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Federalism and innovation support for small and medium-sized enterprises: Empirical evidence in Europe

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FEDERALISM AND INNOVATION SUPPORT FOR SMALL AND MEDIUM-SIZED ENTERPRISES

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GEORG-AUGUST-UNIVERSITÄT GÖTTINGEN

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Research Article

Federalism and innovation support for small and medium-sized enterprises

Empirical evidence in Europe

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Abstract

Private innovative activities receive public innovation support from different political levels. Few studies have empirically evaluated the influence of political systems on the reception of public innovation support and no other studies have evaluated innovation support across Europe with CIS data.

This paper analyses the differences between federal, semi-federal and centralist political systems with CIS data from sixteen European countries. The results show that regional programmes in federal and semi-federal countries reach firms with barriers to innovate, such as small and medium-sized enterprises, while other programmes only claim to reach them. Federal and semi-federal countries therefore support a broader variety of firms compared with centralist countries. European support reaches SMEs better in centralist countries compared with federal and semi-federal countries. Regular and higher expenditure on innovative activities shows a positive influence on the reception of support in all countries, while indicators such as market focus vary between countries and political levels. Regional programmes focus more strongly on companies with a regional market focus, which can be seen as another barrier to innovation. As a policy implication, the paper implies that barriers to innovation can be reduced by a decentralized innovation framework with stronger regional programmes.

Key Words

Innovation; innovation support; SME; Europe; federalism; decentralization

JEL Classification

O31, O38, H77, H71

Words (without figures and tables)

8.797

1 Introduction

Creativity and innovations are key factors of economic growth and development, as Schumpeter (2008) was one of the first economists to recognise. Fostering innovation and thus indirectly economic growth leads governments to support private innovative activities. Governments offer public support either directly via subsidies or indirectly via tax credits. State aid to research, development and innovation comprised an average of 12.5 per cent of total state aid in the European Union[1] in 2008.

This figure prompts the question whether the money is well spent. Many studies analyse the effectiveness of public innovation support, with the majority considering the policy framework within a country to be homogenous. Nonetheless, homogeneity is questionable, especially in federal countries. In countries such as Germany or Belgium or in semi-federal countries, such as Spain or Finland, the regional level strongly influences the innovation framework; for instance, public support in the Basque region might be different than in Valladolid, while Bavaria might offer different subsidies to Saxony.

The purpose of this paper is to evaluate public innovation support, in particular with regard to the influence of federalism.

Innovation is more than research and development (R&D). Accordingly, we use the definition of the Oslo Manual (OECD, 1997, pp. 30–31), which includes the application of research results in the products of the firms. Additionally, it incorporates the implementation of findings that are new not to the entire market but rather to the firm. This definition of innovation is broader than R&D,[2] although R&D forms the core of innovative activities.

Firms face barriers to innovate, given that the results of research and innovations are uncertain and might diffuse to other firms. The barriers to innovate hit smaller companies harder as they have fewer opportunities to diversify their risks. Therefore, most public support programmes focus on small and medium-sized enterprises (SMEs), although innovation theory is unclear about whether smaller (Audretsch, 2001, p. 6; Arrow, 1962) or larger firms (Schumpeter, 2008, p. 106) are the main engines for innovation in an economy.

Studies have rarely analysed the effects and the rationale behind programmes of different political levels (see Vonortas et al., 2007). The very few studies that analyse the different levels of public support in federal and semi-federal countries show differences especially concerning

[1] Own calculations with data from European Commission (2013).

[2] R&D is defined in the Frascati Manual: OECD (2002).

firms that face barriers to innovate. For instance, Fernández-Ribas (2009, pp. 464–465) shows for Catalonia that regional programmes better reach firms with 'obstacles to innovate', which is in line with the findings from Becker (2013) for SMEs in Germany. Blanes and Busom (2004, p. 1474) also find that regional programmes 'reach on average smaller firms' in Spain. (Atkinson, 1991) describes differences between different states in the USA.

We analyse whether these findings are country-specific for Germany and Spain or whether similar results can be found in other federal and semi-federal countries by using country-specific data and data at the European level from Eurostat's Community Innovation Survey (CIS microdata). We match supported and not-supported companies through propensity score matching with a probit estimation as a structural equation to test for characteristics of supported firms.

In the next section, we describe the existing literature concerning innovation policy and federalism both theoretically and empirically. The literature leads to six hypotheses, which are formulated in the third section. In our fourth section, we discuss the data and methods applied in our empirical work before describing the results in section five. The sixth and final section draws conclusions concerning the effect of federal structures on innovation support.

2 Literature review

Historically, Brouwer (2000, p. 149) claims that innovative capacities started growing with capitalism. Moreover, Grossman et al. (1994, p. 32) emphasize the importance of innovations for economic growth from economic history. These historic findings show the importance of innovation policy and its framework. Section 2.1 looks at the justification for public innovation support and gives an overview of empirical findings. Section 2.2 briefly reflects theories of federalism followed by a classification of federal, semi-federal and centralist systems in Europe.

2.1 Justification for public innovation support

Private firms invest in innovation if they expect to make profit from it (Grossman et al., 1994, p. 27; Griliches, 1992, p. 29). However, it is questionable whether this private profit is as high as the profit to society. Studies from Wallsten (2000, p. 83), Klette et al. (2000, p. 486), Blanes and Busom (2004, p. 1459) or Görg and Strobl (2007, p. 1) emphasize the point of higher social returns of R&D or innovation. A more detailed study by Lang (2009, p. 1439) shows that social returns are higher, and that private returns do not occur immediately but rather with a time-lag of approximately two years. Hall et al. (2009, p. 17) and Bohnstedt (2014, p. 13) provide similar results. However, the delayed influence of innovative activities is only one aspect of market failure that causes the socially suboptimal level of private investment.

Innovations can be categorized – at least partially – as a public good, as stated by Arrow (1962). Innovation is a non-excludable and non-rivalrous good in a completely free market (Griliches, 1992, p. 31).[3] When one firm innovates, another firm might recognize this and implement the same innovation. Although the latter firm does not have to pay the costs of innovating, it benefits from its advantages. The implementation of another firm's innovation creates social gains from spillovers or – put differently – positive externalities, although it reduces companies' willingness to innovate. This problem is described in the literature (Nelson, 1959, pp. 305–306; Beaudry and Breschi, 2003, pp. 337–338; Griliches, 1992, p. 31). Duguet (2004, pp. 246–247) mentions intellectual property rights (IPR) as a solution to the problem of non-excludability.

Additionally, firms face uncertainty with regard to the success of innovation as well as the success of securing the benefits (see Arrow, 1962, pp. 609–610; Brouwer, 2000, p. 150; Grossman et al., 1994, pp. 37–38). For example, firms do not know whether one of their high-skilled employees with knowledge of an innovation project will join another company. Additionally, 'no firm can be sure when any of its rivals' R&D efforts will be successful' (Loury, 1979, p. 397). This indicates further uncertainty at the market level, which Czarnitzki and Toole (2008, p. 9) support empirically. Clausen (2009, p. 242) ascertains that R&D 'close to the market' faces less uncertainty than that 'far from the market'.

Most of the uncertainties affect SMEs more strongly than larger companies. Due to the higher wages in larger companies (see Brown et al., 1990, pp. 88–89), SMEs' employees can more easily be attracted to leave the company. Due to the lower possibility of diversifying their risks (see Levine, 1997, p. 694), financial restraints and the effect of uncertainty affect smaller firms more intensely, or as Czarnitzki and Toole (2008, p. 10) state: 'large firms respond less to market uncertainty than small firms.' Hong et al. (2012, p. 429) describe that medium-sized companies in particular face such disadvantages, as an inverted U-shape of innovativeness related to firm size can be found. These results place SMEs at the focus of many governmental programmes fostering innovation.

To reduce the problem of uncertainty, subsidies (or tax credits) are granted. Hussinger (2008, pp. 744–745) argues with Czarnitzki and Toole (2008) that subsidies reduce uncertainty, while Czarnitzki et al. (2011) and Cerulli (2010, pp. 423–424) describe other market imperfections, such as financial restraints.

[3] However, this definition as a pure public good is questioned in Cerulli (2010, p. 423).

For all these causes, Arrow (1962, pp. 622–625) claims that measures of public innovation support are justified. For this reason, the European countries supported private innovative activities with €9.4 billion of direct aid in 2008 (European Commission, 2013).

Its effectiveness has to be analysed as companies tend to take support measures if available, even if they would have innovated without them (see Blanes and Busom, 2004, p. 1463). Scholars often measure the effectiveness of support as additionality, with studies examining whether public support induces additional private innovative activities (Cerulli, 2010).

Aerts and Czarnitzki (2004, p. 16) find additionality in Belgium, as well as Duguet (2004, p. 272) in France, while Czarnitzki and Fier (2002, pp. 17–18) find partial additionality for public innovation support in Germany. Later in Fier and Czarnitzki (2005, p. 4), the authors show that one euro of public support induces another €0.28 of private spending. Hussinger (2008, p. 743) finds even higher additionality as she calculates that one euro of public subsidies leads to one additional euro of private investment. Busom (2000, p. 133) finds additionality for manufacturing firms in Spain, although she cannot completely rule-out a crowding-out effect, whereas González Cerdeira and Pazó Martínez (2008, p. 384) do not show even partial crowding-out in Spain. Görg and Strobl (2007, p. 231) show that additionality can be found especially for smaller grants in Ireland. However, they generally find no evidence of crowding-out independent of grant size.

A survey by Radicic and Pugh (2013, p. 1) ascertains a 'cream-skimming' effect. Accordingly, political actors try to select those companies that can most likely present a success story afterwards. These results are in line with earlier findings from Cantner and Kösters (2012, pp. 932–933) who also show a strategy of 'picking the winner' among public agencies in Thuringia (Germany) to circumvent information problems.

In contrast to the EU, where the majority of studies show at least partial additionality, evidence from the USA is less clear. Levy (1990, p. 172) shows that programmes vary in different states and crowding-out can only sometimes be found. Wallsten (2000, pp. 97–98) finds that the US national innovation grants 'crowd out firm-financed R&D spending dollar for dollar', although David et al. (2000) show partial complementarity. Koga (2005, p. 60) finds complementarity for Japanese innovation support. For Israel, Lach (2002, p. 389) analyses innovation support and finds that the substititutionality depends on the firm size. He cannot completely rule out a crowding-out, although he shows that the risk is much lower for smaller companies.

For our analysis of innovation support, the characteristics of firms supported are important – especially the firm size. In terms of size (measured in his study by sales), Duguet (2004, p. 267) finds that higher sales have a positive influence on the probability of receiving a subsidy. The probability increases with the ratio of R&D to sales, the debt ratio and the reception of public support in the past.

What all of the aforementioned studies mentioned share in common is that they treat innovation support within a country homogenously. By contrast, the following scholars analyse different political levels – namely regional, national or European support – separately.

While Wilson and Souitaris (2002, pp. 1135–1136) only focus on the coordination between different federal levels and question whether coordination exists, Becker (2012, p. 62) finds differences between the three levels of public support in Germany. One result is that SMEs have a lower probability of receiving national and European support in Germany. For the regional level, the coefficient is not significant but remains negative, albeit closer to zero. Becker (2013) finds that regional differences in Germany have a significant effect on the likelihood of receiving public support and that SMEs face obstacles, especially at the European level.

Similar to Wilson and Souitaris (2002), Vitola (2014, p. 9) analyses coordination, governmental structures as well as regional differences around the Baltic Sea (Nordic and Baltic countries). She finds a high amount of coordination among policy-makers and a low risk of overlapping programmes from different political levels (Vitola, 2014, p. 13).

Blanes and Busom (2004, p. 1474) differentiate between all three levels of support in Spain and find a regional focus on smaller companies. Also analysing Spanish CIS data, Busom and Fernández-Ribas (2007, p. 3) focus on the differences between national and European level support: while national programmes focus more strongly on research intensity and international patenting, European programmes show a focus on export intensity and foreign markets in Spain. In general, they find complementarity between the two levels of innovation support. Fernández-Ribas (2009, pp. 464–465) finds similar results for Catalan firms, analysing all three levels of support. Accordingly, firms 'facing major obstacles' are more likely to receive regional support, while 'domestic firms with patenting experience, as well as […] firms operating in high knowledge content industries', receive national support more easily.

In sum, existing literature suggests at least partial additionality of public R&D. Differences between the characteristics of supported firms exist between innovation support programmes from different political levels, whereby smaller companies are better reached by regional programmes - at least in Spain and Germany.

Table 1: R&D&I aid in 2008 (absolute in million € on R&D&I aid, relative as share in % to overall state aid)

Country	*Absolute*	*Relative*
EU-27	9,437.0	12.50%
Bulgaria	6.6	2.89%
Czech Republic	211.0	14.74%
Estonia	3.4	7.62%
Finland	274.4	12.30%
France	1,857.8	13.89%
Germany	2,413.2	14.30%
Hungary	73.3	3.37%
Latvia	0.7	0.52%
Lithuania	0.1	0.05%
Luxemburg	22.8	26.41%
The Netherlands	291.7	11.87%
Portugal	18.5	1.14%
Romania	64.2	7.39%
Slovak Republic	4.0	1.02%
Slovenia	22.0	8.61%
Spain	910.9	16.17%

Data: European Commission (2013), own calculations for 16 countries.

2.2 Federalism operationalized

Tiebout (1956, p. 418) states that local governments provide many public goods in a decentralized manner, whereby differences between cost structures across jurisdictions influence the allocation. Regarding the allocation, he also describes the problem of externalities and free-riding jurisdictions that profit from spillovers of the neighbouring governments. Closely analysing which goods should be provided at which level, Oates (1972, pp. 9–13) shows that pure public goods are better allocated by the national level. By contrast, the decentralized regional levels should allocate goods when different preferences, mobility and willingness to pay taxes exist.

With regard to innovation policy, Loury (1979, p. 395) shows for companies that 'a degree of concentration intermediate between pure monopoly and atomistic (perfect) competition […] is best in terms of R&D performance'. This finding for the market structure can also link to federal structures in the field of public innovation policy, whereby decentralized learning processes lead to more successes (see Saam and Kerber, 2013).

Montmartin (2011, p. 3) describes the problem of spatial externalities and free-riding for the field of innovation policy. These problems underline the discussion of Busom and Fernández-Ribas

(2007, p. 1) concerning whether different jurisdictions 'lead to a globally efficient allocation of R&D and do not duplicate efforts', which we want to analyse in further detail.

Regarding public goods in general, the problem of spatial externalities should not lead automatically to a centralized provision according to Feld (2007, p. 32), but rather to an analysis concerning the level at which the good is better provided. By contrast, Konings and Torfs (2011, pp. 38–39) show the efficiency losses due to missing economies of scale and externalities in a decentralized system.

Highlighting advantages and disadvantages of federal and decentralized structures, Hayek (1948) or Musgrave (1959) outline different fields that can be handled federally.

Differences in innovation programmes between states are linked to the theory of innovation, as described in Atkinson (1991, p. 563). From a more theoretical approach Edler and Kuhlmann (2008, p. 274) claim that the German system as a whole suffers disadvantages due to less coordinated policy measures. Wilson and Souitaris (2002, p. 1125) describe the problem of overlap between political systems in Germany, which Vitola (2014, p. 9) does not find around the Baltic Sea. Nonetheless, regional jurisdictions in a federal state might try to use similar approaches and target groups. This emphasizes the necessity of coordination efforts in the field of innovation policy (see Braun, 2008).

In addition to the theory of federalism, multi-level approaches have become increasingly important, especially for the European level; for instance, Stein and Turkewitsch (2010, p. 3) emphasize that 'federalism and multi-level governance share some important characteristics'. However, they point out that multi-level approaches focus particularly on supranational institutions like the EU.

All these findings lead to a separation between national, regional and EU-level support for innovative activities (Blanes and Busom, 2004, p. 1460; OECD, 2011, p. 76). Furthermore, in recent years the influence of regional governments has grown (see Fernández-Ribas, 2009, p. 457; OECD, 2011, p. 31).

This development to regional structures also influences Europe: the EU comprises a variety of countries with different political and historical backgrounds. Therefore, we find a heterogeneity of political systems all over Europe. Germany, the largest EU Member State, is a federal country, while France, the second largest nation, can clearly be marked as a centralist country. Moreover, Portugal is centralist while Spain is semi-federal, and so on.

Blume and Voigt (2011, p. 241) raise the point that a distinction between federalism and decentralization has to be made: in a federal system, the division of powers is created 'bottom-up', while the national level creates the division 'top-down' in a decentralized yet centralist system.

Lijphart (2012, pp. 174–186) provides an overview of different political systems related to federalism and decentralization. As shown in Table 1, Lijphart (2012) creates an index of federalism for (among others) European countries. He distinguishes the degree of federalism (as the autonomy of a jurisdiction in its decisions) as well as decentralization (as the degree of competencies given to a jurisdiction at a lower level).[4] Given that Lijphart does not categorize most eastern European countries, Roberts (2006, pp. 43–44) adds this aspect and classifies all of these countries as centralist and centralized according to Lijphart's index. In this paper, we aggregate the three categories between federal/decentralized and centralist/centralized to semi-federal.[5] These countries usually have mixed structures. As an example, Scandinavian countries can be generally seen as centralist countries, but they also have decentralized structures regarding innovation support (see Vitola, 2014, p. 7).

While a larger number of centralist and centralized countries exist, federal and semi-federal countries are fewer but a non-negligible factor in Europe. It is important to mention that the degree of decentralization of innovation support might vary compared with federalism in general; for example, Switzerland focuses its innovation support at the national level, while regional programmes also exist in almost all centralized countries. Indeed, only some smaller countries like the Baltic countries or the Slovak Republic show hardly any regional programmes.

Generally, the different innovation frameworks in Europe are described in (OECD, 2011).

In summary, in terms of the political structure in Europe, most countries have a centralized system, which nonetheless offers – to a lesser extent – regional support programmes, while there are only two clear federal countries, especially in the field of innovation, and several semi-federal countries in between.

[4] For detailed distinctions between both categories and the primary and secondary characteristics, see Lijphart (2012, p. 176).

[5] These categories aggregated are centralized but federal countries, semi-federal countries and decentralized but centralist countries.

Table 2: Categorization of countries in the EU

Federal and decentralized	*Semi-federal*	*Centralist and centralized*
• Belgium (after 1993)	• Austria	• **Bulgaria**
• **Germany**	• Denmark	• **Czech Republic**
	• **Finland**	• **Estonia**
	• **The Netherlands**	• **France**
	• **Spain**	• Greece
	• Sweden	• **Hungary**
	• United Kingdom (after 1998)	• Ireland
		• Italy
		• **Latvia**
		• **Lithuania**
		• **Luxembourg**
		• Malta
		• **Portugal**
		• **Romania**
		• **Slovak Republic**
		• **Slovenia**

Notes: Based on Lijphart (2012, p. 178), three categories aggregated to semi-federal, several countries added by Roberts (2006, p. 44), countries included in this study in bold.

3 Hypotheses

The scope of the hypotheses is to test for the effect of political regimes on the likelihood of receiving public innovation support for private innovative activities, as well as the connection to firm characteristics. We combine these fields because firm characteristics are likely to have a strong influence on the likelihood of receiving support, but might be related to political surroundings.

Hypothesis 1: Small and medium-sized enterprises (SMEs) have greater difficulties in securing national and supranational innovation support compared with regional innovation support.

Support programmes are supposed to reduce barriers to innovate. Classical barriers to innovate are higher for smaller companies, such as risk diversification or excludability and rivalry problems. Moreover, access to capital and knowledge might be more difficult for SMEs, as described in the literature. Programmes should thus prefer smaller companies in theory; indeed, innovation support programmes from all levels claim to reach SMEs as one of their main aims. Small and medium-sized companies should be more strongly supported by the regional level as the theory of federalism more closely links the regional level to the preferences of the jurisdictions, which should be directly influenced by the easier access for smaller companies nearby. Fernández-Ribas (2009, pp. 464–465) finds this effect for Spain.

Hypothesis 1 analyses whether the general aim is reached better at the regional level in Europe. We expect a positive and higher coefficient for SMEs at the regional funding level and fewer or no effects at the national and supranational level.

Hypothesis 2: Countries with a more decentralized innovation support framework reach companies with higher barriers to innovate - like SMEs - better with their regional programmes.

Due to a stronger regional level, decentralized countries have an advantage in reducing companies' limitations to innovate. In a centralist system, regional programmes are less likely to have the same importance and, in some countries, they are even less likely to exist. Additionally, they more closely link to national preferences, which define the general policy outline in a centralized system.

In a decentralized framework, different aspects are likely to positively influence the likelihood of support for companies with higher barriers to innovate, including the linkage to regional preferences, as well as more regional programmes and a greater power to develop new

programmes regionally. Fernández-Ribas (2009) and Becker (2013) find a positive effect in two decentralized countries, namely Spain and Germany, respectively. A decentralized system is thus also likely to positively influence the reception of public support in other countries. These expectations are tested in hypothesis 2, and we expect positive coefficients for SMEs in federal and semi-federal countries, especially regarding regional support. The coefficients in centralized countries are expected to be smaller or even negative for SMEs.

Hypothesis 3: National and supranational programmes have a stronger influence in terms of fostering innovative activities in SMEs in centralist countries.

Although decentralized systems are expected to support firms with barriers to innovate with their regional programmes, centralized countries also focus on such firms. As regional programmes are less important in centralist countries, existing innovation support - especially at the national and supranational level - has to focus more strongly on these companies compared to decentralized countries. We expect positive effects of national and supranational programmes on SMEs in centralist countries, which forms the test for hypothesis 3. Therefore, we expect positive coefficients for SMEs in centralized countries at the national and European level.

Hypothesis 4: All programmes focus on companies with a non-regional market focus.

Cantner and Kösters (2012) and Radicic and Pugh (2013) emphasize the problem of 'cream skimming': creators of innovation support programmes select those innovation projects that succeed anyway in order to show off their work. As a proxy for their findings, we see the market focus of the firms supported, namely those with a national and international market focus can be seen as better flagships to show successes. If this is the case, support programmes would focus on companies that not only have a regional market focus, but at least a national if not an international market focus. This 'cream-skimming' and seeking successful flagship projects is analysed with hypothesis 4. Accordingly, we expect a strong and positive influence of a national or an international market focus on the likelihood of receiving innovation support.

Hypothesis 5: All programmes focus on companies that regularly spend a higher amount of money on innovative activities.

Firms that regularly spend more money on innovative activities such as R&D are generally more likely to receive public innovation support. A higher basis of innovative activities filters for the firms that managed to overcome their barriers to innovate, although it can also be seen as another proxy for cream-skimming. Becker (2013) finds an influence in Germany, whereas Busom and Fernández-Ribas (2007) find no such influence for Spain, testing for the regularity of

R&D. We expect a positive coefficient for money spent on innovative activities, as well as their regularity.

Hypothesis 6: Companies that receive innovation support generally have a higher likelihood of introducing innovations in either their products, services and processes or marketing and organization.

Innovation support is supposed to foster innovations despite mixed results in the literature. There, Hussinger (2008, p. 743) finds a positive influence on sales, while Maliranta (2000, p. 117) finds unclear effects of public innovation support on job creation. We expect positive yet minor treatment effects.

4 Data and methods

4.1 Data

We use data from the CIS, which Eurostat coordinates. Eurostat harmonizes data from the member states of the EU from the Oslo manual (OECD, 1997). Given that the CIS is an unbalanced panel, companies might not be included in two consecutive waves. Indeed, this criticism is raised by Mairesse and Mohnen (2010, p. 1149), who argue for a longitudinal data set. However, as we do not have such a data set, we decide to use only one data wave from 2008. In 2008, 22 countries[6] form part of the non-anonymized data wave,[7] which includes more detailed data on R&D expenditure for some of the countries compared with earlier and later data waves.

Although the CIS data are harmonized, huge differences in data quality exist (see, for example, Thomä and Bizer, 2013, p. 41) and more harmonization would be useful (see Mairesse and Mohnen, 2010, p. 1147). Due to this problem, we have to reduce the sample to sixteen countries: Germany as the only federal country, Finland, the Netherlands and Spain as semi-federal countries, as well as Bulgaria, Czech Republic, Estonia, France, Hungary, Latvia, Lithuania, Luxembourg, Portugal, Romania, Slovak Republic and Slovenia as centralist countries. Dropped countries show either measurement differences or missing values in core variables. As an example, Sweden does not report which firms received public support in 2008.

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[6] Bulgaria, Cyprus, Czech Republic, Germany, Estonia, Spain, Finland, France, Hungary, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Portugal, Romania, Sweden, Slovenia, Slovak Republic and Norway.

[7] The non-anonymized data includes exact values for R&D expenditure, numbers of employees and other characteristics that we use in this study.

In some countries like Spain, participation in the CIS is mandatory. This leads to an overrepresentation of Spanish companies, combined with poorer data quality on average.

The selected countries comprise 77,779 observations in 2008. The countries represent approximately 290 million inhabitants of the EU, 48 per cent of whom represent the centralist countries, meaning that semi-federal and federal countries together represent slightly more than half of our sample in terms of population size.

Before analysing the non-anonymized data from 2008, we found similar effects with the anonymized CIS data from 2004 and 2008.

Table 3: Country information

Country	*Observations*	*Per cent*	*Cumulative*
Bulgaria	3,817	4.91	4.91
Czech Republic	2,828	3.64	8.54
Estonia	1,119	1.44	9.98
Finland	1,395	1.79	11.78
France	7,409	9.53	21.30
Germany	5,356	6.89	28.19
Hungary	1,453	1.87	30.06
Latvia	339	0.44	30.49
Lithuania	2,111	2.71	33.21
Luxembourg	323	0.42	33.62
The Netherlands	3,724	4.79	38.41
Portugal	3,770	4.85	43.26
Romania	2,489	3.20	46.46
Slovak Republic	651	0.84	47.29
Slovenia	1,000	1.29	48.58
Spain	39,995	51.42	100.00
Total	*77,779*	*100.00%*	

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

4.2 Binary regressions

We use binary variables of the reception of public innovation support from a certain political level as dependent variables in our structural models. The models test for influential factors of receiving support and calculate the propensity scores. As combinations of support from different levels are possible, we choose seven mutually exclusive binary variables, whereby *funloconly* (regional level), *fungmtonly* (national level) and *funeuonly* (European level) equal one if the firm only received money from the respective political level. The variables *funlocgmt* (regional and national level), *funloceu* (regional and European level) and *fungmteu* (national and European level) equal one for the respective combinations, which is also the case for *funall* if all three political levels grant public innovation support. Like Blanes and Busom (2004, p. 1467), we only observe the reception of a subsidy and not the application procedure.

We want to test for the influence of firm characteristics – especially firm size and the political system in which the firm is located – on the likelihood of receiving public support. Our main set of explanatory variables focuses on three interacted dummy variables, which combine firm size with the political system: when a firm is small and medium-sized according to the EU definition[8] and in a centralist country, *censme* equals one. We create comparable dummy variables in a semi-federal country with *semsme* and *fedsme* in a federal country. Large companies serve independent of the political system as the reference category.

We use *foreign* if a company has its headquarters in another country and *regular* if a country regularly has in-house innovative activities as other explanatory variables. Due to data restrictions in Finland and Spain, the market focus (*national* and *international*) and the amount of money spent on R&D in logs (*lnrdexp*) can only be included in country regressions. We base our general set of variables on existing studies (Busom and Fernández-Ribas, 2007; Fernández-Ribas, 2009; Becker, 2012; Becker, 2013) to enhance comparability.

Our dependent variables have a binary outcome, which leads us to binary regression models described for instance in Wooldridge (2010, pp. 561–642) or Backhaus et al. (2000, pp. 243–296). Freedman and Berk (2008, p. 400) describe problems of combining logit regressions and propensity score matching. Furthermore, the high number of observations favours probit estimations. For these reasons, we decided to use probit regressions, which do not encounter such bias. Probits estimate coefficients that are not directly interpretable in contrast to standard ordinary least squares (OLS) regressions: directions and significances are interpretable, although the size of the coefficient is not interpretable as the size of the effect. We calculate and

[8] We implement the definition with fewer than 250 employees and turnover less than €50 million in the CIS data.

show the marginal effects for each of our regressions in the result to make it possible to interpret the results at first glance.
Our structural models first include seven probit regressions for the seven funding variables for a joint European analysis with the variables available in all sixteen countries:

Equation I: European-level analysis

$$fun_i = \beta_0 + \beta_1\, fedsme_i + \beta_2\, semsme_i + \beta_3\, censme_i + \beta_4\, regular_i + \beta_5\, foreign_i + \varepsilon_i$$

In a second step, we run this set of regressions for each of the sixteen countries with all available variables in the respective country:

Equation II: Country-level analysis

$$fun_i = \beta_0 + \beta_1\, fedsme_i + \beta_2\, semsme_i + \beta_3\, censme_i + \beta_4\, national_i + \beta_5\, international_i + \beta_6\, lnrdexp_i + \beta_7\, regular_i + \beta_8\, foreign_i + \varepsilon_i$$

The market focus cannot be analysed in Finland and Spain and the R&D expenditure cannot be analysed in Finland. Moreover, some of the regressions are not econometrically valid in smaller countries due to a lack of observations.

Table 4: Summary characteristics of variables

Variable	*Observations*	*Mean*	*Std. Dev.*	*Y = 1 (% for Bin. Var.)*
funloconly (regional funding only)	77,779	0.044	0.205	4.40
fungmtonly (national funding only)	77,779	0.062	0.242	6.25
funeuonly (EU funding only)	77,779	0.014	0.119	1.45
funlocgmt (regional and national funding)	77,779	0.023	0.148	2.25
funloceu (regional and EU funding)	77,779	0.003	0.053	0.28
fungmteu (national and EU funding)	77,779	0.012	0.110	1.21
funall (regional, national and EU funding)	77,779	0.010	0.101	1.02
fedsme (SME from a federal country)	77,779	0.038	0.191	3.80
censme (SME from a centralist country)	77,779	0.179	0.383	17.87
semsme (SME from a semi-federal country)	77,779	0.379	0.485	37.86
national (national market focus)	35,751	0.484	0.500	48.38
international (international market focus)	35,751	0.221	0.415	22.15
lnrdexp (R&D expenditures in logs)	37,894	11.802	2.149	
foreign (foreign owned company)	77,779	0.119	0.323	11.87
regular (regular R&D activities)	77,779	0.209	0.407	20.93

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

4.3 Propensity score matching

Similar to Fernández-Ribas (2009), we use a propensity score matching to test for the effects of public support, as we cannot simultaneously compare the effect of a granted subsidy and no subsidy in one company. This leads us to the problems of non-randomness and selection. Among others, Almus and Czarnitzki (2003, p. 230), Görg and Strobl (2007, p. 216), González Cerdeira and Pazó Martínez (2008, p. 377) and Lee (2011, p. 257) mention this problem. In addition to non-randomness, problems can also emerge with omitted or unobservable variables (see Freedman and Berk, 2008, p. 394; Bernini and Pellegrini, 2011, p. 255), which have to be

taken into account. Different solutions to tackle the problems are described in Hussinger (2008, p. 730), while a general introduction can be found in Wooldridge (2010, pp. 903–981).

As we use the CIS 2008, we decide to use a propensity matching approach implemented in Stata (2014) by Leuven and Sianesi (2003):[9] Therefore, we estimate a propensity score by nearest neighbour matching and calculate the effect of public innovation support on four dummy variables: *pdinno*, which equals one if the firm introduced a new product or service; *prinno*, which equals one if the firm introduced a new process; *orinno*, which equals one for a new organizational structure in the company; and *mrinno*, which equals one if a new marketing measure was established. Additionally, we include two variables, *newmar* and *newfirm*, which indicate the turnover generated by products (or services) newly introduced to either the entire market (*newmar*) or the firm (*newfirm*).

These variables form our set of indicators $Inno_i$ upon which we assume that the innovation support has an influence. Together with the propensity to receive innovation support Fun_i, we can calculate the average treatment effect on the treated (ATT). Our matching ensures that firms with similar characteristics are compared as supported and non-supported companies.

Due to the seven different dependent variables in our probit regressions, we also estimate seven different propensity scores for the different sets of public innovation support, plus separate propensity scores in the country regressions.

[9] For the advantages of propensity score matching with CIS data, see Czarnitzki et al. (2007, p. 1354).

Table 5: Characteristics of Supported Firms in Europe by Level of Support (Marginal Effects of probit regressions)

	Regional level only	***National level only***	***EU level only***	***Regional and national level***	***Regional and EU level***	***National and EU level***	***Regional, national and EU level***
	Marg. Eff. (Std. Err.)	*Marg. Eff. (Std. Err.)*	*Marg. Eff. (Std. Err.)*	*Marg. Eff. (Std. Err.)*	*Marg. Eff. (Std. Err.)*	*Marg. Eff. (Std. Err.)*	*Marg. Eff. (Std. Err.)*
fedsme	0.0061	-0.0148 ***	-0.0142 ***	0.0100 ***	0.0024 ***	-0.0164 ***	-0.0090 ***
	(0.0046)	(0.0049)	(0.0033)	(0.0027)	(0.0008)	(0.0034)	(0.0026)
semsme	0.0336 ***	-0.0251 ***	-0.0149 ***	0.0025 *	-0.0001	-0.0176 ***	-0.0046 ***
	(0.0020)	(0.0022)	(0.0013)	(0.0014)	(0.0005)	(0.0015)	(0.0009)
censme	-0.0321 ***	-0.0037	0.0110 ***	-0.0131 ***	0.0012 **	0.0077 ***	-0.0016
	(0.0035)	(0.0028)	(0.0011)	(0.0022)	(0.0006)	(0.0010)	(0.0012)
regular	0.0475 ***	0.0954 ***	0.0077 ***	0.0529 ***	0.0031 ***	0.0225 ***	0.0242 ***
	(0.0019)	(0.0020)	(0.0010)	(0.0015)	(0.0004)	(0.0010)	(0.0011)
foreign	-0.0301 ***	-0.0100 ***	-0.0030 **	-0.0111 ***	-0.0013 *	-0.0038 ***	-0.0090 ***
	(0.0035)	(0.0028)	(0.0014)	(0.0019)	(0.0007)	(0.0012)	(0.0014)
LR chi²(5)	*1312.3500*	*3212.5200*	*581.6500*	*2271.7700*	*77.2400*	*1390.1100*	*1116.6300*
Prob > chi²	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*	*0.0000*
Pseudo R²	*0.0503*	*0.1028*	*0.0622*	*0.1464*	*0.0330*	*0.1641*	*0.1403*

Data: Eurostat CIS 2008 microdata; Notes: Calculated with Stata (2014); *** denotes significance at 1% level; ** at 5% level; * at 10% level.

Table 6: Average Treatment Effects of the Treated (ATT, difference between treated and controls)

	Regional level only	***National level only***	***EU level only***	***Regional and national level***	***Regional and EU level***	***National and EU level***	***Regional, national and EU level***
	ATT	*ATT*	*ATT*	*ATT*	*ATT*	*ATT*	*ATT*
	(Std. Err.)	*(Std. Err.)*	*(Std. Err.)*	*(Std. Err.)*	*(Std. Err.)*	*(Std. Err.)*	*(Std. Err.)*
pdinno	-0.1408	0.1891	0.1931	0.1412	0.1377	0.1458	0.1114
	(0.2658)	(0.2039)	(0.2189)	(0.2322)	(0.1957)	(0.2430)	(0.2489)
psinno	0.4772	-0.0356	0.3051	-0.1448	0.1257	0.0735	0.1518
	(0.2605)	(0.1998)	(0.2145)	(0.2276)	(0.1915)	(0.2307)	(0.2491)
orinno	0.3521	0.2786	0.4149	0.2467	0.2814	0.4774	0.2159
	(0.2605)	(0.1869)	(0.2009)	(0.2129)	(0.1802)	(0.2308)	(0.2284)
mrinno	-0.1187	0.1188	0.1931	0.0739	0.1018	0.4348	-0.0460
	(0.2437)	(0.1998)	(0.2147)	(0.2276)	(0.1925)	(0.2309)	(0.2493)
newmar	0.0797	0.0652	0.0994	0.0653	0.0575	0.1295	-0.0681
	(0.0807)	(0.0373)	(0.0406)	(0.0428)	(0.0396)	(0.0472)	(0.0887)
newfirm	0.1082	0.1169	0.1351	0.1429	0.1068	0.1289	0.0328
	(0.0490)	(0.0163)	(0.0191)	(0.0190)	(0.0232)	(0.0171)	(0.0496)

Data: Eurostat CIS 2008 microdata; 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.

Table 7: Directions of SME coefficients in European countries by level of support (in probit estimations)

	Regional level only		***National level only***		***EU level only***		***Regional and national level***		***Regional and EU level***		***National and EU level***		***Regional, national and EU level***	
	Direction		*Direction*		*Direction*		*Direction*		*Direction*		*Direction*		*Direction*	
Federal														
Germany	**+**	**	**+**	***	+		**+**	***	**+**	*	-		**+**	***
Semi-Federal														
Finland	**+**	***	**-**	**	-		**+**	***	+		-		-	
The Netherlands	+		+		+		-		+		+		+	
Spain	**+**	***	**-**	***	-		**+**	**	**+**	**	**-**	***	**+**	***
Centralist														
Bulgaria	**-**	**	-		-		.		.		+		.	
Czech Republic	**+**	**	**-**	**	-		+		+		+	*	-	
Estonia	**-**	*	+		-		+		.		+		+	
France	**+**	***	**+**	*	+		**+**	***	**+**	***	**+**	**	**+**	***
Hungary	+		+		**+**	***	+		.		**+**	***	-	
Lithuania	.		+		-		+		.		-		+	
Luxembourg	**+**	*	+		+		.		.		+		-	
Latvia	.		.		+		.		.		+		.	
Portugal	**+**	**	-		-		-		+		+		+	
Romania	+		+		+		+		-		**+**	***	+	
Slovenia	+		+		+		-		.		+		.	
Slovak Republic	+		-		+		.		.		-		.	

Data: Eurostat CIS 2008 microdata; Notes: Calculated with Stata (2014); . stands for missing coefficients or regressions, + for a positive coefficient, - for a negative coefficient; *** denotes significance at 1% level; ** at 5% level; * at 10% level; direction of significant coefficients printed in bold.

5 Results

The structural equations aggregated at the European level as well as the different country equations clarify the influences of the political systems: while regional programmes always show a positive influence in federal and semi-federal countries, the effect for centralist countries is negative at the European level and very mixed in the different centralist countries.

The marginal effects of the seven probits for the European comparison are described in Table 5. We focus our analysis on the SME dummies; therefore, we show the direction of the coefficients (either positive or negative) from the different countries in Table 7.

In the European comparison, most of the coefficients are significant. In the country regressions, the relatively small samples in some countries – especially the smaller ones like Latvia, the Slovak Republic or Slovenia – lead to econometrical problems and less significant results.

In the EU comparison, we find positive coefficients for the federal and semi-federal SME dummies with regional level support programmes (albeit only with the last group being statistically significant). This is the case if a firm only receives regional support or a combination of regional and national or regional and European support (with the last combination not significant and minimally below zero for semi-federal SMEs). By contrast, the two federal and semi-federal SME dummies turn negative for national and European support, as well as the combination of both. Moreover, the coefficient for companies receiving support from all three political levels is also negative for federal and semi-federal SMEs.

By contrast, for SMEs from centralist countries, we find a negative coefficient at the regional and national levels (with the last coefficient being slightly above zero and not significant), as well as for the combination of local and national level support. The coefficient in the estimation for solely European support turns positive, as it is also the case for the combinations of regional and European as well as national and European support. The centralist SME dummy is negative in the probit for firms receiving support from all levels, although – in contrast to the other two SME dummies in this regression – it is not significant.

In order to check for country-specific effects, we compare the country regressions. Although the econometrical problems mentioned above reduce the explanatory power, we see that regional level programmes in all federal and semi-federal countries have a positive coefficient, which is significant in all countries aside from the Netherlands.

In the centralist countries, the direction of the SME dummies for regional support varies much more strongly between countries (including in the size of their coefficients). For the other levels,

the distinction between the political systems is less clear. We find more positive coefficients for national and European level programmes in centralist countries, although rarely significant.

Moreover, a country effect for Germany - the only federal country - cannot be excluded in our variable *fedsme*. Unfortunately, no other federal country is available in the CIS 2008 as a comparison. However, in earlier regressions that included Belgium as another federal country, the results were similar.[12]

Regarding the marginal effects, we find a variety of effects from almost 0 for the combination of local and European support to up to 0.03 for semi-federal SMEs at the regional level (positive coefficient) and centralist SMEs with the combination of regional and national support (negative coefficient). Generally, we see that negative effects are greater than positive effects (except for regional support and semi-federal SMEs). As indicated by higher values of the marginal effects, the economic relevance is much greater for our dummy variable concerning whether a firm regularly spent money on innovative activities in the European comparison. Only for European level support and the combination of local and European level support is the coefficient smaller than some of the SME dummies. It always reaches a higher level of econometrical significance.

In the country regressions, we analyse the influence of the money spent on R&D in a company. Aside from regional support only, the coefficient is positive and often significant in almost all countries. This underlines the effect measured in the EU comparison by the dummy for regular spending.

All levels of political support focus on domestic companies. Negative – and for some levels high – marginal effects show this for our dummy variable for foreign companies. We find a smaller and less significant coefficient for European support only and its combinations, although the direction remains negative.

In our country regressions,[13] we analyse the influence of national or international market focus, as well as internal R&D expenditure (in logs). The results can be seen in Tables 8, 9 and 10.

We do not find a clear direction of the effect for the market focus of the analysed firms: the coefficients are rarely significant and the direction of their effect often varies. While the only significant coefficients are negative for regional level programmes, there is a positive coefficient (with the exception of Estonia) for national level programmes and an unclear effect for EU level

[12] In a preliminary version, we compared Belgium with data from 2004. We found similar results, although the 2004 data wave included fewer variables and various other countries were missing. Therefore, we decided to focus on the 2008 data wave.

[13] The respective variables are not available in all countries; therefore, the variables are excluded for the European analysis.

programmes and the combination of two different levels. The effect in companies that receive support from all three levels is generally negative, with the exception of France). Here, we have to assume stronger country effects but we can see an influence of regional programmes, which more strongly focus on companies with a regional market focus. In contrast to earlier findings in Germany by Becker (2013, p. 13), the coefficients are not significant in federal and semi-federal countries. This effect does not seem to be influenced by political systems.

In contrast to these mixed findings, we find a strong and positive influence of the expenditure spent on R&D within a company at all political levels; indeed, this result is similar in all countries across Europe. Out of all the significant coefficients from different countries, only the coefficient for Estonia is negative, while all the other coefficients are positive and often statistically highly significant. We see positive coefficients in federal, semi-federal and centralist countries. The influence of R&D investment on the likelihood of receiving public support is influential without visible differences according to the political systems.

If publicly supported, the effects on innovations are – similar to Becker (2013) for Germany and in contrast to Fernández-Ribas (2009) for Catalonia – questionable, given that none of the ATTs reported in Table 6 are significant. However, the effects are non-trivial and systematic as they remain positive, aside from product and marketing innovations in regional programmes, process innovations in national programmes, process innovations in the combination of local and national programmes and marketing innovations in our estimation for support from all three levels. This can be seen as a link to a positive (albeit not significant) influence on the 27 innovation outcomes of the respective programmes.

Generally, the chosen firm characteristics only partly explain the reception of public innovation support. However, aside from the European level (and its combinations) estimations, our Pseudo R^2 value is always above 0.05, prompting the conclusion that our effects found are politically relevant. These effects show a clear difference between SMEs in federal and semi-federal countries on the one hand and centralist countries on the other. A generally strong influence of the regularity (and amount) of money spent on innovative activities and a lesser effect of the origin (and market focus) of the firms is supported for all political levels.

Table 8: Directions of R&D expenditure coefficients in European countries by level of support (in probit estimations)

	Regional level only		***National level only***		***EU level only***		***Regional and national level***		***Regional and EU level***		***National and EU level***		***Regional, national and EU level***	
	Direction		*Direction*		*Direction*		*Direction*		*Direction*		*Direction*		*Direction*	
Federal														
Germany	**+**	**	**+**	***	+		**+**	***	**+**	***	+	***	**+**	***
Semi-Federal														
The Netherlands	-		+		**+**	**	**+**	***	+		**+**	***	**+**	***
Spain	+		**+**	***	+		**+**	***	**+**	**	**+**	***	**+**	***
Centralist														
Bulgaria	-		+		+		.		.		**+**	***	-	
Czech Republic	**+**	**	**+**	***	+		**+**	**	+		**+**	***	**+**	***
Estonia	**-**	*	**+**	***	+		+		-		+		+	
France	+		+		+		**+**	***	**+**	***	**+**	***	**+**	***
Hungary	-		**+**	***	**+**	***	+		+		**+**	***	+	
Lithuania	-		-		**+**	***	+		.		+		+	
Luxembourg	**+**	**	**+**	*	+		+		+		**+**	***	+	
Latvia	.		.		+		.		.		**+**	*	.	
Portugal	+		**+**	***	**+**	**	**+**	**	+		**+**	***	+	
Romania	**+**	***	**+**	**	**+**	**	**+**	**	+		**+**	***	**+**	**
Slovenia	-		**+**	**	**+**	***	+		.		**+**	***	.	
Slovak Republic	+		+		+		**+**	*	+		+		.	

Data: Eurostat CIS 2008 microdata; Notes: Calculated with Stata (2014); . stands for missing coefficients or regressions, + for a positive coefficient, - for a negative coefficient; *** denotes significance at 1% level; ** at 5% level; * at 10% level; direction of significant coefficients printed in bold.

Table 9: Directions of national market focus coefficients in European countries by level of support (in probit estimations)

	Regional level only		***National level only***		***EU level only***		***Regional and national level***		***Regional and EU level***		***National and EU level***		***Regional, national and EU level***	
	Direction		*Direction*		*Direction*		*Direction*		*Direction*		*Direction*		*Direction*	
Federal														
Germany	+		**+**	***	+		-		+		+		+	
Semi-Federal														
The Netherlands	-		**+**	***	+		-		-		+		**-**	*
Centralist														
Bulgaria	+		**+**	***	**+**	**	.	.	.	.	**+**	**	+	
Czech Republic	**-**	***	**+**	*	**+**	**	-		-		+		**-**	**
Estonia	-		**-**	**	-		.	.	.	.	+		**-**	**
France	-		**+**	***	**+**	*	+		+		+		+	
Hungary	-		+		+		.	.	.	.	-		.	.
Lithuania	**-**	**	-		-		-		.	.	-		**-**	**
Luxembourg	+		+		**-**	*	+		.	.	.	.	-	
Latvia	.	.	.	.	-		.	.	.	.	**-**	**	.	.
Portugal	**-**	***	-		-		-		**-**	**	+		-	
Romania	**-**	**	**+**	***	+		-		**-**	**	-		+	
Slovenia	+		+		+		+		.	.	**-**	*	.	.
Slovak Republic	-		-		+		.	.	.	.	-		.	.

Data: Eurostat CIS 2008 microdata; Notes: Calculated with Stata (2014); . stands for missing coefficients or regressions, + for a positive coefficient, - for a negative coefficient; *** denotes significance at 1% level; ** at 5% level; * at 10% level; direction of significant coefficients printed in bold.

Table 10: Directions of international market focus coefficients in European countries by level of support (in probit estimations)

	Regional level only		***National level only***		***EU level only***		***Regional and national level***		***Regional and EU level***		***National and EU level***		***Regional, national and EU level***	
	Direction		*Direction*		*Direction*		*Direction*		*Direction*		*Direction*		*Direction*	
Federal														
Germany	+		**+**	***	+		-		+		+		+	
Semi-Federal														
The Netherlands	-		**+**	***	-		+		-		+		+	
Centralist														
Bulgaria	-		**+**	***	**+**	*	.	.	-		**+**	*	.	
Czech Republic	**-**	***	**+**	***	+		-		-		+		**-**	**
Estonia	.	.	-		+		.	.	-		+		**-**	*
France	+		**+**	***	+		**+**	***	+		**+**	**	**+**	***
Hungary	-		+		+		+		-		-		+	
Lithuania	.	.	-		-		.	.	.	.	+		**-**	*
Luxembourg	.	.	.	.	.	.	.	.	.	.	.	.	.	.
Latvia	.	.	.	.	+		.	.	.	.	**-**	**	.	.
Portugal	-		**+**	**	+		-		.	.	**+**	*	.	.
Romania	-		**+**	**	+		-		-		+		+	
Slovenia	+		+	**	+		+		.	.	+		.	.
Slovak Republic	-		+		-		.	.	.	.	-		.	.

Data: Eurostat CIS 2008 microdata; Notes: Calculated with Stata (2014); . stands for missing coefficients or regressions, + for a positive coefficient, - for a negative coefficient; *** denotes significance at 1% level; ** at 5% level; * at 10% level; direction of significant coefficients printed in bold.

6 Discussion and conclusion

Few studies have empirically evaluated the influence of political systems on the reception of public innovation support and no other studies have evaluated innovation support across Europe with CIS data.

Our paper analyses the firm characteristics of firms publicly supported in sixteen European countries as well as aggregated from these countries at the European level. The paper focuses on the influence of political systems and regional level support, especially for SMEs as firms with higher barriers to innovate. It analyses the different characteristics from regional, national and European level programmes, as well as common characteristics like the expenditure spent on innovative activities.

We find visible differences between federal, semi-federal and centralist countries, especially regarding the support of small and medium-sized enterprises: Regional programmes reach SMEs better, especially in federal and semi-federal countries. These findings support the theoretical point that decentralized systems more strongly focus on the regional preferences of firms with barriers to innovate, which are reflected by the smaller companies. Therefore, our hypotheses 1 and 2 are supported by our empirical findings: SMEs have greater difficulties in gaining national and supranational support and a decentralized innovation framework better reaches firms with barriers to innovate, in this case SMEs.

We find partial support for hypothesis 3. Positive influences are found for European support (and its combinations with regional or national support), in terms of national support, we do not find clear differences in the (negative) coefficients between federal, semi-federal and centralist countries. Therefore, this hypothesis has to be partially rejected, but the argument for a decentralized framework is supported.

Another partial rejection has to be drawn for hypothesis 4, which predicted that regional programmes more strongly focus on companies with a regional market focus in most countries. However, we find a positive influence of national and international market focus at the other levels of support. Nonetheless, the coefficients vary in their directions between the different countries and political systems, meaning that no general conclusion can be drawn.

As expected, regularly higher expenditures on innovative activities explain the reception of public innovation support, thus supporting hypothesis 5. Combined with the findings on SMEs, we assume that this creates an even higher barrier for the first step to innovation, whereby companies that are already innovative are more likely to receive public support, thus making it more likely that they will innovate in the future.

Regarding hypothesis 6, we have to reject this hypothesis as none of our average treatment effects prove significant (although 27 of 32 ATTs are positive). Therefore, generally across Europe, we do not find a significant impact of public innovation support on the likelihood of introducing product, process, organizational or marketing innovations, in any combinations of support from the different levels.

As a policy implication, a more decentralized system of public innovation support and stronger regional programmes increases the variety of firms supported. Therefore, policy-makers should learn from positive examples of regional innovation support across Europe. However, this fact does not say anything about the effectiveness of public innovation support, which provides ample scope for future research.

While country effects vary between the European countries, our results suggest some common tendencies in the sixteen European countries chosen and particularly across similar political systems, meaning that political actors can learn from other countries in Europe.

This leads us to a further necessity for policy evaluation concerning public support programmes: while many programmes claim to reach SMEs (and other firms that face barriers to innovate), only regional programmes seem to reach them. Combined with issues concerning the effectiveness of support, this has to be further analysed for both individual countries and the EU as a whole.

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References

Aerts, K., Czarnitzki, D., 2004. Using Innovation Survey Data to Evaluate R&D Policy: The Case of Belgium. ZEW Discussion Paper No. 04-55. ZEW, Mannheim, 25 pp. (downloaded on 11 March 2015 from ftp://ftp.zew.de/pub/zew-docs/dp/dp0455.pdf).

Almus, M., Czarnitzki, D., 2003. The effects of public R&D subsidies on firms' innovation activities: The case of Eastern Germany. Journal of business & economic statistics : JBES ; a publication of the American Statistical Association 21 (2), 226–236.

Arrow, K.J., 1962. Economic welfare and the allocation of resources for invention, in: The rate and direction of inventive activity. economic and social factors. a conference of the Universities-National Bureau Committee for Economic Research and the Committee on Economic Growth of the Social Science Research Council, pp. 609–625.

Atkinson, R.D., 1991. Innovation policy making in a federalist system: Lessons from the states for U.S. federal innovation policy making. Research Policy 20 (6), 559–577.

Audretsch, D.B., 2001. The dynamic role of small firms : evidence from the US. World Bank Institute, Washington D.C.

Backhaus, K., Erichson, B., Plinke, W., Weiber, R., 2000. Multivariate Analysemethoden : eine anwendungsorientierte Einführung (12th ed.). Springer, cBerlin [u.a.].

Beaudry, C., Breschi, S., 2003. Are firms in clusters really more innovative? Economics of Innovation & New Technology 12 (4), 325–342.

Becker, L., 2012. Innovation subsidies in a federal system: Innovation policy at different political levels in Germany, in: Proceedings of the 2nd annual International Conference on Innovation and Entrepreneurship (IE 2012). GSTF, Singapore, pp. 59–64.

Becker, L., 2013. No gains of federalism in innovation support?: The case of Germany, in: Conference Proceedings 35th DRUID Celebration Conference 2013. 35th DRUID Celebration Conference 2013, Barcelona. online.

Bernini, C., Pellegrini, G., 2011. How are growth and productivity in private firms affected by public subsidy?: Evidence from a regional policy. Regional science & urban economics 41 (3), 253–265.

Blanes, J.V., Busom, I., 2004. Who participates in R&D subsidy programs?: The case of Spanish manufacturing firms. Research Policy 33 (10), 1459–1476.

Blume, L., Voigt, S., 2011. Federalism and decentralization—a critical survey of frequently used indicators. Constitutional Political Economy 22 (3), 238-264.

Bohnstedt, A., 2014. Are public and private R&D investments complements or substitutes? Ruhr economic papers, Essen, 18 pp. http://www.rwi-essen.de/publikationen/ruhr-economic-papers/617/).

Braun, D., 2008. Lessons on the political coordination of knowledge and innovation policies. Science and Public Policy 35 (4), 289–298.

Brouwer, M.T., 2000. Entrepreneurship and uncertainty: innovation and competition among the many. Small Business Economics 15 (2), 149–160.

Brown, C., Hamilton, J., Medoff, J.L., 1990. Employers large and small. Harvard University Press, Cambridge, Mass [u.a.].

Busom, I., 2000. An Empirical Evaluation of the Effects of R&D Subsidies. Economics of Innovation & New Technology 9 (2), 111–149.

Busom, I., Fernández-Ribas, A., 2007. Do R&D Programs of Different Government Levels Overlap in the European Union?, in: Science, Technology and Innovation Policy. Atlanta Conference on Science, Technology and Innovation Policy, Atlanta. 19-20 Oct. 2007, pp. 1–5.

Cantner, U., Kösters, S., 2012. Picking the winner?: Empirical evidence on the targeting of R&D subsidies to start-ups. Small Business Economics 39 (4), 921–936.

Cerulli, G., 2010. Modelling and measuring the effect of public subsidies on business R&D: A critical review of the econometric literature. The economic record : er 86 (274), 421–449.

Clausen, T.H., 2009. Do subsidies have positive impacts on R&D and innovation activities at the firm level? Structural change and economic dynamics 20 (4), 239–253.
Czarnitzki, D., Ebersberger, B., Fier, A., 2007. The relationship between R&D collaboration, subsidies and R&D performance: Empirical evidence from Finland and Germany. Journal of Applied Econometrics 22 (7), 1347–1366.
Czarnitzki, D., Fier, A., 2002. Do Innovation Subsidies Crowd Out Private Investment? Evidence from the German Service Sector. Applied Economics Quarterly (Konjunkturpolitik) 48 (1), 1–25.
Czarnitzki, D., Hanel, P., Rosa, J.M., 2011. Evaluating the impact of R&D tax credits on innovation: A microeconomic study on Canadian firms. Research Policy 40 (2), 217–229.
Czarnitzki, D., Toole, A.A., 2008. The R & D investment uncertainty relationship: Do competition and firm size matter? Discussion paper / ZEW Zentrum für Europäische Wirtschaftsforschung, Mannheim, 18 S (downloaded on 11 March 2015 from http://ftp.zew.de/pub/zew-docs/dp/dp08013.pdf).
David, P.A., Hall, B.H., Toole, A.A., 2000. Is public R&D a complement or substitute for private R&D? A review of the econometric evidence. Research Policy 29 (4-5), 407–529.
Duguet, E., 2004. Are R&D subsidies a substitute or a complement to privately funded R&D ? An econometric analysis at the firm level. Revue d'Economie Politique 114 (2), 245–274.
Edler, J., Kuhlmann, S., 2008. Coordination within fragmentation: governance in knowledge policy in the German federal system. Science and Public Policy 35 (4), 265–276.
European Commission, 2013. State Aid Scoreboard 2013: Non-crisis aid (downloaded on 19 June 2014 from http://ec.europa.eu/competition/state_aid/scoreboard/non_crisis_en.html).
Eurostat. Community Innovation Survey (CIS), Luxemburg.
Feld, L.P., 2007. Zur ökonomischen Theorie des Föderalismus: Eine prozeßorientierte Sicht, in: Heine, K., Kerber, W. (Eds), Zentralität und Dezentralität von Regulierung in Europa. Lucius & Lucius, Stuttgart, pp. 31–54.
Fernández-Ribas, A., 2009. Public support to private innovation in multi-level governance systems: an empirical investigation. Science and Public Policy 36, 457–467.
Fier, A., Czarnitzki, D., 2005. Zum Stand der empirischen Wirkungsanalyse der öffentlichen Innovations- und Forschungsförderung (downloaded on 11 March 2015 from http://www.zew.de/de/publikationen/evaluationinno/ZEW_Ueberblick_Wirkungsanalyse.pdf).
Freedman, D.A., Berk, R.A., 2008. Weighting Regressions by Propensity Scores. Evaluation Review 32 (4), 392–409.
González Cerdeira, X., Pazó Martínez, C., 2008. Do public subsidies stimulate private R&D spending? Research Policy 37 (3), 371–389.
Görg, H., Strobl, E., 2007. The Effect of R&D Subsidies on Private R&D. Economica 74 (294), 215–234.
Griliches, Z., 1992. The Search for R&D Spillovers. The Scandinavian Journal of Economics 94, 29–47.
Grossman, G.M., Helpman, Elhanan, 1994. Endogenous Innovation in the Theory of Growth. The Journal of Economic Perspectives, 8 (1), 23–44.
Hall, B., Mairesse, J., Mohnen, P., 2009. Measuring the Returns to R&D. National Bureau of Economic Research, Cambridge, MA.
Hayek, F.A. von, 1948. Individualism and economic order. Univ. of Chicago Press, London.
Hong, S., Oxley, L., McCann, P., 2012. A survey of the innovation surveys. Journal of economic surveys 26 (3), 420–444.
Hussinger, K., 2008. R&D and subsidies at the firm level: An application of parametric and semiparametric two-step selection models. Journal of Applied Econometrics 23 (6), 729–747.
Klette, T.J., Møen, J., Griliches, Z., 2000. Do subsidies to commercial R&D reduce market failures?: Microeconometric evaluation studies. Research Policy 29 (4/5), 471–495.
Koga, T., 2005. R&D subsidy and self-financed R&D: The case of Japanese high-technology start-ups. Small business economics : an internat. journal 24 (1), 53–62.

Konings, J., Torfs, W., 2011. Fiscal Federalism, Tax Competition and Economic Agglomeration, in: Flemish Department of Finance and Budget (Ed), Fiscal Federalism in the European Union. EU Presidency Seminar. Larcier, Brussels, pp. 35–56.
Lach, S., 2002. Do R&D Subsidies Stimulate or Displace Private R&D? Evidence from Israel. The Journal of Industrial Economics, 50 (4), 369–390.
Lang, G., 2009. Measuring the returns of R&D: An empirical study of the German manufacturing sector over 45 years. Research Policy 38 (9), 1438–1445.
Lee, C.-y., 2011. The differential effects of public R&D support on firm R&D: Theory and evidence from multi-country data. Technovation : the international journal of technological innovation, entrepreneurship and technology management 31 (5/6), 256–269.
Leuven, E., Sianesi, B., 2003. PSMATCH2: Stata module to perform full Mahalanobis and propensity score matching, common support graphing, and covariate imbalance testing.
Levine, R., 1997. Financial Development and Economic Growth: Views and Agenda. Journal of Economic Literature 35 (2), 688–726.
Levy, D.M., 1990. Estimating the impact of government R&D. Economics Letters 32 (2), 169–173.
Lijphart, A., 2012. Patterns of democracy: Government forms and performance in thirty-six countries (2nd ed.). Yale University Press, New Haven.
Loury, G.C., 1979. Market structure and innovation. The quarterly journal of economics 93 (3), 395–410.
Mairesse, J., Mohnen, P.A., 2010. Using innovation surveys for econometric analysis, in: Hall, B.H., Rosenberg, N. (Eds), Handbook of the economics of innovation. North Holland, Amsterdam [u.a.], pp. 1129–1155.
Maliranta, M., 2000. Job creation by supporting technology advances?: Evidence from Finnish plants, in: Asplund, R. (Ed), Public R & D funding, technological competitiveness, productivity, and job creation. Taloustieto, Helsinki, pp. 87–128.
Montmartin, B., 2011. Centralized Innovation Policy in an agglomeration and growth model: A welfare analysis http://www.worldcat.org/oclc/711418912).
Musgrave, R.A., 1959. The theory of public finance: A study in public economy. McGraw-Hill, New York.
Nelson, R.R., 1959. The Simple Economics of Basic Scientific Research. The Journal of Political Economy, 67 (3), 297–306.
Oates, W.E., 1972. Fiscal federalism. Harcourt Brace Jovanovich, New York, NY.
OECD, 1997. Oslo manual : Proposed guidelines for collecting and interpreting technological innovation data. Organisation for Economic Co-operation and Development (OECD)., Paris http://www.oecd.org/dataoecd/35/61/2367580.pdf).
OECD, 2002. Frascati manual 2002 : the measurement of scientific and technological activities; proposed standard practice for surveys of research and experimental development 254. Organisation for Economic Co-operation and Development (OECD)., Paris http://www.lmt.lt/PROJEKTAI/TEKSTAI/Frascati.pdf).
OECD, 2011. Regions and innovation policy. OECD Publ., Paris.
Radicic, D., Pugh, G., 2013. The impact of innovation support programmes on SME innovation in traditional manufacturing industries: an evaluation for seven EU regions, in: Conference Proceedings DRUID Academy 2013. DRUID Academy 2013, Aalborg. online.
Roberts, A., 2006. What Kind of Democracy Is Emerging in Eastern Europe? Post-Soviet Affairs 22 (1), 37–64.
Saam, N.J., Kerber, W., 2013. Policy Innovation, Decentralised Experimentation, and Laboratory Federalism. Journal of Artificial Societies and Social Simulation 16 (1), 7.
Schumpeter, J.A., 2008. Capitalism, socialism and democracy (3rd ed.). Harper Perennial Modern Classics, New York, NY [u. a.].
Stata, 2014. Stata. StataCorp LP.

Stein, M., Turkewitsch, L., 2010. Multilevel Governance and Federalism: Closely Linked or Incompatible Concepts. Participation - Bulletin of the International Political Science Association 34 (2), 3–5.
Thomä, J., Bizer, K., 2013. To protect or not to protect? Modes of appropriability in the small enterprise sector. Research Policy 42 (1), 35–49.
Tiebout, C.M., 1956. A pure theory of local expenditures. Journal of Political Economy 64 (5), 416–424.
Vitola, A., 2014. Innovation policy mix in a multi-level context: The case of the Baltic Sea Region countries. Science and Public Policy.
Vonortas, N.S., Stampfer, M., Zinöcker, K., 2007. Evidence never lies: introduction to a special issue on New Frontiers in Evaluation. Science and Public Policy 34 (10), 679–680.
Wallsten, S.J., 2000. The effects of government-industry R&D programs on private R&D: the case of the Small Business Innovation Research program. RAND Journal of Economics (RAND Journal of Economics) 31 (1), 82–100.
Wilson, D., Souitaris, V., 2002. Do Germany's federal and land governments (still) co-ordinate their innovation policies? Research Policy 31 (7), 1123–1140.
Wooldridge, J.M., 2010. Econometric analysis of cross section and panel data (2. ed). MIT Press, Cambridge, Mass.