Engjell SKRELI*, Orjon XHOXHI*, Edvin ZHLLIMA* and Drini IMAMI*

Do Agriculture Subsidies Make Farmers Better-off? A Case Study from an EU Candidate Country

Studies on the impact assessment of subsidy schemes on farm performance indicators show contradictory results. Some studies indicate improvements in farm efficiency, while others highlight distortions and negative externalities. This paper analyses the impact of budgetary support provided to dairy farms in Albania based on a structured farm survey. The impact is assessed using causal forest, an adaptation of Breiman's random forest algorithm for treatment effect estimation. Results suggest that subsidies positively impact the number of milking cows, output (quantity of milk sold), and revenues but have no impact on employment, yields, investment, or future investment plans. The study suggests that public support to dairy farmers should be conditioned on technology improvement measures and CAP-like cross-compliance obligations.

Keywords: agricultural subsidies; Albania; impact assessment; dairy sector; machine learning

JEL classifications: Q12; Q18

* Agricultural University of Tirana, Rruga Paisi Vodica, 1025 – Tirana, Albania. Corresponding author: dimami@ubt.edu.al

Received: 13 May 2024; Revised: 23 July 2024; Accepted: 26 July 2024.

Introduction

The crisis that emerged in the last decade has brought the importance of supporting the agriculture sector back onto the political agenda. During 2020-22, total support to agriculture in most developed and emerging economies[1] reached \$851 billion per year. This represents a historic high and an almost 2.5-fold increase compared to 2000-02. The COVID-19 pandemic has pushed countries to use extra support in order to maintain the functioning of existing supply chains, support producers and provide food aid. More than two thirds of the support was provided in the form of price incentives and fiscal subsidies to producers, despite their distorting nature. Only a minor proportion was provided in the form of general services or public goods (FAO UNDP and UNEP, 2021).

Coupled support is still massive and stalling in developed and emerging economies (OECD, 2023). Despite significant reductions, coupled support remains present in the EU, accounting for more than 10% of the direct payments budget. Three livestock-based sectors have always been, and also remained, the largest beneficiaries, receiving 72.9% of all coupled support allocations. The coupled support mechanism in EU is still granted to certain sectors specified in Regulation (EU) 2021/2115, in cases when it is justified with the intervention strategy, the difficulty of the targeted sector, or socio-economic and environmental importance. This kind of support is also still common in developing countries.

Due to its longevity, coupled support has for a long time commanded the attention of researchers. Different studies have found mixed effects on farm performance in terms of employment (Olper *et al.,* 2014; Garrone *et al.,* 2019), investing behaviour (Lehtonen, 2004; Kazukauskas, 2013; Viaggi *et al.,* 2011, Kilic *et al.,* 2015), productivity and technical efficiency (Cillero *et al.,* 2018; Kazukauskas *et al.,* 2013; Kimura and Sauer, 2015; Sipiläinen *et al.,* 2014; Rizov *et al.,* 2013), income (Biagini *et al.,* 2020; Lehtonnen, 2004) and environment protection (Henderson and Lankoski, 2019). The impact is influenced by farm size (Staniszewski and Borychowski, 2020) but also by the conditionalities that characterise the measures (Lankoski and Thiem, 2020).

While there is extensive literature on OECD and EU countries on the effects of the coupled support, the empirical studies from developing and emerging economies are limited. Therefore, this study aims to fill the gap by exploring the effect of coupled support policies in Albania. In the context of the very low level of financial support for agriculture and weak supporting policy environment, it is crucial that such limited resources be used efficiently and with high impact. Thus, there is a need to assess the impact of limited public support to agriculture and provide evidences for policy fine-tuning. This paper aims to assess the joint effect of coupled support (unit of milk) and direct support (per animal head) on dairy farm production factors, investment and income, using causal forests which is an adaptation of the random forest algorithm of Breiman (2001) to the problem treatment effect estimation. The current paper contributes to the impact assessment literature in two ways: assessing the joint effect of market price support and per head of animal support in an important sector of an EU candidate country using a machine learning approach to the problem of treatment effect estimation.

The study targets the dairy sector as a very important agri-food sector in Albania, with approximately 50% of farmers engaged in livestock-related activities, including dairy (Imami *et al.,* 2016). Milk production continues to be predominantly based on cow's milk (more than 80%). While the first two decades of the transition from a planned to a market economy saw an increase in milk production and the number of dairy livestock (e.g., cows), the dairy sector has experienced an unprecedented decline in recent years. The number of dairy cows dropped by 36% in 2021 compared to 2004 (INSTAT, 2023). On the other hand, dairy products represent an important part of the Albanian household consumption basket. Additionally, the dairy sector has been considered a priority for government support due to the contribution of livestock to farm income (Ciaian *et al.,* 2018), food security, and overall rural livelihood.

[1] 54 countries considered in the OECD report Agricultural Policy Monitoring and Evaluation 2023

OPEN ACCESS PEER REVIEWED

The study covers a country with a very limited public support for agriculture. In Albania, for the period 2007-2018, the public support for agriculture has averaged €29 million or approximately 1.5% of the sector GVA. The support is much lower compared to other western Balkan countries (WBCs) and/or EU (Erjavec *et al.,* 2021) where support is respectively 5% and 26% of the agriculture GVA. Thus, it is obvious that the level of funding is far below other countries in the region and EU, placing Albanian famers in an unequal position when compared to neighbouring countries. Moreover, direct payments (similar to Pillar 1) are limited only to a few sectors and farm structural support (similar to Pillar 2) is subject to frequent changes of both policy and eligibility criteria (Erjavec *et al.,* 2021).

For the livestock sector, which is the target of this study, the National/Government Support Schemes for the period analysed (2007-2018) provided budgetary support to dairy farms (cattle and small ruminants) mainly in the form of payments per unit of milk delivered to milk processing plants, per animal head payments, and only marginally grants for investments in stables, feed preparation and storage facilities, and equipment (FAO, 2022). Given the magnitude of support, payments per litre of milk and per animal head are the policy measures considered in this impact evaluation.

The remainder of the paper is structured as follows. The second section provides a literature review, the third section describes the methods that were employed to assess the impact. The main results from the quantitative analysis of the impact assessment are presented in section four, while section five concludes the paper.

Literature review and hypotheses

As stated in the introduction, this paper aims to assess the joined effect of the governmental support package (coupled and per animal head support) on farm employment, investment, productivity and income. Although coupled support to incentivise the production of specific products has been gradually removed in EU due to changing policy vision, it is yet relevant and especially important for the developing and emerging economies. Therefore, the review considers mainly research in developing countries contexts and relevant (though not very recent) research on the effects of EU coupled support.

Research on the relationship between coupled support and employment has produced mixed results. Olper *et al.* (2014) found that CAP payments significantly contributed to maintaining jobs in agriculture, with Pillar I subsidies exerting an effect more than two times greater than that of Pillar II payments. However, a more recent study by Garrone *et al.* (2019) showed that CAP subsidies reduce the outflow of labour from agriculture, but the effect is almost entirely due to decoupled Pillar I payments, with coupled Pillar I payments having no impact on preserving jobs in agriculture. The impact of coupled support for dairy cows on farm employment is subject to various factors, including farm size and type, labour market conditions, and level of mechanisation. On the one hand, coupled support for dairy cows may increase on-farm employment, as more workers may be needed to tackle the needs emerging from increased size. On the other hand, subsidies may negatively affect employment in the context of capital–labour substitution or stimulating land rental market, pushing other farmers towards exiting from agriculture (e.g. more competitive and supported farms can rent land from other farms). Induced income from subsidies may raise farmers' level of education and prepare them for further integration in the off-farm labour market (Berlinschi *et al.,* 2014; Caucutt and Lochner, 2020). The net effect will likely depend on a variety of factors, such as market imperfections, which may differ among countries and over time but also level of support. Given the current type of support, as well as the small size of dairy farms and low level of mechanisation, we expect to see a positive relationship between government support and employment on dairy cow farms.

H1: Government support is expected to result in increased employment.

The positive impact of coupled support is caused by the investment-induced productivity gains resulting by farmers credit risk attitudes relaxation (better credit access, lower cost of borrowing, reduction in risk aversion) which stimulates farmers to borrow capital for investments. Indeed, the provision of the agriculture support has been associated with an increase in capital borrowing for farm investment (Kirchweger *et al.,* 2015). Furthermore, the presence of coupled support increases farmers policy cognition which is known to affect their intentions for investments (Wang *et al.,* 2021). Earlier literature (Lorent *et al.,* 2009) has found a positive effect of subsidies on farm size and investments.

H2: Government support is expected to result in increased herd size, increased current and planned investment in physical assets.

The impact of coupled support on farm productivity and technical efficiency is a topic of debate. Latruffe *et al.* (2017) revealed that coupled support has positively affected efficiency, while in another study the decoupling is associated with negative effects (Latruffe and Desjeux, 2016). Cillero *et al.* (2018) found that coupled payments positively affected farm technical efficiency in Ireland, and this effect remained even after replacing it with decoupled income support. In contrast, Kazukauskas *et al.* (2013) found that de-coupling away from market price support reduced technical efficiency in all countries except Denmark between 2001 and 2007. Coupled support may have positive effects due to new technology adoption or farm exit and consolidation, which allow reallocating resources towards more efficient farms (Kimura and Sauer, 2015). Conversely, evidence suggests that reducing coupled support increases productivity in many countries and contexts. Sheng *et al.* (2020) found that removing market price support in the Australian dairy context contributed positively to productivity growth. Zhu and Milán Demeter (2012) showed that a higher degree of coupling in EU CAP farm support had negatively affected farm efficiency and motivation of farmers. Research in Kosovo found no significant impact of coupled or per head payments on technical efficiency or dairy cow productivity (Bajrami *et al.,* 2019). Such contradictory evidence suggests that the effect of coupled support on farm productivity needs to be re-examined.

The impact of per cow head support on milk productivity can be both positive and negative. On the positive side, per cow head support can provide farmers with financial stability, which can in turn lead to greater investment in herd management, improved genetics, and better feeding and nutrition programmes. These factors can result in increased milk production per cow and overall herd productivity (Krpalkova *et al.,* 2016). However, per cow head support can also have negative impacts on milk productivity if it incentivises farmers to focus solely on increasing the size of their herds without considering other factors that affect milk productivity, such as genetics, nutrition, and animal health. This can lead to overstocking, lower quality milk, and decreased animal welfare.

H3: Government support for dairy cow has a positive impact on cow milk yield.

While evidence supports the positive impact of government support on farm income, the effectiveness of coupled support remains uncertain. The EU's Common Agricultural Policy (CAP) has historically aimed to boost farmers' income, as evidenced by studies such as Biagini *et al.* (2020) and similar findings in countries like Russia (Bezlepkina *et al.,* 2005). However, research by Mark *et al.* (2014) suggests that the Margin Protection Program under the 2014 US Farm Bill, designed to ensure dairy farmers' margins, has had limited payout effectiveness. Yilmaz and Nilgun (2016) also discovered that increased government supports in Turkey led to a 0.13% reduction in agricultural value-added per hectare, highlighting inefficiencies and adverse side effects. Nevertheless, subsidies can benefit small-scale dairy farming by providing crucial financial resources for purchasing high-quality feed, investing in modern equipment, and implementing best practices. These investments often lead to improved productivity and income stability.

H4: Government support is expected to lead to increased sales, increased farmers direct and indirect revenue.

Research indicates that the impact of coupled support (price support and per animal support) on farmers' income can be mixed and sometimes contradictory. Studies have shown that while coupled support can stabilise farm income, it may also lead to inefficiencies and environmental harm. For instance, Henderson and Lankoski (2019) found that such support often results in negative environmental impacts and does not always lead to long-term income benefits. Additionally, research by McCloud and Kumbhakar (2008) highlighted that subsidies might not drive productivity improvements across all contexts, particularly in Nordic dairy farms. This suggests that while coupled support can provide short-term financial relief, it may not consistently enhance productivity or long-term profitability.

Methods and procedures

The Agriculture and Rural Development Programme Fund (ARDPF), through National Support Schemes (NSS), provides budgetary support to dairy farms in the form of per head payments, milk premium and grants for investments in premises, technology lines and equipment. A structured survey was conducted during the end of 2019 with 279 dairy farmers of which 135 farmers were beneficiary of headage and milk premium support and 144 were non-beneficiaries. The sample universe was based on the list of all farmers who benefited from policy support during the period 2013-2018. The non-beneficiaries were selected randomly in the same villages where beneficiaries have been located.

To assess the subsidy scheme impact, causal forest is employed; causal forest is an adaptation of the random forest algorithm of Breiman (2001) to the problem of treatment effect estimation. Causal forest is a non-parametric method for heterogeneous treatment effect estimation that allow for data-driven feature selection while maintaining the benefits of classical methods, i.e., asymptotically normal and unbiased point estimates with valid confidence intervals (Wager and Athey, 2018). The estimate can be thought of as an adaptive nearest-neighbor method, where the data determine which dimensions are most important for selecting nearest neighbours. While classical methods such as k-nearest neighbors seek the k closest points to x according to some pre-specified distance measure (e.g., Euclidean distance); forest/tree-based methods also seek to find training examples that are close to x, but now closeness is defined with respect to a decision tree, and the closest points to x are those that fall in the same leaf as it (Wager and Athey, 2018). Wager and Athey (2018) point out that the advantage of forest/trees model is that their leaves can be narrower along the directions where the signal is changing fast and wider along the other directions, potentially leading a to a substantial increase in power when the dimension of the feature space is even moderately large. Moreover, they show that the estimates of the treatment effect based on an average of multiple trees are asymptotically normal.

To get an overview of the variables used as covariates in the causal forest, Table 1 provides some descriptive statistics for each of them. Table 2 shows descriptive statistics of the main outcomes which are subject of the analysis.

Table 1: Sample characteristics – Covariates used in CF.

Category	Beneficiaries (N=135)		Non-Beneficiaries (N=144)	
	Mean	Std. Dev.	Mean	Std. Dev.
Farmers' Age	48.49	10.98	52.58	11.00
Farmers' Education	10.89	2.35	10.43	2.35
Land planted animal feed (Ha)	10.80	25.39	6.05	9.36
Family size	5.10	1.58	4.82	1.61
Keep notes & Calc. prod cost (Yes/No)	36%	0.48	21%	0.41
License permit shed (Yes/No)	40%	0.49	38%	0.49
Milking machine (Yes/No)	79%	0.41	59%	0.49
Registration with Tax authorities (Yes/No)	24%	0.43	10%	0.30
Intermediary advice on standards (Yes/No)	16%	0.36	11%	0.32

Note: Y/N → the answer is a yes or no; the mean value shows the share of respondents that have answered yes.
Source: Authors' own calculation, based on primary data collected

Table 2: Descriptive statistics of outcomes of interest.

Category	Beneficiaries (N=135)		Non-Beneficiaries (N=144)	
	Mean	Std. Dev.	Mean	Std. Dev.
Number of hired workers	2.56	4.13	1.40	2.65
Number milking cows	18.73	11.93	10.53	11.57
Farm investment 2013-2018 (€)	14 482	34 187	10 283	33 425
Plans to invest in the next 5 years (€)	25 420	66 199	11 547	43 846
Yield (Litres/Cow)	4 382	1 664	3 932	1 614
Revenue from dairy business (direct) (€)	24 107	17 703	12 937	16 613
Revenue from dairy business (indirect) (€)	24 265	18 581	10 785	11 197
Milk sales (Litres)	73 022	51 480	34 745	38 159

Note: Revenue from dairy business (direct) measures the variable by asking a direct question about their revenues from dairy business; Revenue from dairy business (indirect) measures the variable indirectly by multiplying their selling price with quantity sold.
Source: Authors' own calculation, based on primary data collected.

Here causal effects are defined via the potential outcomes model (Imbens and Rubin, 2015). For each sample i, is assumed that the potential outcomes $Y_i(0)$ and $Y_i(1)$ corresponding to the outcome we would have observed had we assigned control or treatment (W) to the i-th sample, and assume that we observe $Y_i = Y_i(W_i)$. The Average Treatment Effect (ATE) is then defined as $\tau = [Y_i(1) - Y_i(0)]$, and the conditional ATE function is $\tau(x) = [Y_i(1) - Y_i(0)|X_i = x]$. In order to identify causal effects, we assume un-confoundedness (i.e., that treatment assignment is as good as random conditionally on covariates).

The causal forest estimation is done through the grf R package, which starts by fitting two separate regression forests to estimate $\hat{m}(\cdot)$ (main effect function) and $\hat{e}(\cdot)$ (propensity function). It then makes out-of-bag predictions using these two first-stage forests, and uses them to grow a causal forest (see equation 7 in Athey and Wager, 2019). Then causal forest is trained and its parameters (e.g., min node size) are tuned by cross-validation (i.e., the parameters that minimise the objective function are selected). In addition, to improve precision as suggested by Athey and Wager (2019) first a pilot random forest is trained on all features (not all are presented here), and then train a second one only on those features that saw a reasonable number of splits in the first step.

In studies of this nature, it is inherently challenging to fully account for variables which affect all farmers in a region, though their impact may vary based on individual farm characteristics and management practices. However, the structured survey, targeted a representative sample including both beneficiaries of support and non-beneficiaries (as highlighted above). By randomly selecting non-beneficiaries from the same villages as beneficiaries, we minimised location-specific external influences, ensuring a more accurate comparison between supported and non-supported farmers. This design helps control for broad external factors that impact the entire farming community similarly.

The study also incorporates a comprehensive set of covariates, such as farmers' age, education, family size, land area planted with animal feed, use of milking machines, and registration with tax authorities. These covariates help account for individual and farm management differences that could influence how external factors impact each farm. While the external factors themselves cannot be directly controlled, their differential effects on individual farms are captured through these covariates.

Lastly, the study employs causal forests, an advanced non-parametric method for treatment effect estimation, which adapts the random forest algorithm to estimate heterogeneous treatment effects. This approach allows for data-driven feature selection and effectively controls for a wide range of covariates, helping to isolate the impact of subsidy schemes from other external influences.

Study results

Table 3 presents the results of the causal forest estimations about the impact of government subsidy schemes.

The study results do not support Hypothesis H1, which posits that government support leads to increased employment. Specifically, the considered support package has not had an effect on the employment of hired labour (ATE = 0.67, and swinging between -0.09 and +1.43). *The study results provide mixed findings on the investment hypotheses*. Findings show that there is an increased herd size among supported farmers. The joint effect of market price support and payment per milking cow is positive and statistically significant (ATE = 6.17 and swinging between 3.62 and 8.72). However, no significant changes are observed in farm investment 2013-2018 (ATE=581, and swinging between -7036 and 8198) and plans to invest in the next 5 years (ATE=4825, and swinging between -7051 and 16701); For both hypothesis the ATE is not different from Zero.

Table 3: Estimation of the Average Treatment Effect (ATE) with causal forest.

	Category	ATE	ATE interval at 95% CI	
			Min	Max
1.	Number of hired workers	0.67	-0.09	1.43
2.	Number of milking cows	6.17	3.62	8.72
3.	Farm investment 2013-2018 (€)	581.00	-7,036.00	8,198.00
4.	Plans to invest in the next 5 years (€)	4,825.00	-7,051.00	16,701.00
5.	Yield (Litres/Cow)	311.05	-62.37	684.47
6.	Revenue from dairy business (direct) (€)	7,338.00	3,451.00	11,225.00
7.	Revenue from dairy business (indirect) (€)	9,867.00	6,670.00	13,064.00
8.	Milk sales (Litres)	28,228.00	18,501.00	37,955.00

Source: Authors' own calculation, based on primary data collected

Hypothesis H3 suggested that government support for dairy cows has a positive impact on cow milk yield. However, the results of the analysis do not support this hypothesis, as the average treatment effect (ATE) for cow milk yield swings from -373.42 to + 311.05, with zero being included in the interval. The findings indicate that the package of support, including payment per unit of milk and per head of cow, has not motivated dairy farmers to improve their farming technology or invest in new breeds, despite increasing the number of animals.

The government's support in the dairy sector has yielded positive results in terms of income, which is supported by retention of hypothesis H4. The ATE for the three variables measuring income is significant at a 95% confidence interval. The results suggest that beneficiaries of subsidy support in the dairy sector have considerably higher revenues than non-beneficiaries. The ATE for direct revenue from dairy business is €7338 (between 3451 and 11225), the ATE for indirect revenue from dairy business is €9867 (between 6670 and 13064), and the ATE for milk sales is €28228 (between 18501 and 37955). These effects are statistically significant as the effect is different from zero. It is worth noting that the increased income is in line with the increased number of dairy cows.

Discussion and Conclusions

This paper assessed the joint effect of coupled support (payment per unit of milk) and direct support (per animal head) on dairy farm production factors, investment and income using causal forests which is an adaptation of the random forest algorithm of Breiman to the problem of treatment effect estimation.

The analysis reveals a positive and significant impact of subsidy schemes on herd size (number of cows), farm sales and revenues. These results are consistent with the hypotheses presented in the preceding sections. The current study results also converge with Skreli *et al.* (2015) and Gecaj *et al.* (2020) in terms of positive impact of government support on production capacities (e.g., planted area in the case of horticulture sector).

Conversely, the support package has not affected employment of hired labour, milk yield, farm physical investment herd size between 2013 and 2018 and farmer's willingness to invest in the future. One possible reason for the lack of impact on external employment is that many family farms, which make up a significant portion of the sector, tend to rely on household labour and may only hire external employees after fully utilising the existing labour resources (under-utilisation of household labour in typical Albanian family farms is quite common). Thus, while government support may not have a direct impact on employment, it may indirectly support job creation by improving the utilisation of the household labour and productivity and profitability of family farms. Regarding the absent impact of support package on investment, it appears that farmers have chosen to increase the number of heads rather than invest in technology as a means of benefiting from government support. The findings of this study also corroborate those of Skreli *et al.* (2015) and Gecaj *et al.* (2020) regarding the lack of impact on yields. The later may result from the fact, that most subsidies scheme, such as those applied to the dairy farmers, are not linked to or conditioned with technology transfer or improving access to advisory services.

In terms of policy implications, it is recommended that government continues to provide per head support to the dairy sector. While the dairy sector in Albania is currently experiencing a crisis - number of dairy cows has decreased by 36% in 2021 compared to 2004 (INSTAT, 2023), the support for the sector has been very limited. Hence, an overall increase of budgetary support and an increase of level of payments is necessary (currently payment per dairy cow is €100 per head, €5.6 million in total or slightly more than 6% of overall budgetary support). Despite the distortive nature of coupled support, using such instrument for a sector in crisis is in line with EU Common Agricultural Policy. Currently in EU, all member states except Ireland and Nederland, carry coupled income support for at least one of the eligible livestock sectors using up to 7% of CAP funding (EC, 2023).

In addition, considering the specific ties between the rural population and grazing, to decelerate migration and stop the exit from livestock, minimum eligibility criteria can be revised for targeted farms. A farm must have at least 10 cows to be eligible for support or subsidies, while previous estimates reveal that dairy farms can be economically viable with 6 cows. Expanding support schemes to include such farms can be effective for maintaining the rural fabric and improving the supply of raw milk.

The results of the study call strongly for a revision of the *financing mechanism* of the support given to dairy farms in the future in Albania. Support packages have to be accompanied by complementary measures, such as investing in improve breeds, improving feeding and feeding practices, and improve animal housing. Additionally, the direct support should be provided based on cross-compliance requirements, such as food safety and environment protection, in order to make the policy conform EU CAP and to contribute to other farm performance indicators. Across sectors, important investments need to be made in public extension service, especially those related to innovation and cross-compliance. Policy makers should combine financial support with information, capacity development instruments, and innovation. Quite often, the problem might not be the lack of funding, but the lack of information and capacities both at individual business and at value chain level.

The Government should consider *increasing substantially the level of support* for farmers as a pre-condition to create financial incentives for farmers to invest – the public support to Albanian agriculture has been lower compared to international practice, European and Western Balkan Countries – less than 3% of the GVA, while it is twice as much in the Western Balkans and seven times higher in the EU (Martinovska Stojcheska *et al.,* 2021). The per head payment covers only a part of the eligible beneficiaries and the milk premium has been provided only for a small part of the production. Given the low number of beneficiaries, government should increase funding and simplify procedures, revising the minimum eligible criteria.

NSS should reformulate support priorities, support measures, and eligibility criteria in the future. Given the absence of a functional farm register and Integrated Administration and Control System (IACS), switching to decoupled support is expected to be costly and time consuming. Sustained efforts should be made to align budgetary support policies with the EU CAP 2030 reforms. Such changes may have similar effects to EU initiatives in Albania, ensuring a clear and positive effect of support on yields.

Acknowledgment

The authors express their gratitude to the FAO and the Ministry of Agriculture and Rural Development of Albania for their support in implementing the farm surveys.

References

Athey, S. and Wager, S. (2019): Estimating treatment effects with causal forests: An application. Observational Studies, **5** (2), 37–51. https://doi.org/10.1353/obs.2019.0001

Bajrami, E., Wailes, E. J., Dixon, B. L., Musliu, A. and Durand-Morat, A. (2019): Do coupled subsidies increase milk productivity, land use, herd size and income? Evidence from Kosovo. Studies in Agricultural Economics, **121** (3), 134–143. https://doi.org/10.7896/j.1913

Berlinschi, R., Swinnen, J. and van Herck, K. (2014): Trapped in Agriculture? Credit Constraints, Investments in Education and Agricultural Employment. The European Journal of Development Research, **26** (4), 490–508. https://doi.org/10.1057/ejdr.2014.30

Bezlepkina I. V., Lansink A. G. O. and Oskam, A. J. (2005): Effects of subsidies in Russian dairy farming. Agricultural Economics, **33** (3), 277–288. https://doi.org/10.1111/j.1574-0864.2005.00067.x

Biagini, L., Antonioli, F. and Severini, S. (2020): The role of the common agricultural policy in enhancing farm income: a dynamic panel analysis accounting for farm size in Italy. Journal of Agricultural Economics, **71** (3), 652–675. https://doi.org/10.1111/1477-9552.12383

Breiman, L. (2001): Random forests. Machine learning, **45** (1), 5–32. https://doi.org/10.1023/A:1010933404324

Caucutt, E. M. and Lochner, L. (2020): Early and late human capital investments, borrowing constraints, and the family. Journal of Political Economy, **128** (3), 1065–1147. https://doi.org/10.1086/704759

Ciaian, P., Rajcaniova M., Guri, F., Zhllima, E. and Shahu, E. (2018): The impact of crop rotation and land fragmentation on farm productivity in Albania. Studies in Agricultural Economics, **120** (3), 116–125. https://doi.org/10.7896/j.1815

Cillero, M. M., Thorne, F., Wallace, M., Breen, J. and Hennessy, T. (2018): The effects of direct payments on technical efficiency of Irish beef farms: a stochastic frontier analysis. Journal of Agricultural Economics, **69** (3), 669–687. https://doi.org/10.1111/1477-9552.12259

Erjavec, E., Volk, T., Rednak, M., Ciaian, P. and Lazdinis, M. (2021): Agricultural policies and European Union accession processes in the Western Balkans: aspirations versus reality. Eurasian Geography and Economics, **62** (1), 46–75. https://doi.org/10.1080/15387216.2020.1756886

FAO (2020): Smallholders and family farms in Albania. Technical Report, available at: https://openknowledge.fao.org/items/3a350f9f-cf77-4835-87a3-e01a347f654a (Accessed on 23 March 2024).

FAO, UNDP and UNEP (2021): A multi-billion-dollar opportunity – Repurposing agricultural support to transform food systems. Rome, FAO. Available at: https://doi.org/10.4060/cb6562en (Accessed on 12 May 2024).

Garrone, M., Emmers, D., Olper, A. and Swinnen, J. (2019): Jobs and agricultural policy: Impact of the common agricultural policy on EU agricultural employment. Food Policy, **87**, 101744. https://doi.org/10.1016/j.foodpol.2019.101744

Gecaj, M., Shahu, E., Imami, D., Skreli, E. and Jambor, A. (2019): Analysing the impact of subsidies on the Albanian agriculture sector. Bulgarian Journal of Agricultural Science, **25** (5), 883–890.

Henderson, B. and Lankoski, J. (2019): Evaluating the environmental impacts of agriculture policies. OECD Food, Agriculture, and Fisheries Papers No. 130. Paris, OECD. Available at https://doi.org/10.1787/add0f27c-en (Accessed on 5 April 2024).

Imami, D., Zhllima, E., Merkaj, E., Chan-Halbrendt, C. and Canavari, M. (2016): Albanian consumer preferences for the use of dry milk in cheese-making: A conjoint choice experiment. Agricultural Economics Review, **17** (875-2017-1552), 20–33.

INSTAT (2023). Albanian Institute of Statistics, Livestock statistical databases. Available at: https://www.instat.gov.al/al/temat/bujq%C3%ABsia-dhe-peshkimi/blegtoria/ (Accessed on 22 February 2024).

Imbens, G. W. and Rubin, D. B. (2015): Causal inference in statistics, social, and biomedical sciences. USA, Cambridge University Press.

Kazukauskas, A., Newman, C., Clancy, D. and Sauer, J. (2013): Disinvestment, farm size, and gradual farm exit: the impact of subsidy decoupling in a European context. American Journal of Agricultural Economics, **95** (5), 1068–1087. https://doi.org/10.1093/ajae/aat048

Kilic, T., Whitney, E. and Winters, P. (2015): Decentralised beneficiary targeting in large-scale development programmes: insights from the Malawi farm input. Journal of African Economies, **24** (1), 26–56. https://doi.org/10.1093/jae/eju021

Kimura, S. and Sauer, J. (2015): Dynamics of dairy farm productivity growth: Cross-country comparison. Available at: https://www.oecd-ilibrary.org/content/paper/5jrw8ffbzf7l-en (Accessed on 4 May 2024).

Kirchweger, S., Kantelhardt, J. and Leisch, F. (2015): Impacts of the government-supported investments on the economic farm performance in Austria. Agricultural Economics (Czech), **61** (8), 343–355. https://doi.org/10.17221/250/2014-AGRICECON

Krpalkova, L., Cabrera, V. E., Kvapilik, J. and Burdych, J. (2016): Dairy farm profit according to the herd size, milk yield, and number of cows per worker. Agricultural Economics (Czech), **62** (5), 225–234. https://doi.org/10.17221/126/2015-AGRICECON

Lankoski, J. and Thiem, A. (2020): Linkages between agricultural policies, productivity and environmental sustainability. Ecological Economics, **178**, 106809. https://doi.org/10.1016/j.ecolecon.2020.106809

Latruffe, L. and Desjeux, Y. (2016): Common Agricultural Policy Support, Technical Efficiency, and Productivity Change in French Agriculture. Review of Agricultural, Food and Environmental Studies, **97** (1), 15–28. https://doi.org/10.1007/s41130-016-0007-4

Latruffe, L., Bravo-Ureta, B. E., Carpentier, A., Desjeux, Y. and Moreira, V. H. (2017): Subsidies and technical efficiency in agriculture: Evidence from European dairy farms. American Journal of Agricultural Economics, **99** (3), 783–799. https://doi.org/10.1093/ajae/aaw077

Lehtonen, H. (2004): Impact of de-coupling agricultural support on dairy investment and milk production volume in Finland.

Acta Agric. Scand., Sect. C, Food Economics, **1** (1), 46–62. https://doi.org/10.1080/16507540410026135
Lorent, H., Sonnenschein, R., Tsiourlis, G. M., Hostert, P. and Lambin, E (2009): Livestock subsidies and rangeland degradation in central Crete. Ecology and Society, **14** (2), 41.
Mark, T. B., Burdine, K. H. and Halich, G. (2014): How Sensitive are the Frequencies and Magnitudes of MPP-Dairy Indemnities? Journal of Agribusiness, **32** (345-2021-1125), 145–164. https://doi.org/10.22004/ag.econ.311255
Martinovska Stojcheska, A. M., Kotevska, A., Stamenkovska, I. J., Dimitrievski, D., Zhllima, E., Vaško, Ž., Bajramovic, S., Kerolli-Mustafa, M., Spahic, M., Kovacevic, V., Ali Koc, A., Ahmet, B. and Ciaian, P. (2021): Recent agricultural policy developments in the context of the EU approximation process in the pre-accession countries (No. JRC124502). Joint Research Centre, Seville, Spain.
McCloud, N. and Kumbhakar, S. C. (2008): Do subsidies drive productivity? A cross-country analysis of Nordic dairy farms. In: Chib, S., Griffiths, W., Koop, G. and Terrell, D. (eds): Bayesian Econometrics (Advances in Econometrics). Vol. 23. United Kingdom, Emerald Group Publishing Limited: 245–274.
OECD (2023): Agricultural Policy Monitoring and Evaluation 2023: Adapting Agriculture to Climate Change, OECD Publishing, Paris.
Olper, A., Raimondi, V., Cavicchioli, D. and Vigani, M. (2014): Do CAP payments reduce farm labour migration? A panel data analysis across EU regions. European Review of Agricultural Economics, **41** (5), 843–873. https://doi.org/10.1093/erae/jbu002
Rizov, M., Pokrivcak, J. and Ciaian, P. (2013): CAP subsidies and productivity of the EU farms. Journal of Agricultural Economics, **64** (3), 537–557. https://doi.org/10.1111/1477-9552.12030
Sheng, Y., Chancellor, W. and Jackson, T. (2020): Deregulation reforms, resource reallocation and aggregate productivity growth in the Australian dairy industry. Agriculture and Resource Economics, **64** (2), 477–504. https://doi.org/10.1111/1467-8489.12351
Sipiläinen, T., Kumbhakar, S. C. and Lien, G. (2014): Performance of dairy farms in Finland and Norway from 1991 to 2008. European Review of Agricultural Economics, **41** (1), 63–86. https://doi.org/10.1093/erae/jbt012
Skreli, E., Imami, D., Jámbor, A., Zvyagintsev, D. and Cera, G. (2015): The impact of government subsidies on the olive and vineyard sectors of Albanian agriculture. Studies in Agricultural Economics, **117** (3), 119–125. https://doi.org/10.7896/j.1525
Staniszewski, J. and Borychowski, M. (2020): The impact of the subsidies on efficiency of different sized farms. Case study of the Common Agricultural Policy of the European Union. Agricultural Economics (Czech), **66**, 373–380. https://doi.org/10.17221/151/2020-AGRICECON
Viaggi, D., Bartolini, F., Raggi, M., Sardonini, L., Sammeth, F. and Gomez y Paloma, S. (2011): Farm investment behaviour under the CAP reform process. Publications Office of the European Union, Luxembourg.
Wager, S. and Athey, S. (2018): Estimation and inference of heterogeneous treatment effects using random forests. Journal of the American Statistical Association, **113** (523), 1228–1242. https://doi.org/10.1080/01621459.2017.1319839
Wang, Y., Wang, J., Wang, X. and Li, Q. (2021): Does policy cognition affect livestock farmers' investment in manure recycling facilities? Evidence from China. Science of the Total Environment, **795**, 148836. https://doi.org/10.1016/j.scitotenv.2021.148836
Yilmaz, H. and Nilgun, A. T. A. (2016): Assessing the impact of dairy policies on the socio-economic and technological characterization of Turkish dairy industry. AgroLife Scientific Journal, **5** (1), 214–222.
Zhu, X. and Milán Demeter, R. (2012): Technical efficiency and productivity differentials owf dairy farms in three EU countries: the role of CAP subsidies. Agricultural Economics Review, **13** (389-2016-23490): 66–92. https://doi.org/10.22004/ag.econ.253496

Annex

Table A1: Direct and investment support to dairy farming, 2013-2018.

Category of support	Cattle	Small ruminants
Direct Payment	2010-2019: **Support for unit of raw milk delivered at processing plants** 2008-2009,2014,2016-2018: **Payment for head of dairy cows**	2018-2019: **Support for unit of raw milk delivered at processing plants**
Investments in farm	2015-2017: Support up to 50% for building or reconstruction of stables and feed soring premisses	2018: Support for improvement of conditions for dwelling of small ruminants at 80% of the total value of tax invoices

Source: Adopted by FAO (2020)