



# The impact assessment of the EU pre-accession funds on agriculture and food companies: The Croatian case

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## Abstract

**Aim of study:** This paper evaluates the effect of pre-accession EU grants on beneficiaries in the agri-food sector using a quasi-experimental approach on the case of Croatia. An insight into the available literature reveals a lack of rigorous research and evaluation of the results of using these funds in Croatia as well as in other beneficiary countries.

**Area of study:** Republic of Croatia, Europe (2006–2017).

**Material and methods:** Two datasets were used: (1) financial and structural data on the population of Croatian enterprises for the 2003–2017 period, and (2) data on SAPARD and IPARD grants in the 2007–2016 period. Data were analyzed using counterfactual impact analysis, *i.e.*, a combination of difference-in-difference approach and propensity score matching.

**Main results:** The grants showed to have a positive effect on firm survival, as well as positive effects on obtaining bank loans and increasing turnover, value added, employment, and total factor productivity. Heterogeneous treatment effects show that the grants resulted in the greatest additionality for micro-sized firms located in Central Croatia. Cost-benefit analysis estimates an increase in the value added, which outweighs scheme-induced costs by 120% in the short run and 90% in the mid run.

**Research highlights:** Pre-accession programs in Croatia had a positive impact on the beneficiaries' growth and business performance indicators in both short and mid term. This paper also promotes the application of similar research in other EU candidate countries where the same or similar funds are implemented.

**Additional key words:** public grants; policy evaluation; SAPARD; IPARD

**Abbreviations used:** ATET (average treatment effect on the treated); CEE (Central and Eastern European); DID (difference-in-difference approach); EU (European Union); FINA (Croatian Financial Agency); HRK (Croatian currency, kuna); IPARD (Instrument for Pre-Accession Assistance–Rural Development); PSM (propensity score matching); SAPARD (Special Pre-Accession Programme for Agriculture and Rural Development); TFP (total factor productivity).

**Authors' contributions:** Conceived the research: MK. Collected and codified the data: MK and BŠ. Analyzed the data: BŠ. Drafted the manuscript: MK, BŠ and JJ. Critically revised the manuscript: JJ. Coordinated and directed research: BŠ and JJ.

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## Introduction

The European Union (EU) countries have a long-term practice of monitoring and evaluating the performance of agricultural policies and programs. During the accession phase, EU candidate countries are entitled to pre-accession EU funds with the purpose of adopting the monitoring and evaluation practice of the implementation of publicly funded programs.

In Croatia, the use of pre-accession funds started in 2006 with the Special Pre-Accession Programme

for Agriculture and Rural Development (SAPARD, 2005–2006), and ended in 2014 with the Instrument for Pre-Accession Assistance – Rural Development (IPARD, 2007–2014) (Table S1 [suppl.]). Objectives of the pre-accession programs were to support the implementation of the *acquis communautaire* regarding to the EU Common Agricultural Policy, as well as to help restructuring and a smooth integration of the agricultural sector into the EU. However, the lack of experience, capacities, and expertise of the national institutions, has led to the implementation difficulties that have

resulted in poor absorption (Ministry of Agriculture, 2011; KPMG Croatia, 2017).

There are certain peculiarities in the Croatian case in relation to other EU members from Central and Eastern Europe (CEE). Firstly, Croatia is the only candidate country that used both SAPARD and IPARD programs. Secondly, during the implementation period, Croatia was hit by a long-term economic crisis (2009–2015). Unlike other CEE economies, it took Croatia six years to bounce back to the growth paths. Public grants that are the focus of this research were introduced just at the onset of this crisis and were running throughout the recession period. Thus, firms in our dataset had to operate in the hostile economic climate for several years before and/or after the grant receipt. The proportion of agriculture gross value added declined from its peak in 2008 (4%) with the onset of the financial crisis, to 3.1% in 2016. Juračak & Vukalović (2013) found that the impact of the crisis on agricultural enterprises in Croatia was greater than the impact on the overall economy. Thirdly, in the early 1990s, Croatian agricultural policy was marginalized due to the Homeland War (1991–1995) and the transition process. The first major step towards a modern national agricultural policy came in 1995 with the Development Strategy for Agriculture (Tanić, 1995). Legislation was being developed gradually, and with the first Act on Agriculture (Official Gazette, 2001) Croatia stepped towards the EU assistance programs.

Existing ex-post evaluations of SAPARD and IPARD programs in Croatia (Ministry of Agriculture, 2011; KPMG Croatia, 2017) offer only *implementation evaluations* based on simple comparison of achieved and targeted values of selected indicators. Actual, rigorous *impact evaluation* of SAPARD and IPARD public grants on individual firm survival and performance in Croatia has not been done.

In this study, the subsequent analysis focuses on the recipients of SAPARD and IPARD grants in the 2007–2016 period that are subject to corporate income tax (profit tax). In total, 157 SAPARD and IPARD grants were awarded with the total amount of received support of 64.9 million EUR (481.2 million HRK), with the average amount of 0.4 million EUR (3.1 million HRK) per project (Table S2 [suppl.]).

We measured and elaborated the impact of SAPARD and IPARD grants on firm survival, output growth, employment growth, capital growth, productivity growth, and indebtedness. We postulate that business development grants may act in both a direct and an indirect way. For example, in McKenzie (2017), administered grants were substantial enough to have a direct impact by enabling capital purchase and immediate hiring. On the other hand, other studies have shown that administered grants can be too small to produce any direct effect but may nonetheless impact firm survival and performance indirectly via

certification effect (Srhoj *et al.*, 2021) or via behavioral additionality (Srhoj *et al.*, 2019). In our case, the observed grants are sufficiently large (on average 0.4 million EUR, *i.e.*, 3.1 million HRK) to directly impact firms' output in the short and midterm.

This research uses firm-level data and is based on a quasi-experimental research approach. It builds on our previous study (Kukoč *et al.*, 2019), based on descriptive analysis, which found that SAPARD and IPARD grants did not have a significant impact on firm survival and firm performance during the recession. In the present study, we utilize counterfactual impact analysis, *i.e.*, a combination of difference-in-difference (DID) approach and propensity score matching (PSM), to investigate policy impact on firm survival and performance. The results of the current analysis show a positive premium of obtaining the grants on firm survival in the short run, and on output and performance additionality in the mid run.

The main objective of this paper is to assess the impact of EU pre-accession grants on survival and performance of beneficiary firms in Croatia. By doing so, we also contribute to the studies and methods of public funds impact evaluation in four main respects. Firstly, we analyze a type of programs that have been largely neglected by the literature, *i.e.*, pre-accession grants targeted exclusively at the agri-food sector. Next, we employ a rich dataset with a universe of firms, which is used to select a counterfactual that is as close as possible to the treated firms. Thirdly, our dataset allows for grant impact evaluation both in the short and the mid run after receiving a grant. Finally, our paper contributes to the literature with an analysis of grants impact on agri-food firms in the conditions of a long recession period.

In addition, we consider this research as an important contribution to the successful adoption of impact evaluation methods of agricultural pre-accession programs in present-day EU candidate countries. In the first place, we are referring to countries which, like Croatia, originated in the former Yugoslavia. We presume they have a similar, inherited, administrative infrastructure, meaning that Croatian experience, including this research, can be applied relatively successfully in these countries.

## Material and methods

### Related literature review

Agricultural sector subsidies and their impact on firm productivity have received growing attention in the literature (Esposti & Sotte, 2013; Kline & Moretti, 2014; Dvouléty & Blažkova, 2019). Arguments in support of such policies often emphasize that the agricultural sector gives rise to positive externalities and spillovers through its multifunctionality, and that market failures in this

sector validate government interventions in lagging regions (Nilsson, 2017). A review of the available literature suggests that the impact of pre-accession funds for agriculture and rural development on the performance of Croatian firms has not been sufficiently investigated, while in most EU member states assessing the impact of public grants is common practice.

Utilizing counterfactual analysis, Mezera & Špička (2013) investigated the impact of investment aid on the processing industry in the Czech Republic and found a positive impact on beneficiaries' financial stability, productivity, and added value, but also a smaller negative impact on their profitability. Similarly, Rättinger *et al.* (2013) analyzed the effect of Czech Rural Development Program 2007–2013 on business performance indicators and identified a positive effect on gross value added, productivity, and indebtedness, and a negative effect on the firm's profit. Pagliarino *et al.* (2014) investigated the impact of the Rural Development Program in the Italian region of Piedmont for the 2005–2012 period on the economic performance of agri-food companies. They determined a positive impact on the average number of employees, value added per employee, and value of assets per employee. Dantler *et al.* (2010) analyzed the impact of Rural Development Program grants in the dairy sector in Austria and found a positive impact on annual income, employment, and gross value added per farm. Using propensity score matching, Läßle & Hennessy (2015) evaluated the effects of a dairy farm extension program operated in Ireland and concluded that farmers who joined before the incentive significantly improved their farm performance, as measured in gross margins and yields, while farmers who joined after the incentive did not significantly benefit from the extension program. Hlavsa *et al.* (2017) evaluated the investment activities of agricultural holdings located in Czech Republic in the period 2011–2015 and concluded that supported farms have higher levels of economic performance and higher labor productivity than unsubsidized farms. Using coarsened exact matching, Nilsson (2017) studied the effects of investment support from the common agricultural policy on labor and total factor productivity of agricultural firms in Sweden, and finds positive treatment effect, albeit only for small firms. More recently, Dvouletý & Blažková (2019) also used counterfactual analysis to analyze the effect of EU public policy on the Czech food processing industry. Their results suggest a positive effect on the performance of supported firms measured by the price-cost margin, value added per labor cost, growth of sales, and growth of tangible assets.

Impact evaluation methods other than counterfactual have also been used, although to a lesser extent. Garcia-Alvarez-Coque *et al.* (2015) tested the influence of internal firm characteristics and of external local system characteristics on the willingness to participate in R&D

activities, on agri-food businesses in Valencia, Spain. Results showed that R&D activities are enhanced in medium and large firms, co-ops, experienced firms, and better physical access to technological centers. Kirchweiger *et al.* (2015) combined matching method with the DID to estimate the impact of supported farm-investment activities on the economic performance of the Austrian farm holdings, and detected an increase in production, land renting and capital borrowing. Bartova & Hornakova (2016) used data envelopment analysis and conditional DID method to evaluate the effects of farm investment support provided under the Rural Development Program in Slovakia over 2007–2013. They found that productivity of both beneficiaries and non-beneficiaries slightly decreased over time. The non-beneficiaries were more technically efficient on average, while beneficiaries who specialized on crop production significantly improved their performance. Špička *et al.* (2017) used a fixed-effect panel data model to investigate effects of EU aid on the meat industry in the Czech Republic. They found a significant impact on increasing productivity in large enterprises, concluding, *inter alia*, that national aid models have a significantly greater impact on business performance than EU aid. Naglova (2018) utilized fixed effects panel data model to estimate the effects of Rural Development Program 2007–2013 subsidies on meat industry in Czech Republic and showed that subsidized firms did not display an increase in performance, although there was a positive impact on the number of employees and the value of fixed assets. Špička (2018) used a combination of propensity score matching, average treatment effect on treated, DID approach and pooled regression with time lags to evaluate the impacts of investment support from the Rural Development Programme on selected key economic indicators for 412 Czech food and beverage firms during 2007–2015. Results show that investment support increases investment activity, the size of supported firm, and that it changes the capital structure of participants towards higher use of bank loans and positively affects long-term profitability.

Focusing now on the scarce studies assessing the impact of SAPARD programs, using before-and-after design, Bryla (2005) identified positive effects on the number of employees, labor productivity, and production value of entities in the Polish food-processing industry. Michalek (2012) assessed the impact of SAPARD programs in Slovakia using conditional DID method and found negative grant impact. In the control group, faster profit growth, higher total profit, and higher profit per hectare of utilized agricultural area were observed in comparison to the beneficiaries' group, while the beneficiaries recorded higher levels of employment only. Similarly, Hapenciuca *et al.* (2014), who analyzed the effect of SAPARD on local tourism in Romania, found no significant effect of using the program on the local economy.

There are a number of studies that assess the impact of IPARD development programs at the macro level, using qualitative methods and indicators such as the number of beneficiaries, socioeconomic characteristics of beneficiaries, and technological characteristics of beneficiaries (Serefoglu & Atsan, 2012; Bezhani, 2015). Some studies consider the program as a whole, while others look at their impact only on individual industries. Using a modeling approach on the example of an apple orchard in Croatia and again without causal analysis, Georgievski & Grgić (2013) estimated that IPARD grants should significantly affect profitability. Yardimci *et al.* (2018) investigated the impact of IPARD support on dairy enterprises in Afyonkarahisar, Turkey, and found a positive premium on production quality, hygiene, and quantity in dairy enterprises.

Actual, rigorous evaluation of SAPARD and IPARD public grants on individual firm survival and performance in Croatia is practically non-existent. Božanić (2018) compared performance indicators and financial stability of fish processing companies in Croatia before and after using IPARD support. Using a naive approach (“before and after”), she found no significant differences between the values before and after using the support for most financial performance indicators, except for financial stability indicators.

Finally, Dvouletý *et al.* (2021) reviewed studies investigating the effects of public grants on firm performance in the EU’s 28 member countries, published from 2000 onwards, covering 30 studies across 13 countries. Three of these studies have focused on Croatia, where they explored effects of public grants for small young firms, public grants for women entrepreneurs and public grants to strengthening business competitiveness of small businesses. Their findings showed mostly positive outcomes of the grants on firm-survival, employment, tangible assets, and turnover, with mixed findings for labor productivity and total factor productivity.

## Data

Two datasets were used: (1) financial reports data of Croatian enterprises for the 2003–2017 period, obtained from Croatian Financial Agency (FINA), and (2) data on SAPARD and IPARD grants in the 2007–2016 period, obtained from the Ministry of Agriculture. The former dataset includes balance sheet and profit and loss statement data covering more than 300 variables for the universe of Croatian trade companies, as well as firm characteristics such as region, size, and industry sector. The Ministry da-

taset includes the name of the grant recipient, the amount of grant given, and the year the grant was paid out.

We started with a dataset in which there were 201,345 firms, 131 of which obtained the analyzed grants. From the dataset, we selected only firms that were eligible for grants, *i.e.*, firms that (1) were not owned by the government or foreigners, (2) had no unpaid debts to the government in the year before the grant, and (3) were engaged in agriculture and food production (NACE rev. 2 divisions A01, C10, and C11). Of the 131 firms that received grants, we excluded firms that received grants more than once because we would not have been able to disentangle the effect of each grant on that firm. In the end, we had 114 grant-awarded firms (treated) and 3,153 potential control firms (3,267 firms in total). In percentage terms, 3.5% of the firms in our final sample received a SAPARD or IPARD grant, leaving the remaining 96.5% as potential control firms. Our analysis included 72.6% of all grant recipients with a total amount of EUR 47.6 million (HRK 354.2 million) and an average amount of EUR 0.4 million (HRK 3.1 million) per grant (Table S2 [suppl.]). Table S3 [suppl.] also shows the distribution of grants by company size, sector, region, and trade orientation.

## Method applied

Our initial methodological approach combined PSM with a DID approach<sup>1</sup>. Propensity score, defined as the conditional probability of receiving treatment given pre-treatment characteristics, was estimated using a standard probit model<sup>2</sup>. Analysis was then restricted only to common support area, thus considering only firms in the intersection of the range of the propensity scores for treated and control firms. Finally, within this common support area, treated and control firms were matched using combination of exact matching and nearest neighbor matching (without replacement). Once the matches were made, we compared the period before the treated firms received the subsidy (one year prior to treatment) and period up to five years after obtaining the subsidy. By concentrating on a five-year window following the treatment, our analysis identified both the short- and the mid-term effect of the analyzed programs. Average treatment effect on the treated (ATET) was then calculated as an average difference in performance of the treated firms between the periods after and before the implementation of the program, and at the same time, also as a difference between the treated and control groups.

To check the robustness of our initial findings, we conducted three robustness checks: (1) a placebo test, (2)

<sup>1</sup> For further details on this approach see Srhoj *et al.* (2019, 2021).

<sup>2</sup> For further details on estimating propensity score using probit model see Becker & Ichino (2002).

sensitivity analysis using different matching methods, and (3) Rosenbaum bounds test. Placebo test was conducted on a dataset of 3,153 potential firms, where we assigned a *placebo* (“fake”)-*treatment* to a random group of 114 firms and repeated the matching procedure on remaining 3,039 *non-placebo-treated* firms. If the observed ATETs were due to the grants, this *placebo-treatment* should have no effect on firm performance. To avoid relying on calculated standard errors (Abadie & Imbens, 2008) or on the normality distribution assumption of the ATETs, we repeated this procedure 10,000 times to obtain *empirical distribution* of the ATET estimates. For second robustness check we used three different types of matching methods: (i) we matched each treated firm with not just one control firm, but with 2, 3 and 4 different nearest neighbors; (ii) we matched each treated firm with not just one control firm, but with 2, 3 and 4 different nearest neighbors, further adding an extra condition that all these 2, 3 and 4 nearest neighbors must be within caliper (in terms of their propensity score – our matching metric) defined as 10% of standard deviation of estimated propensity score; and finally (iii) we matched each treated firm with not just 1, 2, 3 and 4, but with all control firms (radius matching) within caliper (in terms of their propensity score – our matching metric) defined as 10% of standard deviation of estimated propensity score<sup>3</sup>. Finally, as matching methods can suffer from hidden bias (caused by unobservables that simultaneously affect assignment to treatment and the outcome variable), our final robustness check involved Rosenbaum bounds test<sup>4</sup>, which is increasingly used for sensitivity analyses in the literature.

Finally, we performed a cost-benefit analysis, where we present common “back-of-the-envelope” calculation (Czarnitzki & Lopes-Bento, 2013) of the real monetary effects of the grant scheme.

## Variables used in the analysis

As covariates used to calculate propensity score (Table 1), we selected relevant variables from the public call schemes as well as firm characteristics and performance indicators. Some covariates are quite standard (firm age, region, size, total factor and labor productivity) while others require further explanation. Intuition behind including average wages, capital and cash reserves is that financially stronger firms may either not be interested in applying for the grants, or if they do apply, they may “make more out of it” than financially weaker firms. Justification for inclusion of debt ratio and liabilities towards banks is to approximate firms’ financial constraints, as financially more vulnerable firms

may be more inclined to seek public aid (Stucki, 2013). Debt ratio is also included in quadratic form, as firms with more debt might be more motivated to apply for a grant, while those with too large a debt ratio may be rejected per public call rules. We additionally included a full set of firms’ trade orientation dummies as exporting firms were found to be more productive (Costa *et al.*, 2017) and to have specific entrepreneurial skills and human capital (Brambilla *et al.*, 2012), thus affecting both receiving a grant and the potential outcomes.

Outcome variables were categorized in seven groups (Table 2): firm survival, output growth, labor inputs growth, capital inputs growth, intermediate inputs growth, productivity growth, and debt growth. These basic indicators were chosen for several reasons: (1) these were indicators targeted by the grant programs themselves; (2) FINA dataset allowed calculation of all these performance indicators; and finally (3) all these are quite standard in similar recent policy evaluations (Srhoj *et al.*, 2019, 2021). The only exception to the latter reason is Z-score, which we further elaborated. Altman Z-score (Altman, 2013) was used for the assessment of financial (in)stability of the firms included in this research. It is based on a combination of individual business performance indicators calculated from annual financial reports. The Altman Z-score is calculated with the following formula:

$$Z - score = 0.717 X_1 + 0.847 X_2 + 3.107 X_3 + 0.420 X_4 + 0.998 X_5, \quad (1)$$

where  $X_1$  is ratio of working capital and total assets,  $X_2$  is ratio of retained earnings and total assets,  $X_3$  is ratio of earnings before interest and tax and total assets,  $X_4$  is ratio of market value of equity and total liabilities (book values), and  $X_5$  is ratio of sales and total assets. A score below 1.23 means it is likely the company is headed for bankruptcy, while companies with scores above 2.9 are not likely to go bankrupt. The values between these ranges represent the so-called “grey zone” (Zenzerović & Peruško, 2006).

## Results

### Descriptive statistics and matching procedure

Descriptive statistics of performance indicators by firm characteristics in pre-funds period (2003-2006) are presented in Table S4 [suppl.]. In terms of regional distribution, most of firms are situated in eastern part of Croatia, which is predominantly more agrarian

<sup>3</sup> For further details on these different types of matching methods, please see Caliendo & Kopeinig (2008).

<sup>4</sup> For further details on Rosenbaum’s bounds approach, please see Annex [suppl] or Rosenbaum (2002).

**Table 1.** Covariates used for calculation of propensity score

Variable	Description
<i>Treatment variable</i>	
Grant	1 if the firm received any grant scheme funding, 0 otherwise
<i>Firm characteristics</i>	
Age	Age of the firm
Age squared	Squared age of the firm
Ownership	Ownership of the firm: 1, state; 2, private; 3, mixed
NACE 2-digit sector	1, crop and animal production, hunting and related service activities; 10, manufacture of food products; 11, manufacture of beverages
Region of the firm	Region of the firm <sup>[a]</sup> classified as: 1, Zagreb region; 2, Western Croatia; 3, Eastern Croatia; 4, Central Croatia; 5, Southern Croatia
Firm size	Size of the firm: 1, micro; 2, small; 3, medium; 4, large
Trade orientation	Trade orientation of the firm: 1, exporter only; 2, importer only; 3, exporter and importer; 4, domestic market only
<i>Firm performance characteristics</i> <sup>[b]</sup>	
Labor	$\ln(1 + \text{number of employees})$ <sup>[c]</sup>
Average wage	$\ln(1 + \text{real average wage})$
Capital	$\ln(1 + \text{real tangible fixed assets})$
Cash reserves	$\ln(1 + \text{real cash reserves})$
Debt ratio	real total assets / real total liabilities
Debt ratio squared	squared (real total assets / real total liabilities)
Liabilities banks	$\ln(1 + \text{real liabilities towards banks})$
Turnover	$\ln(1 + \text{real turnover})$
Value added	$\ln(1 + \text{real value added})$
Labor productivity	$\ln((1 + \text{real turnover}) / (1 + \text{number of employees}))$
Total factor productivity <sup>[d]</sup>	$\ln(\text{total factor productivity})$
<i>Year</i>	
Year	Dummy for each year in our sample

<sup>[a]</sup> Regions were defined based on the 21 Croatian counties. Details are available on request. <sup>[b]</sup> All monetary variables were deflated using AMECO implicit price deflators with base in 2010. <sup>[c]</sup> The purpose of this transformation is to make variables in our analysis as “normal” as possible (making them follow the normal distribution, “bell” curve) so that the statistical analysis results become more valid. In other words, the log transformation reduces or removes the skewness in original data. Since natural logarithm function is a monotonic transformation, it also preserves ordinal property of original dataset. Transformation  $1 + [var]$  is used simply to reduce the loss of available data, given that  $\ln(0)$  is undefined. So, instead of transforming variables using simply  $\ln[var]$  and losing all observations with zeros as variables values, we use transformation  $\ln(1 + [var])$  which then yields  $\ln(1 + 0) = 0$ . This transformation is also quite standard in similar research (e.g. Srhoj *et al.*, 2019, 2021). <sup>[d]</sup> Total factor productivity (TFP) was estimated using Wooldridge (2009) methodology based on the production function approach using value added as output, labor and capital as inputs, and intermediate inputs to control for unobservables. As technologies used in the production process differ across different industries, TFP was estimated separately for each NACE Rev. 2 two-digit industry.

compared to other regions. However, firms in this region showed the lowest values of total assets, turnover and value added. Central Croatia is the region with highest employment figures in three analyzed industries although average wages seem to be highest in western Croatia. In terms of firm size, majority of them were micro- and small-sized. Most firms are focused only on the domestic market, although there has been a slight increase in firms that are both exporters and importers. Firms that participate in international trade have, on ave-

rage, more assets and sales, employ more people, and pay those employees more money.

Descriptive statistics before and after matching are presented in Table S5 [suppl.]. The average firm in our sample was 9 years old (on the market) (9.0 control firms and 8.5 treated firms), located in Eastern Croatia (46% of control firms and 32% of treated firms), micro-sized (77% of control firms and 49% of treated firms), from the agricultural sector (84% of control firms and 73% of treated firms), and mainly focused on the domestic market (71% of control

**Table 2.** Outcome variables used in the analysis

Variable	Description
<i>Firm survival</i>	
Active on the market	Dummy if firm is still on the market in year $t + q$ , $q \in \{1, \dots, 5\}$
<i>Output growth</i>	
In total assets	Real total assets growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{total assets}_{t+q}) - \ln(\text{total assets}_{t-1})$
In sales (turnover)	Real turnover growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{sales}_{t+q}) - \ln(\text{sales}_{t-1})$
In value added	Real value added growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{value added}_{t+q}) - \ln(\text{value added}_{t-1})$
In profit/loss	Real profit/loss growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{profit/loss}_{t+q}) - \ln(\text{profit/loss}_{t-1})$
<i>Labor inputs growth</i>	
In employees	Number of employees' growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{employees}_{t+q}) - \ln(\text{employees}_{t-1})$
In real average wage	Real total liabilities towards banks growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{liabilities}_{t+q}) - \ln(\text{liabilities}_{t-1})$
<i>Capital inputs growth</i>	
In capital	Real capital growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{capital}_{t+q}) - \ln(\text{capital}_{t-1})$
In bank loans	Real total liabilities towards banks growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{liabilities}_{t+q}) - \ln(\text{liabilities}_{t-1})$
<i>Intermediate inputs growth</i>	
In intermediate input costs	Real intermediate inputs growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{intermediate costs}_{t+q}) - \ln(\text{intermediate costs}_{t-1})$
<i>Productivity growth</i>	
In total factor productivity	Real total factor productivity growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{TFP}_{t+q}) - \ln(\text{TFP}_{t-1})$
In labor productivity	Real labor productivity growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{labor productivity}_{t+q}) - \ln(\text{labor productivity}_{t-1})$
<i>Debt growth</i>	
In debt ratio	Debt ratio growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{debt ratio}_{t+q}) - \ln(\text{debt ratio}_{t-1})$
In Z-score	Z-score growth from $t - 1$ to $t + q$ , $q \in \{1, \dots, 5\}$ , $\ln(\text{Z-score}_{t+q}) - \ln(\text{Z-score}_{t-1})$

firms and 50% of treated firms). Treated firms were on average outperforming their potential controls in performance variables, most notably in the value of capital.

We calculated propensity score using a probit model with a dependent dummy variable indicating whether the firm  $i$  received the grant in time  $t$ , and with all independent covariates (Table 1) from the pre-treatment period  $t-1$ . The estimated model (Table S6 [suppl.]) was found to be statistically significant and the pseudo  $R^2$  shows that the model was able to explain 30.9% variance in the dependent variable.

Control group to all treated observations is then found using this propensity score. We combined exact matching

and nearest neighbor matching. Since our analysis spans over the 2007–2016 period, during which the economic climate in Croatia changed dramatically due to the recession in the period 2008–2015, we wanted to make sure to pair beneficiaries to those non-beneficiaries in very similar economic conditions. For this reason, treated and control observations were exactly matched on year of receiving treatment, region of the firm, and NACE 2-digit sector; and then within each of these combinations of groups we used propensity score to find the nearest neighbor for each treated observation. After matching we found no significant differences in means of all covariates and a significant reduction in standardized bias (Table S5

[suppl.]), implying that both samples were now comparable, and that balancing property was satisfied.

### Average treatment effect on the treated

The ATET estimations are presented in Table 3, encompassing both firms' survival and performance outcomes. The results indicate a positive grant premium on the firm survival rate in one year after receiving the treatment. Grants also induced a positive output additionality in assets, turnover, and value added in both the short and the midterm after receiving the grant. Firms' profit was significantly higher for grant recipients only in the short term (in the first year after the grant was obtained). The treatment also recorded a positive significant effect on employment throughout the analyzed period, even though effects on average wage were not significant. Regarding capital inputs, grants induced positive capital input additionality throughout the analyzed period, while growth rates in bank loans for treated firms were higher starting with the fourth year after undergoing treatment. Intermediate inputs

showed growth effects in both the short and the midterm. Regarding productivity, grants yielded additionality in TFP and labor productivity in both the short and the midterm. Debt analysis revealed that treated firms managed to reduce their debt ratio in the first year following grant receipt, but this effect vanished in the midterm. Treatment effect in Z-score was not shown to be significant.

These findings are corroborated using different robustness tests. Empirical distributions of statistically significant ATETs from original findings for 10,000 replications of placebo test are presented in Fig. S1 [suppl.]. In each histogram green dashed lines divide the top and bottom 10% of the distribution. On the other hand, red line (marking our initial ATET estimates) mostly falls within these 10% tails of distribution, indicating only a small probability that estimated ATETs occur by chance, and are instead attributable to the grants. Next, sensitivity analysis utilizing different matching methods (Table S7 [suppl.]) also confirm the robustness of the main results, as does the Rosenbaum bounds test (Table S8 [suppl.]), indicating that most of our significant effects are robust for up to 20% of hidden bias.

**Table 3.** Treatment effects of SAPARD and IPARD grants on firm performance

Outcome variables	ATET (SE) <sup>[a]</sup>				
	<i>t</i> + 1	<i>t</i> + 2	<i>t</i> + 3	<i>t</i> + 4	<i>t</i> + 5
<i>Firm survival</i>					
Active on the market	0.044** (0.019)	0.061 (0.057)	0.035 (0.066)	0.026 (0.066)	0.001 (0.056)
<i>Output growth</i>					
In total assets	0.157*** (0.061)	0.152** (0.074)	0.160* (0.103)	0.147 (0.136)	0.179 (0.231)
In sales (turnover)	1.379*** (0.447)	1.635*** (0.533)	1.981*** (0.696)	1.536** (0.724)	1.195** (0.685)
In value added	0.780** (0.341)	0.815** (0.424)	1.381*** (0.529)	1.180** (0.626)	1.176*** (0.419)
In profit	0.651*** (0.262)	0.101 (0.284)	0.357 (0.481)	-0.398 (0.417)	0.571 (0.508)
<i>Labor inputs growth</i>					
In employees	0.282*** (0.081)	0.383*** (0.118)	0.502*** (0.155)	0.440*** (0.187)	0.412 (0.332)
In average wage	0.024 (0.089)	-0.114 (0.120)	-0.123 (0.140)	-0.111 (0.168)	-0.323* (0.213)
<i>Capital inputs growth</i>					
In capital	0.535*** (0.199)	0.454** (0.219)	0.513** (0.29)	0.520* (0.380)	0.587 (0.707)
In bank loans	-0.144 (0.442)	-0.326 (0.659)	-0.325 (0.782)	1.270* (0.903)	2.440** (1.442)
<i>Intermediate inputs growth</i>					
In intermediate input costs	0.960*** (0.242)	0.734*** (0.238)	0.811*** (0.299)	0.794** (0.376)	0.767* (0.529)
<i>Productivity growth</i>					
In total factor productivity	1.503*** (0.447)	1.845*** (0.564)	1.945*** (0.682)	1.701** (0.836)	0.657 (0.811)
In total factor productivity	1.503*** (0.447)	1.845*** (0.564)	1.945*** (0.682)	1.701** (0.836)	0.657 (0.811)
<i>Debt growth</i>					
In debt ratio	-0.101** (0.047)	-0.028 (0.053)	0.004 (0.076)	0.159* (0.101)	0.153 (0.170)
In Z-score	-0.087 (0.131)	-0.092 (0.163)	0.024 (0.152)	-0.174 (0.172)	-0.036 (0.173)

<sup>[a]</sup> "*t*" denotes the year the firm received the grant. Standard errors (SE) are presented in brackets below estimated ATETs and are based on Abadie & Imbens (2008). \*  $p < 0.1$ ; \*\*  $p < 0.05$ ; \*\*\*  $p < 0.01$ , one-sided  $p$ -values.

We additionally estimated heterogeneous ATET using different firm characteristics: size, region, and trade orientation (Tables S9 and S10 [suppl.]). In terms of survival on the market, all the significant effects in the first year after obtaining the grant come from micro- and small-sized firms from the Central Croatia region, focused exclusively on the domestic market. In terms of firm size, the most significant and greatest effects were observed in micro-sized firms, particularly in survival on the market (only first year after obtaining the grant) and in output additionality. For the latter, compared to their large competitors, micro-sized firms recorded up to ten times greater growth rates in sales or value added, with significant increases in number of employees and obtained capital. They also managed to increase their TFP in the short and midterm, as well as to reduce their indebtedness. Moving on to results based on regional distribution of beneficiaries, the allocated grants seem to be the most effective in the Central Croatia region, which is somewhat surprising, given that traditionally the eastern parts of Croatia are more reliant on agriculture. Firms situated in Central Croatia showed the greatest grant additionality in turnover, value added, and intermediate inputs. Also, these firms managed to boost their labor productivity and their TFP in the short and mid run, and to reduce their indebtedness in the short run. On the other hand, firms in Western Croatia managed to acquire more capital and recorded a significant increase in total assets. In terms of firms' trade orientation, there does not seem to be a clear pattern in which one group outperforms the other. Firms concentrating solely on the domestic market showed greater survival effects (only in the first year after treatment) and greater increase in turnover and capital. On the other hand, firms that are both exporters and importers managed to increase their value added, employ additional workers, increase their average wage, and boost their labor productivity and TFP.

## Cost-benefit analysis

Focusing on the cost side, the amount of public funds provided for 157 SAPARD/IPARD grants was 64.9 million EUR (2007–2016 period, Table S2 [suppl.]). Switching over to benefits side, awarded grants are associated with average increase in turnover of 0.9 million EUR, 1.3 million EUR and 0.8 million EUR per firm at times  $t+1$ ,  $t+3$ , and  $t+5$ , respectively (Table 4). In terms of total turnover increase (multiplying average values with total number of awarded grants) this amounts to 140.7 million EUR, 202.1 million EUR, and 121.8 million EUR at times  $t+1$ ,  $t+3$ , and  $t+5$ , respectively. This implies that the estimated benefits of the grant schemes (in terms of extra turnover) outweigh the grant scheme costs by 2.2, 3.1, and 1.9 times in the short and midterm after the grants were distributed. We can thus speculate that the grants had the greatest effect in the midterm, three years after they were distributed.

## Discussion

Our results suggest that analyzed grants had different impacts with respect to the period considered, the type of performance indicator, and the group of companies. Overall, positive output additionality in all five years after treatment was found for turnover, value added, and total assets. The beneficiaries of the grants also saw higher growth in employment, TFP, labor productivity, and capital input throughout the five years. The grants affected higher growth in bank loans in a long term ( $t+4$ ,  $t+5$ ), and growth in profits in short term ( $t+1$ ), while decrease in the debt ratio was significant in year  $t+1$ . The treatment did not affect the wage growth and financial stability of the companies. Our results are consistent with those of most other studies examining the impact of investment aids or

**Table 4.** Quantification of treatment effects for the SAPARD/IPARD grant scheme

Outcome variables	$t+1$	$t+2$	$t+3$	$t+4$	$t+5$
Real assets	254,709	246,514	246,514	- <sup>[a]</sup>	-
Real turnover	895,955	1,062,244	1,287,040	997,864	776,012
Real value added	286,569	299,527	507,168	433,350	431,906
Real profit	7,974	-	-	-	-
Number of employees	3	4	6	5	-
Real average wage	-	-	-	-	-
Real capital	614,276	520,880	588,831	597,192	-
Real liabilities towards banks	-	-	-	1,030,955	1,980,383
Real intermediate inputs	698,502	534,017	589,831	577,548	558,179

We estimated the effects for the sample of treated firms in our analysis. All monetary variables are expressed in EUR. 1 EUR ~ 7.42 Croatian kuna (HRK). "t" denotes the year the firm received the grant.

<sup>[a]</sup> We report only significant effects

grants from rural development programs on business operations (Dantler *et al.*, 2010; Pagliarino *et al.*, 2014; Hlavsa *et al.*, 2017). The only difference was found for profit, where other authors found no effect or a negative effect (Mezera & Špička, 2013; Ratering *et al.*, 2013) while we found a positive one. Cost-benefit analysis showed that estimated benefits of the grant schemes outweigh the grant scheme costs in the short and midterm. These benefits are similar to 2.7 times higher value added created by women entrepreneurship policies in Croatia (Srhoj *et al.*, 2019) or by export-oriented policies in Croatia (Srhoj & Walde, 2020). Since the grants also had positive additionality on employment, total social benefits were even higher.

The results obtained largely justify the purpose of the grants, which was the modernization and upgrading of production capacities. Looking at the results by groups of companies, it is interesting that the effect of the grants on survival on the market in year  $t+1$  is concentrated on micro and small enterprises that are focused on the domestic market and located in Central Croatia. Micro-sized enterprises that received grants saw ten times higher growth in sales and value added than large enterprises. For micro-sized enterprises, employment and TFP also increased more, while indebtedness decreased. In terms of regional differences, the grants appear to have had the greatest impact in Central Croatia.

Considering that the results show a much stronger response through the growth of indicators in small enterprises, it is necessary to set rules and criteria in support programs to enable the participation of as many micro and small enterprises as possible. In the current Croatian Rural Development Program, we can see the consequences of criteria set in exactly the opposite way. In the first few calls within the investment measures, small enterprises found it difficult to qualify for an investment grant and the very high amount of the maximum grant per beneficiary (EUR 5 million) led to a drastic decrease in the number of beneficiaries, especially small enterprises.

Despite some circumstances that could lead to opposite conclusions (such as the demanding approval procedure for the grants, relatively modest funding compared to generous national support programs, expensive pre-financing loans, and the unfavorable economic situation), the results of this study suggest that the pre-accession programs in Croatia had a positive impact on the beneficiary's growth and business performance indicators. Given that our analysis captured just under three-quarters of all firms who obtained SAPARD or IPARD funding, we would argue that positive impact of analyzed grants are quite generalizable.

This paper provides an insight into the net impact of pre-accession grants in Croatia, and thus promotes the application of similar research in other EU candidate countries where the same or similar funds are implemented. The study also demonstrates the applicability of the

selected methods in the circumstances of available data at the national level. In addition, we suggest the same approach to be applied for EU programs available to Croatia as an EU member state.

Our research adds a novelty to previous SAPARD/IPARD evaluation papers in several ways. Firstly, our research uses rich firm-level dataset from population of Croatian enterprises, which enabled us to expand the number of analyzed performance indicators, and to analyze grant effect according to different firm characteristics (region, size, sector, export orientation) as suggested by Dvouletý *et al.* (2021). Furthermore, dimensionality of our dataset enabled us to select a counterfactual that is as close as possible to the treated firms, increasing the robustness of our results. Secondly, we have also added a temporal analysis of these grant effects in terms of short- and mid-term effects, as our dataset enables us to follow firms up to 2017. Next, our study is based on quasi-experimental research approach by utilizing counterfactual impact analysis, *i.e.*, a combination of DID approach and PSM, to investigate policy impact on firm survival and performance, which has numerous advantages over simple “before-and-after” analysis. Fourthly, our paper presents a novelty to the policy evaluation literature on agri-food firms as our analysis is performed in specific conditions of a long recession period. Finally, this research can be viewed as an important contribution to the successful adoption of impact evaluation methods of agricultural pre-accession programs in present-day EU candidate countries.

Based on the experience in data collection and obtained results, we developed several recommendations for policy makers regarding the impact analysis of support programs in agriculture and rural development. Firstly, it is necessary to insist on the use of counterfactual analysis as part of the evaluation process of publicly funded development programs to obtain an accurate impact assessment of the program itself and not just an overall assessment of its implementation process. Our second recommendation aims at the need to strengthen existing and/or develop new systems to collect the necessary data on all enterprises, as only in this way can a quasi-experimental approach be applied to the whole population of potential beneficiaries. Consideration should be given to introducing an obligation to provide the business data needed to analyze the impact of the aid scheme. This is particularly important for users who do not have business reporting obligations. Our third recommendation, given the observed differences in the intensity of the program's impact on beneficiaries from different groups (*e.g.*, by size and geographical area), is that rules and criteria for granting aid should be designed to maximize their impact across these heterogeneous groups of firms. Based on these policy recommendations, this research may be of interest to the research community, particularly in neighboring countries, which

have financial databases of enterprises like Croatia, as to how these databases can be used for counterfactual analyses of the impact of public support programs.

Finally, there are a few limitations to our study, some of which can be addressed in further research. First one is related to the possibility that an essential unobserved covariate was not included in the analysis. Therefore, future research should look for new enterprise characteristics, which could be related to organizational and human resources as well, and which may play an important role, especially in small enterprises. Another standard limitation is that we did not conduct a general equilibrium analysis, but an average treatment effect analysis only. There might be spillovers to other firms (*e.g.*, consultancies or suppliers of equipment), the unintended deadweight effects, or interactions with other policies. The quality of the research could also be raised by including the number of points per application during the tender, as rejected applicants could represent an additional control group. Finally, this study includes enterprises that issue financial statements, *i.e.*, are subject to profit tax, meaning that family farms and similar enterprises, which make up by far the largest number of farmers in Croatia, are not included. Consequently, similar research at a comprehensive level requires finding alternative sources of information about assets, production, sales, and business performance. At the end, despite the superiority of counterfactual analysis in quantitative terms, the overall evaluation of the implementation and/or impact of the support program on society and the economy needs to incorporate other, *i.e.*, qualitative methods to provide an answer to the question of why the identified effects occurred.

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