Center for European, Governance and Economic Development Research

Discussion Papers

Number 236 – March 2015

EFFECTIVENESS OF PUBLIC INNOVATION SUPPORT IN EUROPE DOES PUBLIC SUPPORT FOSTER TURNOVER, EMPLOYMENT AND LABOUR PRODUCTIVITY?

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ISSN: 1439-2305

Effectiveness of public innovation support in Europe

Does public support foster turnover, employment and labour productivity?

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Abstract

In the European Union (EU), twenty Member States offer public innovation support for private research and development (R&D) activities through either subsidies or a combination of tax cuts and subsidies. Existing studies show ambiguous results regarding the effectiveness of public innovation support in different countries. Accordingly, following a description of the current public innovation framework in Europe, this paper analyses data from the European Community Innovation Survey concerning the effectiveness of public support. The measures chosen relate to changes in turnover as well as the number of employees and labour productivity (measured as turnover per employee) between 2006 and 2008. The paper finds a positive influence of public innovation support on labour productivity in an innovating company, a negative influence on turnover changes and a negative yet not significant influence on the development of employment. The influences of these factors are very weak, whereas other coefficients such as the money spent on innovative activities clearly show positive effects for all three indicators.

Key Words

Innovation, innovation support, labor productivity, Europe, effectiveness

JEL Classification

O31, O38, H21

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1 Introduction

Governments often use public subsidies or tax credits to foster private innovative activities, aiming to increase the competitiveness of firms in a jurisdiction. Existing studies have already analysed the effect of public innovation support on private R&D/innovation[1] spending, usually measured as additionality; however:

‘We should not forget that, in relation to society as a whole, the R&D effort should be taken as a “means” rather than exclusively as an “end”. The objective of society should be that of increasing national firms' performance (productivity, profitability, and degree of innovativeness) to improve living standards, economic growth and so on. This means that linking R&D additionality due to subsidy programmes to firm output performances is a necessary step to give a complete account of “subsidy effectiveness”.’ (Cerulli 2010: 445)

Therefore, this paper analyses whether publicly induced innovative activities foster the competitiveness of the companies supported. Regarding the aims of public innovation support programmes, supported companies should become more competitive as a result of receiving support. In Asplund (ed. 2000), different authors analyse the Finnish Tekes programme[2] and find mixed results, while a recent study by Becker (2013) also finds mixed results in Germany. However, these existing studies focus on single countries or on a comparison between only a few countries or a small number of companies.

Accordingly, this study enlarges the picture by adding a European perspective, with fifteen European countries included. In particular, it analyses the development of labour productivity (measured by the turnover per employee) as well as the development of employees and turnover between 2006 and 2008 as indicators of competitiveness. Additionally, it investigates the development in the number of employees and the turnover.

With these three factors, this paper expands the analysis of effectiveness of public innovation support, evaluating the supported companies regarding competitiveness in Europe.

An overview on the existing landscape of public innovation support within the EU is provided in the first part of section two, which shows that the vast majority of twenty European countries offer either subsidies or tax cuts and subsidies for private R&D investment.

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[1] Within the overview, R&D includes other innovative activities, as mentioned in European Commission (2013) or Busom et al. (2012). Therefore, R&D is always used synonymously with R&D&I and innovation in general in this paper.

[2] Tekes is the innovation support agency in Finland (Tekniikan edistämiskeskus - Center for Advancement of Technology).

A brief overview of the literature forms the basis of this study, before different measures to evaluate the effectiveness of public support in general are elaborated from existing studies.

The hypotheses, developed in the third section, show the different aspects of effectiveness of innovative activities and subsidies. Section four describes Eurostat's Community Innovation Survey (CIS); in particular, the chosen method of matching supported and not publicly supported companies is presented due to the problem of non-randomness of selection. The results and conclusions of the analysed data are presented in the fifth section, before section five concludes.

2 Literature review

2.1 Public innovation support in Europe

Most EU Member States according to the EU State Aid Scoreboard 2013 (European Commission 2013) offer public support for private innovative activities. Aside from Germany, Lithuania and Sweden, all countries offering public innovation support grant both direct subsidies and tax credits (see Table 1).

For the OECD members, Busom et al. (2012: 2) state the following:

'Canada, the Netherlands and Japan rely mostly on tax incentives, while direct funding is still preferred in Sweden, Finland or Germany. Other countries use both instruments simultaneously: France, Denmark, Spain, the United Kingdom and the United States.'

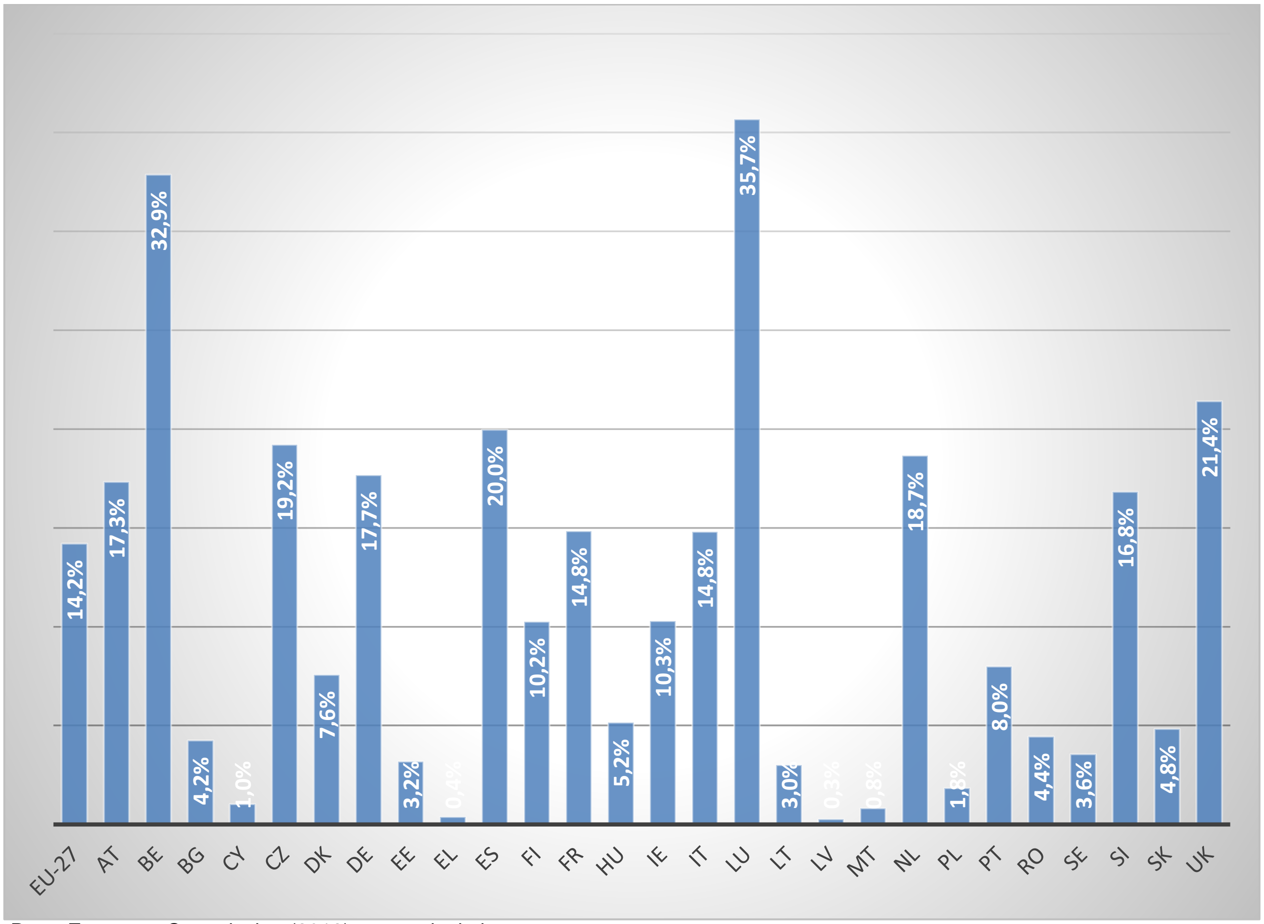
Nonetheless, in terms of those countries using both instruments simultaneously, differences in the relation become visible (see Busom et al. 2012: 38).

Table 1: Forms of public support for private R&D in the EU

Direct subsidies	*Direct subsidies and tax credits*	*No relevant public innovation support**
• **Germany**	• Austria	• **Bulgaria**
• **Lithuania**	• Belgium	• Cyprus
• Sweden	• **Czech Republic**	• **Estonia**
	• Denmark**	• Greece
	• Finland	• **Latvia**
	• **France**	• Malta
	• **Hungary**	
	• Ireland	
	• Italy	
	• **Luxembourg**	
	• **The Netherlands**	
	• Poland	
	• Portugal	
	• **Romania*****	
	• **Slovak Republic**	
	• **Slovenia**	
	• **Spain**	
	• United Kingdom	

Source: Adapted from European Commission (2013) in combination with OECD (2013) and OECD (2011: 271–315); Notes: * All countries spending less than 3% of their total aid budget in 2012 are appointed to this category. ** OECD (2011: 283) claims no public innovation support for private R&D in Denmark, while other sources show both tax incentives and public subsidies. *** Between 2007 and 2012 Romania reduced its spending on R&D support nearly to zero; countries included in this study in bold.

Figure 1: Relative share of public support of R&D (&I) among total public aid (average of 2007-2012)



Data: European Commission (2013); own calculations.

2.2 Additionality of public innovation support in Europe

Czarnitzki et al. (2011), Duguet (2004) and Grossman et al. (1994: 37–8) find general reasons why private companies under-invest in innovation activities, citing the uncertainty of success and the characteristics of a public good.

Every Member State offers public innovation support, as well as the EU itself and many sub-national jurisdictions. Furthermore, recent studies show differences between the different political levels (Fernández-Ribas 2009; Busom and Fernández-Ribas 2007; Becker 2013).

All studies for the EU and its Member States show partial or complete additionality of public support, which at least means that public support does not completely crowd out private investment in R&D and innovation.[3] Duguet (2004: 272) for France, Aerts and Czarnitzki (2004: 16) for Belgium and Czarnitzki and Fier (2002: 17–8)-18) as well as Lehmann and Stierwald (2004: 128) for Germany show the additionality of public innovation support. Furthermore, Busom (2000: 133) for Spain and Görg and Strobl (2007: 17)) for Ireland stress that crowding-out can be ruled out at least for several companies – e.g. domestic firms that received small grants in Ireland – while these two studies do not completely rule out crowding-out. Krohmer's (2010: 51) meta-analysis of 57 studies focusing on R&D support in Germany also shows no general crowding-out of private investments. Thus, this paper assumes at least partial additionality and at most partial crowding-out in the EU.

Outside the EU, Wallsten (2000: 97–8) shows crowding-out in the United States, whereas Levy (1990: 172)) and Hall and van Reenen (2000: 462) find different results. Hall and van Reenen (2000: 462) describe that one dollar of public innovation support generates one additional dollar of private investment in North America. For state programmes in the USA, Atkinson (1991: 563) finds differences in the effectiveness between states; for instance, it is higher in Michigan and Pennsylvania compared with Illinois and Massachusetts.

Regarding the private investment induced, a similar study by Fier and Czarnitzki (2005: 4) for Germany shows a smaller effect of €0.28 of private investment induced by one euro of public spending. By contrast, Hussinger (2008: 743) also finds a complete additionality of R&D for the German manufacturing sector, whereby one euro of public subsidies on R&D stimulates another euro of private R&D investment.

A recent study by Radicic and Pugh (2013: 18) shows that public institutions face a selection problem, which reduces the positive effect of public innovation support. Public institutions have a tendency towards a *'picking the winner'* strategy to evade information problems about the firms applying for innovation support, as Cantner and Kösters (2012: 932–3) outline. These factors reduce additionality and thus lead to a greater degree of crowding-out.

Nonetheless, regarding additionality, the empirical results in Europe present a clear picture that public innovation support induces additional private innovative activities and crowding-out is at least not a general problem.

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[3] Despite not always being synonymously used, for this study R&D spending and innovation spending can be perceived synonymously. For the differences compare the Oslo, OECD (1997), and Frascati, OECD (2002), manuals of the OECD or for a (German) definition of R&D also Haverkamp (2007: 34–5).

2.3 Effectiveness measures of public support

With respect to the effectiveness of public innovation support, a first indicator of the effects towards the entire society is defined with the social rate of return (Griliches 1992: 31–2). Nonetheless, this indicator remains very abstract and difficult to implement empirically.

A comparison of different innovative support schemes - such as between Finland and Germany in Czarnitzki et al. (2007) - also shows effects of public innovation support on R&D activity similar to those mentioned in section 2.2.

Clausen (2009: 242) distinguishes between *'far from the market'* (research) and *'close to the market'* (development), concluding that support *'far from the market'* stimulates private R&D more strongly and with a higher social rate of return (Clausen 2009: 251).

Regarding the effect on a company's sales, Hussinger (2008: 743) shows a positive effect of both R&D efforts in general and publicly induced R&D efforts on the new product sales of a company in Germany.

For Finland, Lehtoranta analyses the growth pattern and labour productivity of firms supported by the *'Tekes'* programme, suggesting that public innovation support positively influences both the growth pattern (Lehtoranta 2000: 27) and labour productivity (Lehtoranta 2000: 31–2). In the same book, Maliranta (2000b: 61–2) finds a less clear effect on productivity growth in general: while he highlights a positive effect at the industry level, the observations of one period had to be removed as outliers before finding a positive effect.

SMEs particularly benefit from industry-specific R&D support (Maliranta 2000a: 117). Job creation is only supported for private R&D, while the effect for publicly-financed R&D is *'ambiguous'* (Maliranta 2000a: 117). A recent paper by Pajarinen and Rouvinen (2014)[4] summarizes that the effect of *'Tekes'* on labour productivity has been rejected by more recent studies, although the authors strongly criticize the approach of such studies.

As another factor of effectiveness, Afcha and García-Quevedo (2014: 18) analyse the development of employees working in R&D. They find a positive influence in general but no significant effect for regional subsidies in Spain.

Bogliacino et al. (2014: 33–4) adopt a broader perspective on labour effects, analysing the labour effect in general, rather than restricted to R&D employees. For a relatively small sample of 677 European firms, they emphasize that service and high-tech sectors show stronger effects, in contrast to no effect in traditional manufacturing. They find a small yet significant effect of

[4] Unfortunately, the report itself is only available in Finnish (apart from the abstract) but based upon the abstract, correspondence with the authors and translation programmes, the work of the paper is summarized here.

R&D investment increasing a company's employment, but they also argue that process innovations are generally labour-unfriendly.
Analysing the development turnover and return on sales, Becker (2013: 13) finds unclear results for the influence of public innovation support granted by the state and the European level in Germany (see Table 2). A positive impact is only clearly supported at the federal level.

Generally, the empirical evidence shows a certain ambiguity and mainly small effects are detected independent of the indicator. Aside from one study that uses a very small dataset, none of the studies analyses the EU as a broader entity. As indicators, labour productivity in Finland, sales in Germany or employees in Spain or Europe form an interesting basis for the further analysis of competitiveness.

Table 2: Effects of public support on turnover and return on sales (logistic regressions, logit)

	Turnover rise (turnup)					*Turnover fall (turndown)*					*Return on sales rise (rosup)*					*Return on sales fall (rosdown)*				
	Coef.	*Std. Err.*		*Odds Ratio*		*Coef.*	*Std. Err.*		*Odds Ratio*		*Coef.*	*Std. Err.*		*Odds Ratio*		*Coef.*	*Std. Err.*		*Odds Ratio*	
suppst	-0.1640	0.1139		0.8487		0.2316	0.1156	**	1.2606	**	0.0015	0.1304		1.0015		0.0758	0.1796		1.0787	
suppfe	0.6039	0.1116	***	1.8292	***	-0.6078	0.1152	***	0.5445	***	0.5279	0.1158	***	1.6954	***	0.1483	0.1661		1.1599	
suppeu	0.2172	0.1499		1.2426		-0.2123	0.1539		0.8087		-0.2907	0.1696	*	0.7477	*	-0.2406	0.2417		0.7861	
_cons	0.3614	0.0278	***	1.4354	***	-0.5254	0.0283	***	0.5913	***	-1.3857	0.0341	***	0.2501	***	-2.2453	0.0464	***	0.1059	***
LR chi²(3)	*43.87*					*40.13*					*22.44*					*1.67*				
Prob > chi²	*0.0000*					*0.0000*					*0.0001*					*0.6442*				
Pseudo R²	*0.0054*					*0.0050*					*0.0036*					*0.0004*				

Data: ZEW MIP 2007; Notes: Calculated with Stata (2014); *** denotes significance at 1% level; ** at 5% level; * at 10% level.
Source: Becker (2013: 13).

3 Hypotheses

While existing studies have addressed different aspects of public innovation support, this study focuses on effectiveness. For this purpose, the study considers different aspects of competitiveness in a European context:

Hypothesis 1: R&D investment increases a firm's competitiveness.

Although political actors claim increased competitiveness to be one main aim of public innovation support (Atkinson 1991: 573), the effect is unclear in other studies (González Cerdeira and Pazó Martínez 2008: 385). A detailed analysis of different aspects is necessary, as Maliranta (2000b: 70) claims that '*the return to R&D seems to be clearly negative for medium-sized firms only'*, whereas Lang (2009: 1438) suggests that '*recent data seems to confirm the positive effect of research input on productivity dynamics'*.

Therefore, positive average treatment effects of the treatment is expected.

Hypothesis 2: Public support for private R&D investment increases a firm's competitiveness.

Public innovation support is justified through potential under-investment in R&D due to the problem of uncertainty and the non-excludability of the results of successful innovation projects. Therefore, reducing under-investment results in increased competitiveness for the company supported. Moreover, other influences also have to be considered, including the general market surrounding and the situation in a country.

All countries with public innovation support claim the aim of fostering their innovativeness and the competitiveness of their economies by supporting R&D. Therefore, an effect at the micro-level is a necessary precondition for achieving the aims at the macro-level. Maliranta (2000a: 106) ascertains that *'manufacturing firms supported by Tekes have been able to create jobs in net terms at a considerable rate since 1994'*, thus supporting this hypothesis.

A positive yet smaller effects of the public support variables in the regressions is expected.

Hypothesis 3: Different countries achieve different levels in their effectiveness of public innovation support.

Resulting from hypothesis 3, as well as different support schemes and innovative frameworks in the different EU Member States, differences between countries exist, including in the effectiveness of public innovation support. One such example of a difference is between

Luxembourg and Portugal, which are the countries that, in recent years, have seen the highest increase in public R&D support: while Luxembourg already had a very high level of public innovation support, Portugal has merely built up its innovation support from scratch in recent years. Moreover, while Luxembourg only has half a million inhabitants and about 2,500 square kilometres, Portugal has 10.5 million inhabitants and a land area of more than 92,000 square kilometres. These factors prompt different effects, which influence the effectiveness of innovation support. For example, the control of public support is easier in Luxembourg, increasing the effect in comparison with Portugal, whereas the variety of firms supported is probably higher in a larger country with a more diversified economy, which creates a positive effect for Portugal compared with Luxembourg – in addition to other country effects.

Accordingly significantly different dummy variables for at least some of the participating countries are expected.

4 Data and methods

4.1 Data

Eurostat's CIS offers the possibility to use harmonized data[6] for the relevant EU Member States. I use data from the 2008 data wave, which include more variables concerning the total amount of R&D spending in a firm compared with later data waves. Regarding the questions mentioned, the dataset uses data from almost all the countries mentioned above that offer public innovation support. Some countries such as Cyprus, Finland, Italy or Sweden are dropped due to having either missing data or data that are not harmonized. Problems in the harmonization of the CIS are well described in Mairesse and Mohnen (2010: 1147), prompting the need for stronger harmonization, at least for some core variables. Additionally, firms complete the CIS questionnaire subjectively, which also creates problems (Mairesse and Mohnen 2010: 1137).

As the CIS is an unbalanced panel,[7] the analysis uses the data as cross-sectional data. Nonetheless, the variables for turnover and the number of employees are included lagged from both 2006 and 2008. Although this is not a classical lag by a panel, the questionnaire includes a question concerning the same figures from two years before. However, these two variable pairs are used to calculate differences in turnover and employee numbers, as well as labour productivity. The sample comprises 29,451 firms.

[6] For details see OECD (1997).

[7] In an unbalanced panel a firm might be dropped in one year after participating earlier in the panel and might return in a later year.

Table 3: Summary characteristics of variables by reception of public innovation support

	Untreated (fungen=0)		*Treated (fungen=1)*	
	Mean	*Std. Dev.*	*Mean*	*Std. Dev.*
fungen	0.000	0.000	1.000	0.000
regular	0.363	0.481	0.617	0.486
lnrdexp	11.574	2.044	12.676	1.957
sme	0.495	0.500	0.514	0.500
centralist	0.524	0.499	0.321	0.467
federal	0.068	0.252	0.057	0.231
dturnover	9980330	-140000000	18000000	280000000
dempl	-4.890	1098.789	6.514	618.738
dturnemp	24575.570	724273.100	34277.310	716845.500
pdinno	0.721	0.449	0.749	0.434
psinno	0.735	0.441	0.735	0.441
orinno	0.599	0.490	0.642	0.480
mrinno	0.467	0.499	0.457	0.498
turnmar	0.093	0.197	0.131	0.237
turnin	0.138	0.243	0.144	0.243

Data: Eurostat CIS microdata 2008; Notes: Calculated with Stata (2014).

4.2 Propensity score matching

With data from a non-experimental setting, the assumption of randomness is questionable, as mentioned by Klette et al. (2000: 478–9):

'Given the many factors involved in the political economy process that determines the allocation of R&D subsidies, random allocation may not be too misleading in some cases. However, assuming that governments' deliberate selection process is largely random is clearly dubious and there might be a significant bias involved in the estimated impact parameters.'

These problems are mentioned by other authors, including Blanes and Busom (2004: 1461), González Cerdeira and Pazó Martínez (2008: 377), Almus and Czarnitzki (2003: 232), Görg and Strobl (2007: 2–3) or more generally by Wooldridge (2013: IV4-5).

Additionally, Radicic and Pugh (2013: 20) find the problem of *'cherry picking'*, which will further reduce the randomness. Accordingly, the institutions granting public support often pick those firms that have a higher likelihood of becoming a successful example (see also Cantner and Kösters 2012: 932–3).

Methodologically, the approach of Becker (2013) has to be expanded by measures to reduce the potential problems of biased data. Due to the relatively high number of observations in the CIS, a control group of not-supported yet innovatively active firms can be created to test not only for hard factors, but also for some softer, less-observable ones. I apply propensity score matching (nearest neighbour matching) to find companies similar to those supported.[8] With a structural probit estimation on the support as the dependent variable and several controls as independent variables, propensity scores are calculated and used to find a firm with no public innovation support with similar firm characteristics. During this matching, the average treatment effects of the treated (ATTs) are also calculated with Leuven and Sianesi (2003). Czarnitzki et al. (2007: 1354) show that due to the lack of potential instrumental variables as well as longitudinal panel data, propensity score matching is a reliable approach using CIS data.

4.3 OLS regression

In addition to these treatment effects, I study the influencing factors on turnover, employment and labour productivity development.

For this analysis, I run an ordinary least squares regression (OLS) on the differences of the three aforementioned variables with several firm characteristics as explanatory variables. As all three variables are continuously available in the dataset, I do not reduce them to dummy variables but rather calculate the differences. The coefficients are highly different due to the very different scales of turnover, the number of employees and labour productivity (as turnover per employee), although the effects become visible.

In order to reduce the problems mentioned in the previous sub-section, the weights calculated during the propensity score matching are implemented to weight the OLS regression. When an observed firm is the nearest neighbour for not only one but several other firms in the sample, its impact is higher in both the propensity score matching process and the OLS. This increases the robustness of the OLS regression but reduces some of the coefficients.

4.4 Variables

Due to data restrictions, I focus on three dependent variables. In line with earlier studies, the development of turnover (*dturnover*, difference to the reference period in euro) and the number of employees (*dempl*, difference to the reference period in employee numbers) are analysed. Based upon these two variables, I calculate the labour productivity as turnover per employee,[9] including its differences between 2006 and 2008 (*dturnemp*, difference to the reference period in euro per employee). The differences are calculated to show whether a positive or negative development is found, as well as the amplitude of this development across the two years.

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[8] For a brief summary of different approaches to reducing the bias, see Hussinger (2008: 730).

[9] Authors including Koski and Pajarinen (2014) and Pajarinen and Rouvinen (2014) use value added per employee. However, these data are not available in the CIS at the European level.

The effect of R&D on productivity reflects an inverted U-shaped curve, as Lang (2009: 1442) ascertained. Therefore, the effect of R&D activities has to be examined with a time lag, which is included in the dataset by measuring the activities in the last two years with two different variables in the general cross-sectional data. These lags should further mitigate the problem of endogeneity (Lee 2011: 263).

Possible influences and thus explanatory variables are public R&D support (*fungen*, dummy variable) and regular R&D activities (*regular*, dummy variable). In particular, the funding variable is underestimated in the OLS due to the previous propensity score matching, in which the variable formed the dependent variable of the structural model.

Firm and market characteristics are included, such as R&D expenditure (*lnrdexp*, in order to be comparable with earlier studies in logarithms), company size (*sme*, dummy variable) and international ownership (*foreign*, dummy variable).

After a first version with dummy variables for centralist political systems (*centralist*, *federal*, dummy variables, reference variable *semfed*), I test for country-specific effects (*BG, CZ, EE, ES, FR, HU, LT, LU, LV, NL, PT, RO, SI, SK*, dummy variables, reference variable *DE*) and provide further details, especially compared with the general set of variables with only political system dummy variables.

Table 4: Average treatment effects (Propensity score matching, nearest neighbour matching)

	Matching with political system dummies		*Matching with country dummies*
	ATT		*ATT*
	(Std. Err.)		*(Std. Err.)*
dturnover	-8544464.73		-10386210.2
	(5191538.18)		(5036436.11)
dempl	-17.3353		-10.5085
	(7.4442)		(8.7330)
dturnemp	3570.1983	x	23624.6210
	(18825.0709)		(10256.3847)
pdinno	0.0015	x	0.0108
	(0.0091)		(0.0092)
psinno	-0.0004	**	-0.0064
	(0.0091)		(0.0091)
orinno	0.0168		0.0269
	(0.0101)		(0.0101)
mrinno	-0.0097		-0.0117
	(0.0104)		(0.0103)
turnmar	0.0183		0.0182
	(0.0046)		(0.0045)
turnin	-0.0028		-0.0072
	(0.0052)		(0.0052)

Data: CIS microdata 2008; Notes: Calculated with Stata (2014) and Leuven and Sianesi (2003), Std. Err. does not take into account that the propensity score is estimated; *** denotes significance at 1% level; ** at 5% level; * at 10% level, x as mentioned in the text close to significance.

Table 5: Influence of firm characteristics on differences in turnover, employees and labour productivity (weighted OLS)

	Difference of turnover			*Difference of employees*			*Difference of labour productivity*		
	Coef.	*Std. Err.*		*Coef.*	*Std. Err.*		*Coef.*	*Std. Err.*	
fungen	-6292662	2513869	**	-4.5714	4.3865		21752.53	8373.833	***
regular	-6210972	2438772	**	-7.5291	4.2554	*	516.6723	8123.684	
lnrdexp	1.60E+07	629223.8	***	7.5117	1.0979	***	4769.09	2095.979	**
sme	-8804903	2562554	***	-0.3056	4.4714		-12573.23	8536.008	
foreign	-2.25E+07	3467971	***	10.6915	6.0513	*	-22443.31	11552	*
BG	2.29E+07	7567256	***	-12.3803	13.2042		8759.187	25206.94	
CZ	2.14E+07	6033915	***	2.3604	10.5286		17547.78	20099.3	
EE	1.21E+07	8037448		-0.3785	14.0246		28114.58	26773.18	
ES	-496909.4	4511361		-16.8613	7.8719	**	12357.21	15027.59	
FR	5277138	4965668		-25.3568	8.6646	***	17992.65	16540.91	
HU	3.80E+07	6862713	***	-30.8492	11.9748	**	148748.7	22860.07	***
LT	1.19E+07	9457510		-9.3192	16.5025		18521.66	31503.48	
LU	1.46E+07	1.37E+07		-16.3103	23.9398		-57779.2	45701.3	
LV	5052685	2.49E+07		-13.8126	43.5045		20865.94	83050.71	
NL	-4323064	5406561		-20.5956	9.4340	**	-5669.816	18009.55	
PT	2.60E+07	5635168	***	-13.2714	9.8329		5172.744	18771.05	
RO	1.25E+07	1.05E+07		-2.7626	18.2396		2306.753	34819.63	
SI	-394967.5	1.20E+07		-5.5594	16.5884		9864.733	40055.22	
SK	4.89E+07	1.36E+07	***	-4.6919	23.6778		27998.3	45201.17	
_cons	-1.68E+08	9506710	***	-59.2931	16.5884	***	-56340.82	31667.37	*
F(19, 29431)	*51.17*			*4.75*			*4.03*		
Prob > F	*0.0000*			*0.0000*			*0.0000*		
R^2	*0.0320*			*0.0031*			*0.0026*		
Adj. R^2	*0.0314*			*0.0024*			*0.0020*		
Root MSE	*190000000*			*323.73*			*620000*		

Data: Eurostat CIS microdata 2008; Notes: Calculated with Stata (2014) after propensity score matching with Leuven and Sianesi (2003), observations are weighted with the weights of the matching process; *** denotes significance at 1% level; ** at 5% level; * at 10% level.

5 Results

The estimations provide ambiguous results: while the average treatment effects for all tested variables are insignificant, several firm characteristics show significant influences on the different measures of competitiveness.

However, the influences on the ATTs reported in Table 4 are unclear: regarding the three competitiveness indicators, the effects are negative for turnover and employment and positive for labour productivity, although none is significant. The same is true for the variables indicating whether a firm introduced a new product (or service), process, organizational procedure or market innovation, as well as the turnover of new-to-the-market and new-to-the-firm innovations. The ATTs for product (and service) and organizational innovations are positive but not significant, while the ATTs for process and marketing innovations as well as the ATTs for turnover of new-to-the-market or new-to-the-firm products are negative and not significant.

The general insignificance only shows in the tests with country dummies to reduce country-specific effects. By contrast, in a second version with explanatory variables for political systems, a negative ATT on process innovations turns significant at the 5 per cent level, while labour productivity and the likelihood of a new product innovation are close to significance (and both positive). All other ATTs remain (highly) insignificant.

Nonetheless, I observe effects of the explanatory variables in the OLS regressions (Table 5, page 14) on the development of the three competiveness indicators.

All five explanatory variables and several country dummies significantly influence the differences in turnover between 2006 and 2008, whereby the reception of public funding strongly reduces the turnover by more than €6 million. Furthermore, I also examine similar findings for companies that regularly undertake R&D activities. By contrast, the coefficient for firms that invest more money in R&D marks a higher turnover, while the coefficients for SMEs and foreign-owned companies show lower turnovers after the two years. Both coefficients are higher than the first effects, with €8 million for SMEs and €22 million for foreign companies. Country effects on turnover strongly influence Bulgaria, the Czech Republic, Hungary, Portugal and the Slovak Republic.

In the second regression on the change in the number of employees, I recognize weak significance for a negative coefficient of regularity, indicating a reduction of 7.5 employees, and a positive coefficient for foreign-owned companies, marked by an increase of 10.7 employees. The effect of the R&D expenditure is positive and highly significant, indicating that a one percent increase in R&D expenditure increases the number of employees by 0.075, while the negative coefficients for funding and SMEs are insignificant. Country-specific employment effects are evident for Spain, France, Hungary and the Netherlands.

The third regression provides the following results for labour, with productivity measured as the change in turnover per employee between 2006 and 2008.

With a coefficient of almost €22,000 per employee, the reception of public innovation support shows a highly significant and positive coefficient. As in the two previous regressions, R&D expenditure shows a positive and significant (at a 5 per cent level) coefficient. By contrast, the weakly significant coefficient for foreign-owned firms is negative, with slightly above €22,000 per employee. Only the country effect for Hungary proves significant in this regression.[10]

It is important to mention that the explanatory power of the OLS regressions is very low, which is unsurprising given that other factors have a much stronger impact on turnover, employment and labour productivity development compared with my explanatory variables. The explanatory power is further reduced by the combination with the matching approach, while the non-significance of the ATTs also supports these findings. Nonetheless, part of these variables influences the competitiveness measures and thus reflects one possible instrument for policy makers.

6 Conclusion

Owing to the ambiguous results, drawing conclusions is somewhat difficult. For instance, the presented analysis shows no significant effects of public innovation support on the average treatment effects, leading to a rejection of the hypotheses (especially hypothesis 2), although significant coefficients in the OLS regression, support at least partially the hypotheses.

While the regularity of R&D does not show clear influences on the three indicators of competitiveness, the amount of money spent on innovative activities always has a positive and significant influence; accordingly, a firm with more money spent on innovations has a higher turnover, more employees and a higher labour productivity, thus supporting hypothesis 1.

The effect of public innovation support mentioned in hypothesis 2 is mixed: while it shows a negative and significant coefficient for the turnover development, whereby companies that received public innovation support *ceteris paribus* show lower turnover differences, the effect on employment is not significant (but also negative). By contrast, the coefficient for public innovation support in the regression on the differences of labour productivity is highly significant

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[10] This means that all three country coefficients are only significant for Hungary. However, their validity is doubtful as the coefficients show different directions and dubious values.

and positive. The results reveal a positive effect on labour productivity, although negative effects on employment and turnover. In terms of competitiveness, firms receiving public support can be seen as more efficient due higher labour productivity, although declining turnovers can also be seen as an indicator for a negative trend in the market. Therefore, my results regarding hypothesis 2 are ambiguous and thus this hypothesis is to be rejected.

With respect to the country effects, different countries show different results; however, as the effects vary between the different regressions and – apart from Hungary – no country shows statistically significant effects in all three estimations, the effect is unclear. Nonetheless, differing country-specific effects exist and thus hypothesis 3 cannot be rejected, but is weakly supported.

It is important to mention that the results of my OLS regressions with their low R^2 values have to be considered carefully: regarding the development of employees and labour productivity – as well as turnover development, to a lesser extent – other indicators have stronger impacts. Nonetheless, the public support programmes are one common tool that policy makers often use across Europe. Moreover, the European analysis shows that there are indicators for the effectiveness of public innovation support programmes that extend beyond the literature on additionality. However, further research at both the European and the national levels is required, as the results are ambiguous and only show weak influences on competitiveness.

For policy makers, this prompts the need to evaluate innovation support more closely, focusing on the original objectives, namely supporting companies that face barriers to innovate (Fernández-Ribas 2009; Becker 2015) the effects on competitiveness have to be addressed both in the policy making process and later in the accountability of institutions that grant support. However, these two objectives might also enter into conflict, given that while it is positive for the aim of effectiveness to focus on larger and generally more successful companies that already have an advantage, such a policy would clearly reduce the opportunities for companies such as SMEs with barriers to innovate to participate in innovation support.

This leads us to the question of political preferences and different programmes at different political levels. As economists, it is not our role to decide upon this question, but a higher transparency in the targets – and their conflicts – of support programmes and their deployment would help to simplify the decision-making process of policy makers, thus increasing the transparency of the process.

Acknowledgements

This paper is based upon data from the Eurostat CIS 2008. The responsibility for all conclusions drawn from the data lies entirely with the author.

Thanks to Prof. Dr. Kilian Bizer, Prof. Dr. Markus Spiwoks and the PhD students for their input during two seminars at the Georg-August-University in Göttingen for their feedback. I also thank Prof. Jeffrey M. Wooldridge, PhD for his very valuable comment to the matching process (and see insights before at a summer school on advanced econometrics). Further thanks to Prof. Dr. Hanna Hottenrott for her general remarks on this paper. Special thanks also to Eurostat and especially Geneviève Villette for the possibilities at the Safe Centre in Luxembourg. Additionally, I am grateful to all those who checked this paper for linguistic errors.

This work was supported by the German Bundesministerium für Bildung und Forschung (BMBF) via Friedrich-Naumann-Stiftung für die Freiheit (FNF) [ST 6754 / P 622].

Appendix

Table A1: Development of the relative share of public support of R&D (&I) to total public aid in the EU, 2007-2012

	2007	*2008*	*2009*	*2010*	*2011*	*2012*	*Difference 2012-2007*
EU-27	*12.29%*	*12.50%*	*14.62%*	*15.60%*	*15.68%*	*14.49%*	*2.20%*
AT	16.36%	17.81%	15.03%	22.64%	16.58%	15.53%	*-0.83%*
BE	35.28%	34.45%	37.89%	45.23%	21.83%	22.50%	*-12.78%*
BG	4.25%	2.89%	6.72%	6.07%	3.48%	2.08%	*-2.17%*
CY	1.99%	0.90%	0.18%	1.50%	0.44%	1.14%	*-0.85%*
CZ	18.20%	14.74%	23.02%	21.31%	20.30%	17.68%	*-0.52%*
DK	3.87%	7.58%	6.57%	9.33%	9.92%	8.12%	*4.26%*
DE	14.57%	14.30%	14.67%	18.42%	25.05%	18.98%	*4.41%*
EE	7.07%	7.62%	2.63%	1.33%	0.23%	0.18%	*-6.89%*
EL	0.75%	0.74%	0.36%	0.08%	0.08%	0.21%	*-0.53%*
ES	14.46%	16.17%	24.91%	23.36%	21.48%	19.38%	*4.91%*
FI	8.00%	12.30%	11.47%	11.56%	9.48%	8.69%	*0.69%*
FR	18.26%	13.89%	14.66%	12.49%	15.66%	14.07%	*-4.19%*
HU	0.53%	3.37%	6.14%	1.47%	4.43%	15.01%	*14.49%*
IE	9.99%	4.82%	9.56%	14.34%	12.18%	10.87%	*0.87%*
IT	10.07%	15.53%	18.36%	13.58%	13.25%	17.98%	*7.91%*
LU	23.71%	26.41%	51.53%	43.72%	25.12%	43.50%	*19.79%*
LT	0.00%	0.05%	2.65%	7.08%	3.77%	4.48%	*4.48%*
LV	0.08%	0.52%	0.08%	0.16%	0.47%	0.25%	*0.17%*
MT	0.04%	0.01%	1.71%	0.24%	2.17%	0.72%	*0.69%*
NL	12.28%	11.87%	18.62%	25.20%	24.94%	19.03%	*6.74%*
PL	2.30%	1.19%	1.09%	2.08%	0.89%	3.42%	*1.12%*
PT	0.85%	1.14%	2.99%	12.00%	8.13%	22.75%	*21.90%*
RO	3.01%	7.39%	3.43%	11.11%	0.70%	1.03%	*-1.97%*
SE	2.84%	3.36%	4.23%	3.69%	3.47%	3.71%	*0.87%*

	2007	*2008*	*2009*	*2010*	*2011*	*2012*	*Difference 2012-2007*
SI	11.00%	8.61%	18.31%	26.71%	18.54%	17.83%	*6.83%*
SK	1.64%	1.02%	2.81%	6.03%	8.44%	9.03%	*7.39%*
UK	18.74%	20.67%	23.36%	24.98%	22.00%	18.73%	*-0.01%*

Data: European Commission (2013); own calculations.

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