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Counterfactual Impact Evaluation of Public Funding of Innovation, Investment and R&D

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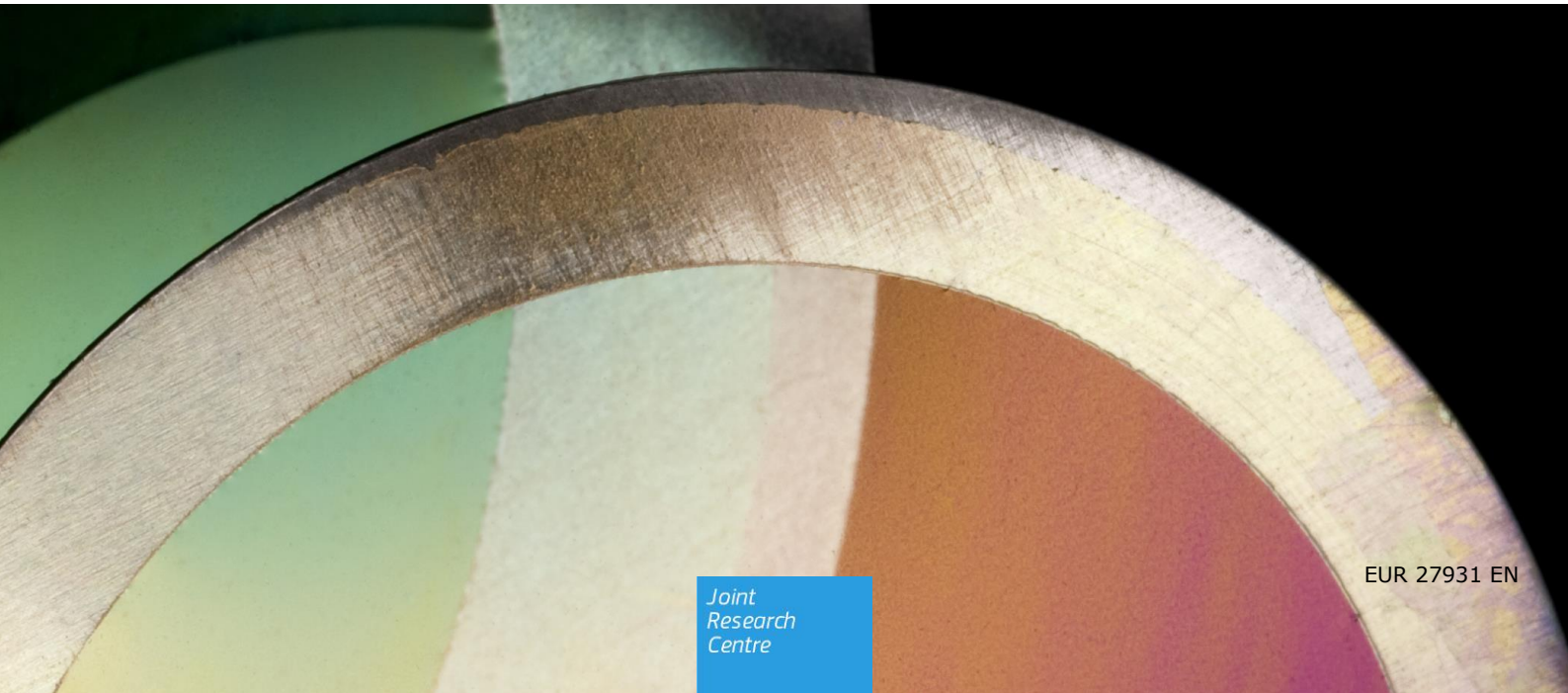

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Preface

This report was prepared in the context of the three-year research project on *European Innovation Policies for the Digital Shift* (EURIPIDIS) jointly launched in 2013 by JRC-IPTS and DG CONNECT of the European Commission in order to improve understanding of innovation in the ICT sector and of ICT-enabled innovation in the rest of the economy.[1]

The purpose of the EURIPIDIS project is to provide evidence-based support to the policies, instruments and measurement needs of DG CONNECT for enhancing ICT Innovation in Europe, in the context of the Digital Agenda for Europe and of the ICT priority of Horizon 2020. It focuses on the improvement of the transfer of best research ideas to the market.

EURIPIDIS aims are:

1 to better understand how ICT innovation works, at the level of actors such as firms, and also of the ICT "innovation system" in the EU;

2 to assess the EU's current ICT innovation performance, by attempting to measure ICT innovation in Europe and measuring the impact of existing policies and instruments (such as FP7 and Horizon 2020); and

3 to explore and suggest how policy makers could make ICT innovation in the EU work better.

This report uses data from Efige and from Bureau Van Dijk's Amadeus and Orbis to estimate the relationship between public funding and subsidies to firms' innovation and R&D on the one hand and firms' innovation, employment, sales, added value on the other one. More specifically, we look at different types of public support programs: i) public support to innovation from national programs; ii) public support to innovation from EU funded programs (i.e. FP6 and 7); public support to investment and R&D (irrespective of the source).

We find that both national and EU funding are important in stimulating product innovation, while funding from the EU seems to matter more than national funding for process innovation. We also find that funding from national programs has positive causal impacts on firms' employment, sales, added value. Due to the limited number of observations we are not able to separately estimate the causal impact of EU funding on such variables. We also find that generic support to firm-level investment projects has positive impacts on employment and added value. However, no statistically significant impacts are estimated for subsidies which support R&D expenditures exclusively.

[1] For more information, see the project web site: http://is.jrc.ec.europa.eu/pages/ISG/EURIPIDIS/EURIPIDIS.index.html

Acknowledgements

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Abstract

This report uses data from Efige and from Bureau Van Dijk's Amadeus and Orbis to estimate the effect of funding from the EU and national programmes on firms' employment, sales, added value, productivity and innovativeness. It also looks at the impact of subsidies to investment and R&D (irrespective of the source of funding) on the same variables.

In the first part of the report we use only the Efige dataset (covering the years 2007-2009) and we look at (contemporaneous) correlation between public support (from national and EU sources) and product and process innovation. Our results indicate that national and EU funding are equally important in stimulating product innovation. However, EU funding has a higher correlation with process innovation.

We also find a positive correlation between public support to private R&D and product innovation (but no significant correlation between the former and process innovation). On the other hand, public support to private investment (including ICT capital) is positively associated with process innovation but not with product innovation.

In the second part of the report we perform a proper counterfactual analysis, where we merge the Efige dataset with the Bureau Van Dijk's Amadeus (years 2001-2012) and Orbis (2006-2012) databases. This allows us to test whether firms funded between years 2007 and 2009 have a significantly different economic performance (measured in terms of employment, sales, and value added) in the years 2009-2012, while controlling for firms characteristics measured prior to 2007 (i.e. in the pre-treatment period).

Our results indicate that receiving public support from national funds generates positive increments in employment, sales and added value, compared to the counterfactual status of the absence of public intervention. We do not find evidence that EU funds have additional impacts on employment, sales or value added (relative to firms receiving only national funding or no funding). This result is most likely due to the small sample size of firms receiving EU funds, which does not allow us to precisely estimate the impact of EU funding alone or in conjunction with national funding. It is also likely to depend upon the features of EU funding, which is geared towards research that produces results over a longer time horizon than the one observable in our data.

We also find that generic support to firm-level investment projects has positive impacts on employment and added value. However, no statistically significant impacts are estimated for subsidies which support R&D expenditures exclusively (possibly due to the nature of R&D support policies, which often require more time to yield noticeable impacts on general firm-level performance).

1. Introduction

This report uses data from Efige and from Bureau Van Dijk's Amadeus and Orbis to estimate the effect of funding from the EU and national programmes on firms' employment, sales, added value, productivity and innovativeness. It also looks at the impact of subsidies to investment and R&D (irrespective of the source of funding) on the same variables.

The Efige dataset contains survey data covering the years 2007- 2009. However, the information on public subsidies is limited to 2008-2009, while the information on innovation outputs and inputs contained is for the years 2007-2009. Thanks to a common firm-identifier (the Bureau Van Dijk ID number, which contains the national tax identifier of a firm), the Efige database has been merged with both the Bureau Van Dijk's Amadeus (years 2001-2012) and Orbis (2006-2012) databases.

Due to the features of the Efige dataset, it has not been possible to clearly identify the exact timeline which relates the granting of public funding to firms' innovative performance (i.e. we cannot observe the innovative behaviour of firms after they have been treated; only their contemporaneous innovative behaviour is observable). For this reason the part of the report that analyses the relationship between public funding and innovation (Section 3) is not a proper counterfactual impact evaluation analysis, and it should be considered as a correlation analysis.

We originally planned to look at the ICT-producing sector separately from the other sectors. However, the number of observations on firms in the ICT sector alone is not sufficient to perform a sector-specific analysis and we therefore considered all sectors.

For the part of the analysis that looks at the correlation between public support and product and process innovation (Section 3), the results indicate that national and EU funding are equally important in stimulating product innovation. However, EU funding has a higher correlation with process innovation. Moreover, public support to private R&D is positively associated with product innovation but not with process innovation. On the other hand, public support to private investment (including ICT capital) is positively associated with process innovation but not with product innovation.

For the part of the analysis which estimates the counterfactual impact of public funding on firm-level outcomes (Section 4), our results indicate that receiving public support from national funds generates positive increments in employment, sales and added value, compared to the counterfactual status of the absence of public intervention. We do not find evidence that EU funds have additional impacts on employment, sales or value added (relative to firms receiving only national funding). This result is likely due to the small sample size of firms receiving EU funds and to the features of EU funding (geared towards research that produces results over a longer time horizon). We also find that generic support to firm-level investment projects has positive impacts on employment and added value. However, no statistically significant impacts are estimated for subsidies which support R&D expenditures exclusively (possibly due to the nature of R&D support policies, which often require more time to yield noticeable impacts on general firm-level performance).

2. Data and descriptive statistics

The data available for the analysis derive from three sources:

- the Efige survey;
- the (2001-2012) Bureau Van Dijk's Amadeus database;
- the (2006-2012) Bureau Van Dijk's Orbis database.

The Efige (European Firms in a Global Economy) database contains survey data from a data-collection project sponsored by the European Commission's Directorate General for Research and Innovation through its 7th Framework Programme and coordinated by Bruegel. The Efige survey covers measures of firms' international activities and their R&D and innovation, labour organization, financing and organizational activities, and pricing behaviour. The survey covers almost 15,000 firms in the manufacturing industry with at least 10 employees, located in seven European countries (Germany, France, Italy, Spain, the United Kingdom, Austria, and Hungary). The survey collects information from 2007 to 2009. From the Efige database, it can be inferred whether or not a firm received national versus EU co-sponsored public support and whether or not a firm received public support for generic investment projects versus funding for R&D and innovation, in the years 2008-2009. Information on whether or not a firm produced product and/or process innovation is recorded for the years 2007-2009.

The Amadeus database contains balance sheet information on European corporate firms covering the location and industrial sector of the firm, in addition to (among other things) yearly data on employment, sales, added value and labour productivity. Orbis contains similar information, but it extends beyond Europe.

2.1 Merge of the databases

The Efige survey data was merged with the Amadeus and Orbis. The merges were based on a common firm identifier (the Bureau Van Dijk firm ID, which contained the unique national tax code of the firm). The results of the merges are highlighted in Table 1.

Table 1: Merge between Efige and Amadeus-Orbis databases

N. firms in Efige (+ Amadeus 2001-09)	N. of Firms successfully merged between Efige and Amadeus 2006-12	% firms merged	N. of Firms successfully merged between Efige and Orbis 2006-12 (*)	% firms merged
14,759	11,082	75.08%	13,169	89.22%

(*) The firms, for which the Efige-Orbis database constructed at IPTS contains missing information for all the Orbis sales, employment and added value variables in the years 2011, 2007 and 2006, have not been counted as "firms successfully merged".

2.2 Data Cleaning

Because of possible errors in digitalizing the balance sheet information, missing values and/or because of mergers and acquisitions that can alter firm composition over time, the Amadeus and Orbis data needed to be cleaned before they could be used for longitudinal analyses. This is particularly relevant for CIE analyses, in which it is of great importance to transform the outcome variables into before/after-treatment changes. In order to purge possible data errors from the data, the following procedure was implemented:

I) separately for each outcome variable of the analysis (employment, sales, added value, labour productivity), firms with missing data or zero values in the crucial

years for the analysis (i.e. 2006, 2008 and 2010) were eliminated from the estimation sample;

II) separately for each outcome variable of the analysis, the distributions of both the post intervention (2010-2008) and the pre-intervention (2008-2006) trends were derived;

III) based on these distributions, firms displaying extreme variations included within the lowest and highest 0.5 quantile were excluded from the analysis.

Table 2 displays the results of this cleaning procedure, sorted by type of analysis (based on the type of dependent variable), separately for the merged Efige-Amadeus database (Table 2.a) and the Efige-Orbis database (Table 2.b).

Table 2: Data cleaning procedure for the Efige-Amadeus and Efige-Orbis databases

	N. firms initially in the database	N. Firms discharged because of missing/zero values in 2011, 2007, 2006	N. firms discharged because of extreme 2011/2007 or 2007/06 changes	N. firms post-cleaning	% Firms discharged
a) Efige-Amadeus					
Y= employment	11,082	5,874	156	5,052	54,41%
Y=sales	11,082	4,797	186	6,099	44,96%
Y= added value	11,082	5,492	166	5,424	51,05%
Y= labour productivity	11,082	6,616	127	4,339	60,84%
b) Efige-Orbis					
Y= employment	13,169(*)	6,558	197	6,414	51.29%
Y=sales	13,169(*)	4,978	243	7,948	39.64%
Y= added value	13,169(*)	5,566	227	7,376	43.98%
Y= labour productivity	13,169(*)	7.736	162	5,271	59.97%

(*) Excluding firms with missing information for the sales, employment and added value variables in all years (2006-2012).

2.3 Descriptive Statistics

The descriptive statistics, sorted by country, of the data available for the analysis are described in Tables 3-5. Table 3 shows the number of firms that reported in the Efige survey that they had undertaken process-innovation, product-innovation or both during the years 2007-2009. Because this information is independent from the Amadeus-Orbis portion of the data, these descriptive statistics refer to the whole sample of 14,759 firms contained in the Efige database, prior to the data cleaning procedure (which is based solely on the Amadeus-Orbis information).

Table 3: Product and Process innovation in Efige firms

	No innovation (1=1 firm)	Process Innovation (1=1 firm)	Product Innovation (1=1 firm)	Process & Product Innovation (1=1 firm)	Total (1=1 firm)
AUT	107	74	78	184	443
FRA	1,298	359	557	759	2,973
GER	1,038	430	717	750	2,935
HUN	216	58	108	106	488
ITA	983	552	685	801	3,021
SPA	860	681	515	776	2,832
UK	677	181	427	782	2,067
Total	5,179	2,335	3,087	4,158	14,759

Figures based on the whole sample of firms in the Efige database

Tables 4 and 5 summarize the number of firms, sorted by country, which reported in the Efige survey that they had received public funding in the years 2008-2009. Because this information is used in the analysis to estimate the impact of public funding on firm-level performance measured by the Amadeus-Orbis portion of the data, the descriptive statistics of Tables 4 and 5 are based on the sample of firms displayed in Table 2 that survived the data cleaning procedure.

Table 4 summarizes the number of firms that reported that they had received public funds in the years 2008-2009, distinguishing between national funds and EU-cosponsored funds. This distinction is important because it allows us to analyse whether or not receiving EU co-sponsored funding, in addition to national funding, generates additional effects (over those due to receiving national funding). Table 5 contains the same descriptive statistics related to public support for generic investment projects versus public support to R&D expenditures. The latter distinction allows us to analyse the extent to which public support targeting R&D expenditures yields impacts on firm performance that are different from those generated by public support to (generic) investment. Despite the fact that the immediate goal of R&D funding is to increase R&D activity [2], the latter ultimately affects firms performance, as captured by labour productivity, value added and, possibly, employment. While the data available for the analysis do not allow us to estimate counterfactual impacts of R&D funding on R&D or innovation outputs (due to the contemporaneity of the variables observed in Efige), by exploiting the match between Efige and Amadeus/Orbis, we can estimate the impacts of R&D funding on the previously mentioned firm-level performance indicators. Because R&D support policies may also be viewed as instruments to promote economic recovery, it is important to gather empirical evidence on their actual impact on firm-level performance compared to more generic support to investment measures.

[2] Public funding is justified by the positive externalities generated by R&D. In the absence of public intervention, R&D expenditures would occur at sub-optimal levels.

Table 4: Firms with public subsidies in the Efige-Amadeus and Efige-Orbis databases. National funds vs. EU-Cosponsored funds

	No subsidies	National funding (only) (1=1 firm)	EU-cosponsored funding (only) (1=1 firm)	EU-cosponsored funding mixed with National funding (1=1 firm)(a)	Missing Information (1=1 firm)	Total (1=1 firm)
a) Efige-Amadeus						
AUT	81	53	0	5	1	140
FRA	575	311	1	13	0	900
GER	264	85	0	8	0	357
ITA	1,308	540	8	22	1	1,879
SPA	911	474	3	27	0	1,415
UK	280	60	1	13	7	361
Total	3,419	1,523	13	88	9	5,052
b) Efige-Orbis						
AUT	28	17	0	2	0	47
FRA	429	202	1	8	0	640
GER	845	271	1	22	0	1,139
ITA	1,476	581	8	23	1	2,089
SPA	1,361	633	6	34	0	2,034
UK	291	62	1	13	7	374
HUN	61	29	0	1	0	91
Total	4,491	1,795	17	103	8	6,414

Figures based on the sample of firms with usable information on the employment levels in 2006, 2007 and 2011 in the cleaned Efige-Amadeus and Efige-Orbis databases

Table 5: Firms with public subsidies in Efige-Amadeus and Efige-Orbis databases: support to generic investment projects vs. support to R&D expenditures

	No subsidies	Support to generic investment projects (only) (1=1 firm)	Support to R&D (only) (1=1 firm)	Support to R&D and support to generic investment projects (1=1 firm)	Missing Information (1=1 firm)	Total (1=1 firm)
a) Efige-Amadeus						
AUT	36	13	18	20	53	140
FRA	232	23	147	43	455	900
GER	152	23	17	24	141	357
ITA	513	106	194	142	929	1,879
SPA	205	167	65	227	751	1,415
UK	100	14	43	24	180	361
Total	1,238	346	484	480	2,504	5,052
b) Efige-Orbis						
AUT	8	7	6	6	20	47
FRA	172	14	91	32	331	640
GER	443	82	40	81	493	1,139
ITA	554	109	206	143	1,077	2,089
SPA	289	244	100	267	1,134	2,034
UK	105	13	46	24	186	374
HUN	13	2	8	1	67	91
Total	1,584	471	497	554	3,308	6,414

Figures based on the sample of firms with usable information on the employment levels in 2006, 2007 and 2011 in the cleaned Efige-Amadeus and Efige-Orbis databases

3. Correlation between public funds and product/process innovation

The information contained in the Efige database does not allow us to properly estimate the impact of the availability of public subsidies on innovation outcomes. This is because, as previously mentioned, the Efige questionnaire collects information on the availability of public funds and on the existence of product and process innovation at around the same points in time (i.e. the years 2008-2009 for the existence of public subsidies and 2007-2009 for the achievement of product and/or process innovation). While the estimation of any reliable causal inference linking the public subsidies to innovation outcomes cannot be attempted due to this limitation, the Efige database allows us to investigate how the existence of public subsidies correlates with the achievement of product and/or process innovation.

This empirical evidence can be obtained through the following general probit model:

$$P[Y_{inn}=1] = \Phi[h(T_c, X)] \qquad (1)$$

Where:

$Y_{inn}=[0,1]$ whether or not a firm undertook product/process innovation during the 2007-2009 period;

$T_c \in \{0,1\}$ with c = {investment support, R&D support, National, EU co-sponsored}, set of categorical treatment status binary variables, signalling whether or not a firm received different types of support;

X = set of firm characteristics that includes:

- SIZE: through the inclusion of a set of 4 categorical dummies (10-19 employees; 20-49 employees; 50-249 employees; 250 or more employees)[3]. These variables aim to control for potential economy of scale effects or different opportunities to borrow funds from private credit markets to support R&D/innovation expenditures;
- AGE: distinguishing between firms established after 2003 ("new firms") and firms established in 2003 or in the years before. These variables aim to control for new firms and firms which have already been operating on the markets for more than a decade possibly having different tendencies to innovate;
- SECTOR: through the inclusion of a set of 11 categorical dummies (at the Nace two-digit level) which aim to capture sector-specific common innovation trends;
- COUNTRY: through the inclusion of a set of 7 categorical dummies aimed at capturing common political, institutional and economic traits that can determine country-specific innovation trends;
- PREVIOUS TREND: through the inclusion of the 2006-2005 variation in sales. As explained below, this variable is included only in a selected number of model specifications.

Model (1) was implemented in the analysis through the twelve different specifications summarized in Table 6.

These specifications differ because of:

- the type of dependent variables used in the analysis (i.e. the binary status variable for product innovation, process innovation and mixed innovation);

[3] The variable 10-19 employees is embedded in the intercept of the model.

- the type of classification for the public funding received: a) national funds only versus EU funds in conjunction with national funds; b) support to investment projects only versus support to R&D expenditures only, versus support to R&D in conjunction with support to investment projects[4].
- the set of control variables (*X*) included in the model. Two different options are implemented in the analysis: one that includes among the controls (*X*) the previous (2005-06) trend of sales, and a second one that does not include this variable. Each option has advantages and disadvantages. On the one hand, the pre-intervention trend of *Y* is an important proxy which captures and controls for unobservable heterogeneity without imposing strict fixed-effect assumptions. On the other hand, the pre-intervention trend of *Y* is at risk of being endogenous to the subsidies because it may have been affected by unobserved previous rounds of the same public funds for which impact estimates are retrieved. As a consequence, with the inclusion of the pre-intervention trend, the risk for selection bias is potentially lower, but only assuming that unobserved previous rounds of the subsidies played a marginal role in affecting the product/process innovation outcome variables of the analysis. If we assume, instead, that the pre-intervention trend of *Y* was significantly affected by unobserved previous rounds of the subsidies, including the pre-intervention trend among the controls (*X*) would not reduce the potential for selection bias and it would worsen the risk of endogeneity bias. For these reasons, both options are estimated in the analysis as a way of testing the robustness of the results.

Table 6: Specifications for the Probit model of eq. 1

	Specifications											
Variables	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
Y [1=product innovation; 0=otherwise]	x	x	x	x								
Y [1=process innovation; 0=otherwise]					x	x	x	x				
Y [1=mixed innovation: Prod.&Process; 0=otherwise]									x	x	x	x
T [1=Nazional Funds; 0=otherwise]	x	x			x	x			x	x		
T [1=EU Funds; 0=otherwise]	x	x			x	x			x	x		
T [1=Support to Investment; 0=otherwise]			x	x			x	x			x	x
T [1=Support to R&D; 0=otherwise]			x	x			x	x			x	x
T [1=Support to Inv. & supp. to R&D; 0=otherwise]			x	x			x	x			x	x
X [SIZE(4 dummies), AGE(1 dummy), NACE(11 dummies), COUNTRY(7 dummies), PRE-TREND(Δsales)]	x		x		x		x		x		x	
X [SIZE(4 dummies), AGE(1 dummy), NACE(11 dummies), COUNTRY(7 dummies)		x		x		x		x		x		x

[4] These two classifications are both mutually exclusive and they need to be estimated in separate model specifications.

The results of the analysis are summarized in Tables 7-9. Table 7 contains the results (in terms of average marginal effects) for the specifications I-IV in which the dependent variable (*Y*) is whether or not a firm reported it had achieved some **product innovation** in the 2007-2009 period. The results of the analysis highlight that having received public subsidies in the form of national funds is correlated with a 13.1% -13.6 % increase in the probability of reporting product innovation. Having received EU cosponsored funds is correlated with a 10.5%-13.7% increase in the probability of reporting product innovation. On the other hand, the results show that the receipt of public subsidies to support generic investments is not significantly correlated with any increase in the probability of achieving product innovation. However, having received public subsidies to support solely R&D expenditures (or R&D expenditures in conjunction with generic investment projects) increases the probability of reporting product innovation by 11.2%-12.2%.

Table 7: Results for product innovation(*) (**)

	Specifications							
Variables	I		II		III		IV	
T_nat_funds [0,1]	0.136	***	0.131	***				
T_eu_funds [0,1]	0.105	***	0.137	***				
T_investment [0,1]					-0.004	-	0.017	-
T_R&D [0,1]					0.122	***	0.112	***
T_inv+R&D [0,1]					0.115	***	0.114	***
- 0 no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates are in terms of average marginal effects								
(**) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

Table 8 summarizes the average marginal effect estimates for the specifications V-VIII, in which *Y* is whether or not a firm reported it had achieved some **process** innovation in the 2007-2009 period. The results of the analysis highlight how receiving public subsidies in the form of national funds correlates with a 13.1%-13.7% increase in the probability of reporting process innovation. Receiving EU cosponsored funds correlates with a slightly higher probability increase of reporting process innovation (16.6%-17.4%). Unlike product innovation, public subsidies to support generic investment projects do correlate with a significant increase (9.7%-9.8%) in the probability of reporting process innovation. Public support to R&D expenditures alone, instead, is weakly correlated with any significant increase in the probability of reporting process innovation. The combination of support to innovation and to R&D expenditures correlates with a probability increase of achieving process innovation of 12.0%-12.4%.

Table 8: Results for process innovation (*) (**)

	Specifications							
Variables	V		VI		VII		VIII	
T_nat_funds [0,1]	0.137	***	0.131	***				
T_eu_funds [0,1]	0.174	***	0.166	***				
T_investment [0,1]					0.097	***	0.098	***
T_R&D [0,1]					0.018		0.030	*
T_inv+R&D [0,1]					0.120	***	0.124	***
- 0 no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates are in terms of average marginal effects								
(**) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

Table 9 illustrates the estimates for the specifications IX-XII in which *Y* is whether or not a firm reported **both product and process** innovation. The results of the analysis indicate that receiving national funds and EU co-sponsored funds similarly correlates with an increase in the probability of reporting both product and process innovation at the same time (with average marginal effect estimates of 10.3%-10.7% for the national funds and 8.4%-11.0% for the EU funds). Public support to generic investments and public support to R&D expenditures similarly correlate with a positive increase in the probability of innovation (5.0%-6.4%), while the combined public support to both generic investment and R&D expenditures correlates with the highest increase (13.3%) in the probability of innovation.

Table 9: Results for product innovation in conjunction with process innovation

	Specifications							
Variables	IX		X		XI		XII	
T_nat_funds [0,1]	0.103	***	0.107	***				
T_eu_funds [0,1]	0.084	***	0.110	***				
T_investment [0,1]					0.050	**	0.064	***
T_R&D [0,1]					0.053	***	0.064	***
T_inv+R&D [0,1]					0.133	***	0.133	***
- 0 no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates are in terms of average marginal effects								
(**) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

4. The impact of public funds on employment, sales, added value and labour productivity

As previously mentioned, the merged Efige-Amadeus and Efige-Orbis databases both contain suitable information for attempting a Counterfactual Impact Evaluation (CIE) on the effects of public funding on subsequent firm outcomes. However, as shown in Table 5, the Efige-Orbis database contains a slightly larger sample of firms with usable information than the Efige-Amadeus database. For this reason the present section illustrates the results of the latest analysis performed on the Efige-Orbis database (using as outcome variables the 2007-2011 changes in employment, sales, added value, and labour productivity). The results of the analysis implemented on the Efige-Amadeus database are contained in the Appendix I of this report.

4.1 Methods

For CIE analyses involving enterprise support subsidies, the main threats to the validity of the analysis are twofold:

- the potential differences between the pre-subsidy characteristics of the assisted and non-assisted firms (this last group of firms is used in the analysis to estimate the counterfactual: what would have happened to the assisted firms in the absence of the public subsidies).
- the risk that assisted and non-assisted firms may be exposed to different market-trends at the time during which the public subsidy programme is implemented.

These two threats are generally described in the literature as potential sources of "selection bias" and/or "omitted variable bias". In recent years a stream of statistical literature has suggested and/or reviewed newly-defined estimators to limit "selection/omitted" variable bias in public programme impact evaluation without experimental data. Recent examples include:

- contributions that oppose Coarsened Exact Matching to Propensity Score Matching (e.g. Iacus, King, Porro 2011);
- contributions that compare the effectiveness of matching methods for causal inference, arguing that there is an optimum in the trade-off between the ability of methods to balance the covariates and statistical efficiency (e.g. King, Nielsen, Coberley, Pope 2011);
- comparison of the properties of alternative estimators for programme evaluation (Blundell and Costa-Dias 2008).

This stream of theoretical literature on estimators for CIE, however, is at risk of being misinterpreted by scholars and/or practitioners involved in producing empirical evidence on actual policies and programmes. This is because most of this literature adopts a common set up in which:

- the covariates X of the units of observation of the analysis to be controlled for are given a-priori. This is done typically in the form of continuous data, with equal importance of each covariate as potential source of bias.
- the programme impact identification strictly relies on CIE assumptions (alias, "selection on observables" assumptions). This is a necessary assumption only for impact evaluations in which the outcome (Y) is a one shot–in-time variable (e.g. the employment status for a job-training programme targeting the unemployed). However, it is not a necessary assumption in the case of business incentive programmes in which the outcome variables used in the analysis can be differentiated over-time (in a before/after programme-intervention manner), resulting in the possibility to control some unobserved heterogeneity between the treated and the non-treated through the superimposing of a Difference in Difference (DD) scheme.

This standard set-up misleads many scholars and practitioners, who may think that the characteristics of the units of observations to be balanced between the treated and the comparison groups are simply the covariates that happen to be available in the particular database at hand.

As also discussed in Ho, Imay, King and Stuart (2007) and Bondonio (2009), state-of-the-art firm-level CIE involves instead a different approach. The factors to be balanced between the treated and the comparison group have to be identified independently from the data that happen to be available to the analysis. Each possible important source of potential selection bias has to be detected and thoroughly discussed, based primarily on informed knowledge of the factors that may affect the outcome variable (*Y*) of the analysis. Only at this point, is the list of these important sources of bias compared with the observable covariates available to the analysis. Through this comparison, the best suitable impact identification methods are chosen. Next, for each important source of potential bias, the assumptions under which they are controlled for are thoroughly explained.

Based on this premise, the description of the methods used in the analysis begins by the listing the main factors that may lead to selection/omitted variable bias if not balanced between the treated and the comparison group and/or if not appropriately controlled for in the econometric analysis. This list includes, in order of importance:

- country location of firm: being located in different countries exposes firms to different institutional factors, changes in tax regimes, availability of financing through the private credit market. However, the geographic location of firms at the sub-national level is less likely to be a crucial source of potential bias. This is because the firms contained in the Efige database operate in sectors for which the local markets, in the neighbourhood of the firms' location, do not constitute a prevailing market outlet of the firms' products. For this reason, a firm's geographic location at the regional- or province-level is a lower risk factor for selection bias than its location at country-level.
- industrial sector;
- size of the firm: because firms of different sizes are exposed to different economies of scale and have different opportunities to acquire funding from the private credit market (due to different availabilities of credit collaterals);
- managerial abilities, strength of the brand-identity, position in niche markets;
- age of the firm.

It is, in principle, possible to control for these sources of potential bias in the Efige-Amadeus/Orbis database by using four econometric models (2-5) that represent different options in the trade-off between statistical efficiency and effectiveness in balancing the important sources of selection bias between the treated and the comparison group. These four different methodological options are presented in the following paragraphs.

Option I) CDD with a multiple regression framework

The first option is a Conditional Difference in Difference (CDD) model implemented within a multiple regression framework. The model achieves the maximum statistical efficiency at the expense of controlling for the sources of potential bias only through some model dependence (though all the covariates included in the model are controlled for with a flexible functional form). This model dependence (as also detailed in the variable description presented below) comes in the form of assuming that the effect on ΔY of each independent variable (*Tn* and *X*) is the same across all the countries and the industrial sectors contained in the estimation sample.

$$\Delta Y_i = f\,[\sum_n Tn_i,\ X] \qquad (2)$$

Where:

ΔY_i = 2010-2008 change in the outcome variable of the analysis (i.e. employment, sales, added value, labour productivity);

$T_n \in \{0,1\}$ with n = {investment support, R&D support, National funding, EU co-sponsored funding}, set of categorical treatment status binary variables, signalling whether or not a firm received different types of support;

X = set of firm characteristics that includes: SIZE, AGE of the firm, SECTOR (Nace two digits), COUNTRY, PREVIOUS TREND.

The model controls for the sources of potential bias in the following way:

- Country location: through the inclusion of set of country dummy variables, assuming that the impact on *Y* of the other independent variables is the same in the different countries;
- Residual differences in the firms' regional/province location: through the Difference in Difference (DD) scheme of equation (2), assuming that these differences have a time-invariant effect on the outcome variable;
- Industrial sector: through the inclusion of set of 12 (Nace2) dummy variables, assuming that the impact on *Y* of the other independent variables is the same across firms in different sectors;
- Managerial abilities, strength of the brand-identity, position in niche markets: through the DD scheme, assuming that these unobservable characteristics are time-invariant effects;
- Firm size: through the inclusion of a set of 4 categorical dummies (10-19 employees; 20-49 employees; 50-249 employees; 250 or more employees). This option avoids imposing linearity, but requires the assumption that the impact on *Y* of the other independent variables is the same across firms of different sizes;
- Firm age: through the inclusion of a categorical dummy for new firms, assuming that any residual potential for selection bias (outside the dichotomous categorization of the age of the firm) is a time-invariant effect controlled for by the DD scheme.

Since the analysis focuses on 4 different outcome variables and since, as previously discussed, there are advantages and disadvantages in including the pre-intervention trend of the outcome variable *Y* among the controls, the general CDD model (2) was implemented in the analysis with the sixteen different specifications detailed in Table 10.

Table 10: Specifications for the CDD model of eq. 2

	Specifications															
Variables	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI
Y [Δemployment 2010-2008]	x	x	x	x												
Y [Δsales 2010-2008]					x	x	x	x								
Y [Δadded value 2010-2008]									x	x	x	x				
Y [Δlabour productivity 2010-2008]													x	x	x	x
T [1=Nazional Funds; 0=otherwise]	x	x			x	x			x	x			x	x		
T [1=EU + national Funds; 0=otherwise]	x	x			x	x			x	x			x	x		
T [1=Support to Investment; 0=otherwise]			x	x			x	x			x	x			x	x
T [1=Support to R&D; 0=otherwise]			x	x			x	x			x	x			x	x
T [1=support to inv. + supp. to R&D; 0=otherwise]			x	x			x	x			x	x			x	x
X [SIZE(4 dummies), AGE(1 dummy), NACE(12 dummies), COUNTRY(6 dummies)]	x		x		x		x		x		x		x		x	
X [SIZE(4 dummies), AGE(1 dummy), NACE(12 dummies), COUNTRY(6 dummies) PRE-TREND(DY2008-2006)]		x		x		x		x		x		x		x		x

Option II) CDD with perfect balancing of country location

The second model is a CDD approach similar to that of equation (2), but implemented with perfect balancing of the country in which the firm is located between the treated and comparison group. This is achieved by running the model of equation (2) separately for each country:

$$\Delta Y_i = [\ f\ [\sum_n T_{ni},\ X]\ \ |\ \text{COUNTRY}_i = c\ ] \qquad (3)$$

with c= AUT, FRA, GER, ITA, SPA, UK.

Model (3) is less efficient than (2), but, ensuring perfect balancing of the country of firm location between the treatment and comparison group allows us to control for the sources of potential bias with weaker functional form assumptions. The different specifications with which model (3) is implemented in the analysis are similar to those described in Table 10.

Option III) CDD with PSM and perfect balancing of country location

The third model is a Conditional Propensity Score Matching (CPSM) implemented by superimposing a DD scheme and perfectly balancing the country of firm location. This is achieved through differencing the outcome variable Y [i.e. ΔY_i (2010-2008)] and through running a separate PSM analysis for each country of location of the Efige firms. In detail, the model can be described as follows:

- Step I) Estimation (separately for each categorical treatment n and for each country c of the predicted probabilities of receiving the treatment n, based on an estimation sample formed solely by the subset of firms located in country c and either receiving public funding n or no public funding of any kind:

$$\left.\begin{array}{ll} P[T_{n=naz}=1] = \Phi[h(X)] & \text{| COUNTRY}=c \\ P[T_{n=EU}=1] = \Phi[h(X)] & \text{| COUNTRY}=c \end{array}\right\} \quad (4)$$

$$\left.\begin{array}{ll} P[T_{n=inv}=1] = \Phi[h(X)] & \text{| COUNTRY}=c \\ P[T_{n=R\&D}=1] = \Phi[h(X)] & \text{| COUNTRY}=c \\ P[T_{n=mix}=1] = \Phi[h(X)] & \text{| COUNTRY}=c \end{array}\right\}$$

- Step II) Checking that within each stratum of adjacent propensity scores each control variable X is balanced between treated and non-treated firms (i.e. the average levels of X for the treated firms are not statistically different from those for the non-treated firms);
- Step III) Separately for each categorical treatment n and country c, matching of the Tn=1 firms with the non-treated firms with similar propensity score (based on a radius matching algorithm, with a tolerance Δ=0.01);
- Step IV) Estimation of the sets of CDD treatment impacts, separately for each country and for each type of treatment Tn, in the form of differences between the mean pre-post intervention (2010-2008) outcome changes ΔY of the treated (Tn=1) and the matched non-treated firms.

Compared to the parametric model of eq. (3), this option ensures that the results are less sensitive to the functional form choice of the control variable (e.g. Heckman et al. 1997, 1998; Bondonio 2009). Also in this case, the different specifications with which the model is implemented in the analysis are similar to those illustrated in Table 10.

Option IV) CDD with PSM and perfect balancing of country location and industrial sector

The fourth model is a Conditional Propensity Score Matching (CPSM) implemented by superimposing a DD scheme and perfectly balancing both the country of firm location and the industrial sector. This model is less efficient for retrieving impact estimates of the public subsidies, but it ensures perfect balancing between the treated and non-treated firms of the two most important sources of potential bias in the analysis (country location and industrial sector). The implementation steps of the model are very similar to the steps I-IV) described above, with the difference that the steps I, III and IV are performed separately by type of treatment and by each country and industrial sector.

Because in the Efige-Orbis database the sample of firms that received the different types of subsidies considered in the analysis is quite small within each different country and/or industrial sector (see Table 4 and 5), the preferred methodological approach for the

analysis is the most efficient model of equation (2) [Option I]. In light of this limitation, the methodological options II), III) and IV) seriously risk yielding impact estimates with insufficient statistical efficiency.

4.2. Results

Table 11 summarizes the impact estimates for employment. The results from specification I and II of the model of equation (2) show that receiving subsidies from national public funds increases employment (compared to a counterfactual status of no public subsidies) by an average of 1.82-1.88 employees per firm. Because of the small sample size of Efige firms that received EU co-sponsored aids (as previously highlighted in Table 4), impact estimates for receiving public subsidies that also include EU funds do not reach statistical significance. The results from specification III and IV highlight an average impact (against a counterfactual status of no public subsidies) of +3.59 - +3.60 employees per firm for the subsidies to support generic investment projects. Receiving public subsidies that include support for R&D expenditures, instead, generates an employment increase of 4.35 -4.45 employees per firm. However, no significant employment variation compared to the counterfactual status is estimated for the subsidies to support R&D expenditures exclusively.

Table 11: Impact estimates for Employment(*)

	Specifications							
Variables	I		II		III		IV	
T_nat_funds [0,1]	1.88	***	1.82	***				
T_mix_EU+NAZ [0,1] (b)	0.96	-	1.12	-				
T_investment [0,1]					3.59	***	3.60	***
T_R&D [0,1]					-1.70	-	-1.81	-
T_MIX_INV&ReD [0,1]					4.45	***	4.35	***
1=1 employee								
- no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

Table 12 summarizes the results for sales. Specifications V and VI yield estimates for receiving subsidies from national funds only versus subsidies that include EU cosponsored interventions. Compared to a counterfactual status of no public subsidies, receiving support only from national funds is estimated to increase sales by an average of 360 € per firm. Similarly to the employment results, the impact estimates for receiving support that also includes EU co-funding are highly insignificant. The impact estimates from the specifications VII and VIII that exploit information on the Efige questionnaire on the availability of public support for generic investment projects versus public support that also includes R&D projects also have no statistical significance, with the exception of the receiving support for both generic investment and R&D expenditures that is estimated to increase sales by an average of 649,800€ -652,500€.

Table 12: Impact estimates for Sales(*)

	Specifications							
Variables	V		VI		VII		VIII	
T_nat_funds [0,1]	359.7	***	360.0	***				
T_mix_EU+NAZ [0,1] (b)	-757.4	-	-755.5	-				
T_investment [0,1]					493.5	-	485.9	-
T_R&D [0,1]					-483.6	-	-472.7	-
T_MIX_INV&ReD [0,1]					652.5	**	649.8	*
1=1,000 €								
- no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

The estimated impacts for added value outcomes (Table 13) can be summarized as follows. Receiving subsidies from national funds only is estimated to increase added value by an average of 106,300€ - 108,300€ per firm (specification, compared to a counterfactual status of no public subsidies. However, no statistical significance is reached by the impact estimates for receiving public subsidies with EU co-sponsoring. Receiving public subsidies to support generic investment projects (specification XI and XII) increases added value by 256,000€- 282,300€, while receiving public subsidies to support both generic investment and R&D expenditures is estimated to increase added value by 208,100€- 211,700€, compared to the counterfactual status of no public subsidies. On the other hand, no statistically significant changes compared to the counterfactual status is estimated for receiving public subsidies to support only R&D expenditures.

Table 13: Impact estimates for Added Value(*)

	Specifications							
Variables	IX		X		XI		XII	
T_nat_funds [0,1]	106.3	**	108.3	**				
T_mix_EU+NAZ [0,1] (b)	-35.1	-	-8.4	-				
T_investment [0,1]					282.3	**	256.0	**
T_R&D [0,1]					-160.6	-	-151.6	-
T_MIX_INV&ReD [0,1]					211.7	*	208.1	*
1=1,000 €								
- 0 no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

For labour productivity, finally, no impact estimate reaches statistical significance (Table 14). This is also due to the fact that (as shown in Table 2) the merged EFIFE-Amadeus database contains the smallest sample size of firms for which usable information is available on labour productivity.

Table 14: Impact estimates for Labour Productivity(*)

	Specifications			
Variables	XIII	XIV	XV	XVI
T_nat_funds [0,1]	2.65 -	2.30 -		
T_mix_EU+NAZ [0,1] (b)	-12.39 -	-12.50 -		
T_investment [0,1]			6.49 -	6.68 -
T_R&D [0,1]			4.65 -	4.10 -
T_MIX_INV&ReD [0,1]			0.32 -	0.43 -
1=1,000€ sales per employee				
- 0 no statistical significance; * = 90% significant; **=95% significant; ***=99% significant				
(*) Coefficient estimates of the X firm characteristics are omitted for brevity				
Complete results are available upon request to the authors				

5. Sensitivity analysis

The sample of Efige firms that can be successfully merged in the Orbis database ranges from about 40% to 60% (as shown in Table 4). This sample of merged firms does not completely overlap with that of the firms successfully merged with the Amadeus database used in the previous stages of this analysis. For this reason, Appendix I summarizes the results from replicating the analysis on the Efige-AMADEUS database, as a way of testing the robustness of the results with regard to possible attrition bias issues and/or data measurement errors. The results of this sensitivity analysis are, for the most part, well aligned with those presented in Tables 11-14 of this report. The results from the Efige-Amadeus database presented in Appendix I, however, do show, in general, a lower level of statistical significance than those illustrated in the main body of this report. This is because of the small sample size of usable firms for the analysis contained in the Efige-Amadeus database. Moreover, for the employment impact estimates of the EU funds mixed with National funds, the results based on the Efige-Amadeus data contrast with those from the Efige-Orbis data. In the Efige Orbis data, a non-significant employment impact is estimated (Table 11). In the Efige-Amadeus data, however, a positive and significant impact of +4.80-5.47 employees per firm (Table AI.1) is estimated.

A possible second limitation to the analysis is due to the lack of detail in the Efige questionnaires on the actual timing (within the 2008-2009 period) in which the different types of public subsidies were received by firms. This lack of information is important as it does not allow us to identify precisely the most appropriate point in time at which to measure the post-intervention outcomes. In the analysis presented in the previous sections, the post-intervention time is set as the year 2011, with the pre-intervention time set as the year 2007. A second possible option is to set the post-intervention time as the year 2010. This second option would reduce the potential bias in the impact estimates due to confounding factors and/or treatment contamination issues (the latter related to possible spillovers from the treated firms to the non-treated firms). Such threats to the validity of analysis are of lower intensities if the distance between the post-intervention time used in the analysis and the actual time in which the intervention occurred is smaller. However if this distance is reduced too much, the analysis faces an increased risk of measuring post-intervention firm-level outcomes that did not have enough time to be duly affected by the public subsidies. To test how sensitive the results are to the adoption of different post-intervention times, Appendix II contains the impact estimates obtained by replicating the analysis on the 2010-2007 changes of the Efige-Orbis employment, sales, added value and labour productivity outcome variables. These results are quite well aligned with those presented in the main body of this report. The most noticeable exception is, once again, the employment impact of the mix of EU and national funds that is estimated to be +4.20-4.29 employees in the case of the 2010-2007 analysis (Table AII.1), compared to the non-significant employment changes estimated for the 2011-2007 analysis (Table 11).

6. Conclusions

In recent years, counterfactual impact evaluation (CIE) of public interventions has been increasingly recognized as a crucial tool to improve the EU policy decision-making process. Since a large share of public funds are devoted to firm-level interventions to support innovation and R&D expenditures in the EU, conducting CIE studies on the impact of these interventions is of growing importance, in order to acquire crucial empirical evidence to refine future policy interventions at the EU and national/regional levels. Applying CIE studies to subsidies to support firm-level investments and/or innovation and R&D expenditures, however, is not an easy task. Firm-level CIE requires reliable micro data on:

- programme activity data for the programmes being evaluated, which contains: a list of beneficiary firms; type and amount of subsidies awarded to each firm; dates of completion of the subsidized investment and/or expenditures; a common firm-identifier suitable for merging this data with databases recording firm-performance outcomes, the list of possible rejected applicants (if any exist);
- information on the existence of additional public programmes that may affect the firm-level outcome variables of the analysis independently from the programmes being evaluated;
- firm-level data on innovation outputs and/or firm-level outcomes, for example in the form of: employment, sales, added value, labour productivity.

Because of these cumbersome data requirements, no large scale CIE study based on firm-level micro-data that encompass multiple countries has yet been carried out in Europe. In this regard, the features of the Efige database exploited in this research are of great interest for the analysis. In principle, the Efige database contains complete information on whether or not a firm received public subsidies for a full sample of firms spanning seven different EU countries. Efige also contains a unique firm-identifier (based on the national tax code of the firms) that allows the data to be merged with other firm-level databases such as the Bureau Van Dijk's Amadeus and Orbis databases. Thus, the analysis presented in this research report, based on merging the Efige data with the Amadeus and Orbis data, does offer unprecedented external validity, generated by the inclusion in the estimation sample of firms from seven different EU countries.

In practical terms, however, the analysis presented in this report has a number of data limitations that diminish to a certain degree its policy relevance and, in certain cases, the robustness of the estimated results. These limitations stem from the fact that the Amadeus and Orbis databases contain balance-sheet information only on corporate firms and from the fact that when the Efige project was designed and implemented, the needs related to performing CIE studies were not taken into account. For these reasons:

- for a large portion of the Efige firms, no balance sheet information can be traced in the Amadeus and Orbis databases, in terms of pre- and post-intervention firm-level employment, sales, added value and labour productivity performances;
- the information on the availability of public funds and on the existence of product and process innovation is collected in Efige at around the same points in time (i.e. the years 2008-2009 for the existence of public subsidies and 2007-2009 for the achievement of product and/or process innovation). This feature of the Efige survey does not allow the analysis to estimate the actual impact of public funding on product and process innovation outcomes;
- the information related to the availability of public funding is collected in Efige solely with the generic reference to the two-year period 2008-2009. Furthermore, no additional details are available on the amount of public funding received and the specific aims of the public subsidies received (apart from the generic information on the source of the subsidy, distinguishing between national funds and EU funds on the one hand and between support to generic investment projects and support to R&D expenditures on the other one).

- Despite these limitations, the analyses presented in this research report do offer empirical evidence that appears to have some noticeable policy implications. This empirical evidence can be summarized as follows:

A) For the part of the analysis correlating product and process innovation to receiving public support:

- the estimated results seem to indicate that national and EU funding are equally important in stimulating product innovation. However, EU funding has a higher correlation with process innovation. This might be due to more stringent rules governing the funding of process innovation in the EU;
- public support to private R&D is positively associated with product innovation but not with process innovation. On the other hand, public support to private investment (including ICT capital) is positively associated with process innovation but not with product innovation. Both results are in line with our expectations;
- receiving public support for both R&D expenditures and for unspecified firm-level investment projects is positively associated with both product and process innovation.

B) For the part of the analysis estimating the impact of public funding on firm-level outcomes:

- receiving public support from national funds is estimated to generate positive increments in employment, sales and added value, compared to the counterfactual status of the absence of public intervention. When the public assistance is in the form of EU funds mixed with national funds, however, no statistically significant differences are estimated compared to the counterfactual status of absence of public support. This is likely due to two characteristics of our data. First, the sample size of firms that receive EU funds is much smaller (about 100 firms) than the sample size of firms that receive national funds (about 1,800 firms). Second, the type of support offered through EU funds in the last programming period was more strictly geared toward supporting innovation and R&D expenditures, than support offered by national funds. For this reason, the impact of EU funding on the general firm-level performance outcomes measured in this analysis may require more time than the time span embraced by the data used in the analysis;
- receiving public subsidies to support firm-level investment projects (of a generic nature) is estimated to generate positive impacts on employment and added value outcomes. No statistically significant impacts are however estimated for receiving public subsidies to support R&D expenditures exclusively. Also in this case, it may be due to the nature of the support to R&D expenditures that often requires more time to yield noticeable impacts on general firm-level performance.

7. Directions for future research

To overcome most of the data limitations described in the previous sections, future research should involve merging the FP7 programme activity database available at JRC-IPTS with the Bureau van Dijk's Amadeus/Orbis databases. A merged database of this kind would offer the following advantages compared to the current Efige- Amadeus/Orbis databases used in the current analysis:

i. enlarged sample size of usable firms;

ii. more complete information on crucial funding features (such as the nature and scope of the subsidy, economic value of the support, admissible expenditures, exact dates for when the supported investments were made).

With this information, a robust counterfactual impact evaluation (CIE) study could be conducted to estimate the impact of FP7 programmes for firms and SMEs on some relevant firm-level performance outcomes (such as employment, sales, added value, cost of labour and labour productivity) detectable in the Amadeus/Orbis databases. A CIE study of this kind could provide empirical evidence of unprecedented importance for the EC on the actual social benefit of the FP7 cooperation programme in terms of additional employment and firm-level economic activity.

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Appendix I: Results from replicating the analysis on the Efige-Amadeus database

Table AI.1: Impact estimates for Employment(*)

	Specifications							
Variables	I		II		III		IV	
T_nat_funds [0,1]	1.15	*	1.02	-				
T_mix_EU+NAZ [0,1] (b)	5.47	**	4.80	**				
T_investment [0,1]					2.57	-	2.68	*
T_R&D [0,1]					0.60	-	-0.73	-
T_MIX_INV&ReD [0,1]					3.52	**	3.41	**
1=1 employee								
- no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

Table AI.2: Impact estimates for Sales(*)

	Specifications							
Variables	V		VI		VII		VIII	
T_nat_funds [0,1]	317.1	**	315.1	**				
T_mix_EU+NAZ [0,1] (b)	-903.9	-	-918.0	-				
T_investment [0,1]					239.8	-	241.6	-
T_R&D [0,1]					-265.7	-	-266.4	-
T_MIX_INV&ReD [0,1]					643.2	*	643.4	*
1=1,000 €								
- no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

Table AI.3: Impact estimates for Added Value(*)

	Specifications							
Variables	IX		X		XI		XII	
T_nat_funds [0,1]	90.2	-	102.2	*				
T_mix_EU+NAZ [0,1] (b)	84.2	-	146.6	-				
T_investment [0,1]					163.2	-	160.4	-
T_R&D [0,1]					0.87	-	4.20	-
T_MIX_INV&ReD [0,1]					211.9	-	214.8	-
1=1,000 €								
- 0 no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

Table AI.4: Impact estimates for Labour Productivity(*)

	Specifications							
Variables	XIII		XIV		XV		XVI	
T_nat_funds [0,1]	2.95	-	2.75	-				
T_mix_EU+NAZ [0,1] (b)	-9.02	-	-9.15	-				
T_investment [0,1]					3.93	-	4.06	-
T_R&D [0,1]					3.64	-	3.81	-
T_MIX_INV&ReD [0,1]					1.25	-	1.56	-
1=1,000€ sales per employee								
- 0 no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

Appendix II: Results from replicating the analysis on the (2010-2007) changes of firm-level outcomes

Table AII.1: Impact estimates for Employment(*)

	Specifications							
Variables	I		II		III		IV	
T_nat_funds [0,1]	1.52	**	1.59	**				
T_mix_EU+NAZ [0,1] (b)	4.22	*	4.29	**				
T_investment [0,1]					3.42	**	3.40	**
T_R&D [0,1]					0.31	-	0.46	-
T_MIX_INV&ReD [0,1]					3.25	**	2.96	**
1=1 employee								
- no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

Table AII.2: Impact estimates for Sales(*)

	Specifications							
Variables	V		VI		VII		VIII	
T_nat_funds [0,1]	251.0	**	253.6	**				
T_mix_EU+NAZ [0,1] (b)	-358.8	-	-302.7	-				
T_investment [0,1]					255.5	-	244.2	-
T_R&D [0,1]					-689.4	**	-645.4	**
T_MIX_INV&ReD [0,1]					29.8	-	26.3	-
1=1,000 €								
- no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

Table AII.3: Impact estimates for Added Value(*)

	Specifications							
Variables	IX		X		XI		XII	
T_nat_funds [0,1]	106.3	**	108.3	**				
T_mix_EU+NAZ [0,1] (b)	-35.1	-	-8.4	-				
T_investment [0,1]					282.3	**	256.0	**
T_R&D [0,1]					-160.6	-	-151.6	-
T_MIX_INV&ReD [0,1]					211.7	*	208.1	*
1=1,000 €								
- 0 no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

Table AII.4: Impact estimates for Labour Productivity(*)

	Specifications							
Variables	XIII		XIV		XV		XVI	
T_nat_funds [0,1]	1.67	-	1.14	-				
T_mix_EU+NAZ [0,1] (b)	-2.94	-	-3.12	-				
T_investment [0,1]					3.04	-	3.54	-
T_R&D [0,1]					3.78	-	3.16	-
T_MIX_INV&ReD [0,1]					1.54	-	1.73	-
1=1,000€ sales per employee								
- 0 no statistical significance; * = 90% significant; **=95% significant; ***=99% significant								
(*) Coefficient estimates of the X firm characteristics are omitted for brevity								
Complete results are available upon request to the authors								

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