 4,164 jobs (AWU), which was 2.74 jobs per supported farm. When considering the total investment support allocated, this implies the average cost per one preserved job is 108 891 EUR (Table 2 and Figure 3).

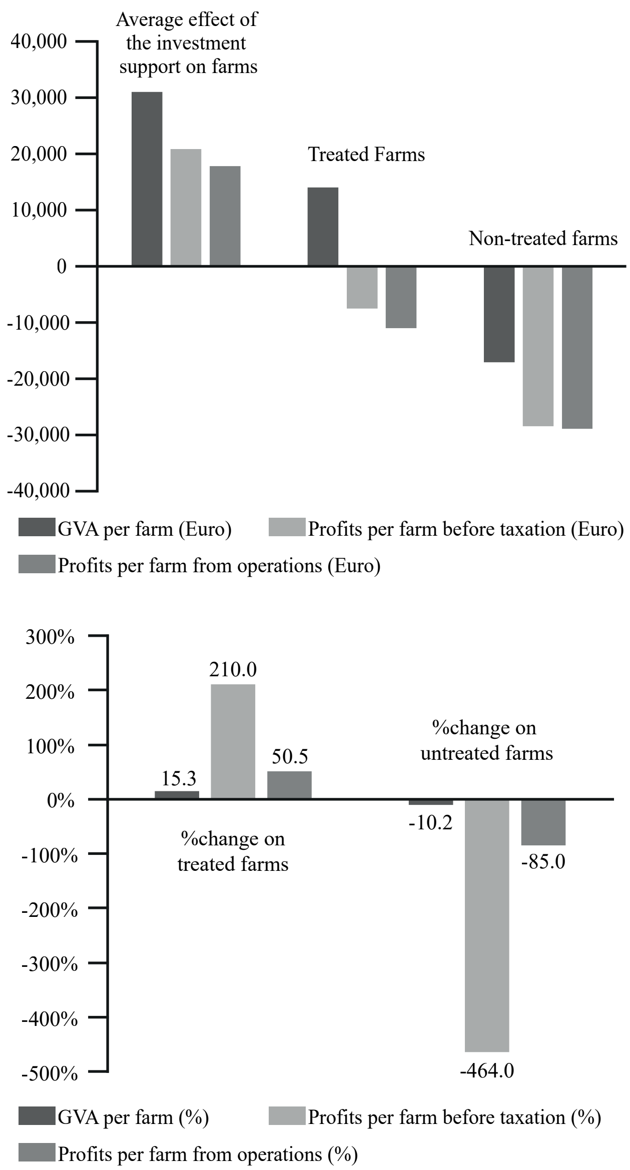

Figure 2: The estimated impact of investment support on Gross Value Added, profits per farm before taxation and Profits per farm from operations in Euros and in % change

Source: own composition

[2] Profit includes profit from operations and profit from financial operations. Profit before taxation is therefore profit from operations plus profit from financial operations.

Table 2: Effects of investment support on employment.

	Estimated effects of the farm investment support on employment per farm
Effects on employment at farms	2.78 AWU
% change of employment	
Treated	+7.60 %
Non-treated	-44.8%
Change of employment	
Treated	-12.29 AWU
Non-treated	-15.07 AWU
Efficiency of investment support	108 891 EUR per job created

Source: own composition

Table 3: Effects of investment support on labour productivity.

	Estimated Effects of farm investment support Labour productivity
Effects on labour productivity, GVA/AWU	-1 138 EUR/AWU
% change of productivity (% GVA/AWU per farm)	-44%
% change of labour productivity	
Treated	+ 44.0%
Non-treated	+ 58.9%
Change of labour productivity	
Treated	+3 763 EUR/AWU
Non-treated	+4 902 EUR/AWU

Source: own composition

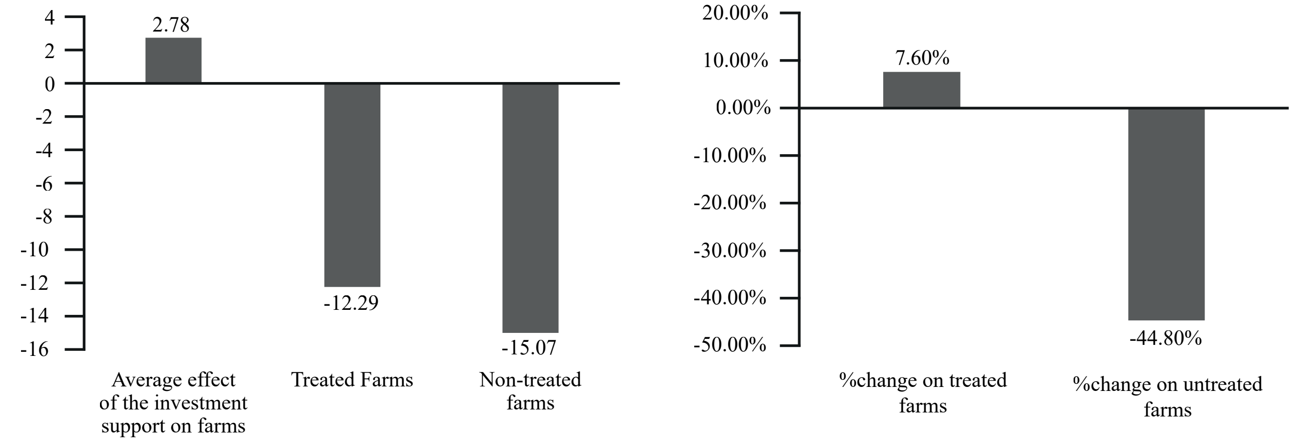

Figure 3: The estimated impact of investment support on Employment in AWU and in % change

Source: own composition

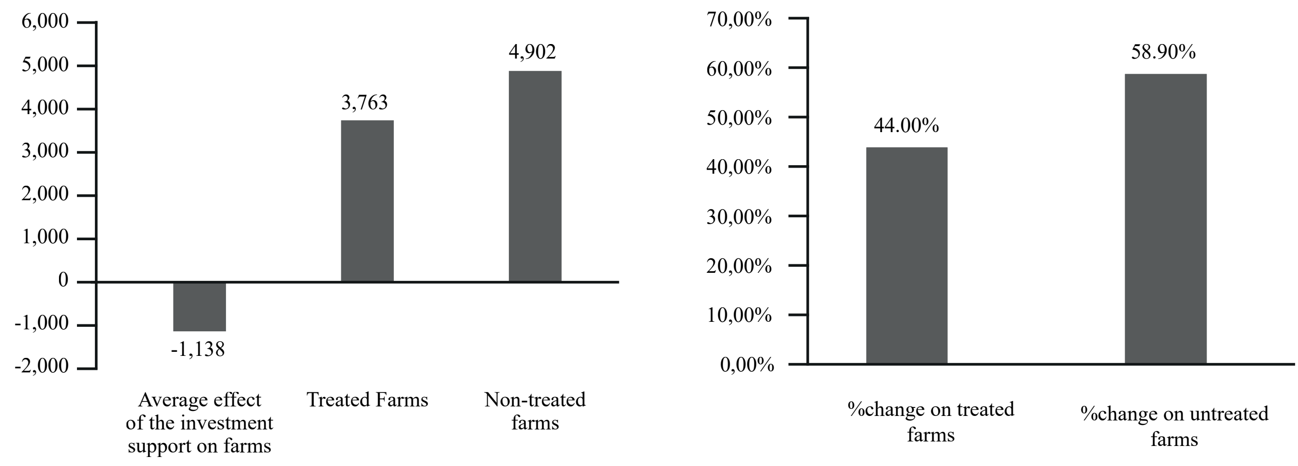

Figure 4: The estimated impact of investment support on labour productivity in GVA/AWU and in % change.

Source: own composition

The positive impact of the programme on employment was reduced because of the significant transfers of support to current consumption of farms through significant growth of expenditures on wages and salaries for supported firms while there was no similar increase of expenditures on wages and salaries of non-supported.

The estimated results suggest that farm investment support had a negative effect on labour productivity. Between 2007 and 2015 labour productivity of both supported and non-supported farms increased but increase of productivity among non-supported farms was higher (Table 3). The main objective of the investment support was to maintain employment and one of the conditions for receiving support was that farms must create new jobs. Furthermore, investment into labour intensive commodities was predominantly supported (fruits, vegetables, animal production) rather than into capital or land intensive commodities such as cereals or oilseeds. Consequently, supported farms reduced employment less than non-supported farms (Figure 4).

Overall, the estimated results show that the investment support had high level of deadweight cost, at 87%. That is, a large proportion of supported firms would undertake projects in approximately similar size even without the investment support. Many firms, which did not receive the investment support realized projects from own or borrowed funds. The high deadweight cost confirms high administrative intensity of project preparation, filing of projects and their implementation and monitoring, while the gains are rather small as shown above.

Low agricultural value added and employment per hectare are major challenges of the Slovak agricultural policy (Ministry of Finance of Slovakia, 2019, Ministry of Agriculture and Rural Development of Slovakia, 2023, Ciaian et al., 2009). The reason is that the Slovak farming sector is dominated by large corporate farms that specialize in production of cereals and oilseeds that have high productivity of labour, but low value added and employment per hectare. The investment support reflected on these challenges and included selection criteria that prioritized investment projects into expansion of modern fruits and vegetables production and animal production that are characterized by higher value added and employment than dominant oilseeds and cereals production. Similarly, to increase GVA and employment, farms with direct sales to consumers were also prioritised. Farms were therefore motivated to adjust production structure towards more labour-intensive types of agricultural commodities and activities.

The investment support in Slovakia also included the criterion of creating additional employment on farms, which supported farms had to fulfil. Non-supported farms, on the other hand, were free not to expand artificially farm employment and their labour productivity increased relative to supported farms.

There is a need for political discussion at the EU level, whether value added, and specifically rural employment should be a priority in the Common Agricultural Policy, or the priority should instead be on competitiveness and productivity of farms, which is in accordance with the EU food security objective.

Many large farms in the EU do not face financial constraints that would significantly prohibit them from investing using their own or commercially borrowed financial resources. In Slovakia, for example, a financial gap exists mainly among small farms and farms of young farmers (Pokrivcak and Toth, 2022). Many farms that were main beneficiaries of the investment support in Slovakia therefore did not face financial constraints that would prevent them from investing without the investment support. A large proportion of supported firms would undertake projects of approximately similar size even without the investment support. This fact is reflected in the large deadweight costs of the investment support, meaning that significant amount of resources has been used to support farms that do not really need the support.

Discussion on the use of public funds for supporting large farms in the European Union have been around for a long time. Most scientific papers and policy documents recommend targeted subsidies to farms that need them (Pokrivčák et al., 2020). The high deadweight costs of investment grants is one of the reasons for targeted subsidies. Our paper stresses that policy makers that decide on the implementation of farm subsidies should consider whether large farms face budget constraints or make a significant contribution to the provision of public goods. The current CAP contains several policy instruments that can be used to reduce the deadweight costs of public support like degressivity or capping of support for large farms – both direct payments and investment grants.

However, as stressed by political economy of farm subsidies literature in the EU (Swinnen, 2018; Pokrivcak et al., 2006), there is a political economy aspect of agricultural policy making and EU decision making that prevents politicians from significantly reducing support to large farms.

Conclusions

The objective of the paper has been to estimate the impact of the farm investment support granted in Slovakia under the EU Rural Development Programmes during the programming period 2007–2013. We have applied a Difference-in-Differences propensity score matching (PSM) methodology to estimate the farm level impact of the support using farm level data of large commercial farms for 2006 and 2015. We have estimated the impact of the support on gross value added of farms, labour employment, labour productivity, and profits.

The results of this paper show that the farm investment support caused both improvement and a decrease in competitiveness for supported firms in Slovakia because it stimulated growth of gross value added, farm profits, and maintenance of employment in the agricultural sector, while at the same time it reduced labour productivity. Overall, the estimated results show that the aggregate effect of the investment support on gross value added of farms reached 46.5 million EUR. This represents around 10% of the total investment support granted to farmers. Investment support, however, had a negative effect on productivity of farms. Productivity of labour declined due to investment support by 1138 EUR of GVA per AWU. The decline of labour productivity represents approximately 5% of the productivity of labour in Slovak agriculture.

These estimates suggest that the effect of investment support on rural economy in Slovakia is therefore ambiguous. On the one hand, it leads to the enhancement of farms' gross value added, while on the other side, it leads to the decline of labour productivity. Further, the investment support has had a positive effect on the growth of employment. The support helped farms to maintain 4,164 rural jobs. This is about 6% of the total employment in the Slovak agriculture in the period 2006-2015.

The data shows that in the period between 2004 and 2015 employment in the Slovak agriculture declined from 96,000 employees to about 70,000 employees (Slovak Statistical Office, various years). This decline of employment in the Slovak agriculture was likely caused by technological progress, which led to increase in productivity of labour, and by the reduction of competitiveness of the Slovak agriculture at the European level, which is manifested by worsening of trade balance in agricultural and food products. Our estimates show that although the RDP support did not cause the creation of new jobs, it helped to maintain jobs which alleviated the negative trends of agricultural employment observed in Slovakia. That is, the supported firms reduced employment less than unsupported firms, causing a lower aggregate agricultural employment decline in Slovakia that would have occurred without the support. However, the efficiency of the investment support in maintaining employment was relatively low. One preserved job through investment support cost 109,000 EUR of public money.

Investment support helped to maintain rural jobs, which occurred partly at the expense of labour productivity. Projects creating rural jobs were prioritised in the selection process. Production of fruits and vegetables and animal production are sectors of agricultural economy that are the most labour intensive and create the most value added per hectare (Ciaian, et al., 2004). To create rural jobs, the project selection criteria prioritised farms that:

- expanded modern and competitive crop production, especially fruits and vegetables with higher value added;
- contributed to modernisation of animal production;
- expanded the direct sale of production to consumers;
- directed investment to specific locations (less developed regions);
- targeted investment to specific segments and types of farms; and
- invested in certain sizes of projects.

The programme also gave preference to projects in animal production and production of fruits and vegetables which are labour intensive activities. On the other hand, firms that had not received support, invested own or borrowed funds into projects that created less jobs but enhanced labour productivity.

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Appendix

Table A1: Balancing treated and non-treated farms by PSM.

Variable	Unmatched / Matched	Mean Treated	Mean Control	% bias	% bias reduction	t-test t	t-test p>|t|
Total assets	Unmatched	81,887	33,856	67.9		7.35	0
	Matched	53,679	53,372	0.4	99.4	0.06	0.952
Fixed Assets	Unmatched	48,062	18,931	65.6		7.11	0
	Matched	30,821	29,176	3.7	94.4	0.52	0.605
Value of land	Unmatched	1,944.4	876.06	17.8		1.84	0.066
	Matched	1,186.8	1,399.2	-3.5	80.1	-0.6	0.551
Value of Buildings	Unmatched	26,301	10,679	59.6		6.59	0
	Matched	17,691	16,984	2.7	95.5	0.33	0.744
Value of grassland	Unmatched	1,341.9	549.32	17.3		1.97	0.05
	Matched	769.35	558.14	4.6	73.4	0.66	0.511
Value of Animals	Unmatched	2,868.4	951.53	66.8		7.11	0
	Matched	1,763.3	1,681.6	2.8	95.7	0.39	0.7
Financial capital	Unmatched	1,895.5	503.61	32.9		3.41	0.001
	Matched	817.18	629.49	4.4	86.5	0.91	0.363
Variable capital	Unmatched	33,054	14,486	60		6.45	0
	Matched	22,131	23,319	-3.8	93.6	-0.55	0.582
Total sales	Unmatched	3,103.6	1,292.3	16.8		1.77	0.077
	Matched	2,026.2	1,801.5	2.1	87.6	0.31	0.758
Sales of own production	Unmatched	38,476	17,262	54.9		6.06	0
	Matched	27,759	25,491	5.9	89.3	0.76	0.445
Sales of crop production	Unmatched	15,743	8,385.8	45.2		4.88	0
	Matched	12,534	13,072	-3.3	92.7	-0.41	0.685
Sales from agrotoursm	Unmatched	143.97	0.73786	13		1.32	0.189
	Matched	2.0367	2.6266	-0.1	99.6	-0.31	0.757
Total costs	Unmatched	60,344	26,791	63.2		6.87	0
	Matched	43,050	42,272	1.5	97.7	0.19	0.847
Material and energy costs	Unmatched	24,640	10,720	53		5.91	0
	Matched	18,258	16,833	5.4	89.8	0.68	0.497
Labour costs	Unmatched	12,263	5,498.6	66.5		7.16	0
	Matched	8,723.6	8,286.6	4.3	93.5	0.56	0.573
Bank loans	Unmatched	8,462.7	3,118.5	44.9		4.76	0
	Matched	4,683.8	5,257.9	-4.8	89.3	-0.81	0.421
Labour	Unmatched	49.248	23.245	65.3		7.09	0
	Matched	36.429	33.637	7	89.3	0.9	0.37
Total subsidies	Unmatched	11,090	5,203.3	76.1		8.33	0
	Matched	7,951.2	7,855.1	1.2	98.4	0.16	0.874
Total land	Unmatched	1,544.8	823.83	68.9		7.71	0
	Matched	1,204.3	1,236.2	-3.1	95.6	0.35	0.727
Total LPIS Land	Unmatched	1,424.9	749.81	72.2		8	0
	Matched	1,107.9	1,138.5	-3.3	95.5	-0.39	0.699
Arable land	Unmatched	1,036.8	527.6	61.8		6.74	0
	Matched	822.71	822.47	0	100	0	0.997
Grassland	Unmatched	351.42	198.45	33.9		3.84	0
	Matched	260.66	263.44	-0.6	98.2	-0.07	0.947
RDP support	Unmatched	63,403	21,195	33.1		3.46	0.001
	Matched	36,331	31,538	3.8	88.6	0.72	0.471

Variable	Unmatched / Matched	Mean: Treated	Mean: Control	% bias	% bias reduction	t-test: t	t-test: p>|t|
LFA area	Unmatched	734.71	352.25	46.8		5.18	0
	Matched	562.87	574.05	-1.4	97.1	0.15	0.884
Wheat production	Unmatched	1,122.3	543.7	49.9		5.35	0
	Matched	877.28	857.66	1.7	96.6	0.21	0.831
Maize production	Unmatched	635.98	345.83	28		2.99	0.003
	Matched	483.78	491.65	-0.8	97.3	0.1	0.918
Oilseed production	Unmatched	421.46	223.93	43.8		4.82	0
	Matched	365.61	353.46	2.7	93.8	0.3	0.767
Sugar beet production	Unmatched	1,135.7	622.34	20.8		2.31	0.021
	Matched	1,021.6	1,054.7	-1.3	93.6	0.13	0.895
Potato production	Unmatched	40.934	12.219	13.7		1.4	0.161
	Matched	11.954	10.572	0.7	95.2	0.25	0.805
Milk production per cow	Unmatched	3,462.5	1,567.2	68		7.79	0
	Matched	2,606.3	2,586	0.7	98.9	0.08	0.938
Income before taxes	Unmatched	1,843.3	940.29	19		2.09	0.037
	Matched	1,068.4	1,022.2	1	94.9	0.11	0.911
Income before taxes per labour	Unmatched	48,768	90,274	-7.5		-0.82	0.412
	Matched	55,505	30,296	4.6	39.3	0.64	0.525
Income before taxes without subsidies	Unmatched	-9,359	4,385.7	-61.4		-6.77	0
	Matched	-7,198.4	-7,133.6	-0.8	98.7	0.09	0.927

Source: own calculations

Table A2: Matching quality indicators before and after propensity score matching.

	Pseudo R2	LR chi2	p>chi2	MeanBias	MedBias
Unmatched	0.173	138.97	0.000	45.9	49.9
Matched	0.047	31.73	0.530	2.7	2.7

Source: own calculations