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An Assessment of the Differentiated Effects of the Investment Support to Agricultural Modernisation: the Case of the Czech Republic

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Anotace

I když je podpora investic považovaná za klíčový instrument politiky rozvoje zemědělství, bylo jí dosud věnováno jen málo pozornosti v české ekonomické literatuře. Cílem tohoto článku je posoudit ekonomické dopady opatření 121, Modernizace zemědělských podniků PRV pro období 2007-2013. Výzkum je zaměřen na distribuční aspekty podpor a na diferencované dopady podle výrobních podmínek a velikosti podniků. V článku je použit kontrafaktuální přístup využívající přímé přiřazování s možností ošetření heteroskedasticity. Ilustrujeme signifikantní přínosy investičních podpor na rozsahu podnikání (reprezentované hrubou přidanou hodnotou) a zvyšování produktivity práce. Analyzováním souboru žadatelů u opatření 121 poukazujeme na fakt, že velké farmy dostávají co do rozsahu větší podpory než malé farmy. Rozdělením souboru hodnocených podniků podle přírodních podmínek a velikosti demonstrujeme, že přínosy jsou větší na farmách v horších přírodních podmínkách a na středních farmách jak v absolutním tak relativním vyjádření. Když prozkoumáme změny v bankovní zadluženosti, ukazuje se, že v průměru podpory mobilizují další zdroje pro financování investic. Ovšem, na velkých farmách změna bankovní zadluženosti není statisticky signifikantní v důsledku investičních podpor. To se dá interpretovat jako spíš vysoká mrtvá váha u velkých podniků, zatímco v průměru je mrtvá váha nízká. Následně tvrdíme, že opatření by se společensky zefektivnilo, pokud by se zaměřilo na střední a malé zemědělské podniky.

Klíčová slova

Kontrafaktuální analýza, přímé přiřazování nejbližšího souseda, heteroskedasticita, mrtvá váha, modernizace.

Abstract

Despite being considered as a key instrument of the agricultural development policy, the investment support has received only limited attention in the Czech economic literature. The objective of this paper is to assess economic effects of the measure 121 "Modernisation of Agricultural Holdings" of the RDP 2007-2013 on the Czech farms. A particular focus is on the distribution of the supports and differentiated impacts of the supports according to the production conditions and farm size. The counterfactual approach is adopted, deploying direct matching algorithm with the treatment of hereoscedasticity. We show significant benefits of the investment support in terms of business expansion (represented by Gross value added) and labour productivity improvements. Analysing the sample of applicants for Measure 121 we show that large farms get much larger support than smaller farms. By splitting the sample by natural conditions and by size we demonstrate that benefits are higher on farms in less favoured areas and on medium-size farms in both the absolute and relative terms. Investigating the changes in bank indebtedness we yield an indication that on average the support mobilised additional resources to finance the sector investment. However, there is no statistically significant increase of bank indebtedness on large farms due to investment support. In turn, it can be interpreted that deadweight is rather high on large farms, while on average the deadweight of the investment support programme is rather low. Thus, the programme can improve its social efficiency if it is targeted to small and medium size farms.

Key words

Counterfactual analysis, direct nearest neighbour matching, heteroscedasticity, deadweight, modernisation.

Introduction

As we pointed out in our earlier paper (Medonos et al., 2012) encouraging investment activities has always been considered as a principal vehicle for enhancing competitiveness of the Czech agriculture. In spite of their adherence to the investment support instrument, politicians as well as other stakeholders paid only little attention to the investment support programmes evaluation before the EU accession. Also the national scientific literature is rather scarce on agricultural investment in the Czech Republic in general. Medonos (2007) analysed investment behaviour of farms in the effort to assess barriers in farms' access to the financial sources. Řezbová and Škubna (2010) looked at factors affecting investment in farm machinery in the period before and shortly after the EU accession (1999-2008) paying an attention to the national and EU investment support programmes. Žídková et al. (2011) and Rosochatecká et al. (2008) concentrated on the dynamics of the sector gross fixed capital formation suggesting that increasing investment activity is likely associated with farmers' expectations of benefits from the accession and full adoption of the Common Agricultural Policy (CAP).

The need for a more rigorous assessment arrived with the EU rural development programmes. This is particularly justifiable, if we consider that the investment support to the modernization of Czech agriculture accounts about 9.4% of the total budget of the current Rural Development Programme (2007-2013), i.e. approximately € 329.4 million i. e. CZK 8,235.0 million (MoA, 2012). The respective evaluation follows the Commission's Common Evaluation a Monitoring Framework (EC, 2006), however, this is methodologically weak pursuing simple comparison of result indicators (as production or GVA[1]) between supported and non-supported groups. Thus the evaluation omits the fact that farm's GVA is affected by a number of other internal and external factors and that the investment measures are targeted to or exploited by only some groups of producers/regions (Henning and Michalek, 2008). In the Czech context, evaluation studies (e. g. DHV CR and Tima, 2010) applied the comparative analysis of supported and non-supported farms but without the counterfactual approach. Medonos et al., (2012) adopted a rigorous counterfactual approach (see also Khandker et al., 2010; Abadie and Imbens (2006)). Medonos et al. (2012) showed using the propensity score matching approach on a sample of about 800 farming companies that there were benefits of the investment support measures in terms of improved GVA and labour productivity. However, when extending the sample to about 1,300 observations the heterogeneity of farms increased and we faced a serious problem of heteroscedasticity[2]. To deal with it we adopted an alternative matching approach suggested by Abadie and Imbens (2002).

The general objective of the paper is to confirm significant economic benefits of the measure 121 "Modernisation of Agricultural Holdings" of the Rural Development Programme (RDP) 2007-2013 on the extended sample of Czech farms. The specific objective is to choose appropriate methods which will separate as much as possible the effect of Measure 121 from other factors influencing investment and production behaviour of farmers. A particular attention is paid to the issues of equity (i.e. distribution of the supports in respect to farm size), differentiated impacts of the supports according to the production conditions and deadweight.

The paper is structured as follows: in the next section, we briefly review some recent literature concerning differentiated effects among farm groups and deadweight. It is followed by the methodological part including a brief description of data. The core part of the paper consists of empirical results presented in the fourth part. The investigation is summarised in the concluding paragraph.

Some inspiring literature

In spite of increasing emphasis on the counterfactual evaluation of policies, there are not many publications in outstanding agricultural economics journals on this topic. Actually, most of the relevant works are published at conferences and seminar. Some literature we already listed in Medonos et al. (2012). Here, we mention two most recent conference papers which are closely related to our research efforts.

Kirchweger and Kantelhardt (2012) separated from the Austrian sample of farms two subsets: dairy farms and granivore farms. They showed that

[1] Gross Value Added

[2] This issue is discussed in Pufahl and Weiss (2009).

the farm investment supports perform differently in these two sub-samples: insignificant effects among dairy farms and significant effects in the sector of granivore farms. We also acknowledge differences of production systems splitting the samples by natural conditions and by size. As it will be apparent from the analysis of recipients, we expect that the effects of the support will be less pronounced in the subsample of very large farms.

Michalek et al. (2013) attempted to estimate the deadweight effect of the support by investigating the changes in total assets due to the participation in the support programme. They found that there is no significant average effect of participation on total assets suggesting that there is strong deadweight loss of the investment support policy among the dairy farms in Schleswig-Holstein. Because total assets is used as a structural variable determining similarity of farms we have decided for changes of bank credits (indebtedness) as an alternative indicator of the dead weight. Significant increase of indebtedness is regarded as a mobilisation of additional resources for financing modernisation of agricultural holdings, while insignificant changes or negative changes will indicate high deadweight.

Materials and methods

Since it is principally impossible to observe on the same farm the effects of participation and non-participation in the measure, one has to choose or to construct a control farm with "identical" characteristics from the pool of non-participating producers. The standard framework in evaluation analysis to formalise the above problem provides Roy-Rubin-model (Caliendo and Kopeinig, 2008). In this model, the parameter which has received the most attention of scholars is the Average Treatment Effect on Treated (ATT); it is defined

$$\tau_{ATT} = E[\tau \mid D = 1] = E[Y(1) \mid D = 1] - E[Y(0) \mid D = 1] \quad (1)$$

where $\tau = Y(1)-Y(0)$, $Y(D)$ is a result variable, D equals 1 if the unit got an investment support (treatment) and 0 otherwise. The sample ATT (SATT) takes the form of

$$\tau_{SATT} = \frac{1}{N_1} \sum_{i \in participip} \left[Y_i^T(1) - Y_i^C(O) \right], \quad (2)$$

where the upper indices T and C indicate participating and control farms respectively. Matching estimators are based on imputing a value on the counterfactual outcome for each unit. Abbadie and Imbens (2002), propose direct matching which is based on metric $||x|| = (x'Vx)^{1/2}$, where x is a vector of structural variables and V is a positive semidefinite matrix. This metric is used to determine the nearest similar unit(s). Let M denotes the number of nearest control units to the treated unit i. We define the distance $d_M(i)$, which follows

$$\sum_{D_j=1-D_i} I\left(\left\|X_j - X_i\right\| < d_M(i)\right) < M \text{ and}$$
$$\sum_{D_j=1-D_i} I\left(\left\|X_j - X_i\right\| \leq d_M(i)\right) \geq M \quad (3)$$

Where $I()$ is an indicator function which is equal to one if the expression in brackets is true and zero otherwise. Let $J_M(i)$ denotes a set of indices of the control units which are as close as the M^{th} control unit and $card(J_M(i))$ is a number of the elements of $J_M(i)$. We define

$$K_M(i) = \sum_{j=1}^{N} I(i \in J_M(j)) \frac{1}{card(J_M(j))} \quad (4)$$

Obviously, the sum of $K_M(i)$ over all observations is equal N (i.e. to the number of all observations), over participating units to N_0 (i.e. to the number of controls) and over non-participating units to N_1. Now, we can construct a simple estimator

$$Y_i^C(0) = \begin{cases} Y_i(0), \ when \ D_i = 0 \\ \frac{1}{card(J_M(i))} \sum_{j \in J_M(i)} Y_j, \ when \ D_i = 1 \end{cases} \quad (5)$$

Equation (5) means that a counterfactual is an average of the nearest control units. Putting (5) in (4) we yield a sample average treatment effect on treated (SATT)

$$\tau_{SATT} = \frac{1}{N_1} \sum_{i=1}^{N} [D_i - (1 - D_i) K_M(i)] Y_i \quad (6)$$

In the same manner, we can derive estimators of the average treatment effect on controls (ATC, SATC) and the overall average treatment effect (ATE, SATE). The latter constructs the counterfactual matches to both – the participants and non-participants in the programme.

The simple estimator (3) will be biased in the finite set if the matching is not exact. Abbadie and Imbens (2002) propose a bias-corrected matching estimator (i.e. adjusting the difference within the matches

for the differences in their covariate values) by using regression estimates of Y as a linear function of the considered structural variables (covariates); for SATT in the control group ($\hat{\mu}_0(x)$), for SATC in the sub-sample of participants ($\hat{\mu}_1(x)$) and for SATE using the both regressions. The adjusted estimator of the effect over controls is now

$$\tilde{Y}_i^C(0) = \begin{cases} Y_i(0), \ when \ D_i = 0 \\ \frac{1}{card(J_M(I))} \sum_{j \in J_M(i)} \left(Y_j + \hat{\mu}_0(X_i) - \hat{\mu}_0(X_j) \right), \ when \ D_i = 1 \end{cases} \quad (7)$$

The adjusted SATT

$$\tilde{\tau}_{SATT} = \frac{1}{N_1} \sum_{i \in particip} \left(Y_i - \tilde{Y}_i^C(0) \right) \quad (8)$$

Similarly, SATC and SATE are constructed.

With the new sample of Albertina (CreditInfo) in which the number of observations (farms) doubled, the problem of heteroscedasticity occurred. The heteroscedasticity affected the variance of the estimates and the significance of the results of the counterfactual analysis. It called for dealing with heteroscedasticity. First, we removed outliers, but the principal treatment rest in an improved estimation method. For SATT (as defined in (4)) the variance is given by

$$V_{SATT} = \frac{1}{N_1^2} \sum_{i=1}^{N} ([D_i - (1 - D_i) K_M(i)])^2 \sigma_{D_i}^2(X_i) \quad (9)$$

where $\sigma_D^2(X)$ represents the conditional of the performance indicator Y in respect to the vector of its covariates. If there is no heteroscedasticity, then

$$\sigma_1^2 = \frac{1}{2N_1} \sum_{i \in particip} \left[\frac{1}{card(J_M(i))} \sum_{j \in J_M(i)} \left(Y_i - Y_j - \tau_{SATT} \right)^2 \right] \quad (10)$$

In the same way one can express it also for SATC a SATE.

If the variance $\sigma_D^2(X)$ is unstable, we need to estimate it for each unit in the sample. It can be done by further matching. Define $d'_M(i)$ as a distance to the M^{th} unit with the same indication of the treatment (participation).

$$\sum_{D_j = 1 - D_i, i \neq j} I\left(\|X_j - X_i\| < d'_M(i) \right) < M \text{ and}$$
$$\sum_{D_j = 1 - D_i, i \neq j} I\left(\|X_j - X_i\| \leq d'_M(i) \right) \geq M$$

Similarly, we construct $J'_M(i)$ as a set of the indices of the first M nearest neighbours to unit i. The conditional variance is estimated as a sample variance of this set extended of the unit i:

$$\sigma_1^2(X_i) = \frac{1}{card(J'_M(i))} \sum_{j \in J'_M(i) \cup \{i\}} \left(Y_j - \bar{Y}_{J'_M(i) \cup \{i\}} \right)^2 (11)$$

where

$$\bar{Y}_{J'_M(i) \cup \{i\}} = \frac{1}{card(J'_M(i)) + 1} \sum_{j \in J'_M(i) \cup \{i\}} Y_j \quad (12)$$

is an average of the performance indicator in the set $J'_M(i) \cup \{i\}$.

This approach is implemented in STATA as the nnmatch procedure (Abadie et al., 2004).

If selected neighbours exhibit more or less identical values of the performance indicators as the participant at the time of launching the investment support programme we can compare directly the values of the performance indicators at the time horizon t. The *ATT* will refer to the distance between the solid and dashed lines at the point t in Figure 1. However, often there is a considerable difference between the values of the performance indicators of the participants and counterfactuals. In this case, we compare changes over the time period t instead of the final figures. This approach is called "difference in difference" and the respective effect is marked as *ATT(d-i-d)* in Figure 1.

The advantage of using d-i-d estimators is demonstrated and discussed in Smith and Todd (2005). In addition we are introducing two relative indicators of the effects

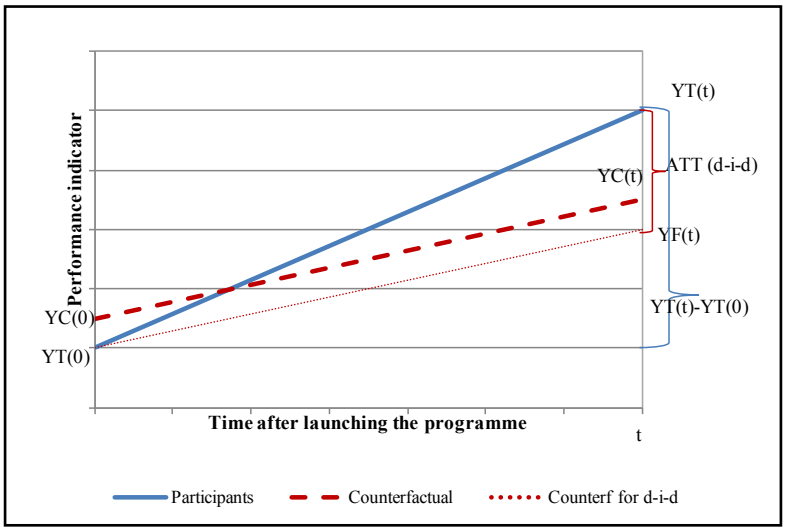
$$relATT_{fin} = \frac{ATT\_(d-i-d)}{Y^T(t)},$$

$$relATT_{change} = \frac{ATT\_(d-i-d)}{Y^T(t) - Y^T(0)}$$

The former referring to the share of the *ATT* on the final value (Y^T) and the latter referring to the share of *ATT* on the change of the performance indicator over the time t (see Figure 1).

We used several sources of data on farm characteristics and performance: Albertina (Creditinfo) database, Land Parcel Identification System (LPIS), data on agricultural supports published by the State Agricultural Intervention Fund[3] (SZIF) and

[3] which is the Paying Agency for CAP in the Czech Republic.



Note: YT – performance of the treated (i.e. participants), *YC* – performance of the counterfactual, *ATT(d-i-d)* - average treatment effect on treated in the difference-in-difference mode
Source: own chart based on Khandker et al. (2010)

Figure 1: Support chart for relative effects.

provided by Ministry of Agriculture. The Albertina data set is the main source, it is a database built on annual reports of companies which are obliged to publish their economic and book keeping figures. Since the Albertina database includes only financial indicators, we linked information on the utilised agricultural area (UAA) and on type of land use from LPIS. Similarly, the information on the investment supports was linked from the database of SZIF provided by Ministry of Agriculture.

There were 1,274 agricultural businesses in the Albertina database which provided all economic figures for all four years of the period 2007-2010. A slightly more than a third of them (447) were awarded an investment support from the Czech RDP (measure 121).

In order to investigate differences in investment support impacts we have divided the sample in several sub samples by size (measured by total assets) and by production conditions and orientation (given by the share of grasslands, e.g. grasslands >20%, <20%, <10% etc.).

The characteristics of the applicants of Measure 121

From the sectoral point of view, most of the support was directed in the livestock production; in terms of project numbers it was 57% and in terms of funds 72% in the period 2007-2012. This bias against the livestock sector results directly from the policy preferences (Medonos et al., 2012).

There are also differences among applicants/ project holders of the measure 121 in terms of size measured in hectares of UAA or by the value of the total assets. As showed in Table 1, the farms applied for 2 projects on average in the period 2007-2012, small farms (up to 100 ha of UAA) applied for one or two projects (on average 1.5) while large farms over 1,500 hectares applied often for 3 and more projects, the absolute extreme are 13 farms over 5,000 hectares which applied for 11 projects on average in the period 2007-2012.

In contrast to their activity, very large farms (over 3,000 hectares) are notably less successful in getting their project approved than the rest of the farms applying for the support in Measure 121; the success rates of the categories "3,000-5,000 ha" and ">5,000 ha" are 80% and 71% respectively, while the national average is 85%. But these relative figures are a bit misleading, because in absolute terms the large farms get more projects and more support (the very large farms 3 and 8 projects respectively).

The overlap between the sample of applicants for the Measure 121 from SZIF and the Albertina

Category by UAA	Number of farms	Number of Applications	Applications per farm	of the total applications			The share of approved projects
				Approved	of it Completed	Rejected	
<20 ha	287	445	1.6	378	182	67	85%
20 - 50 ha	262	357	1.4	318	131	39	89%
50 - 100 ha	270	419	1.6	358	155	61	85%
100 - 250 ha	321	590	1.8	504	186	86	85%
250 - 500 ha	244	484	2.0	421	158	63	87%
500 - 1000 ha	332	667	2.0	572	204	95	86%
1000 - 1500 ha	270	647	2.4	546	175	101	84%
1500 - 2000 ha	155	472	3.0	401	132	71	85%
2000 - 3000 ha	175	530	3.0	440	137	90	83%
3000 - 5000 ha	72	287	4.0	229	91	58	80%
> 5000 ha	13	147	11.3	105	33	42	71%
Total	2,401	5,045	2.I	4,272	1,584	773	85%

Source: own calculation, processed on the basis of data provided by Managing body of RDP (MoA)

Table 1: The distribution of applications by the farm size categories.

sample accounts for 837[4]. We split the resulting sample in ten size categories by the average value of total assets over the period 2008-2010. Using total assets instead of the area helps us to avoid bringing among small farms capital intensive enterprises which do not cultivate land such as pig fattening or poultry production. It is important to keep in mind that farms from Albertina sample are only legal entities and thus large farms representing just about 5% of farms, nevertheless cultivating almost 34.7% of the total UAA according to LPIS for 2010. Thus "small" in the following analyses has to be understood in this context.

It is evident from Figure 2 that the size of the project increases with the size of the farm[5]. The investment projects of farms of the largest category (10) are on average 10 times bigger than the investment projects of farms in the smallest category (1). The lower rate of the co-financing (Figure 2) affects the final disproportion between the investment supports from the RDP funds only marginally. Thus farms from category (1), i. e. the smallest farms, got on average an investment support of CZK 3.6 million (EUR 142 thousand) while the very large farms (category 10) got 9.4 times more (i. e. CZK 33 million, EUR 1.3 million).

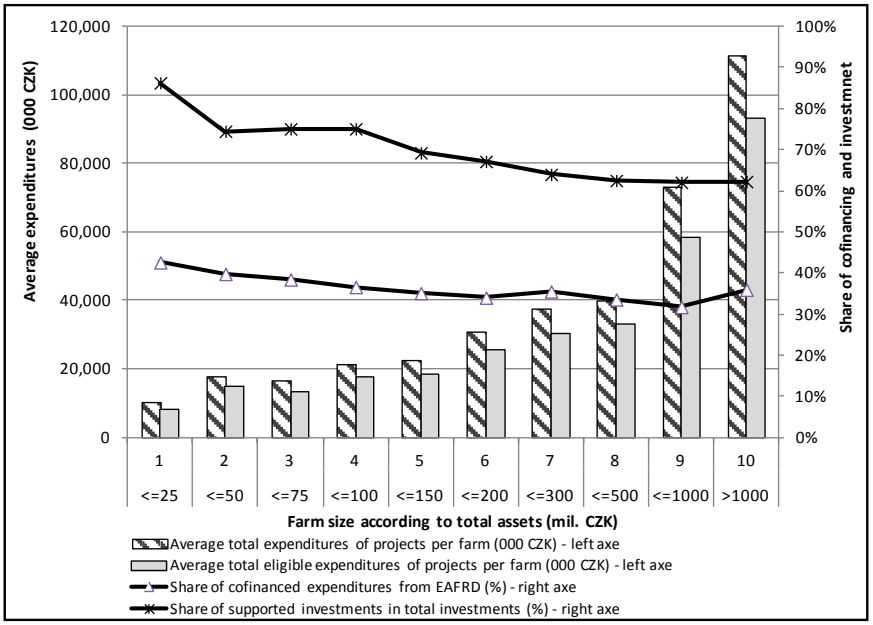
The importance of supports of Measure 121 declines with the scale of farming. The average share of Measure 121 supported projects on the total investment is 85% in Category (1) while it is only 63% in the three largest categories (with the total assets over CZK 500 millions, EUR 20 millions)

Bringing the above observations together we can conclude that there is serious indication that the current system supports those who are needed less than those who are well.

One of the policy relevant questions is if more supports generate more benefits. In Figure 3 we depicted efficiency (measured by the ratio GVA/Revenue) and labour productivity (the ratio GVA/Labour costs). Note that the chart includes only farms which received investment support in the period 2007-2010. The efficiency and labour productivity evidently increases with the level of supported investment. However, as we pointed out earlier, the size and the number of projects increases with farm size, thus the share of supported investment on total investment increases with farm size. Therefore, it is not clear if the higher efficiency and productivity is a result of the higher investment support or due to the economy of scale.

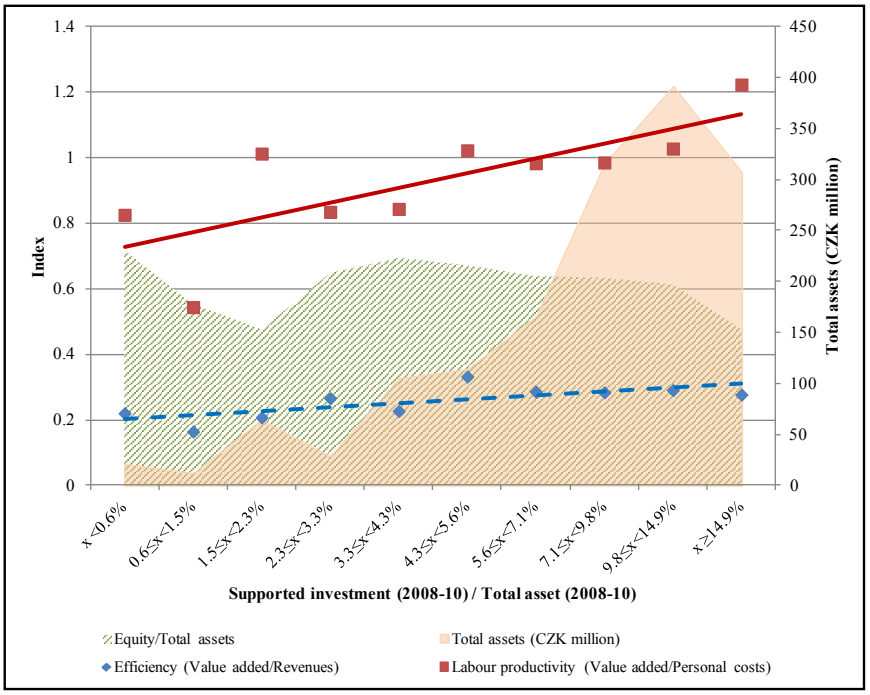
[4] 2,685 projects were authorised for Measure 121till 30th July of the 2012 for total number of 1,536 applicants with total value of investment expenditures CZK 15,103 million and total volume of subsidies CZK 6,198 million. Our sample thus represents 55% of all supported farms, 56% of all projects, 87% of total volume of investment expenditures and 77% volume of investment support.

[5] The relationship is rather linear, the exponential shape is given by the non-linear axis x/no-linear categories.



Source: own calculation based on Albertina and SZIF samples

Figure 2: Characteristics of recipients of the investment support (Measure 121) by size categories.



Source: own calculation based on Albertina and SZIF samples

Figure 3: Efficiency and productivity in relationship to the level of the support.

Results and discussion

There are significant differences between participating and non-participating farms in the Albertina sample. The average utilised agricultural area of participating farms is substantially greater (1,800 ha) than the one of non-participants (1,135 ha) and

a similar difference is in terms of total assets (the participating farms: CZK 134 million, the controls: CZK 68 million). The participating farms are on average not only substantially larger but also more capital intensive than non-participating ones[6]. In contrast, the groups do not differ statistically in terms of the share of grasslands (24.4% for the participating farms and 23.6% for the control group) and investment activity (the averages of the investment/total assets ratio are 0.134 and 0.151 respectively).

For selecting the nearest neighbours we used 7 structural variables (Table 2) regarded as likely determinants of farm participation in the modernisation programme (most of them were used in the propensity score matching in Medonos et al., 2012). The total assets and sales represent size of the business; the share of grasslands indicates if a farm is in the less favoured area, and the rest are variables referring to financial sources for investment.

We chose 6 performance variables (GVA, GVA/labour cost, profit, bank indebtedness, cost/revenue ratio and investment intensity) on which we measured results of the investment support programme. The first four were used also in the difference-in-differences form.

With exception of profit in the difference in differences form, all variables exhibit a significant effect of the investment support to modernisation (Table 3). Note that the sector crisis was deepest

[6] The indicator total assets per hectare is however affected by the presence of intensive pig and poultry farms having no or little land. Thus if we take the whole sample we yield a large difference between group averages (CZK 634 thousands), but insignificant due to the even larger variance. If we eliminate the intensive pig and poultry farms we yield a smaller but significant difference between the groups of participating and non-participating farms (the group averages of CZK 70 thousands and CZK 53 thousands respectively).

Year 2007	Unit	Number		Mean		T stat.	P	Signif.
Indicators		particip.	controls	particip.	controls			
Total assets	CZK million	447	827	134,909	68,195	11.079	0.000	***
UAA in LPIS	ha	447	827	1,800	1,135	10.257	0.000	***
The share of grasslands	%	447	827	24%	24%	0.486	0.627	
Cash flow	CZK million	447	827	16,272	8,390	10.592	0.000	***
Revenue	CZK million	447	827	75,337	41,477	8.887	0.000	***
Cash flow/Labour costs		447	827	0.940	1.996	-3.261	0.001	***
Indebtedness		447	827	0.428	0.523	-6.778	0.000	***

Source: own calculation, Albertina sample

Table 2: Description statistics of structural variable.

	Particip.	Controls	ATT	st. error	T	P	Signif
GVA	20,251	16,436	3,815	686	5.558	0.000	***
Productivity (GVA/Labour cost)	0.874	0.651	0.223	0.057	3.949	0.000	***
Profit	4,229	2,731	1,498	478	3.131	0.002	***
Bank credits	0.162	0.122	0.039	0.008	4.871	0.000	***
Investment in fixed assets	45,888	29,647	16,240	2,120	7.660	0.000	***
Cost Revenue ratio	0.948	0.962	-0.014	0.005	-2.603	0.009	***
Investment / Fixed assets	0.200	0.164	0.036	0.007	5.296	0.000	***
Difference-in-Difference							
GVA	-4,846	-6,801	1,955	668	2.925	0.004	***
Productivity (GVA/Labour cost)	-0.212	-0.368	0.156	0.047	3.333	0.001	***
Profit	-2,985	-3,667	682	497	1.372	0.170	
Bank indebtedness	0.035	0.002	0.033	0.007	4.782	0.000	***

Source: own calculation (nnmatch, Stata 11)

Table 3: Average treatment effect on treated, the whole Albertina sample, 2007-10.

in 2010 and thus the over-time differences (difference in differences) of GVA and productivity are negative. Thus the investment support effect is reflected in a smaller decline of these indicators in the group of beneficiaries that in the control group.

Similarly strong positive effects of the investment support can be found also in the sub-sample of farms with the high share of grasslands (over 20%). The production systems with a significant share of grasslands are likely farms in less favoured areas (LFA) with important cattle, particularly dairy, production. These productions were in the policy focus as pointed out earlier (see also Medonos et al., 2012). Positive effects can also be showed in the sub-sample of arable farms (grasslands below 20%), however, some indicators like profit (in both modes) and GVA in the difference-in-difference mode are not statistically significant.

The significant productivity effects in (d-i-d terms) can be observed in the both size sub-samples; on medium size farms these effects are bigger than on large farms. Also, on medium-size farms one can see the gains in terms of GVA and profit in d-i-d terms while it cannot be found (statistically significant) on the large ones.

Except for large farms, all samples and subsamples exhibit increased bank indebtedness on participating farms in both terms – the final value as well as in the difference in difference mode (Table 4). It can be interpreted as a mobilisation of additional resources (bank credits) to finance modernisation of agriculture. From this point of view, we can judge on the rather low deadweight effect of Measure 121 in medium farms, and in contrast on considerable deadweight in large farms (i. e. with the total assets over CZK 150 million, EUR 6 million).

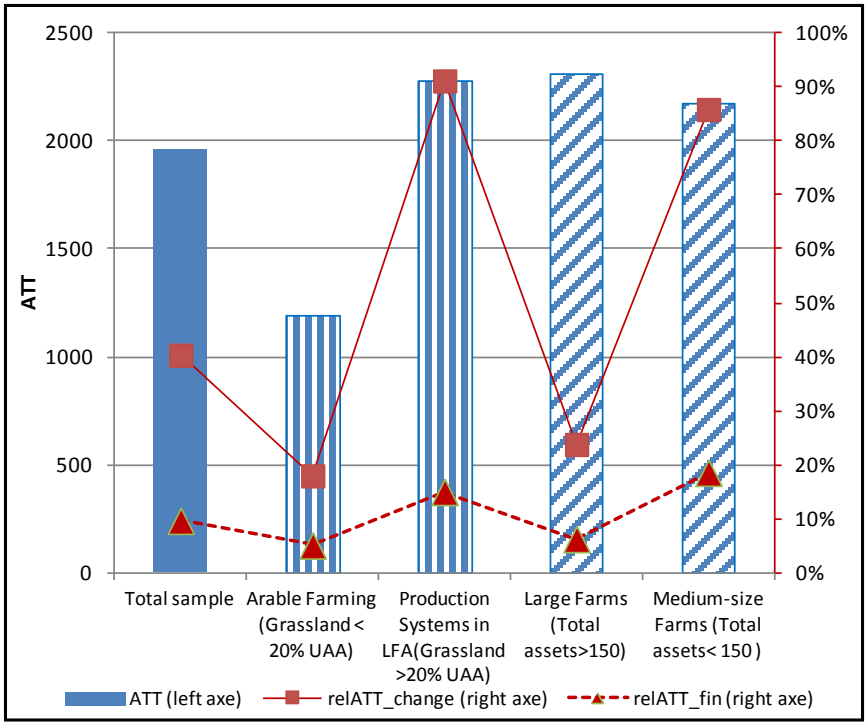
Looking at relative gains from the participation in the modernisation measure (M121, RDP) in Figure 4 we can observe that relative gains from the support are substantially more pronounced in the subsample of farms with the higher share of grasslands and in the subsample of medium-size farms. Actually, the case needs a careful interpretation since the change of the GVA between 2007 and 2010 is negative. Thus, the programme beneficiaries of these two sub-samples reduced almost to half the impacts of the sector crisis (comparing to their counterfactual farms). From the perspective of the final value of GVA, 15 and 19 per cent respectively can be accounted to the support of the measure 121.

In terms of labour productivity, the situation is a bit more complicated. First, only arable farms and large farms exhibit the ratio GVA/Labour costs higher than 1; in turn it means that GVA on farms in LFA and medium farms does not cover (on average) even the cost of labour – these farms would not survive without subsidies. Second, labour productivity

Indicator	Total sample		Arable Farming (Grassland < 20% UAA)		Production Systems in LFA(Grassland >20% UAA)		Large Farms (Total assets>150)		Medium-size Farms (Total assets< 150)	
GVA	3,815	***	3,950	***	4,077	***	6,277	***	2,618	***
Productivity (GVA/Labour cost)	0.22	***	0.16	***	0.32	***	0.11	**	0.24	***
Profit	1,498	***	1,000		1,779	***	2,047	*	1,310	***
Bank indebtedness	0.04	***	0.04	***	0.03	**	0.03	*	0.05	***
Investment in fixed assets	16,240	***	16,253	***	15,721	***	22,601	***	12,593	***
Difference-in-Difference										
GVA	1,955	***	1,191		2,280	***	2,312		2,175	***
Productivity (GVA/Labour cost)	0.16	***	0.14	**	0.16	**	0.11	**	0.16	***
Profit	682		22		945	*	-129		1,083	***
Bank indebtedness	0.03	***	0.03	***	0.03	***	0.01		0.04	***

Source: own calculation (nnmatch, Stata 11)

Table 4: Average treatment effect on treated (ATT) in sub-samples.



Source: own calculation (nnmatch, Stata 11)

Figure 4: The effect of the investment support on GVA; the difference in difference model, 2007-10.

declined on all farms - the most dramatic drop was on medium-size farms of almost 23% in the group of participants and of 43% in the control group. On large farms the decline in labour productivity is much more moderate (15% for participants and 24% for the control group). Third, there are significant gains in productivity in all four sub-samples, the most pronounced are again for farms in LFA and medium size farms in both the absolute (Table 4) and the relative terms (relATTfin(arable) = 13%, relATTfin(LFA) = 27%, relATTfin(large) = 10%, relATTfin(medium-size) = 21%).

Conclusions

On the enlarged sample of farms included in the Albertina database which now covers almost 50% of the national UAA we confirmed significant positive effects of the investment support measure (Modernisation of agricultural holdings (M121) of the Czech RDP. Our pervious analysis (Medonos et al., 2012) was enriched in several respects:

First, we captured some distributional effect. Analysing the sample of applicants for Measure 121 we could show that large farms get more and larger projects, thus, in spite of the lower level of co-financing from public budgets they get much larger support than smaller farms. In contrast the importance of the support for financing investment is much higher on small than on large farms.

Second, by splitting the sample by natural conditions (represented by the share of grasslands) and by size (total assets) we could show differentiated response of farms the support. Gains in terms of GVA and labour productivity are higher on farms in LFA and on medium-size farms (i.e. with the total assets less than CZK 150 million, EUR 6 million) in both the absolute and relative terms. Nevertheless, labour productivity remains tremendously low on farms in LFA (high share of grasslands) and medium-size farms.

Third, investigating the changes in bank indebtedness we yield an indication that on average the support mobilised additional resources to finance the sector investment. It was also showed that there is no statistically significant increase of bank indebtedness on large farms due

to investment support. In turn, it can be interpreted that on average and in the subsample of medium sized farms the deadweight of the investment support programme is rather low and on large farms it is rather high. It definitely complements our results from interviews which were included in Medonos et al. (2012).

The most general conclusion of the presented research is that the investment support measure (Modernisation of agricultural holdings (M121) has positive effects, however that there are serious indications that the measure is biased toward large (even very large) farms where the deadweight is rather high. Thus, the measure can be more socially effective and efficient if it is targeted to medium-size and small farms.

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