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EVALUATION OF INNOVATION SUPPORT FROM EU FUNDS IN THE MANUFACTURING OF WOOD AND WOOD PRODUCTS IN THE SLOVAK REPUBLIC

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ABSTRACT

Innovation support is extensively implemented in world, with different kind of measures and activities on all levels. Most of them are related to high tech sectors, but relatively little attention is paid to the traditional sectors with lower added value. In this article we analyse effectiveness of EU cohesion policy and its impact on competitiveness of enterprises in the sector of manufacture of woods and products of woods in Slovakia over the period 2007–2013. We use standard Cobb-Douglas production function specification where subsidy is assumed to have an impact on labour productivity through change in total factor productivity and elasticity of labour productivity to total capital stock channel. Our results suggest that the subsidy did not have expected positive short-term effect in baseline specification, but once accounting for size of subsidy there is an evidence of short term improvement in labour productivity that, however, dissipates in the following year. Introducing non-linearities to specification, the optimal size of a subsidy is estimated to be lower than the average size of subsidy granted to treated firms.

Key words: wood processing, public support, innovation, structural funds, labour productivity.

INTRODUCTION

Innovations are important for economic growth. However, the sectors and regions within different national economies are in different stages of their development and require different preconditions to be able stimulate their development (CAPELLO 2012), so it is necessary to analyse different types of sectors and their specific needs to foster their innovations activities. Generally, traditional sectors as wood processing are usually less innovative, capturing later achievements of other high tech sectors with no or very limited in house research and development (UKRAENSKI and KAJANUS 2011. This sector is dominantly supplier-dominated sector. Technological knowledge in supplier-dominated sectors is embodied mainly in the machinery, equipment, and capital assets that other sectors produce (VEGA-JURADO *et al*. 2009). Innovations among supplier-dominated firms are low in all dimensions; that is, in forms of inputs, in formal planning as well as in management attitude. Innovation mainly consists of process innovation (DE JONG and MARSILI 2006). This is also the case of Slovak republic (MERKOVÁ *et al*. 2015).

The wood processing industry is among the traditional industrial sectors in Slovakia. In number of enterprises in Slovakia is fourth highest within European Union countries in 2010 (EUROSTAT 2017). However, despite of these numbers, sector is stagnating over the years in terms of sales and value added. Despite very high number of enterprises and above average wage adjusted labour productivity, average company was much smaller than in EU in 2010. More than 97% of them are small and medium enterprises (EUROSTAT 2017). The industry in Slovakia is one of less competitive and sustainable in Europe (VOCES *et. al*. 2012) is more and more at risk of losing comparative advantage (SUJOVÁ *et al*. 2015a). Slovakia has the highest comparative advantage in trade with raw wood material (PAROBEK 2016), but nearly no advantage in higher value added production. Domestic Slovak sawmills are typically small and use technologies that result in low recovery rates and inefficient use of raw materials (KAPUTA *et al*. 2016). A large part of the firms is established in locations where production capacities have existed for several tens of years. The region must therefore tackle the lock-in problem and pays very little attention to the creation of new market in main or related sectors. Also, foreign direct investments flow into businesses in the region, taking place on the basis of the acquisitions of the existing capacities of Slovak businesses (ŠIPIKAL 2013), resulting in lack of interaction among actors (RAMENSTEINER *et al*. 2005) and lead to not very innovative environment. Foreign investment brings more innovation culture into acquired companies, especially in the field of process innovations. On the other hand, many decision regarding non incremental innovations are done outside the country (ŠIPIKAL 2013). Isolationism cause many innovation barriers that has been internal to companies – lack of understanding of need for innovation planning, limited trust to public research institutions, unwillingness of management to support innovation culture (HORŇÁKOVÁ 2006). Innovations are oriented mainly on machinery equipment, with much less attention paid to intangible assets and innovations (MERKOVÁ *et.al.* 2015). As dominant innovation strategies, bigger companies mainly focus on the purchase of new technologies, while small companies are oriented on the innovations of the existing technology with the aim to meet the requirements of the existing standards (LOUČANOVÁ *et.al.* 2017). Sector is undercapitalized and Slovak firms in the industry consider financial and capital difficulties together with the limited access to capital to be one of the most significant barriers to their development activities (MERKOVÁ *et al.* 2015, KAPUTA *et al*. 2016). This lead to comparable lower innovation activities to other important sectors in Slovakia as automotive or engineering (ŠIPIKAL 2013).

The public policy programs should help to overcome mentioned difficulties. Governments pay a lot of attention to set up appropriate measures to support innovations. Also European Union through its cohesion policy tries to stimulate innovation in less developed regions. This support is complemented with other national, regional and also local resources of the member countries with evidence showing different effects of various types and forms of support (BONDONIO and GREENBAUM 2014). Latest years, clear decline of "one size fit all" policy (TÖDTLING and TRIPPL 2005) has led to various studies on what kind of support is appropriate in different conditions, sectors or regions (CAPELLO 2012). In the literature generally prevail micro-studies exploring the impact of public aid (REINKOWSKI *et al*. 2010). The impact can be reported briefly up to run, other measures cause mid-term response and rarely have long-term effects on supported entities (RODRÍGUEZ-POSE and FRATESI 2004).

Several possible measures are also implemented in Slovakia and most of them under cohesion policy or common agricultural policy of the European Union. Some of them are directly oriented on research (e.g. a government programs of Ministry of Education (known as "VEGA programs") and Slovak Research and Development Agency (known as

“APVV programs”) allowing universities to obtain research grants for specific basic research activities or Operational Programme Research and Development mainly for applied research and development grants for research institutions as well as private companies), some on cooperation among different institutions or creation of competence or technology centres (also within OP Research and Development). There are also possibilities from rural development programs (more in SARVAŠOVÁ *et al*. 2010). Other way of stimulating innovation activities is through direct support of competitiveness of enterprises, mainly by technology transfer programs (under Operational Programme Research and Development) or improvement of quality of workforce (under Operational Programme Education and OP Employment and social inclusion).

All this support except rural development programs is not oriented on particular sectors. However, implementation of this support always affects sectors differently and has different impact on them. Usually, policies has been favoured science-based innovation and high-tech industries, with the low-tech industries receiving less explicit political attention and support (HIRSCH-KREINSEN 2008). The criteria are usually set up to support higher value added enterprises but in some cases also traditional sectors obtain quite substantial proportion of innovation support, as e.g. also in Slovakia (ŠIPIKAL *et al*. 2017). Very limited studies are done on more specific sectoral influence of general public support programs. For traditional sectors and lagging regions, as it is our case, usually support of enterprises is not oriented on high research activities, but rather towards imitation of more successful enterprises in developed regions (CAPELLO 2012). As already mentioned, innovation in low-tech industries is based more on company's enabling configuration of resources rather than through R&D. As policy response, this very often lead to technology transfer programs which should for them provide better results as direct R&D support.

In this paper, such a technology transfer program measure ‘Operational Programme Competitiveness and Economic Growth’, 1.1. Innovation and Technology Transfers, sub-measure 1.1.1 Support for Introducing Innovation and Technology Transfer is analysed. This measure covers state aid scheme to support the introduction of innovative and advanced technologies in industry and services. The scheme was open for all industrial sectors in less developed regions in Slovakia. This type of measure should be according to above mentioned studies very suitable for wood processing companies. It should help to solve their undercapitalization as well as it suits to their innovation strategies oriented on machinery equipment.

The analysis the impact of this support on selected traditional sector – Manufacture of wood and of products of wood and cork (NACE 16) was conducted. There are also other NACE sectors (Manufacture of Furniture and Manufacture of paper and paper products) including in wood processing industry, however, there was only limited number of companies supported within them, so only NACE 16 was analysed. This sector is very traditional in Slovakia and several studies deal with sector competitiveness and innovations (RAMENSTEINER *et al*. 2005; SUJOVÁ *et al*. 2015b; KAPUTA *et al*. 2016), but none of them related to policy evaluation of implemented measures. We choose one of such measures to evaluate influence of support on companies applying. Empirically, since firms in traditional sector with lower value added are neither active in patent submission nor separately record research and development expense (CAPELLO 2012), we focus our attention on investigating effects of support policy on improvement in firms’ competitiveness. We follow the argument put forward by PEETERS and DE LA POTTERIE (2005) advocating existence of close link between innovative processes and increase in labour productivity that ultimately translates into higher firm’s competitiveness. Empirically, competitiveness is defined as the nominal value of sales over number of employees (CompNet Task Force 2014). Labour productivity represents good measure of competitiveness of companies, so it is appropriate indicator of efficiency of government support.

The aim of article is to estimate effect of subsidies within mentioned measure on labour productivity of supported companies in manufacturing wood and products of woods by using standard Cobb-Douglas production function and by comparing it with changes in labour productivity of non-supported companies applying for same support.

METHODOLOGY

For our analysis, we used six calls for grant applications for businesses in Slovakia within sub-measure 1.1.1 Support for Introducing Innovation and Technology Transfer. These calls (KaHR-111SP-0801, KaHR-111SP-0902, KaHR-111SP-1001, KaHR-111SP/LSKxP-1101, KaHR-111SP-1101, KaHR-111SP) were announced on yearly basis within the 2008–2012 period. Small and medium enterprises from all NUTS 2 regions of Slovakia, except Bratislava region, were eligible to apply under this scheme. As firms were allowed to participate in more than one call, no matter their success in the previous calls, the average monetary treatment is estimated per one firm rather than one project. The original list provided by the Ministry of Finance was adjusted in the following way before used for final estimation in order to increase innate consistency of the sample. Our dataset does not include group of sole-proprietors due to high non-reliability of data as this group is not required to make their yearly financial statements public in any form, contrary to the private and public companies. Additionally, regulatory and legislative conditions imposed on sole-proprietors differ from the regulation pertaining to the business conduct of public and private limited companies.

As the programming period 2007–2013 spans over 7 years and includes six separate calls in total, no regulation prohibited any individual firm to successfully apply for the subsidy in more than one successive round. Yet, as potential effects of the subsidy are likely to influence behaviour of a firm over a medium to long time horizon as well, inclusion of firms funded by subsidy more than once might introduce strong bias into our estimates. From methodological point of view, since we introduce lags associated with subsidy dummy and monetary effects for more than one year as part of our robustness check the potential overlapping effects of multiple subsidies would simply invalidate our estimates. From this reason we keep only those firms that successfully applied for a subsidy in exactly one round (treated group) and firms that unsuccessfully applied in at least one call (control group). As per official program requirements, we require firms to be established no later than one year before a call. In order to achieve minimum requirements or size of a dataset we work with unbalanced panel dataset. As part of the robustness check we keep only those firms that report consistent data on number of employees over entire period 2008–2013. The results do not change significantly.

As common in these types of studies, the selection bias due to correlation between unobserved characteristics and participation in the program might spoil estimated outcome. We advocate that the selection bias is likely to be minimized due to the following reasons. Firstly, the assessment criteria under this scheme heavily relied on quality of project submitted rather than past or present economic performance and characteristics of a firm applying for a subsidy. Additionally, our dataset includes only those firms that applied for the subsidy, both successfully or not. On top of that, possible existence of unobserved characteristics is expected to be captured by the cross-sectional fixed effects entering all specifications. By Hausmann test, the fixed-effect estimator with individual clustered robust standard errors applied in this study delivers also more efficient estimators in comparison to random-effect model.

For total number of enterprises, whose obtain (treated) or ask for support, but not obtain (non – treated), you can see table 1. The wood processing enterprises count for 2.98 percent of supported companies. There were more unsuccessful applicants than on average (75% compare to 63.98%). Support was quite unevenly distributed among regions, especially central Slovakia obtain much smaller portion compare to its share on industry and also compare number of applicants. Even despite the fact that industry is concentrated in central Slovakia, with more than half of whole Slovak Republic production.

Tab. 1 Total number of enterprises received support from 1.1. measure.

Region	BB	KE	NT	PO	TN	TT	ZA	Total
				NACE all, except 16				
Treated	36	39	33	46	34	21	51	260
Non-Treated	76	72	63	74	59	42	76	462
Total	**112**	**111**	**96**	**120**	**93**	**63**	**127**	**722**
				NACE 16				
Treated	1	0	1	3	0	1	2	8
Non-Treated	8	1	1	4	1	2	7	24
Total	**9**	**1**	**2**	**7**	**1**	**3**	**9**	**32**

Model specification

The production function framework might serve as a basis to model growth or productivity of firms (e.g. HALL and MAIRESSE 1995; CAPRON and CINCERA 1998). In order to link innovation practices in firms with labour productivity serving as a measure of firm competitiveness we use standard Cobb-Douglas production function specification (CIN *et al*. 2014; DUCH *et al*. 2007; PEETERS and DE LA POTTERIE 2005).

Several counterfactual evaluation suggests determinants of aid effectiveness which distinctly include firm characteristics such as size of the company measured by number of employees (REINKOWSKI *et al*. 2010), with mostly expected to be negatively correlated with productivity of labor (AGUIAR and GAGNEPAIN 2017; CIN *et al*. 2014), or ownership or the age of the firm (DUCH – BROWN *et al*. 2011). Also market share could play a role, highly capital endowed companies with a bigger market share achieve comparably higher productivity (PEETERS and DE LA POTTERIE 2005; AGUIAR and GAGNEPAIN 2017).

Other determinants are related to support specifications. According to a number of empirical studies also critical for the support effect is the amount aid or support intensity (BONDONIO and GREENBAUM 2014). Important is also to undertake corporate investments that preceded the actual support and form of financing development projects (HUERGO *et al*. 2015). Not only the level but also the area of support is crucial - other effects have infrastructure projects and other are produced by soft - support projects such as education and investment in human resources (RODRÍGUEZ-POSE and FRATESI 2004). The actual impact of aid varies on the basis sector; generally greater effect on manufacturing industry compared to other sectors such as services (HUERGO *et al*. 2015).

The set of exogenous variables is represented by the X^j vector including firm, sector and regional characteristics (see Table 2). Time-invariant firm, sectoral or regional characteristics will be captured by the fixed-effect dummy variable. Time dummies capture common trend in year-to-year fluctuations in labour productivity caused by potential macroeconomic or other shocks. In order to control for size of a firm we use log of number of employees, and investment intensity.

Investments into human capital are approximated by average employee costs. Higher labour costs serves to capture higher average wage level that is often positively associated with higher quality of labour capital leading to higher firm productivity (e.g. ABOWD *et al*. 1999; BUHAI *et al*. 2008; HELLERSTEIN *et al*. 1999). Maturity of a firm is captured by the variable measured as years of activity since firm's foundation year. The dominant position of a firm within the sector is approximated by ratio of firm sales to total sales of a sector (AGUIAR and GAGNEPAIN 2017). The only time-varying sector characteristics is approximated by log of total sales per sector defined by the first number of the NACE 2 revised specification. Time variant regional differences are captured by the variables measuring level of unemployment, population living in the nearby area and level of economic development measured by GDP per capita.

Tab 2. Data Sample Characteristics and Sources.

Specification	Description	Source
Treatment	Dummy variable, 1=treated	Ministry of Economy of the Slovak republic, Slovak Innovation and Energy Agency
Monetary effect	Value of subsidy, th EUR	Ministry of Economy of the Slovak republic, Slovak Innovation and Energy Agency
Q	Total sales, th EUR	Orbis database, Register of Financial Statements Ministry of Finance of the Slovak Republic
K	Net book value of fixed assets (tangibles and intangibles), th EUR	Orbis database, Register of Financial Statements Ministry of Finance of the Slovak Republic
L	Number of employees by separate groups	Orbis database, Register of Financial Statements Ministry of Finance of the Slovak Republic
K*	Amount of fixed tangible and intangible assets, th EUR	Orbis database, Register of Financial Statements Ministry of Finance of the Slovak Republic
Cost	Employee costs, th EUR	Orbis database, Register of Financial Statements Ministry of Finance of the Slovak Republic
Age	Years of activity since foundation year	Register of Commerce of the Slovak republic
Sector dominance	Ratio of firm's sales to total sales in sector of its activity at level 1 by NACE2 rev. classification	Statistical Office of the Slovak republic
Total sales in sector	Total sales of the sector at level 1 by NACE2 rev. classification, th EUR	Statistical Office of the Slovak republic
Unemploymen t	Unemployment rate at LAU1 level, %	Statistical Office of the Slovak republic
Population	Number of citizens at LAU2 level, %	Statistical Office of the Slovak republic
GDP p.c.	GDP p.c. in current prices at NUTS3 level, th EUR	Statistical Office of the Slovak republic

We estimate the effect of EU subsidy by two models; once assuming that the subsidy affects total factor productivity of a firm and once accounting for the effect of a subsidy on elasticity of a labour productivity to total capital stock. Due to the perfect collinearity of effect on total factor productivity and effect on capital stock we estimate both models separately. Additionally, we assume that the effect of a subsidy granted in year t affects firm productivity with a lag of one year due to the administrative requirements related to the implementation of a project.

As in CIN *et al*. (2014) we express labour productivity of a firm in logarithmic form while assuming constant returns to scale ($\beta_1 + \beta_2 = 1$). Firstly, the innovation subsidies are expected to increase companies' competitiveness thus affecting the total factor productivity. This is modelled as follows:

$$\ln(Q_{it}/L_{it}) = \ln(A_{it}) + \gamma_1 \ln(A_{it}) D_{it-\mathrm{j}} + \beta_1 \ln(K_{it}/L_{it}) + \beta_j X_{it}^j + \mu_i + \theta_t \tau_t + \varepsilon_{it} \quad (1)$$

where $\mathrm{D_{it-j}}$ denotes zero-one dummy having values of one for a firm i being treated by subsidy in year $\mathrm{t-j}$, $\mathrm{X_{it}^{j}}$ is a set of other explanatory variables taken from the relevant literature, μ_i time-invariant firm-specific characteristics, τ_t time dummy for a year τ, and ε_{it} time varying error distributed independently across firms and independently across of all μ_i.

Secondly, EU funding might be expected to affect responsiveness of labor productivity to an increase of capital stock of a company while investing into purchase of new machinery or other intangible assets. This effect might be modelled in the following way:

$$\ln(Q_{it}/L_{it}) = \ln(A_{it}) + \gamma_1 \ln(K_{it}) D_{it-\mathrm{j}} + \beta_1 \ln(K_{it}/L_{it}) + \beta_j X_{it}^j + \mu_i + \theta_t \tau_t + \varepsilon_{it} \quad (2)$$

where $\mathrm{D_{it-1}}$ denotes zero-one dummy having values of one for a firm i being treated by subsidy in year $\mathrm{t-j}$, $\mathrm{K_{it}}$ level of capital stock for a firm i at time t, $\mathrm{X_{it}^{j}}$ is a set of other explanatory variables taken from the relevant literature, μ_i time-invariant firm-specific characteristics, τ_t time dummy for a year τ, and ε_{it} time varying error distributed independently across firms and independently across of all μ_i.

Estimation of the models (1) and (2) as a special case of the error component models requires a special approach. When μ_i is a random component with a distribution independent of the observed right-hand side variables, then the conventional generalized least squares produces consistent and efficient estimator. However, if the firm specific effect is correlated with ε_{it} due to the existing link between $D_{it-\mathrm{j}}$ and μ_i, then the OLS estimator of the policy parameter γ_1 could produce a simultaneity bias. Since our dataset includes only firms that applied for the subsidy, thus manifesting the so-far unobserved innate abilities to some extent, we assume that the simultaneity bias is to be reduced.

From the policy makers' point of view it might be important to reveal optimal size of a subsidy expressed in monetary terms. If there exists an optimal size of a subsidy the non-linear nature of link between labour productivity and subsidy size will be captured by inclusion of squared term in equations [1] and [2]. Hence, the model in [1] is adjusted in the following way with size of a subsidy replacing the dummy variable:

$$\ln(Q_{it}/L_{it}) = \ln(A_{it}) + \gamma_1 \ln(A) \varphi_{it-\mathrm{j}} + \gamma_2 \ln(A) \varphi_{it-\mathrm{j}}^2 + \beta_1 \ln(K_{it}/L_{it}) + \beta_j X_{it}^j + \mu_i + \theta_t \tau_t + \varepsilon_{it} \quad (3)$$

where $\varphi_{\mathrm{it-j}}$ denotes value of the EU subsidy to a firm i in year $\mathrm{t-j}$, $\mathrm{K_{it}}$ level of capital stock for a firm i at time t, $\mathrm{X_{it}^{j}}$ is a set of other explanatory variables taken from the relevant literature, μ_i time-invariant firm-specific characteristics, τ_t time dummy for a year τ, and ε_{it} time varying error distributed independently across firms and independently across of all μ_i.

In this manner, the model in [2] is adjusted to account for a non-linear relationship between labour productivity and EU subsidy in the following way:

$$\ln(Q_{it}/L_{it}) = \ln(A_{it}) + \gamma_1 \ln(K_{it}) \varphi_{it-\mathrm{j}} + \gamma_2 \ln(K_{it}) \varphi_{it-\mathrm{j}}^2 + \beta_1 \ln(K_{it}/L_{it}) + \beta_j X_{it}^j + \mu_i + \theta_t \tau_t + \varepsilon_{it} \quad (4)$$

where $\varphi_{\mathrm{it-j}}$ denotes value of the EU subsidy to a firm i in year $\mathrm{t-j}$, $\mathrm{K_{it}}$ level of capital stock for a firm i at time t, $\mathrm{X_{it}^{j}}$ is a set of other explanatory variables taken from the relevant literature, μ_i time-invariant firm-specific characteristics, τ_t time dummy for a year τ, and ε_{it} time varying error distributed independently across firms and independently across of all μ_i.

As discussed in the previous section, the ε_{it} must fulfill all the standard conditions and effect of subsidy is expected to materialize one year after subsidy had been granted.

The effect of subsidy is assumed to materialize with one year lag in baseline specification, hence putting j equal to one in (1) to (4). As part of the analysis investigating sustained effects of subsidy we estimate (1) to (4) with j equal to two (two-year lagged effect). However, these results should be taken with enough grain of salt as clustering of support granted in 2011 and 2012 years decreases number of treated firms to half in this subsample.

RESULTS AND DISCUSSION

Before economic modelling of the subsidy effects, the comparison of supported enterprises with other sectors shows that grant receivers are smaller companies (average number of employees was around 35% compare to average of all enterprises), with much lower average cost per employee. More detailed comparison is in table 3.

Tab. 3 Comparison of supported enterprises.

Variable	All enterprises		NACE 16	
	Mean 2008	Mean 2013	Mean 2008	Mean 2013
Sales per employee	134.27	132.68	167.71	73.64
# of employees	101.62	93.94	38.40	31.60
Cost per employee	12.59	13.31	6.97	7.61
Capital intensity	49.44	77.61	52.40	37.79
Age (years)	9.15	14.15	6.20	11.20
Monetary treatment (EUR)	782 798		517 881	

As can be seen, also average grant awarded and cost per employees are smaller than average. However, key difference is regarding development of sales per employees, which goes down quite dramatically in supported companies in the sector as result of crisis, even when comparing with non-treated firms in NACE 16 (they only dropped by 20%).

The EU subsidy aims to motivate build-up of innovation potential of treated firms that will lead to increase in capital stock as well improvement in its utilization in its initial phases. If the transfer or innovation practices are successful, it will be ultimately translated into increase in labour productivity leading to better competitiveness. Based on this reasoning, in this section we present results of estimations analysing change in labour productivity in treated firms by fixed effect estimator (Table 4).

Model I (column 1 and 2) investigates presence of improvement in total factor productivity with and without sector dominance variable. Firms achieving higher share on total sectoral production are associated with higher labour productivity, a finding robust across all specification. Our outcomes are expected to be robust to potential effects of endogeneity due to the inclusion of this variable (higher productivity improves sector dominance), as estimations across all models are stable and keep their statistical (in-) significance.

In both cases the baseline specification with dummy variable distinguishing supported from non-support firms does not deliver statistically significant results. This confirm mixed results from previous studies. Support for firms to increase their innovation activities and competitiveness has or should have regularly positive impact in terms of stated objectives of policy measures (REINKOWSKI *et al*. 2010), but some studies show not significant, zero or even negative effects of public interventions to support innovation (LACH 2002). Hence, in this specification the EU subsidy did not lead to improvement in utilization of capital via various channels (R&D development, increasing labour expertise or introduction of new innovative practices) into production process. The same holds for models estimating possible effects of EU subsidy on capital elasticity of labour production (Model II, column 3 and 4). This was probably due only later purchase of similar technologies in these companies. It looks like this support only led to distort competition without very high impact on the productivity of the sector. These results are similar to be found by qualitative studies (ŠIPIKAL 2013). In this respect, however, this sector is not different from other industrial sectors.

Contrary to the standard estimations with dummy variable, models III and IV integrating size of a subsidy into regression specification deliver statistically significant results in all specification at 5 and 1 percent level of significance. On top of that, the existence of optimal thresholds for subsidy size is confirmed by statistically significant negative sign associated with squared term of treatment variable. Hence, taking into account not only a simple act of granting subsidy (dummy variable) but also volume effects of such a subsidy seems to be crucial. On average, nonlinear function linking labour productivity and EU subsidy achieves its optimum around 336 th EUR for model III (total factor productivity) and very similar for model IV (elasticity of substitution).

On one hand, improvement in R&D and innovation processes and utilization of capital requires not only longer time to materialize, but is also likely to be associated with higher requirements on monetary support. On average, the value of subsidy granted in our sample of firms (Table 2) is set around 517 th EUR, an amount which represents around double of optimal value of subsidy derived from our model. Hence, majority of firms tend to find themselves in a region of increasing total returns to labour productivity given the size of a subsidy. This might suggest that this sector is more technologically demanding than the EU subsidy initially assumed requiring higher funding for expenditures on R&D and innovation processes. Since we do not have data that would allow for a more disaggregate analysis we cannot specify the channel through which the change occurs but can only conclude that the funding has been used to improve labour productivity. On the other hand, shift to optimal improvement in output elasticity of capital does not depend on higher subsidy expenditure as the threshold is set at approximately 336 th EUR. This is different compared to all enterprises where the optimal level was more than twofold higher than average support (SZITÁSIOVÁ *et al*. 2016). Since the EU subsidy allows also for replacement of old-fashioned technologies by newly created ones the pure act of replacement leading to higher labour production elasticity might be delivered by a lower amount of money than average subsidy.

Among the set of control variables, negative coefficient for size of a firm approximated by size of labour force might point to the negative returns to scale in case of the labour as an input factor of production, as indicated also in other studies (e.g. CIN *et al*. 2014, AGUIAR and GAGNEPAIN 2017). In other words, indication of the negative marginal returns to labour should lead companies to substitute labour for capital in order to increase their productivity, a behaviour that we expect firms included into our dataset to follow. Additionally, firms in this sector tend to benefit from smaller size allowing them to utilize production inputs in a more efficient way rather than suffering from diseconomies of scale as in the case of bigger firms (e.g. co-ordination problems, X-inefficiency). However, this factor should be studied and discussed in more details in order to be able to understand this result since the literature does not provide a decisive empirical evidence on effects of size on productivity (e.g. CIN *et al*. 2014 reports negative effect, DUCH *et al*. 2014 reports positive effect).

Tab. 4 Support effects estimates.

Model	Model I		Model II		Model III		Model IV	
Constant	27.47	29.77	28.31	30.71	35.07	36.60	35.38	37.00
	(0.269)	(0.288)	(0.249)	(0.265)	(0.135)	(0.174)	(0.124)	(0.160)
L1.treatment	0.057	0.122						
	(0.722)	(0.467)						
L1.treatment*ln(K)			0.012	0.022				
			(0.594)	(0.366)				
L1. Monetary effect					**1.202****	**1.385****		
					(0.017)	**(0.020)**		
L1. Monetary effect squared					**-1.788*****	**-1.851*****		
					(0.000)	**(0.001)**		
L1. Monetary effect*ln(K)							**0.191*****	**0.218****
							(0.008)	**(0.010)**
L1. Monetary effect squared*ln(K)							**-0.286*****	**-0.294*****
							(0.000)	**(0.000)**
Age	0.010	-0.017	0.009	-0.017	0.030	-0.000	0.030	0.000
	(0.844)	(0.760)	(0.856)	(0.758)	(0.524)	(0.995)	(0.545)	(1.000)
Size = ln(L)	**-0.567*****	**-0.438****	**-0.570*****	**-0.443****	**-0.579*****	**-0.443****	**-0.584*****	**-0.450*****
	(0.000)	**(0.016)**	**(0.000)**	**(0.013)**	**(0.000)**	**(0.018)**	**(0.000)**	**(0.009)**
Capital intensity = ln(K/L)	**0.215****	**0.319*****	**0.213****	**0.316*****	**0.212****	**0.322*****	**0.210****	**0.319*****
	(0.036)	**(0.005)**	**(0.036)**	**(0.005)**	**(0.037)**	**(0.005)**	**(0.039)**	**(0.005)**
Employee costs = ln(Cost/L)	**0.175****	**0.197***	**0.173****	**0.194***	**0.172****	**0.194***	**0.170****	**0.191***
	(0.034)	**(0.065)**	**(0.035)**	**(0.065)**	**(0.029)**	**(0.063)**	**(0.030)**	**(0.064)**
L1.ln(Sector dominance)	**0.268***		**0.264***		**0.287***		**0.284***	
	(0.095)		**(0.099)**		**(0.076)**		**(0.078)**	
L1.ln(Unemployment)	0.221	0.349	0.226	0.351	0.183	0.321	0.185	0.321
	(0.263)	(0.136)	(0.253)	(0.132)	(0.357)	(0.174)	(0.345)	(0.173)
L1.ln(Population)	-0.205	-0.443	-0.258	-0.496	-0.469	-0.702	-0.483	-0.718
	(0.839)	(0.733)	(0.797)	(0.700)	(0.621)	(0.585)	(0.606)	(0.572)
L1.ln(GDP p.c.)	-1.155	-1.401	-1.181	-1.429	-1.475	-1.689	-1.488	-1.703
	(0.373)	(0.316)	(0.357)	(0.299)	(0.233)	(0.205)	(0.221)	(0.192)
Time dummies	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**	**YES**
R_2	**0.827**	**0.815**	**0.827**	**0.816**	**0.840**	**0.826**	**0.840**	**0.827**
F	**152.38**	**93.76**	**153.13**	**94.83**	**236.29**	**165.04**	**232.21**	**160.07**
Number of observations	**127**	**130**	**127**	**130**	**127**	**130**	**127**	**130**
Number of groups (firms)	**29**	**30**	**29**	**30**	**29**	**30**	**29**	**30**
Optimal monetary effect I (th EUR)					336 065	374 100		
Optimal monetary effect II (th EUR)							336 136	370 308

Note: * denotes significance at 10 percent level, ** denotes significance at 5 % level, *** denotes significance at 1 % level. P-values in parenthesis. Treatment represents zero-one dummy variable for EU subsidy. Monetary effect stands for value of EU subsidy in EUR. K denotes stock of fixed assets (tangibles and intangibles), L number of employees. Source: authors´ calculation.

Age of a company does not contribute to firm's performance in any of specification, finding not uncommon in other studies (CIN *et al.* 2014). The labour productivity is positively associated with the capital intensity captured by capital-labour ratio as building up of both tangible and intangible assets should lead to higher performance. The projects supported by this particular EU subsidy allows for replacement of old-fashioned technologies by new ones, a fact that should positively contribute to improvement of labour productivity and competitiveness via this channel. These outcomes are in line with prevalent empirical studies (PEETERS and DE LA POTTERIE 2005; CIN *et al*. 2014). Such a need was identified also in Slovak conditions (KAPUTA 2016).

Investments into human capital (average labour costs per employee ratio) are expected to bring about positive increase in labour productivity (CIN *et al*. 2014), as confirmed by statistically significant and highly positive elasticity coefficient in all specifications.

Regional characteristics are not significant, in all cases. However, the results might be biased do the missing data on lower than NUTS3 or LAU1 level for GDP p.c. or unemployment rate variable, respectively. Additionally, due to relatively small number of firms entering our dataset located in just a few regions (feature of the NACE16 sector) the regional characteristics might not play a significant part in specifying differences in labour productivity.

Due to the time dimension of our dataset (6 years in total) and clustering of EU support for NACE16 sector in later years of 2007–2013 programming period, the analysis of a delayed effect for robustness purposes was restricted to the lag of order 2. The effect of a subsidy seems to evaporate shortly after one year as no significant effect is found for lag 2. We are inclined to attribute this outcome to some of the following hypotheses. Firstly, a possible high speed of adjustment among non-treated firms reacting to increase in competitiveness of treated firms might lead to loss of statistical significance in subsequent year. Secondly, while first year positive effects might be induced by the introduction of new technologies or replacement of written-off capital stock, the consequent year is likely to be adversely affected by rise of operational costs related to newly-utilized capital or newly-hired employees. Lastly, assuming higher substitutability between labour and capital, initially positive effect might be just driven by an eventual reduction of lower-skilled labour force that formally leads to improvement in the labour productivity.

Another reason could lie in support of enterprises not in the regions with high concentration of wood processing sector. Sector is concentrated in Central Slovakia, as also number of applications for support suggests, but comparably fewer enterprises were supported in this region. Most of supported enterprises cannot take an advantage from sector concentration within the region, which could eliminate effect of support. As potential policy implications, the support should be extended behind just allowing the technology replacement, but better evaluate and understand level of technology upgrades within projects. Also, evaluate not only the project of the company, but wider environment around this company that could influence the support utilisation. The total amount of grants could be set to a slightly lower level per project than in these calls.

The inefficiency of the policy can also be caused by the policy itself. In general, it is the pick of winners and the weakness of government institutions to make adequate choices (STOREY, 1994). Inappropriate project selection occurs more often when different projects of different sectors are evaluated under one call (ŠIPIKAL 2015), because projects are often not evaluated by people directly aware of the sectors in detail, supporting the inappropriateness of "one size fits all" policy (TÖDTLING and TRIPPL 2005).

The technology transfer is one of most wanted and most used way of improvement competitiveness in wood processing industry (MERKOVÁ 2015), including manufacture of woods and products of woods. As study show, the direct support for this transfer is inefficient and do not lead to significant improvement. This could lead to several possible policy implications. If the companies only used the support as ordinary technology replacement, then it required better definition and selection of projects within measure or support the measures aimed at higher level or more direct innovation activities as introduction of new products or cooperation with public research institutions. Another possibility is, that declared financial barriers by companies are not the main reasons for lower innovation activities in reality and policy should focus on activities generally more accepted as innovation drivers as common projects with public research or improvement of innovation culture within companies (especially small and medium ones), as suggested by other studies from countries with similar conditions (UKRAENSKI and KAJANUS 2011, RATNASINGAM *et al.* 2013)

CONCLUSIONS

The support of enterprises from cohesion policy under sub measure „Support for Introducing Innovation and Technology Transfer" was analysed and showed only limited benefits for wood processing enterprises. Most of the projects resulted in only a slight variation and upgrade technology, the overall effect is shown only as a short-term compared with companies that did not receive support. The size of firm, capital intensity and sector dominance were statistically significant variable influencing the effect of subsidies.

In the second model, the significance of amount of support play an important role, suggesting the support allowing more complex and more costly solution brings better results in productivity improvement. However, the optimal size of support was lower than real average support, indicating the overspending regarding the level of support. For small and medium enterprises probably lower level of project support will be satisfactory, allowing more project to be supported.

For further research, also the longer evaluation period will be interesting to analyse and influence support on enterprises' research or product innovations. Also, longer term analysis could answer longer term impact of subsidies that may not by visible after only few years.

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