

The Credit Channel of Public Procurement

Ricardo Duque Gabriel

Federal Reserve Board

ASSA 2024

Motivation

Public procurement accounts for a **significant fraction of economic activity**:

- ◆ 13% of GDP (30% of G) in OECD countries.

► OECD

Governments can potentially foster firm growth with this tool:

- ◆ buying from the private sector (Ferraz et al. 2021; Hebous and Zimmermann 2021; Lee 2023).

This paper documents a mechanism through which procurement affects (firm) growth:

- firms use **procurement contracts as collateral** to increase credit;
- this mechanism **amplifies the local fiscal multiplier**.

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- ◆ **Data:** assemble **new** micro database.
 - e-procurement in Portugal mandatory since 2009 → 1 million contracts;
 - link to credit registry and tax-fillings data of the universe of Portuguese firms.
- ◆ **Identification:** award of procurement contracts via **public contests**.
 - focus on **competitive** contracts;
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 - *ex-ante* no predictable winner.

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Macro: Does the credit raised by firms mediate the impact of procurement on output?

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Macro: Does the credit raised by firms mediate the impact of procurement on output?

At the **firm-level**, public procurement is associated with:

- ◆ increase in corporate **credit**;
→ $\approx 80\%$ of which is **accounted** for by **cash-flow based** lending activities.
- ◆ decrease in **interest** rates (\approx expenses);
- ◆ increase in **credit lines** and **liquidity** → easing credit constraints;
- ◆ increase in **investment** and employment for **smaller** firms.

At the **regional-level**, an additional €1 of procurement is associated with:

- ◆ an increase in regional output by €1.8 → $\approx 10\%$ explained by the **credit** channel;
- ◆ **spillover** effects especially at the firm **HQ** location.

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Procurement Contracting in Portugal and Data

ELECTRONIC PROCUREMENT IN PORTUGAL IS MANDATORY SINCE 2009

Publication date	07-06-2022
Description	Concurso Público nº 1030/2022 - Aquisição de desinfetantes - Álcool e Acetona
Contracting entities	Centro Hospitalar Universitário do Porto, EPE. (CHP) (508331471)
Contracted entities	Proclinica Eq.Pr.Clinicos, Lda (500222665)
CPVs	33690000-3
Contract date	01-06-2022
Contract value	46.116,48 €
Execution deadline	365 dias
Execution place	Portugal, Porto, Porto
Competing entities	DIMOR LUSITANA, LDA (500730741) , ENZYMATIC, S.A. (510662625) , ESTERIPLAS (502020776) , PROCLINICA (500222665) , PMH,SA (502376899) , VWR INTERNATIONAL - MATERIAL DE LABORATÓRIO, SOC. UNIPessoal, LDA. (503842770)

Public Procurement:

→ web scraped 1 million contracts over 2009-2019 including **138,578 public contests**.

► Procurement as % of GDP

► Procurement by firm size

► Procurement by industry

► Contracts Statistics

Annual **firm-level** and **credit registry** data:

→ Private non-financial corporations in activity, with total assets above percentile 1 (\approx €800), and at least 1 paid worker based in Portugal.

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PUBLIC PROCUREMENT AWARDS

Direct Awards (90% of contracts):

→ hiring entity announces the project and the hired entity.

Public Contests (10% of contracts \approx 50% of value):

→ hiring entity announces the project;

→ firms apply **once** with a fully fleshed **costly** proposal;

→ third party ruler ensures **anonymity** and applies contest's rules;

→ firm with **lowest bid** wins the contract ($> 99\%$).

Assumption: *ex ante* no predictable winner

► Are winners and runner-ups similar?

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Empirical Strategy

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- ◆ $\text{Award}_{i,t}$: **total amount of procurement** announced in year t for firm i
- ◆ Control for lagged awards and firm-level variables
- ◆ α_i and $\delta_{s,t}$ are firm and industry \times year fixed effects
- ◆ $100 \times \beta^h$: **elasticity** of Y in cents to the award value of a marginal €1 for each h

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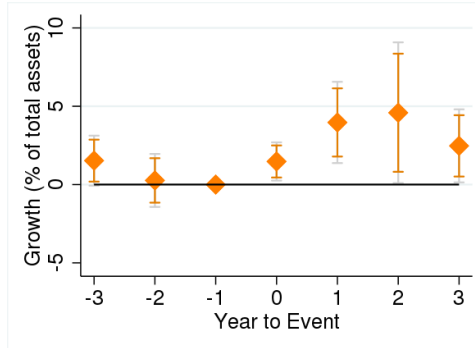
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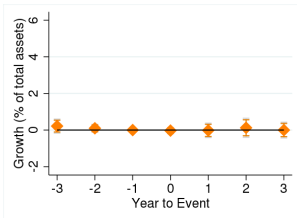
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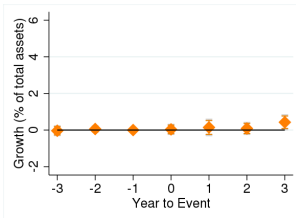
Results

Figure 1: Credit response to procurement award

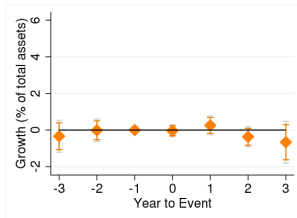




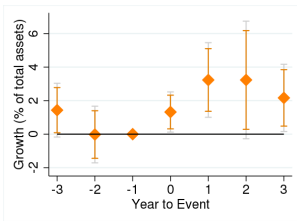
(a) Real collateral mortgaged



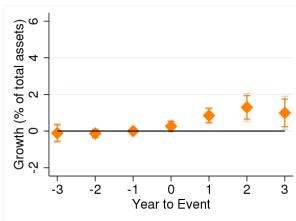
(b) Real collateral not mortgaged



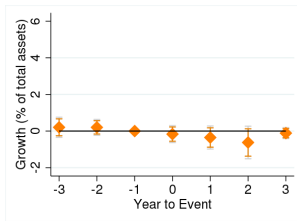
(c) Financial collateral



(d) Firm guarantees



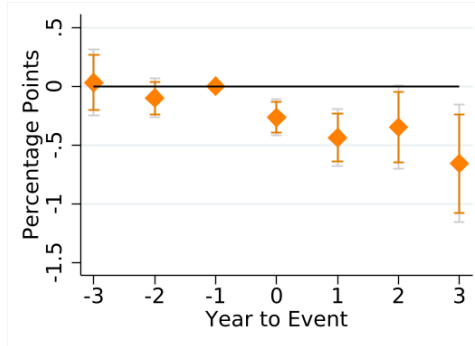
(e) State guarantees



(f) Other guarantees

INTEREST RATES DECREASE BY UP TO 0.5 P.P.

Figure 3: Interest rates response to procurement award





Notes: average interest rate response proxied by total interest expenses over lagged credit.

After **winning** a procurement contract:

- ◆ credit increases (80% of which is accounted for by firm guarantees);
- ◆ (average) interest rates decrease.



Evidence in favor of **credit supply** driving the response:

- ◆ firms negotiate **new credit lines** and increase liquidity; 
- ◆ **smaller** (\approx credit constrained) firms react disproportionately **more**. 

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- ▶ Local Projections Difference-in-Differences
- ▶ Credit maturity responses
- ▶ Non-performing loans response
- ▶ Measuring financial constraints
- ▶ Further heterogeneous effects
- ▶ Firm real effects

Aggregate Effects

$$\frac{\text{GVA}_{i,t+h} - \text{GVA}_{i,t-1}}{\text{GVA}_{i,t-1}} = \alpha_i^h + \delta_t^h + \beta^h \frac{\text{Proc}_{i,t}}{\text{GVA}_{i,t-1}} + \psi^h \text{Controls}_{i,t-1} + \varepsilon_{i,t+h}$$

- ◆ $\text{GVA}_{i,t}$ is the gross value added in region i and year t
- ◆ 25 Nuts III regions in Portugal
- ◆ aggregate procurement shocks by region where winning **firm's HQ** is located

► GVA Aggregation

Assumption: there is no correlation between the award allocation and the region's economic cycle (due to the unanticipated location of the winning firm)

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CROSS-SECTIONAL VARIATION IN PROCUREMENT SPENDING

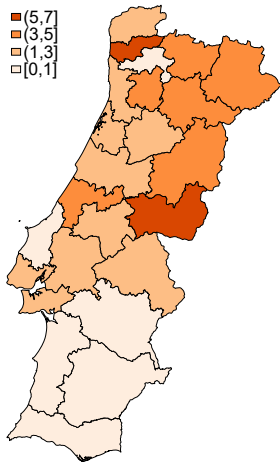


Figure 4: $\sum_{t=2009}^{2019} \frac{\text{Proc}_{i,t}}{\text{GVA}_{i,t-1}} \times 100$

- ◆ Public procurement as a percentage of lagged gross value added allocated to regions displays strong cross-sectional variation
- ◆ Northern regions receive relatively more procurement spending also when looking at absolute or per capita values

► Maps

AGGREGATE EFFECTS

	Horizon (Year)			
	Impact	1 Year	2 Years	3 Years
Proc	1.76*** (0.46)	1.75*** (0.53)	2.02*** (0.51)	2.40*** (0.66)
Controls	✓	✓	✓	✓
FE	✓	✓	✓	✓
Observations	150	150	150	150

$$\Delta \text{GVA}_{i,t+h} = \beta^h \text{Proc}_{i,t} + \gamma^h \text{Proc}_{i,t} \times \Delta \text{C}_{i,t} + \omega^h \Delta \text{C}_{i,t} \\ + \alpha_i + \delta_t + \psi^h \text{Controls}_{i,t-1} + \varepsilon_{i,t+h}$$

$\Delta \text{C}_{i,t}$ is the amount of "cash-flow-based credit" change between $t - 1$ and t of procurement winning firms in region i in year t

Assumption: "cash-flow based credit" change is due to winning procurement contracts

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THE CREDIT CHANNEL OF PUBLIC PROCUREMENT ACCOUNTS FOR 10% OF THE RESPONSE

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Proc	1.39*** (0.35)	1.51*** (0.44)	1.77*** (0.49)	2.12*** (0.62)
Proc × Credit	0.28** (0.13)	0.32** (0.15)	0.30** (0.15)	0.28* (0.16)
Controls	✓	✓	✓	✓
FE	✓	✓	✓	✓
Observations	150	150	150	150

Notes: Increasing the amount of cash-flow-collateralized credit of procurement winning firms by 1% of GVA raises the local procurement multiplier by, approximately, 10%, from 1.39 up to 1.67. The average increase is about 0.5% of GVA.

Conclusion

Public procurement:

- ◆ alleviates credit constraints;
- ◆ promotes growth at both the micro and macro level.

Potential policy implications:

- ◆ relatively **higher marginal effects** for credit constrained and **smaller firms**;
- ◆ procurement-fueled **credit amplifies fiscal policy** effects;
- ◆ **location** of government spending **matters** — effects are mainly felt at the firm HQ and not at the spending location.

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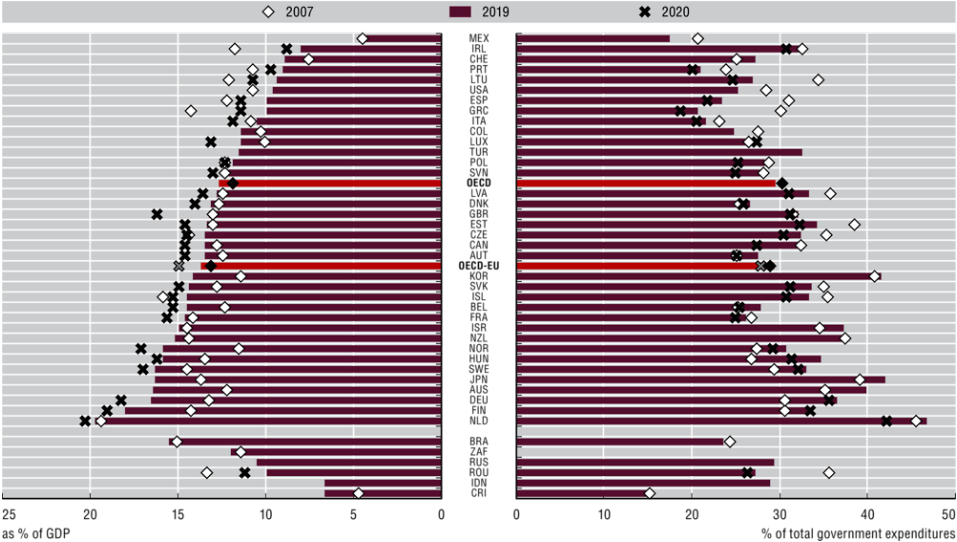
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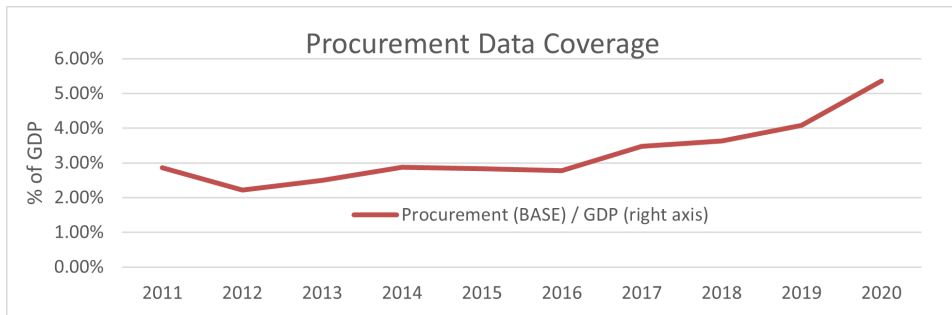
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Thank you!

Appendix

PUBLIC PROCUREMENT IN OECD COUNTRIES





PUBLIC CONTESTS AS IMPORTANT AS DIRECT AWARDS

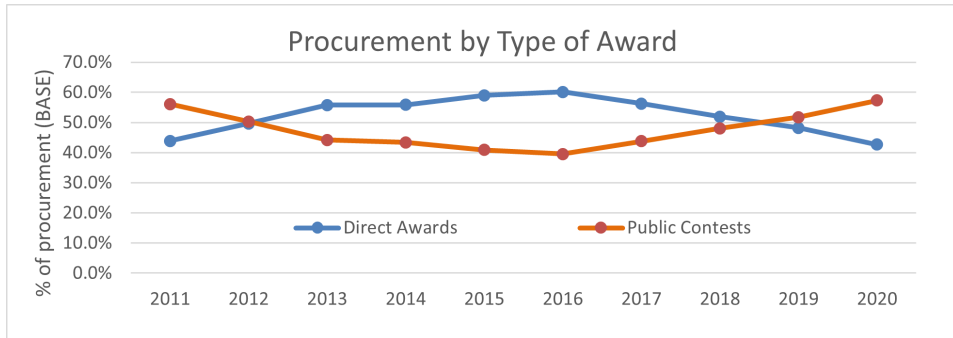


Table 1: Who received procurement contracts in 2019?

Firm Size	Number	Value
Micro	28.3%	9.9%
Small	31.0%	21.1%
Medium	22.7%	28.6%
Big	18.1%	40.4%

Notes: This table presents statistics for the award of public procurement contracts by firm size. Micro firms have at most 10 workers and €2 million in revenues; Small firms up to 50 workers and €10 million; Medium firms up to 250 workers and €50 million in revenues; Big firms comprise all the others.

Table 2: Which industries received procurement contracts in 2019?

CPV	Description	2019		2018
		Number	Value	Value
45	Construction	12.9%	42.5%	32.5%
33	Medical equipment, pharmaceuticals and personal care products	40.1%	17.7%	18.6%
9	Petroleum products, fuel, electricity and other sources of energy	2.2%	7.1%	6.2%
79	Business services: law, marketing, consulting, recruitment, security	12.3%	7.0%	5.9%
90	Sewage, refuse, cleaning and environmental services	4.0%	5.9%	4.2%
72	IT services: consulting, software development, Internet and support	6.4%	4.7%	3.9%
34	Transport equipment and auxiliary products to transportation	3.9%	4.4%	2.5%
50	Repair and maintenance services	8.0%	3.9%	3.1%
71	Architectural, construction, engineering and inspection services	7.9%	3.7%	3.3%
55	Hotel, restaurant and retail trade services	2.3%	3.1%	5.1%

Notes: This table presents statistics for the award of public works by firm industry in 2019 and 2018.

	Mean	Std. Dev.	P5	Median	P95	Obs
Public Contests						
Award (€)	291,031	1,473,640	634	73,279	1,027,066	138,578
Duration (Days)	348	402	28	257	1,095	138,578
# Contestants	4	5.1	1	1	15	138,578
Public Contests ($n > 1$)						
Award (€)	296,911	1,518,677	967	78,052	1,009,989	65,202
Duration (Days)	353	384	26	245	1,095	65,202
# Contestants	7.6	5.8	2	6	19	65,202
Direct Awards						
Award (€)	35,897	425,979	154	9,700	94,030	896,654
Duration (Days)	181	256	1	60	730	896,654
# Contestants	0.4	1.4	0	0	3	896,654

Notes: Summary statistics of procurement contracts divided by the awarding mechanism type. The first panel displays information for all public contests in my sample. The second panel focuses on public contests for which I can scrape information of at least one other competitor. The last panel displays the summary statistics for directly awarded contracts.

	Procurement Firms						No Procurement Firms					
	Mean	Std. Dev.	P10	Median	P90	Obs	Mean	Std. Dev.	P10	Median	P90	Obs
Total fixed assets	14,100	248,000	11	287	6,053	34,490	837	45,000	0	14	392	3,049,057
Turnover	21,600	208,000	237	1,927	3,391	34,490	963	17,700	15	115	1,059	3,049,057
Liquidity	14.7%	17.4%	0.6%	7.7%	39.5%	34,490	19.7%	30.0%	0.5%	9.4%	57.1%	3,049,057
Total liabilities	16,100	205,000	111	1,052	13,200	34,490	954	36,100	9	86	817	3,049,057
Employees	120	577	3	20	169	34,490	9	87	1	3	13	3,048,990
Wages per worker	21.8	16.3	9.8	17.9	37.3	34,490	12.8	11.7	5.8	10.6	21.3	3,048,990
Award	405	791	15	50	1,015	34,490						
Total Credit	4,401	26,300	21	475	7,018	27,236	472	6,381	2	31	477	1,659,673
Used Credit	2,137	12,400	1	208	3,607	27,236	359	4,496	0	23	382	1,659,673
Potential Credit	2,264	15,600	3	137	2,821	27,236	112	3,165	0	2	68	1,659,673
Non-performing Credit	46	1,268	0	0	0.3	27,236	18	8,741	0	0	0.2	1,659,673
Real Col. Mortgaged	344	4,919	0	0	250	27,236	106	1,754	0	0	63	1,659,673
Real Col not Mortgaged	160	2,877	0	0	23	27,236	32	1,542	0	0	3	1,659,673
Financial Col.	308	4,332	0	0	138	27,236	62	2,469	0	0	12	1,659,673
Personal guarantee Col.	865	5,268	0	70	1,620	27,236	153	1,569	0	8	190	1,659,673
State guarantee Col.	182	1,155	0	0	416	27,236	23	600	0	0	20	1,659,673
Other Col.	307	3,545	0	0	78	27,236	36	1,361	0	0	0	1,659,673
Implicit interest rate	7.4%	7.4%	1.5%	4.9%	20.6%	21,623	6.6%	6.4%	1.0%	4.8%	13.9%	1,227,784

Notes: This table presents the summary statistics for the key firm level variables in this paper dividing them in firm-year observations when a firm won a public contest vs when a firm lose or did not participate in public contests. All economic variables are in thousand euros. **Variables are not winsorized.**

Step	Description	Observations
0	Web scraped contracts	1,035,232
1	Keep public contests	138,578
2	Keep positive awards	137,858
3	Keep contracts with solely one winner	134,993
4	Collapse same year awards	44,919
5	Merge with Portuguese credit registry	38,431
6	Keep private non-financial corporations	37,980
7	Keep only non-liquidated firms	37,906
8	Keep only firms with lagged total assets above p1 (€827.28)	37,829
9	Keep only firms with available information on lagged assets	36,575
10	Keep only firms with at least one paid employee	34,490

ARE WINNERS AND RUNNER-UPS REALLY SIMILAR? YES!

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	Winners		Losers		T-test	Obs
	Mean	Median	Mean	Median		
Firm Balance Sheet						
Assets	€ 240,000	€ 4,466	€ 198,000	€ 4,172	0.08	6,136
Sales	€ 199,000	€ 4,790	€ 156,000	€ 4,127	0.19	6,136
Value Added	€ 35,800	€ 1,208	€ 34,300	€ 1,129	0.74	6,136
Employees	312	31	328	30	0.54	6,134
Firm Age	24	20	23	20	0.52	6,136
Liquidity	13.8%	6.6%	13.8%	6.9%	0.67	6,136
Total Hours Worked	552,628	54,208	575,205	51,072	0.92	6,094
Liabilities	€ 188,000	€ 2,503	€ 159,000	€ 2,320	0.10	6,136
Firm Credit Info						
Total available credit	€ 12,800	€ 807.7	€ 16,100	€ 696.7	0.42	4,200
Total used credit	€ 7,649	€ 296.1	€ 11,100	€ 256.2	0.36	4,200
Total potential credit	€ 5,118	€ 295.1	€ 5,065	€ 246.5	0.96	4,200
Short maturity credit	€ 3,452	€ 42.1	€ 5,492	€ 43.8	0.35	4,200
Long maturity credit	€ 4,196	€ 138.0	€ 5,582	€ 118.8	0.47	4,200

Notes: This table compares characteristics of firms in (thousands of euros) that either won (winners) or lost (losers) public contests for government procurement contracts. The panel is based on the *firm level data on public contests contracts with exactly 2 contestants* at the year before the contract award. The table reports number of observations, mean, median, and the p-value of the two-sample t-test for whether the difference on each characteristic between the winner and the loser for each contest is equal to zero. Firm level variables are not winsorized.

$$\text{Winner}_{z,j,t} = \gamma \mathbf{X}_{j,t-1} + \kappa_z + \delta_{s,t} + \varepsilon_{z,j,t}$$

Lagged Firm Characteristics	
F-statistic	2.3
P-value	0.21

Dep. var: Winner _{z,j,t}	T-Statistic
Assets	1.71*
Sales	0.84
Value Added	0.56
Employees	0.02
Liquidity	0.36
Total Hours	1.01
Liabilities	-1.42
Total Credit	-0.60
R-squared	0.5789

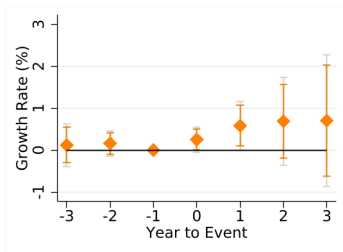
Apply a **nearest neighbor matching algorithm** to find the best counterfactual from the participant pool with j firms for each contract with the **smallest Mahalanobis distance**:

$$d(i, j) = \sqrt{(\mathbf{x}_i - \mathbf{x}_j) \Sigma^{-1} (\mathbf{x}_i - \mathbf{x}_j)}$$

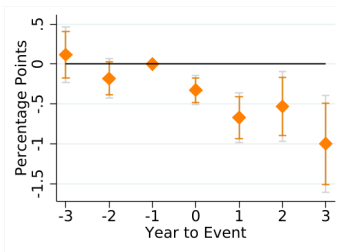
Estimate a local projections **difference-in-differences** at the contract level z (Dube et al. 2022):

$$\frac{y_{z,i,t+k} - y_{z,i,t-1}}{y_{z,i,t-1}} = \beta^k \mathcal{I}(\text{Winner}_{z,i,t}) + \alpha_z^k + \delta_t^k + \gamma_j^k \mathbf{X}_{z,i,t-1} + \epsilon_{z,i,t}^k \quad \text{for } k \in \{-3, \dots, 3\}$$

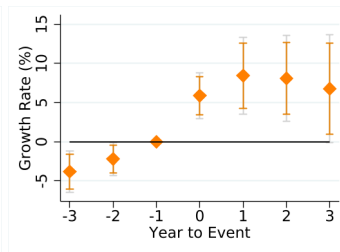
PERCENTAGE POINT DIFFERENCE BETWEEN WINNER AND RUNNER-UP

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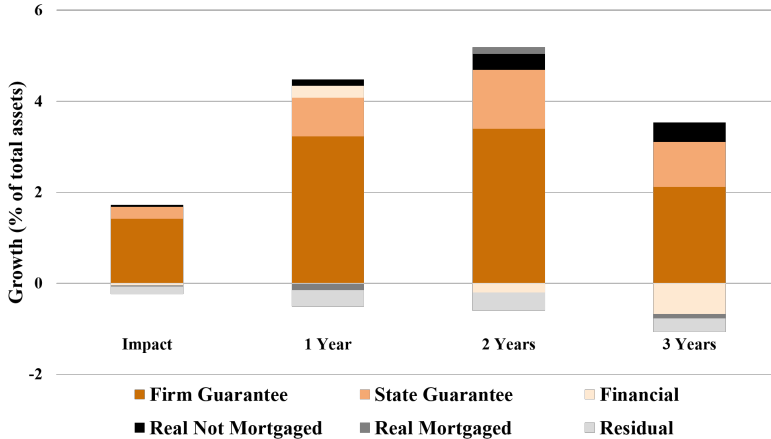
(a) Credit (2,063 contracts)

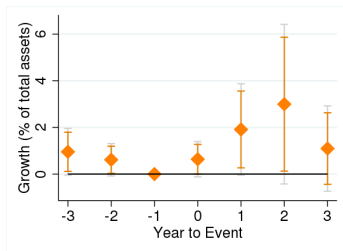


(b) Interest Rates (2,063 contracts)

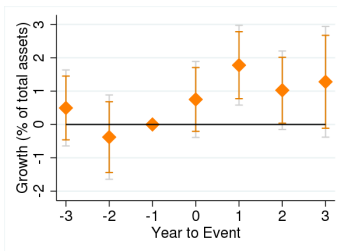


(c) Turnover (3,279 contracts)

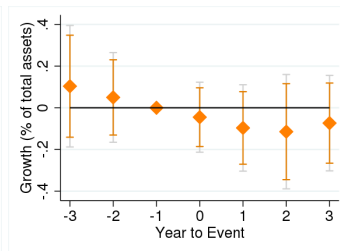
Figure 6: Credit increase by collateral type



(a) Long maturity credit ($> 1y$)



(b) Short maturity credit ($\leq 1y$)



(c) Non-performing credit

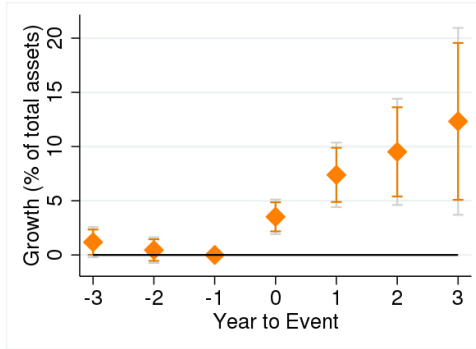
Firms typically classified as constrained do not actually behave as if they were constrained (Farre-Mensa and Ljungqvist, 2016) → try different proxies for financial constraints.

More constrained firms are usually:

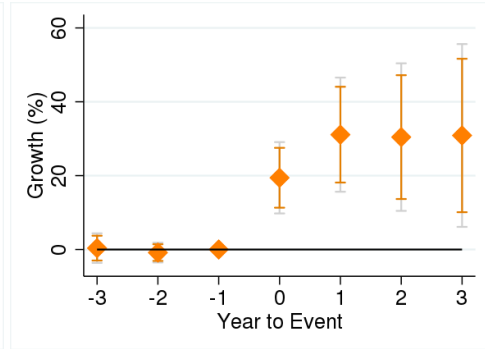
- ♦ smaller
- ♦ younger
- ♦ less liquid
- ♦ more leveraged
- ♦ and have less (no) credit lines

	Credit Growth								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Award	5.47*** (1.97)	4.12*** (1.33)	2.34*** (0.74)	4.01*** (1.56)	4.58*** (1.56)	2.16*** (0.82)	8.95 (6.41)	5.03*** (1.67)	3.65*** (1.35)
Panel A: Financial Constraints									
×Old	-3.75** (1.80)								
×Big		-1.66** (0.81)							
×No Credit Lines			1.00*** (0.28)						
×High Liquidity				-0.20 (1.56)					
×High Leverage					-1.23 (1.39)				
Panel B: Other Characteristics									
×Long Contract						1.79** (0.83)			
×High Proc Rev							-4.65 (6.46)		
×High Prod								-1.86 (1.33)	
×New Winner									0.43 (0.79)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	27,229	27,229	27,229	27,229	27,228	27,229	27,229	26,620	27,229

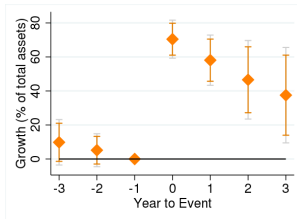
Figure 8: Investment and employment responses to procurement award



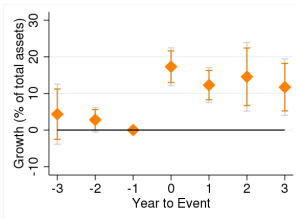
(a) Non-current assets



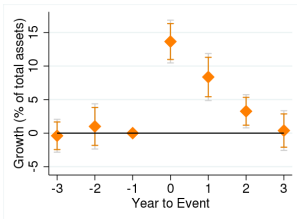
(b) Paid employees



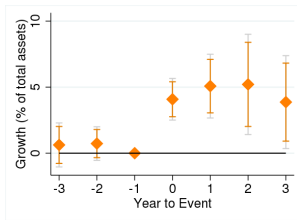
(a) Turnover: sales income



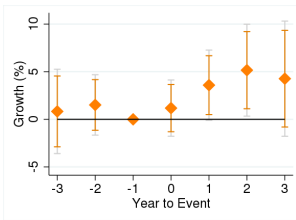
(b) Costs of goods sold



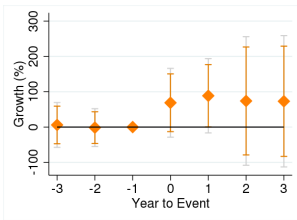
(c) Net Income



(d) Total liabilities



(e) Wages per worker



(f) Value added

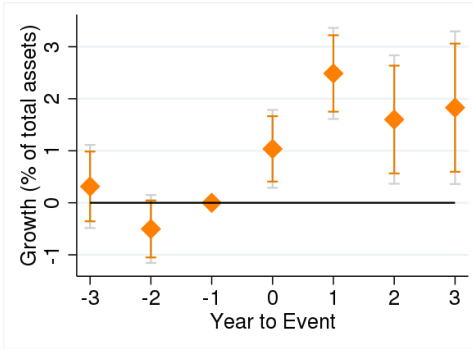
- ▶ Importance of credit to investment response
- ▶ Static heterogeneous effects
- ▶ Dynamic heterogeneous effects

$$\Delta \text{Inv}_{i,t+1} = \beta_1 \text{Award}_{i,t} + \beta_2 \Delta \text{Credit}_{i,t} + \beta_3 \text{Award}_{i,t} \times \Delta \text{Credit}_{i,t} + \psi \text{Controls}_{i,t-1} + \alpha_i + \delta_{s,t} + \varepsilon_{i,t}$$

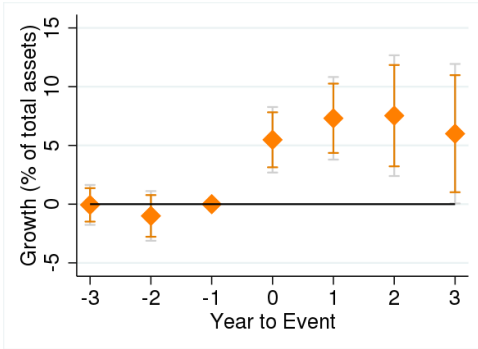
	Firm Investment	
	(Baseline)	(Interaction)
Award	7.39*** (1.32)	1.83 (1.17)
Credit Growth		0.25 (0.16)
Interaction		0.76*** (0.25)
Observations	30,487	27,229

Notes: Column (Baseline) was obtained by estimating the baseline specification and column (Interaction) by adding an additional control variable of credit growth from t to $t + 1$ and its interaction with the award value as described above.

PROCUREMENT AWARDS INCREASE ACCESS TO CREDIT AND FIRM LIQUIDITY

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(a) Credit lines



(b) Cash and bank deposits

	Credit Growth			
	Impact	1 Year	2 Years	3 Years
Award	1.48** (0.62)	3.97*** (1.32)	4.59** (2.29)	2.47** (1.19)
× Small	2.05** (0.98)	5.47*** (1.97)	8.46*** (3.20)	5.24** (2.63)
× Big	0.57** (0.24)	1.72* (0.95)	0.72 (0.82)	- 0.30 (0.68)
HAC p-value	0.08	0.04	0.01	0.02
Controls	✓	✓	✓	✓
FE	✓	✓	✓	✓
Observations	34,490	27,229	19,973	13,367

FURTHER HETEROGENEOUS EFFECTS OF INVESTMENT

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	Firm Investment								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Award	10.78*** (2.67)	8.84*** (1.90)	7.16*** (1.49)	7.66*** (2.03)	12.97*** (19.10)	8.75*** (3.27)	41.10*** (3.02)	9.46*** (1.97)	6.35*** (2.35)
Panel A: Financial Constraints									
×Old	-5.06*** (2.60)								
×Big		-3.82*** (1.34)							
×No Credit Lines			0.59 (0.73)						
×High Liquidity				-0.24 (3.28)					
×High Leverage					-7.33*** (2.74)				
Panel B: Other Microfoundations									
×Long Contract						6.30 (4.56)			
×High Proc Rev							-31.43 (19.07)		
×High Prod								-0.23 (2.51)	
×New Winner									1.20 (0.82)
Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓
FE	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	30,487	30,487	30,487	28,046	30,486	30,487	30,487	29,479	30,487

	Investment				Employment			
	Impact	1 Year	2 Years	3 Years	Impact	1 Year	2 Years	3 Years
Panel A: Baseline Specification								
Elasticity	3.52*** (0.82)	7.39*** (1.32)	9.51*** (2.50)	12.32*** (4.40)	19.42*** (4.93)	31.10*** (7.89)	30.44*** (10.19)	30.88** (12.63)
Panel B: Small versus Big Firms								
Small Firms	4.34*** (1.83)	9.22** (4.69)	10.46** (5.20)	11.17* (6.66)	22.12*** (8.75)	35.27** (17.71)	36.45* (19.33)	36.98* (20.67)
Big Firms	1.50* (0.89)	1.23 (1.38)	0.50 (1.47)	- 0.05 (1.96)	3.94*** (1.76)	4.50* (2.44)	2.27 (2.31)	1.80 (1.12)
HAC p-value	0.09	0.04	0.01	0.00	0.05	0.02	0.01	0.01
Controls and FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	38,819	30,487	25,803	19,964	38,819	30,487	25,803	19,964

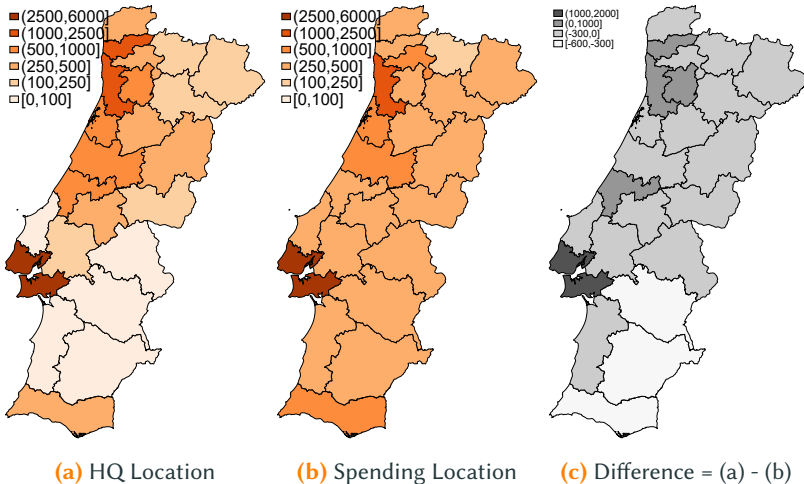
Different investment and credit responses can be rationalized together:

- ◆ hard to measure financial constraints (Farre-Mensa and Ljungqvist 2016)
- ◆ **smaller** firms are more credit **constrained** (Beck et al. 2005)
- ◆ **financial accelerator hypothesis**: they will react more to the same demand shock because they were sub-optimally investing (Bernanke et al. 1996)
- ◆ increase in cash flow based lending alleviates constraints

Aggregation matters

LOCATION OF SPENDING DIFFERS FROM LOCATION OF ACTUAL PRODUCTION

Figure 11: Differences in procurement spending by aggregation method



GDP DECOMPOSITION BY AGGREGATION METHOD

$$\frac{\text{GDP}_{i,t+h}^c - \text{GDP}_{i,t-1}^c}{\text{GDP}_{i,t-1}} = \alpha_i + \delta_t + \beta^h \frac{\text{Proc}_{i,t}^{\text{Agg}}}{\text{GDP}_{i,t-1}} + \psi^h \mathbf{X}_{i,t-1} + \varepsilon_{i,t+h} \quad \text{for Agg} \in \{\text{HQ; LOC}\}$$

Horizon (Year)	HQ Aggregation				Location Aggregation			
	Impact	1 Year	2 Years	3 Years	Impact	1 Year	2 Years	3 Years
GDP	1.50** (0.73)	1.42 (1.10)	1.89 (1.49)	2.43** (1.22)	1.23 (0.79)	1.29** (0.58)	1.78** (0.75)	1.83*** (0.55)
Consumption (residual)	1.64*** (0.61)	1.47*** (0.52)	1.91*** (0.78)	1.94*** (0.91)	0.89 (0.98)	0.77 (1.18)	3.14*** (0.88)	2.94*** (0.77)
Gov. Spending	-0.09 (0.21)	-0.03 (0.34)	-0.04 (0.36)	0.32 (0.41)	-0.29*** (0.09)	-0.47*** (0.16)	-0.47*** (0.16)	-0.33** (0.16)
Investment	1.01** (0.50)	1.21** (0.62)	1.28** (0.56)	1.68*** (0.65)	0.03 (0.37)	0.19 (0.44)	-0.95 (0.59)	-0.72 (0.61)
Net Exports	-1.06** (0.50)	-1.23 (0.89)	-1.26 (1.03)	-1.51* (0.90)	0.60 (0.70)	0.79 (0.85)	0.06 (0.72)	-0.67 (0.64)
Controls and FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	150	150	150	150	150	150	150	150

SPILLOVER EFFECTS OF PUBLIC PROCUREMENT BY AGGREGATION METHOD

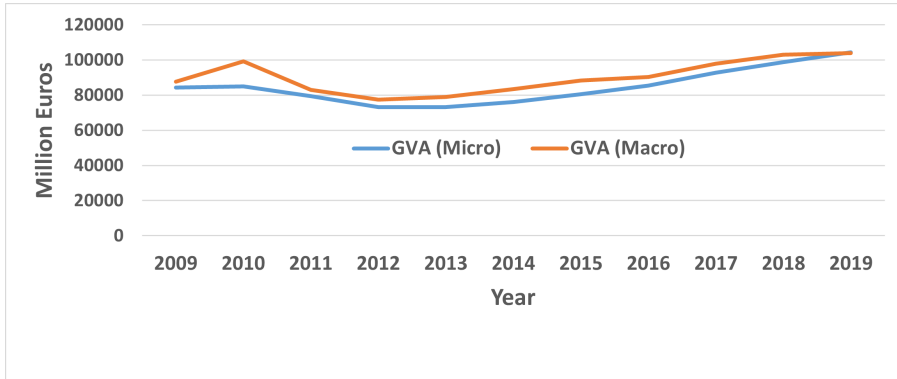
$$\frac{\sum_i \text{GVA}_{i-w,t+h} - \sum_i \text{GVA}_{i-w,t-1}}{\sum_i \text{GVA}_{i-w,t-1}} = \alpha_i + \delta_t + \beta^h \frac{\sum_i \text{Proc}_{i,t}^{Agg}}{\sum_i \text{GVA}_{i-w,t-1}} + \psi^h \text{Controls}_{i,t-1} + \varepsilon_{i,t+h} \text{ for } Agg \in \{\text{HQ; LOC}\}$$

Horizon (Year)	HQ Spillover				Location Spillover			
	(0)	(1)	(2)	(3)	(0)	(1)	(2)	(3)
Spillover	0.68*** (0.2)	0.75*** (0.3)	0.85** (0.4)	0.72* (0.4)	0.25 (0.3)	0.38 (0.3)	0.47 (0.4)	0.40 (0.5)
Controls and FE	✓	✓	✓	✓	✓	✓	✓	✓
Observations	150	150	150	150	150	150	150	150

FURTHER MACROECONOMIC EFFECTS OF PUBLIC PROCUREMENT

	Horizon (Year)			
	Impact	1 Year	2 Years	3 Years
R&D	4.42** (1.88)	3.51** (1.55)	6.43*** (2.36)	6.05*** (2.07)
TFP	3.40 (2.84)	6.58* (3.56)	5.44*** (1.96)	4.43 (3.46)
Employment	0.13 (0.54)	0.41 (0.90)	1.04 (1.18)	2.04* (1.19)
Compensation	1.24 (0.79)	1.69 (1.22)	2.42 (1.57)	3.86*** (1.21)
Credit	0.24 (0.52)	0.18 (0.45)	0.29 (0.48)	0.35 (0.32)
Inflation	-0.01 (0.09)	0.06 (0.13)	-0.07 (0.14)	-0.28 (0.17)
Controls and FE	✓	✓	✓	✓
Observations	150	150	150	150

- ▶ State-dependent effects
- ▶ Aggregation by spending location



GVA (Macro) = output - intermediate consumption

GVA (Micro) = $\sum_i (\text{sales}_i - \text{production costs}_i)$

Figure 12: Procurement (per capita €)

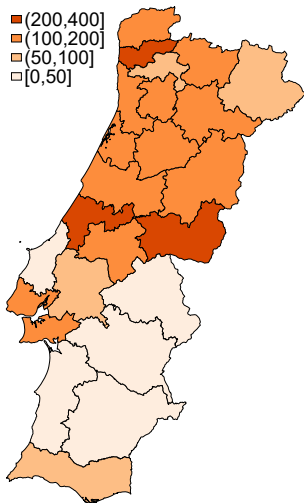
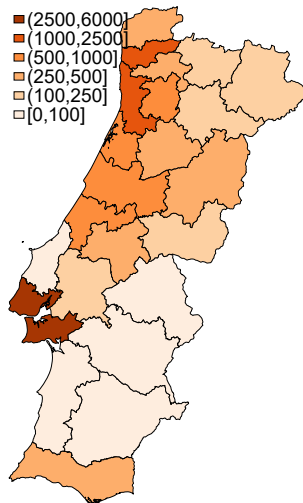


Figure 13: Procurement (mio. €)



	Horizon (Year)			
	Impact	1 Year	2 Years	3 Years
Proc	1.23 (0.79)	1.29** (0.58)	1.78** (0.75)	1.83*** (0.55)
Controls	✓	✓	✓	✓
FE	✓	✓	✓	✓
Observations	150	150	150	150

	Horizon (Year)			
	Impact	1 Year	2 Years	3 Years
Proc	1.76*** (0.46)	1.75*** (0.53)	2.02*** (0.51)	2.40*** (0.66)
Proc×Small	1.85*** (0.56)	1.78*** (0.58)	2.23*** (0.83)	2.67*** (0.88)
Proc×Big	1.50** (0.70)	0.82 (0.75)	0.51 (0.62)	0.47 (0.49)
HAC Test	0.80	0.43	0.09	0.05
Controls	✓	✓	✓	✓
FE	✓	✓	✓	✓
Observations	150	150	150	150

	Horizon (Year)			
	Impact	1 Year	2 Years	3 Years
Proc×Long	0.54 (0.54)	0.76 (0.51)	1.80** (0.71)	2.45*** (0.83)
Proc×Short	1.54** (0.73)	1.67*** (0.63)	1.24** (0.50)	0.97 (0.67)
HAC Test	0.37	0.25	0.52	0.22
Proc×Investment	1.80*** (0.62)	1.36*** (0.47)	1.78*** (0.64)	2.15*** (0.76)
Proc×Consumption	−0.50 (1.37)	0.14 (0.89)	0.96 (1.66)	1.11 (1.77)
HAC Test	0.24	0.27	0.67	0.65
Controls and FE	✓	✓	✓	✓
Observations	150	150	150	150