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Do coupled subsidies increase milk productivity, land use, herd size and income? Evidence from Kosovo

This study assesses the effectiveness of the Subsidy per Head Scheme (SPHS) in increasing milk productivity, land use, herd size and income in dairy farms across the seven regions of Kosovo. SPHS represents one of the largest coupled subsidy programs in the agricultural sector of Kosovo in terms of farmer participation and budget allocation. We use a Propensity Score Matching approach to assess the impact of this program by comparing a group of participants with a group of non-participants during the 2013–2014 farming seasons. We test the robustness of the impact results using four different matching algorithms. Results reveal SPHS was not effective in increasing land use, gross income and farm size (number of cows), although SPHS had a limited impact on improving milk productivity. In addition, the study highlights the need to reformulate coupled subsidies and develop new, complementary strategies that address farmers' needs more efficiently.

Keywords: coupled subsidy, propensity score matching, impact evaluation, Kosovo

JEL classification: Q18

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Introduction

The agricultural sector in Kosovo is highly subsidised. The Ministry of Agriculture, Forestry and Rural Development (MAFRD) has been implementing the Direct Payments (DP) Program since 2009. This policy involves several direct payment schemes, such as a subsidy per head (referred to later as the Subsidy per Head Scheme (SPHS)) and subsidy per hectare of planted grains and subsidy on milk quality (MAFRD, 2010). All these subsidies are coupled and are intended to help Kosovo dairy farmers a) increase income, milk production and quality; b) intensify the use of currently unused land and pastures; c) improve input quality, food safety and food quality standards; and d) develop a management capacity compliant with European Union (EU) requirements. Over the past years, agricultural economists have been concerned with the effects of direct payments (Bajrami and Ostapchuk, 2019). A number of empirical studies have shown efforts to estimate their effect, predominantly on farm level outcomes, such as productivity (Guan and Oude Lansink 2006; Bezlepikina and Oude Lansink, 2006; McCloud and Kumbhakar, 2008; Henningsen *et al.*, 2009; Rizov *et al.* 2013), farm structure (Kim *et al.*, 2005; Ahearn *et al.*, 2006), and farm income (Dewbre and Mishra, 2007).

Empirical findings on subsidies' effects on these outcomes are mixed. Several studies have shown that subsidies positively affect farm productivity (Guan and Oude Lansink 2006; McCloud and Kumbhakar, 2008), while some other studies have found a negative relationship between subsidy and production (Bezlepikina and Oude Lansink, 2006; Henningsen *et al.*, 2009). In line with the productivity findings, a number of studies also agree that subsidies contribute to farm income (Pufahl and Weiss, 2009; Bojnec and Fertó, 2019).

Overall, there has been less research on the effects of coupled direct payments. This might be due to the decoupling of direct payments, which occurred in many countries, specifically across the EU. However, coupled direct payments

are still applied, particularly across some pre-candidate and EU candidate countries. Their continued application might result in substantial disadvantages for farm development. Among the main drawbacks, the literature highlights that coupled payments might hinder further farm investments, disincentivize farm size growth, productivity improvement and diversification, and lessen support for small farms since most support is intended for large farms. There is considerable empirical evidence showing that coupled payments negatively affect productivity (Karagiannis and Sarris, 2005; Zhengfei and Oude Lansink, 2006; Rizov *et al.* 2013).

For example, Rizov *et al.* (2013) investigated the impact of the Common Agricultural Policy (CAP) on the total EU commercial farm productivity and found that subsidies negatively impacted farm productivity. Henningsen *et al.* (2009) showed that coupled subsidies have a considerable effect on input use and output level. In terms of farm size growth and structural transformation, Edmeades *et al.* (2019) has analysed the effects of coupled payments on the agricultural sector of Croatia. The report highlights that coupled payments have slowed down the structural transformation process of Croatian agriculture since large farms absorb the majority of support.

Although subsidies' effects have been studied by a plethora of authors, there is little evidence on the observable effects of coupled direct payments on the livestock sector. Furthermore, the literature gap is wider with regard to pre-candidate countries for the EU. In this paper, we examine empirically the actual effects of a coupled subsidy program. For this purpose, the livestock sector of a pre-candidate country - Kosovo - was chosen.

Over the years, Kosovo's livestock sector has been one of the key drivers of agricultural development. However, this sector suffered severe damage during the 1998–1999 war. More than half of the livestock were killed or stolen, and about 40% of infrastructure and machinery was destroyed (MAFRD, 2003). Nevertheless, during the post-war period,

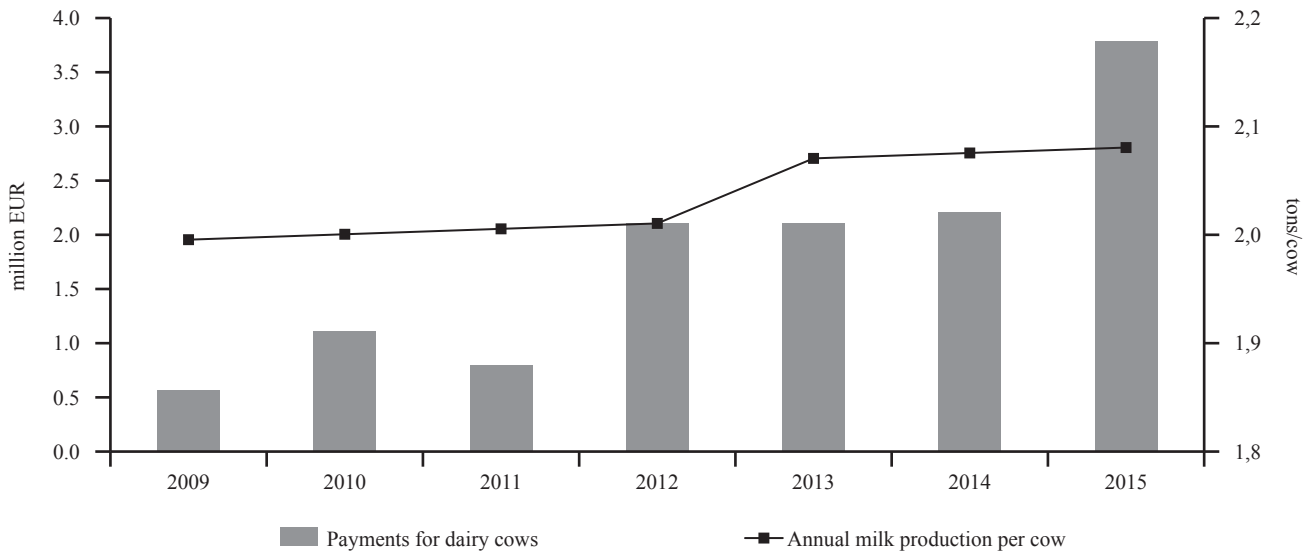


Figure 1: Budget allocation for SPHS (€) and annual milk productivity per cow (t).

Source: Constructed by authors using data retrieved from MAFRD (2016).

the livestock sector, specifically dairy, has emerged as one of the most important agricultural sectors, contributing about 10% to the total national GDP (Bytyqi *et al.*, 2014).

In 2015, there were over 258 thousand cattle in Kosovo, distributed across more than 63 thousand households, with an average herd size of four cows (MAFRD, 2016). Most of Kosovo's dairy farms are characterized by low milk productivity, poor infrastructure and inefficient land use (Miftari *et al.*, 2014). Milk yields per cow are low compared to other European countries. In 2014, the estimated average milk yield per cow in Kosovo was 2,075 litres per year (MAFRD, 2015), while the EU-28 average was 6,727 litres (European Commission, 2015). Primary dairy products are produced predominantly by the large number of subsistence and semi-subsistence dairy farms in the country. During the post-war period, dairy farmers in Kosovo faced the challenges posed by small-scale dairy farms, characterized by low milk productivity, traditional breed genetics, poor feeding, poor hygiene and breeding conditions and fragmented land use. These challenges caused low efficiency (Bajrami *et al.*, 2017) even though the dairy sector was heavily subsidised from 2009 to 2016, mainly by direct payment schemes from the government (Figure 1).

One of the main objectives of the SPHS is to increase milk production. Although annual milk production per cow increased 0.7% a year in the period 2009–2015, Kosovo's cattle inventory decreased drastically over the same period. Dairy cow numbers declined by 5% annually, and total milk production declined by an annual average of 4.3%.

MAFRD spent over €50 million to implement all (crop and livestock) schemes of the DP program from 2009 to 2014. In addition, since 2009 MAFRD has been allocating a significant portion of its budget to implementing the SPHS, where over €3.7 million was allocated in 2015, a 71% budget increase for this scheme as compared to 2014 (Figure 1). Although significant budget has been allocated to SPHS, to date there has not been any systematic evaluation of this programs actual impact on the Kosovo dairy sector, particu-

larly in terms of increasing land use, income, herd size and improving production.

The present study addresses this gap in the literature by investigating the effects resulting from the SPHS policy on Kosovo's dairy sector. We assess the impact of SPHS using survey data. Specifically, we use farm-level survey data collected from randomly selected dairy farmers ($n=327$) to estimate the SPHS effects on its main three objectives (increasing milk production, intensifying land use, improving farm income) and the SPHS specific objective of increasing herd size (farm structure). The survey data are analysed using a Propensity Score Matching (PSM) model. We assess the robustness of the estimated results by employing four alternative matching algorithms.

Material and methods

A survey instrument was developed, pre-tested and administered to dairy farmers in Kosovo during a period of two months, specifically from mid-July to mid-September 2015. Primary data on farmer socio-economic characteristics (e.g., age, gender, education, farming experience, household size), their dairy activity (farm size, farm assets, milk production and quality, dairy product sales) and participation status in different governmental programs were collected from 327 randomly selected dairy households across all the seven regions of Kosovo.

In order to estimate the impact of SPHS on milk productivity, land use, farm structure and farm income, two groups of dairy farmers (participants and non-participants in the SPHS) were randomly selected for the study. In most of the reviewed studies using the PSM approach, the non-participants' groups are at least twice as large as the participants' group, mainly due to better chances to obtain more matched observations with members of the participant's group (Pufahl and Weiss, 2009; Becerril and Abdulai, 2010; Birol *et al.*, 2011; Kabunga, 2014). Therefore, for this study, a proportion

size of 1:3 (participants to non-participants) across the seven sampled regions was used to increase the chances of having more matched observations. Subsequently, the number of respondents per region was estimated using a weighting technique on the population list of participant farmers in the SPHS in 2014. All sampled farmers were listed on MAFRD records as having five¹ or more dairy cows in 2014, which is also the SPHS support eligibility criteria MAFRD applies. In contrast to the EU, where farmers receive subsidies non-exclusively linked to production (Takácsné-György and Takács, 2012), SPHS is a subsidy coupled to the number of dairy cows.

In order to isolate the effect of SPHS, only those observations that received support exclusively from SPHS were included. Ninety out of the 327 sampled dairy farmers were supported by more than one direct payment scheme and, therefore, were removed from the analysis. Eighty-eight observations were dropped due to missing data, leaving a total of 149 observations for further analysis, precisely 40 participants and 109 non-participants.

Specification of the PSM Impact Evaluation Model

Estimating the effect of participating in a specific program is the main goal of evaluation studies. A number of evaluation techniques can be utilized to estimate treatment effects. According to Pufahl and Weiss (2009), evaluation studies estimate the mean effect of participating in a program. Among a plethora of techniques, PSM is a widely used approach in evaluation studies. It can be used as a combination of methods; however, it is also commonly used as a single approach (see: Becerril and Abdulai, 2010; Birol *et al.*, 2011; Kabunga, 2014). Our PSM impact evaluation model estimates the mean effect (impact) of the SPHS on milk productivity, land use, farm structure and farm income. Following Kabunga (2014), this impact is estimated as the average treatment effect on the treated (ATT) participants in the SPHS program:

$$ATT = E[y_{1i} - y_{0i} | D_i = 1] = E[y_{1i} | D_i = 1] - E[y_{0i} | D_i = 1], \quad (1)$$

where E is the expectations operator, y_{1i} is the observed outcome of farmer i (participant), y_{0i} is the observed outcome of the same farmer i (non-participant) and $D_i = 1/0$ denotes whether the farmer participated in the SPHS or not.

Missing data in the counterfactual is a major issue in evaluation studies since we cannot observe the outcomes of participating farmers (treated) had they not been treated ($y_{1i} | D_i = 1$). Therefore, the mean effect of program participation is estimated by constructing a control group similar to the treated group, which enables measuring the outcome that would have been observed for the treated group if they had not been treated. While a simple comparison of the mean outcomes between treated and non-treated groups seems

intuitive, it can lead to biased results. One potential source of bias is that treated and non-treated farmers may differ in terms of observed characteristics (covariates) such as experience in milk production, formal education, age of the farm manager, corn planted area, whether the farmer uses grazing or not and whether they keep farm records. A second source of bias between these two groups might be the differences in unobserved characteristics such as motivation and managerial skills. Rosenbaum and Rubin (1983) introduced the PSM to control for the observed characteristics and subsequently estimate the mean outcomes of participants and non-participants, respectively.

A set of observable covariates must be chosen for the purposes of matching prior to applying the matching procedures and constructing comparison groups. Caliendo and Kopeinig (2008) emphasize that only covariates that simultaneously influence the participation decision and the outcome covariate should be included, while covariates that might be affected by the treatment should not be included. Economic theory and the previous knowledge of the researcher regarding the program and observed units should be used in specifying the model (Sianesi, 2004; Smith and Todd, 2005). Experience in milk production, corn planted area, formal years of education, farm manager age, a binary variable indicating if the farm manager keeps farm records or not and a binary variable for grazing or non-grazing production systems were used as observed covariates to conduct matching. It is assumed covariates simultaneously could affect the outcome and the participation decision.

Following Kabunga (2014), the observable impact of SPHS was measured in two stages. In the first stage, propensity scores $P(x_i)$ for each individual farmer were generated using a probit model. The propensity score indicates the probability of a dairy farmer joining the SPHS program given the observed covariates, x_i :

$$\Pr(P_i = 1 | x_i) = p(x_i), \quad (2)$$

The control (non-participants) group was constructed by matching the participants with non-participant farmers based on their propensity score values. Observations without an appropriate match were dropped from further analysis.

Subsequently, prior to estimating the *ATT*, two conditions must be satisfied: the assumption of Conditional Independence and the assumption of Common Support. Following Rosenbaum and Rubin (1983), the Conditional Independence Assumption (CIA) can be specified as follows:

$$(y_1, y_0) \perp D | X, \quad (3)$$

stating that a given set of observable covariates X are not affected by treatment, and potential outcomes y are independent of treatment assignment D (Khandker *et al.*, 2010). As noted in Khandker *et al.* (2010), Rosenbaum and Rubin (1983) called this assumption “un-confoundedness”, implying that uptake of the program is based entirely on observed covariates. This assumption reduces bias when the untreated units are constructed.

Following Khandker *et al.* (2010), the Common Support assumption, which can be specified as

¹ Due to random selection, some of the visited farmers had fewer or more cows compared to the number of cows recorded on the list. Between the period that they were registered in the program and our visit, they decreased or increased their number of cows.

$$0 < P(D = 1|X) < 1, \quad (4)$$

allows that treatment observations have comparison observations “nearby” in the propensity score distribution (Heckman *et al.*, 1999). Basically, this assumption ensures that participants and non-participants have an equal chance of being either an adopter or non-adopter; therefore, participation in the treatment is not exclusively controlled by an unobservable variable(s) (covariate(s)). When these two assumptions are satisfied, the treatment assignment is said to be strongly ignorable (Rosenbaum and Rubin, 1983), allowing for unbiased mean comparisons.

In the second stage, the *ATT* of SPHS was estimated. We measure the impact of SPHS on four outcome variables: milk productivity per cow per day (y_1), land use (y_2), gross income (y_3) and farm size (number of cows (y_4)). The impact of SPHS was measured separately for each of these four outcome variables. Given that CIA and Common Support assumptions hold, following Kabunga (2014), the PSM estimator for *ATT* was measured as follows:

$$ATT^{psm} = E[y_{1i}|D_i = 1, p(x_i)] - E[y_{0i}|D_i = 0, p(x_i)], \quad (5)$$

where ATT^{psm} measures the mean difference of the outcome of interest (e.g., milk productivity per cow) between the participants and non-participant farmers with similar propensity scores, $p(x_i)$. The variable $p(x_i)$ denotes the estimated propensity score for farmer i . These observations are balanced on their propensity score and lie within the region of common support (Kabunga, 2014). In other words, the PSM estimator is simply the mean difference in outcomes over the common support, properly weighted by the propensity score distribution of participants (Caliendo and Kopeinig, 2008).

Before estimating the *ATT*, treated farmers must be matched with non-treated farmers (control). Treated units must be similar to non-treated units in terms of observed characteristics unaffected by participation. Therefore, some non-treated units might be dropped to ensure comparability (Khandker *et al.*, 2010).

Treated units were matched with non-treated units based on the estimated propensity scores, constructed by the selected observed covariates listed above. In total, four matching methods were used to match treated with non-treated farmers: the Nearest Neighbour Matching (NNM), Caliper or Radius Matching, Stratification and Interval Matching, and Kernel-based Matching method (KBM). The different matching methods were used to measure the robustness of the results to the matching method (Kabunga, 2014).

In NNM, each treatment unit is matched to a comparison unit with the closest propensity score. The number of matched units (n) is set up prior to matching (usually $n = 5$ is used). NNM can be conducted with or without replacement, where with replacement approach indicates that the same non-participants (non-treated farmers) can be used as a match for different participants (treated farmers). Following Khandker *et al.* (2010), NNM can be specified as follows:

$$|p_i - p_j| = \min_{k \in \{D = 0\}} \{|p_i - p_k|\}, \quad (6)$$

where p_i denotes the propensity score of treated farmer i , and p_j denotes propensity score of the non-treated farmer. The difference in propensity scores for a participant and its closest non-participant neighbour may be very high with NNM. Therefore, this matching method may result in poor matches.

The Caliper or Radius Matching method addresses the issue of large differences in propensity scores between matches by imposing a threshold “tolerance” or caliper on the maximum propensity distance². Therefore, caliper provides a certain range where treated units can be matched (with replacement) with non-treated units (Khandker *et al.*, 2010). Caliper or Radius Matching (E) can be specified as follows (Heinrich *et al.*, 2010):

$$E(\Delta Y) = \frac{1}{N} \sum_{i=1}^N [Y_i - \bar{Y}_{0j(i)}], \quad (7)$$

where $\bar{Y}_{0j(i)}$ denotes the average outcome for all comparison units who are matched with case i , Y_i is the outcome for case i , and N is the number of treated cases. Therefore, this approach does not limit the number of matches with a given participating dairy farmer, as long as the units are “close” enough (Heinrich *et al.*, 2010).

Stratification and Interval Matching divide the common support of the propensity score into a set of intervals (strata) and afterwards, the mean outcome difference (impact) between treated and non-treated group within each interval is calculated. One of the main issues with this approach is selecting the number of strata to use. As cited in Caliendo and Kopeinig (2008), Cochran (1968) demonstrated that five subclasses are often enough to remove 95% of the bias associated with a given, single covariate. According to Aakvik (2001), one way to justify the number of strata used is to check the balance of the propensity score or the covariates within each stratum, implying that the estimated propensity score is appropriate only if it balances covariates.

Finally, the *KBM* method uses a weighted average of the propensity scores of all non-participants to construct the counterfactual match for each participant. *KBM* assigns weights to each non-participant farmer and subsequently, farmers are matched based on these weights. Following Khandker *et al.* (2010), *KBM* can be specified as follows:

$$\omega(i, j)_{KBM} = \frac{K\left(\frac{P_j - P_i}{a_n}\right)}{\sum_{k \in C} K\left(\frac{P_k - P_i}{a_n}\right)}, \quad (8)$$

where ω denotes the estimated weight, P_i denotes the propensity score for participant i , P_j is the propensity score for the non-participant j , K denotes the Kernel function and a_n denotes the bandwidth parameter.

These matching procedures need to be checked for balance within the distribution of the observed covariates in both treated and non-treated groups (Kabunga, 2014). Basically, this procedure compares the covariates that are used

² Caliper represents the maximum tolerance level or maximum propensity score distance by which a match can be made (Heinrich *et al.*, 2010). As noted by Smith and Todd (2005), a possible drawback of caliper matching is that it is difficult to know a priori what value for the tolerance level is reasonable.

for matching, before and after matching to check for any remaining differences after conditioning on the propensity score (Caliendo and Kopeinig, 2008). For example, formal education in years is compared prior to matching and after matching. Stata was utilized for estimation purposes.

Results and discussion

Table 1 reports the summary statistics for farm and household characteristics of sampled dairy farmers.

Estimated average daily milk production per cow is 11.88 litres per cow, amounting to 3,623 litres of annual production over 305 days of lactation. This average differs markedly from MAFRD (2015), where average annual milk production per cow in Kosovo in 2014 was estimated at 2,075 litres per cow. However, this difference is expected since the MAFRD estimate included all dairy farms in Kosovo, while our sample includes only the farms that are or potentially could be SPHS participants. These farms are considered to be commercial and semi-commercial, indicating their production levels might be higher due to market participation. Nushi and Selimi (2009) report milk yields in Kosovo vary from 1,500 to 6,000 litres per cow, depending on the farm and breed. A minimum of five dairy cows owned is a condition for participating in the SPHS program. Dairy farmers in the selected sample have an average of 7.06 dairy cows.³ According to MAFRD (2015), the average number of cattle in agricultural households in Kosovo is four.

Dairy operations average €8,030 in annual gross income. This mean is very similar to the average annual gross income for all agricultural household types in Kosovo which MAFRD (2015) estimates at €8,466. In terms of experience, dairy farmers in this sample had an average of nine years of experience in dairy operations. Further, they averaged 11 years of formal education.

Results from Propensity Score Matching (PSM)

Since SPHS was implemented in both years 2013 and 2014, two groups of farmers (participants and non-participants) were formed. Participants were SPHS participants only in 2014, while non-participants could be from 2013 and/or 2014. Farmers were proportionally distributed among the seven regions based on the number of dairy farmers per region (Table 2).

Twenty-six per cent of these dairy farmers were participants, while the majority, more than 73%, were non-participants in SPHS. At the regional level, farmers from Prishtina and Peja constitute the highest share of the sample, while Ferizaj and Gjakova constitute the lowest participation numbers. From the total sample of 149 dairy farmers, a sample of 132 was used for matching purposes – since the 17 omitted observations (non-participants) did not satisfy the common support criteria.

This sample was selected based on several covariates (experience, education, age, corn planted area, farm records and grazing) that help to increase the balance between the two

³ PSM sample was truncated at four cows per farm since MAFRD supported also farmers with four cows in 2014.

Table 1: Summary Statistics: Farm and Household characteristics.

Variable	Description	Mean	S.D. ¹
Nocows	Number of dairy cows per dairy farm	7.06	3.51
Mcowday	Daily milk production per cow (liters/cow)	11.88	1.98
Mcowyear	Annual milk production per cow (liters/cow)	3,623.97	604.90
Dailycons	Daily milk consumption per person (kg/person)	0.61	0.13
Grains	Area planted with grains (ha)	3.78	4.41
Wheat	Area planted with wheat (ha)	2.36	3.14
Corn	Area planted with corn (ha)	1.36	1.81
Landuse	Total land use (ha)	4.00	4.54
Dairyincome	Annual gross dairy income (€)	8,030.59	4,949.23
Experience	Experience in years in dairy operation	9.10	6.06
Education	Formal education in years	11.09	2.83
Age	Age in years	43.03	17.85
Household	Number of household members	9.10	4.84
Grazing	If the farmer uses grazing (yes=1)	0.87	0.33
Barn	If the farmer keeps cows tied in the barn (yes=1)	0.97	0.16
Frecords	If the farmer keeps farm records (yes=1)	0.40	0.49

N=149.

¹S.D. - Standard Deviation.

Source: authors

Table 2: Number of sampled participant and non-participant dairy farmers by region.

Region	Ferizaj	Gjakova	Gjilan	Mitrovica	Peja	Prishtina	Prizren	Total
Participants	1	3	1	2	14	12	7	40
Non-participants	2	4	15	8	24	34	22	109
Total	3	7	16	10	38	46	29	149

Source: authors

groups (participants and non-participants). After matching, there should be no statistical mean differences for the selected covariates between these groups. Therefore, to examine mean differences in observed characteristics between participants and non-participants, t-tests were performed (see Table 3).

Dairy farmers (SPHS participants and non-participants) differed in terms of number of dairy cows, land use, gross dairy income, experience, age and education (see Table 3). On average, participants had 15% more dairy cows, and 2.05 more planted hectares with grains compared to non-participants. In contrast, non-participants had on average 2.42 more years of experience in dairy operation and were on average 14 years older compared to participants. However, participant dairy farmers were better off in several other characteristics compared to non-participants. Specifically, participants had, on average, more years of education, higher annual gross dairy income, and most importantly, even for the four outcome variables (daily milk yield per cow, land use, gross income and number of dairy cows), SPHS participants were better off. Daily milk yield per cow for the participants (non-participants) group was estimated at 12.7 (11.4) litres on average, their farms averaged €8,185 (€6,568) annual gross income from the dairy operation, were using on average 3.6 ha (2.6 ha) for grains and other crops and had, on average, 7.1 (6.2) number of cows. Prior to matching, significant differences were found for daily milk yield per cow, corn planted area, total grains planted area, total land use, annual

Table 3: Difference in mean for the matching and outcome variables for potential and selected participants and non-participants (controls).

Variable	Potential participants	Potential Controls ¹	Difference	Selected participants	Selected Controls ²	Difference
No. of observations	40	109	/	40	92	/
Number of dairy cows (log)	1.96	1.82	0.14	1.96	1.84	0.12
Daily milk yield per cow in liters (log)	2.54	2.43	0.10***	2.54	2.43	0.11***
Wheat planted area (ha)	3.19	2.06	1.12	3.19	1.97	1.22
Corn planted area (ha)	2.02	1.12	0.90**	2.02	1.79	0.23
Area under grain cultivation (ha)	5.28	3.23	2.05*	5.28	3.84	1.44
Land use (log)	1.29	0.95	0.34*	1.29	1.19	0.10
Annual gross dairy income in euro (log)	9.01	8.79	0.21*	9.01	8.77	0.24
Years of experience in dairy operation	7.33	9.75	2.42*	7.33	7.73	0.40
Formal education in years	11.13	11.08	0.04	11.13	11.78	0.65
Age of the dairy farm manager	33.05	46.69	13.64***	33.05	35.95	2.90
Household size	8.65	9.27	0.62	8.65	7.78	0.88
Dummy for Grazing/ Non-grazing	0.93	0.85	0.07	0.93	0.95	0.02
Dummy for farm records	0.38	0.40	0.03	0.38	0.43	0.05

Significance levels: * p<0.05, ** p<0.01, *** p<0.001;

¹Potential controls – Potential non-participants;

²Selected controls – Selected non-participants.

Source: authors

gross income, experience in dairy operation and age of the farm manager. In contrast, means of demographics such as education and household size did not differ significantly between potential participants and potential non-participants (see Table 3).

The initial differences between SPHS participants and non-participants are a potential source of biased estimates of program impact. Therefore, eliminating the initial statistical differences implies, for example, better-off farmers are not more likely to participate in the program; thus, all the dairy farmers in the selected sample have an equal chance of being an adopter or non-adopter relative to their propensity scores. As noted in Kabunga (2014), this suggests that there is no positive selection bias in adoption behaviour. The summary statistics from Table 3 suggest there is no statistical difference between selected participants and selected controls (non-participants) on selected covariates for matching.

Results from PSM for daily milk production, land use, number of cows and gross income

The selection of matching covariates was based on the previous studies in the dairy sector in Kosovo (Musliu *et al.*, 2009; Miftari *et al.*, 2010), previous studies of impact assessments using PSM in the dairy sector (Kirchweiger and Kantelhardt, 2012; Kabunga, 2014; Rawlins *et al.*, 2014; Alemu and Adesina, 2015) and the relevant theory and institutional settings following Smith and Todd (2005). In addition, the selected variables were tested for correlation with the treatment variable (SPHS participation).

Propensity scores for each observation were generated by an estimated Probit model. The dependent variable is participation/non-participation coded as 1 for participants and 0 otherwise (see Equation 2). Estimated Probit coefficients are reported in Table 4.

This Probit model was used to measure the impact of the SPHS on the four outcomes discussed above. For the estimated Probit model, the pseudo-R² is above 0.14, indicating a good model fit (Kabunga, 2014). Caliendo and Kopeinig (2008) argue that the pseudo-R² indicates how well the regressors explain the participation probability and its value

Table 4: Probit coefficient estimates for the PSM.

Dependent variable is SPHS 1/0	Coefficient	S.E. ¹
Experience	-0.01	0.02
Corn	0.16*	0.08
Records	-0.22	0.25
Education	-0.02	0.04
Grazing	0.79	0.45
Age	-0.03**	0.01
Constant	-0.12	0.70
N		149
LR χ^2		24.95
Pseudo-R ²		0.14

Significance levels: * p<0.05, ** p<0.01, *** p<0.001.

¹S.E. - Standard Error

Source: authors

should be fairly low. Second, most variables included in the model have the expected signs. Farmers with more experience, more years of education, older farmers and those who keep farm records are less likely to join the SPHS program. In contrast, farmers using grazing and growing corn are more likely to participate in SPHS. Among these variables, age is highly significant (p<0.01). Corn is statistically significant (p<0.05), implying farmers planting more corn are more likely to join the program. There was no significant relationship between SPHS participation and experience, education, grazing and farm records.

King and Nielsen (2019) critique propensity score matching for producing biased estimates and being less efficient than other matching methods. Much of the cause for PSM inferiority results from “pruning”, in other words discarding observations that do not match well with other observations. With this in mind, we note that after discarding the 17 observations that lack common support, the means of the independent variables in the Probit model show no statistically significant differences (p<0.05) which implies some balance between treated and control observations. King and Nielsen (2019) note that reducing imbalance leads to less biased estimates. We also note that two of the matching methods used - stratification matching and KBM - use all 132 observations, thus avoiding some of the bias induced by pruning.

Table 5: Average treatment effects of SPHS on treated (*ATT*) from three matching algorithms.

Nearest neighbour matching (NNM)				
Outcome	ATT	t-value	Treated	Control
Milk yield (log)	0.107 (-0.07)	1.534	40	23
Land use (log)	0.103 (-0.3)	0.286	40	23
Gross income (log)	0.236 (-0.24)	1.003	40	23
Farm size in cows (log)	0.120 (-0.19)	0.656	40	23
Stratification matching				
Milk yield (log)	0.116*** (-0.03)	3.827	30	102
Land use (log)	0.213 (-0.14)	1.448	30	102
Gross income (log)	0.096 (-0.09)	1.019	30	102
Farm size in cows (log)	0.030 (-0.07)	0.362	30	102
Kernel based matching (KBM)				
Milk yield (log)	0.114** (-0.05)	2.441	40	92
Land use (log)	0.168 (-0.17)	0.992	40	92
Gross income (log)	0.202 (-0.13)	1.513	40	92
Farm size in cows (log)	0.15 (-0.13)	1.178	40	92

Standard errors are in parentheses.
Source: authors

The impact of the SPHS program on milk productivity per cow, land use, gross income and number of dairy cows was estimated subsequent to imposing the common support condition, i.e., matching participants with non-participants in the region of common support (Sianesi, 2004). The PSM framework matches participants with non-participants on a single dimension-propensity score. Similar propensity scores were generated from similar covariates. Balancing tests after the matching process indicated no statistical differences in the observed covariates between the two groups. As noted in Kabunga (2014), the overall matching quality before and after propensity score estimation is shown also by the relatively low pseudo-R², implying that there are no systematic differences in the distribution of covariates.

After the matching procedures, the net impact (*ATT*) of the SPHS on daily milk productivity, land use, gross income and number of dairy cows is estimated using Equation 5. All the outcome variables were measured in logs to reflect percentage changes. The results of the estimations based on NNM, Stratification matching, and *KBM* are presented in Table 5⁴.

⁴ We also estimated Radius Matching algorithm, however the method resulted in using only 24 observations, which is such a small size for a PSM study that we deemed the results irrelevant.

The milk productivity outcome is the log of daily milk production per cow per farm and the other three dependent variables are also logged. Thus, the estimated *ATT* are continuous percentage change rates. Participation in SPHS results in increases in milk productivity of 10.7%, 11.6%, and 11.4% with NNM, Stratification, and *KBM* matching methods, respectively. The impact of SPHS is statistically significant under the stratification and *KBM* methods but not statistically different from zero with the NNM method.

One of the main objectives of the SPHS is to increase the use of currently unused land and pastures. Therefore, the land use outcome was measured as the land area used by the farmer for intensive crop production, including grains and other crops. All three matching algorithms (NNM, Stratification Matching, and *KBM*) revealed insignificant *ATT*, indicating that SPHS did not have any effect on increasing land use among the program participants.

Gross income of dairy farmers from the dairy operation was measured as the total annual gross income combined from different income sources of the dairy operation such as income received from milk sales, secondary dairy products sales such as cheese, cottage cheese, income from animal sales, and manure sales. All three matching algorithms displayed insignificant *ATT* (Table 5).

Increasing the average number of dairy cows is another objective of SPHS; therefore, the farm size outcome was measured as the total number of dairy cows in the barn. Similar to the results for land use, three of the matching algorithms showed insignificant impacts on increasing the number of dairy cows for the participant farms.

Discussion

Direct payments in the agricultural sector constitute a frequently used policy tool, especially across European countries. Subsequently, the evaluation of this policy scheme has been greatly emphasized over the last years. A special focus has been given to coupled direct payments, where their effects have been questionable in the literature. Therefore, our study contributes to the emerging literature by evaluating a coupled, direct payment program in Kosovo.

The results do not provide robust evidence for the first policy objective (milk production per cow) across matching algorithms. The findings from NNM are consistent with Bajrami *et al.* (2016) and GAP (2016), who concluded that the MAFRD subsidies did not show any positive effect on increasing production. However, results are robust for the other three objectives, revealing that SPHS did not increase land use, gross income and farm size (number of cows). The lack of statistically significant average treatment effects confirms results from previous studies (Bajrami *et al.*, 2016; GAP, 2016) that SPHS did not have any significant effect on increasing land use, farm size and gross income for dairy farmers who participated in the program.

For land use, these results might be expected, considering that the majority of farms are small, and they tend to use the same amount of land area over time. Similarly, Kastner International and AWI (2012) claimed that due to the application of thresholds being used as eligibility criteria for direct payments, small farms are motivated to continue farming and not release their land for use by bigger farms that could produce at a lower cost.

For gross income, GAP (2016) found that the SPHS increases farmer income in the short run. Contrary to the findings of GAP (2016), we did not find any effect on improving dairy farmers' income. Nevertheless, GAP (2016) also claimed that in the long run, this scheme prevents the development of the dairy sector, since it supports and keeps less productive farmers from terminating production.

Lastly, an important focus of policy analysis in agriculture is their effect on farm size. According to MAFRD (2015), small farms (1–9 cows) constitute 65% of cattle inventory in Kosovo. Therefore, we examined the effects of SPHS on farm size as the number of dairy cows. Results revealed that SPHS did not have any statistically significant effect on increasing farm size. Furthermore, one of the matching algorithms revealed negative effects, suggesting SPHS reduced the number of dairy cows on supported farms. Findings of GAP (2016) showed that this policy impacted the farm structure, with 94.2% being family farms (1–5 milking cows).

These findings are important. Since the SPHS program was initiated in 2009, MAFRD has spent over €8 million funding it. Furthermore, over the same period, MAFRD has increased its budget allocation for this program by an annual average of 47%. In 2014, over €2.2 million was expended by MAFRD to implement the SPHS. The results from this impact assessment suggest SPHS has not been effective in reaching its objectives. Four alternative matching algorithms tested the robustness of results; one of the first studies employing this technique to evaluate direct payment's effects.

Conclusions

Our findings suggest that SPHS has had a slightly positive impact on milk productivity and a generally insignificant impact on land use, gross income and farm size. Direct payments are considered inefficient measures for promoting growth, since their effect tends to diminish over many years (Kastner International and AWI, 2012). Likewise, our findings suggest the SPHS needs to be reformulated or replaced with a program that more effectively and efficiently achieves the objective of improving the competitiveness of the Kosovo's dairy sector. Perhaps budget could be reallocated to upgrading the genetic potential of dairy cows and improving research and extension services to enhance management skills.

Our use of a Propensity Score Matching approach with four matching algorithms is a more rigorous test of policy effectiveness than done in most similar past studies. The results of this study can be generalized beyond Kosovo by highlighting the ineffectiveness of coupled direct payments and the need to formulate new strategies that address farmers' needs more effectively.

This study shed light on the ineffectiveness of coupled direct payments to address the needs of small-scale farmers. One concern about the findings of this study is that assessment is based on recall observations for only two years, 2013 and 2014 (recall data). However, some dairy programs tend to have long-term objectives; therefore, an ideal dataset would have had a longitude of five years (2009–2014). Nevertheless, research with a larger sample over a longer period would be desirable particularly if data were collected from producers after each year. Additionally, the number of observations used in the PSM models is small, so results must be evaluated with this caveat in mind. However, we generally find no persuasive evidence of SPHS effectiveness, which is more defensible than if the results had led to statistically significant findings.

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