The Dynamic Effects of Investment Support of the EU Rural Developent Programme on Czech Farms' Structure and Performance

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Abstract:

The objective of the paper is to assess economic and structural effects of the measure "Modernisation of Agricultural Holdings" of the Rural Development Programme 2007-2013 on the Czech farms. A particular attention is paid to its dynamic and time-differentiated impacts. We use Direct Covariate Matching to address issues of potential selection bias, simultaneity bias or functional form misspecification. Our empirical results show significant short as well as long-term investment support effects, which, however, markedly vary between support periods. This may relate to the rapidly changing overall financial and investment conditions for agriculture. The investment support of the earlier period of 2008-2011 which overlaps with the time of economic crisis is found to have larger and more significant structural and performance effects than later investment support. It resulted in significant ruminant production expansion at the expense of farm cost efficiency, but contributed to a short-term TFP increase. These effects of support vanished in the latter periods characterized by favourable financial conditions. For this period, we find negative effects of investment support on total factor productivity that could indicate loss of additionality of investment support and/or differences in type of investments and their productivity realized by supported and non-supported farms.

Acknowledegment:

JEL Codes: Q12, Q14

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Key words: investment support, Rural Development Programme, productivity, structural change, counterfactual analysis, direct nearest neighbour matching.

1. Introduction

Encouraging investment activities has been considered an important instrument of boosting competitiveness of European agriculture for long time and became the core element of the productivity enhancing strategy of the Common Agricultural Policy (CAP) of the European Union. In the period 2007-2013, investment support was provided under the umbrella of the CAP's Rural Development Programme (RDP). It included a range of measures aimed at modernisation in agriculture and forestry, adding value to agricultural, food and forestry products or diversification in non-agricultural productions like renewable energy or tourism and non-commercial activities. The 2013 CAP reform made the investment support available also in the financial programming period 2014-2020.

The investment support has been a popular measure of the RDP also in the Czech Republic. Czech Republic thus belongs to EU countries with an above-average rate of investment subsidies (per Economic Size Unit) (Svoboda et al. 2016). Farms that participated in the investment support measure "Modernisation of Agricultural Holdings" (M121) during the programming period 2007-2013 cultivate in total about half the agricultural land. The supported investment constituted about one quarter of the Gross Fixed Capital Formation (GFCF); the support itself represented 7.5% of GFCF. The importance of the investment support grew in the time of the economic depression following the financial crisis of 2008. Between 2009 and 2011, the support resources contributed by 12% to GFCF and stimulated about 40% of the investment activity. In terms of the distribution of the supports, most of the support was acquired by large farms with over 1000 ha of agricultural land; two thirds of farms in this category participated in M121 measure. About 60 % of the M121 programme resources were allocated to farms with land in less favoured areas (LFA) (MoA, 2017).

It remains a concern of policy-makers, taxpayers as well as agricultural public, whether these measures aimed at stimulating structural adjustments and technological progress deliver expected productivity, efficiency and competitiveness growth outcomes. Despite the policy and societal relevancy, the number of studies assessing the investment support impact is relatively low. Moreover, the empirical evidence is marked by inconclusive results.[1] This may be given by the case studies diversity as the countries and regions subject to analyses differ significantly in their farm structures or financial and land market conditions. Furthermore, empirical results of existing studies reveal that the effects of investment support on farm economic success tends to depend on farm production orientation, performance indicators and time of surveying the performance indicators, however, no systematic relations between these structural factors and the policy outcomes have been identified so far.

Among some comprehensive investment support impact assessments, Kirchweger and Kantelhardt (2015) show for the case of Austria that government-supported farm investments significantly foster farm growth with regard to both total livestock units and utilized agricultural area; with greater support effects on the former that is less affected by constraints of the land market. These structural effects are shown to display great dynamics as they accumulate over a longer post-investment period and to be farm-type specific. The authors emphasize that these results may be particularly of significance in the Austrian context where farms are relatively small on average and the potential for economies-of-scale effects is high. Kirchweger et al. (2015) found that investment support resulted in an increase in production, land renting and capital borrowing and detected a shift from the non-farm to farm activities, but with no statistically significant impact on the total income. Michalek, Ciaian and Kancs (2016) investigated the effect of investment support policies on investment activities of farms

[1] The history of efforts to evaluate investment supports is well presented in Kirchweger and Kantelhardt (2015).

in northern Germany. Their results provide an evidence of a significant and almost complete crowding-out effect of investment support, which implies that farms use public support to substitute for private investment. Their data do not give any support to an inter-temporal substitution of investments. Medonos et al. (2012) showed some positive investment support outcomes in form of improved farm performance, concretely benefits in terms of improved Gross Value Added (GVA) and labour productivity, but not profit. Ratinger et al. (2013) also identified a positive impact of investment support on capital borrowing which they interpreted as a mobilisation of the external capital in agriculture and argued that the deadweight of the measure is rather low. However, they could not confirm this finding on the sub-sample of large farms leading the authors to draw the conclusion that in the case of large farms the deadweight is high. Forstner and Ebers (2016) also provide evidence of positive productivity implications of investment support, concretely for the case of dairy farms in north-west Germany. Although, the empirical evidence of positive effects of investment support on farm performance based on these studies is still rather sparse, in their recent meta-analysis of the effect of public subsidies on farm technical efficiency found in scholarly papers, Minviel and Latruffe (2017) show that among various categories of subsidies, investment subsidies have the highest likelihood to be found with a positive effect on technical efficiency.

The objective of this paper is to contribute to the current state of investment support assessments with an analysis of the support impact on a greater range of economic indicators than delivered so far. Similarly to Kirchweger and Kantelhardt (2015) the dynamic effects of the support are assessed. The paper further aspires to deliver a more methodologically sound analysis of the policy outcomes than has been done in similar studies. Due to the great farm heterogeneity and methodological issues related to potential selection bias, simultaneity bias or functional form misspecification, the policy impact evaluations increasingly employ techniques of counterfactual analysis based on matching between treated (i.e. supported) and control (not supported) farms. These techniques were also included in and recommended by the guidelines on the evaluation of the RDP 2007-2013) provided by the European Evaluation Network for Rural Development (EC 2014). They were employed with variation in matching approaches also by the discussed studies. As Ratinger et al. (2015) show there are significant differences in the performance of these alternative approaches and based on their comparison of Direct Covariate Matching (DCM) and Propensity Score Matching (PSM) and argue that DCM performs better. They also suggest excluding too distant matched pairs from the analysis using, for example, caliper. Kirchweger and Kantelhardt (2015b) also argue that it is important to consider potential dynamics of the policy effects, because if only the immediate years after the realisation of the supported investments are considered, the effects might be underestimated. We follow these methodological trends, considerations and discussion, and carry out the investment support impact analysis with emphasis on the dynamics and consistency of the effects captured by various indicators.

The paper has a standard structure of an applied study. In the following section, we describe the RDP investment support to Czech farms, including the specifics of the support distribution over time and in the context of farm structure. Section 3 introduces used methods and data, and Section 4 presents empirical results. Section 5 concludes the study with short discussion of the main results and policy implications.

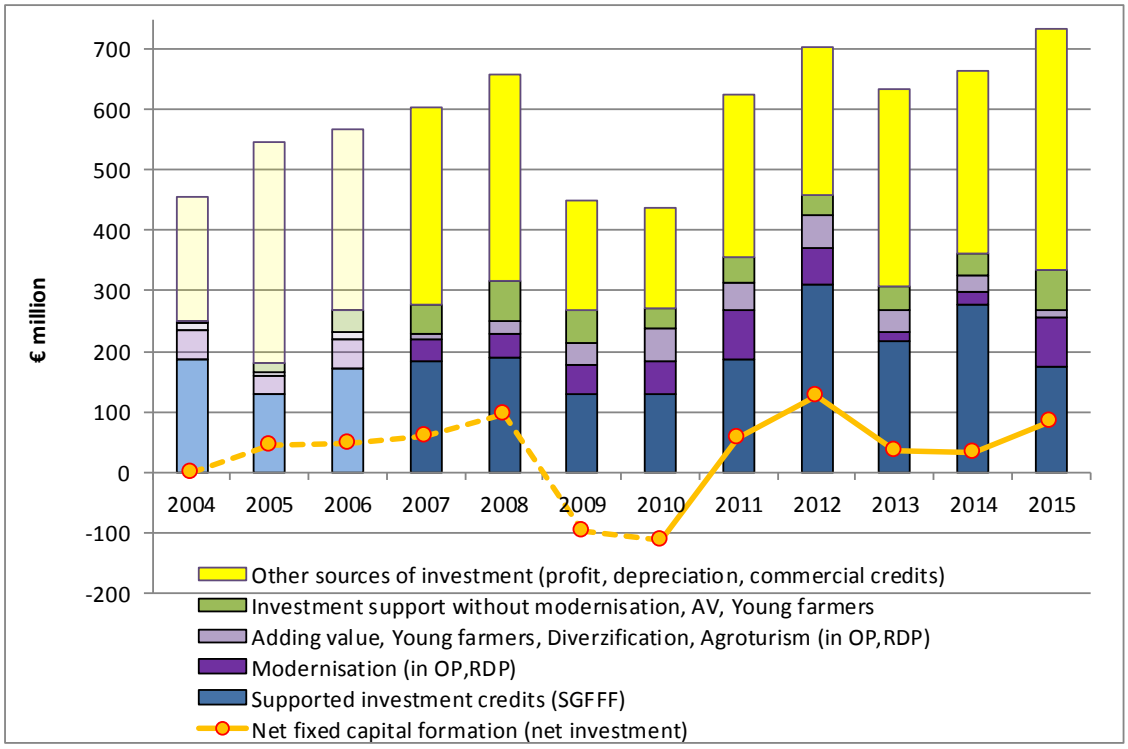
2. The Investment support in the Czech Rural Development Programme

In the period 2007-2013, it was the main tool of Axis 1 of the Rural Development Programme (measures M121, M123, and M124). While measure M121 (Modernisation of agricultural holdings) attracted farmers' interest that its budget had to be increased twice totally by 16% in comparison with the original programming document since 2007 and this

measure with 10% share in total public expenditures of RDP was the largest measure. The other two measures M123 (Adding value to agricultural and forestry products) and M124 (Cooperation for development of new products, processes and technologies in the agriculture and food sector and the forestry sector) were considered as too demanding, and their potential stayed somehow hidden for farmers. Only 31% of application for M123 came from farmers, the rest were food processors. In Axis 3, farms participated in two investment support measures: M311 on Diversification in non-agricultural activities including bioenergy and M313 supporting to touristic facilities.

The development of investments in agriculture and importance of investment support is visible from the next figure.

Figure 1 Development in volume and structure of investment in the Czech agriculture



Source: CZSO, SGFFF, MoA, own calculations

M121 was designed to support the modernisation of farms where there is an inadequate level of investments, in terms of both structures and technologies, in crop as well as animal production. The general economic objective of this investment support was to improve the efficiency of production factors (labour, land and capital). During the programming period 2007-2015, most of the support in terms of the number of projects as well acquired funds went to the livestock sector (75.6% and 76.9%, respectively). According to structure of expenditures in livestock production, nearly two thirds was focused on the technology for animal breeding with positive impact on animal welfare and productivity aspects, next 22% was used on waste management, which is a very important type of investment in terms of positively influencing the environment and the rest 16% for construction or renovation of feed stores. If we spread investment expenditures according to the type of animals, more than quarter expenditures was invested in cattle breeding including suckler-cows, dairy cows with 18%, poultry 15% and pigs with 14% shares.

Investments in plant production formed less than a quarter of the total amount. Farms invested the most money in storage technology (more than 60 per cent of the investment into plant production), which will enable them to increase the quality of stored products and

achieve higher postharvest prices. Investments in machines and equipment for crop production, and supporting establishment of permanent crops (each accounting for 11 per cent of the investment into plant production) were also significant. The share of investment in the technology of biomass processing was negligible within the Modernisation measures (0.2 per cent of the investment spending).

The distribution in favour of the livestock sector was due to direct preferential criteria for livestock investment and LFA, and due to the exclusion of mobile machinery from the eligible investment (with exception in year 2015 when only the mobile machinery was supported). If a project was realised in LFA, then the investment support rate increased by 10 percentage points. In addition, young farmers (below age 40) received additional 10 percentage points to the support rate. Young farmers constituted 29% of recipients of the support of M121. Young farmers participated rather in investment projects for crop production (48% of support volume) than in those for animal production (23%). On the top, farmers could acquire preferential points if they decreased the rate of public co-financing: for each percentage point of lowering the co-financing they got one preferential point (up to 10 preferential points).

Projects in LFA presented 63.6% of total number of projects and acquired 59.7% of the of the M121 funds). Since the projects in LFA areas were on average smaller (by €26 000) their share on total eligible expenditures reached only 55.6%. Thus, projects in the areas outside the designated LFA are bigger, but the support expressed per hectare of UAA is smaller (€174 per hectare) comparing to the projects in LFAs (€233 per hectare).

Another important aspect in providing structural support is the distribution of the support. This section describes the distribution of support by recipient farm size within the completed RDI 2007-13, which we consider to be a more serious issue for policymakers than the consideration of abolishing or maintaining the preference criterion for LFAs. Sixty percent of enterprises received only one project under measure M121, which represented about one third of all projects but only 21% of the budget of the measure. By contrast, enterprises with 3 or more projects accounted for only 19% of beneficiaries, but they drew more than half of the aid (57%). This uneven distribution over the projects caused also uneven distribution support over the farm size.

Table 1 Size structure of recipients receiving support from measure M121 (RDP 2007-13)

Average farm size	Share in all recipients			Share of supported farms in national structure of all farms > 5ha
	No. of farms	Total invest. expenditures	Volume of support	
<=50 ha	19,7	11,8	13,2	3,0
50 ha < 500 ha	31,0	2,1	22,2	10,2
500ha < 1 000 ha	11,6	12,1	12,2	32,1
>1 000 ha	35,2	52,0	48,3	64,4
without agric. land	2,5	4,0	4,1	0,2

Source: IS SZIF 2016, LPIS, own calculations

The largest group of beneficiaries are farms over 1 000 ha. They participated in the group of aid beneficiaries M121 by 35%, representing 64% supported in all farmes in this size category (national structure). Large agricultural farms have received less than half of the aid and have generated more than half of the supported investment. The second largest group was enterprises with 50 to 500 ha of agricultural land (31%), but their category in the national

structure covered only 10%. These farms benefited more than a fifth of the structural support. Small farms up to 50 hectares consisted of about one-fifth of the beneficiaries and 13% of the budget, and the remaining category of farms with 500 – 1 000 hectares of agricultural land represented less than 12% of the beneficiaries.

3. Data and Methods

Abbadie and Imbens (2002), propose direct covariate matching between treated and control groups which is based on Mahalanobis 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). The counterfactual is given as an average of the result variable of the few nearest units. Abadie and Imbens (2002) define further a function $K_M(i)$ which indicate how many times a control unit (farm) i is matched, and showed that the average treatment effect on treated (ATT) estimator as well as its variance depends on this frequency. They therefore propose an approach for correcting estimation bias and heteroscedasticity. This approach is implemented in STATA as the nnmatch procedure (Abadie et al., 2004). We adopted this approach for the similar reasons as pointed out in Kirchweger and Kantelhardt (2015b) since this approach does not require a parametric description of the connections between investment support and outcome variables. In addition, we favour it, because it provides robust estimates of the variance. We followed the recommendation of using 4 matching controls and applied calliper to eliminate distant nearest neighbours. Based on the matched datasets, we apply a non-parametric difference in difference (d-i-d) estimator which allows for controlling unobservable, linear and time-invariant effects (Heckman et al., 1998).

We used several sources of data on farm characteristics and performance: Albertina database containing financial data from the annual reports of public limited liability companies, Land Parcel Information System (LPIS), the livestock statistics and data on agricultural supports published by the State Agricultural Intervention Fund (SZIF[2]). In practice, the Albertina database involving their economic and book keeping figures is enriched of data on land use, livestock, production orientation and farms's participation in RDP measures from the other mentioned sources. The sample we used for the analysis includes 1313 farming companies.

For the purpose of the assessment of the dynamics of the effects we applied investment support window of three years: i.e. participations in the support measure (M121) in the period 2008 to 2010, then 2009 to 2011, and 2010 to 2012. As potential control farms to all groups (windows), we use farms which did not receive any support during the entire period of 2007-2015; this group contains 659 farms. The number of considered participating (treated) farms varies between 84 to 199. Matching is applied for each of those windows separately and refers to a year before the first year of the support window. Effects are evaluated for the last year of the window onwards until 2015.

We investigated 19 performance or result indicators to assess effects of the investment support measures of the RDP 2007 – 2013. These can be divided in three distinctive groups: 1. Economic and Production indicators, 2. Productivity and efficiency indicators and 3. Capital and investment activity indicators (for details see **Table 2**)

Table 2 Performance (result) indicators by assessment target groups

#	*Economic and Production.*	#	*Productivity and efficiency*	#	*Capital and Investment*
1	Revenue	8	GVA/Labour Cost	17	Bank Credits

[2] *Státní zemědělský intervenční fond - the paying agency of the Czech Republic.*

2	GVA	9	Cash Flow (CF)/Labour Cost	18	Long-term Bank Credits
3	Profit	10	Total Factor Productivity (TFP)	19	Investment Activity (IA)
4	Beef Cows (LU)	11	TFP incl. Eco-services (TFPE)		
5	Dairy Cows (LU)	12	(EBIT+Depreciation)/Labour cost		
6	Total Ruminants (LU)	13	Total Costs/Revenue		
7	Livestock Density (LU/UAA)	14	Production Costs/Revenue		
		15	CF/Revenue		
		16	Returns on Assets (ROA)		

Source: own selection and grouping

Note: GVA-Gross Value Added, LU-livestock unit, UAA-Utilised agricultural area, CF-Cash Flow, EBIT-Earnings Before Interest and Tax, ROA-Return on Assets, Investment Activity (IA) = (Tangible assets$_{(t)}$ – Tangible assets$_{(t-1)}$ + Depreciation$_{(t)}$ + Investment support$_{(t)}$) / (Tangible assets$_{(t)}$ + Investment support$_{(t)}$)

We use Thiel-Tornquist Total Factor Productivity index calculated to the average of the 2007 sample for all 1313 farms with panel data in period 2007-2015 in two modes: the standard one (TFP) considering only revenue (production) of market goods and the one including the revenue/production of "public goods" or "ecosystem services" valued at agri-environmental payments (TFPE).

Matching (more accurately DCM) is done using "structural" covariates. These refer to factors identified by the Principal Component Analysis (ref) enriched of some other covariates deemed to be important in the decision on participating or referring to preferential criteria (e.g. production orientation). The 8 factors (from PCM) represent 90% of variability of nearly 50 indicators of production structure and economic performance. The structural covariates include the capacity of the business (Total Revenue and Capital Intensity); the farming conditions (the shares of Mountain Areas and of Other LFA); Livestock Intensity (LU of Ruminants per hectare of UAA); the performance of the business (EBIT, Profit to Sales ratio and Capital Return ratio); and Overall Indebtedness indicating potential financial threat to farm business. Most of them are significant determinants of farms' participation in the investment support measures in various combinations for the considered support periods (windows) according to probit analysis.

Generally, supported legal entities tend to be large. Hence, unsupported farms are on average smaller. It has appeared that there are not enough comparable large units among non-supported farms which can also well match with the other structural indicators. If using all 11 structural covariates, the discrepancy in terms of size (revenue) between supported and control farms was about 20% and statistically significant, while the used ratios and indices of productivity, efficiency and financial stability matched well. Size is rather stable characteristic if the farm (in spite of the fact that price fluctuation affects revenue), while some of the ratios refer rather to the temporal situation of the farm at the time of making decision of participating in the measure (M121). Therefore, we consider also control group determined by matching the size (revenue) and the agri-environmental conditions (the share of mountain and other less favoured areas).

A substantial part of result indicators and structural covariates consists of indices and ratios; for them it is more appropriate to apply multiplicative than additive operations. Therefore, we do matching and ATT assessment on their logarithmic transformations.

4. Main results

In this paragraph we first review the main results and concentrate on several particular issues later in the section. Table 3 shows orientation and significance of the considered effect

indicators (ATT) in the investigated post-investment (support) periods when matching is performed using all eleven structural variables (see Table A-9 in the Appendix). Statistically significant and positive effects concern mainly expansion of livestock production, is some years bank credit indebtedness. There are also a number of significant results concerning performance, however, not only in positive terms. We can see significant positive signs of ATT of cost/revenue ratios, which in turn mean loss of competitiveness due to the support in respect to control farms. This is also reflected in the negative signs of ATT on the cash-flow to revenue ratio. The results greatly vary between the support windows which may indicate differences in the overall financial and investment conditions for agricultural or potential systematic differences between farms participating in support in earlier and later time windows. Also, investment behaviour of farms forming control group, i.e. those not participating in the investment support program, may evolve over time (see Table A-2 in the Appendix), which may change the results of the counterfactual analysis over time.

Table 3 Dynamic effects of investment support on selected structural and performance indicators in individual consequent years after the investment support windows

Support Window	2008-2010						2009-2011					2010-2012				2011-2013		
Year of effect: 2000+	10	11	12	13	14	15	11	12	13	14	15	12	13	14	15	13	14	15
Revenue	-	-	-	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
GVA	+	-	-	+	+	+	+	+	+	+*	+	+	-	+	+	+	+	+
Profit	-	-	-*	-	-	-	-	-	+	+	-	+	+	+*	+	+	+*	+
Beef Cows (LU)	+	+	+	+	+	+	-	-	+	+	+	-	+	+	+	-	+	+
Dairy Cows (LU)	+	+	+	+	+	+	-	-	+	+	+	-*	-*	-*	-	+*	-*	-
Total Rumin (LU)	+	+	+**	+**	+**	+**	+	+**	+**	+**	+**	+	-	-	-	+	-	-
Livestock Density	+	+	+***	+***	+**	+***	-	+**	+**	+**	+***	-	-	-	-	+	-	-
GVA/Lab. Cost	+*	+	+	+	+*	+**	-	-	-	-	+	-	-**	-	-*	-**	-	-*
CF/ Lab. Cost	+	+	+	-	-	+	-	-	-	+	+	+	+	+	+	+	+	+
TFP	+**	-	-	+	-	+	+	+	+	+	+	-	-***	-	-	+***	-	-
TFPE	+	-	-	-	-	-	-	-	-	+	-	-*	-***	-	-*	+***	-	-*
(EBIT+Dep)/Lab.cost	+*	+	+	-	-	+	-	-	-	+	+	-	-	+	+	+	+	+
Total Costs/Revenue	-	+	+	+	+**	+	+**	+**	+**	+	+**	+	+	+	+	+	+	+
Prod. Costs/Revenue	-	+	+	+	+*	+	+*	+*	+	+	+	+	+	-	+	+	-	+
CF/Revenue	+	-*	-	-	-**	+	-*	-**	-	-	-	-	-	-	-	-	-	-
ROA	+**	-	+	+	-*	+	-	-	+	-	+	+	+	+	+	+	+	+
Bank Credits	+***	+***	+	-	-	-	+***	+**	+	+	+	+***	+	+	+	-	+	+
Longt. Bank Credits	+***	+***	+	-	-	-	+***	+	+	-	-	+	+	+	-	+	+	-

Source: own calculations.

Note: *, **, *** indicate statistical significance at 10, 5 and 1% significance level, respectively; + and - indicate average positive and negative value of the effect of investment support (treatment) on treated farms (difference-in-difference), respectively. Please, note that ratios and indices (i.e. last eleven indicators, starting GVA/Labour Cost) are used in their logarithmic transformation as pointed out in the methodological section. Negative ATT thus mean that the ratio "after to before" of these indicators is below 1 and positive signs refer to ratio over 1.

We can see some differences in the investment support effects (meaning in the significance of ATT) between the first two and the latter two support periods (support windows). We can assert that the earlier investment support (in the first two periods) resulted in livestock (ruminants) production expansion at the expense of farm production efficiency (cost/revenue ratios, CF/Revenue ratio) but with a contribution to labour productivity (GVA/labour cost), however, this only in the first support period. The modernisation support had also a positive short-term impact on TFP. These effects of support vanished and even the

productivity (of labour, of all factors - TFP) deteriorated (comparing to the matched controls) in the latter periods. Weakly significant (if we accept 10% level) negative effects concern the decrease of dairy cows too, but these can have rather positive interpretation of "enabled adjustment" in the time of the milk market decline (2009-2010).

In order to eliminate the influence of (randomly varying) weather and market conditions on the results, we further use three-year moving averages of outcome indicators instead of the annual figures as presented in Table 3. These recalculated ATT of the result indicators confirm significant positive effects of the M121 on cattle expansion for the first two investment windows; significant increase of the cost/revenue ratios on farms supported in the second window 2009-2011; and significant negative effects on total factor productivity (ln(TFP), ln(TFPE)) in the third support window of 2010-2012.

Some weak effects might also result from the imbalance in size between the supported and control farms. By using another set of structural variables focussing mainly on the size and agri-environmental conditions' similarities of the supported and control farms (see Table A-6 in the Appendix), we tried to eliminate this problem (while losing some other similarities). **Fehler! Verweisquelle konnte nicht gefunden werden.** presents the level of the fit of the investment support effects using different sets of structural variables for matching; the fit is considered in terms of the same sign. In case of the same effect sign, the sign is presented in the table. If either of the matching produced statistical significance of the effects at one of the three significance levels (1%, 5% or 10%), it is marked by "*!". The original tables for each type of matching are presented in Table A-7 and Table A-8 in the Appendix. In this case, we present the results for three-year moving averages of the indicators. Actually, two thirds of results overlap: in terms of revenue and GVA the overlap is 90%; high overlap is also found in the effect on the number of livestock units (100%) and livestock density (89%), and cost revenue ratios (100 and 89%). In contrast, there is little conformity of results (ATT) for indebtedness and labour productivity.

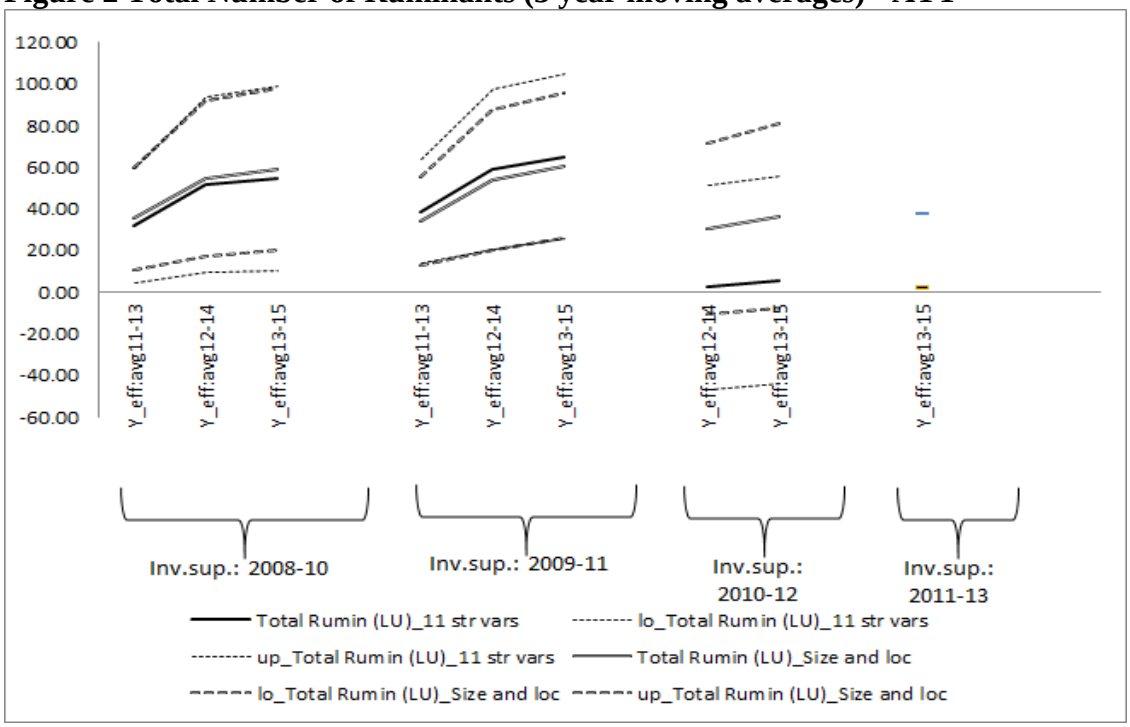
Table 4 Dynamic effects of investment support on selected structural and performance indicators over three consequent years after the investment support window (moving averages)

Support Window	2008-2010				2009-2011			2010-2012		2011-2013
Year of effect: 2000+	10-12	11-13	12-14	13-15	11-13	12-14	13-15	12-14	13-15	13-15
Revenue		+	+	+*!	+*!	+*!	+*!	+	+	+
GVA		+	+	+	+	+	+*!	+	+	+
Profit	-*!	-*!	-*!	-	-	-				+
Beef Cows (LU)		+	+		+	+	+		+	-
Dairy Cows (LU)	+	+	+	+	+	+	+	-	-	+
Total Ruminants (LU)	+*!	+*!	+*!	+*!	+*!	+*!	+*!	+	+	+
Livestock Density	+	+*!	+*!	+*!	+*!	+*!	+*!			+
GVA/Lab. Cost		-		+		-		-	-	-
CF/ Lab. Cost		-*!	-				+			+
TFP	+*!				+	+	+	-*!	-*!	+*!
TFPE					-	-	-	-*!	-*!	
(EBIT+Dep)/Lab.cost		-*!	-		-	-	+			+
Total Costs/Revenue	+	+	+	+	+*!	+*!	+*!	+*!	+*!	+*!
Prod. Costs/Revenue	+	+	+	+	+*!	+*!	+	+*!		+
CF/Revenue	-*!	-*!	-*!	-*!	-*!	-*!	-	-		
ROA			-	-	-	-	+	+	+	
Bank Credits	+*!			-*!	+*!					+
Longt. Bank Credits	+*!		-*!	-*!						

Note: *! - at least one of the sets produces significant result at either of the 3 significance level – 1%, 5%, 10%.
Source: own calculations.

Following what was said above, we can state that the investment support (M121) has positive effect on the number of livestock (ruminants). In the first two windows, we can see that the number of animals even increased during the first two-three years (Figure 2), likely until reaching the full capacity of the new housing and other facilities stemming from the support.

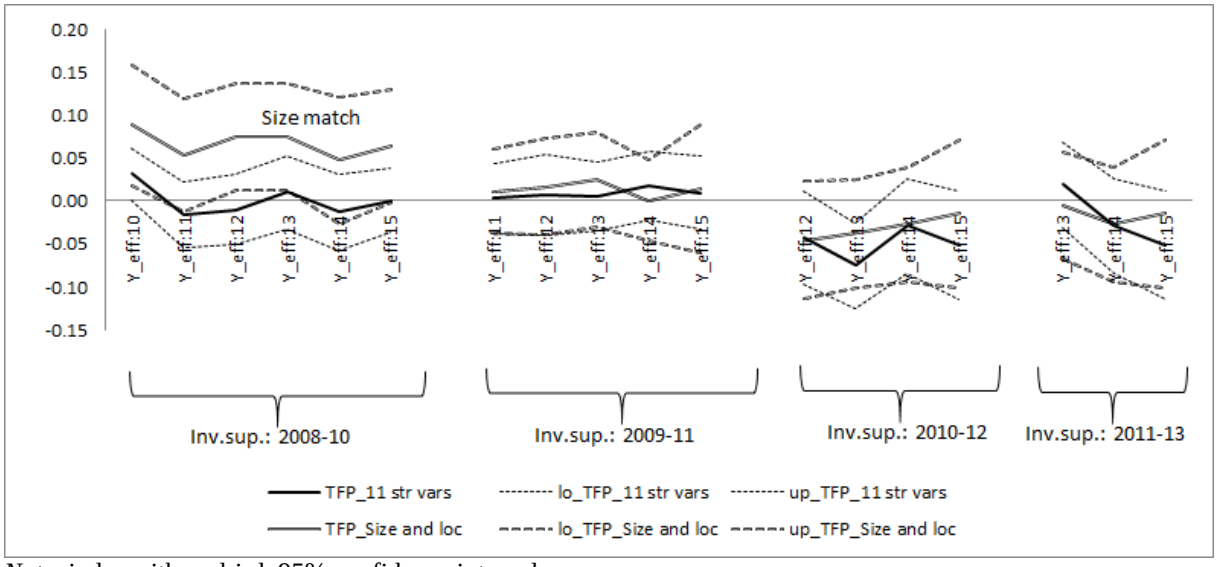
Figure 2 Total Number of Ruminants (3 year moving averages) - ATT



Note: d-i-d, 95% confidence interval, no confidence intervals displayed for the last period
Source: own calculation

The supported farms exhibit lower productivity figures, although these are mostly insignificant. This is well illustrated for the TFP index in Figure 3. An exception is the first period for matching on size and location structural covariates. For the investment support window 2008-2010 the total factor productivity index is significantly higher on the supported farms than on the control farms in the investigated after-investment period 2012-2015. For the other investment support windows the results are very conform between the matching approaches (in terms of structural variables used). Adding ecosystem services among farm outputs, surprisingly brings the ATTs (referring to structural variables) closer also for the first window.

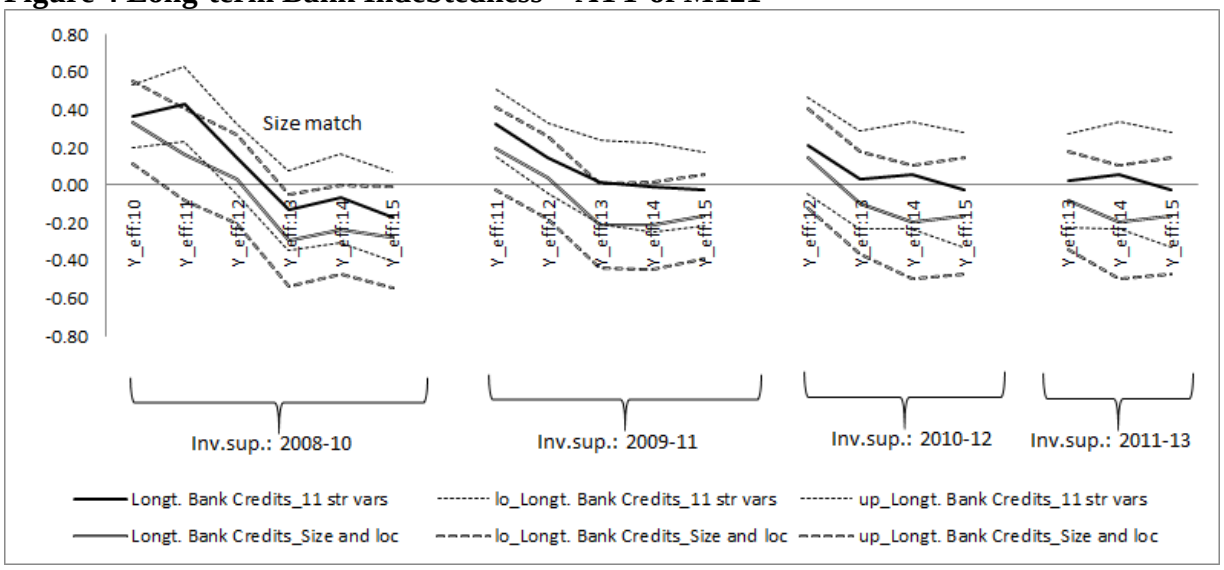
Figure 3 Total Factors Productivity (3 year moving averages) - ATT



Note: in logarithm, d-i-d, 95% confidence interval
Source: own calculation

The finding of a negative effect of investment subsidy on TFP in the last period (Table 4 and Figure 3) may result from fast changes in the indebtedness and investment activity of farms in the control group. These farms that have not applied for modernisation support over the entire period are specific in these particular aspects, especially farms without dairy production. They are characterized by high total indebtedness (significantly higher than farms in any of the support window) (see Table A-3), but simulataneously lowest banking indebtedness and lowest investment activity in the innitial years of the analyzed period. These could be transition-related specifics of some Czech farms related to high indebtedness to the eligible persons to financial settlements from restitutions and cooperative farms' transformation. This high indebtedness may constrain these farms' access to credit and thus their investment activity. They could thus be found in the innitial years of the analysis with high investment needs a potential. The improved financial standing of these farms due to high direct support allowed these farms‘ significant pay-off of the transformation debts over the analysed period and, at the same time, improve their access to finance from banks (see Table A-4). Over the period of 2007-2015, they caught up in their investment activity with the supported farms. Assuming free choice of investments and larger modernisation potential of the control farms, these investments may be assumed to have a greater positive impact on total factor productivity compared to investments supported by M121. This may result in the negative difference in TFP change between the control and supported farms.

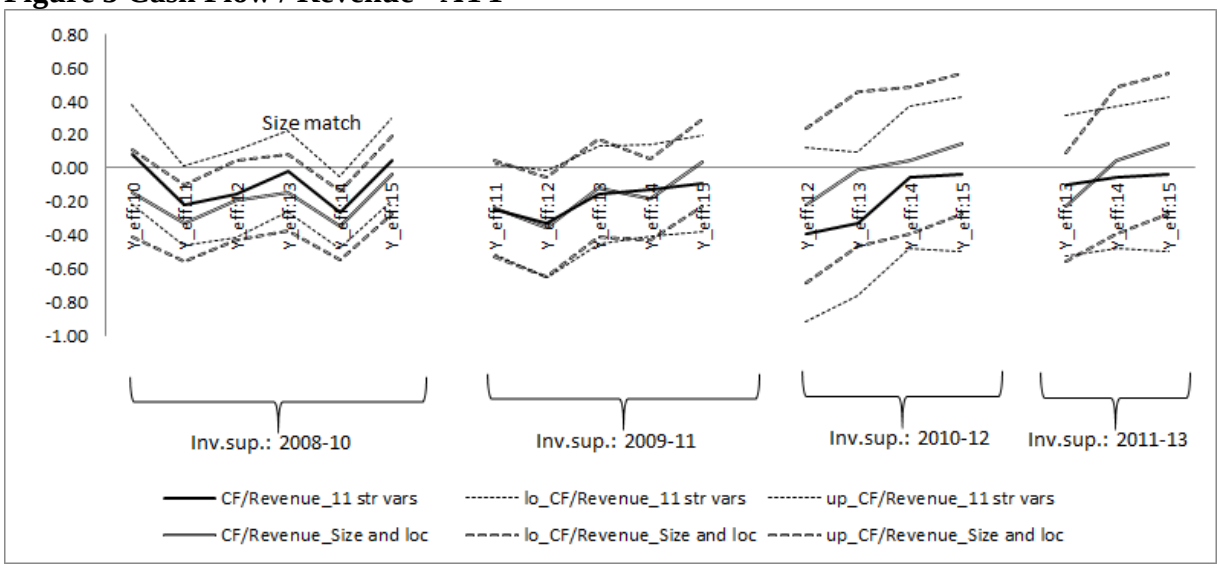
Figure 4 Long-term Bank Indebtedness – ATT of M121



Note: in logarithm, d-i-d, 95% confidence interval
Source: own calculation

We regard the Long-term Bank Indebtedness as an indicator of the attraction of external capital due to the support. In our earlier work (Medonos et al. 2012, Ratinger et al. 2013) we observed immediate increase of the Long-term Bank Indebtedness which we regarded as a confirmation that the support attracts additional external capital for the development. However, the investigation of the dynamics of this indicator shows that the increase of bank loans (above the normal level given by counterfactuals) is only temporal (Figure 4), these loans are repaid likely as soon as the support is paid as it is visible from the table A-4 in Appendix. Thus the leverage and additionality of the support is questionable. Although we pointed out earlier that the signs do not fit for the indebtedness indicators between the different sets of structural variables applied for DCM, Figure 4 shows high conformity of these results in terms of trends.

Figure 5 Cash Flow / Revenue - ATT

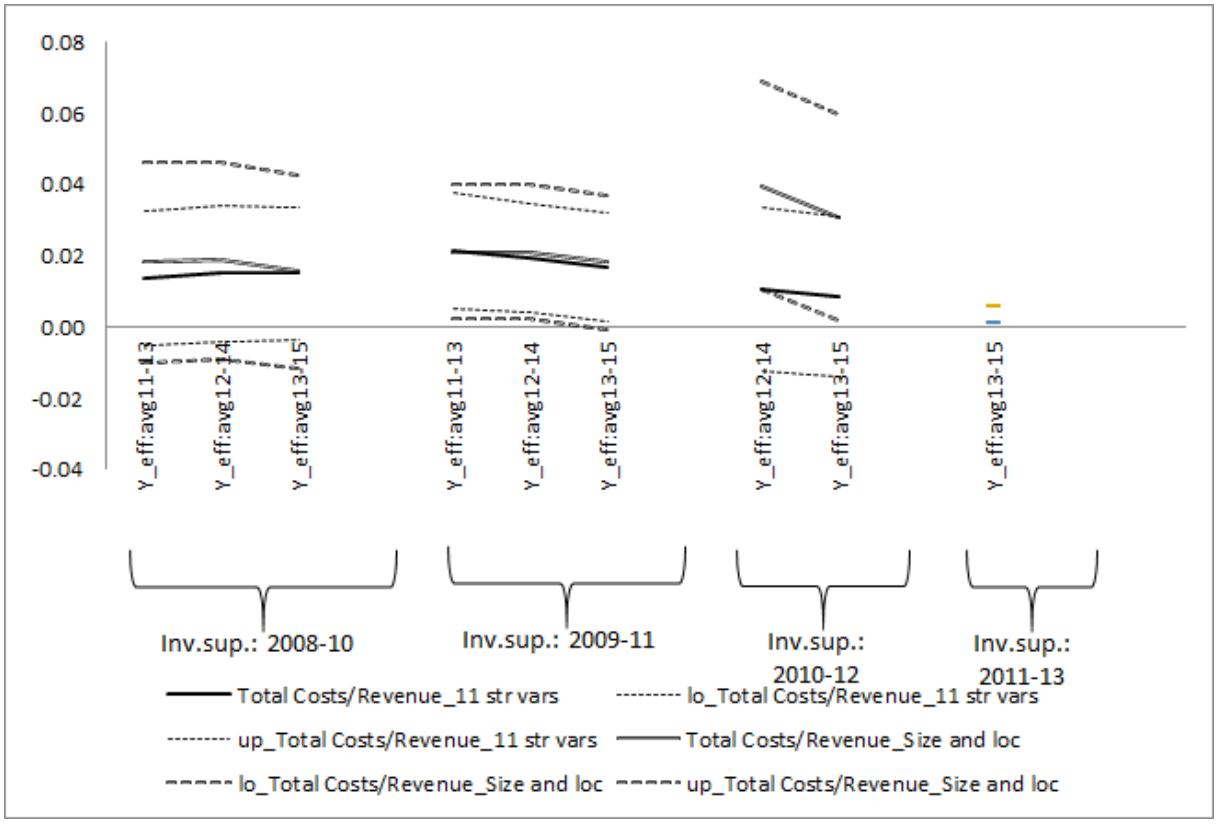


Note: in logarithm, d-i-d, 95% confidence interval
Source: own calculation

Cash-flow represent one of the sources for renewal of the physical capital. If the investment support is to encourage investment activity of farms then there should be a

reflection of it in cash flow. However, it is not such case, although some improvement can be noticed (Figure 5). One explanation can rest in the fact that the capital proportional to the support cannot be depreciated in the accounting, other in the outflow of saved sources to land and capital owners[3] and the rest in increased cost due to new investment. Actually, the Total Cost/ Revenue ratio is worse on the supported farms than on their unsupported pairs (controls)` and this difference is statistically significant in many cases at the level α=0.05 in the first two windows of the intervention. However, as it is evident from Figure 6, the inefficiency tends to diminish over time not only on supported farms but also the supported farms exhibit in later windows lower inefficiency (the ATT of the logarithm of the cost/revenue ratio goes to 0). Conformity of the matchings based on the two different sets of structural variables is very high from the first two investment support windows.

Figure 6 The Total Cost/ Revenue Ratio - ATT



Note: in logarithm, d-i-d, 95% confidence interval

Source: own calculation

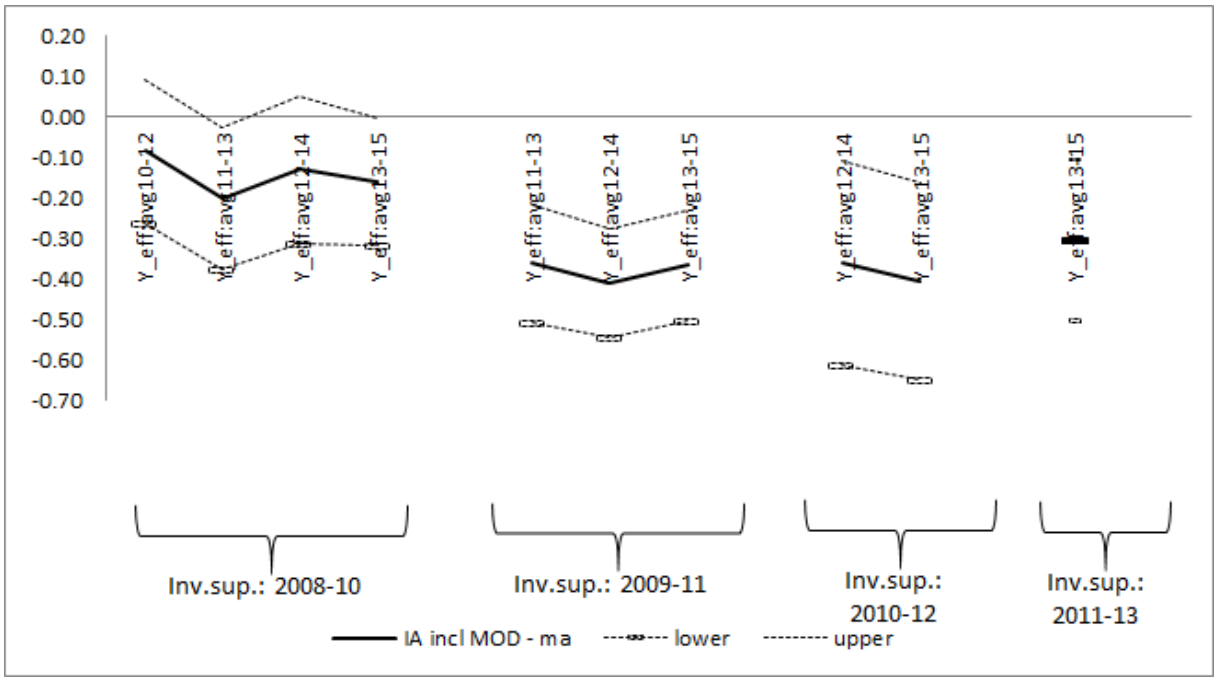
We applied also tree-year moving averages in the assessment of the impact of the investment support on investment activity (IA incl. MOD – ma[4]). Similarly to other ratios, we worked with the logarithmic transformation of the indicator. The ATT is negative, predominantly significant (**Fehler! Verweisquelle konnte nicht gefunden werden.**, last row). Figure 7

[3] The uneven distribution of investment aid for the acquisition of fixed capital is also projected through the dead weight effect to the savings of the own resources of the beneficiaries of these subsidies, and the owners of this capital will use the (saved) sources of investment to divide these effects in the form of net profit from the enterprise. This can be illustrated in Figure A-13 in Appendix, where 10% of the largest beneficiaries of investment subsidies from the RDP 2007-2013 per hectare received this subsidy in the period 2008-2015 on average CZK 35,675 / ha and simultaneously distributed among the owners of these on average, the highest net profit of CZK 26,953 / ha.

[4] In this particular case, Investment Activity of supported farms includes also the support of the measure M121 (MOD); ma stands for tree-year moving averages.

provides more details on the dynamics of the Investment Activity indicator. It is given by the fact that supported farms have relatively high level of investment activity over the whole period and it doesn't change significantly over the time as you can see in table A-2 in Appendix. While investment conditions given by better financial situation of farmers and in general decreasing and low interest rates also for not-supported farmers improved significantly and it has impact on their increasing investment activity. Average interest rate for loans to agricultural businesses decreased from 6.5% in 2007 to 3.63% in 2015.

Figure 7 Investment activity (3 year moving averages) - ATT



Note: in logarithm, d-i-d, 95% confidence interval
Source: own calculation

5. Conclusions

Considering dynamics in the evaluation of the structural (investment) support impacts is of a great importance as these measures can have long-term effects. Indeed, results of our counterfactual analysis (DCM) show that investment support has some significant short as well as long-terms effects on farm structural characteristics, their efficiency and productivity, and improves access to capital. These effects, however, markedly vary between the support periods which may relate to the rapid changes in the overall financial and investment conditions for agriculture or potential systematic differences between farms participating in the support program in the earlier and later time windows. The investment support of the earlier period of 2008-2011 which overlaps with the time of economic crisis and financial constraints of farms mainly in the control group is found to have larger and more significant structural and performance effects than later investment support. In these years the structural support helped to finance a high share (up to 65%) of all investments in agriculture. It resulted in livestock (ruminants) production expansion at the expense of farm cost efficiency, but contributed to a short-term TFP increase. These effects of support vanished in the latter periods. The later support periods are characterized by favourable financial conditions and lesser differences in farm indebtedness between groups of supported and control farms due to direct payments from Pillar I of the EU Common Agricultural Policy and their increase in consequence of phasing-in. The policy treatment analyses results for this period indicate

negative effects of investment support on TFP that could indicate loss of additionality of investment support and/or differences in type of investments and their productivity chosen by supported and non-supported farms.

It is intended for the next step of the analysis to shed more light on these results by investigating more closely the supported investments (their non-productive content) and analyse the support effect for different subgroups of farms. These subgroups will consider different farm sizes, levels of initial indebtedness and investment activity, or investment support intensity. One important aspect needing more attention is the problem of leakage of subsidies to land or capital owners in case of large-scale farms.

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Appendix

Table A-1: Development of total revenues (size) (thsd. CZK) of farms with and without M121 support during 2007-2013, mean values for subgroups of dairy farms and farms without dairy production

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Farms without dairy									
controls	25266	26978	20275	21376	26153	25793	27048	28030	27691
Sw2008-10	24621	**26770**	**22121**	**23198**	26388	26466	27489	28085	27454
Sw2009-11	23743	25339	**21560**	**22530**	**26097**	26765	26627	28141	27027
Sw2010-12	20758	22036	18739	**19638**	**23227**	**24512**	24935	27210	25378
Sw2011-13	15316	17090	14494	14921	**18249**	**18839**	**20694**	22199	20629
Farms with dairy									
controls	42175	42705	32195	33750	41569	42281	43286	47116	42904
Sw2008-10	64159	**66175**	**49947**	**53449**	63632	65588	69847	74216	67826
Sw2009-11	61172	63520	**49732**	**52771**	**64095**	66015	68663	73581	67832
Sw2010-12	64515	66451	53934	**56729**	**69372**	**70971**	74311	79230	74079
Sw2011-13	57984	60928	49208	52520	**65437**	**65870**	**70612**	75707	71014

Note: Sw stands for support window, i.e. window of 3 following years in which a farm receives the modernisation investment support (M121). Farms can receive one or multiple support (for several investment projects) in either of the window years.

Table A-2: Development of investment activity (incl. investment support M121) of farms with and without M121 support during 2007-2013, mean values for subgroups of dairy farms and farms without dairy production

	2007	2008	2009	2010	2011	2012	2013
Farms without dairy							
controls	0.142	0.201	0.190	0.187	0.220	0.206	0.208
Sw2008-10	0.206	**0.253**	**0.193**	**0.173**	0.165	0.187	0.182
Sw2009-11	0.221	0.267	**0.250**	**0.212**	**0.193**	0.209	0.203
Sw2010-12	0.231	0.286	0.286	**0.260**	**0.233**	**0.208**	0.210
Sw2011-13	0.274	0.338	0.349	0.334	**0.319**	**0.283**	**0.260**
Farms with dairy							
controls	0.160	0.150	0.149	0.186	0.201	0.195	0.176
Sw2008-10	0.185	**0.191**	**0.154**	**0.169**	0.173	0.187	0.169
Sw2009-11	0.175	0.198	**0.181**	**0.191**	**0.188**	0.184	0.169
Sw2010-12	0.158	0.200	0.207	**0.220**	**0.210**	**0.193**	0.172
Sw2011-13	0.151	0.184	0.207	0.233	**0.236**	**0.193**	**0.175**

Note: Sw stands for support window, i.e. window of 3 following years in which a farm receives the modernisation investment support (M121). Farms can receive one or multiple support (for several investment projects) in either of the window years; Investment activity refers to a 3year average, i.e. investment activity in 2007 column represents the average investment activity of 2007-2009. Shaded areas indicate investments that include investment support M121.

Table A-3: Development of total indebtedness of farms with and without M121 support during 2007-2013, mean values for subgroups of dairy farms and farms without dairy production

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Farms without dairy									
controls	0.624	0.588	0.573	0.526	0.493	0.475	0.447	0.431	0.421
Sw2008-10	0.471	**0.470**	**0.441**	**0.389**	0.338	0.342	0.335	0.336	0.332
Sw2009-11	0.472	0.477	**0.454**	**0.429**	**0.390**	0.370	0.352	0.366	0.365
Sw2010-12	0.518	0.504	0.489	**0.483**	**0.457**	**0.448**	0.428	0.410	0.404
Sw2011-13	0.558	0.563	0.516	0.543	**0.510**	**0.536**	**0.512**	0.529	0.525
Farms with dairy									
controls	0.494	0.490	0.483	0.456	0.459	0.434	0.421	0.403	0.404
Sw2008-10	0.437	**0.456**	**0.442**	**0.403**	0.386	0.386	0.375	0.367	0.363
Sw2009-11	0.447	0.464	**0.456**	**0.436**	**0.427**	0.429	0.417	0.407	0.404
Sw2010-12	0.453	0.457	0.446	**0.447**	**0.442**	**0.450**	0.436	0.424	0.423
Sw2011-13	0.485	0.486	0.470	0.470	**0.466**	**0.469**	**0.458**	0.442	0.441

Note: Sw stands for support window, i.e. window of 3 following years in which a farm receives the modernisation investment support (M121). Farms can receive one or multiple support (for several investment projects) in either of the window years; Total indebtedness is calculated as total external funds/total liabilities.

Table A-4: Development of banking indebtedness of farms with and without M121 support during 2007-2013, mean values for subgroups of dairy farms and farms without dairy production

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Farms without dairy									
controls	0.105	0.120	0.132	0.130	0.127	0.129	0.131	0.125	0.132
Sw2008-10	0.113	**0.141**	**0.149**	**0.143**	0.124	0.118	0.114	0.104	0.110
Sw2009-11	0.119	0.151	**0.156**	**0.155**	**0.144**	0.134	0.128	0.123	0.133
Sw2010-12	0.140	0.147	0.143	**0.162**	**0.159**	**0.156**	0.142	0.127	0.121
Sw2011-13	0.147	0.169	0.170	0.201	**0.205**	**0.203**	**0.196**	0.193	0.192
Farms with dairy									
controls	0.103	0.108	0.107	0.097	0.099	0.123	0.137	0.136	0.143
Sw2008-10	0.124	**0.156**	**0.164**	**0.149**	0.140	0.152	0.156	0.156	0.158
Sw2009-11	0.121	0.150	**0.159**	**0.151**	**0.155**	0.172	0.173	0.175	0.181
Sw2010-12	0.126	0.124	0.136	**0.148**	**0.156**	**0.176**	0.180	0.178	0.190
Sw2011-13	0.130	0.131	0.131	0.139	**0.162**	**0.189**	**0.204**	0.196	0.199

Note: Sw stands for support window, i.e. window of 3 following years in which a farm receives the modernisation investment support (M121). Farms can receive one or multiple support (for several investment projects) in either of the window years; Banking indebtedness is calculated as debts to banks + financial assistance/total liabilities

Table A-9: Eleven matching indicators and their effect on effective matching

	significance of the deviation				percentage (absolute) deviation			
investment window	2008-10	2009-11	2010-12	2011-13	2008-10	2009-11	2010-12	2011-13
basic year	2007	2008	2009	2010	2007	2008	2009	2010
Revenue	+***	+***	+***	+**	19%	17%	26%	19%
EBT	+***	+**	+*	+*	32%	34%	57%	34%
Livestock density (LU/ha)	+	+	+	+	4%	5%	6%	4%
CF/Labour Cost	-	-	+	+	2%	2%	3%	8%
ROS1 (EBIT/Sales)	+	+	-	-	0%	2%	1%	2%
Total Cost / Total Revenue	-	-	-**	-	8%	9%	49%	7%
Long-term Bank Indebtedness	-	+	+	+*	6%	5%	0%	8%
Total Indebtedness	-	-	-	+	4%	3%	3%	3%
CF/ UAA(ha)	+*	+**	+***	+***	3%	6%	8%	8%
Fixed Capital / Labour Cost	-	+	+	+	2%	0%	5%	5%
Depreciation / Fixed Capital	+	-	-**	-	0%	1%	5%	3%

Source: own calculation

Table A-10: Tree matching indicators and their effect on effective matching

	significance of the deviation				percentage (absolute) deviation			
investment window	2008-10	2009-11	2010-12	2011-13	2008-10	2009-11	2010-12	2011-13
basic year	2007	2008	2009	2010	2007	2008	2009	2010
Revenue	-	+	+*	+	0%	0%	4%	2%
Share of area in Mountain LFA in UAA	+	+**	-	-	1%	3%	1%	1%
Share of area in Other LFA in UAA	-	-	+	+	3%	0%	2%	0%

Source: own calculation

Table A-11: Dynamic effects of investment support on selected structural and performance indicators over three consequent years after the investment support window (moving averages) for 11 structural variables

Support Window	2008-2010				2009-2011			2010-2012		2011-13
Year of effect: 2000+	10-12	11-13	12-14	13-15	11-13	12-14	13-15	12-14	13-15	13-15
Revenue	-	+	+	+**	+	+	+	+	+	+
GVA	-	+	+	+	+	+	+	+	+	+
Profit	-*	-	-	-	-	-	+	+	+	+
Beef Cows (LU)	+	+	+	-	+	+	+	+	+	-
Dairy Cows (LU)	+	+	+	+	+	+	+	-	-	+
Total Ruminants (LU)	+**	+**	+**	+**	+***	+***	+***	+	+	+
Livestock Density	+	+***	+***	+***	+***	+***	+***	-	-	+
GVA/Lab. Cost	+	-	+	+	-	-	-	-	-	-
CF/ Lab. Cost	+	-	-	+	-	-	+	+	+	+
TFP	+	-	-	-	+	+	+	-**	-**	+**
TFPE	-	-	-	-	-	-	-	-**	-**	+**
(EBIT+Dep)/Lab.cost	+	-	-	+	-	-	+	+	+	+
Total Costs/Revenue	+	+	+	+	+**	+**	+**	+	+	+
Prod. Costs/Revenue	+	+	+	+	+**	+*	+	+	-	+
CF/Revenue	-	-*	-	-	-**	-*	-	-	-	+
ROA	+	+	-	-	-	-	+	+	+	+
Bank Credits	+***	+*	+	-	+**	+	+	+**	+	+
Longt. Bank Credits	+***	+	-	-	+	+	+	+	+	+

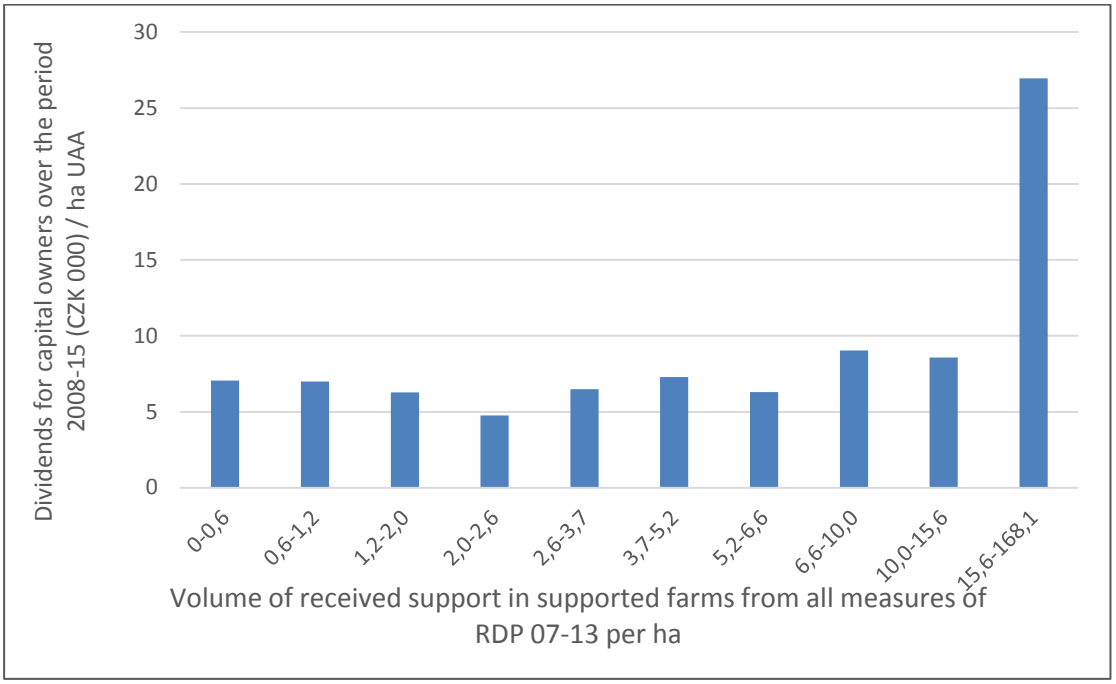
Note: *! - at least one of the sets produces significant result at either of the 3 significance level – 1%, 5%, 10%.

Table A-12: Dynamic effects of investment support on selected structural and performance indicators over three consequent years after the investment support window (moving averages) for 3 structural variables

Support Window	2008-2010				2009-2011			2010-2012		2011-13
Year of effect: 2000+	10-12	11-13	12-14	13-15	11-13	12-14	13-15	12-14	13-15	13-15
Revenue	+	+	+	+	+*	+*	+*	+	+	+
GVA	+	+	+	+	+	+	+*	+	+	+
Profit	-**	-**	-*	-	-	-	-	-	-	+
Beef Cows (LU)	-	+	+	+	+	+	+	-	+	-
Dairy Cows (LU)	+	+	+	+	+	+	+	-	-	+
Total Ruminants (LU)	+***	+***	+***	+***	+***	+***	+***	+	+	+
Livestock Density	+	+***	+***	+***	+***	+***	+***	+	+	+
GVA/Lab. Cost	-	-	-	+	+	-	+	-	-	-
CF/ Lab. Cost	-	-*	-	-	+	+	+	-	-	+
TFP	+**	+**	+**	+**	+	+	+	-	-	+
TFPE	+*	+	+	+	-	-	-	-**	-*	-*
(EBIT+Dep)/Lab.cost	-	-*	-	-	-	-	+	-**	-	+
Total Costs/Revenue	+	+	+	+	+**	+**	+*	+***	+**	+**
Prod. Costs/Revenue	+	+	+	+	+	+	+	+**	+	+
CF/Revenue	-**	-***	-**	-*	-***	-**	-	-	+	-
ROA	-	-	-	-	-	-	+	+	+	-
Bank Credits	+	-	-	-**	+	-	-	-	-	+
Longt. Bank Credits	+	-	-*	-**	-	-	-	-	-	-

Note: *! - at least one of the sets produces significant result at either of the 3 significance level – 1%, 5%, 10%

Table A-13: Distribution of the dividends depending on the volume of invest. aid per ha



Source: MoA, database Albertina and own calculations