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Effects of the investment support in the Czech meat processing industry

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Abstract: The goal of the paper is to quantify and evaluate the effects of investment subsidies in the Czech meat processing industry. The investment subsidies should enhance the economic results of the supported companies and increase their competitiveness. The analysis is based on the fixed-effect modelling of balanced panel data of 130 meat processors in the period 2008–2013. It quantifies the impact of investment subsidies from the Rural Development Programme (RDP) and the national support programme (Decree of MoA) on profitability, labour productivity, credit debt ratio and the efficiency of production consumption. The conclusions can be generalized for medium-sized and large companies. The results show that investment subsidies from the RDP had not such a significant effect as expected. Investment subsidies from the RDP affected only the labour productivity of large meat processors and the ROA of non-family companies. However, they should preferably help small and medium-sized companies to be more competitive. Subsidies from the national programme increased the profitability of family-owned and medium-sized companies and changed the capital structure of the supported companies which used more bank loans for upgrading the technology.

Keywords: fixed-effect model, impact assessment, national subsidies, Rural Development Programme

The problem areas of the Czech economy include a low self-sufficiency in pork, i.e. 57.6%, and in poultry meat, i.e. 70.8% (MoA 2015). Recent studies show that there have also been structural changes in slaughtering of cattle, chicken and pork processing during a period of increasing oversight of food safety. According to the results, labour and capital costs are rising and the share of the cost of meat has fallen in most industries (Ollinger 2011). According to Horská and Oremus (2008), the diversification of the portfolio of products and product innovation in line with the trends in nutrition, the market orientation on the Visegrad countries, as well as the development of marketing relationships are also important issues in the meat industry. According to Čechura and Šobrová (2008), the agri-food chain is demand-driven. They explicitly concluded that the type of market structure implies that the agricultural support is in this case shared within the vertically related markets and thus it is less efficient. According to Troy and Kerry (2010), the innovation and investment play an important role in the equipment in relation to respond to the consumer interests and their expectations. Meat industry should invest and implement innovation to be sustainable. Coad and Rao (2008) assume that no company can survive without at least some degree of innovation.

The recent studies have focused on the impact of the investment supports on the company performance. For example, Geroski and Machin (1992) revealed the positive impact of innovation on two performance parameters, i.e. profitability (ROS) and company growth (rate of growth in sales). Freel (2000) suggests other possibilities for measuring the business performance, such as the objective measures (growth in assets), subjective evaluation based on the attitude of the company according to performance index. He concludes that the innovator's assets and employment grows faster than the companies with a low innovation

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activity. The most common way to measure growth is by sales and employment growth (Delmar 1997).

Wren (2005) concludes that the investment grants in the UK are successful in creating new jobs and the expansion of businesses. The author challenges the ability of grants to attract foreign direct investments and their impact on productivity. Likewise, according to Harris (1991), investment subsidies contribute to create more job opportunities and investments in the region, while Harris and Trainor (2005) argue that the investment aid reduces the possibility of the closure of manufacturing enterprises by 15–24%. Harrison et al. (2014) studied the influences of the process and product innovations introduced in companies to increase employment in manufacturing companies (France, Germany, Spain, UK). The trend of increasing productivity is the source of reducing the requirements for employees while the product innovation does not reduce the demands on staff. Actually, the induced demand growth of new products is the most powerful force for creating new jobs. Their results show that approximately 40% of the companies in the UK and 60% of the companies in Germany are innovative manufacturing firms. Reports on the effectiveness of investment grants also focus on the impacts of investment on different size groups of enterprises, especially small and medium-sized enterprises. The study on small and medium-sized enterprises reports that investment in the product innovation is the most popular expansion strategy, this finding can be applied to various industries (Hay and Kamshad 1994). According to Storey (1994), innovation is associated with a faster growth in small businesses. According to Heunks (1998), innovations even encourage the growth of small businesses. Roper (1997) adds that innovations in small firms are important because it is a direct contribution to the competitiveness of the company, but also because of the potential of the small business sector acting as an initiator for broader technical changes. The author found that the output growth in innovative small businesses is faster than the output in non-innovative firms. In Germany, the production growth (output) was achieved through innovative strategies that dramatically increased productivity, but reduced the number of employees. The UK and Irish small firms applied a more balanced attitude to the employment growth and productivity associated with the innovative behaviour. When compared with the organization of the production innovation, it was indicated that German small businesses are less market-oriented and less risky and have a more formally organized approach than the British and Irish firms. Lefebvre et al. (1998) found a positive effect of investment activity on the company´s survival and sales in the sample of small businesses in Canada. Tether and Massini (1998) found a positive impact of investment on employment in the UK small firms.

Profit has been also the assessed as a key measure of the businesses performance. Nevertheless, the positive effects of investments on profit have not been proven by all authors. Geroski and Machin (1992) note there are relatively large and persistent differences in profit between innovators and non-innovators. The innovators achieve substantially higher profits. However, in the short term, investments in the small companies lead to growth and efficiency but not immediately to higher profits (Heunks 1998). Low profits may be associated with the cost of investment (fixed costs). In addition, the success of the innovation may not be obvious in the increase of profits for several years after placing the product on the market. Wynarczyk and Thwaites (1997) concluded that the innovative enterprises have higher profits. The internal efficiency growth can lead to lower costs and a better performance which, at the same time, can increase the market price and willingness to pay (Freel 2000). Alternatively, Moore (1995) did not indicate any relationship between innovation and profitability. However, small innovators also experience a slower growth of profit than the less innovative companies. According to Geroski and Machin (1992), margins of innovative companies are significantly and consistently larger than that of less innovative firms. Margins may therefore be considered as the measures to improve the internal efficiency and value added.

Theoretical studies also recognize innovation as a factor of the companies' revenue growth (Aghion and Howitt 1992; Geroski 2005). On the other hand, empirical studies have problems in identifying the strong relationship between innovation and the revenue growth. Cesaratto and Stirati (1996) in Italy found that innovations are not related to sales, employment and productivity. Some studies have found the impact of innovation on the sales growth. Scherer (1965) found the positive impact of innovation on business profits through the revenue growth in the USA. A special remark in this study is that innovations usually do not increase profit margins, but instead of this, they increase profits through the increased sales. Revenue growth is partly an important indicator of the innovation performance. On the other hand, Harris

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and Robinson (2004) found that the UK investment subsidies have an effect on productivity. Similarly, Bergström (2000) found a very small effect on the productivity of investment subsidies in Sweden. Panel data distinguish between the subsidized and unsubsidized enterprises in the manufacturing industry.

Because the effects of investments and investment subsidies on the company's performance are not always equivocal and the conclusions of the recent literature could not be generalized for the Czech Republic, it is highly important to make a case study that would evaluate the effects. The goal of the paper is to quantify and evaluate the effects of investment subsidies in the Czech meat processing industry in the period 2008–2013. The meat processing industry is the most important part of the Czech food industry and investment subsidies should improve its low competitiveness. The low competitiveness of the Czech meat processors results from the long term deep negative trade balance towards foreign producers and processors (Pohlova and Mezera 2014). The evaluation involves the effects on profitability, labour productivity, and efficiency of production inputs. We also focus on the change of the capital structure.

The paper provides an overview of the impact assessment methods with references on the recently published articles, the general description of fixed-effect model, specification of the model applied in the meat processing industry, results and conclusions.

METHODS

The evaluation of effects of investment subsidies on economic indicators of supported companies has been processed through various approaches. The models differ in their analytic focus (sectoral conditions or the general economy), as well as the geographic level ranging from the regional to transnational application (Harvey 1990).

A study by the European Commission (2014) dealt with the evaluation of the investment support from the Rural Development Programme. It presented various methods for the evaluation and assessed their suitability for measuring the efficiency, effectiveness and impact of investment support measures. To evaluate the causal link between these political interventions and their outcomes, it is necessary to use econometric methods. One of the methods applied for the evaluation of investment support in the Rural Development Programme (RDP) was the Input-Output Analysis based on the economic modelling (Psaltopoulos et al. 2004).

One of the most popular methods has been the counter-factual analysis that compares the average treatment effects as a difference of economic indicators between the supported companies (participants) and not-supported companies – nonparticipants (Arkarhem et al. 2010; Bernini and Pellegrini 2011; Božík 2012; Ratinger et al. 2013). The Propensity Score Matching (PSM) is based on the probability of the participation and non-participation obtained from the probit or logit regression. The evaluators can use several methods of matching pairs, such as the Mahalanobis distance (Božík 2012; Špička and Krause 2013) or the Kernel matching. Such an approach is appropriate when there are sufficient numbers of the supported and unsupported companies and the overlap in terms of their propensity to participate which should be matched through a specific statistical method of matching. However, the impact evaluation of the investment support through the counter-factual analysis is difficult when there is a relatively small number of companies and a big structural gap between the supported and unsupported groups, as in the case of the meat processing industry. Caliendo and Kopeinig (2008) presented a standard approach for the impact analysis in the form of the Roy-Rubin model. The model answers the question what would happen if the supported enterprises did not receive an investment support (if they are the non-participants). The model works with the Average Treatment Effect on Treated (ATT) as presented by Ratinger et al. (2013). The third popular method of the counter-factual analysis is the nearest neighbour matching. The European Commission recommends to pair four non-participants with one participant in order to avoid bias.

Psaltopoulos et al. (2004) dealt with modelling the impact of the CAP (Pillar I and II) on the European economies through the CGE-model. The CGE modelling is one of the possible quantitative instruments that can support the analysis of the potential impacts associated with changes in the agricultural and rural development policies. The CGE model was also used by Basco et al. (2006) or Gohin and Latruffe (2006).

Not only quantitative methods, but also qualitative methods have been used for the impact assessment of development programmes. Chen (1990) applied the Programme-Theory-Based Evaluation (TBE) that relies on the quantitative information, financial inputs and outputs, and the qualitative estimates of

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the results and impacts. The European Commission (2012) used the MAPP for the evaluation of the RDP (Method for Impact Assessment of Programmes and Projects) which is based on discussions. The Strategic Environmental Assessment (SEA) is a structured process used for the environmental assessment, similar to the TBE. In the simple form, it is the qualitative theory based framework that can be extended to more advanced methods (Hanley et. al. 1999; Pearce 2005). Overall, the qualitative impact analysis has been mostly used for the estimates of environmental measures and social impacts of the rural development policy (Midmore et al. 1993; High and Nemes 2007; Purvis et al. 2009).

Because there are quite different structural characteristics of non-participants in the Czech meat processing industry (most of the medium and large companies have been supported) and the number of companies with the available accounting data in the branch is relatively small, we cannot use the Propensity Score Matching method. Thus, we have chosen the alternative method for the impact analysis – a fixed-effect econometric modelling.

Assuming fixed effects over individuals, we can propose the following panel data regression model, also known as the fixed effects model, i.e.:

$$y_{it} = \alpha + x'_{it}\beta + u_{it} \quad i = 1, \ldots, N; t = 1, \ldots, T \qquad (1)$$

where i denotes the cross-section dimension and t the time-series dimension. Henceforward let i be a slower index. Therefore y_{it} is an observation of a dependent variable for i-th unit in time t; α is a scalar common to all entities; is it-th row of $NT \times K$ matrix X, which contains the observed values of K regeressors; β is a K-dimensional parametric vector; and for u_{it} we can write:

$$u_{it} = \mu_i + v_{it} \qquad (2)$$

when μ_i is an unobservable and timeindependent individual specific effect, or fixed effect, for i-th unit and v_{it} is an iid disturbance term with mean zero and variance σ. Regarding the above stated regression, it is possible to estimate through a least squares dummy variables (LSDV) estimator, see for example Baltagi (2008). Diagnostics of the fixed effect model include the Chow test for poolability (Chow 1960), the Durbin-Watson statistics of autocorrelation, the Wald test for groupwise heteroskedasticity, the Wald test for common significance of time variables, (see for example Greene 2000). In order to evaluate the time effect, we included the time dummy variables dt_1 – dt_6 which measure the effect of each year from the period 2008–2013 on the economic results of companies. In order to respect the limited length of the paper, the chapter "Results" describes the effect of the significant years (dt_n) only.

The fixed-effect model was enhanced by the robust GMM (Generalized Method of Moments) estimator (Arellano and Bond 1991). Since the panel data have both a time-series and a cross-sectional dimension, one might expect that, in general, the robust estimation of the covariance matrix would require handling both heteroscedasticity and autocorrelation (the HAC approach). The fixed-effect model was processed by the software Gretl. The default robust estimator is that suggested by Arellano (2003), which is the HAC, provided the panel is of the "large n, small T" variety (that is, many units are observed in relatively few periods). The Arellano estimator is:

$$\hat{\sum}_A = \left(X'X\right)^{-1}\left(\sum_{i=1}^{n} X'_t\hat{u}_i\hat{u}'_i X_i\right)\left(X'X\right)^{-1} \qquad (3)$$

where X is the matrix of regressors (with the group means subtracted, in the case of fixed effects) $\hat{u}_i$ denotes the vector of residuals for unit i, and n is the number of cross-sectional units. Virtually, because of at least the autocorrelation or heteroskedasticity posed a problem for the statistical inference in each estimated regression (according to the results of above stated tests), the robust estimator of covariance matrix was chosen in all cases. The solution, which keeps the efficiency of the OLS-parameters unaffected, was not at the disposal, mainly due to the structure of the data.

The fixed-effects were estimated as a panel regression between the economic indicator (y) and investment subsidies (x). There were two fixed-effect models estimated – the model with binary regressors (0 = unsupported company, 1 = supported company) and the model with numeric regressors (the total amount of investment subsidy from the RDP and the national programme in the individual companies). So, the model with binary regressors estimates the average impact of the investment subsidy on the change of the selected economic indicator, while the model with the numeric regressors calculates the value change of the economic indicator per one thousand crowns of the investment subsidy. The following economic indicators were used as dependent variables.

- ROA (Return on Assets) = Earnings before Interests and Taxes/Total Assets × 100

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– Labour Productivity = Value Added[1]/Total Personnel Expenses
– Credit Debt Ratio = Bank loans/Total Assets × 100
– Efficiency of production consumption = Sales[2]/Production consumption[3]

The economic indicators represent the key ratios of profitability, labour productivity, capital structure and efficiency.

In case of the Czech meat processing industry, the authors applied the model in the following form:

$$y_{it} = \alpha + \beta_1 x_{1it} + \beta_2 x_{2it} + \sum_{j=2}^{6} \gamma_j d_j + \mu_i + v_{it} \quad (4)$$

where:

y_{it} = one of the dependent variables (ROA, Labour Productivity, Credit Debt Ratio, or Efficiency of production consumption);

x_{1it} = the total amount of investment subsidy from the RDP (once expressed as an indicator variable, in the sense that the one goes for the company engaged in the RDP and zero otherwise; and also taken as a classical numeric variable for the second)

x_{2it} = the total amount of investment subsidy from the national programme (once expressed as an indicator variable, in the sense the one for the company engaged in national programme and zero otherwise and also taken as a classical numeric variable for the second);

d_j = year-specific time variable; in the meaning that d_2 takes one for the year 2009 and zero otherwise, d_3 takes one for the 2010 and zero otherwise.

Explanatory variables are both taken either as indicator or numeric but not as the mixture of these.

Data

The data on meat processors was selected from the database Bisnode Albertina. It contains the income statements and balance sheets of companies in all branches. The original dataset was processed to include meat processors with the complete financial statements in the period 2008–2013. The companies with a negative equity were also removed from the original dataset since there is a high probability for them to go bankrupt. Meat processors are defined as companies with the prevailing CZ-NACE 10.1 "Processing and preserving of meat and production of meat products". The final dataset of 130 companies was processed by the econometric analysis. It is a panel of data with the same number of companies in every year. The final sample covers small, medium and large companies. A special model for each size group of meat processors was created. The size of the company is an important typology because each company size has a different access to the capital, access to different support programmes or different flexibility of management.

The Table 1 provides information about the share of the sample in the total number of meat processors classified by size groups. Micro-, small and medium-sized enterprises (SMEs) are defined according to the EU recommendation 2003/361.

The sample is not representative in the group of the micro and small meat processors. So, the results can be generalized for the medium and large-sized companies only.

Besides the evaluation of the effects of investment subsidies on economic indicators by the company size, the impact analysis in the family and non-family companies was processed. The reason why we distinguish between the family and non-family business is the superior financial performance of family businesses compared to the non-family ones (Anderson and Reeb 2003; Dibrell and Craig 2006), reduced levels of debt in the balance sheets (Kachaner et al. 2012) and a different system of values of family companies (values shared across family business stakeholders generate synergistic effects, Habbershon and

Table 1. Representation of the sample in the population by size groups of enterprises in 2011– 2013

Sample/population	Year	Micro and small	Medium	Large
Sample	2011	89	27	14
Population		1 614	60	17
%		**5.51**	**45.00**	**82.35**
Sample	2012	89	27	14
Population		1 638	61	19
%		**5.43**	**44.26**	**73.68**
Sample	2013	89	27	14
Population		1 631	61	17
%		**5.46**	**44.26**	**82.35**

Source: own calculation based on data from the Czech Statistical Office

[1]Value Added = (Sales of goods – Cost on goods sold) + (Sales of production – Cost of sales)
[2]Sales = Sales of goods + Sales of production
[3]Production consumption = Costs of material, energy and services

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Table 2. Number and size of family and non-family companies in 2013 (total assets in thousands CZK)

Category	Number	Mean	Stand. Deviation	Min	Max
Family companies	72	67 690.43	157 543.8	495	936 956
Non-family companies	58	221 979	438 534.1	957	2 204 613
Total	130	136 526.9	323 363	495	2 204 613

Source: own calculation

Williams 1999). The family companies are defined as meat processors where the individual or family members hold a significant part (more than 50%) of the capital share (Massis et al. 2012). We considered only the direct ownership between the individual or family members and meat processor without any intermediary company (one level back). All sole-holder enterprises (individual entity) are labelled as family companies. Non-family companies are the meat processors directly owned by corporations (legal entities). Table 2 shows the number and size of the family and nonfamily companies in 2013.

Data on investment support were gathered from the Ministry of Agriculture. Since the meat processors can apply for investment support in various programmes, we distinguish between the Rural Development Programme (RDP) and the national support programme. Investment subsidies from the RDP are co-financed by the European funds and the Czech Republic sources. In the period 2007–2013, the RDP provided investment subsidies for small and medium enterprises within two sub-measures: I.1.3.1 Adding value to agricultural and food products, and I.1.3.2 Cooperation for development of new products, processes and technologies (or innovations) in food industry. The national support programme No. 13 (Decree of the Ministry of Agriculture) supports large food processing enterprises. The RDP measure I.1.3 shall be granted for tangible and intangible investments concerning processing and/or marketing and/or the development of new products, processes and technologies linked to products, covered by Annex I to the EC Treaty (except fishery products), and respecting the EC standards applicable to the investment concerned. The investments shall improve the overall performance of the small and medium enterprises and shall contribute to the increased competitiveness of the agri-food industry. The national support programme No. 13 is very similar to the RDP measure I.1.3, but it is eligible for larger companies.

For the analysis, we used the investment support data relating to meat processors in the period 2008–2013. The reference year of support was the year of the completion of the project. The year 2007 was not included since there were only project applications in the RDP and no projects were completed. The supports were principally similar in the both programmes.

Drawing investment subsidies from the RDP is the domain of small and medium enterprises. In the sample, 17 small enterprises, 15 medium-sized enterprises and only 7 large enterprises[4] were supported by the total amount of 400 million CZK in the period 2008–2013. The amount of national subsidies is lower (292 million CZK). Investment subsidies from the national funds of the Ministry of Agriculture were used mainly by large enterprises. The national subsidies were drawn by 11 large enterprises, 5 medium and by 2 small meat processors. If we calculated the total amount of investment subsidies per one supported company, the average support was less than 10 million CZK from the RDP and 16 million CZK from the national programme of the Ministry of Agriculture. The co-financing ratio in the national support programme of the Ministry of Agriculture was lower (25%) than in case of the RDP subsidies (up to 50% of the eligible investment expenditures)[5]. So, the national subsidies increase the Credit Debt Ratio as a consequence of the more intensive investment activity and higher capital demands of large enterprises and the need for more liabilities to finance investment projects. The project value within the national programme ranged between 1 and 60 million CZK, in the RDP it ranged between 0.1 and 30 million CZK per one project.

RESULTS

Before we start to describe the results of the fixed-effect model, it would be interesting to look at the

[4]Large enterprises were supported from the measure I.1.3.2 Cooperation for development of new products, processes and technologies (or innovations) in food industry.

[5]The real average support rate was 42.6 % of the eligible investment expenditures.

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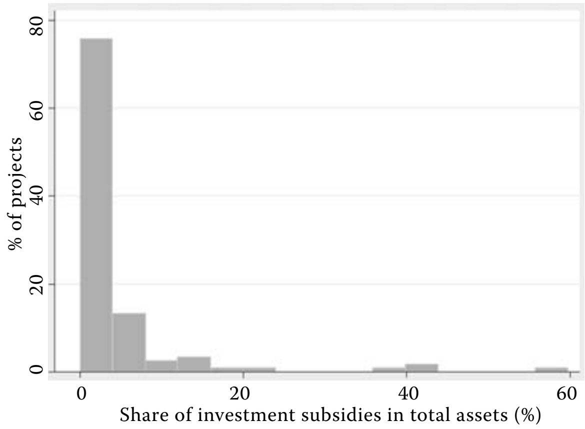

Figure 1. Share of investment subsidies in the total assets

Source: own calculation

significance of investments in the supported companies. Figure 1 presents the share of investment subsidies in the total assets in the supported companies.

The finding is that 75% projects had less than 4% share of investment subsidies in the total assets. On the other hand, the project might be relatively large if we take into account that about 10% is the depreciation rate under the assumption of 10-year average economic life of the projects. This finding should justify the results when there are not so important effects of investment subsidies as we have expected (Mezera and Špička 2013).

First part of results is devoted to the estimation of the fixed effect models with **binary regressors**. The results are captured in Tables 3–6. At first, the fixed effects with binary regressors were estimated for the whole sample of meat processors (category "all") including subsidized and non-subsidized enterprises. The next part of the analysis focuses on the ownership structure (the group of family businesses "F" and the group of non-family "NF") and the size structure (the group of small businesses "S", the group of medium-sized businesses "M" and the group of large businesses "L"). The results also include the impact assessment of each year on the economic indicators (only statistically significant). From the formal point of view, the parentheses highlight standard errors, the square ones mark p-values.

Table 3. Binary regressors, ROA

	All	F	NF	S	M	L
RDP	0.9900 (1.0771) [0.3583]	–0.9479 (1.5522) [0.5418]	3.0904 (1.1817) **[0.0094]**	1.4249 (2.3474) [0.5442]	0.5506 (1.2136) [0.6508]	0.3248 (0.6311) [0.6086]
NS	2.9942 (1.8972) [0.1150]	4.3226 (2.4984) **[0.0845]**	3.3320 (2.1385) [0.1203]	–4.2383 (1.0924) **[0.0001]**	4.2068 (2.5255) **[0.0982]**	4.9278 (3.5122) [0.1655]
dt_4 (2011)					–3.8261 (2.0193) **[0.0604]**	
dt_5 (2012)	–4.8660 (2.1511) **[0.0240]**			–5.4868 (2.8985) **[0.0590]**	–6.3363 (1.9702) **[0.0016]**	
dt_6 (2013)					–5.7215 (2.4442) **[0.0208]**	
Wald test for common significance of time dummy variables	13.6383 [0.0181]	8.1037 [0.1506]	9.8763 [0.0788]	9.4080 [0.0939]	38.6038 [< 0.0001]	15.3313 [0.0090]
Wald test for groupwise heteroskedasticity	169 838.0 [< 0.0001]	94 557.3 [< 0.0001]	149 961.0 [< 0.0001]	80 371.0 [< 0.0001]	3 805.9 [< 0.0001]	3 629.7 [< 0.0001]
Durbin-Watson statistics	1.5621 [0.4575]	1.6706 [0.8789]	1.3612 [0.0192]	1.6141 [0.6213]	1.1469 [< 0.0001]	0.8723 [0< 0.0001]
Chow test for poolability	2.5247 [< 0.0001]	2.5701 [< 0.0001]	2.4977 [< 0.0001]	2.4651 [< 0.0001]	4.3971 [< 0.0001]	1.6058 [0.1073]

Source: own calculation

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Table 4. Binary regressors, labour productivity

	All	F	NF	S	M	L
RDP	−0.0072 (0.0702) [0.9185]	−0.0319 (0.0788) [0.6857]	0.2443 (0.2144) [0.2554]	−0.0298 (0.1188) [0.7900]	0.0744 (0.0558) [0.1849]	0.0557 (0.0252) **[0.0307]**
NS	0.1421 (0.1652) [0.3806]	0.0048 (0.1488) [0.9740]	0.3348 (0.3344) [0.3176]	−0.0201 (0.2576) [0.9378]	0.2476 (0.1877) [0.1897]	−0.0590 (0.0981) [0.5499]
Wald test for common significance of time dummy variables	12.8355 [0.0250]	7.3756 [0.1942]	8.2787 [0.1415]	9.7645 [0.0822]	14.2147 [0.0143]	21.8229 [0.0057]
Wald test for groupwise heteroskedasticity	$1.57*10^7$ [< 0.0001]	$1.06*10^6$ [< 0.0001]	697 934 [< 0.0001]	$4.56*-10^7$ [< 0.0001]	42 319.1 [< 0.0001]	2 832.9 [< 0.0001]
Durbin-Watson statistics	1.2185 [< 0.0001]	1.6176 [0.7495]	1.2029 [0.0002]	1.2207 [< 0.0001]	0.6169 [< 0.0001]	1.1236 [< 0.0001]
Chow test for poolability	1.1780 [< 0.0001]	3.0041 [< 0.0001]	1.0905 [0.3189]	1.1442 [0.1940]	7.8438 [< 0.0001]	5.3585 [< 0.0001]

Source: own calculation

In the group "all", the impact of national subsidies on Credit Debt Ratio (α = 0.05) is statistically significant. It means that the national subsidies increased the Credit Debt Ratio by 3.96% on average (Table 5).

In case of the indicators ROA and Credit Debt Ratio (Tables 3 and 4), the influence of the year 2012 is obvious. The year 2012 decreased the ROA by 4.87% on average and the Credit Debt Ratio increased by 2.35% on average. The ROA decreased due to the

Table 5. Binary regressors, Credit Debt Ratio

	All	F	NF	S	M	L
RDP	1.6164 (1.3470) [0.2306]	3.5568 (2.2265) [0.1111]	-0.5535 (1.0295) [0.5912]	3.3641 (3.0794) [0.2752]	0.4601 (1.0623) [0.6657]	1.1216 (0.8806) [0.2075]
NS	3.9644 (1.5926) **[0.0131]**	−8.9090 (1.3126) **[0.0000]**	4.1476 (1.6847) **[0.0144]**	3.1450 (2.1269) [0.1399]	2.6810 (1.9820) [0.1785]	5.3226 (2.2274) **[0.0199]**
dt_5 (2012)	2.3484 (1.3447) **[0.0812]**					5.7196 (3.0043) **[0.0615]**
dt_6 (2013)						4.9617 (2.9183) **[0.0940]**
Wald test for common significance of time dummy variables	5.0916 [0.4048]	4.0989 [0.5353]	3.8306 [0.5741]	4.7218 [0.4508]	2.5969 [0.7618]	9.4952 [0.0909]
Wald test for groupwise heteroskedasticity	$1.59*10^6$ [< 0.0001]	479 771.0 [< 0.0001]	698 628.0 [< 0.0001]	717 545.0 [< 0.0001]	$1.11*10^6$ [< 0.0001]	2003.24 [< 0.0001]
Durbin-Watson statistics	1.0971 [< 0.0001]	1.0196 [< 0.0001]	1.2703 [0.0019]	1.0653 [< 0.0001]	1.0900 [< 0.0001]	1.5238 [0.0134]
Chow test for poolability	12.2609 [< 0.0001]	11.0503 [< 0.0001]	15.0887 [< 0.0001]	9.81416 [< 0.0001]	14.8566 [< 0.0001]	28.6516 [< 0.0001]

Source: own calculation

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increase in the production consumption. Sales grew, but at a slower pace than the production consumption. Indebtedness probably increased due to the growing sales and the expectations of an improving situation in the sector after the crisis. The impact of the investment subsidies (the national programme and the RDP subsidies) on other economic indicators (ROA, labour productivity, efficiency of production consumption) was not statistically significant in the period 2008–2013.

The following part of the results describes the impact analysis on the family and non-family meat processors. The national subsidies had a positive impact on the return on assets (ROA) in the **family-owned enterprises** (Table 3). The national subsidies increased the ROA by 4.32% on average and helped companies to use their assets more effectively. The national subsidies also affected the Credit Debt Ratio (Table 5) – the use of debt decreased on average by 8.91% ($\alpha = 0.05$). Family businesses use more own capital than external capital to finance the investment projects. When they finance the investment projects through the investment subsidy, they simply replace some of the bank loans by the investment grant (dead weight effect). The influence of investment subsidies on other economic indicators were not evaluated as statistically significant.

The ROA of **non-family companies** (Table 3) was significantly influenced by subsidies from the RDP ($\alpha = 0.05$). The ROA decreased by 3.09% on average. Even though the RDP policy has aimed at supporting the small and medium enterprises (which may have the nature of family businesses), the impact of the RDP subsidies is evident in the non-family companies. National subsidies from the Ministry of Agriculture increased the Credit Debt Ratio by 4.15% on average (at α =5%). No statistically significant impacts of investment subsidies on labour productivity and the efficiency of production consumption (Tables 4 and 6) have been proven.

From the company's size point of view, the national subsidies decreased the ROA indicator of **small en-**

Table 6. Binary regressors, the efficiency of production consumption

	All	F	NF	S	M	L
RDP	−0.0597 (0.1366) [0.6622]	0.0068 (0.2491) [0.9782]	−0.1216 (0.2108) [0.5644]	−0.2586 (0.2827) [0.3609]	0.0770 (0.1305) [0.5560]	−0.2338 (0.3155) [0.4614]
NS	−0.7005 (0.8199) [0.3932]	−0.1381 (0.3479) [0.6916]	−0.5757 (1.0264) [0.5753]	0.4678 (0.6194) [0.4505]	−0.1551 (0.2242) [0.4903]	−2.3483 (1.1431) **[0.0441]**
dt_4 (2011)					0.3028 (0.1772) **[0.0899]**	
dt_5 (2012)						−2.2653 (1.1710) **[0.0575]**
dt_6 (2013)						−1.7379 (0.8699) **[0.0501]**
Wald test for common significance of time dummy variables	3.1874 [0.6711]	2.5752 [0.7651]	4.8668 [0.4324]	2.9719 [0.7043]	5.0662 [0.4079]	6.6069 [0.2516]
Wald test for groupwise heteroskedasticity	$2.51–10^7$ [< 0.0001]	$4.28*10^6$ [< 0.0001]	492 942.0 [< 0.0001]	$4.69*10^6$ [< 0.0001]	$1.20*10^5$ [< 0.0001]	475.23 [< 0.0001]
Durbin-Watson statistics	1.3158 [0.0004]	0.9458 [< 0.0001]	1.6523 [0.6773]	1.3249 [0.0024]	1.5316 [0.0099]	1.2907 [0.0004]
Chow test for poolability	11.2063 [< 0.0001]	19.0558 [< 0.0001]	2.6800 [< 0.0001]	10.6320 [< 0.0001]	150.7340 [< 0.0001]	8.7746 [< 0.0001]

Source: own calculation

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terprises by 4.24% on average (Table 3). The effect of subsidies on other variables has not been proven. Moreover, the effects of the year 2012 decreased the ROA by 5.49% on average. Similar findings can be concluded in the group of **medium-sized enterprises**. The national subsidies affect significantly the ROA which increased by 4.21% on average. The impact of national subsidies and the RDP subsidies on other economic indicators did not appear. However, the medium-sized enterprises experienced the impacts of 2011, 2012 and 2013, which reduced the value of ROA by 3.83%, 6.34% and 5.72%, respectively. The year 2011 increased the efficiency of the production consumption by 0.3 CZK on average. The RDP subsidies significantly increased the labour productivity in the group of **large meat processors** (by 0.06 thousands CZK on average). It is an important finding since there was not any impact of the RDP subsidies in other size groups of companies (small, medium-sized). Although the support from the RDP was aimed primarily at the small and medium enterprises, there have been also supported large enterprises in the measure 1.1.3.2 "Cooperation for development of new products, processes and technologies (or innovations) in food industry". Another key finding is that the national subsidies had an obvious impact on the efficiency of production consumption, unlike in small and medium-sized companies. National subsidies reduced this indicator by 2.35 CZK on average. Moreover, the efficiency of production consumption was also affected by the years 2012 and 2013. There was a decrease of this indicator by 2.27 CZK (2012) and 1.74 CZK (2013). In the group of large meat processors, the national subsidies significantly increased the Credit Debt Ratio by 5.32% on average. The Credit Debt Ratio was also influenced by the individual years 2012 (an increase by 5.71% on average) and 2013 (an increase by 4.96% on average). In the same years, it also affected the level of the efficiency of production consumption.

Overall, the fixed-effect model with binary regressors shows higher impacts of investment subsidies on the economic indicators in the group of large companies where the RDP subsidies positively affected the labour productivity, and the national subsidies influenced the Credit Debt Ratio and efficiency of production consumption. In other groups of meat processors, there was the only one significant effect – an impact of national subsidies on the ROA indicator.

The RDP subsidies influenced the ROA just in the group of non-family companies (statistically

Table 7. Numeric regressors, ROA and the efficiency of production consumption

	ROA				Efficiency of production consumption		
	RDP and NS	RDP	NS		RDP and NS	RDP	NS
All	$2.40*10^{-5}$ ($5.40*10^{-5}$) [0.6567]	0.0000 (0.0000) [0.5116]	0.0004 (0.0029) [0.1378]	All	$-2.90*10^{-5}$ ($2.57*10^{-5}$) [0.2575]	$2.46*10^{-7}$ ($3.52*10^{-6}$) [0.9444]	−0.0002 ($1.10*10^{-4}$) **[0.0618]**
dt_2 (2009)	3.3724 (1.81891) **[0.065]**		5.3048 (2.4171) **[0.0309]**	dt_5 (2012)	−0.6010 (0.3285) **[0.0686]**		−1.6371 (0.8791) **[0.0661]**
dt_3 (2010)	3.3748 (1.78545) **[0.0600]**			dt_6 (2013)	−0.7064 (0.3652 **[0.0543]**		
Wald test for common significance of time dummy variables	29.3132 [< 0.0001]	48.3362 [< 0.0001]	37.7211 [< 0.0001]	Wald test for common significance of time dummy variables	5.3534 [0.3743]	4.9805 [0.4183]	6.0546 [0.3009]
Wald test for groupwise heteroskedasticity	54 892 [< 0.0001]	22 103.2 [< 0.0001]	10 108.9 [< 0.0001]	Wald test for groupwise heteroskedasticity	625 437 [< 0.0001]	532 915 [< 0.0001]	3 690.8 [< 0.0001]
Durbin-Watson statistics	1.1578 [0.0001]	1.2824 [0.0005]	0.8692 [< 0.0001]	Durbin-Watson statistics	1.2451 [0.0019]	1.5931 [0.1618]	1.1605 [< 0.0001]
Chow test for poolability	1.7875 [0.0030]	1.5944 [0.0214]	2.2868 [0.0069]	Chow test for poolability	32.4865 [< 0.0001]	56.1312 [< 0.0001]	6.7780 [< 0.0001]

Source: own calculation

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Table 8. Numeric regressors, labour productivity and the Credit Debt Ratio

	Labour productivity				Debt Bank Ratio		
	RDP and NS	RDP	NS		RDP and NS	RDP	NS
All	$-1.36*10^{-6}$ ($2.42*10^{-6}$) [0.5759]	$-1.76*10^{-6}$ ($2.10*10^{-6}$) [0.4022]	$8.07*10^{-7}$ ($1.03*10^{-5}$) [0.9382]	All	$1.69*10^{-4}$ ($8.32*10^{-5}$) **[0.0428]**	0.0001 ($5.84*10^{-5}$) **[0.0639]**	0.0005 ($2.60*10^{-4}$) **[0.0738]**
Wald test for common significance of time dummy variables	11.3933 [0.0441]	9.22788 [0.1003]	26.6064 [< 0.0001]	Wald test for common significance of time dummy variables	6.9873 [0.2216]	5.6007 [0.3470]	6.9332 [0.2257]
Wald test for groupwise heteroskedasticity	104 520.0 [< 0.0001]	95 861.6 [< 0.0001]	5 344.19 [< 0.0001]	Wald test for groupwise heteroskedasticity	104 292.0 [< 0.0001]	127 962.0 [< 0.0001]	25 914.6 [< 0.0001]
Durbin-Watson statistics	1.0685 [< 0.0001]	1.0718 [0.00000]	1.0006 [< 0.0001]	Durbin-Watson statistics	1.3510 [0.0217]	1.3080 [0.0009]	1.2606 [< 0.0001]
Chow test for poolability	7.0306 [< 0.0001]	6.6602 [< 0.0001]	6.4229 [< 0.0001]	Chow test for poolability	14.4882 [< 0.0001]	16.3153 [< 0.0001]	23.5049 [< 0.0001]

Source: own calculation

significant and positive effect), as well as the labour productivity in the group of large enterprises (statistically significant and positive effect). National subsidies had a greater effect than the RDP subsidies. National subsidies had a significant effect on the ROA in the groups of family enterprises, small and medium enterprises. National subsidies had also an impact on the Credit Debt Ratio in the groups of all companies, family owned companies, non-family companies and large enterprises. The impact on the efficiency of the production consumption in the large companies is also obvious.

Tables 7 and 8 show the results of the estimation of the fixed effect models based on **numeric regressors**. Numeric regressors represent the specific amounts of investment subsidies from the national programme and the RDP. The models assess the summary impact of both types of subsidies (the national and the RDP subsides together) and also an individual impact of each type of the subsidy. The model was estimated only in the sample of the supported companies. The sample was not divided into other specific groups. The results show that the investment subsidies affected the Credit Debt Ratio only. One thousand CZK of subsidies decreased the Credit Debt Ratio by 0.00017%. There was not any significant effect of investment subsidies on the other three indicators (ROA, labour productivity and efficiency of production inputs). When we distinguish the effect of the national and the RDP subsidies, the national subsidies had a significant effect on the Credit Debt Ratio. One thousand CZK of national subsidies increased the indicator by 0.0005%. The opposite impact had the national subsidies on the efficiency of production consumption – one thousand CZK of national subsidies decreased this indicator by 0.0002 thousands CZK. The RDP subsidies had also a significant impact on the Credit Debt Ratio. They increased this indicator by 0.0001% on average. Moreover, the ROA indicator was influenced by the market situation in 2009 and 2010, when this indicator increased by 3.37% in both years. In the case of the efficiency of production consumption, the year 2012 decreased the value of this indicator by 0.6 CZK and the year 2013 by 0.71 CZK.

CONCLUSIONS

The aim of the article was to quantify and evaluate the effects of investment subsidies in the Czech meat processing industry in the period 2008–2013 through the fixed-effect models with binary and numeric regressors. The method should be used as an alternative way of the impact evaluation when there is a lack of enterprises for the matching-based counterfactual analysis.

Investment subsidies from the RDP positively affected the labour productivity of large meat processors and the ROA in non-family companies. There was not any other significant effect of the RDP subsidies. However, subsidies from the RDP aim at the small and medium enterprises and family farms. So, the evaluation system of project applications should be improved in the new RDP 2014–2020. The policy should target on the support of more complex invest-

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ment projects, not the partial upgrading small scale investment as in the previous programming period.

National subsidies had a more significant effect on economic indicators. They increased the ROA in the family and medium-sized companies and the credit debt ratio of the non-family and large companies. Generally, investment subsidies affected the use of the bank loans as they have increased the Credit Debt Ratio. It was confirmed by both the binary and numeric regression models. The binary model also revealed the significant impact of the recent years 2012 and 2013 when the economic situation was recovering after the crisis period and the companies increased their investment activity. So, we identified the simultaneous effect of the increasing investment activity, a higher use of bank loans and investment subsidies in the last years of the “old” programming period 2007–2013.

Overall, the positive impact of investment subsidies on profitability, efficiency and labour productivity in the whole sample of 130 companies was not identified. There are only partial effects in the subsamples. It seems that the Ministry of Agriculture did not use an appropriate system of the project evaluation to ensure that only projects with a high value added and the potential to significantly improve the competitiveness of meat processors in the Czech Republic were selected for financing.

REFERENCES

Aghion P., Howitt P. (1992): A model of growth through creative destruction. Econometrica, 60: 323–351.

Anderson R., Reeb D. (2003): Founding family ownership and firm performance: Evidence from the S&P 500. Journal of Finance, 58: 1301–1328.

Arellano M. (2003): Panel Data Econometrics. Oxford University Press, Oxford.

Arellano M., Bond S. (1991): Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations, The Review of Economic Studies, 58: 277–297.

Arkarhem M., Daunfeldt S.O., Quoreshi S., Rudholm N. (2010): Do regional investment grants improve firm performance? Evidence from Sweden. Technology and Investment, 1: 221–227.

Baltagi B.H. (2008): Econometric Analysis of Panel Data. John Wiley and Sons, Chichester.

Bascou P., Londero P., Munch W. (2006): Policy reform and adjustment in the European Union: Changes in the CAP and enlargement. In: Blandford D., Hill B. (eds): Policy Reform and Adjustment in the Agricultural Sectors of Developed Countries. CABI, Wallingford.

Bergström F. (2000): Capital subsidies and the performance of firms. Small Business Economics, 14: 183–193.

Bernini C., Pellegrini G. (2011): How are growth and productivity in private firms affected by public subsidy? Evidence from a regional policy. Regional Science and Urban Economics, 41: 253–265.

Božík M. (2012): Impacts assessment of the agroenvironmental support in the Rural Development Programme 2007–2013 at the farm level. Economic of Agriculture, 1: 34–46.

Caliendo M., Kopeinig S. (2008): Some practical guidance for the implementation of propensity score matching. Journal of Economic Surveys, 22: 31–72.

Čechura L., Šobrová L. (2008): The price transmission in pork meat agri-food chain. Agricultural Economics – Czech, 54: 77–84.

Cesaratto S., Stirati A. (1996): The Economic Consequences of Innovation in Italian Manufacturing Firms: Theory and Results from the Community Innovation Survey. WP 40, ESRC Centre for Business Research, University of Cambridge.

Chen H.T. (1990): Theory-driven Evaluations. Sage, Thousand Oaks, CA.

Chow G.C. (1960): Test of equality between sets of coefficients in two linear regressions. Econometrica, 28: 591–605.

Coad A., Rao R. (2008): Innovation and firm growth in high-tech sectors: A quantile regression approach. Research Policy, 37: 633–648.

Delmar F. (1997): Measuring growth: methodological considerations and empirical results. In: Donckels R., Miettinen A. (eds): Entrepreneurship and SME Research: On the Way to the Next Millennium. Ashgate Publishing, Aldershot.

Dibrell C., Craig J.B. (2006): The natural environment, innovation, and firm performance: a comparative study. Family Business Review, 19: 275–288.

European Commission (2012): Ex-post Evaluations of Rural Development Programmes 2000–2006, Kantor. Directorate-General for Agriculture and Rural Development, Brussels.

European Commission (2014): Investment Support under Rural Development Policy. Final Report. Directorate-General for Agriculture and Rural Development, Brussels.

Freel M.S. (2000): Do small innovating firms outperform non innovators? Small Business Economics, 14: 195–210.

Geroski P.A. (2005): Understanding the implications of empirical work on corporate growth rates. Managerial and Decision Economics, 26: 129–138.

doi: 10.17221/367/2015-AGRICECON

Geroski P.A., Machin S. (1992): Do innovating firms outperform non-innovators? Business Strategy Review, 3: 79–90.

Gohin A., Latruffe L. (2006): The Luxembourg Common Agricultural Policy reform and the European food industries: What's at stake? Canadian Journal of Agricultural Economics, 54: 175–194.

Greene W.H. (2000): Econometric Analysis. Pearson Education, Harlow.

Habbershon T.G., Williams M. (1999): A resource-based framework for assessing the strategic advantages of family firms. Family Business Review, 12: 1–25.

Hanley N., Whitby M., Simpson I. (1999): Assessing the success of agri-environmental policy in the UK. Land Use Policy, 16: 67–80.

Harris R. (1991): Regional Economic Policy in Northern Ireland 1945–1988. Aldershot, Avebury.

Harris R., Robinson C. (2004): Industrial policy in Great Britain and its effect on total factor productivity in manufacturing plants, 1990–1998. Scottish Journal of Political Economy, 51: 528–543.

Harris R., Trainor M. (2005): Capital subsidies and their impact on total factor productivity: firm-level evidence from Northern Ireland. Journal of Regional Science, 45: 49–74.

Harrison R., Jaumandreu J., Mairesse J., Peters B. (2014): Does innovation stimulate employment? A firm-level analysis using comparable micro-data from four European countries. International Journal of Industrial Organization, 35: 29–43.

Harvey D.R. (1990): Agricultural sector modelling for policy development. In: Jones J.G.W., Street P.R. (eds): Systems Theory Applied to Agriculture and the Food Chain. Elsevier, London.

Hay M., Kamshad K. (1994): Small firm growth: intentions, implementation and impediments. Business Strategy Review, 5: 49–68.

Heunks F. (1998): Innovation, creativity and success. Small Business Economics, 10: 263–272.

High C., Nemes G. (2007): Social learning in LEADER: Exogenous, endogenous and hybrid evaluation in rural development. Sociologia Ruralis, 47: 103–119.

Horská E., Orémus P. (2008): Processes and problems of the marketing management adaptation at the EU market: The case of the Slovak meat processing industry. Agricultural Economics – Czech, 54: 392–398.

Kachaner N., Stalk G., Bloch A. (2012): What you can learn from family business. Harvard Business Review, 90: 102–106.

Lefebvre E., Lefebvre L.A., Bourgault M. (1998): R&D-related capabilities as determinants of export performance. Small Business Economics, 10: 365–377.

Massis A., Sharma P., Chua J. H., Chrisman J. J. (2012): Family Business Studies – an Annotated Bibliography. Edward Elgar Publishing, Northhampton.

Mezera J., Špička J. (2013): Economic effects of investment support of adding value to food products. Agris on-line Papers in Economics and Informatics, 5: 39–49.

Midmore P. (1993): Input-output forecasting of regional agricultural policy impacts. Journal of Agricultural Economics, 44: 284–300.

MoA (2015): Situační a výhledová zpráva vepřové maso 2014. Ministry of Agriculture, Prague.

Moore B. (1995): What Differentiates Innovative Small Firms? Innovation Initiative Paper No. 4, ESRC Centre for Business Research, University of Cambridge.

Ollinger M. (2011): Structural change in the meat and poultry industry and food safety regulations. Agribusiness, 27: 244–257.

Pearce D. (2005): What Constitutes a Good Agri-environmental Policy Evaluation? In Evaluating Agri-Environmental Policies. OECD Publishing.

Pohlova K., Mezera J. (2014): Analysis of development of Czech foreign trade in foods and beverages. Agris on-line Papers in Economics and Informatics, 6: 121–131.

Psaltopoulos D., Thomson K.J., Efstratoglou S., Kola J., Daouli A. (2004): Regional SAMs for structural policy analysis in lagging EU rural regions. European Review of Agricultural Economics, 31: 149–178.

Purvis G., Louwagie G., Northey G., Mortimer S., Park J., Mauchline A., Finn J., Primdahl J., Vejre H., Vesterager J.P., Knickel K., Kasperczyk N., Balázs K., Vlahos G., Christopoulos S., Peltola J. (2009): Conceptual development of a harmonised method for tracking change and evaluating policy in the agri-environment: the agri-environmental footprint index. Environmental Science and Policy, 12: 321–337.

Ratinger T., Medonos T., Hruška M. (2013): An assessment of the differentiated effects of the investment support to agricultural modernisation: The case of the Czech Republic. Agris On-line Papers in Economics and Informatics, 5: 153–164.

Roper S. (1997): Product innovation and small business growth: a comparison of the strategies of German, U.K and Irish companies. Small Business Economics, 9: 523– 537.

Scherer F.M. (1965): Corporate inventive output, profits, and growth. Journal of Political Economy, 73: 290–297.

Storey D. (1994): Understanding the Small Business Sector. Routledge, London.

Špička J., Krause J. (2013): Selected socioeconomic impacts of public support for agricultural biogas plants: the case of the Czech Republic. Bulgarian Journal of Agricultural Science, 19: 929–938.

doi: 10.17221/367/2015-AGRICECON

Tether B.S., Massini S. (1998): Employment creation in small technological and design innovators in the UK during the 1980s. Small Business Economics, 11: 353–370.

Troy D.J., Kerry J.P. (2010): Consumer perception and the role of science in the meat industry. Meat Science, 86: 214–226.

Wren C. (2005): Regional grants. Are they worth it? Fiscal Studies, 26: 245–75.

Wynarczyk P., Thwaites A. (1997): The economic performance, survival and non-survival of innovative small firms. In: Oakey R., Mukhtar S. (eds): New Technology Based Firms in the 1990s. Vol. III, Paul Chapman, London.

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