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# The impact of R&D tax incentives in Portugal - SIFIDE

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# 1. Motivation

- Innovation widely recognized as important for growth and competitiveness
- R&D is needed to foster innovation
- Firms typically invest less in R&D than socially optimal (externalities from knowledge and technology spill-overs, uncertainty and financial difficulties)
- Rationale for state intervention (normally through grants and tax incentives)
- Policy efficacy may be undermined by: difficulty to identify viable projects that would not otherwise be implemented; firms' rent seeking behaviour or crowding out
- Policy evaluation useful to promote efficacy and efficiency
- This paper analyses impact of SIFIDE at the level of the firm (intangible investment, staff in R&D and exports - we do not consider the impact of possible externalities from knowledge and technology spill-overs).

## 2. Description of SIFIDE – System of tax incentives for corporate R&D

- Created in 1997. Reintroduced in 2006 after a 2 year discontinuation
- **Tax incentive:** costs with R&D are deducted from profit taxes
- **Firms self-select** (only minor eligibility requirements for firms: taxable profits not determined by indirect methods; firms do not owe to the State and Social Security)
- Firms can apply **several times**
- **Carry forward option:** firm with insufficient tax collection can carry forward the credit for 8 years
- Tax incentive calculated according to a volume rate and incremental rate (**hybrid regime**)

SIFIDE eligible expenditures	% of total
Fixed tangible assets allocated to R&D	13,27
R&D staff	42,58
Participation of managers in org. of R&D entities	0,03
Operating costs in R&D	35,30
Contracting R&D from other entities	7,60
Participation in capital of R&D entities	0,94
Patent registry	0,15
Patent acquisition	0,05
Auditing R&D activity	0,03
Demonstration of R&D activities	0,03

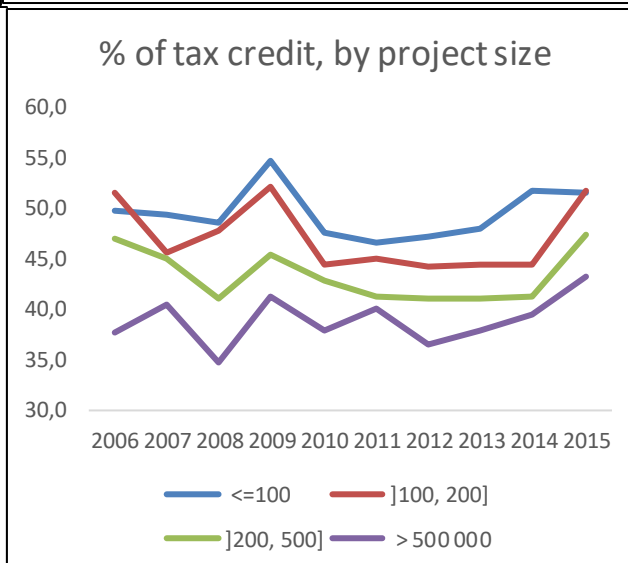
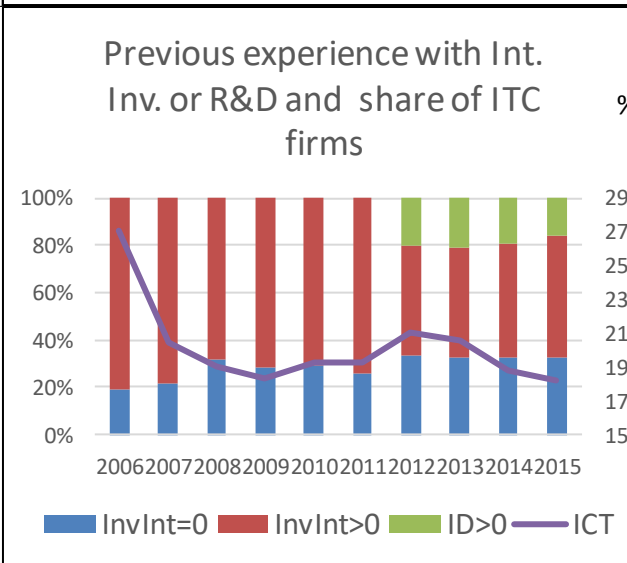
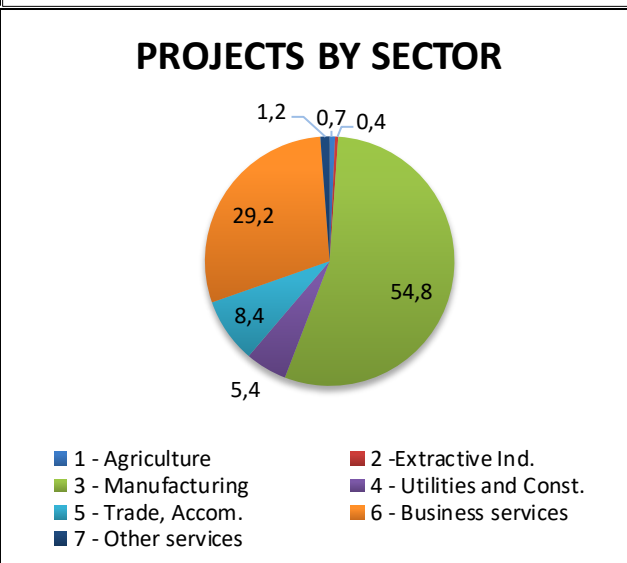
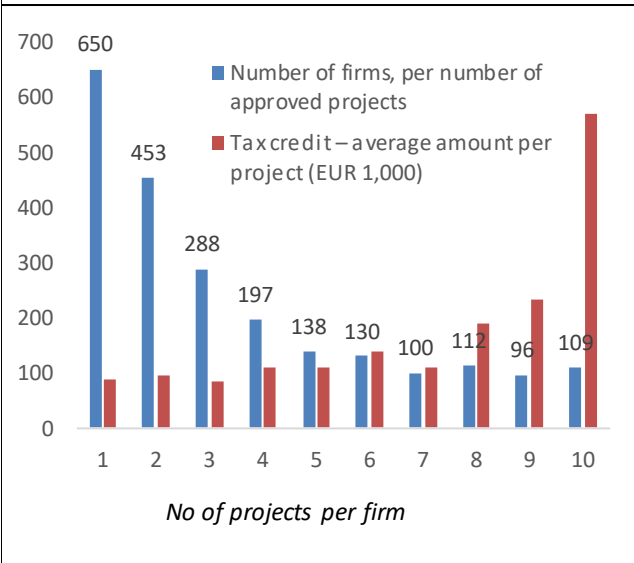
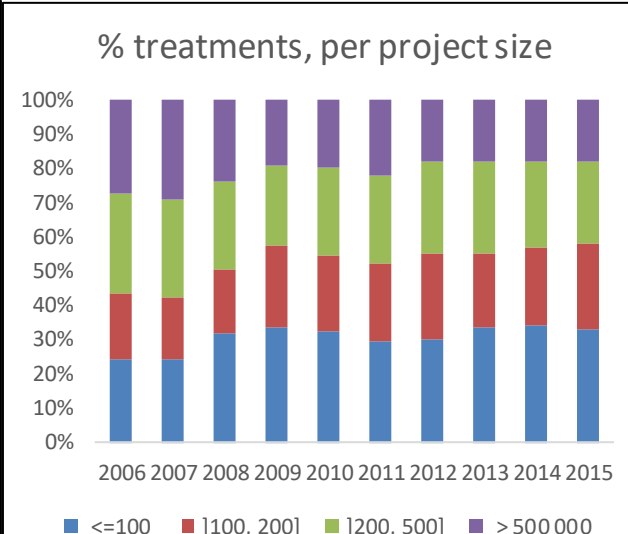
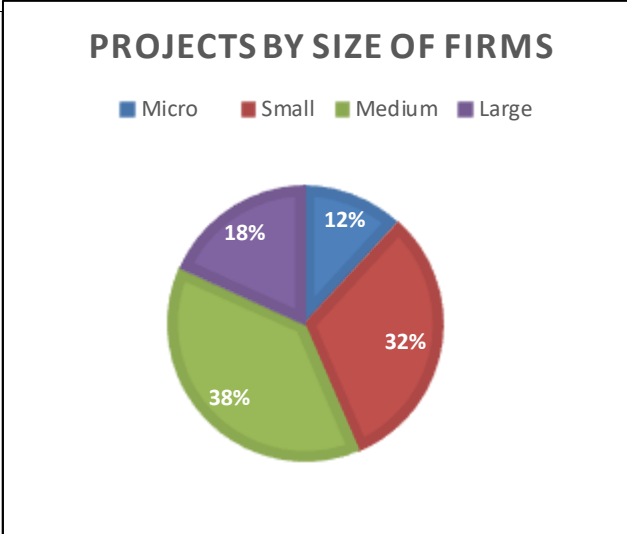
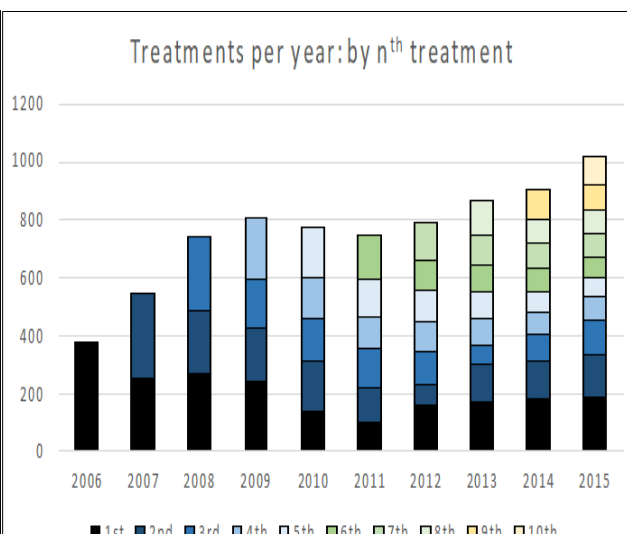
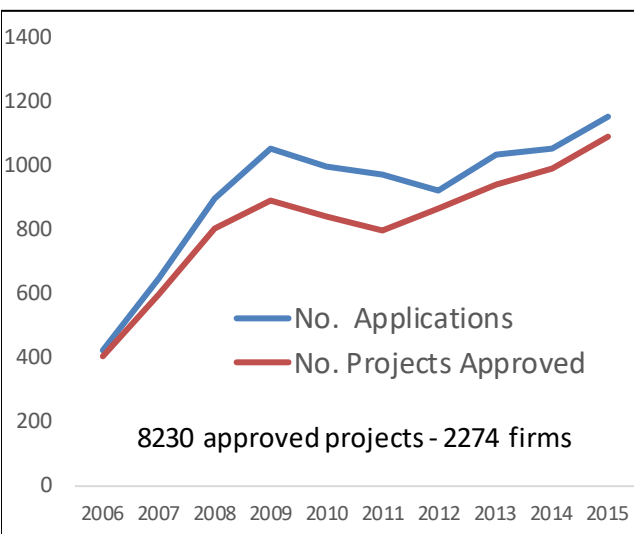
$$\text{Tax credit} = 0,325 * Tot_t + I$$

$$I = 0,5 * [Tot_t - \left(\frac{Tot_{t-1} + Tot_{t-2}}{2}\right)] \text{ up to a limit of €1,500,000 or}$$

$$I = 0,15 * Tot_t \text{ (if micro ou SME with less than 2 years)}$$

*Tot = total eligible expenditures*

# 3. Characteristics of supported firms

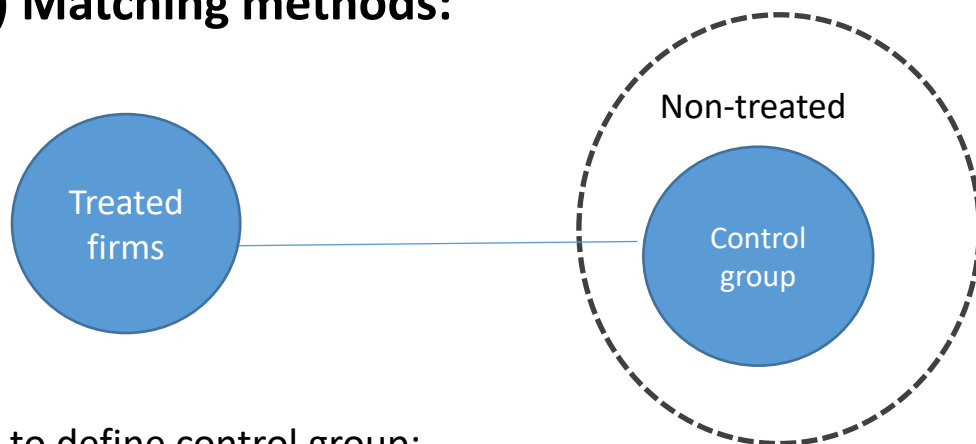


# 4. Methodology

- ❑ Policy evaluations -- counterfactual?
- ❑ **Endogeneity** concerning factors affecting **both** programme **participation** and **outcome: Selection bias**
- ❑ Easier if policies randomly applied only to some firms: most policies (SIFIDE) do not have these features

Methods used to reduce selection bias:

- **A) Matching methods:**

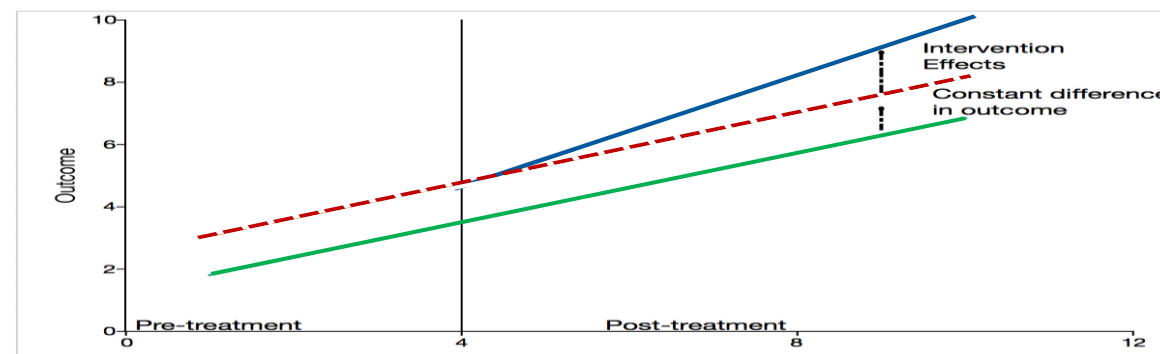


- 1) Metrics to define control group:

- Propensity score matching:  $\text{Prob}(T_i = 1 | X_i) = \alpha_0 + \sum_{i=1}^k \beta_i X_i + \varepsilon$
- Mahalanobis (multivariate): distance based on correlation matrix of X

- 2) Match observations: 3 methods: (i) Nearest neighbour (ii) Stratification and (iii) Kernel

- **B) Differences-in-differences (DiD):**



$$Y_{it} = \alpha_0 + \alpha_1 t + \alpha_2 T_i + \alpha_3 t * T_i + \sum \beta_i X_{it} + \varepsilon_{it}$$

4 specifications of model: with and without controls and fixed effects (with and no controls)

Conditions: A) No omitted variables

B) No time variant effects

# 4. Methodology

## Characteristics of treated and untreated firms

Variables	Treated Companies	Untreated Companies
Intangible investment (EUR 1,000)	682,79	5,60
Firms with Inv. intangible assets (%)	0,50	0,14
R&D employees	3,89	0,01
Employment	164,25	6,83
Turnover (EUR 1,000)	41300,00	651,30
FBCF (EUR 1,000)	2276,51	33,81
B&S exports (% sales)	32,18	5,43
Labour productivity (EUR 1,000)	75,26	20,07
Graduated Employees (% Employment)	32,72	12,64
Net Results on total assets	1,60	-123,28
Operating results	3483744,00	33.813,17

## Control variables

Variable	Description
DIntInv	Dummy variable =1 if Intangible investment >0, 0 otherwise
DPropID	Dummy variable =1 if R&D>0 in any year analysed, 0 otherwise
Subs	Subsidiaries
Staff(log)	No of staff (in logs)
Univ%	Categorical variable measuring the % of staff with a university degree, = 1 if [0, 15]; = 2 if ]15, 30], = 3 if > 30.
Age	Categorical variable measuring the firm age in years, = 1 if [0, 5]; = 2 if ]5, 10]; = 3 if >10.
GFCF(log)	Gross Fixed Capital Formation (in logs)
Turnover(log)	Turnover (in logs)
FinAut	Capital in % of total assets: categorical variable = 1 if [0, 20]; = 2 if ]20, 40], =3 if >40.
Profit	Net returns in % of total assets. categorical variable = 0 if <=0; 1 if ]0, 15]; = 2 if ]15, 30], =3 if >30.
i.NUTS	Dummy for regional Classification
i.Sectors	Dummy for sector classification
i.Yr	Dummy for Year of application

## Four scenarios for matching:

- General case
- Firms with positive Investment in intangible assets before treatment
- Firms with no previous Investment in intangible assets
- Firms with propensity to R&D

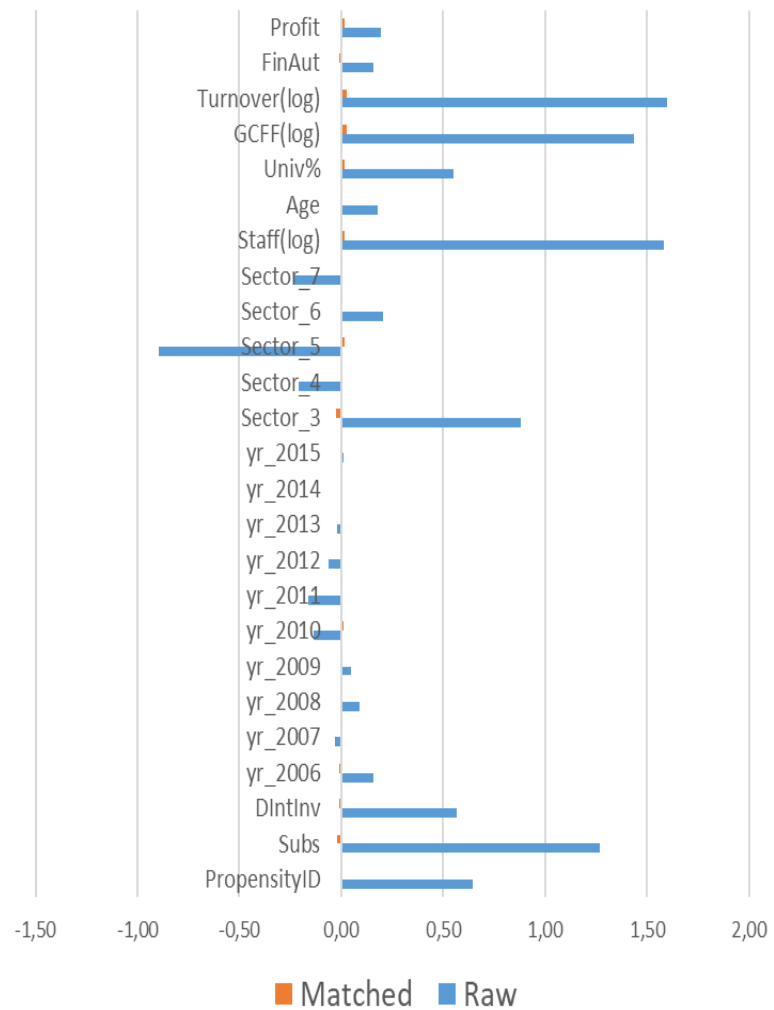
Matching 2 periods before treatment

- Effects on first treatments
- Firms treated only once

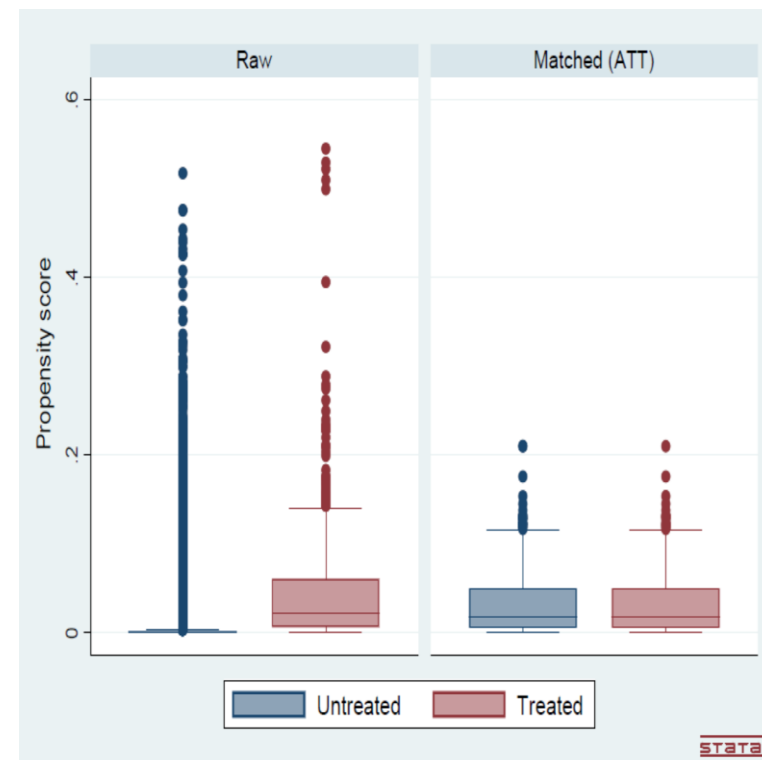
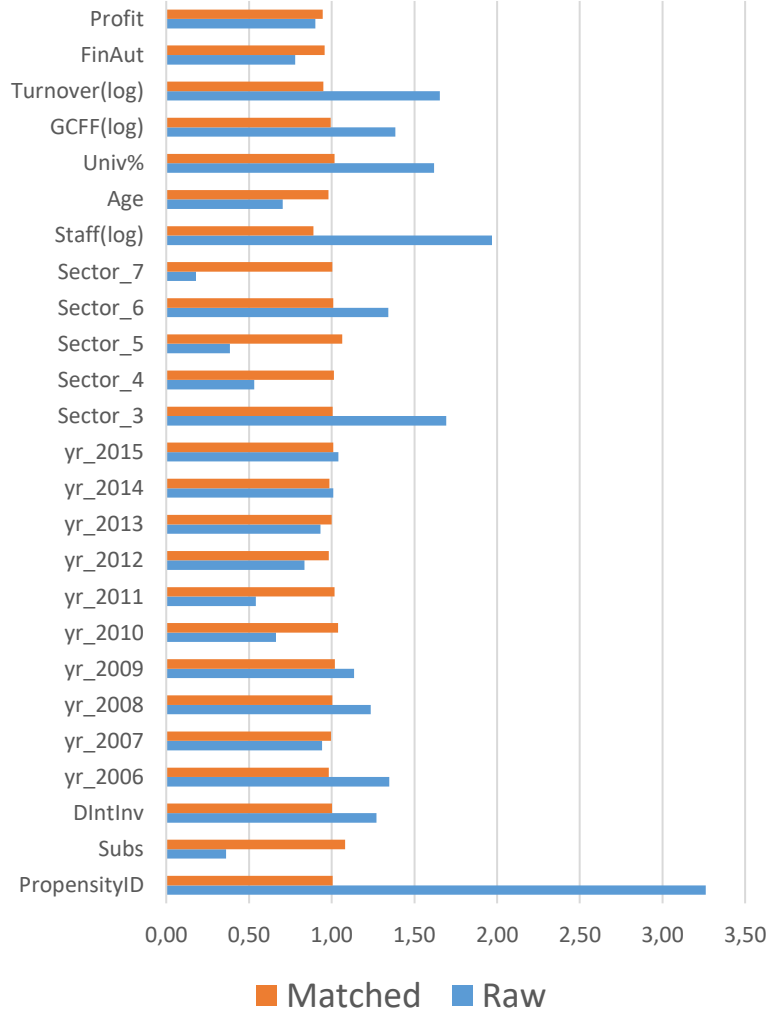
# 5. Results

Matching process allowed balances samples: Example: propensity score – general case

Std Dif Means



Variance ratios





# 5. Results | Impact on Intangible investment (% of total assets)

- **Positive impact of the programme on intangible assets** (more directly related with SIFIDE eligible costs): **Reject the hypothesis of full crowding-out**
- results consistent along several matching methods
- more significant for firms that had invested before in intangible assets and even more for firms with a propensity to R&D
- firms treated only once maintain higher levels of intangible investment a few years after the programme is completed
- the increase in intangible investment as a result of the programme exceeds policy costs directly associated with it, thus confirming **additionality**
- conclusions obtained through the matching methods are confirmed by DiD: higher and more significant effects in the initial years of the programme
- **Insignificant impact of policy changes:**

2009: tax base increase from 20 to 32,5% and **limit for incremental part doubled** (from 750 to 1500 EUR 1000s)  
 2014: **extension of carry forward** period from 6 to 8 years

Effects on large or non profitable firms not significant: **previous limits appear non-binding**

Variable	PS (kernel)		Mahalanobis		PS (NN)		PS (Stratification)	
	ATT	t	ATT	t	ATT	t	ATT	t
a) General model: all firms								
IntInv	0,88 ***	6,16	0,95 ***	6,61	0,84 ***	4,96	1,00 ***	6,86
b) Firms with positive Intangible Investment before treatment								
IntInv	1,11 ***	5,04	1,30 ***	5,83	1,15 ***	4,33	1,16 ***	5,25
c) Firms with no intangible investments before treatment								
IntInv	0,45 ***	2,90	0,39 ***	2,70	0,16	0,93	0,26 *	1,78
d) Firms with propensity to R&D								
IntInv	2,33 ***	4,55	2,38 ***	4,93	2,19 ***	4,67	2,34 ***	5,07

## Firms treated only once: persistence of impact

Variable	PS (kernel)		Mahalanobis	
	ATT	t	ATT	t
a) General model: all firms				
IntInv	1,03 ***	3,70	1,07 ***	4,16
IntInv+1	0,8015 ***	3,22	0,78 ***	3,39
IntInv+3	0,33 **	2,11	0,24	1,56
b) Firms with positive Intangible Investment before				
IntInv	1,15 ***	2,66	1,28 ***	3,14
IntInv+1	0,801 *	1,73	1,05 ***	2,74
IntInv+3	-0,32	-1,62	-0,10	-0,81
c) Firms with no Intangible Investment before				
IntInv	0,72 ***	2,11	0,65 **	2,02
IntInv+1	0,4561 *	1,92	0,30	1,33
IntInv+3	0,37	1,31	0,35	1,25
d) Firms with propensity to R&D				
IntInv	1,44 ***	2,20	1,55 ***	2,71
IntInv+1	2,2845 ***	2,56	2,03 ***	2,43
IntInv+3	-0,414	-1,07	-0,27	-1,25

## Additionality

PS (kernel)		Mahalanobis	
ATT	t	ATT	t
0,08 ***	4,74	0,14 ***	5,71

# 5. Results | Impact on Intangible investment (% of total assets), by setor and firms' size

- Sectors (NACE Rev.2 Sections):

- effects of the SIFIDE programme are more significant in the **business services sector** (Sections J-N) than in the manufacturing industry (Section C)
  - 84% of the projects financed with SIFIDE
- Firms in the **ICT sector** also perform particularly well

- Firms' size:

- more significant impacts in **micro and small firms** in all scenarios considered
- for large firms, only those with propensity to R&D show significant results from SIFIDE, although lower than smaller firms

**Sectors, NACE Rev.2 Sections**

IntInv Sector	PS (kernel)		Mahalanobis	
	ATT	t	ATT	t
a) General model: all firms				
1 - Agric. for. & fishing	0,98	1,05	0,98	1,05
2 - Extr. Industries	--	--	--	--
3 - Manufacturing Ind.	0,44 ***	4,33	0,44 ***	5,39
4 - Utilities & constr.	0,80	1,42	0,87	1,63
5 - Trade & accom.	0,42	1,62	0,38	1,63
6 - Business services	2,16 ***	4,66	2,16 ***	4,8
7 - Other services	2,18 *	1,76	2,10 *	1,84
ICT_SECTOR	2,09 ***	3,4	2,36 ***	4,11
b) Firms with positive Intangible Investment before treatment				
3 - Manuf. Ind.	0,64 ***	3,33	1,02 ***	2,13
6-B. Services	2,59 ***	3,40	2,82 ***	3,93
c) Firms with no Intangible Investment before treatment				
3 - Manuf. Ind.	0,04	0,59	0,05	0,078
6-B. Services	1,27 **	2,22	1,24 **	2,39
d) Firms with propensity to R&D				
3 - Manuf. Ind.	1,05 ***	2,58	1,36 ***	4,31
6-B. Services	4,62 ***	3,41	4,40 ***	3,26

**Firms' Size**

InvInt Size	PS (kernel)		Mahalanobis	
	ATT	t	ATT	t
a) General model: all firms				
Micro	1,97 ***	2,42	2,37 ***	3,32
Small	0,90 ***	4,60	0,92 ***	3,80
Medium	0,44 **	2,54	0,52 ***	3,77
Large	0,18	1,32	0,26 *	1,65
b) Firms with positive Intangible Investment before treatment				
Micro	2,55 ***	2,7	2,36 ***	2,68
Small	1,67 ***	3,80	1,63 ***	3,17
Medium	0,72 ***	2,38	0,76 ***	3,04
Large	0,39	1,67	0,20	0,84
c) Firms with no Intangible Investment before treatment				
Micro	2,41 ***	2,47	2,28 **	2,37
Small	0,35 **	2,01	0,24	1,48
Medium	-0,03	-0,69	-0,06	-1,51
Large	0,00	-0,12	-0,24 ***	-4,04
d) Firms with propensity to R&D				
Micro	4,51 ***	2,93	4,09 ***	2,72
Small	3,60 ***	2,92	3,28 ***	2,69
Medium	1,04 ***	2,52	1,32 ***	3,45
Large	0,56 ***	2,57	0,34	1,65

## 5. Results | Impact on R&D Staff and Total Exports

- R&D Staff (Number & Difference from pre-treatment):
  - **Treated firms have more staff in R&D activities**
  - **Firms with previous intangible investment and propensity to R&D have higher R&D staff** as a result of the programme
- Exports (% of total sales):
  - Firms which benefit from SIFIDE also have **higher export volumes** (in % of total sales).
  - **Firms with propensity to R&D seem to have increase exports** as a consequence of SIFIDE

### R&D Staff (Number & Diff. from pre-treatment)

Variable	PS (kernel)		Mahalanobis	
	ATT	t	ATT	t
a) General model: all firms				
StaffID	1,24 ***	6,03	1,23 ***	5,78
DStaffID	1,16 ***	2,86	0,92 ***	3,2
b) Firms with positive Intangible Investment before treatment				
StaffID	1,29 ***	5,10	1,22 ***	4,10
DStaffID	0,84 ***	2,30	1,08 ***	4,32
c) Firms with no Intangible Investment before treatment				
StaffID	0,85 ***	5,20	0,86 ***	5,47
DStaffID	0,29	0,68	0,30	0,8
d) Firms with propensity to R&D				
StaffID	1,59 ***	3,60	1,96 ***	4,40
DStaffID	1,24 ***	3,14	1,55 ***	3,36

### Exports (% of total sales)

Variable	PS (kernel)		Mahalanobis	
	ATT	t	ATT	t
a) General model: all firms				
ExpTot	9,24 ***	5,96	11,37 ***	7,99
DExpTot	2,40 ***	2,79	2,09 ***	2,59
b) Firms with positive Intangible Investment before treatment				
ExpTot	11,97 ***	4,99	12,44 ***	5,67
DExpTot	2,37	1,66	2,69 **	2,13
c) Firms with no Intangible Investment before treatment				
ExpTot	7,89 ***	3,36	9,43 ***	4,31
DExpTot	1,49	1,06	1,19	0,97
d) Firms with propensity to R&D				
ExpTot	21,45 ***	5,68	21,32 ***	6,14
DExpTot	4,37 *	1,72	4,94 *	1,92

## 6. Conclusions

- **Positive effects** of SIFIDE in promoting investment in intangible assets and staff in R&D activities. Less clear impact on exports.
- SIFIDE encouraged additional private investment in an amount greater than the amount of the tax credit (**crowding-in or additionality**).
- **Persistence of results**: higher investment in intangible assets remains after the conclusion on the programme.
- **Consistency of results** with various models and matching method provides **robustness** to the analysis.
- **Higher impact on micro and small firms, in services or in the ICT sector** may justify redesigning the policy in order to **differentiate support according to these features** – as in most other countries.
- The lower effectiveness at encouraging R&D in companies that did not invest in intangible assets before: may justify a **revision of the methodology for calculating the tax credit** (i.e. the value of the incremental rate).
- **Recent policy changes did not seem to alter incentives for firms** more likely to benefit from them (large firms or firms with lower profits). This suggests that limits under previous rules were non-binding and questions the usefulness of these policy changes.
- **Future research**: analyse impact multiple treatments and externalities arising from technology spill-overs.