



# R&D Subsidies and SMEs' Debt Financing

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- ✓ Debt and bank financing continue to play a major role in financing young and SMEs, especially in bank-based capital markets...
  - This study investigates the effects of R&D subsidies on debt financing of SMEs in Italy
  
- ✓ Research questions: whether receiving public R&D subsidies
  - (1) affects **overall indebtedness** of recipient firms
  - (2) reduces the **cost of debt** of recipient firms
  - (2) changes the **structure of debt** over time
  
- ✓ **Contribution**: To shed new lights on the impact of public programs on *debt financing*, which has been less investigated than equity financing by impact evaluation literature.

## Motivation (1)



It is commonly held that:

- ✓ **R&D and innovation** are key drivers of competitiveness, productivity and economic growth.
- ✓ SMEs face extensive **financial constraints**:
  - 1) Banks and VCs are highly selective in providing financing
  - 2) Access to public capital market is often unavailable
- ✓ SMEs indicate **the access to finance** as a significant **obstacle to innovation**.  
→ reject R&D projects hampering growth in empl., sales, export
- ✓ **Public support for R&D** may alleviate **financial constraints** by reducing the uncertainty between financiers and firms

## Theoretical background (1)



- ✓ The rationale for public subsidies to support private R&D lies in **market failures**:
- **Limited appropriability**: knowledge generated through R&D is a quasi-public good and firms cannot appropriate all the returns from their R&D investments
- **Imperfections of capital markets**:
  - Asymmetry information
  - Riskiness of R&D investments that can't be used as collateral
  - Ext. investors have not info/competencies to evaluate R&D projects limiting the provision of funds (*Hall, 2002*)
- ✓ As a consequence, private investments in R&D tend to be lower than the socially desirable level (*Arrow, 1962*)
- ✓ Hence, public subsidies may foster R&D investments of private sector by helping firms to overcome market failures.

## Theoretical background (2)



- ✓ The effectiveness of R&D subsidies has been assessed using the concept of **additionality**:
  - (1) **Input**: whether public funding reduce or stimulates the inputs (R&D expenditure, R&D personnel)
  - (2) **Output**: whether public funding improves performance (Patents, Innovations)
  - (3) **Behavioral**: changes induced in firms' behavior (organization, market strateg.)
  
- ✓ A recent strand of literature is focusing on the ability of subsidies to address financing constraints of targeted firms.
  
- ✓ Subsidies can generate 2 types of effects:
  - (1) **liquidity effect**, reducing the amount of int./ext. financial resources (Direct)
  
  - (2) **certification effect**, serving as a signal to external financiers on the quality of R&D activities of funded firms (Indirect or Secondary effect)

## Theoretical background (3)



- ✓ The importance of **certification** is widely recognized in Corporate Finance literat. (*Megginson and Wiess, 1991; Tirole, 2006*)
- ✓ Being awarded with a subsidy, under a competitive program, convey a positive signal to external financiers about the quality of R&D activities under some assumptions (*Takalo and Tanayama, 2010*).
- ✓ Assumptions:
  - Public agency is **better informed** about R&D projects than external investors
  - It is **costly** for the recipient firms to acquire the “**certification**”
  - Public agency has a **reputational capital**
  - **Signal easily observable** by outsiders



### Testable implications of the certification hypothesis:

- ✓ R&D subsidies reduce....
  - information asymmetries facilitating the access to external sources of finance (*Lerner 1999*)
  - the screening cost of borrowers and projects to external financiers. This has an effect on the probability of raising debt but also on the conditions offered by debt providers (*Hottenrott & Demeulemeester 2017*)
- ✓ The certification effect is stronger for **long-term debt financing** than for short-term debt financing. (LT Debt is more risky and debt providers grant it when they have favorable information)  
(*Meuleman & DeMaeseneire 2012; Hottenrott et al. 2018*)

Due to the **certification effect** firms receiving R&D subsidies:

- ✓ increase (not decrease) the total amount of debt
- ✓ increase the incidence of long-term debt over total debt
- ✓ have a lower average cost of debt
- ✓ these effects are more obvious in the medium term



## The program (1)



- ✓ Program: implemented/managed at regional level (Marche region of Italy) but funded by the European Regional Development fund.
- ✓ The aim: promote firms' R&D investments in radical or incremental innovations of products, services and processes
- ✓ Form: direct grants for projects of industrial research and experimental development activ.
- ✓ Design: applications are evaluated by a commercial bank (financial feasibility) and by a committee of independent experts (merit)
- ✓ Why this program:
  - Local economy based on SMEs (79% of manufacturing workers in firms with < 10 empl.)
  - Regional SMEs have low R&D investments (Modes of innovation: learning by doing and learning by interacting).

## The program (2)



### Eligible criteria:

- Firms **headquartered** in the region
- **SMEs** (employees <250; turnover <€50 million or Tot. Assets <€43 million)
- **Technology-intensive sectors** (ICT, new materials, Nanotechnology, etc.)
- **No other public subsidies** for R&D. This excludes potential confounding factors to identify the causal effects of the regional program.
- **Individual** R&D projects.
- Funded projects had to start within 1 month and concluded within 18 m.
- Total cost of the projects between €100,000 and €1 million.
- The subsidy consists of a on-repayable capital contribution up to 35% of total costs of the project.

We consider **two calls of the program** (2005, 2007). Out of 441 applications, 282 were accepted (64%), while 159 were rejected (36%)

## Data (1)



1. List of subsidized firms from the public agency
2. Firms balance sheets data from ORBIS – Bureau van Dijk
3. We select the entire universe of the regional firms in ORBIS to identify the control group
4. We exclude:
  - large firms,
  - firms operating in sectors not involved in public policies,
  - distressed firms
  - firms financed by other regional programs

### Final Sample

- ✓ Funded firms: **176** (78, 98)
- ✓ Firms not applying (control group): **5,127**
- ✓ Time span: 2003-2012 (Panel data)

## Identification strategy (1)



- ✓ We rely on the (**DID**) *estimator* that **compares treated** and **non-treated** units in terms of outcome changes before and after the treatment.
- ✓ **Issue!**, public grants across firms could be not randomly distributed
  - Hence, both **subsidized** and **non-applying firms may not** constitute a random samples and show differences (in t-1 subsidized firms: older, larger, innovation-oriented).
- ✓ In order to select appropriate comparison groups and to reduce selection bias, we combine **DID** with propensity score matching (**PSM**).
- ✓ **PSM** observable heterogeneity between the two groups of firm. No unobserved differences in the treatment and comparisons populations
- ✓ **DID** unobserved time-invariant heterogeneity (fixed effects, human capital, managements, etc). Plausible in the short period

## Identification strategy (3)



✓ The estimation procedure is implemented in two steps:

### 1. **PSM** based on:

- (a) observed firm characteristics (sector, total assets, cash flow, ROE, EBITDA/sales, juridical form, age, tangible and intangible investments, patents, wages, location)
- (b) in the baseline year (one year before the subsidy)
- (c) using the Kernel matching algorithm

### 2. **DID** to estimate the average effect of the public program

We run DID in different years after the treatment to capture:

- short-term effects (1-2 years)
- medium-term effects (3-5 years)

## Data (2)



Notes: <sup>a</sup> Thousands of euros. ***, **, * statistically significant at the 1, 5 and 10% level	<b>Subsidized</b>	<b>Non-subsidized</b>	<b>Mean difference test</b>
	<i>Mean</i>	<i>Mean</i>	<i>t-statistic</i>
Age	18.6	8.1	11.1***
Sales <sup>a</sup>	8,946	3,900	10.3***
Value added <sup>a</sup>	2,460	837	13.5***
Employees	55.3	31.1	4.4***
Total assets <sup>a</sup>	7,601	3,636	6.5***
EBITDA/sales	12.8	9.3	1.2
ROE	3.3	8.2	-2.3***
Tangible assets <sup>a</sup>	1,266	1,012	0.5
Intangible assets <sup>a</sup>	173.5	45.5	3.1***
R&D intensity (%)	0.5	0.3	0.5
Wages <sup>a</sup>	1,087	679.6	5.7***
Patents	0.06	0.2	7.6***
Cash flow	485	181	6.4***

## Data after PSM (2)



	Round 2005		Round 2007	
	Subsidized firms	Difference from unsubsidized firms after matching	Subsidized firms	Difference from unsubsidized firms after matching
Indebtedness	5.4	1.0	11.1	0.1
Cash flow <sup>†</sup>	666.8	-22.2	333.1	28.9
Age	19.6	-0.6	17.2	0.4
Total assets <sup>†</sup>	9,824	-75.9	7,323	123.2
EBITDA/sales	9.3	1.1	15.6	-0.1
Return on equity (ROE)	3.4	-0.1	4.5	-0.1
Tangible assets <sup>†</sup>	1,369	0.05*	1,156	-0.01
Intangible assets <sup>†</sup>	167.5	0.01	179.2	-0.01
Wages <sup>†</sup>	1,369	-70.7	1,006	10.2
Patents	0.06	0.01	0.06	0.01
<sup>†</sup> Thousands of euros				

The financial **outcome variables** are:

## Total debt

- (1) Debt-to-Equity ratio
- (2) Tot. Debt (% change)
- (3) ST Debt (% change)
- (4) LT Debt (% change)
- (5) LT Debt / Tot. Debt
- (6) Cost of Debt

## Debt vs banks

- (1) Debt vs Banks / Tot. Debt
- (1) Total Debt vs Banks (% change)
- (2) ST Debt vs Banks (% change)
- (3) LT Debt vs Banks (% change)
- (4) LT Debt vs Banks / Tot. Debt vs Banks



R&D subsidies does not affect total debts, while it has three major advantages for subsidized firms

### Total debt

#### 1. Indebtedness:

- ✓ No statistical effects on total debts

#### 2. Short-term debt:

- ✓ Decreases in the short- and medium period

#### 3. Long-term debt:

- ✓ Increases in the short- and medium period
- ✓ The effect is stronger in the medium period and 2005 wave

#### 4. Cost of debt:

- ✓ Decreases in the short- and medium period
- ✓ The effect is stronger in the medium period and 2005 wave

### Debt vs banks

#### 1. Debt vs banks:

- ✓ Increases in the short- medium-term
- ✓ **Increases the incidence on total debts in the medium-term**

#### 2. Short-term debt:

- ✓ Increases in the short- and medium-term
- ✓ The effect is stronger for the 2005 wave

#### 3. Long-term debt:

- ✓ Increases in the short- and medium-term
- ✓ The effect is stronger in the medium-term and for the 2005 wave
- ✓ **Increases more than short-term debt especially in the medium-term**

In general, these effects hold in the short- and medium-term. In some cases, they are stronger in the medium-term, providing support to the certification hypothesis



- ✓ **PSM:** we replicate our analysis by using the **nearest-neighbor matching algorithm**, (instead of Kernel) where each subsidized firm is matched to 5 comparable non-subsidized firms with the closest PS
  - lower statistical significance (2007 wave) but the **main findings are confirmed**
- ✓ **DID:** we test the **parallel-trend assumption** comparing changes in outcomes for the two groups two years before the program. (Gertler et al. 2011).
  - we find similar outcome confirming the plausibility of the assumption



- ✓ We analyze the effects of a regional R&D subsidy program for SMEs in term of:
  - (1) debt financing (Tot Debt & Debt vs Banks) in the Short- & Medium-Term
  - (2) cost of debt
- ✓ Our results suggest that the public intervention based on monetary subsidies has a beneficial effect on firms' financial variables which are consistent with the **Certification hypothesis** provided by the public agency managing the intervention
- ✓ Supporting SMEs through R&D subsidies may help them to overcome financial constraints.
- ✓ The design of the program is relevant



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**THANK YOU!**

<u>Total debt</u>		Round 2005	Round 2007
<i>Debt-equity ratio</i>			
Short-term average effect		-0.591 (0.549)	-0.322 (0.575)
Medium-term average effect		-0.192 (0.476)	-0.652 (0.530)
<i>Long-term debt over total debt</i>			
Short-term average effect		0.020** (0.009)	0.010 (0.007)
Medium-term average effect		0.036*** (0.008)	0.015** (0.007)
<i>Change in short-term debt (%)</i>			
Short-term average effect		-0.041* (0.022)	-0.030* (0.018)
Medium-term average effect		-0.014 (0.023)	-0.038** (0.016)
<i>Change in long-term debt (%)</i>			
Short-term average effect		0.131 (0.087)	0.329*** (0.100)
Medium-term average effect		0.187** (0.083)	0.379*** (0.086)
<i>Borrowing cost</i>			
Short-term average effect		-0.145* (0.079)	0.056 (0.037)
Medium-term average effect		-0.169** (0.073)	-0.098*** (0.034)

<u>Debt vs banks</u>	Round 2005	Round 2007
<i>Debt vs banks over total debt</i>		
Short-term average effect	0.011 (0.021)	0.008 (0.022)
Medium-term average effect	0.041* (0.021)	0.034* (0.020)
<i>Long-term debt vs banks over total debt vs banks</i>		
Short-term average effect	0.056* (0.032)	0.007 (0.021)
Medium-term average effect	0.107*** (0.029)	0.058** (0.028)
<i>Change in total debt vs banks (%)</i>		
Short-term average effect	0.581*** (0.205)	0.238* (0.134)
Medium-term average effect	0.443** (0.180)	0.087 (0.107)
<i>Change in short-term debt vs banks (%)</i>		
Short-term average effect	0.430** (0.217)	0.221 (0.181)
Medium-term average effect	0.381** (0.194)	0.080 (0.256)
<i>Change in long-term debt vs banks (%)</i>		
Short-term average effect	0.275** (0.135)	0.422** (0.200)
Medium-term average effect	0.204 (0.287)	0.203** (0.098)

## The program (3)



### Descriptive statistics of the regional program (two rounds, mln of Euro)

	<b>2005</b>	<b>2007</b>
<b>Total amount of grants</b>	<b>15.3</b>	<b>28.4</b>
<b>Projects funded</b>	<b>103</b>	<b>179</b>
<b>Projects approved but not funded</b>	<b>0</b>	<b>0</b>
<b>Projects not approved</b>	<b>90</b>	<b>69</b>
<b>Admissible amount of projects</b>		
<b>Min.</b>	<b>0.1</b>	<b>0.2</b>
<b>Max.</b>	<b>1</b>	<b>2</b>
<b>Average amount of funded projects</b>	<b>0.185</b>	<b>0.212</b>