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Article

Do R&D subsidies support innovation or imitation?

Do R&D Subsidies Support Innovation or Imitation? Evidence from Four EU Countries

*Rostislav STANĚK – Michal KVASNIČKA – Ondřej KRČÁL**

Abstract

This paper presents an empirical analysis of the effects of public R&D subsidies on the innovative activities of private firms in Bulgaria, the Czech Republic, Germany, and Portugal. We investigate whether public R&D subsidies make firms' activities more innovative. We measure these effects using firm-level data from the 2010 and 2012 Community Innovation Survey and estimated the effects by propensity score matching. We find that the subsidies do not fully crowd out private sources of R&D expenditure in any of these countries. However, there is a substantial heterogeneity in the impact of the subsidies on firms' innovativeness. R&D subsidies do support true innovations in the Czech Republic and Germany, but they enhance only imitations in Bulgaria and Portugal.

Keywords: *R&D subsidies, CIS, innovation output, crowding out*

JEL Classification: O38, H32, L20

Introduction

Governments all around the world strive to increase the R&D intensity of their economies. For example, one of the European Union's 2020 targets is to have 3% of European GDP invested into R&D activities (EC, 2010). Governments support investment into private R&D using two conventional tools: direct subsidies and tax incentives. Public subsidies for private R&D activities are based on solid theoretical arguments dating back to Nelson (1959) and Arrow (1962). One traditional argument states that R&D investment creates positive technological spillovers, motivating other companies to free ride. This leads firms to underinvest in their own R&D activities. This lack of investment is

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especially severe with highly innovative R&D projects with high risk and high potential gain for the society, as firms capturing only a small part of the overall gain might not be willing to incur the risks.

Even though the benefits of public R&D subsidies are well grounded in theory, the positive effect of such subsidies cannot be taken for granted. Firms always have incentives to apply for public subsidies, even if the R&D project would still be conducted without it. The principal question to be answered when evaluating the effect of a public subsidy is what the firm's R&D activities would have been if it had not received that subsidy. There are two different channels through which public subsidies may affect the firm's behavior. Public subsidies may increase the amount of R&D expenditure, or they may provide incentives to engage in more innovative R&D activities. Previous literature decisively shows that public subsidies do indeed increase the spending on R&D, i.e. there is not a full crowding out effect on private investment. Moreover, it seems that the increased spending spurs the development of new products. However, less is known regarding whether the new products are true innovations, i.e. products and services created first in the world, or mere imitations, i.e. products and services that are new only for the firm or its local market.

The main goal of this paper is to investigate whether public subsidies support radical innovations or mere imitations. The former is typically defined as a strategy when a firm invests substantially in R&D and aims to be the first to bring the innovative product. The latter is characterized as producing pure clones or products which are only incrementally different from products existing elsewhere. Compared to imitation, innovations have higher potential to push the technological frontier of a firm or even a sector, and create positive technological spillovers.

We use data from Community Innovation Surveys (CIS) 2010 and 2012, which ask several questions that allow us to address our research question. We estimate the effect of public subsidies by propensity score matching, a non-parametric method that is a standard procedure in this strand of literature. We estimate the effects of the R&D subsidies in four countries: Bulgaria, the Czech Republic, Germany, and Portugal. The countries were selected on the basis of data availability; other countries in the CIS datasets do not provide all the necessary data.

The comparison of the effect of R&D subsidies in these countries provides the second contribution of the paper. The current literature offers some evidence that R&D subsidies induce more radical innovations. However, this evidence is limited to the most developed European countries. Our sample includes Germany, but also less developed countries, two of which were part of the Eastern Bloc

(Czech Republic and Bulgaria) and one western less developed country (Portugal). By estimating the effect of R&D subsidies in these countries, we show whether and to what extent R&D subsidies induce more radical innovations, even in less developed countries.

The paper is organized as follows: In the next section, we will briefly discuss recent empirical studies of the impact of R&D subsidies. The methodology and data are presented in Section 2. The main analysis is conducted in Section 3. The last section provides a discussion of the results.

1. Literature Review

Many empirical studies have assessed the impact of public subsidies on the amount R&D investment. The main interest of these studies is the so called crowding-out hypothesis which postulates that public subsidies do not increase R&D spending. Zúñiga-Vicente et al. (2014) provide a meta-analysis of studies on the crowding-out effect of R&D subsidies. They found that more than 60% of 76 micro-level studies reject the crowding-out effect, which means that public subsidies increase the firms' spending on R&D. More recent studies, not included in the review by Zúñiga-Vicente et al. (2014), are even more likely to reject the crowding-out hypothesis (see Carboni, 2011; Cerulli and Potì, 2012; Hottenrott and Lopes-Bento, 2014, for examples of studies that reject the hypothesis). The crowding-out hypothesis was also rejected for the Czech Republic during years 2000 – 2008 (Vokoun, 2016). The majority of these studies use CIS data (e.g. Aerts and Schmidt, 2008; Clausen, 2009; Cerulli and Potì, 2012; Hud and Hussinger, 2015) or survey data with a similar structure (e.g. Bérubé and Mohnen, 2009; Huergo, Trenado and Ubierna, 2016).

In this paper, we are mainly interested in whether public subsidies encourage firms to undertake more innovative projects. Encouraging first-to-the-world innovations rather than mere imitations is more desirable because it generates higher value for the global economy, which can be, to some extent, captured by the innovators. This could be even more beneficial in those countries in our sample whose institutions do not sufficiently support innovation, such as the Czech Republic, Portugal, and Bulgaria,[1] because it might create positive spillovers on innovativeness of other firms in the same economy, for example through corporate culture (Tellis, Prabhu and Chandy, 2009).

[1] A widely used measure of the innovativeness of an economy is the Bloomberg Innovation Index 2018 in which the Czech Republic ranks 28th, Portugal 30th, and Bulgaria 41th (see <https://www.bloomberg.com/news/articles/2018-01-22/south-korea-tops-global-innovation-ranking-again-as-u-s-falls>.) [Accessed on 6/8/2018.]

Studies of the impact of R&D subsidies on the innovativeness of R&D activity are relatively rare. Bérubé and Mohnen (2009) use survey data from Canadian firms to investigate whether subsidized firms engage in more innovative projects. Their results show that subsidized firms introduced more world-first innovations.

In a similar line of research, Bronzini and Piselli (2016) evaluate the effect of subsidy programs implemented in Northern Italy on the number of patent applications. Hottenrott and Lopes-Bento (2014) investigated the same research question using data from Germany. Both studies find that subsidy programs increased the likelihood of a firm's applying for a patent. Neicu, Teirlinck and Kelchtermans (2016) use survey data on Belgian firms to show that R&D subsidies induce firms to invest more into research activities than in development activities. Using a representative firm-level dataset covering the period between 1999 and 2011 of the Swiss innovation survey, Beck, Lopes-Bento and Schenker-Wicki (2016) hypothesize that public subsidies affect radical and incremental innovations differently. They use sales percentages of newly introduced or innovated products as measures of the success of radical or incremental innovation and show that public subsidies only increase the success of radical innovations.

Taken together, these studies provide some evidence that R&D subsidies may induce more radical innovative activities. Nevertheless, the geographical scope of studies evaluating this effect of public R&D support is limited to the most developed European regions (Northern Italy, Belgium, Switzerland) and Canada. Little is known regarding whether public subsidies induce more radical innovations even in less-developed countries. This paper contributes to the current knowledge of the effect of public R&D subsidies by providing firm-level evidence of the effect for several European countries. Countries in our sample are different with respect to the level of economic development and sophistication of the production process.

The sophistication of the production process is measured in World bank survey[2] on the 7 point scale, where 1 means „production uses labor-intensive processes or old technology" and 7 stand for „production uses sophisticated and knowledge-intensive processes". The index values for countries in the year 2012 were the following: Germany 6.38, Czech Republic 4.66, Portugal 4.26, Bulgaria 3.37. Due to these differences, we are able to show whether the R&D subsidies induce innovative activities to the same extent in more developed countries as in less-developed European countries.

[2] <https://tcdata360.worldbank.org/indicators/inv.prod.soph?country=CZE&indicator=555&viz=line_chart&years=2007,2017>. [Accessed on 3/6/2018.]

2. Data and Estimation Procedure

We use data from the Community Innovation Survey (CIS) 2010 and 2012. We focus on manufacturing firms (NACE group C) that attempted a product innovation in the examined years and were located in one of the following four countries: Bulgaria, the Czech Republic, Germany, and Portugal. The other countries included in the CIS datasets do not provide all the necessary variables or have too few complete observations.

Following Bérubé and Mohnen (2009), we divided manufacturing into four groups: resource intensive manufacturing C1 (NACE codes 10, 16, 17, 19, 20, 21, 22, and 23), labor intensive manufacturing C2 (codes 13, 14, 31, 32, and 33), scale intensive manufacturing C3 (codes 18, 24, 25, 29, and 30), and science based and specialized manufacturing C4 (codes 26 to 28). We dropped all incomplete observations and observations in which the firms were not sure about the novelty of their products. Table 1 shows the numbers of observations and the share of firms that received a subsidy in each country, year, and industry group.

T a b l e 1

Number of Complete Observations in Each Country, Year, and Industry Group. The Share of Firms that Received a Subsidy is in Parentheses

Country/year	C1	C2	C3	C4
Bulgaria 2010	369 (10.8%)	165 (8.5%)	118 (22%)	137 (27.7%)
Bulgaria 2012	347 (18.2%)	191 (12.6%)	118 (16.1%)	134 (26.9%)
Czech Republic 2010	230 (26.5%)	89 (32.6%)	114 (40.4%)	130 (40.8%)
Czech Republic 2012	261 (35.6%)	117 (27.4%)	141 (39.7%)	149 (49.7%)
Germany 2010	401 (26.9%)	189 (31.7%)	223 (32.3%)	447 (52.6%)
Germany 2012	309 (33.7%)	145 (39.3%)	167 (41.3%)	364 (53.8%)
Portugal 2010	337 (39.5%)	158 (33.5%)	217 (35%)	145 (34.5%)
Portugal 2012	312 (47.1%)	146 (46.6%)	184 (40.8%)	120 (47.5%)

Source: CIS 2010 and 2012, prepared by the authors.

We use the information whether a firm developed a product that is new only to its country of residence, new to the EU, or new to world as the main outcome variables (variables INPFDC, INPDFE, INPDFW from the CIS dataset). This allows us to explore whether public R&D subsidies support innovations or imitations. If they support radical innovations, we should observe a large and statistically significant treatment effect in the development of products that are new to the world. If, on the other hand, they support only imitations, we should observe a significant treatment effect only in the development of products that are new only to the firms' home countries. In the unlikely scenario in which the subsidies do not generate any product innovations at all, all these treatment effects should be insignificant.

We measure treatment with a binary variable that takes a value of 1 if a firm has been awarded at least one public subsidy by any government (variables FUNLOC, FUNGMT, FUNEU, and FUNRTD from the CIS data[3]).

Our aim is to estimate the average treatment effect on the treated (α_{TT}), which is the difference between the outcomes of firms that received subsidies and the outcomes that the same firms would achieve if they were not awarded the subsidies. The treatment effect can be expressed by the following equation

$$\alpha_{TT} = \mathrm{E}\left(y^t \mid s=1\right) - \mathrm{E}\left(y^{\mathrm{c}} \mid s=1\right)$$

where y^t is the actual outcome variable (e.g. R&D expenditure) of the treated firm and y^{c} is the potential outcome variable if the treated firm had not been treated. The variable *s* indicates the firm's treatment status: *s* = 1 denotes a treated firm, and *s* = 0 denotes a non-treated firm. The outcome of a treated firm $\mathrm{E}\left(y^t \mid s=1\right)$ is directly observable as it can be calculated as a sample mean of the outcome variable in the group of treated firms. On the other hand, the counterfactual situation $\mathrm{E}\left(y^{\mathrm{c}} \mid s=1\right)$ cannot be simply calculated from non-treated firms due to the non-random assignment of treatments. The fundamental problem is therefore the estimation of this counterfactual situation.

In order to address this problem, we use a propensity score matching estimator (Rosenbaum and Rubin, 1983). Many studies have recently applied matching estimators to evaluate innovation policies (e.g. Aerts and Schmidt, 2008; Bérubé and Mohnen, 2009; Carboni, 2011; Hottenrott and Lopes-Bento, 2014; Hud and Hussinger, 2015). The main idea of the propensity score matching estimator is to construct a correct sample counterpart of the treated firms by matching each treated firm with a non-treated firm with similar characteristics. It is assumed that the treatment is randomly assigned to firms with the same set of exogenous characteristics *X*. Conditioning on variables *X* therefore controls for selection bias due to observable differences between treated and non-treated firms. Consequently, the treatment effect can be calculated as

$$\alpha_{TT} = \mathrm{E}\left(y^t \mid s=1, X=x\right) - \mathrm{E}\left(y^{\mathrm{c}} \mid s=0, X=x\right)$$

Propensity score matching reduces the set of observable characteristics *X* into a single index which is the conditional probability that a given firm belongs to the treatment group given the characteristics *X*. Firms with the closest propensity

[3] These variables show whether a firm received a subsidy from local or regional authorities (FUNLOC), from central governments (FUNGMT), from the European Union (FUNEU), and from the EU 7th Framework Programme for Research and Technical Development (FUNRTD).

score are then matched into pairs. In some situations, it can also be appropriate to impose additional restrictions based on some subset of *X*. For example, one may want to match together only firms from the same industry or firms of the same size.

The matching procedure used in this paper proceeds in the following steps:

1. We define and estimate the logit model that explains whether a firm receives a direct or indirect subsidy. Our control variables include industry group, two measures of firm size (turnover and number of employees[4]), whether the firm is part of an enterprise group, and where the headquarters is located, and variables measuring the geographical scope of the firm's relevant market.[5] We include these variables because previous studies show that likelihood of getting an R&D subsidy depends on the firm size (Aerts and Schmidt, 2008; Hottenrott and Lopes-Bento, 2014), export-orientation (Huergo, Trenado and Ubierna, 2016; Hud and Hussinger, 2015) and whether a firm is part of an enterprise group (Hud and Hussinger, 2015). The exact specification and results of the model are presented in the Appendix A. Based on this model, we compute propensity scores for each firm.

2. We divide the firms in two groups. The first group is the treated group ($s = 1$), which contains firms that received subsidies. The second group is the non-treated group ($s = 0$), which contains firms that invest in R&D activities and do not receive subsidies.

3. Each firm in the treatment group is matched to a non-treated firm in the same country, the same industry, with the same firm size measured by the number-of-employees category, and the same survey year (2010 or 2012). The firm with the minimum distance between propensity scores is selected from this subset as a control firm. If the propensity score distance is greater than one quarter of the standard deviation, we drop the observation.

4. Using the matched sample, the treatment effect is calculated as the mean difference of the outcome variable between treated firms and control firms.

$$\alpha_{tt} = \frac{1}{N}\left(\sum_{i=1}^{N} y_i^t - \sum_{i=1}^{N} y_i^c\right)$$

As the same firm may appear more than once in the control group, we follow Abadie and Imbens (2006) to calculate a consistent estimator of the standard error of the treatment effect.

[4] Firms are divided in three categories according to the number of employees: with less than 50 employees, with 50 to 249 employees, and with 250 employees or more.

[5] Here we differentiate between local, national, European, and global relevant markets.

After the matching, we do not observe any significant differences between the treated and control observations with regard to control variables. This indicates that our matching procedure was successful. Therefore, significant differences in the mean value of the outcome variable after the matching can be interpreted causally.

Table 2 illustrates this statement for the sample of Czech firms in 2012. While the firms in the treated and non-treated groups differ in many respects before matching, there are no significant differences in any of the covariates after the matching. Similar tables for all countries and time periods in the sample can be found in Appendix B.

T a b l e 2

Mean Values and Standard Deviations of the Covariates (in parentheses) **for the Czech Republic in 2012**

Variable	Control before	Treatment before	Control after	Treatment after
Industry group C1	0.407 (0.242)	0.365 (0.233)	0.366 (0.232)	0.366 (0.232)
Industry group C2	0.206 (0.164)	0.125*** (0.11)	0.126 (0.11)	0.126 (0.11)
Industry group C3	0.206 (0.164)	0.22 (0.172)	0.22 (0.172)	0.22 (0.172)
Industry group C4	0.182 (0.149)	0.29*** (0.207)	0.287 (0.205)	0.287 (0.205)
Not part of an enterprise group	0.494 (0.251)	0.443 (0.248)	0.411 (0.242)	0.445 (0.247)
Headquarters in country of enterprise	0.126 (0.11)	0.255*** (0.191)	0.272 (0.198)	0.252 (0.188)
Headquarters in EU/EFTA/CC	0.3 (0.211)	0.239* (0.183)	0.244 (0.185)	0.24 (0.182)
Headquarters elsewhere in the world	0.08 (0.074)	0.063 (0.059)	0.073 (0.068)	0.063 (0.059)
Log(turnover)	16.001 (3.925)	16.757*** (2.797)	16.803 (3.405)	16.749 (2.779)
Size under 50	0.337 (0.224)	0.169*** (0.141)	0.173 (0.143)	0.169 (0.141)
Size 50 to 249	0.32 (0.218)	0.333 (0.223)	0.318 (0.217)	0.335 (0.223)
Size 250 and more	0.344 (0.226)	0.498*** (0.251)	0.509 (0.25)	0.496 (0.25)
Local relevant market	0.741 (0.192)	0.792 (0.165)	0.814 (0.152)	0.791 (0.165)
National relevant market	0.886 (0.101)	0.941** (0.056)	0.953 (0.045)	0.941 (0.056)
European relevant market	0.835 (0.138)	0.925*** (0.069)	0.925 (0.069)	0.925 (0.069)
Global relevant market	0.523 (0.25)	0.702*** (0.21)	0.663 (0.223)	0.701 (0.21)

Note: The two left-hand columns represent the data before matching; the two right-hand columns represent the matched data. The columns denoted as "treatment" represent firms that have been awarded an R&D subsidy; the columns denoted as "control" represent firms that did not receive any R&D subsidy. The statistically significant differences between the respective control and treatment values are denoted by asterisks: * for $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Source: CIS 2010 and 2012, model estimated by the authors.

3. Results

The estimated average treatment effects of public R&D subsidies on R&D expenditure and product innovations of the treated firms in each country are summarized in Table 3. The results show that we can group our sample of countries into two pairs according to the effect of R&D subsidies. The first pair is the Czech Republic and Germany. The second pair is Portugal and Bulgaria.

T a b l e 3
The Estimated Average Treatment Effects of R&D Subsidies on the Dependent Variables

Estimate	BG	CZ	DE	PT
Product first to world	0.006 (0.025)	0.079** (0.034)	0.115*** (0.028)	0.015 (0.033)
Product first to Europe	0.022 (0.027)	0.063* (0.036)	0.068*** (0.026)	0.030 (0.034)
Product first to country	0.080* (0.041)	0.167*** (0.040)	0.076*** (0.028)	0.123*** (0.032)
Innovation expenditure	0.046*** (0.011)	0.067*** (0.012)	0.065*** (0.007)	0.057*** (0.005)
No. of matched obs.	(326)	(428)	(1064)	(587)

Note: Each value shows the average difference between the subsidized and matched non-subsidized firms in percentage points. Standard errors are in parentheses. Asterisks denote statistical significance in a t-test at the 1% (***), 5% (**), and 10% (*) level. The innovation expenditures of German firms are based only on CIS 2012 as data are not available from CIS 2010.

Source: CIS 2010 and 2012, model estimated by the authors.

R&D subsidies support radical innovation as well as imitations in the first pair of countries. In Germany, the subsidies make a major difference in the first--to-the-world innovations: they increase the probability that a firm produces a successful product innovation that is new to the world by almost 12 percentage points. The average treatment effects on the probability that a firm produces a product that is new to the EU or only to its home country are lower. Some first--to-the-world innovations are incentivized by public subsidies in the Czech Republic. They raise the probability that a firm produces first-to-the world innovation by 8 percentage points. But unlike in Germany, the main effect of R&D subsidies in the Czech Republic is on first-to-the-country innovations.

The effect of R&D subsidies is starkly different in Bulgaria and Portugal. In these countries, the subsidies make a major difference in imitation because the average treatment effects on the probability that a firm produces a product that is new to the EU, or even new to the world, are close to zero and statistically insignificant. The R&D subsidies in Portugal increase the probability that a firm produces a successful product innovation that is new to its home country by almost 12 percentage points. In Bulgaria, R&D subsidies raise this probability by only 8 percentage points and this difference is only marginally statistically significant. Thus, it seems that in these countries, subsidies promote mainly local imitations of products already introduced elsewhere, and they do not induce more first-in--the-world or first-in-the-EU innovations.

We also explore the impact of R&D subsidies on the firm's overall innovation expenditure, measured as a share of its revenue. The average treatment effect measures the impact of public subsidies on firms' R&D investment. If the subsidized firms spend significantly more on R&D than the non-subsidized firms, it means that public subsidies raise the overall spending on R&D, i.e. that private subsidies are not fully crowded out by public subsidies. Public R&D subsidies increase innovation expenditures by 4 to 7% in each explored country,

and the increase is statistically significant at least on a 1% significance level. This result confirms that public subsidies do not fully crowd out private funding of innovation expenditures in any of our sample countries. This is in line with the findings of most of the international studies (Zúñiga-Vicente et al., 2014; Carboni, 2011; Cerulli and Potì, 2012; Hottenrott and Lopes-Bento, 2014).

Conclusion

This paper investigated two possible channels through which public R&D subsidy might affect private innovation activities. Mainly, we investigated whether firms that receive public subsidies engage in more innovative projects. In addition, we tested whether public subsidy increases private R&D investment or whether it only replaces private investment into R&D activities. We estimate the effect of R&D subsidies on a sample of four European countries that are diverse in terms of economic development. This enables us to provide a better assessment of the effect of R&D subsidies and to show whether there is country--specific heterogeneity in the effects of R&D subsidies.

If we look at the effect of R&D subsidies on innovation inputs, measuring R&D activity by the share of innovation expenditure on total revenue, we confirm that the R&D subsidies increase firms' R&D expenditures by 4 to 7% of their total revenue in all four countries. The absolute value of the effect cannot be obtained as our data lack information about the size of the subsidies. Still, the subsidies motivate firms to spend more on R&D than they would in the absence of subsidy programs. This effect is robust across all countries in our sample.

However, the question is whether the R&D budgets boosted by subsidies are used for developing innovative projects, or rather for introducing products invented elsewhere. Here, we found substantial heterogeneity among the countries in our sample. It would be interesting to know more about the sources of this heterogeneity. One apparent source may be the differing levels of economic development and sophistication of the production process. The firms with less sophisticated production may simply increase their productivity with imitation, thus sparing themselves from engaging in costly innovations.

The Czech Republic is a country in which R&D subsidies encourage radical innovations as well as imitations of existing products. Although R&D subsidies do not increase the likelihood of new-to-the-world innovations in the Czech Republic as much as they do in Germany, the effect is positive. Apart from Germany and the Czech Republic, R&D subsidies were found to encourage first-to-the-world innovations also in Canada and Switzerland (Bérubé and Mohnen, 2009; Beck, Lopes-Bento and Schenker-Wicki, 2016) and research rather than development

activities in Belgium (Neicu, Teirlinck and Kelchtermans, 2016). These findings suggest that the Czech Republic belongs to a wider group of developed countries where R&D subsidies help creating highly innovative products. In this respect, the Czech Republic differs from two other sample countries in which R&D subsidies do not promote first-in-the-world or first-in-the-EU innovations: from Portugal, a county of comparable size and economic level, and from Bulgaria, another post-communist country in our sample.

References

ABADIE, A. – IMBENS, G. (2006): Large Sample Properties of Matching Estimators for Average Treatment Effects. Econometrica, *74*, No. 1, pp. 235 – 267.

AERTS, K. – SCHMIDT, T. (2008): Two for the Price of One? Additionality Effects of R&D Subsidies: A Comparison between Flanders and Germany. Research Policy, *37*, No. 5, pp. 806 – 822.

ARROW, K. (1962): Economic Welfare and the Allocation of Resources for Invention. In: NELSON, R. R. (ed.): The Rate and Direction of Inventive Activity: Economic and Social Factors. New York: Princeton University Press, pp. 609 – 626.

BECK, M. – LOPES-BENTO, C. – SCHENKER-WICKI, A. (2016): Radical or Incremental: Where does R&D Policy Hit? Research Policy, *45*, No. 4, pp. 869 – 883.

BÉRUBÉ, C. – MOHNEN, P. (2009): Are Firms that Receive R&D Subsidies more Innovative? Canadian Journal of Economics/Revue Canadienne d'économique, *42*, No. 1, pp. 206 – 225.

BRONZINI, R. – PISELLI, P. (2016): The Impact of R&D Subsidies on Firm Innovation. Research Policy, *45*, No. 2, pp. 442 – 457.

CARBONI, O. A. (2011): R&D Subsidies and Private R&D Expenditures: Evidence from Italian Manufacturing Data. International Review of Applied Economics, *25*, No. 4, pp. 419 – 439.

CERULLI, G. – POTÌ, B. (2012): Evaluating the Robustness of the Effect of Public Subsidies on Firms' R&D: An Application to Italy. Journal of Applied Economics, *15*, No. 2, pp. 287 – 320.

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*, No. 4, pp. 239 – 253.

EC (2010): Europe 2020: A Strategy for Smart, Sustainable and Inclusive Growth. [Accessed on 13/3/2017.] Available at: <http://www.voced.edu.au/content/ngv:22040>.

HOTTENROTT, H. – LOPES-BENTO, C. (2014): R&D Collaboration and SMEs: The Effectiveness of Targeted Public R&D Support Schemes. Research Policy, *43*, No. 6, pp. 1055 – 1066.

HUD, M. – HUSSINGER, K. (2015): The Impact of R&D Subsidies during the Crisis. Research Policy, *44*, No. 10, pp. 1844 – 1855.

HUERGO, E. – TRENADO, M. – UBIERNA, A. (2016): The Impact of Public Support on Firm Propensity to Engage in R&D: Spanish Experience. Technological Forecasting and Social Change, *113*, pp. 206 – 219.

NEICU, D. – TEIRLINCK, P. – KELCHTERMANS, S. (2016): Dipping in the Policy Mix: Do R&D Subsidies Foster Behavioral Additionality Effects of R&D Tax Credits? Economics of Innovation and New Technology, *25*, No. 3, pp. 218 – 239.

NELSON, R. R. (1959): The Simple Economics of Basic Scientific Research. Journal of Political Economy, *67*, No. 3, pp. 297 – 306.

ROSENBAUM, P. R. – RUBIN, D. B. (1983): The Central Role of the Propensity Score in Observational Studies for Causal Effects. Biometrika, *70*, No. 1, pp. 41 – 55.

TELLIS, G. J. – PRABHU, J. C. – CHANDY, R. K. (2009): Radical Innovation across Nations: The Preeminence of Corporate Culture. Journal of Marketing, *73*, No. 1, pp. 3 – 23.

VOKOUN, M. (2016): Innovation Behaviour of Firms in a Small Open Economy: The Case of the Czech Manufacturing Industry. Empirica, *43*, No. 1, pp. 111 – 139.

ZÚÑIGA-VICENTE, J. Á. – ALONSO-BORREGO, C. – FORCADELL, F. J. – GALÁN, J. I. (2014): Assessing the Effect of Public Subsidies on Firm R&D Investment: A Survey. Journal of Economic Surveys, *28*, No. 1, pp. 36 – 67.

A p p e n d i x A

The Probability Score Model (logit) Used for Matching (part 1)

Term	BG 2010	BG 2012	CZ 2010	CZ 2012
(Intercept)	–4.091*** (1.568)	–8.343*** (1.428)	–8.934*** (1.588)	–4.876*** (1.377)
Industry group C2	–0.068 (0.355)	0.06 (0.295)	0.465 (0.314)	–0.184 (0.266)
Industry group C3	0.916*** (0.293)	–0.259 (0.302)	0.368 (0.273)	0.148 (0.233)
Industry group C4	1.052*** (0.275)	0.342 (0.26)	0.52* (0.271)	0.618*** (0.233)
Headquarters in country of enterprise	0.332 (0.294)	0.062 (0.3)	0.077 (0.281)	0.074 (0.258)
Headquarters in EU/EFTA/CC	–0.593 (0.432)	–0.726* (0.412)	–1.262*** (0.303)	–1*** (0.257)
Headquarters elsewhere in the world	–15.527 (754.596)	–0.388 (0.862)	–1.525*** (0.436)	–1.125*** (0.389)
Log (turnover)	0.08 (0.119)	0.441*** (0.105)	0.413*** (0.106)	0.223** (0.097)
Size 50 to 249	0.472 (0.303)	–0.462* (0.279)	–0.217 (0.322)	0.247 (0.293)
Size 250 and more	0.829 (0.531)	–1.002** (0.495)	–0.135 (0.44)	0.313 (0.402)
Local relevant market	0.496* (0.281)	0.061 (0.23)	0.146 (0.214)	0.225 (0.213)
National relevant market	–0.211 (0.256)	0.45* (0.261)	0.129 (0.394)	0.118 (0.351)
European relevant market	0.13 (0.282)	0.697*** (0.263)	1.381*** (0.445)	0.315 (0.321)
Global relevant market	0.667** (0.272)	–0.052 (0.243)	0.583*** (0.225)	0.265 (0.206)

Note: The dependent variable is subsidies. Standard errors are in parentheses. Asterisks denote statistical significance in a t-test at 1% (***), 5% (**), or 10% (*) level.

Source: CIS 2010 and 2012, model estimated by the authors.

The Probability Score Model (logit) Used for Matching (part 2)

Term	DE 2010	DE 2012	PT 2010	PT 2012
(Intercept)	–3.128*** (0.556)	–3.695*** (1.041)	–6.676*** (1.372)	–3.56*** (1.328)
Industry group C2	0.166 (0.2)	0.225 (0.217)	0.083 (0.226)	–0.045 (0.231)
Industry group C3	0.145 (0.19)	0.323 (0.205)	–0.028 (0.199)	–0.082 (0.207)
Industry group C4	1.003*** (0.155)	0.762*** (0.168)	–0.164 (0.227)	0.05 (0.233)
Headquarters in country of enterprise	–0.219 (0.168)	–0.408** (0.182)	0.075 (0.212)	0.184 (0.213)
Headquarters in EU/EFTA/CC	–1.156*** (0.295)	–0.702** (0.291)	–0.831*** (0.312)	–0.447 (0.318)
Headquarters elsewhere in the world	–0.928** (0.362)	–0.587 (0.36)	–0.891* (0.486)	–0.437 (0.505)
Log (turnover)	0.168** (0.066)	0.123* (0.07)	0.417*** (0.096)	0.141 (0.093)
Size 50 to 249	–0.618*** (0.191)	–0.317 (0.198)	0.099 (0.239)	0.5** (0.245)
Size 250 and more	–0.517* (0.312)	–0.475 (0.338)	0.385 (0.413)	1.351*** (0.42)
Local relevant market	0.192 (0.126)	0.256* (0.138)	–0.551** (0.215)	0.073 (0.234)
National relevant market	0.481* (0.263)	1.054*** (0.295)	0.137 (0.299)	0.198 (0.304)
European relevant market	0.379* (0.196)	0.071 (0.23)	–0.038 (0.228)	0.475* (0.262)
Global relevant market	0.417** (0.165)	0.366* (0.191)	0.09 (0.197)	0.239 (0.214)

Note: The dependent variable is subsidies. Standard errors are in parentheses. Asterisks denote statistical significance in a t-test at 1% (***), 5% (**), or 10% (*) level.

Source: CIS 2010 and 2012, model estimated by the authors.

Appendix B

Mean Values and Standard Deviations of the Covariates (in parentheses) for Bulgaria in 2010

Variable	Control before	Treatment before	Control after	Treatment after
Industry group C1	0.49 (0.25)	0.339*** (0.226)	0.342 (0.225)	0.342 (0.225)
Industry group C2	0.225 (0.175)	0.119*** (0.105)	0.12 (0.105)	0.12 (0.105)
Industry group C3	0.137 (0.118)	0.22** (0.173)	0.214 (0.168)	0.214 (0.168)
Industry group C4	0.148 (0.126)	0.322*** (0.22)	0.325 (0.219)	0.325 (0.219)
Not part of an enterprise group	0.805 (0.157)	0.678*** (0.22)	0.695 (0.212)	0.684 (0.216)
Headquarters in country of enterprise	0.1 (0.09)	0.237*** (0.183)	0.256 (0.191)	0.231 (0.178)
Headquarters in EU/EFTA/CC	0.082 (0.075)	0.085 (0.078)	0.048 (0.046)	0.085 (0.078)
Headquarters elsewhere in the world	0.013 (0.013)	0*** (0)	0 (0)	0 (0)
Log(turnover)	13.67 (2.701)	14.46*** (2.896)	14.338 (2.491)	14.443 (2.865)
Size under 50	0.602 (0.24)	0.373*** (0.236)	0.354 (0.229)	0.376 (0.235)
Size 50 to 249	0.329 (0.221)	0.449** (0.25)	0.508 (0.25)	0.453 (0.248)
Size 250 and more	0.069 (0.064)	0.178*** (0.148)	0.138 (0.119)	0.171 (0.142)
Local relevant market	0.762 (0.182)	0.831* (0.142)	0.789 (0.167)	0.829 (0.142)
National relevant market	0.687 (0.215)	0.729 (0.199)	0.769 (0.178)	0.726 (0.199)
European relevant market	0.505 (0.25)	0.669*** (0.223)	0.678 (0.218)	0.667 (0.222)
Global relevant market	0.262 (0.194)	0.508*** (0.252)	0.514 (0.25)	0.504 (0.25)

Note: The two left-hand columns represent the data before matching; the two right-hand columns represent the matched data. The columns denoted as "treatment" represent firms that have been awarded an R&D subsidy, while the columns denoted as "control" represent firms that did not receive any R&D subsidy. The statistically significant difference in the means between the controls and treatments is denoted by stars: * for $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Source: CIS 2010 and 2012, model estimated by the authors.

Mean Values and Standard Deviations of the Covariates (in parentheses) for Bulgaria in 2012

Variable	Control before	Treatment before	Control after	Treatment after
Industry group C1	0.438 (0.247)	0.444 (0.249)	0.446 (0.247)	0.446 (0.247)
Industry group C2	0.258 (0.192)	0.169** (0.141)	0.165 (0.138)	0.165 (0.138)
Industry group C3	0.153 (0.13)	0.134 (0.117)	0.129 (0.113)	0.129 (0.113)
Industry group C4	0.151 (0.129)	0.254*** (0.191)	0.259 (0.192)	0.259 (0.192)
Not part of an enterprise group	0.824 (0.145)	0.725** (0.201)	0.703 (0.209)	0.741 (0.192)
Headquarters in country of enterprise	0.102 (0.092)	0.183** (0.151)	0.183 (0.15)	0.173 (0.143)
Headquarters in EU/EFTA/CC	0.065 (0.061)	0.077 (0.072)	0.082 (0.075)	0.072 (0.067)
Headquarters elsewhere in the world	0.009 (0.009)	0.014 (0.014)	0.032 (0.031)	0.014 (0.014)
Log(turnover)	13.669 (3.337)	14.708*** (2.506)	14.613 (2.404)	14.622 (2.142)
Size under 50	0.59 (0.242)	0.43*** (0.247)	0.426 (0.244)	0.439 (0.246)
Size 50 to 249	0.329 (0.221)	0.423** (0.246)	0.474 (0.249)	0.432 (0.245)
Size 250 and more	0.082 (0.075)	0.148** (0.127)	0.101 (0.091)	0.129 (0.113)
Local relevant market	0.761 (0.182)	0.754 (0.187)	0.676 (0.219)	0.755 (0.185)
National relevant market	0.705 (0.208)	0.838*** (0.137)	0.871 (0.113)	0.835 (0.138)
European relevant market	0.56 (0.247)	0.789*** (0.168)	0.782 (0.171)	0.784 (0.169)
Global relevant market	0.319 (0.218)	0.507*** (0.252)	0.542 (0.248)	0.504 (0.25)

Note: The two left-hand columns represent the data before matching; the two right-hand columns represent the matched data. The columns denoted as "treatment" represent firms that have been awarded an R&D subsidy, while the columns denoted as "control" represent firms that did not receive any R&D subsidy. The statistically significant difference in the means between the controls and treatments is denoted by stars: * for $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Source: CIS 2010 and 2012, model estimated by the authors.

Mean Values and Standard Deviations of the Covariates (in parentheses) for the Czech Republic in 2010

Variable	Control before	Treatment before	Control after	Treatment after
Industry group C1	0.452 (0.248)	0.323*** (0.22)	0.36 (0.23)	0.36 (0.23)
Industry group C2	0.16 (0.135)	0.153 (0.131)	0.137 (0.118)	0.137 (0.118)
Industry group C3	0.182 (0.149)	0.243* (0.185)	0.23 (0.177)	0.23 (0.177)
Industry group C4	0.206 (0.164)	0.28* (0.203)	0.273 (0.199)	0.273 (0.199)
Not part of an enterprise group	0.5 (0.251)	0.423* (0.245)	0.422 (0.244)	0.422 (0.244)
Headquarters in country of enterprise	0.158 (0.133)	0.291*** (0.207)	0.261 (0.193)	0.261 (0.193)
Headquarters in EU/EFTA/CC	0.251 (0.189)	0.212 (0.168)	0.242 (0.184)	0.242 (0.184)
Headquarters elsewhere in the world	0.091 (0.083)	0.074 (0.069)	0.075 (0.069)	0.075 (0.069)
Log(turnover)	15.767 (3.785)	16.867*** (3.166)	16.706 (3.245)	16.71 (3.136)
Size under 50	0.345 (0.227)	0.159*** (0.134)	0.161 (0.135)	0.18 (0.148)
Size 50 to 249	0.342 (0.226)	0.286 (0.205)	0.323 (0.219)	0.298 (0.209)
Size 250 and more	0.313 (0.216)	0.556*** (0.248)	0.516 (0.25)	0.522 (0.25)
Local relevant market	0.596 (0.241)	0.646 (0.23)	0.612 (0.238)	0.652 (0.227)
National relevant market	0.856 (0.124)	0.942*** (0.055)	0.941 (0.056)	0.944 (0.053)
European relevant market	0.778 (0.173)	0.963*** (0.036)	0.981 (0.018)	0.981 (0.018)
Global relevant market	0.42 (0.244)	0.698*** (0.212)	0.686 (0.215)	0.658 (0.225)

Note: The two left-hand columns represent the data before matching; the two right-hand columns represent the matched data. The columns denoted as "treatment" represent firms that have been awarded an R&D subsidy, while the columns denoted as "control" represent firms that did not receive any R&D subsidy. The statistically significant difference in the means between the controls and treatments is denoted by stars: * for $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Source: CIS 2010 and 2012, model estimated by the authors.

Mean Values and Standard Deviations of the Covariates (in parentheses) for the Czech Republic in 2012

Variable	Control before	Treatment before	Control after	Treatment after
Industry group C1	0.407 (0.242)	0.365 (0.233)	0.366 (0.232)	0.366 (0.232)
Industry group C2	0.206 (0.164)	0.125*** (0.11)	0.126 (0.11)	0.126 (0.11)
Industry group C3	0.206 (0.164)	0.22 (0.172)	0.22 (0.172)	0.22 (0.172)
Industry group C4	0.182 (0.149)	0.29*** (0.207)	0.287 (0.205)	0.287 (0.205)
Not part of an enterprise group	0.494 (0.251)	0.443 (0.248)	0.411 (0.242)	0.445 (0.247)
Headquarters in country of enterprise	0.126 (0.11)	0.255*** (0.191)	0.272 (0.198)	0.252 (0.188)
Headquarters in EU/EFTA/CC	0.3 (0.211)	0.239* (0.183)	0.244 (0.185)	0.24 (0.182)
Headquarters elsewhere in the world	0.08 (0.074)	0.063 (0.059)	0.073 (0.068)	0.063 (0.059)
Log(turnover)	16.001 (3.925)	16.757*** (2.797)	16.803 (3.405)	16.749 (2.779)
Size under 50	0.337 (0.224)	0.169*** (0.141)	0.173 (0.143)	0.169 (0.141)
Size 50 to 249	0.32 (0.218)	0.333 (0.223)	0.318 (0.217)	0.335 (0.223)
Size 250 and more	0.344 (0.226)	0.498*** (0.251)	0.509 (0.25)	0.496 (0.25)
Local relevant market	0.741 (0.192)	0.792 (0.165)	0.814 (0.152)	0.791 (0.165)
National relevant market	0.886 (0.101)	0.941** (0.056)	0.953 (0.045)	0.941 (0.056)
European relevant market	0.835 (0.138)	0.925*** (0.069)	0.925 (0.069)	0.925 (0.069)
Global relevant market	0.523 (0.25)	0.702*** (0.21)	0.663 (0.223)	0.701 (0.21)

Note: The two left-hand columns represent the data before matching; the two right-hand columns represent the matched data. The columns denoted as "treatment" represent firms that have been awarded an R&D subsidy, while the columns denoted as "control" represent firms that did not receive any R&D subsidy. The statistically significant difference in the means between the controls and treatments is denoted by stars: * for $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Source: CIS 2010 and 2012, model estimated by the authors.

Mean Values and Standard Deviations of the Covariates (in parentheses) for Germany in 2010

Variable	Control before	Treatment before	Control after	Treatment after
Industry group C1	0.373 (0.234)	0.227*** (0.176)	0.225 (0.175)	0.225 (0.175)
Industry group C2	0.164 (0.138)	0.126* (0.111)	0.127 (0.111)	0.127 (0.111)
Industry group C3	0.192 (0.156)	0.152* (0.129)	0.144 (0.123)	0.144 (0.123)
Industry group C4	0.27 (0.197)	0.495*** (0.25)	0.504 (0.25)	0.504 (0.25)
Not part of an enterprise group	0.564 (0.246)	0.579 (0.244)	0.577 (0.244)	0.59 (0.242)
Headquarters in country of enterprise	0.301 (0.211)	0.354* (0.229)	0.349 (0.227)	0.341 (0.225)
Headquarters in EU/EFTA/CC	0.092 (0.083)	0.04*** (0.038)	0.048 (0.046)	0.041 (0.039)
Headquarters elsewhere in the world	0.043 (0.041)	0.027 (0.027)	0.026 (0.025)	0.028 (0.027)
Log(turnover)	9.407 (3.191)	9.668** (4.963)	9.54 (3.104)	9.54 (4.16)
Size under 50	0.386 (0.237)	0.402 (0.241)	0.414 (0.243)	0.41 (0.242)
Size 50 to 249	0.381 (0.236)	0.305*** (0.213)	0.306 (0.212)	0.311 (0.214)
Size 250 and more	0.233 (0.179)	0.293** (0.207)	0.28 (0.202)	0.279 (0.201)
Local relevant market	0.516 (0.25)	0.566* (0.246)	0.521 (0.25)	0.558 (0.247)
National relevant market	0.882 (0.105)	0.949*** (0.048)	0.952 (0.046)	0.948 (0.049)
European relevant market	0.713 (0.205)	0.855*** (0.124)	0.853 (0.125)	0.852 (0.126)
Global relevant market	0.572 (0.245)	0.752*** (0.187)	0.77 (0.177)	0.747 (0.189)

Note: The two left-hand columns represent the data before matching; the two right-hand columns represent the matched data. The columns denoted as "treatment" represent firms that have been awarded an R&D subsidy, while the columns denoted as "control" represent firms that did not receive any R&D subsidy. The statistically significant difference in the means between the controls and treatments is denoted by stars: * for $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Source: CIS 2010 and 2012, model estimated by the authors.

Mean Values and Standard Deviations of the Covariates (in parentheses) for Germany in 2012

Variable	Control before	Treatment before	Control after	Treatment after
Industry group C1	0.367 (0.233)	0.244*** (0.185)	0.245 (0.185)	0.245 (0.185)
Industry group C2	0.157 (0.133)	0.134 (0.116)	0.134 (0.116)	0.134 (0.116)
Industry group C3	0.175 (0.145)	0.162 (0.136)	0.16 (0.134)	0.16 (0.134)
Industry group C4	0.301 (0.211)	0.46*** (0.249)	0.461 (0.248)	0.461 (0.248)
Not part of an enterprise group	0.528 (0.25)	0.589* (0.243)	0.562 (0.246)	0.591 (0.242)
Headquarters in country of enterprise	0.333 (0.222)	0.315 (0.216)	0.335 (0.223)	0.313 (0.215)
Headquarters in EU/EFTA/CC	0.086 (0.079)	0.061 (0.057)	0.073 (0.068)	0.061 (0.057)
Headquarters elsewhere in the world	0.054 (0.051)	0.035 (0.034)	0.031 (0.03)	0.035 (0.034)
Log(turnover)	16.492 (3.683)	16.603 (4.636)	16.596 (3.843)	16.584 (4.482)
Size under 50	0.385 (0.237)	0.413 (0.243)	0.424 (0.244)	0.414 (0.243)
Size 50 to 249	0.376 (0.235)	0.333 (0.223)	0.347 (0.227)	0.334 (0.222)
Size 250 and more	0.24 (0.183)	0.254 (0.19)	0.228 (0.176)	0.252 (0.188)
Local relevant market	0.549 (0.248)	0.624** (0.235)	0.612 (0.237)	0.624 (0.235)
National relevant market	0.866 (0.116)	0.96*** (0.038)	0.962 (0.036)	0.96 (0.038)
European relevant market	0.776 (0.174)	0.869*** (0.114)	0.869 (0.114)	0.868 (0.114)
Global relevant market	0.658 (0.225)	0.779*** (0.172)	0.796 (0.163)	0.779 (0.172)

Note: The two left-hand columns represent the data before matching; the two right-hand columns represent the matched data. The columns denoted as "treatment" represent firms that have been awarded an R&D subsidy, while the columns denoted as "control" represent firms that did not receive any R&D subsidy. The statistically significant difference in the means between the controls and treatments is denoted by stars: * for $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Source: CIS 2010 and 2012, model estimated by the authors.

Mean Values and Standard Deviations of the Covariates (in parentheses) for Portugal in 2010

Variable	Control before	Treatment before	Control after	Treatment after
Industry group C1	0.374 (0.235)	0.426 (0.245)	0.426 (0.245)	0.426 (0.245)
Industry group C2	0.193 (0.156)	0.17 (0.141)	0.19 (0.154)	0.19 (0.154)
Industry group C3	0.259 (0.192)	0.244 (0.185)	0.225 (0.174)	0.225 (0.174)
Industry group C4	0.174 (0.144)	0.16 (0.135)	0.159 (0.134)	0.159 (0.134)
Not part of an enterprise group	0.741 (0.192)	0.567*** (0.246)	0.682 (0.217)	0.651 (0.227)
Headquarters in country of enterprise	0.152 (0.129)	0.288*** (0.206)	0.248 (0.187)	0.271 (0.198)
Headquarters in EU/EFTA/CC	0.083 (0.076)	0.112 (0.1)	0.047 (0.044)	0.062 (0.058)
Headquarters elsewhere in the world	0.024 (0.023)	0.032 (0.031)	0.023 (0.023)	0.016 (0.015)
Log(turnover)	14.906 (2.157)	16.072*** (3.599)	15.62 (2.593)	15.621 (2.582)
Size under 50	0.58 (0.244)	0.311*** (0.215)	0.38 (0.236)	0.364 (0.232)
Size 50 to 249	0.35 (0.228)	0.455*** (0.249)	0.473 (0.249)	0.496 (0.25)
Size 250 and more	0.07 (0.065)	0.234*** (0.18)	0.147 (0.126)	0.14 (0.12)
Local relevant market	0.877 (0.108)	0.808*** (0.156)	0.872 (0.112)	0.857 (0.123)
National relevant market	0.912 (0.08)	0.929 (0.066)	0.969 (0.03)	0.969 (0.03)
European relevant market	0.758 (0.184)	0.84*** (0.135)	0.837 (0.136)	0.822 (0.147)
Global relevant market	0.583 (0.243)	0.724*** (0.2)	0.721 (0.201)	0.702 (0.209)

Note: The two left-hand columns represent the data before matching; the two right-hand columns represent the matched data. The columns denoted as "treatment" represent firms that have been awarded an R&D subsidy, while the columns denoted as "control" represent firms that did not receive any R&D subsidy. The statistically significant difference in the means between the controls and treatments is denoted by stars: * for $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Source: CIS 2010 and 2012, model estimated by the authors.

Mean Values and Standard Deviations of the Covariates (in parentheses) for Portugal in 2012

Variable	Control before	Treatment before	Control after	Treatment after
Industry group C1	0.398 (0.24)	0.424 (0.245)	0.448 (0.247)	0.448 (0.247)
Industry group C2	0.188 (0.153)	0.196 (0.158)	0.192 (0.155)	0.192 (0.155)
Industry group C3	0.263 (0.194)	0.216 (0.17)	0.208 (0.165)	0.208 (0.165)
Industry group C4	0.152 (0.129)	0.164 (0.138)	0.151 (0.128)	0.151 (0.128)
Not part of an enterprise group	0.723 (0.201)	0.553*** (0.248)	0.599 (0.24)	0.599 (0.24)
Headquarters in country of enterprise	0.166 (0.139)	0.285*** (0.204)	0.268 (0.196)	0.268 (0.196)
Headquarters in EU/EFTA/CC	0.089 (0.081)	0.127* (0.111)	0.123 (0.108)	0.123 (0.108)
Headquarters elsewhere in the world	0.022 (0.021)	0.035 (0.033)	0.009 (0.009)	0.009 (0.009)
Log(turnover)	14.977 (2.524)	16.097*** (3.268)	15.98 (2.855)	16.003 (2.965)
Size under 50	0.576 (0.245)	0.285*** (0.204)	0.29 (0.206)	0.29 (0.206)
Size 50 to 249	0.349 (0.228)	0.455*** (0.249)	0.483 (0.25)	0.479 (0.25)
Size 250 and more	0.075 (0.069)	0.259*** (0.193)	0.227 (0.176)	0.23 (0.177)
Local relevant market	0.855 (0.124)	0.841 (0.134)	0.825 (0.144)	0.852 (0.126)
National relevant market	0.884 (0.103)	0.928** (0.067)	0.953 (0.045)	0.94 (0.056)
European relevant market	0.759 (0.183)	0.908*** (0.084)	0.909 (0.083)	0.909 (0.083)
Global relevant market	0.648 (0.229)	0.824*** (0.145)	0.855 (0.124)	0.823 (0.145)

Note: The two left-hand columns represent the data before matching; the two right-hand columns represent the matched data. The columns denoted as "treatment" represent firms that have been awarded an R&D subsidy, while the columns denoted as "control" represent firms that did not receive any R&D subsidy. The statistically significant difference in the means between the controls and treatments is denoted by stars: * for $p < 0.1$, ** $p < 0.05$, and *** $p < 0.01$.

Source: CIS 2010 and 2012, model estimated by the authors.