Unlocking Growth? European Investment Programs and Firm Performance

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Disclaimer: The views expressed are those of the authors and do not necessarily reflect those of the ECB.

Introduction

Orbis

Cohesion

Merging

Results

Heterogeneity

Conclusion

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Growing debate on causes of sluggish productivity growth in the EU and how public investments can address this challenge Draghi (2024).

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This project: empirically assesses the impact of EU's Cohesion policy as an investment programme on firm productivity.

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  2. What are the effects of receiving funding on firm performance?
- **Method:** empirical study using firm-level data matched with project-level data.
- **Results:**
  1. the funding is allocated to growing and under-capitalised firms,
  2. firms that receive funding see their productivity steadily increase up to 3% over a four year horizon,
  3. productivity gains are larger for smaller and more financially constrained firms,
  4. funding given for "SME investment" improves firm performance more than funding for "Green transition".

Literature Review

EU-wide studies using firm data

- Bachtrögler and Hammer (2018) study effects of cohesion funds (2007-2013 programming period) on manufacturing firms finding positive effects on employment and capital, but little evidence of positive TFP effects.

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EU-wide studies using regional data

- Finding positive effects on output, investment and labour productivity: **DesantisVinci**; Durand and Espinoza (2021); Fiuratti et al. (2023); Canova and Pappa (2021).

Data

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2. Cohesion fund data - project-level data on Cohesion Funds for the 2014-2020 programming period for the 27 EU member states.
3. Eurostat - aggregate variables at sectoral (NACE) and regional (NUTS) level.

Orbis coverage across EU27 member states

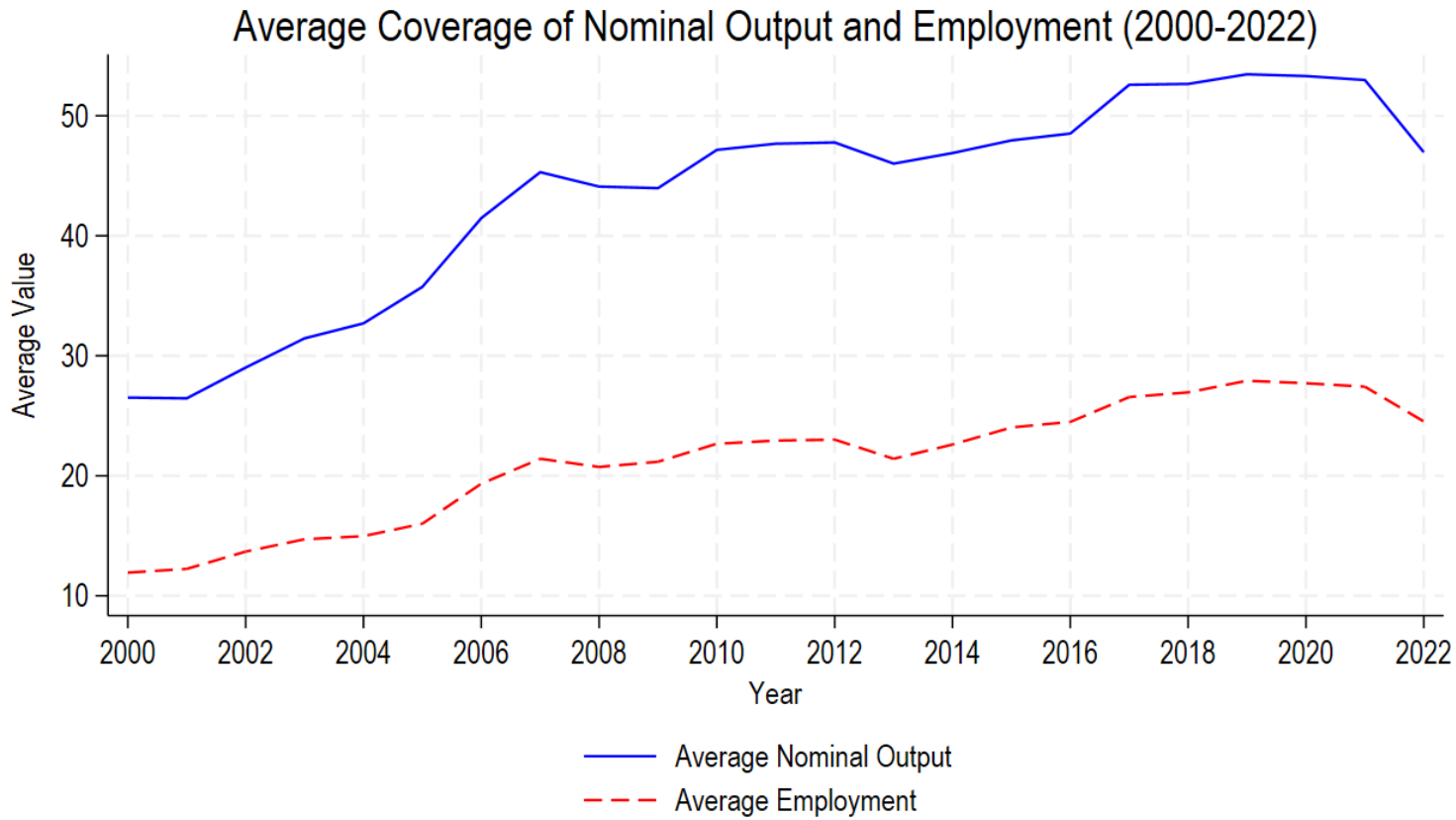

Figure 1: Coverage over time averaged across the EU27 countries in our cleaned Orbis sample. Coverage of X% means that we have firm level data for firms accounting for X% of the national total from Eurostat.

Orbis coverage over time

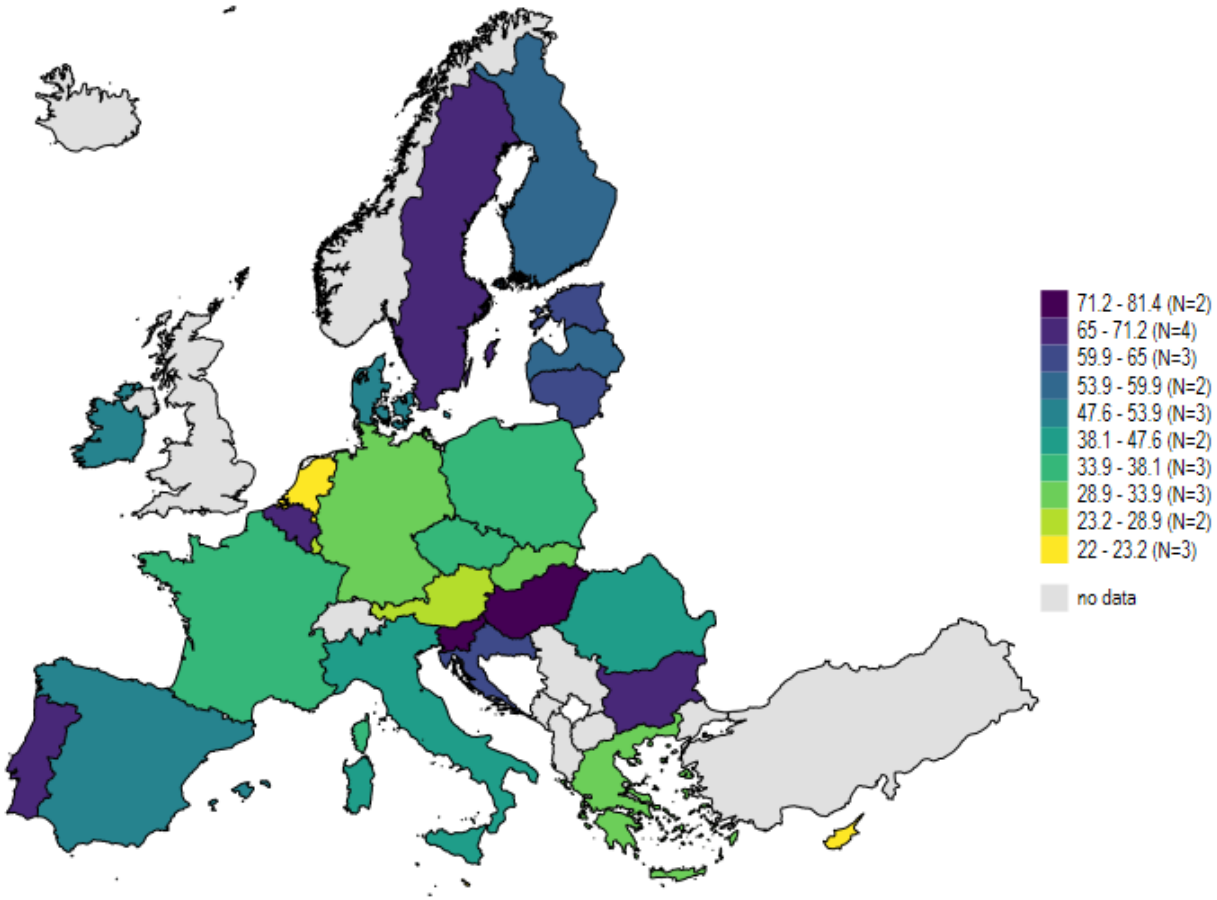

Figure 2: Average Gross Output coverage over the period 2010-2022 in our cleaned Orbis sample

Estimating firms' Total Factor Productivity (TFP)

Logarithm of the Cobb-Douglas production function:

$$y_{i,t} = \alpha + \beta_l l_{i,t} + \beta_k k_{i,t} + \beta_m m_{i,t} + \omega_{i,t} + \epsilon_{i,t}$$

- $y_{i,t}$ is (log) value added,
- $l_{i,t}$ is (log) employment,
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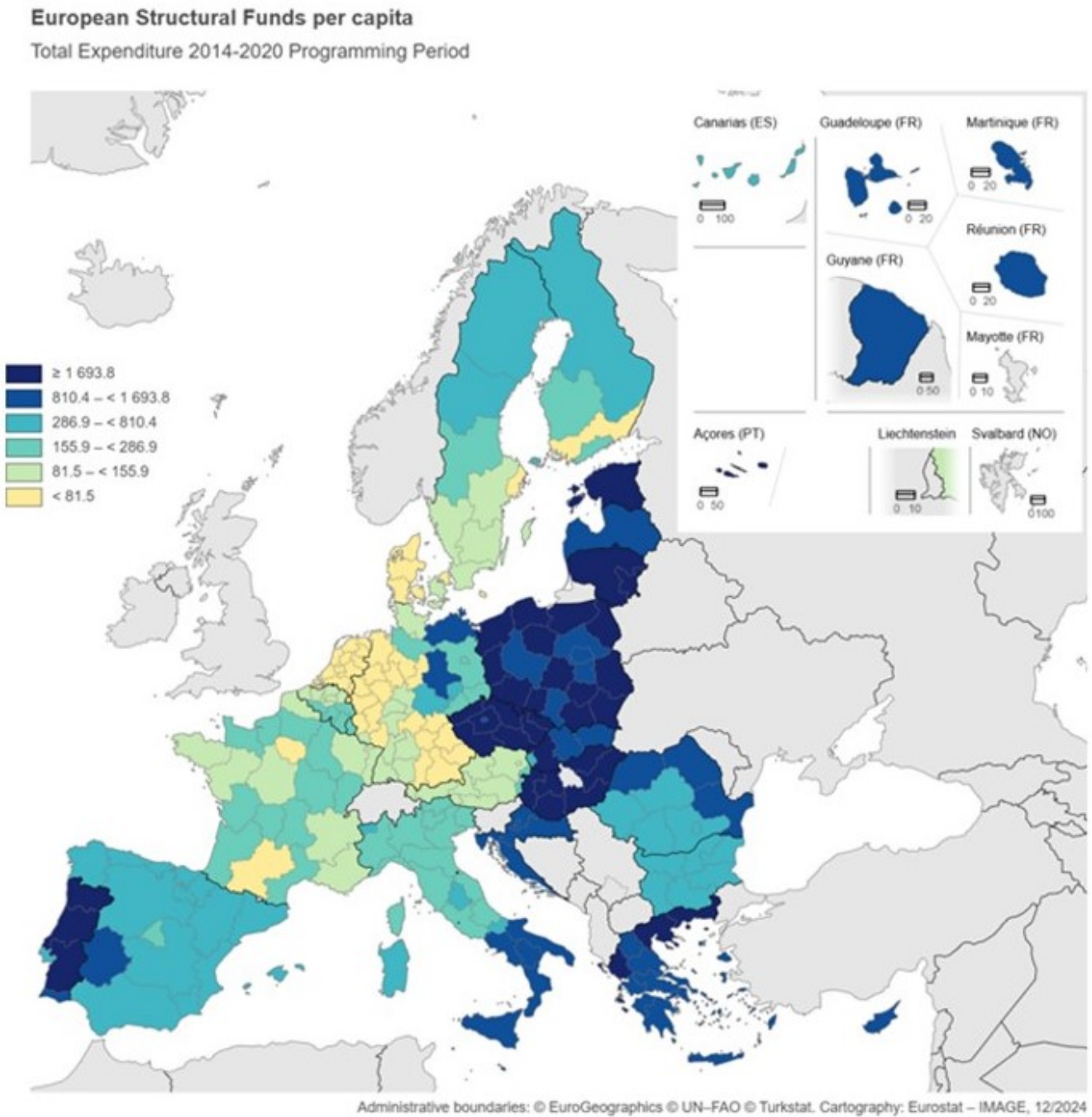
We estimate productivity functions separately for each country sector pair (sectors at NACE 2-digit level).

Cohesion policy per capita expenditure



Application process from firm's perspective

Identify funding opportunities

- Calls posted on EU Funding & Tenders Portal or national/regional portals.

Check eligibility

- Ensure alignment with EU priorities.
- Verify co-financing capacity (typically 15–50%).

Prepare and submit application

- Project proposal, budget, impact assessments, and legal/financial documents.

Evaluation & decision

- Evaluated by Managing Authorities.

Implementation & reporting

- Comply with EU reporting standards and audits.

Decision-makers and evaluation criteria

- **Who decides?**
  - **EU Programmes**: European Commission panels and external experts.
  - **Regional Funds**: National/regional Managing Authorities.
- **Evaluation criteria**
  - Alignment with EU priorities (e.g., climate action, digitalization).
  - Innovation, feasibility, and scalability.
  - Economic, social, or environmental impact.
  - Cost-effectiveness and sustainability.

Merging Orbis with Cohesion

Name matching algorithm:

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Outcome: 730k unique beneficiary names, 90k valid matches, 70k excluded matches. €16 billion of cohesion funding matched to firms (34% of the €47 billion directly allocated to firms).

Firms' Cohesion projects

	mean	p25	p50	p75	std dev
Total funds awarded	176,924	3,750	12,499	60,375	2,399,000
Total project size	319,805	6,545	18,190	103,306	3,195,000
Co-finance rate	0.75	0.50	0.80	1.00	0.23
Funds awarded / Assets	0.11	0.01	0.04	0.13	0.21
Funds awarded / Sales	0.44	0.01	0.04	0.12	10.88
Project size / Assets	0.17	0.01	0.05	0.18	0.33
Project size / Sales	0.65	0.01	0.05	0.16	16.01
Active projects	1.25	1	1	1.125	7.39
Years with projects data	2.13	1	2	3	1.53

Table 1: Based on 90k firms that were successfully matched to cohesion projects. Monetary values are in 2015 EUR. Funds are total amounts received by firm during our sample period. Assets and sales (annual) are average values.

More Stats

Matched projects' descriptions

Figure 3: Word cloud of projects descriptions - matched firms.

In which sectors did recipient firms operate?

	Non-recipient firms	Recipient firms
Non-manufacturing	3,416,714	47,528
	86.6%	74.2%
Low-technology	243,467	7,118
	6.2%	11.1%
Medium-low-technology	198,238	5,588
	5.0%	8.7%
Medium-high-technology	71,651	3,233
	1.8%	5.1%
High-technology	13,355	613
	0.3%	1.0%
Total	3,943,425	64,080

Table 2: Using Eurostat's "High-tech classification of manufacturing industries" and data on firms' NACE 2-digit sector. Classification

Which firms receive funding?

Binary outcome variable model:

$$\texttt{logit}[P(Y_i = 1 \mid \bar{X}_i')] = \beta_0 + \sum_{j \in J} \beta_j \bar{X}_{i,j} + \gamma_s + \delta_c$$

- $Y_i = 1$ if firm i received funding, 0 otherwise,
- $\bar{X}_{i,j}$ are firm-level variables averaged over 2010-2013,
- γ_s and δ_c are sector and country intercepts.
- Odds Ratio$_j = e^{\beta_j}$:
  - if equal to 0.5 $\longrightarrow$ probability halves for 1 unit increase in $\bar{X}_j$,
  - if equal to 2 $\longrightarrow$ probability doubles for 1 unit increase in $\bar{X}_j$.

Which firms receive funding?

	(1)	(2)	(3)	(4)	(5)	(6)
Assets	1.65***	1.65***	1.65***	1.64***	1.65***	1.64***
Capital/Labour	0.76***	0.77***	0.64***	0.65***	0.50***	0.52***
Sales growth	1.19***	1.19***	1.20***	1.19***	1.15***	1.15***
Age	1.05*	1.05*	1.05**	1.05**	1.04*	1.03*
Leverage ratio			1.29***	1.29***	1.27***	1.27***
Current ratio			0.53	0.55	0.44	0.45
Sales/Assets					0.80***	0.78***
TFP growth					1.02***	1.02**
Employment growth					1.08***	1.08***
Capital growth					1.07***	1.08***
Intangible intensity					0.68***	0.67***
Observations	1,568,454	1,568,228	1,379,406	1,379,230	1,379,108	1,378,932
Sector dummies	Letter	2 digit	Letter	2 digit	Letter	2 digit
NUTS2 dummies	YES	YES	YES	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Reported coefficients are odds ratios (values > 1 mean positive effect, values < 1 mean negative effect on probability of receiving funds). Variables are Z-score normalized. Robust standard errors were clustered by NUTS2 region.

Which firms receive funding?

Conditional on sector and region, firms are more likely to have received funding under cohesion policy if they were:

1. larger,
2. growing,
3. less capital intensive,
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$\Rightarrow$ These structural differences make not-yet-treated firms the most appropriate control group.

Effects of funding on firm performance

LP-DiD model of Dube et al. (2023). For each $h = 0, \ldots, H$ estimate:

$$y_{i,t+h} - y_{i,t-1} = \beta_0^h + \beta^h \Delta D_{i,t} + \gamma_1^h X_{i,t-1} + \gamma_2^h X_{i,t-2} + \tau_t^h + \gamma_s^h + \delta_c^h + \varepsilon_{i,t}^h$$

- $y_{i,t+h} - y_{i,t-1}$ is cumulative growth in the outcome variable,
- $X_{i,t}$ are firm-level controls,
- τ_t^h, γ_s^h, δ_c^h are time, NACE 1 digit sector, country fixed effects.
- β^h captures the difference in cumulative outcomes (at the h horizon) between firms that were:
  - Not-yet (but eventually) treated, i.e. $\Delta D_{i,t+h} = 0$ and $D_{i,T} = 1$,
  - Treated at t, i.e. $\Delta D_{i,t} = 1$.

Controls Assumptions

Effects of funding on firm performance **Capital**

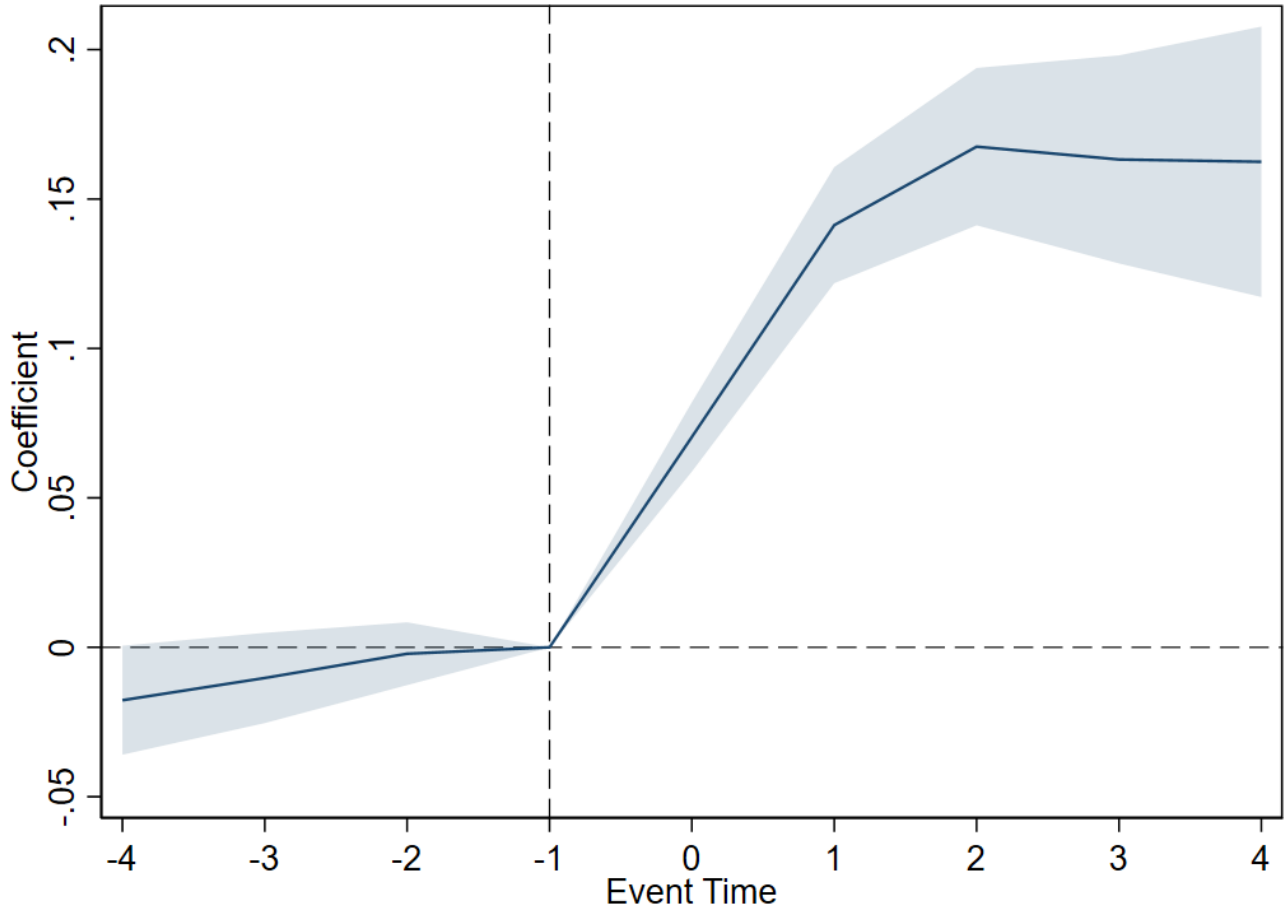


Figure 4: Cumulative effect on firm **Capital** with 99% Confidence Interval (SEs clustered at firm level). Coefficient of 0.01 means 1% growth effect. Time in years relative to when firm first received funding.

Effects of funding on firm performance **Intangible Intensity**

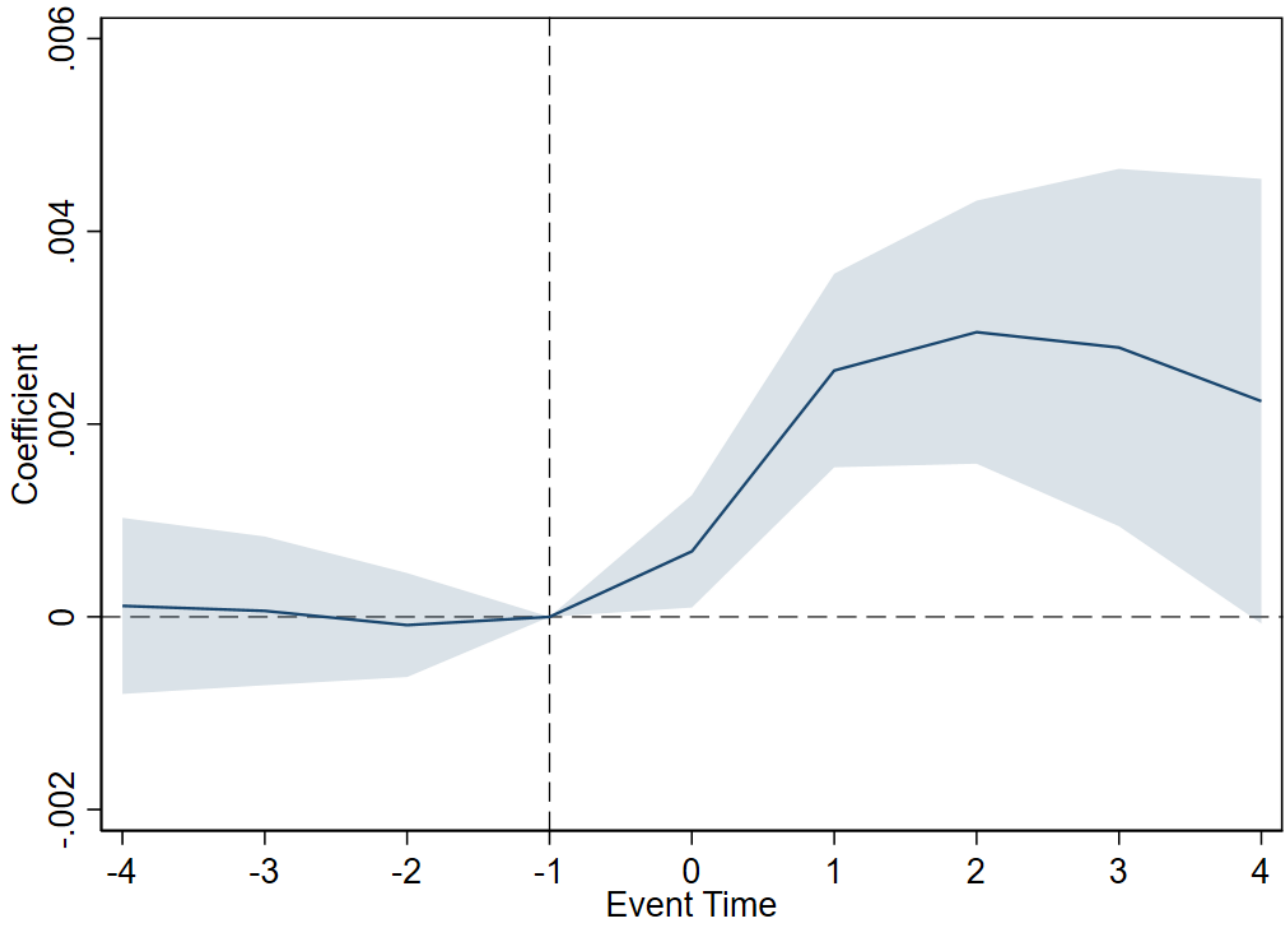


Figure 5: Cumulative effect on firm **Intangible Intensity** with 99% Confidence Interval (SEs clustered at firm level). Time in years relative to when firm first received funding.

Effects of funding on firm performance **TFP**

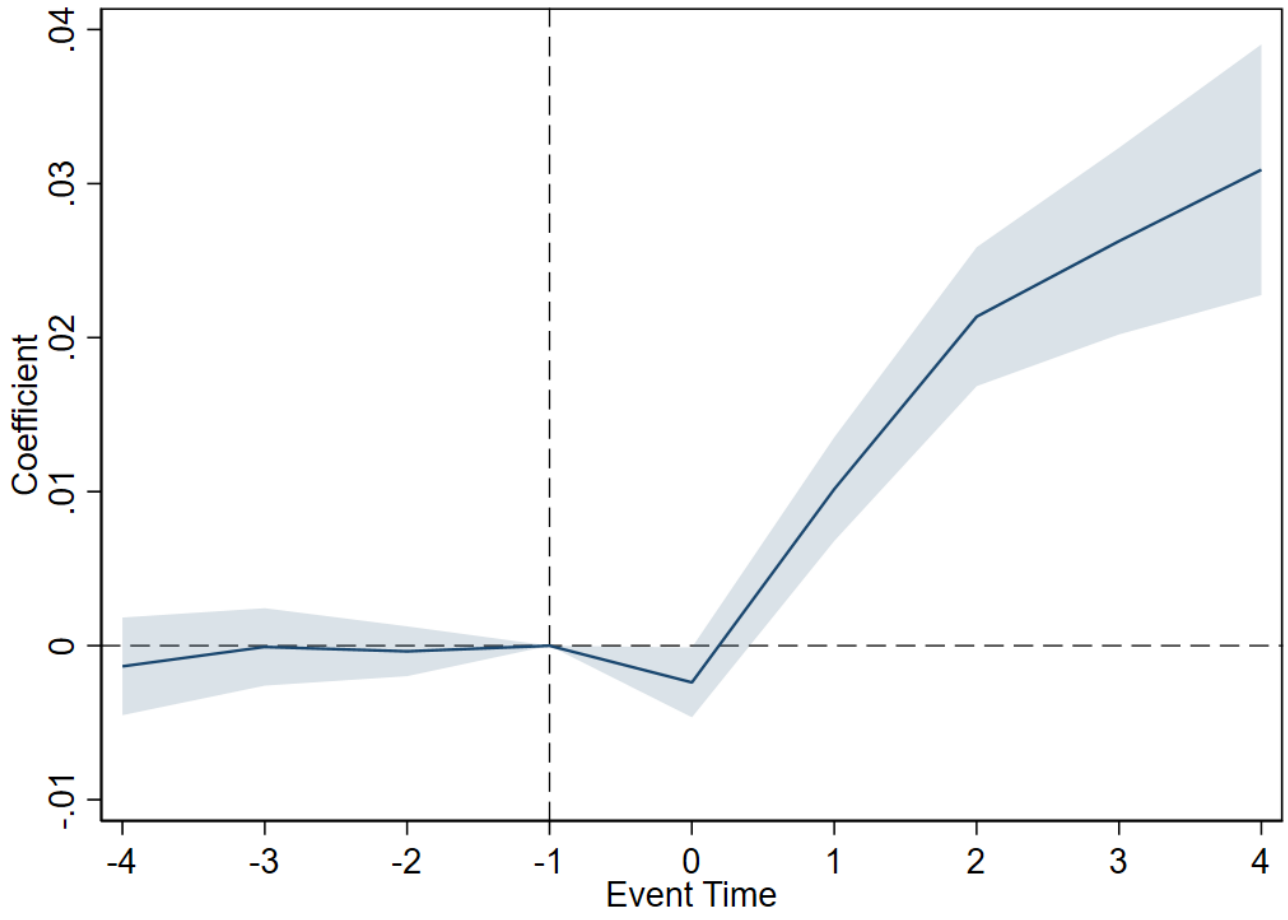


Figure 6: Cumulative effect on firm **TFP** with 99% Confidence Interval (SEs clustered at firm level). Coefficient of 0.01 means 1% growth effect. Time in years relative to when firm first received funding.

Effects of funding on firm performance **Leverage**

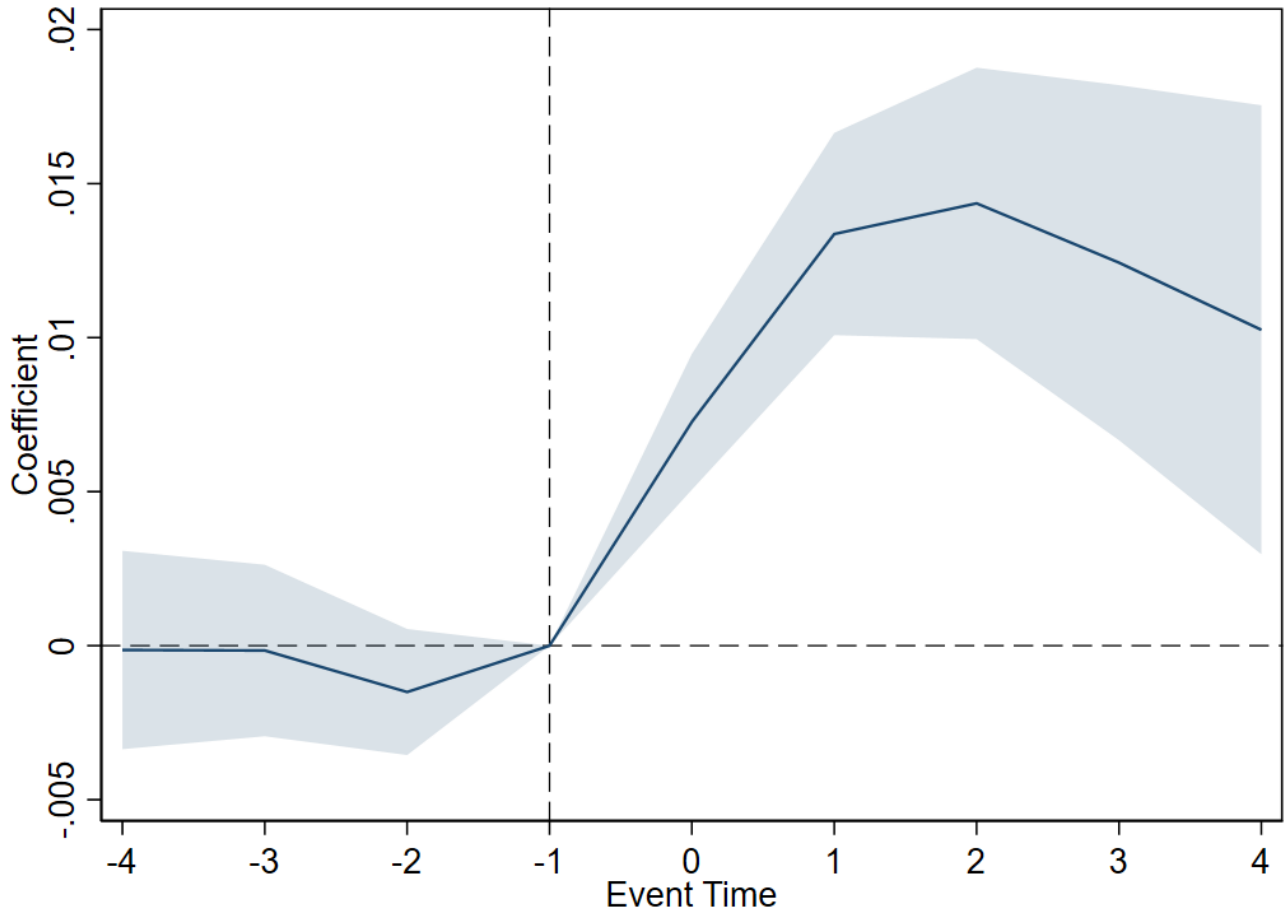


Figure 7: Cumulative effect on firm **Leverage Ratio** with 99% Confidence Interval (SEs clustered at firm level). Time in years relative to when firm first received funding.

Robustness

We verify that our main results are not affected by the following changes in our empirical method:

- using Lasso to select the variables that predict firms receiving EU funding, details
- no additional sample restrictions (we keep firms with poor coverage and firms that first received Cohesion funding late in the sample), details
- including more Fixed Effects (we interact region x sector fixed effects), removing region and sectors Fixed Effects, details
- adding more firm level time varying controls. details

Heterogeneity Analysis

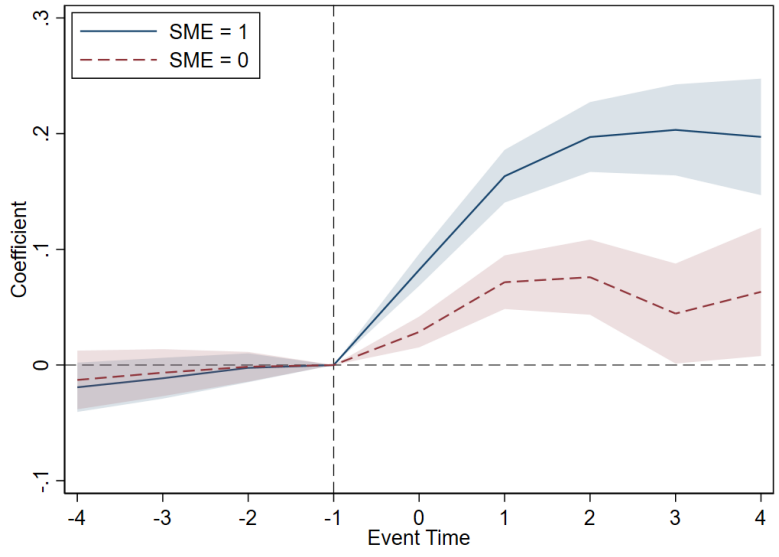
We study how the effects of receiving funding differ depending on:

- Recipient firm characteristics:
  - small firms (< 50 employees),
  - financially constrained firms (young high leverage firms).
- Policy priority behind the funding awarded:
  - SME investment,
  - Green transition.

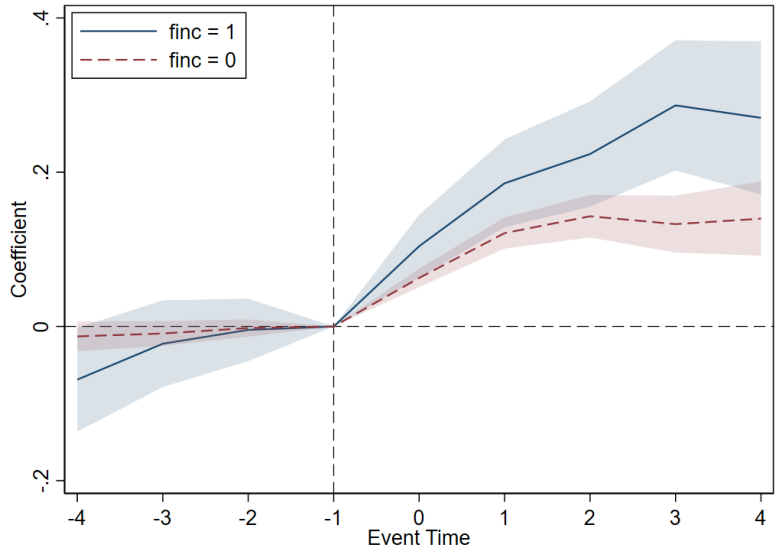
Our regression equation becomes:

$$y_{i,t+h} - y_{i,t-1} =$$
$$(1+\tau^h B_{i,t})*(\beta_0^h+\beta^h \Delta D_{i,t}+\gamma_1^h X_{i,t-1}+\gamma_2^h X_{i,t-2})+\tau_t^h+\gamma_s^h+\delta_c^h+e_{i,t}^h$$

Heterogeneity Analysis **Capital**



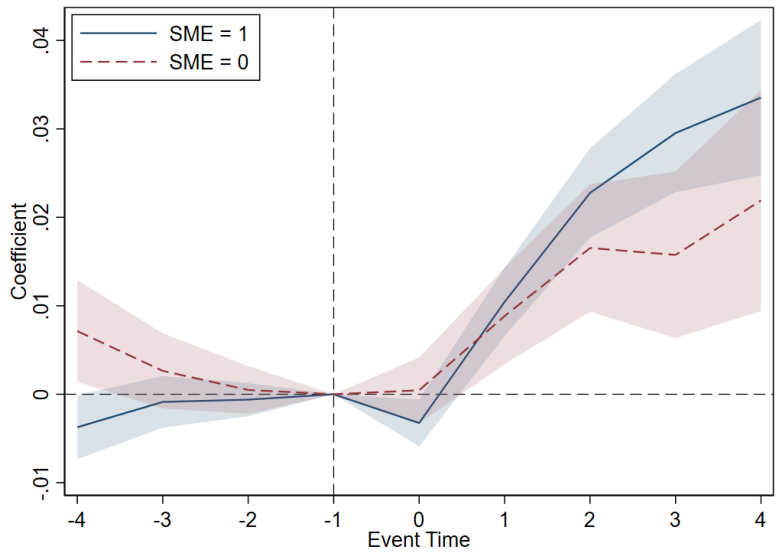
(a) Size



(b) Fin. Const.

Figure 8: Cumulative effect on firm **Capital** with 99% Confidence Interval (SEs clustered at firm level). Coefficient of 0.01 means 1% growth effect. Time in years relative to when firm first received funding.

Heterogeneity by firm characteristics **TFP**



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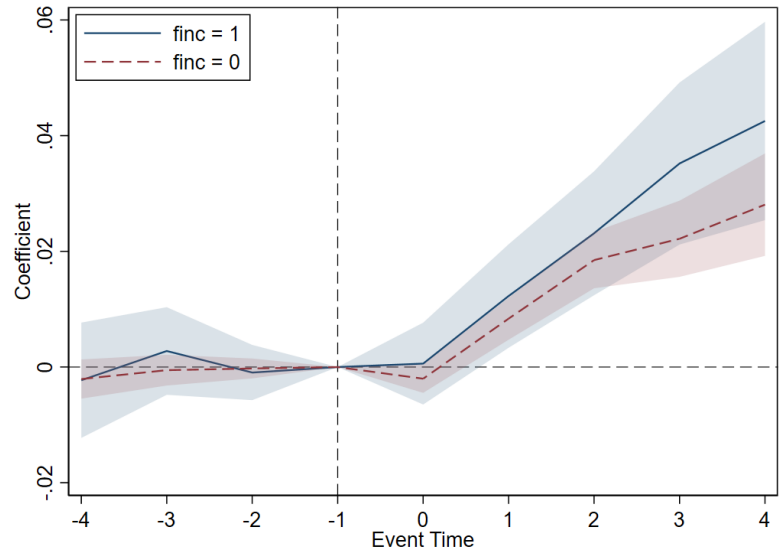

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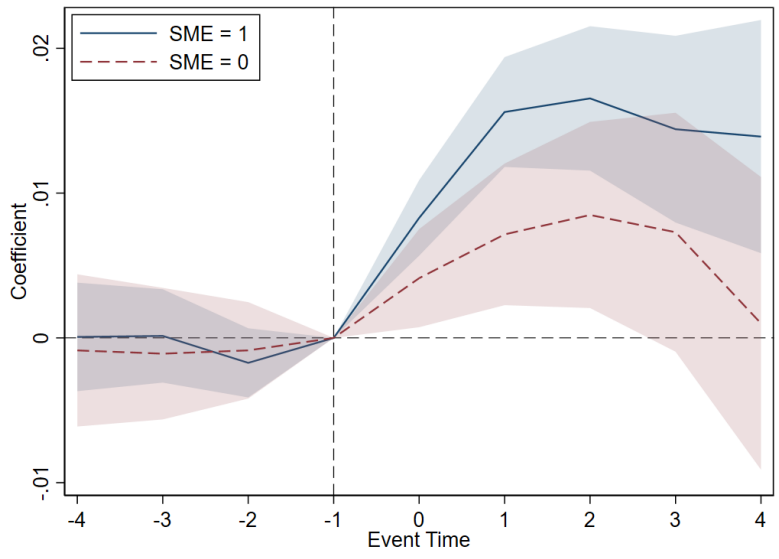
Figure 9: Cumulative effect on firm **TFP** with 99% Confidence Interval (SEs clustered at firm level). Coefficient of 0.01 means 1% growth effect. Time in years relative to when firm first received funding.

Heterogeneity by firm characteristics **Leverage**



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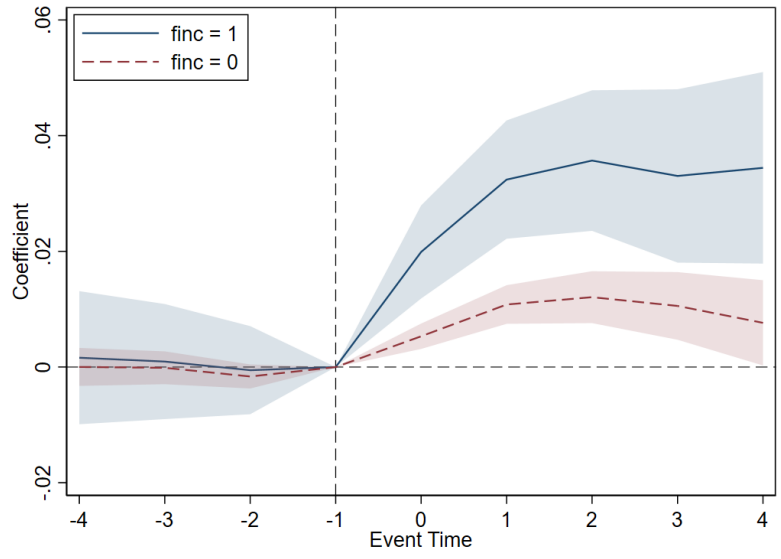
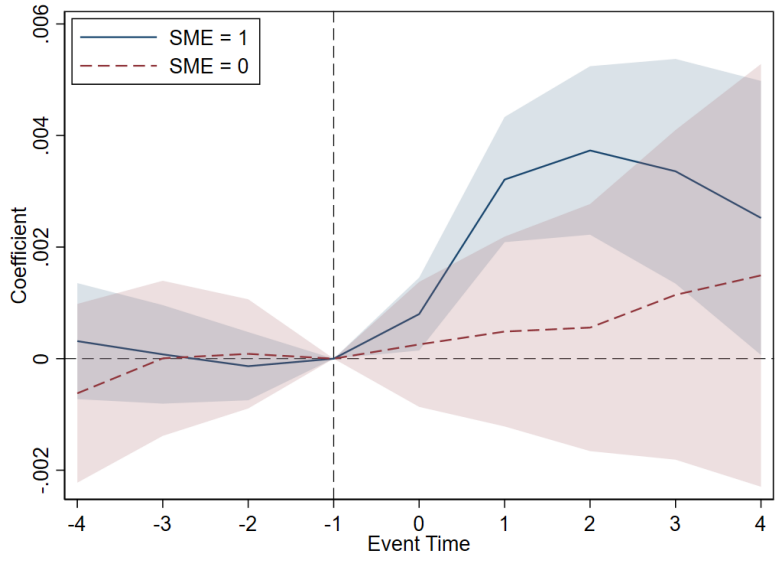


(b) Fin. Const.

Figure 10: Cumulative effect on firm **Leverage Ratio** with 99% Confidence Interval (SEs clustered at firm level). Time in years relative to when firm first received funding.

Heterogeneity by firm characteristics **Intangible Intensity**



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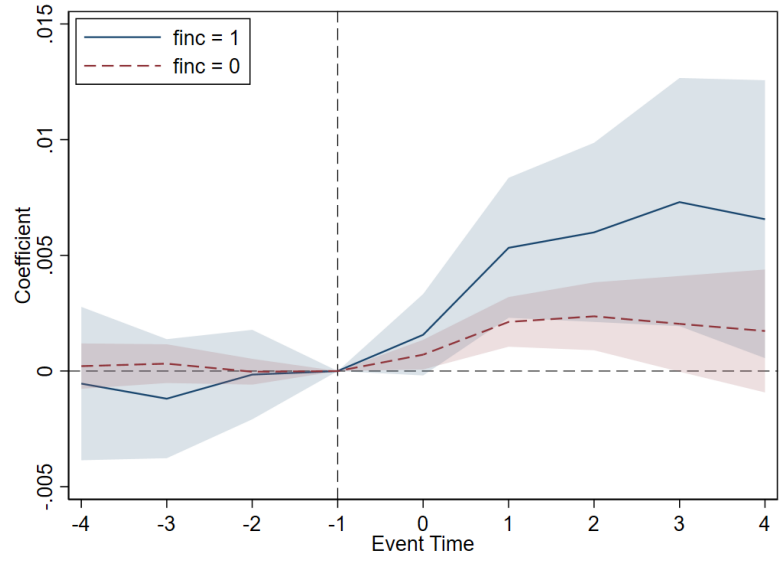


(b) Fin. Const.

Figure 11: Cumulative effect on firm **Intangible Intensity** with 99% Confidence Interval (SEs clustered at firm level). Time in years relative to when firm first received funding.

Project descriptions by funding category

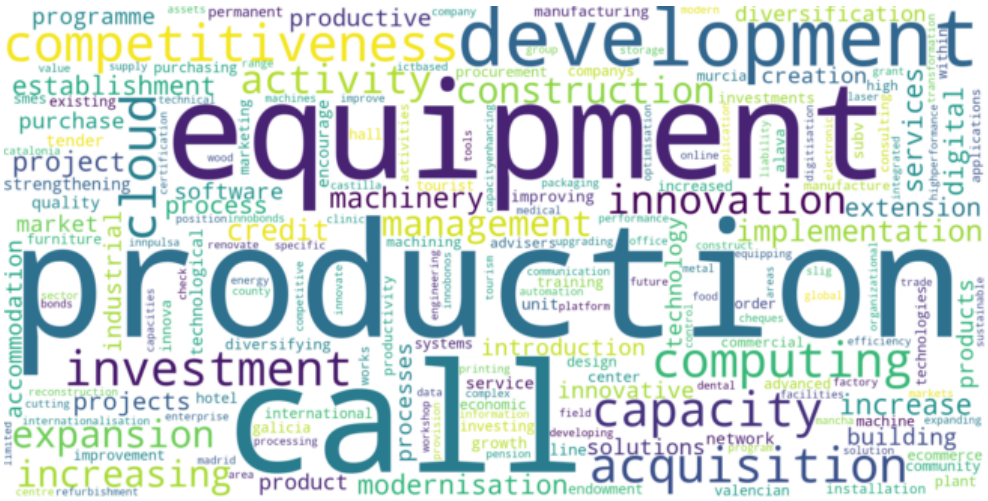


Figure 12: SME investment

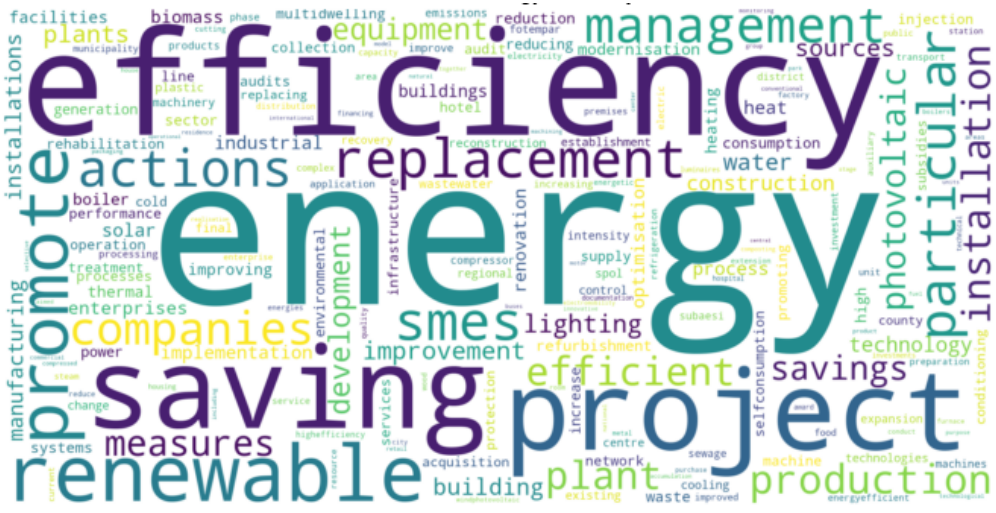
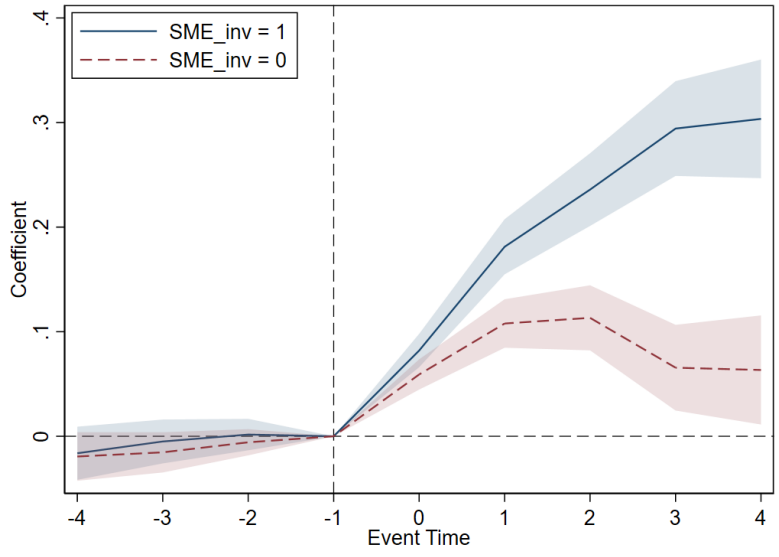
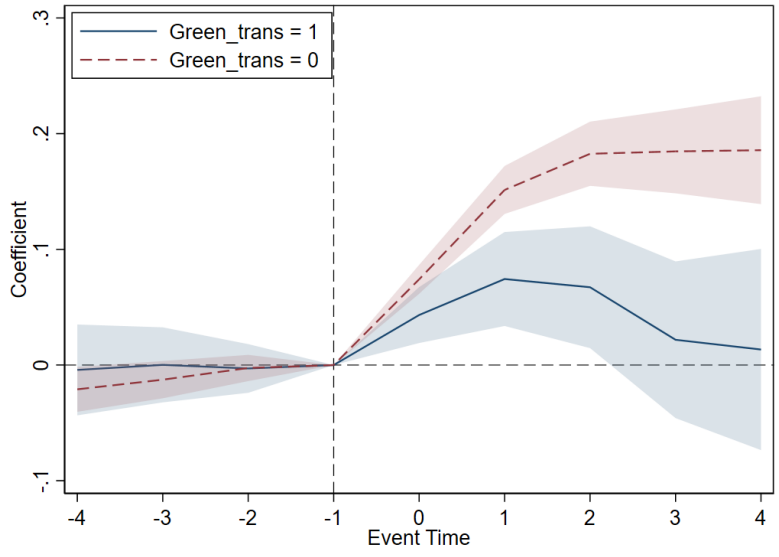


Figure 13: Green transition

Heterogeneity by funding category **Capital**



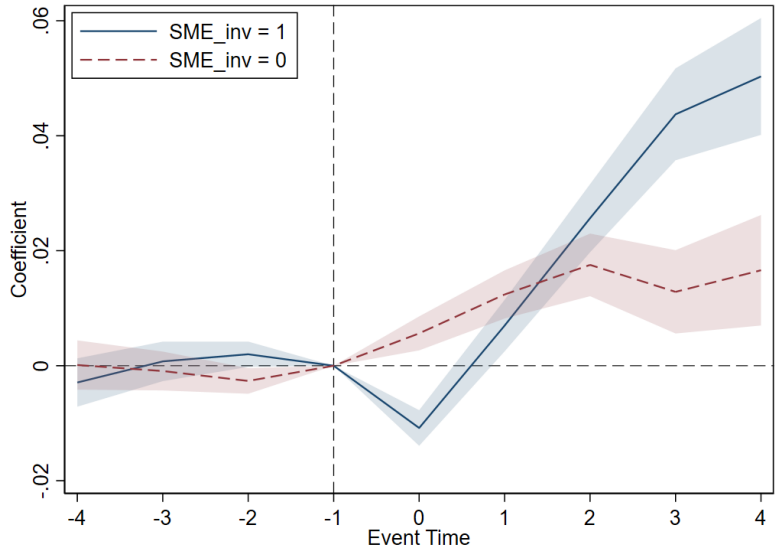
(a) SME investment



(b) Green transition

Figure 14: Cumulative effect on firm **Capital** with 99% Confidence Interval (SEs clustered at firm level). Coefficient of 0.01 means 1% growth effect. Time in years relative to when firm first received funding.

Heterogeneity by funding category **TFP**



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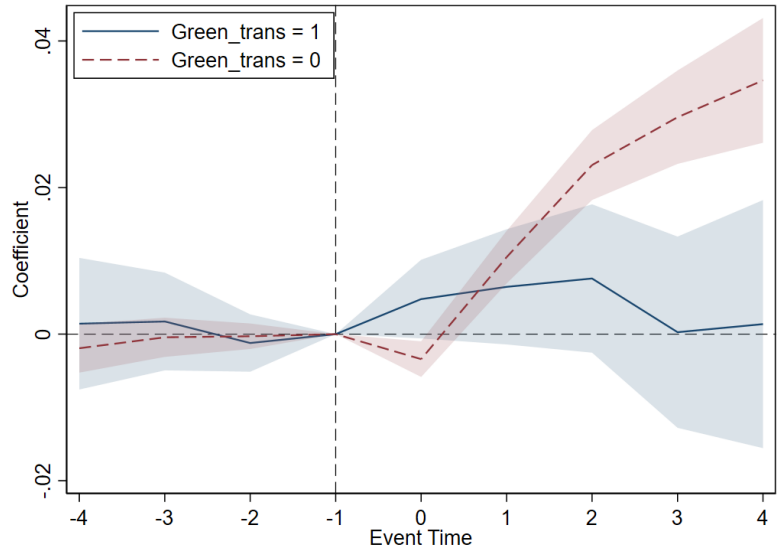
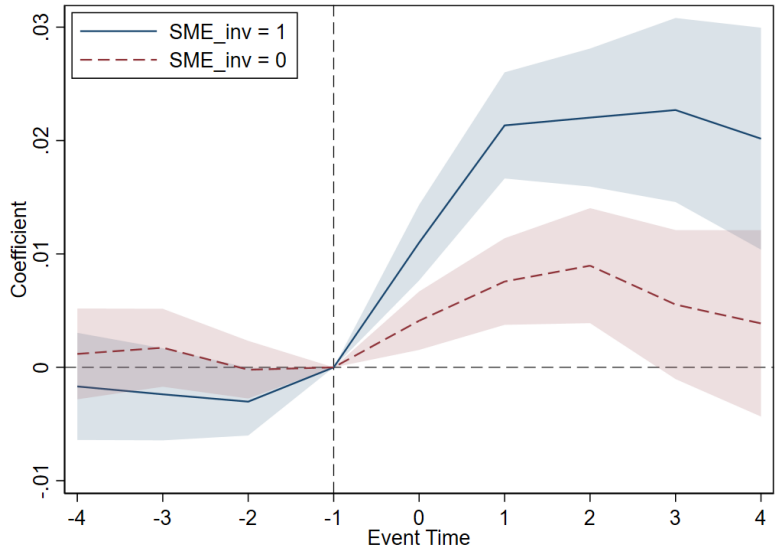


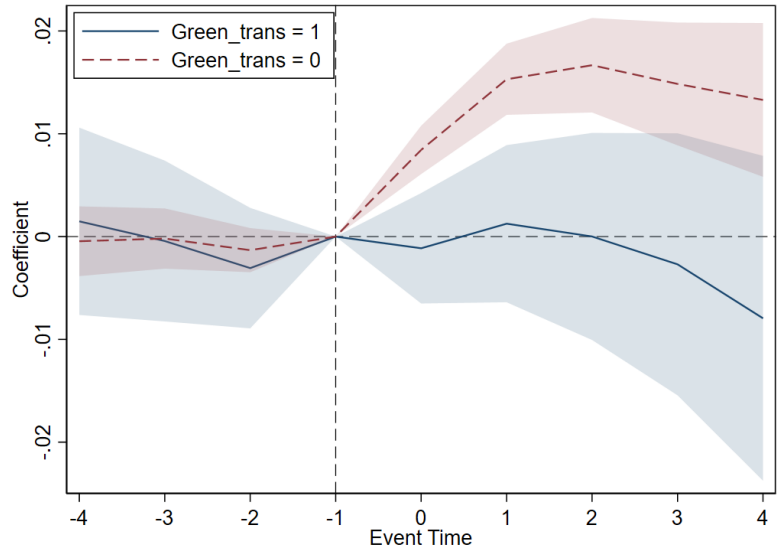
(b) Green transition

Figure 15: Cumulative effect on firm **TFP** with 99% Confidence Interval (SEs clustered at firm level). Coefficient of 0.01 means 1% growth effect. Time in years relative to when firm first received funding.

Heterogeneity by funding category **Leverage**



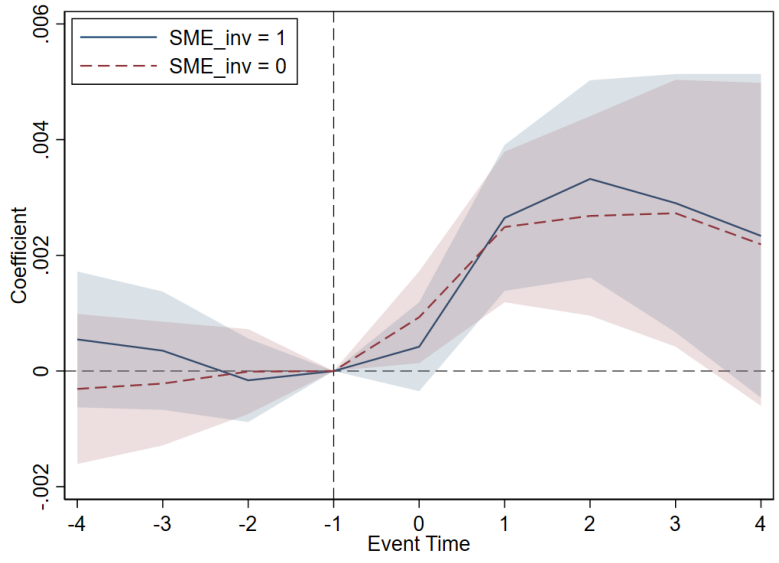
(a) SME investment



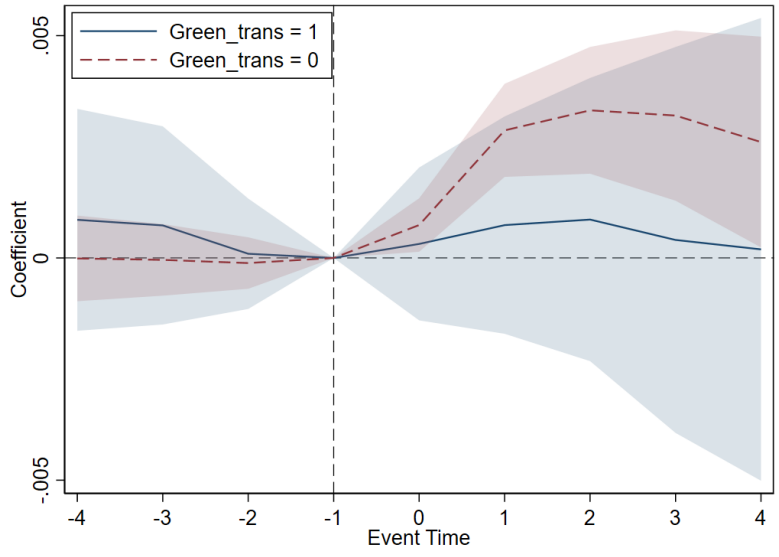
(b) Green transition

Figure 16: Cumulative effect on firm **Leverage Ratio** with 99% Confidence Interval (SEs clustered at firm level). Time in years relative to when firm first received funding.

Heterogeneity by funding category **Intangible Intensity**



(a) SME investment



(b) Green transition

Figure 17: Cumulative effect on firm **Intangible Intensity** with 99% Confidence Interval (SEs clustered at firm level). Time in years relative to when firm first received funding.

Conclusion & Next Steps

Summary:

- Cohesion policy funding went to firms that were expanding but undercapitalised.

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- Firms that received funding boosted their investment and saw a persistent increase in productivity.
- The size of the effects varies depending on firm characteristics as well as policy priorities behind the awarded funding.

Next steps:

- Estimate "multipliers" to quantify the effects of each EUR spent.

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Orbis Cleaning Steps

- Drop firms with negative age, liabilities assets, employment, sales, or $>$ 2M employees.
- Drop firm-years with missing/zero/negative values for key financials.
- Drop firms without a NACE code.
- Filter top/bottom 0.1% based on key financial ratios.
- Drop extreme or inconsistent values in financial statements.
- Apply growth filters for employment, sales, and revenue based on firm size.
- Exclude sectors A,T and U (agriculture, household & extraterritorial activities).
- Deflate all monetary variables using country specific GDP deflators (with base year 2015).

Go Back

Total Factor Productivity Estimation

- We begin with log-linear Cobb-Douglas production function:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + \omega_{it} + \varepsilon_{it},$$

  where: y_{it}, k_{it}, l_{it}, m_{it} are log values of capital, labour, and materials, ω_{it} is unobserved productivity (TFP), and ε_{it} is i.i.d. measurement error.
- We assume material input is chosen as a function of capital and unobserved productivity: $m_{it} = f\big(k_{it}, \omega_{it}\big)$, with f strictly monotonic in ω_{it}.
- This allows inversion: $\omega_{it} = h\big(k_{it}, m_{it}\big)$.
- Substituting the control function into the production function, we write:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \beta_m m_{it} + h\big(k_{it}, m_{it}\big) + \varepsilon_{it}.$$

Summary statistics for matched and unmatched firms

	Control Group			Treatment Group		
	mean	median	obs	mean	median	obs
revenue	5,953,601	306,186	27,280,366	13,221,530	771,970	740,843
sales	5,657,518	297,390	26,758,172	12,650,531	734,950	736,961
totalassets	8,201,400	281,042	27,280,366	17,770,130	694,215	740,843
capital_labour_ratio	90,655	7,527	26,109,180	53,421	14,227	738,464
numberofemployees	25.4	4	27,280,366	60.3	9	740,843
producitivity_growth	0.7%	0.1%	13,112,474	1%	1%	473,910
employment_growth	1.6%	0.0%	19,240,478	4%	0%	616,499
sales_growth	1.4%	1.0%	19,504,156	5%	4%	614,524
profit_margin	33.4%	57.6%	12,292,197	53%	54%	493,446
capital_growth	-0.9%	-7.2%	18,906,352	5%	-5%	603,926
debt_equity_ratio	0.11	0.00	19,940,642	0.18	0.11	573,387
sales_assets_ratio	1.68	1.25	26,758,172	1.43	1.13	736,961
leverage_ratio	0.11	0.00	19,940,804	0.18	0.11	573,389
intangible_intensity	0.03	0.00	27,028,142	0.03	0.00	739,376
equity_to_assets_ratio	0.45	0.43	27,257,884	0.43	0.40	740,839
current_ratio	122.7	1.7	26,923,680	11.4	1.7	732,842

Table 4: Monetary variables are expressed in 2015 EUR. Growth rates are annual log growth rates, i.e. $ln(Y_t) - ln(Y_{t-1})$. Treatment group are firms that received cohesion funding. Summary statistics based on the entire sample period 2010-2022. Go Back

Eurostat's High-tech classification of manufacturing industries by NACE 2 digit sectors I

High-Technology

- Basic pharmaceutical products and preparations (21)
- Computer, electronic and optical products (26)

Medium-High-Technology

- Chemicals and chemical products (20)
- Electrical equipment (27)
- Machinery and equipment n.e.c. (28)
- Motor vehicles, trailers and semi-trailers (29)
- Other transport equipment (30)

Medium-Low-Technology

- Coke and refined petroleum products (19)
- Rubber and plastic products (22)
- Other non-metallic mineral products (23)
- Basic metals (24)
- Fabricated metal products (25)
- Repair and installation of machinery and equipment (33)

Eurostat's High-tech classification of manufacturing industries by NACE 2 digit sectors II

Low-Technology

- Food products (10)
- Beverages (11)
- Tobacco products (12)
- Textiles (13)
- Wearing apparel (14)
- Leather and related products (15)
- Wood and products of wood and cork (16)
- Paper and paper products (17)
- Printing and reproduction of recorded media (18)
- Furniture (31)
- Other manufacturing (32)

Go Back

Assumptions

Assumption 1. Conditional no anticipation

$$E\left[Y_{it}(p) - Y_{it}(0) \mid W'_{i,t-1}\right] = 0, \quad \text{for all } p \text{ and } t \text{ such that } t < p.$$

Assumption 2. Conditional parallel trends

$$E\left[Y_{i,t+h}(0) - Y_{i,t-1}(0) \mid W'_{i,t-1}, p_i = p\right] =$$

$$E\left[Y_{i,t+h}(0) - Y_{i,t-1}(0) \mid W'_{i,t-1}\right],$$

for all $t \in \{2, \ldots, T\}$, all $h \in \{0, \ldots, T-1\}$, and all $p \in \{1, \ldots, T, \infty\}$.

Assumption 3. Linear conditional expectation function

$$E\left[Y_{i,t+h}(0) - Y_{i,t-1}(0) \mid W'_{i,t-1}\right] = \delta_t^h + W'_{i,t-1}\theta^h$$

Assumption 4. Treatment effects are independent of covariates

Go Back

Controls in the LP-DiD model

In addition to controling for time, country and sector (NACE letter) fixed effects we control for firms' age and the first lag of:

- age,
- total assets,
- sales growth,
- current ratio (current assets / current liabilites),
- sales to assets ratio,
- capital to labour ratio.

Go Back

Robustness - Lasso procedure

We includes more firm-level predictors $X_{i,j}$, but not all are selected.

$$\frac{1}{2n}\sum_{i=1}^{n}\left(Y_i - \beta_0 - \sum_{j\in J}\beta_j \bar{X}_{i,j} - \sum_{s\in S}\beta_s \mathbf{s}_{i,s} - \sum_{c\in C}\beta_c \mathbf{c}_{i,c}\right)^2 + \lambda\sum_{j=1}^{p}|\beta_j|$$

1. We evaluate models over 100 λ values, computing BIC for each model.
2. We select the λ that minimizes $\text{BIC} = -2\ln(\hat{L}) + p\ln(n)$.
3. We use the selected predictors $S \subset J$ in subsequent Logit model.

Go Back

	(1)	(2)	(3)
Labour	1.35***	1.44***	1.47***
Capital	1.27***	1.15**	1.16**
Value Added	1.09	0.97	0.97
Materials	1.06		
TFP growth	1.05***	1.04***	1.04***
Employment growth	1.09***	1.09***	1.09***
Capital growth	1.07***	1.07***	1.07***
Value Added growth	1.20***	1.19***	1.19***
Debt/Equity	0.60	0.69	1.53
Sales/Assets	0.63***	0.66***	0.67***
Leverage ratio	2.64	2.38	1.08
Intangible intensity	0.73***	0.72***	0.72***
Capital/Labour	0.76***	0.79***	0.78***
Equity/Assets	1.18***	1.18***	1.19***
Current ratio	0.73		
Age	1.00	0.99	0.99
<50 Employees	1.33***	1.39***	1.43***
Financially constrained	0.96**	0.96***	0.96
>p10 TFP	1.49***	1.52***	1.52***
>p10 Leverage ratio	2.63***	2.78***	2.70***
>p10 Current ratio	1.25***	1.27***	1.25***
>p50 TFP	1.35***	1.37***	1.35***
>p50 Leverage ratio	0.50***	0.47***	0.48***
>p50 Capital/Labour	0.85***		
>p50 Current ratio	0.93**	0.93*	0.93**
>p90 TFP	1.08**	1.10***	1.10***
>p90 Leverage ratio	0.45***	0.42***	0.43***
>p90 Current ratio	0.71***	0.70***	0.70***
>p90 Capital/Labour	0.78***	0.76***	0.77***
Less than 5 years old	0.96*	0.96**	0.97
Less than 10 years old	1.01	1.01	
Observations	1,382,291	1,382,114	1,380,609
Sector dummies	Letter	2 digit	3 digit
NUTS2 dummies	YES	YES	YES

*** p<0.01, ** p<0.05, * p<0.1

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Robustness - no coverage restrictions

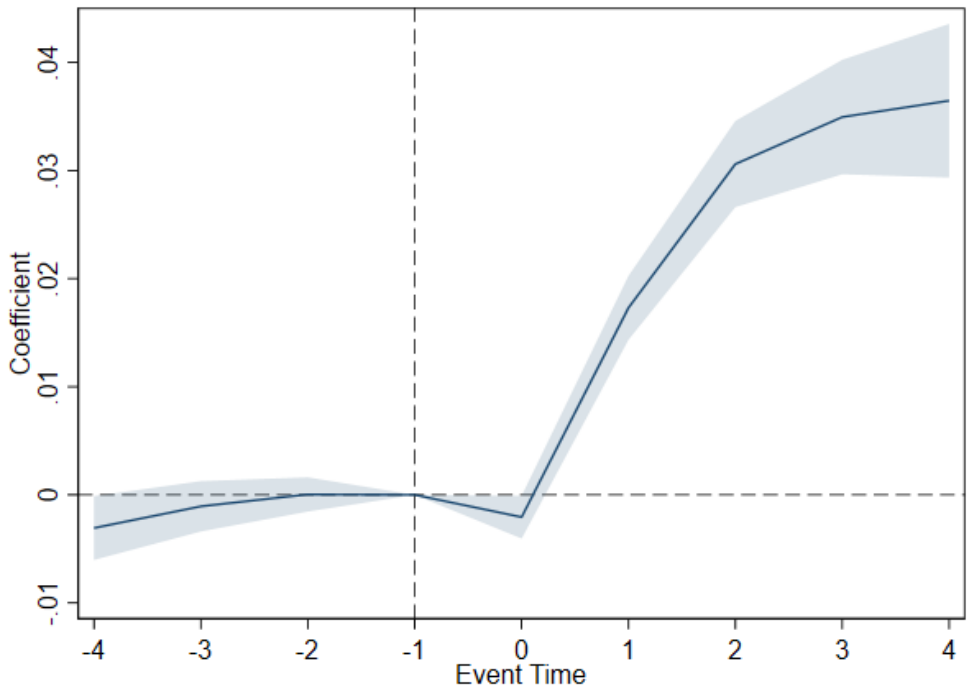
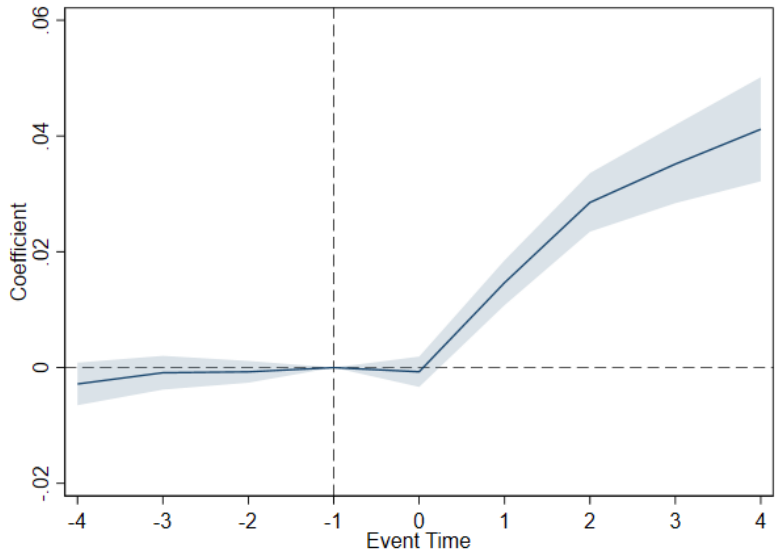
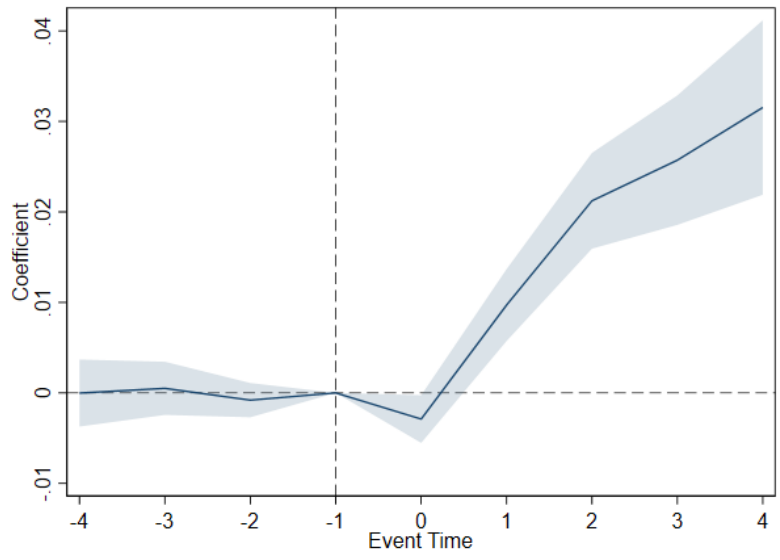


Figure 18: Effect on TFP. Sample of all eventually treated firms (without a minimum coverage restriction, i.e. unbalanced panel). Go Back

Robustness - more or less Fixed Effects



(a) No region or sector FEs



(b) region by sector FEs

Figure 19: Effect on TFP. The left panel removes region and sector fixed effects ($\gamma_s^h + \delta_r^h$), while the right panel replaces them with region by sector fixed effects ($\gamma_s^h + \delta_r^h$ becomes $\xi_{s,r}^h$). Go Back

Robustness - More time varying controls

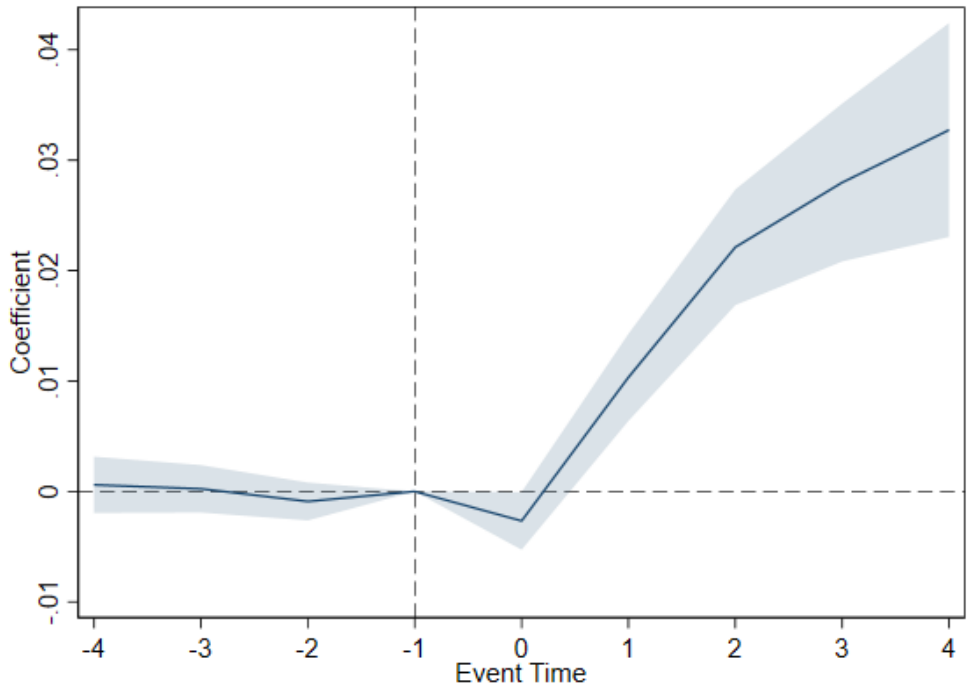


Figure 20: Effect on TFP. Controls include the first three lags of: capital growth, value added growth, sales growth, employment growth, (log) employment, (log) total assets, (log) capital, (log) materials, (log) value added,intangible intensity, sales to assets ratio, capital to labour ratio and age. Go Back