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Authors: Jerzy Michalek, Pavel Ciaian, Jan Pokrivcak

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Contact information
Pavel Ciaian
Address: Edificio Expo. c/ Inca Garcilaso, 3. E-41092 Seville (Spain)
E-mail: pavel.ciaian@ec.europa.eu
Tel.: +34 95 448 8429
Fax: +34 95 448 8300

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Abbreviations

AWU	Annual work unit
CAP	Common Agricultural Policy
DID	Difference in differences
EAFRD	European Agricultural Fund for Rural Development
EU	European Union
GVA	Gross value added
LFA	Less-favoured area
LIPIS	Land Parcel Identification System
MS	Member State(s)
PO	Producer Organisation
PPA	Agricultural Paying Agency of Slovakia
PSM	Propensity score matching
RDP	Rural Development Programme
SAPARD	Special Accession Programme for Agriculture and Rural Development
UAA	Utilised agricultural area

The impact of producer organisations on farm performance: A case study of large farms in Slovakia[1]

Jerzy Michalek,[1] Pavel Ciaian,[2] Jan Pokrivcak[3]

[1]Independent researcher, Kiel, Germany
[2]Joint Research Centre, European Commission, Seville, Spain
[3]Faculty of Economics and Management, Slovak University of Agriculture, Nitra, Slovakia

1 Introduction

Support for collective action by farmers in both developed and developing countries attracts a relatively high degree of policy attention. In the European Union (EU), farmers' cooperation has been supported under the Common Agricultural Policy (CAP) since 2001, through the recognised producer organisations (POs). This policy action is motivated primarily by the ongoing concentration of downstream and upstream firms in the food chain, which puts farmers in a disadvantageous position when negotiating terms of trade, or setting up contractual relations. Other market pressures faced by farmers include increasing consumer demand for high-quality diverse food products and the rise and spread of food quality standards. Policy support for promoting cooperative behaviour is based on the assumption that acting collectively should allow farmers to cope more effectively with these market challenges than when acting individually (Ostrom 1990; Cook and Chambers 2007; OECD 2013; Fałkowski and Ciaian 2016).

There is relatively extensive literature analysing the cooperative behaviour of farmers. The literature has studied, among other things, governance structure and enforcement mechanisms of cooperative behaviour (e.g. Hakelius 1996; van Bekkum and van Dijk 1997; MacLeod 2007; North et al. 2009); social capital, trust and attitudes towards cooperative behaviour (e.g. Hansen et al. 2002; Ollila et al. 2011; Zheng et al. 2012); group heterogeneity and collective action (e.g. Varughese and Ostrom 2001; Francesconi and Wouterse 2015); dynamics of cooperative organisations' development (Cook and

[1] This report is based on Michalek, Ciaian and Pokrivcak (2018). The authors are solely responsible for the content of the paper. The views expressed are purely those of the authors and may not in any circumstances be regarded as stating an official position of the European Commission.

Chambers 2007); and the impact of POs on smallholders' market access (Staal et al. 1997; Chirwa et al. 2005). The literature investigating the impact of POs (or other forms of collective action) on their members' performance is relatively limited and produces mixed findings, as well as it is focusing predominantly on developing countries (e.g. Bernard et al. 2008; Vandeplas et al. 2013; Duvaleix-Tréguer and Gaigné 2015; Verhofstadt and Maertens 2015). Most of the available studies assess the performance of POs as whole (Van Herck 2014).

This report contributes to the literature by estimating farm-level impacts of PO membership, as well the efficiency of support granted to POs under the EU Rural Development Programme (RDP). We employ the propensity score matching and difference in differences (PSM-DID) approach, using 939 observations of large commercial farms in Slovakia for 2006 and 2015.

This study is particularly relevant as it analyses the performance of POs in a new EU Member State (MS) (i.e. Slovakia). In general, the penetration of POs in new MSs is much lower than in old MSs (e.g. OECD 2013; COPA-COGECA 2015). It has been widely argued that long periods under communist regimes in new MSs in Central and Eastern Europe have negatively affected the level of social capital and attitudes towards cooperative behaviour (e.g. Lovell 2001; Paldam and Svendsen 2001; Fidrmuc and Gërxhani 2008; Fałkowski and Ciaian 2016). This report attempts to shed light on whether POs can generate benefits for farmers in the context of a new MS socio-economic environment. It is often argued in the literature that small farms are in a better position to gain from cooperative behaviour, while there is less scope for large farms to engage in such actions (e.g. Chechin et al. 2013; Ma and Abdulai 2016). For example, Chechin et al. (2013) have shown that farm size is negatively correlated with commitment to collective action. Larger farms are likely to benefit less from cooperation with other farmers because they have a higher bargaining position as well as better ability to access input and output markets. Further, large farms are found to be more inclined to exit POs because of their stronger bargaining position, potentially causing a high failure rate of established POs with a high proportion of large members (Ollila 1985; Ollila et al. 2011). This report tries to shed some light in this discussion by providing empirical evidence of the impact of PO membership on large commercial farms in Slovakia. Finally, the report attempts to provide evidence on the effectiveness of the PO support granted under the RDP. This is an important policy question given that the functioning of EU food chains, and in particular the improvement of farmers' positions in the supply chain, is subject to policy intervention in the current CAP, as well being under intensive discussion for the post-2020 CAP reform (EP 2011, 2016; European Commission 2013, 2017). Although the support provided for POs within the CAP has a

relatively long history,[2] there is little empirical evidence on its effects on the EU farming sector (Fałkowski and Ciaian 2016).

The report is structured as follows. Section 2 provides a brief review of the literature on the impact of POs on farm performance. Section 3 discusses the role of the government and the conceptual challenges of setting up efficient state support for POs. Section 4 describes PO support in Slovakia. Sections 5 and 6 present the estimation approach and data used in the report, respectively. Section 7 describes the estimated results. Finally, Section 8 draws the main conclusions and policy implications.

2 Producer organisations and farm performance: findings from the literature

The small size of farms relative to downstream and upstream companies leads to increasing cooperation among farmers to enhance and concentrate their bargaining position in the food supply chain, and thus to contribute to the improvement of their economic performance. Two main forms of cooperation can emerge between farmers: (i) bargaining cooperatives/organisations (horizontal organisations), or (ii) supply and/or marketing cooperatives/organisations (vertical organisation). The main purpose of bargaining organisations is to improve farmers' negotiating power with buyers to achieve a higher price and better terms of trade. Given that bargaining organisations represent larger production volumes, it gives them greater market power and allows them to be more effective in negotiations than individual farmers. Besides improving the bargaining position of farmers, supply and/or marketing organisations are also involved in processing agricultural and food products, to add value to members' products and to extract a greater share of returns along the food chain. Other areas of cooperation among farmers may involve joint supply or service provision. Supply cooperation aims to reduce input costs for members by making large-scale purchases of inputs such as seeds, fertilisers, fuel, etc. Service cooperation aims to provide members with specialised services, such as advice on farm practice, technology adoption, food quality standards, market intelligence, etc., which is usually more costly if acquired individually by farmers. Note that the form of cooperation between farmers may include a combination of the above functions (USDA 2000; Sexton and Lavoie 2001).

Theoretical studies show that there are various channels through which POs' farm membership affects farm performance. POs can help farmers to improve their

[2] In the EU, farmers' cooperation in the fruit and vegetable sector has been supported under the CAP through recognised POs since 2001, and since 2011 in the milk sector. The 2013 CAP reform extended this form of farm cooperation to all agricultural sectors. The CAP aims in particular to strengthen through POs the bargaining position of farmers in the food supply chain. Other policy aims of the CAP with respect to POs are the improved market promotion of members' products; optimisation of production costs; technical assistance for environmental protection, farm practices and food standards; and in general a more coordinated response to market pressures.

productivity and profitability through strengthening their bargaining position in the supply chain, by facilitating better responses to changing consumer preferences (environment, food quality) or by reducing their transaction costs of input and output market access. They may reduce market risks, associated with a greater capacity to diversify products and markets, or, when they integrate downstream (e.g. feed mills, genetic services) and upstream activities, they may add value to their members' raw products through innovation, product quality and product differentiation. POs can address market failures in environments where markets do not function well by countervailing the presence of holdup problems, monopolies, credit market imperfections, etc. (Kyriakopoulos et al. 2004; Cook and Plunkett 2006; Valentinov 2007; Alho 2015). However, the extent to which POs succeed in delivering benefits to their members depends on their ability to offset a collective action problem, such as a free-rider problem, collective decision-making costs, constraints related to members' commitment to collective action, etc. (Cook and Plunkett 2006; Hernández-Espallardo et al. 2013).

Depending on the type, POs can generate benefits at farm level or from collective investments at PO level. Cook and Plunkett (2006) distinguish two types of PO: (i) a 'traditional' (defensive) form of cooperation established as a response to market failures such as holdup problems or market power (e.g. bargaining organisations); and (ii) a vertically integrated (offensive) organisation (e.g. marketing/processing cooperatives). According to Cook and Plunkett (2006), the primary objective of a 'traditional' (defensive) PO is to safeguard returns at farm level to increase returns from farm-level investments, rather than to generate returns at the PO level. The POs that evolved into more vertically integrated (offensive) organisations, besides attempting to generate gains at farm level, also attempt to extract rents from collective investments, including investments in processing activities, distribution facilities, intangible assets such as brand name, etc. These characteristics of POs have important implications for empirical analysis. To identify the gains POs generate for their members, one needs to assess the performance of both POs and farmers in the case of vertically integrated (offensive) POs. This is because gains might occur through both better terms of trade and the economic valuation of the vertically integrated organisation (joint assets), which might not be translated into farm income (e.g. if profits from POs are paid in the form of dividends, or are reinvested in collective investments). In traditional (defensive) POs, the gains occur primarily at farm level; hence it is desirable to use a farm-level approach to assess PO membership performance. Approaches that evaluate the performance of POs as a whole will fail to identify the membership effect of traditional POs.

Most of the available empirical studies assess the performance of POs as whole (Ferrier and Porter 1991; Oustapassidis 1992; Van Herck 2014). The empirical literature investigating the impact of POs (or other forms of collective action) on their members' performance is relatively limited and produces mixed findings, as well focusing predominantly on developing countries (e.g. Bernard et al. 2008; Ito et al. 2012; Abebaw and Haile 2013; Vandeplas et al. 2013; Duvaleix-Tréguer and Gaigné 2015; Verhofstadt and Maertens 2015; Chagwiza et al. 2016; Latynskiy and Berger 2016). In developing countries the fundamental objective of POs is to address market imperfections constraining farmers' market participation (commercialisation) and access to high-value (international) markets, and POs are often promoted to address rural poverty, particularly for small farming households. POs are widely seen as a tool for reducing market barriers related to farmers' transaction costs of accessing input and output markets, credit, market information, technologies, food safety standards and certifications (Markelova et al. 2009; Chagwiza et al. 2016; Latynskiy and Berger 2016). In developed countries, the primary objective of POs is to rebalance the bargaining position of farmers to ensure a more equitable distribution of income along the food supply chain, as well as to facilitate better responses by farmers to changing market conditions (e.g. changes in consumer preferences, quality standards).

The empirical literature focusing on PO members' performance and developed countries has analysed among other things how farm performance is affected by PO typology (Duvaleix-Tréguer and Gaigné 2015), farmers' perceived (self-reported) valuation of benefits from membership of agricultural producer cooperatives (Alho 2015), the importance and type of members' social capital for cooperative action (Ollila et al. 2011), and factors that determine whether or not farms join POs (Szabó et al. 2017; Zohra and Zago 2017).

Duvaleix-Tréguer and Gaigné (2015) investigated the impact of different PO types (marketing, supply, bargaining or multipurpose cooperatives) on the cost structure and the margins of French hog farmers. Their estimates show that different PO types affect farmer performance in different ways. According to their estimates, supply cooperatives that integrate downstream activities (e.g. feed mills or genetic selection) perform better than other POs studied (i.e. marketing, bargaining or multipurpose cooperatives). Members of the supply cooperatives attain the lowest marginal costs and among the largest margins relative to members of other PO types. These results could be caused by the self-selection effect, given that larger farms prefer to join a type of cooperative that exhibits sufficiently high economies of scale (cost advantage), causing lower costs and greater margins, and also given that these POs are able to pass scale economies obtained from integrated downstream (backward) activities on to farmers. The lowest

performance is shown by farms that are members of bargaining POs. These farms have the highest marginal costs and achieve negative margins because they are smaller on average and thus appear unable to benefit from the scale economies required to achieve higher margins. The results of Duvaleix-Tréguer and Gaigné (2015) further suggest that farm members of multipurpose marketing cooperatives (i.e. cooperatives that integrate downstream activities and processing activities) realise significantly lower output prices than other hog farms, which calls into question the efficiency of the multipurpose cooperatives' strategy. Overall, the results of Duvaleix-Tréguer and Gaigné (2015) suggest that large farms are in a better position to benefit from POs, as they may be more able to benefit from the economies of scale generated by POs.

Alho (2015) analysed self-reported valuation of benefits from the membership of agricultural producer cooperatives among Finnish dairy and meat farmers and found that, overall, farmers place a significant value on several membership benefits provided by cooperatives (e.g. stable market channel, competitive producer price, services offered by the cooperative). However, self-reported valuations of membership benefits differ according to farmer characteristics and type of cooperation, which is in line with the findings of Duvaleix-Tréguer and Gaigné (2015). For example, the competitive producer price provided by cooperative membership appears to be more important to dairy farmers than to meat farmers. The findings of Alho (2015) suggest that both dairy and meat farmers perceive a stable channel for selling their production as the most important benefit of cooperative membership. This is valid for both large and small farmers, although the reduced uncertainty brought by a stable market channel is particularly valued by farmers who are investing in farm expansion.

Ollila et al. (2011) analysed the degree of loyalty (social capital) among Finnish farmers to marketing cooperatives. They distinguish three types of social capital: bonding capital (characteristic of close social relationships), linking capital (characteristic of relationships between asymmetric bodies) and bridging capital (characteristic of normal business relationships). Their empirical analysis suggests that bonding capital and bridging capital are interrelated; members do not distinguish between them for their cooperative motivations, and they represent 'traditional cooperative values'. Approximately half of farmers report 'traditional cooperative values' (i.e. bonding capital and bridging capital) as motives to join cooperatives, and the other half perceive cooperative membership as a normal business relationship (i.e. bridging capital). These findings do not confirm widely held expectations that older and smaller farmers are strongly motivated by traditional cooperative values, while younger and larger farms are more attracted by a standard business relationship.

3 Role of government and conceptual challenges to efficient state support for producer organisations

Various studies show that government could play an important role in facilitating the development of POs. For this reason, support for cooperation among farmers attracts a relatively high degree of policy attention in various countries. However, the question remains of how this support should be organised in an efficient manner.

It must be recognised that any government support for POs operates to an extent in a 'knowledge vacuum', given that the 'true' benefits and costs of POs are not fully understood. This is related in particular (but not exclusively) to the contribution of POs in addressing unequal power distribution throughout the food chain, combating unfair trading practices, mitigating distortions in distribution of income along the food chain, and determining contractual relationships at various stages of the food chain, the effects of which are ultimately expected to be reflected in improved farmer performance (Fałkowski and Ciaian 2016).

The assessment of PO market viability is critical to avoid inefficient deployment of public resources, and in particular to avoid the emergence of cooperation solely for the purpose of accessing public support. In this respect, it is important to establish rules that promote genuine cooperation and avoid 'artificial' cooperation with the purpose of rent-seeking and extraction of public resources. In new EU MSs, concerns have been raised that some POs were established solely to take advantage of available financial support, and will be dissolved as soon as that support finishes. A similar argument was raised by Meinzen-Dick (2009) and Hoff and Stiglitz (1993), who suggest that POs are often dormant (or passive) in developing countries because they were established largely to attract external support and thus lack an economic justification. Further, POs set up in a top-down approach (e.g. by state agency) or by third parties (e.g. processors) may not necessarily fully realise potential gains for farmers, and the public support granted to such POs might instead be wholly or partly diverted to non-farmers (e.g. Golovina and Nilsson 2011).

There is limited evidence to suggest whether or not there exists an optimal type of organisation/governance of POs that can address the needs of members in the most efficient way. As argued above, the empirical evidence tends to suggest that both farm characteristics and type of POs affect members' performance (e.g. Alho 2015; Duvaleix-Tréguer and Gaigné 2015). Policies that impose a strict organisational/governance structure on publicly supported POs may thus lead to the creation of inefficient POs, or crowd out market-based forms of cooperation, thus causing an inefficient allocation of public resources (Francesconi and Wouterse 2015; Fałkowski and Ciaian 2016).

The existence of cooperative behaviour among farmers is usually explained in the literature as motivated by market failures in food supply chains (e.g. market power), through its potential to reduce transaction costs and to develop 'countervailing power' able to constrain market power exerted on input and output markets (Sykuta and Cook 2001; Hendrikse and Bijman 2002; Valentinov 2007). Thus, a policy of supporting cooperation among farmers might be desirable from a social welfare perspective in situations where market failures are present (e.g. high cost of contract enforcement, imperfect information transmission in food chains, market power). However, this implies that the benefits of the POs and the PO support are context specific. The benefit of cooperation accruing to a cooperative's members depends on the structure of a particular supply chain, and this is equally true in the farming sector.

Although the above arguments are relatively well understood from a conceptual point of view, their empirical applicability becomes problematic. Empirical analysis of the effectiveness of public support for POs, and its impact on farmers' performance in the EU and new MSs in particular, but also in other regions and countries, is rather limited and does not provide conclusive results (Hellin et al. 2009; Markelova et al. 2009; Francesconi and Wouterse 2015; Fałkowski and Ciaian 2016).[3] In the following sections we attempt to shed some light on whether or not POs and support provided to POs under the RDP generate benefits for farmers in the context of a new MS socio-economic environment (i.e. Slovakia), characterised by past experience of state-enforced (top-down) cooperation.

4 Produce organisation support in Slovakia

In general, the supported POs in Slovakia tend to be defensive in type (i.e. bargaining organisations), according to the classification of Cook and Plunkett (2006). They are therefore expected to generate the majority of their gains at farm level. Slovakia started to grant POs public support before EU accession in 2004. Prior to joining the EU, PO support was granted under the Special Accession Programme for Agriculture and Rural Development (SAPARD). SAPARD was established by the EU as an assistance programme to address structural adjustment problems in agricultural sectors and rural areas, as well as to help regulatory and administrative harmonisation with the CAP in accession countries.

After EU accession in 2004, Slovakia continued to grant support to POs, as part of the RDP of CAP, during the financial period 2004-2006. The objective was to support the

[3] For example, using data for 500 farmer organisations in Ghana, Francesconi and Wouterse (2015) show that programmes offering support for collective action may be counterproductive because they may promote rent-seeking and crowd out equity capital formation. Further, by setting stringent participation criteria, the programme may end up selecting younger organisations and leave out the more consolidated and potentially more efficient organisations.

establishment, functioning and administrative capacity of POs. Further, the support aimed to help PO members to adjust the quantity of production to market demand, to undertake joint marketing of products, to increase value added, to harmonise product quality, to improve bargaining power and to facilitate delivery to large retailers and processors. In total, EUR 11.24 million was allocated to the support of POs in the period 2004-2006, which led to creation of 38 new POs with 388 participating farms (PRV 2008).

The subsequent RDP for the period 2007-2013,[4] which is covered by our report, granted POs support in a similar way. The programme specifically acknowledges the threat of supermarkets' rising bargaining power, increasing support for closer cooperation among small and medium-sized farms. Under the RDP 2007-2013, 66 POs applied for support, and 59 of them received it. The total PO support amounted to EUR 16.92 million. By production sector, 38 POs were approved in the area of crop production, 15 in milk production, four in pork production, and one each in poultry production and cattle production. POs in crop production received 59.4% of total support, and the remaining 40.6% was obtained by POs in animal production. A total of 398 farms were members of POs supported within the 2007-2013 RDP (Table 1).

Table 1: Producer organisations (POs) by sector (31 December 2015)

Production sector	Approved applications	Turnout of POs (thousands EUR)	Payments (thousands EUR)	
			Contribution from EAFRD	Total[a]
Crop production	38	104 556.93	7 544.52	10 059.36
Milk	15	51 970.33	3 643.26	4 857.68
Cattle	1	1 086.29	141.34	188.45
Pigs	4	8 045.56	698.01	930.68
Poultry	1	3 512.52	669.70	892.93
Total	59	169 171.63	12 696.82	16 929.10
Payments for POs approved in 2004-2006	34	-	1 343.11	1 874.16

Source: PPA (Agricultural Paying Agency of Slovakia).
Notes: EAFRD, European Agricultural Fund for Rural Development.
[a]This column includes the sum of contributions to PO support from EAFRD and from the national budget.

The support was granted to newly established POs and was linked to the value of sales of the PO. The support was paid to POs over a five-year period. The annual payment could not exceed a maximum limit set beforehand. All major crop and livestock products were eligible for support. The subsidies received by POs could be invested in collective

[4] Note that the period of the this RDP programme was extended to 2014 due to the delayed adoption of the new CAP reform for the period 2014-2020.

investments (e.g. machinery, transport) or distributed to their members. Most of the POs distributed subsidies to their members.

According to a survey of subjective self-valuation of PO performance by their managers, conducted for the ex post evaluation of the RDP 2007-2013 (PRV 2016), the vast majority of POs (48 of 59) reported an improvement in the bargaining power of their members relative to purchasers of their products (processors, retailers), while 40% of POs (23 POs) reported improvement in their bargaining power relative to providers of inputs, which resulted in lower prices of inputs or higher quality. Some POs undertook joint marketing of their products. Several POs made investment in transport and other machinery. Further, according to the survey, the management of 17% of POs thought that POs prevent new entrants to the market and reduce competition in the sector.

The average number of members per PO was seven, while five was the minimum number, as set in the 2007-2013 RDP programme. Eight POs had more than 10 members. POs with more members were mainly in the milk sector. However, the number of members could and did change when new farms joined POs, or when farms exited POs, during the period of support implementation.

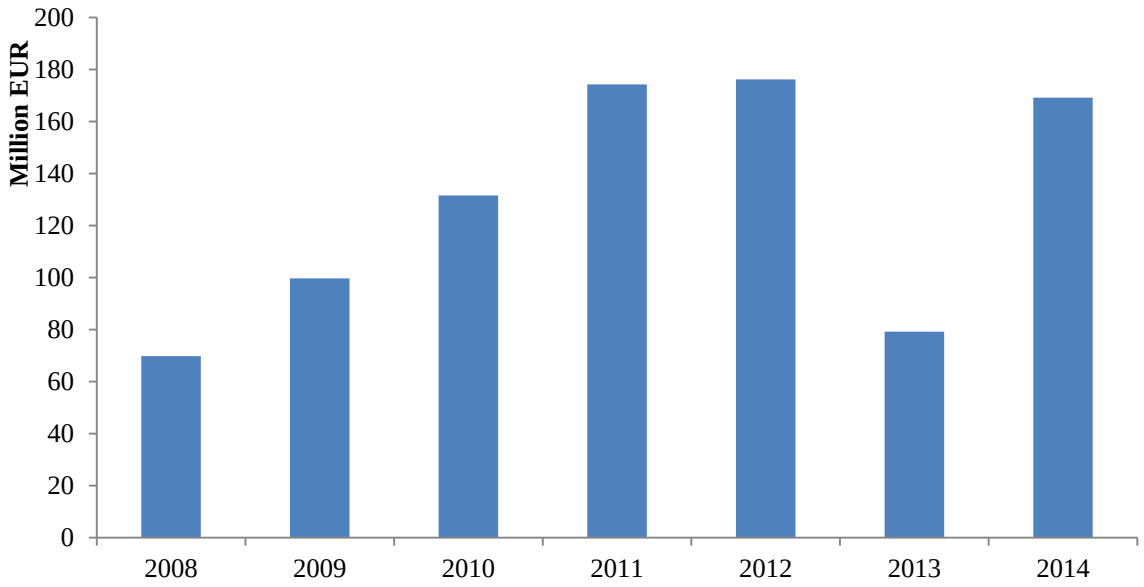
Interestingly, some farms were members of several POs (in different commodities). Out of 398 members of POs, 55% were members of a single PO only, while the remaining farms were members of at least two POs. Several POs had the same address, which means that one farm coordinated several POs established in different sectors.

Out of 59 supported POs within the 2007-2013 RDP, 25 (42% of supported POs) were still functioning by June 2016, four POs were in the process of liquidation process and 30 had already been closed down. According to the ex post evaluation, there are several reasons for this low survival rate (PRV 2016). First, most POs did not have independent professional management. Instead they were managed by one of the participating farms, which often led to conflicts between members. Second, in spite of the fact that the support was officially intended for small and medium-sized farms, most members of the POs were large farms. It appears that the main goal of the PO members was to attract public support; when that support came to an end, many POs were dissolved. From the perspective of survival, POs in milk were the most successful. Out of 16 milk POs, 11 remained in operation in 2016 (PRV 2016).

Figure 1 shows the development of revenues of POs during the period 2008-2014, covering the POs supported under the 2007-2013 RDP. The increase in revenues of all POs in the first years was caused by the incremental growth of the number of POs, whose date of establishment varied. Revenues in 2013 are lower because they do not include the revenues of some POs for which the support period had finished.

Of 25 POs that continued functioning after the completion of support from the 2007-2013 RDP, nine continued to have stable or growing revenue in subsequent years, two saw their revenues significantly decline immediately after the end of the project and then rise slightly, and the remaining 14 POs saw their revenues reduced almost to zero (PRV 2016).

Figure 1. Development of producer organisation revenues



Source: PPA (Agricultural Paying Agency of Slovakia).

5 Methodology

We analyse the impact of farmers' PO membership (treatment) on their performance, as measured by the average treatment effect on the treated (ATT), a method widely applied in the literature for counterfactual impact analysis of policies (e.g. Démurger and Wan 2012; Ito et al. 2012; Abebaw and Haile 2013; Hoken and Su 2015; Michalek et al. 2016; Nilsson 2017). This approach is based on the estimation of the average difference in outcome variables (e.g. income), Y, of members (D = 1) and non-members (D = 0) of POs. That is, the causal effect of PO membership is the difference between the potential outcome with PO membership (treated farms), Y_1, and the potential outcome without PO membership (untreated farms), Y_0: $Y_1 - Y_0$. The expected value of potential outcome without PO membership is not directly observed. In most non-experimental settings, the estimation of the causal effect of a programme uses non-PO member farms as a control group. However, this may result in a selection bias, because the selection in or out of the PO membership is usually not random, implying that means of Y_0 for members (D = 1) and Y_0 for non-members (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). The selection bias is particularly relevant for PO support granted under the RDP, because farms self-select whether they do or do not apply for the support. To address the selection bias, we define the ATT conditional on the probability distribution of observed covariates:

(1) $ATT(Z) = E(Y_1 - Y_0 | X = Z, P(Z) = p, D = 1)$

where *X* is a set of variables representing the pre-exposure attributes (covariates) of farms, *Z* is a subset of *X* representing a set observable covariates and *P* is a probability distribution of observed covariance *Z.*

The estimation of the ATT using the matching estimator (Heckman and Navarro-Lozano 2004) may be difficult owing to the 'curse of dimensionality' of the conditioning problem (Black and Smith 2004; Zhao 2005; Todd 2006). Rosenbaum and Rubin (1983) have shown that the dimensionality of the conditioning problem can be significantly reduced by implementing matching methods through the use of balancing scores $b(Z)$, such as propensity score. For random variables *Y* and *Z* and for discrete variable *D*, the propensity score can be defined as the conditional probability of receiving the treatment (i.e. being a PO member) given pretreatment characteristics, *Z*: $p(Z) = Pr(D = 1|Z) = E(D|Z)$. According to Rosenbaum and Rubin (1983), if treatment is random conditional on *Z*, it is also random conditional on $p(Z)$:

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

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, $Pr(D = 1|Z)$. The conditional independence therefore 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*, *semi-parametrically* reduces dimensionality of the matching problem substantially to one dimension only, that is, 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:

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

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).

5.1 Difference-in-differences propensity score matching estimator

Whereas the PSM can be applied to control for selection bias on observables at the beginning of the programme, a combination of the PSM with DID methods (conditional DID estimator) allows for controlling of selection bias in both observables and unobservables (e.g. Heckman 1997; Bratberg et al. 2002; Smith and Todd 2005). The PSM-DID measures the impact of PO membership 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 PO support implementation:

$$(4)\ \text{PSM-DID} = \left\{ \sum_i [Y_{it} \mid (D=1) - Y_{it} \mid (D=0)] - \sum_i [Y_{it'} \mid (D=1) - Y_{it'} \mid (D=0)] \right\} / n$$

where $Y_{it} \mid (D=1) - Y_{it} \mid (D=0)$ is the difference in mean outcomes between *i* PO member and *i matched* non-PO member *after* the access to the PO support, and $Y_{it'} \mid (D=1) - Y_{it'} \mid (D=0)$ is the difference in the mean outcome between *i* PO member and *i matched* non-PO member in the period *prior* to the programme implementation.

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

6 Data and approach

To assess the effect of PO membership and PO support on farm performance, we use a commercial farm database for Slovakia for 2006 and 2015 available from the Slovak Ministry of Agriculture. The farm database is a system of data collection that takes place each year and collects detailed accountancy data for commercial farms. The farming sector in Slovakia is dominated by large commercial farms. According to the latest available Eurostat data, for 2013, commercial farms account for around 81% of Slovakia's total agricultural area, with an average size of 559 ha per farm. The database covers the representative sample of large commercial farms (939 farms) in Slovakia.[5] The average farm size in the sample is 1392 ha, which is greater than that reported in

[5] The database does not include individual farms, which, according to Eurostat data for 2013, are usually small, with 18 ha average farm size and account for approximately 19% of agricultural area in Slovakia.

Eurostat for commercial farms. However, the sample size forms a relatively sizeable proportion of total utilised agricultural area (UAA) in Slovakia. The sample of 939 farms used in this report covers around 68% of UAA in Slovakia.

The choice of data for 2006 and 2015 is determined by the timing of the application for PO support as part of the RDP. This report analyses the impact of RDP support granted during the financial period 2007-2013, which was extended to 2014 as a result of the delayed adoption of the new CAP reform for the period 2014-2020. The data we employ in this report cover one year before the start of the PO support (2006) and one year after the end of the support (2015). This allows us to evaluate the impact of farms' membership of POs that received support during the period 2007-2014.

The farm database allows us to identify farm members of POs with and without support granted in the period 2007-2014. Note that only newly established POs could receive support in the period 2007-2014; POs with support are newly established organisations, whereas POs without support were established before 2007.[6] To better identify the effect of PO support, we consider several farm groups depending on whether they are members of supported or non-supported POs, defined as follows:

A. all PO members (supported and non-supported) versus non-PO members (referred to as *all PO members*);
B. members of supported POs versus non-PO members (referred to as *supported PO members*);
C. members of non-supported POs versus non-PO members (referred to as *non-supported PO members*);
D. members of supported POs versus members of non-supported POs (referred to as *supported versus non-supported PO members*);
E. members of supported POs that existed in 2015 versus non-PO members (referred to as *supported PO members existing in 2015*).

The matching of farms in group A (*all PO members*) compares the performance of all farms that are members of at least one PO (treated farms) — independently of whether the PO is supported or not — relative to the non-PO members control group (untreated farms). This allows us to estimate the overall performance of PO membership over the period covered. The matching of farms in group B (*supported PO members*) aims to estimate the impact of PO support by comparing the performance of farms that are members of supported POs (and newly established POs) with the performance of the control, non-member, farms. The matching of farms in group C (*non-supported PO members*) does the reverse, by estimating the performance of farms that are members

[6] POs established before 2007 could have received support under the previous SAPARD or RDP programmes. This was probably the case because a relatively significant number of POs received support in the past.

of non-supported POs (and older POs). The matching of farms in group D (*supported versus non-supported PO members*) enables the performance of farm members of supported POs to be compared with that of farms that are members of non-supported POs. These estimates will indicate the performance of supported and newly created POs to be compared with that of older POs without support during the period under consideration. Given that there was relatively high exit rate among supported POs, in the matching of farms in group E (*supported PO members existing in 2015*) we consider a more restricted set of farms that are members of supported POs that existed at least until 2015, and compare them with non-PO members. These estimates will indicate the performance of those POs that survived after the expiration of the support programme.

The numbers of farms in the various groups available in the database are reported in Table 2. In total, 431 farms are members of at least one PO (46% of all farms), of which 295 (31%) were in POs that did not receive support. The remaining 136 (14%) were members of POs that received support during the period 2007-2014. In total, 106 farms (11%) were members of supported POs that did not cease their operation until at least 2015.

Table 2: Number of farms by farm groups available in the database

	Number of farms	Proportion of total number of farms (%)
All PO members	431	46
Members of supported POs	136	14
Members of non-supported POs	295	31
Members of supported PO that existed in 2015	106	11
Non-PO members	508	54
Total number of farms	939	100

Notes: PO, producer organization.

We consider four outcome variables, *Y*, as proxies to test farm performance of PO membership: farm gross value added (GVA), farm profits, farm employment and labour productivity (GVA/annual work unit (AWU)). The purpose of including these variables is to capture both the revenue side and the input side of farm performance. We do not have detailed information about POs, particularly in which sectors (e.g. meat, dairy, cereals, fruits and vegetables) they operate, or what services they provide to members. As a result, we cannot assess the impact of PO membership on the price of particular products, or particular services offered by POs. Further, the objective of many POs is to improve bargaining position on both output and input markets, and to add value to farm products. Moreover, some farms might be members of more than one PO, operating in different sectors. For this reason we have opted for outcome indicators that measure

overall farm performance, such as GVA, profits and employment. These outcome indicators are also in line with the policy objectives of PO support which, among other things, aims to contribute to the improvement of POs' value added and economic viability.

7 Results

Table 3 shows the effectiveness of PSM in balancing the PO members and the comparison control groups. The results show that matching performed well in balancing the observable covariates, with standardised differences between the treated PO members and control groups reduced from as high as 50%, before matching, to below 10%, after matching, for all five matching groups (A to E). However, after matching for most covariates, the standardised differences were reduced to less than 5%. Further, after matching the differences are no longer statistically significant, suggesting that matching reduced the bias associated with observable covariates. The exception is the covariate *sales from agro-tourism*, where the difference is statistically significant after matching, but lower than 10%, suggesting that the bias is relatively low. These results suggest that matching reduced the differences between treated PO members and the non-treatment group by between 80% and 99% for the relevant covariates that are statistically significant before matching (Table 3).

The tests of joint significance of covariates show similar results. The likelihood ratio tests were statistically significant before matching and insignificant after matching for all five matching groups (A to E). The pseudo-R^2 was reduced after matching, compared with its value before matching, by a factor greater than 4. The matching reduced the overall bias by more than 75%. These tests show that the proposed specification of the propensity score has a balanced distribution of covariates, meaning that the differences in the covariate means between the treated PO members and the control groups were eliminated (Table 4).

Table 3: Balancing between groups before and after matching

	A. All PO members			B. Supported PO members			C. Non-supported PO members			D. Supported versus non-supported PO members			E. Supported PO members existing in 2015		
	Difference in means between treated and control (%)†		Bias reduction (%)	Difference in means between treated and control (%)*		Bias reduction (%)	Difference in means between treated and control (%)*		Bias reduction (%)	Difference in means between treated and control (%)*		Bias reduction (%)	Difference in means between treated and control (%)*		Bias reduction (%)
	Before	After		Before	After		Before	After		Before	After		Before	After	
Total assets	35.2***	2.2	93.8	46.2***	0.8	98.3	31.3***	2.2	93	6.2	1.6	73.4	48.2***	4.5	90.7
Fixed capital	33.2***	2	94	43.3***	−1.3	96.9	29.8***	1.4	95.4	4.5	0.5	88.2	47.1***	5.9	87.5
Value of land	−0.2	−1.1	−404.9	−6.7	0.4	93.5	2.4	−0.5	78.8	−16	−2.7	82.9	−7.4	1.3	82.4
Value of buildings	44.8***	3.9	91.3	58.4***	−0.6	98.9	39.2***	2.6	93.5	12.7	−1.7	86.7	65.4***	7.2	89
Value of grass land	5.4	5	7.4	5.5	−0.7	86.4	5.3	6.1	−13.9	−0.6	9.7	−1531.3	9.7	4.9	48.8
Value of livestock	25.1***	−1.1	95.7	39.8***	6.9	82.7	19.5***	1	94.7	16.6	1.2	92.7	39.5***	2.1	94.8
Financial capital	3.3	−4.2	−28.9	8.8	−2	76.8	0.7	0.1	90.4	10.3	1.7	83	7.6	3.1	58.8
Variable capital	32.7***	2.2	93.1	43.7***	4.1	90.7	28.5***	3	89.6	8.7	3.1	64.7	43.2***	1.9	95.5
Total sales	−3.2	−1.6	51.3	−10	−0.9	91.3	−0.4	−1.2	−229.5	−18.6	−3.1	83.5	−10.4	−0.6	94.5
Sales from own production	37.1***	1.5	96	51.1***	0.3	99.5	31.5***	0.5	98.3	12.3	3.5	71.9	49.5***	1.3	97.3
Crop production	25.3***	1	96.2	33.8***	−2.1	93.7	21.4***	0.9	95.6	11.9	1.4	88.5	30.7***	−2.8	91
Sales from agro-tourism	4.4	0.1	97.6	8.5	3.8	55.6	0.1	3.2	−2973.3	8.4	9.2	−10.1	10.5	−8.7**	16.8
Total costs	31.4***	0	99.9	40.6***	−1.7	95.9	27.6***	−0.4	98.7	9.1	2.7	70.2	40***	1	97.4
Material and energy costs	37.9***	−0.1	99.7	50.1***	−2.8	94.5	33.2***	−2.5	92.3	9	2.9	67.6	48.9***	2.8	94.4
Labour costs	41.3***	−0.3	99.4	58.6***	1.8	96.9	33.2***	2.7	91.8	24.2**	3.8	84.3	58.4***	1.3	97.7
Bank loans	14.8**	2.7	82	9.2	−1.4	84.6	16.7**	0.5	97.3	−12.9	0.2	98.1	11.2	1.9	83.5
Labour	42***	−1.7	96.1	59.9***	−2	96.6	33.5***	1.7	94.9	26.4**	5.4	79.7	60.2***	−1	98.3
Total subsidies	31.8***	−2.2	93	37.4***	−1.6	95.8	29.6***	−1.3	95.7	2.4	5.2	−111.7	44.8***	−1.7	96.3
Total land	30.2***	−0.6	98.1	41.6***	−4.7	88.7	25.6***	−0.1	99.6	11	4.4	60.3	46.9***	−2	95.7
Total LIPIS land	31.6***	−0.7	97.8	44***	−6.8	84.4	26.4***	−0.3	98.7	14	3	78.6	48.2***	−1.2	97.5
Arable land	30.2***	0.7	97.8	40.9***	−7.9	80.7	25.6***	0.4	98.5	12.4	0.3	97.2	37.9***	1	97.3
Grass land	14.5**	−2.6	82.2	18.2**	1.8	90.1	12.6*	−1.3	89.4	6.2	4.9	21	30.2***	−4.6	84.8
RDP support	22.7***	−5	78	16.3*	−3.1	80.7	25.2***	−6.4	74.5	−12.8	2.7	78.9	21**	5.5	73.6
LFA area	20.5***	1.5	92.6	23.1**	−6.3	72.5	19.4***	−3	84.3	2.8	1.3	52.2	35.6***	−3.8	89.4
Wheat production	26.1***	1.1	96	40.3***	−0.3	99.3	18.9***	1.5	92.3	22.4**	−2.2	90.1	37***	4.1	88.8
Maize production	16.5**	2.7	83.9	19.5**	−8.8	54.7	15.2**	−0.4	97.2	3.3	−1.2	63.6	17.6*	−0.3	98.1
Oilseed production	15.2**	−0.1	99.6	25***	−2.5	90	10.6	−0.6	94.2	14.2	2	85.9	21.6**	1.1	94.9
Sugar beet production	21.7***	−3.4	84.4	43.8***	7.9	82.1	9	−1	88.4	37***	1	97.4	31.7***	−4	87.3
Potato production	14.2**	0.8	94.4	15.7**	3.6	77	14.7**	0.4	97.2	8.2	2.3	72.4	18.2***	−4.6	74.5
Milk production	53.5***	−3.4	93.6	95.2***	−8.1	91.5	37***	3.8	89.7	53.3***	1.3	97.5	96.6***	2.7	97.2
Income before taxes	7.3	−1.7	76.9	3.5	0.9	73.2	8.6	−5.9	31.6	−6.7	0.2	96.4	0.2	−2.8	−1079.8
Income before taxes per labour unit	4.4	−1.2	72.3	3.4	7.4	−114.5	5	−1.3	73.3	−0.3	1.3	−296.6	5.2	−4.8	6.8
Income before taxes without subsidies	−21.1***	0	99.8	−33.7***	4.5	86.7	−16**	−4.1	74.3	−13.2	−4.5	65.5	−39.9***	0.1	99.7

* Significant at 10%; **significant at 5%; ***significant at 1%; after, after matching; before, before matching; RDP, Rural Development Programme; LFA, less-favoured area; LPIS, Land Parcel Identification System.

†Standardised difference in means (in %) = $100(\bar{x}_{treated} - \bar{x}_{control})/[(s^2_{treated} + s^2_{control})]^{1/2}$, where $\bar{x}_{treated}$ and $\bar{x}_{control}$ are means, and $s^2_{treated}$ and $s^2_{control}$ are variances, in the treated and control groups, respectively.

Table 4: Matching quality indicators before and after matching

	Pseudo-R^2		Likelihood ratio		Bias reduction (%)
	Before matching	After matching	Before matching	After matching	
A. All PO members	0.092	0.008	119.58***	9.66	92
B. Supported PO members	0.210	0.036	139.38***	11.74	90
C. Non-supported PO members	0.072	0.007	75.98***	5.77	90
D. Supported versus non-supported PO members	0.167	0.019	89.98***	6.72	78
E. Supported POs members in 2015	0.228	0.056	128.55***	14.24	93

Significant at 10%; **significant at 5%; ***significant at 1%.

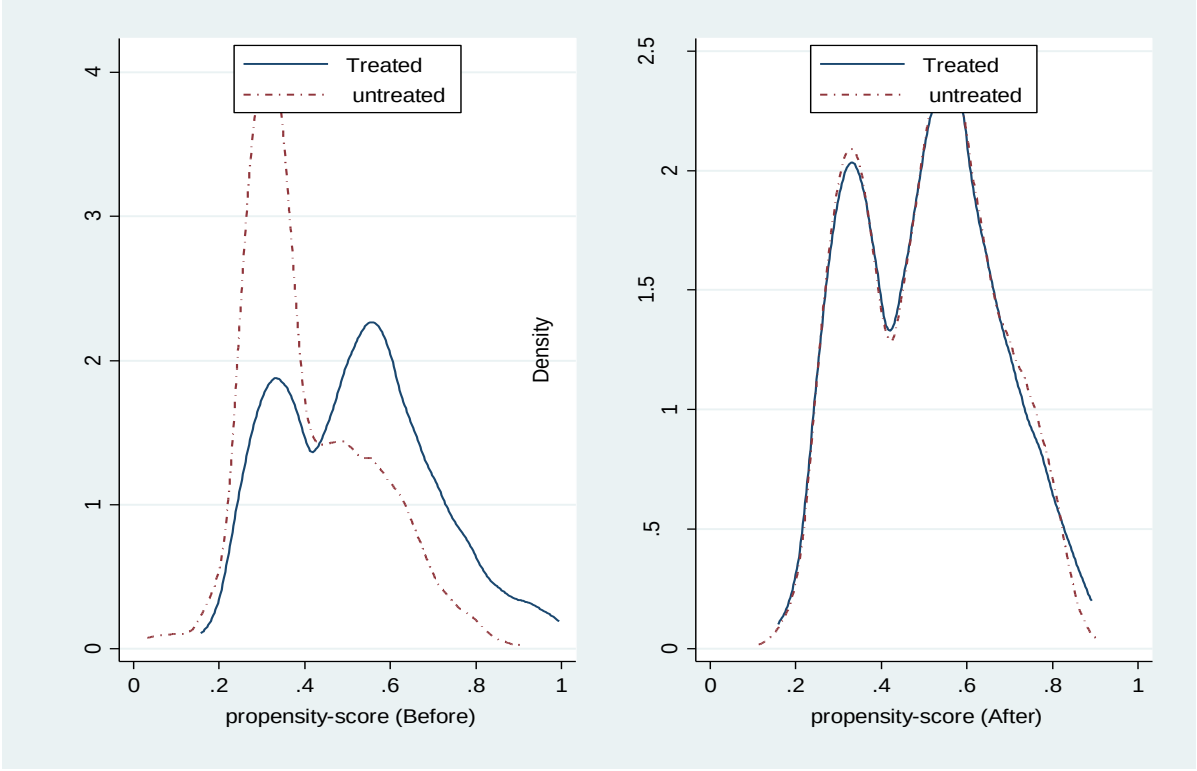
PO, producer organisation.

Figure 2 plots the density distribution of propensity scores for the PO members (treated farms) and the control non-treated groups for the five matching groups (A to E). The horizontal and vertical axes show the estimated propensity score and the frequency of observations, respectively. The distribution of control (non-treated farms) farms is skewed towards the left, whereas the distribution of PO members (treated farms) appears to be relatively more symmetrical. Thus, the observations of PO members whose propensity scores are higher than the maximum of control farms are excluded from estimations to restrict the farm observations in the region of common support. Overall, visual examination of Figure 2 suggests that the distributions of the propensity scores for the PO members and the control groups are more similar (and therefore highly comparable) after matching. There is evident overlapping of the distributions after matching for all five matching groups (A to E).

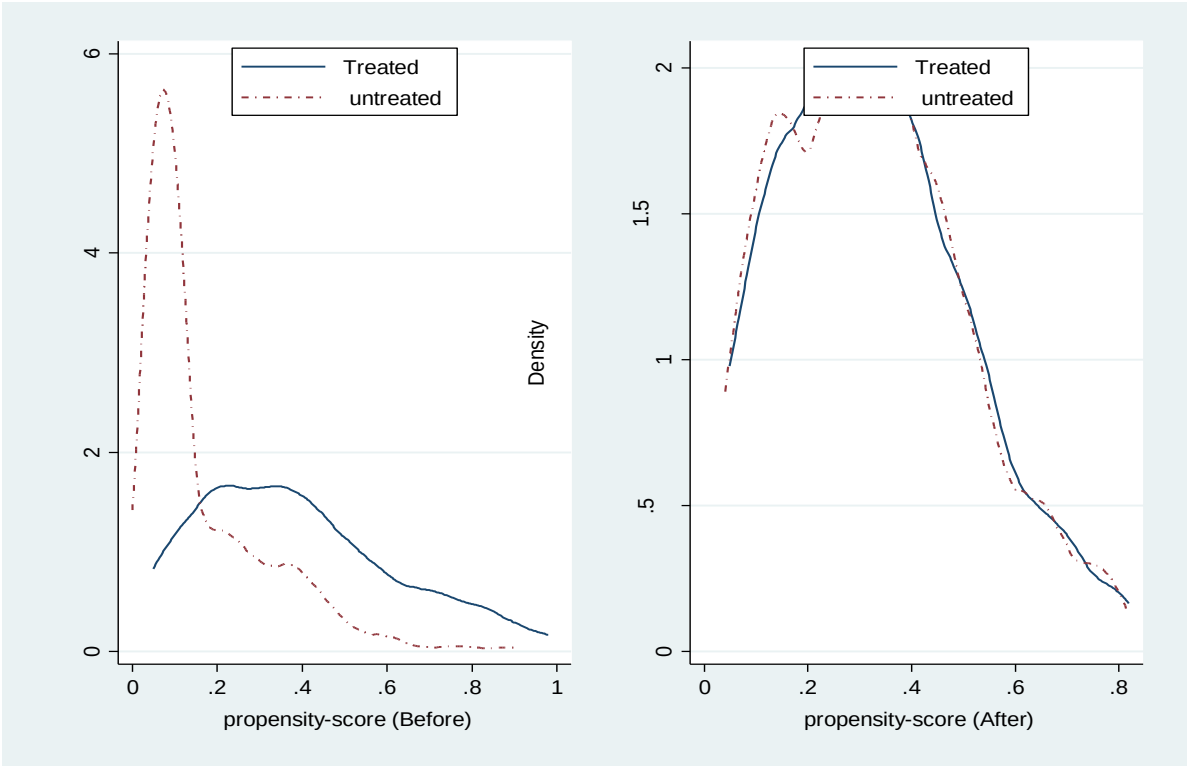
The estimated results for PSM-DID are reported in Table 5. The table summarises the effects for the four outcome variables considered (farm gross value added, farm profits, farm employment and labour productivity) and for all five matching groups (A to E). The estimated results show that belonging to a PO increases economic performance (group A). PO membership improves farm performance for all four outcome variables. That is, farm members of POs increase gross value added by EUR 41 700, farm profits by EUR 7345, farm employment by 1.73 AWUs and labour productivity by EUR 620 per AWU compared with similar farms that are not members of POs.

Figure 2. Propensity score distribution: comparison of before matching (right panel) versus after matching (left panel)

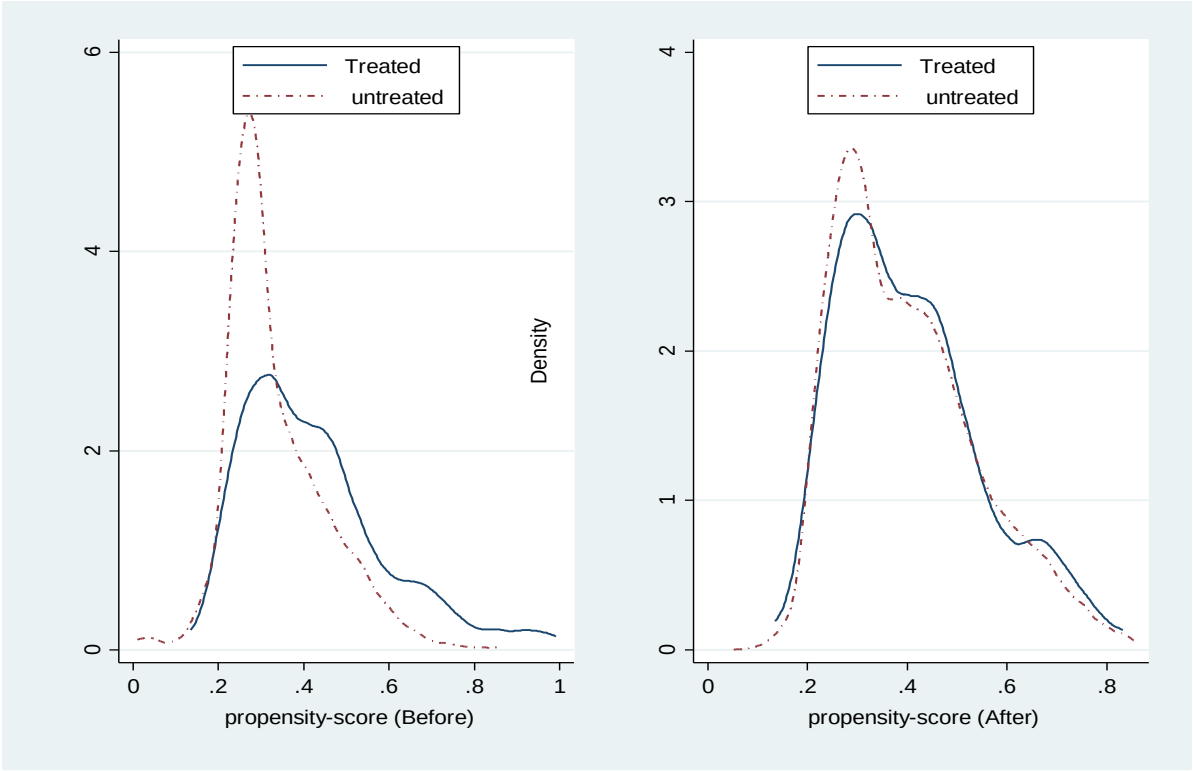
A. All PO members



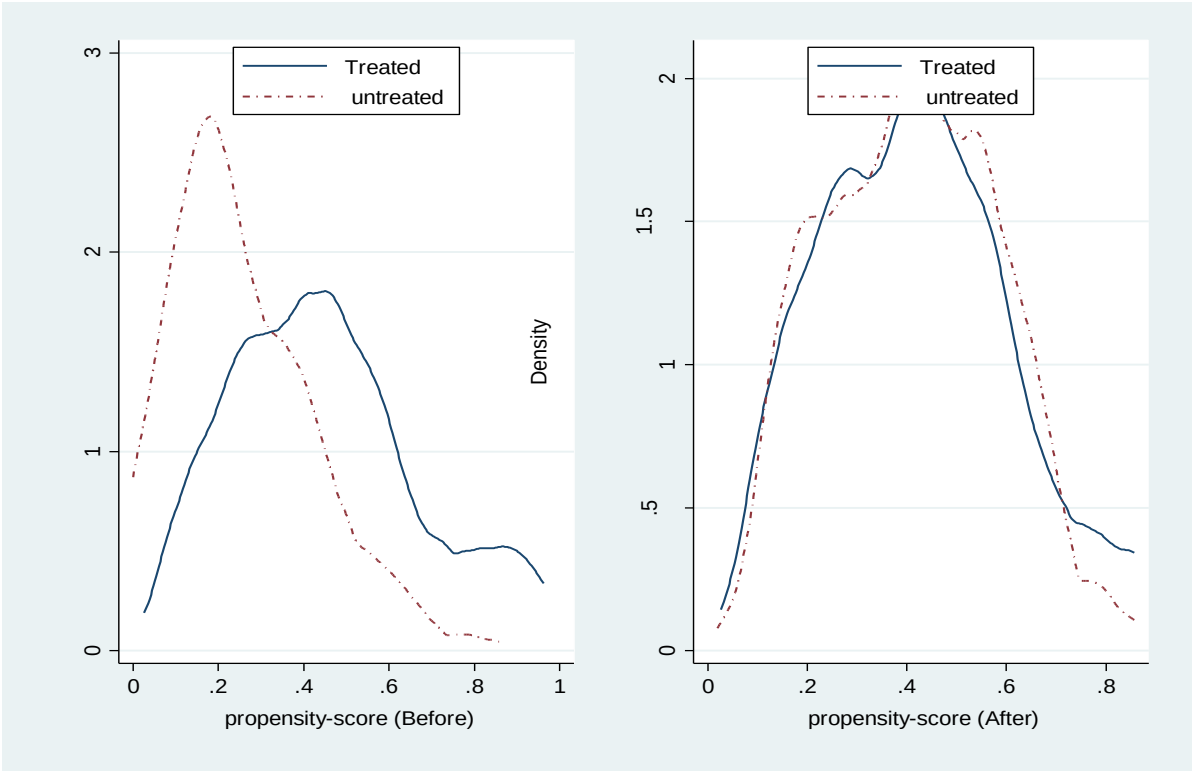
B. Supported PO members



C. Non-supported PO members



D. Supported versus non-supported PO members



E. Supported PO members in 2015

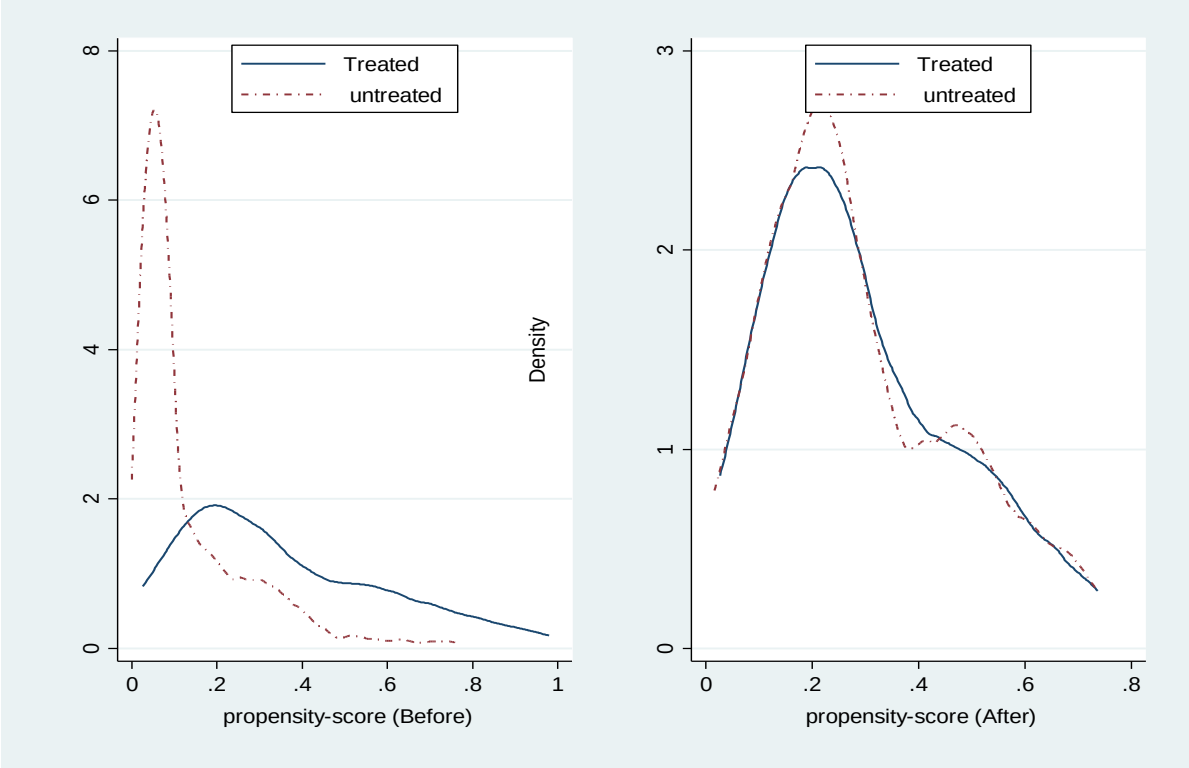


Table 5: Impact of PO membership on farm performance: estimated PSM-DID results for average treatment effect on the treated

	Sample size (in common support)		GVA	Profits	Employment	Labour productivity (GVA/AWU)
	Treated farms	Control farms				
A. All PO members	416	508	+41 700	+7345	+1.73	+620
B. Supported PO members	118	508	–19 287	–14 570	+2.141	–1155.6
C. Non-supported PO members	285	508	+60 139	+27 847	+1.548	+39.76
D. Supported versus non-supported PO members	128	295	–61 230	–54 209	–2.074	–1324.86
E. Supported PO members in 2015	92	508	–18 115	–8054	+1.332	–1676.8

AWU, annual work unit.

The DID-ATT estimates suggest that PO support did not have a positive impact on farm performance. Farms that were members of POs and received support during the period 2006-2014 achieved negative values for the outcome indicators compared with similar non-PO members (group B). The exception is farm employment, which improves in supported PO members relative to the control group (Table 5). The estimated negative effect of PO support suggests that the primary objective of many newly established POs is to benefit from the support offered rather than to enhance the collective good (i.e. the

bargaining position) of their members. Indeed, according to PRV (2016), the dissolution of supported POs by the RDP for 2006-2013 was high, with 58% of them dissolved by the end of June 2016. This is indirectly confirmed by the estimates for group E, where only farm members of supported POs that survived until 2015 were considered in the estimations. Farm members of POs that survived until 2015 still show negative performance for most outcome indicators, but they perform better in three outcome indicators (GVA, profits and labour productivity) than farms that are members of any supported POs (group B). This might be because the inefficient POs (including those that intended only to benefit from the availability of additional funds) were dissolved, while more efficient POs continued to operate, resulting in better performance of PO members in group E than in group B.

In addition, farm members of non-supported PO achieve higher values on all four outcome variables considered than the control group of non-PO members (group C). Similarly, the non-supported PO members perform better than supported PO members (group D). Note that non-supported POs might have received support under the previous rural development programmes in the period before that covered by this report (i.e. during the RDP for 2004-2006 or under SAPARD). Indeed, a relatively large number of POs were supported under past programmes (e.g. 38 POs by the RDP for 2004-2006) (PRV 2008). Given that a substantial proportion of non-supported POs received support in the past, our estimated results suggest that the previous RDP programme was more efficient than RDP 2007-2013 in establishing POs that deliver benefits to members in terms of increasing income, value added and labour productivity. However, this is valid only for POs that survived and continued their operation after support ended. There might also have been some POs that received support in the past (i.e. before 2007) and which were dissolved after the finalisation of the support programme, which would challenge the potential efficiency of past RDP support allocation. However, we do not have data to evaluate the performance of these POs.

The differences in the estimated effects between group B and group E suggest potentially significant inefficiencies in the PO support granted during the period 2007-2014. POs that survived until 2015 performed better (or generated lower negative outcome indicators for their members) than all supported POs during the period 2007-2014. That is, farm members of all supported POs (including those that ceased to function) performed worse than farm members of the supported POs that survived at least until 2015. These results suggest that many low-performing farms (PO members) received RDP support without benefiting from a new collective good; the administrative procedures (e.g. eligibility criteria, screening process) were not able to detect bad POs and separate them from good POs.

In fact, the comparison between the supported and the non-supported POs (group D) is a comparison between older and younger POs, because only newly established POs could receive support during the period 2007-2014, while non-supported POs were established before 2007. One reason why older POs might perform better than younger ones is that they have probably acquired a more consolidated position in the market, with developed business relationships and networks (e.g. with processors, retailers, input providers), which allows them to generate benefits for their members from collective activities (Francesconi and Wouterse 2015).

Younger POs need to establish governance structures, invest in collective assets and develop business relationships and networks. This usually takes time and may actually generate losses for members during the first operating years of the PO, as suggested by our estimates. This is supported by the 'cooperative life cycle' concept developed by Cook and Chambers (2007), according to which growth of POs and greater gains for members can be realised after the establishment and design phases, when the rules governing the functioning of a PO have been set up. After the initial phases of the life cycle, POs may be in position to generate added value for members.

8 Conclusions

The RDP supports the establishment of POs in Slovakia with the aim of enhancing the bargaining position of farmers in the supply chain, and thus contributing to the improvement of their value added and economic viability. The objective of this report is to estimate the effectiveness of PO support and the impact of PO membership on farm performance in Slovakia. We employ the PSP-DID econometric approach on a database of commercial farms for 2006 and 2015. This database allows us to estimate the performance of the RDP support granted to newly established POs during the financial period 200-2013, and to compare it with that of the non-supported POs.

Our estimates allow us to derive several conclusions related to the performance of POs and PO support. First, the estimation results show that, in general, belonging to a PO improves the economic performance of farms in Slovakia. That is, farms that are members of POs attain higher profitability, added value, employment and labour productivity than farms that are not members of POs. Second, in the short run the support granted to newly established POs does not improve their performance in terms of delivering economic benefits to members (farmers). It appears that only established and older POs (including those supported in the past) are able to generate benefits for their members. Third, the estimates provide some indirect evidence that, contrary to the policy expectations of the Slovak RDP, the disbursement of PO support granted in the financial period 2007-2013 was not always effective in selecting POs with the highest potential to generate benefits for their members. It appears that many POs were created

for the sole purpose of benefiting from the support on offer. This result is reinforced by the observed high closure rate of supported POs after the expiration of the support programme.

The database considered in this report includes predominantly large commercial farms. Therefore, we cannot fully extrapolate the result of the potential impact of PO membership and PO support on small individual farms. Our results of positive PO membership impact on farm performance tend to be in line with the findings of Duvaleix-Tréguer and Gaigné (2015), which suggest that large farms are also in a better position to benefit from POs because they may be more able to benefit from the economies of scale generated.

Our results have important policy implications. The setting of criteria for programme participation needs to be improved to ensure the selection of POs with higher growth potential. Granting support to newly established POs might not always be an appropriate instrument in guiding the allocation of public funds, if the selection criteria are not based on objectively verifiable business plans and enterprise performance. This problem might be addressed either by making support conditional on achieving a pre-defined performance, going beyond the duration of the RDP programme, or by tailoring support to more consolidated POs that have records of past performance, or to those farmers with a weak bargaining position in the market, where gains from cooperation are expected to be greatest.

When drawing conclusions, one needs to be aware that our findings obviously reflect the data limitations and estimation assumptions. First, as argued above, our results cannot be extrapolated to all farms in Slovakia; they are valid only for commercial farms which are relatively large compared with farm structures in other EU MSs. A second potential caveat for our analysis is that, due to the data limitations, we could not take into account in our analysis more detailed information about POs (e.g. type of PO, size of PO, governance structure, sector, services offered to members) or its implications for PO member performance. Third, due to the relatively small number of farms in the database, we were not able to analyse how the effects differ between different farm typologies (e.g. by farm specialisation or farm size). Therefore, the arguments in this report should be interpreted with care.

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