The Credit Channel of Public Procurement

Ricardo Duque Gabriel
University of Bonn

January, 2023

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:

- by buying from the private sector (Ferraz et al. 2021; Hebous and Zimmermann 2021; Lee 2022)

Policy debate: Should governments target specific firms?

- US Small Business Act: fair allocation of federal contracts to small businesses
- EU Parliament supports positive discrimination in favor of SMEs

This paper documents a mechanism through which procurement can affect firm growth: firms use procurement contracts as collateral to increase credit ▸ Graph

Research Question

RQ: Does public procurement promote corporate credit?

- **Data**
  - → 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 is not random ▸ Graph
  - → focus on **competitive** contracts → **public contests**
  - → lowest anonymous bidder wins the contest
  - → *ex-ante* no predictable winner

Preview of results

At the **firm-level**, public procurement promotes:

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

At the **regional-level**, an additional €1 of public procurement promotes:

- an increase in regional output by €1.8 (≈10% accounted by the credit channel)

Related Literature and Contribution

- **Public procurement and firm performance:** Adelino et al. (2020); Hebous and Zimmermann (2021); Bonfim et al. (2022); di Giovanni et al. (2022); Ferraz et al. (2022); Lee (2022)
  → focus on **credit** and firm **heterogeneities**

- **Cash-flow based lending:** Lian and Ma (2021); Ivashina et al. (2021); Drechsel (2022)
  → procurement contracts act as **collateral**
  → study **future** cash-flows

- **Regional Multipliers:** Nakamura and Steinsson (2014); Aghion et al (2014); Chodorow-Reich (2019); Auerbach et al (2020); Juarros (2021); Gabriel et al (2022); Bird et al (2022)
  → focus on regional **procurement** multipliers (direct effect of spending)

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

Data

Public Procurement

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

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

→ Private non-financial corporations in activity, with total assets above percentile 1 (≈ €800), and at least 1 paid worker based in Portugal ▸ Summary Statistics

Final dataset with 2 million observations with **34,490 winner-year obs** ▸ Sample

Public contests

▸ Graph

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 ($> 99\%$)

ex ante **no** predictable winner

▸ Are winners and runner-ups similar? ▸ Random assignment test

Empirical Strategy

Empirical Strategy

$$\frac{\text{Credit}_{i,t+h} - \text{Credit}_{i,t-1}}{\text{Assets}_{i,t-1}} = \beta^h \frac{\text{Award}_{i,t}}{\text{Assets}_{i,t-1}} + \psi^h \text{Controls}_{i,t-1} + \alpha_i^h + \delta_{s,t}^h + \varepsilon_{i,t}^h \quad \forall_{h \in \{-3,\dots,3\}}$$

- $\text{Award}_{i,t}$: **total amount of procurement** announced in year t for firm i
- Control for lagged awards and firm observables
- α_i and $\delta_{s,t}$ are firm and industry×year fixed effects
- $100 \times \beta^h$: **elasticity** of **credit** in cents to the award value in euros

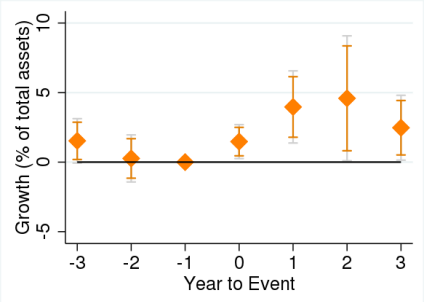
Identification:

$$E\left(\varepsilon_{i,t} | \alpha_i, \delta_{s,t}, \text{Award}_{i,t}, \text{Controls}_{i,t-1}\right) = 0$$

▸ Are winners and runner-ups similar? ▸ Random assignment test

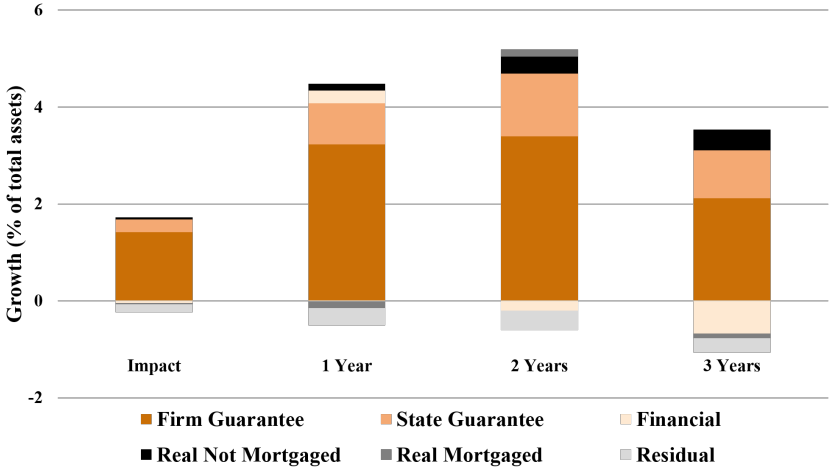
Results

Figure 1: Credit response to procurement award



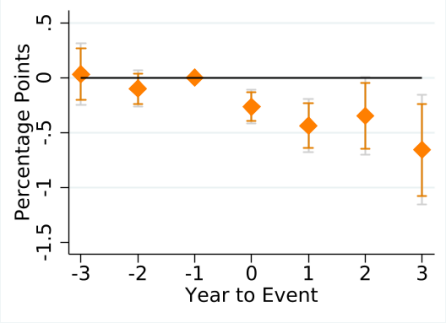
Notes: This figure displays the estimated coefficient β for each horizon h relative to the year of the award $h = 0$. The boxplot displays the coefficient estimate ($\diamond$) and the corresponding 95% and 90% confidence bands for the response of firm credit relative to total assets in the previous year to the amount awarded after winning a procurement contract which is also normalized by the lagged value of total assets. The estimation includes firm and industry$\times$year fixed effects. All standard errors are clustered at the firm level.

Figure 2: Credit increase by collateral type



Interest rates decrease by up to 0.5 p.p.

Figure 3: **Interest rates** response to procurement award



Notes: This figure displays the estimated coefficient β for each horizon h relative to the year of the award $h = 0$. The boxplot displays the coefficient estimate ($\diamond$) and the corresponding 95% and 90% confidence bands for the implicit interest rate response (proxied by total interest expenses over lagged credit) to the amount awarded after winning a procurement contract which is normalized by the lagged value of total assets. The estimation includes firm and industry$\times$year fixed effects. Standard errors are clustered at the firm level.

Taking stock: the credit SUPPLY channel of public procurement

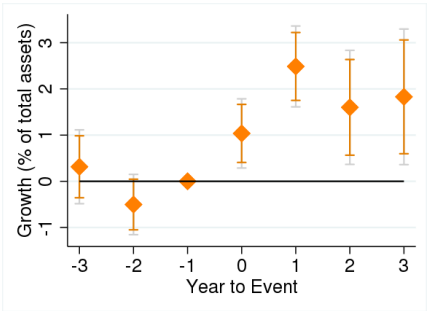
After **winning** a procurement contract, a firm displays:

- an increase in credit
  - → 80% of which is accounted by cash-flow collateral provided by firm guarantees
- a decrease in interest rates

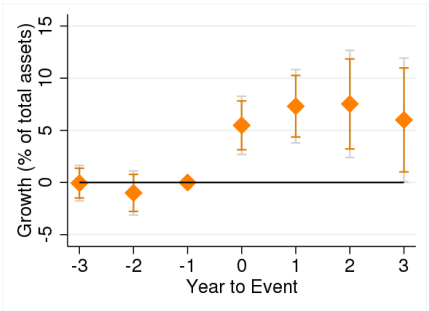
Credit supply is driving the response. If that is the case, then:

- firms should be able to negotiate **new credit lines**
- **smaller** (≈ credit constrained) firms should react **more**

Procurement awards increase access to credit and firm liquidity



(a) Credit lines



(b) Cash and bank deposits

Heterogeneous credit elasticities to public procurement awards

	Credit Growth			
	Impact	1 Year	2 Years	3 Years
Award	1.48**	3.97***	4.59**	2.47**
	(0.62)	(1.32)	(2.29)	(1.19)
×**Small**	2.05**	5.47***	8.46***	5.24**
	(0.98)	(1.97)	(3.20)	(2.63)
×**Big**	0.57**	1.72*	0.72	- 0.30
	(0.24)	(0.95)	(0.82)	(0.68)
HAC p-value	0.08	0.04	0.01	0.02
Controls	✓	✓	✓	✓
FE	✓	✓	✓	✓
Observations	35,555	27,229	19,973	13,367

Notes: This table examines the effect of the procurement award on corporate credit. The unit of observation is the firm-year level i, t. The sample period is 2009-2019. In the first row, I present the baseline results on the *cumulative* response of credit from period $t + h$ relative to period $t - 1$ for each horizon $h = 0, 1, 2, 3$. In the second panel, I study the differences between small and big firms defined as *firms being below or above the median in terms of total assets across the winning sample*. The HAC p-value presents the p-value of the difference between states using the heteroskedasticity and autocorrelation consistent test. Standard errors clustered at the firm level are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level, respectively.

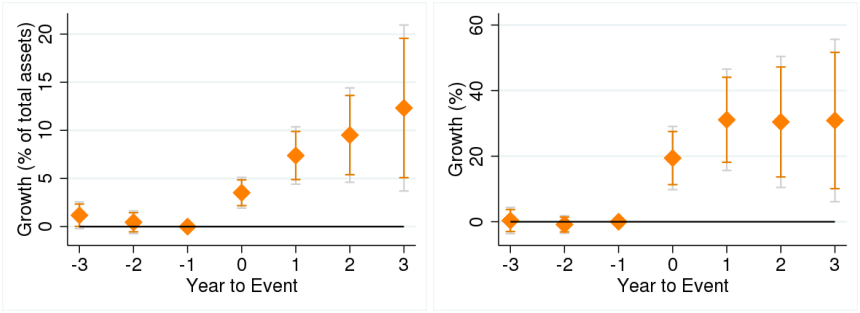
Further analysis

- Matching exercise
- Credit maturity responses
- Non-performing loans response
- Measuring financial constraints
- Further heterogeneous effects

Firm Investment and Employment

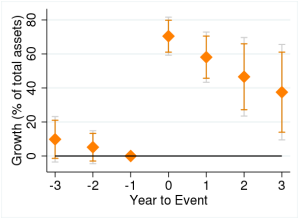
Procurement awards increase firm investment and employment

Figure 5: Investment and employment responses to procurement award

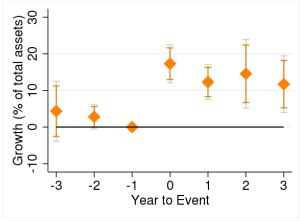


(a) Non-current assets **(b) Paid employees**

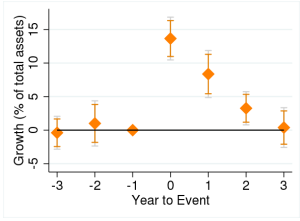
Other firm dynamics



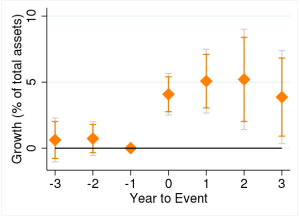
(a) **Turnover**: sales income



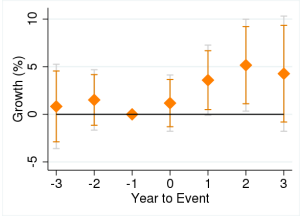
(b) **Costs** of goods sold



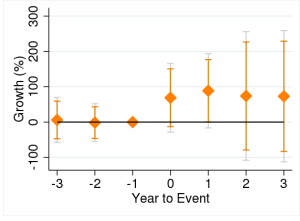
(c) **Net Income**



(d) Total **liabilities**



(e) **Wages** per worker



(f) **Value added**

Further analysis

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

Aggregate Effects

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

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

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

Cross-sectional variation in procurement spending

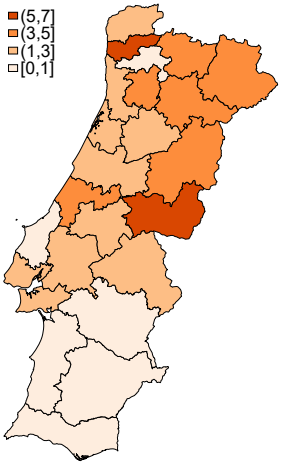


Figure 7: $\sum_{t=2009}^{2019} \frac{\text{Proc}_{i,t}}{\text{GVA}_{i,t-1}} \times 100$

- 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^{***}	1.75^{***}	2.02^{***}	2.40^{***}
	(0.46)	(0.53)	(0.51)	(0.66)
Controls	✓	✓	✓	✓
FE	✓	✓	✓	✓
Observations	150	150	150	150

Notes: The unit of observation is the region-year level i, t. I estimate specification $\Delta \text{GVA}_{i,t+h} = \alpha_i + \delta_t + \beta^h \text{Proc}_{i,t} + \psi^h \text{Controls}_{i,t-1} + \varepsilon_{i,t+h}$. I present the results for the coefficient β^h for each horizon $h = 0, 1, 2, 3$. β^h can be interpreted as the response of regional production (proxied by gross value added) from period $t + h$ relative to period $t - 1$ to regional procurement spending aggregated at the headquarter location. I use a matched sample period from 2010 to 2016 (25 regions $\times$ 6 years) so that changes in the estimate can't be associated to sample changes. Robust standard errors clustered at the region-level are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level for the typical null hypothesis that $\beta^h = 0$, however colored cells indicate whether the coefficient is statistically significantly different from one, $\beta^h = 1$, at the 5% level.

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

- $\Delta \text{Var}_{i,t+h} = \frac{\text{Var}_{i,t+h} - \text{Var}_{i,t-1}}{\text{GVA}_{i,t-1}}$
- $\Delta \text{C}_{i,t}$ is the amount of "cash-flow-based credit" increase between $t-1$ and t of procurement winning firms in region i in year t

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

The credit channel of public procurement accounts for 10% of the response

	Horizon (Year)			
	Impact	1 Year	2 Years	3 Years
Proc	1.76***	1.75***	2.02***	2.40***
	(0.46)	(0.53)	(0.51)	(0.66)
Proc	1.39***	1.51***	1.77***	2.12***
	(0.35)	(0.44)	(0.49)	(0.62)
Proc × Credit	0.28**	0.32**	0.30**	0.28*
	(0.13)	(0.15)	(0.15)	(0.16)
Controls	✓	✓	✓	✓
FE	✓	✓	✓	✓
Observations	150	150	150	150

Notes: The unit of observation is the region-year level i, t. In the first row, I repeat the baseline estimates. In the second panel, I present estimates of specification $\Delta \text{GVA}_{i,t+h} = \beta^h \text{Proc}_{i,t} + \gamma^h \text{Proc}_{i,t} \times \Delta \text{C}_{i,t} + \omega^h \Delta \text{C}_{i,t} + \alpha_i + \delta_t + \psi^h \text{Controls}_{i,t-1} + \varepsilon_{i,t+h}$ for the coefficients β^h and γ^h. I use a matched sample period from 2010 to 2016 (25 regions × 6 years) so that changes in the estimate can't be associated to sample changes. Robust standard errors clustered at the region-level are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Further analysis

- Aggregation by spending location
- Further macroeconomic effects
- GDP decomposition
- Spillover effects
- State-dependent effects

Conclusion

Conclusion

Public procurement:

- increases **credit** and alleviates financial frictions (liquidity and credit lines)
- increases **investment** and **output** at both the micro and macro level

Policy implications:

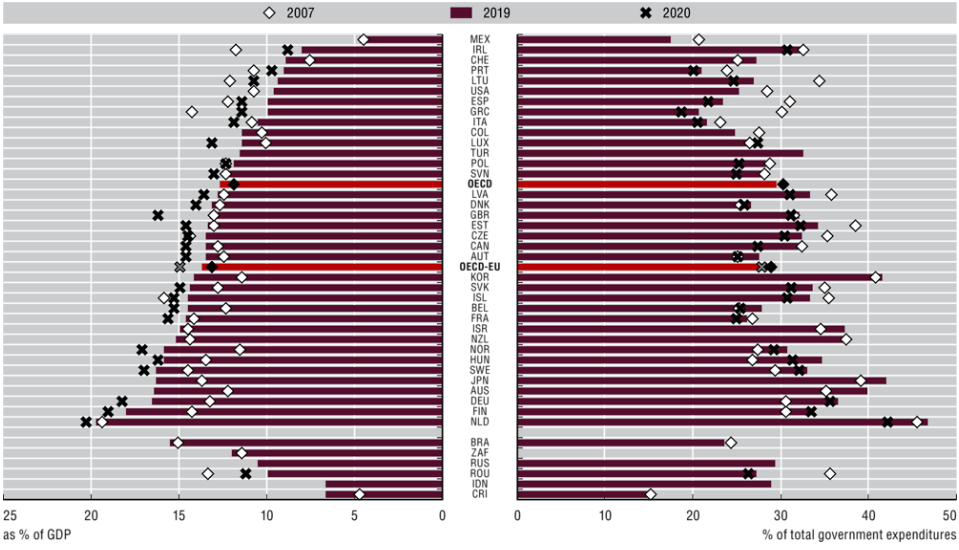
- promotes relatively **higher marginal effects** when procurement contracts are awarded to smaller firms
- **lowers credit risk** by allowing firms to use procurement contracts as collateral

Thank you for your time!

Appendix

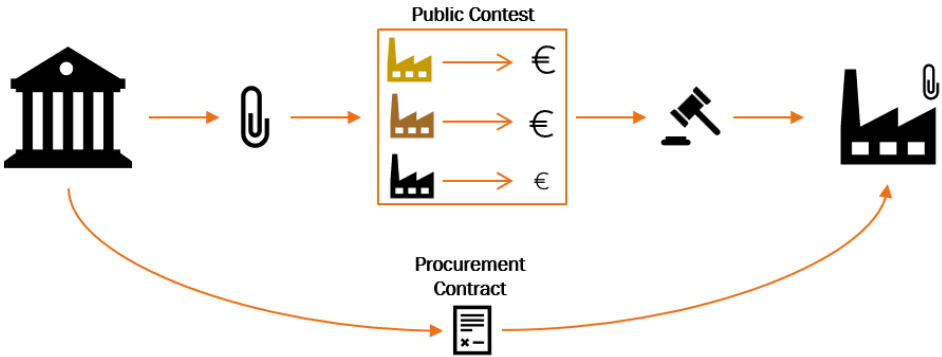
Public Procurement in OECD Countries

Back



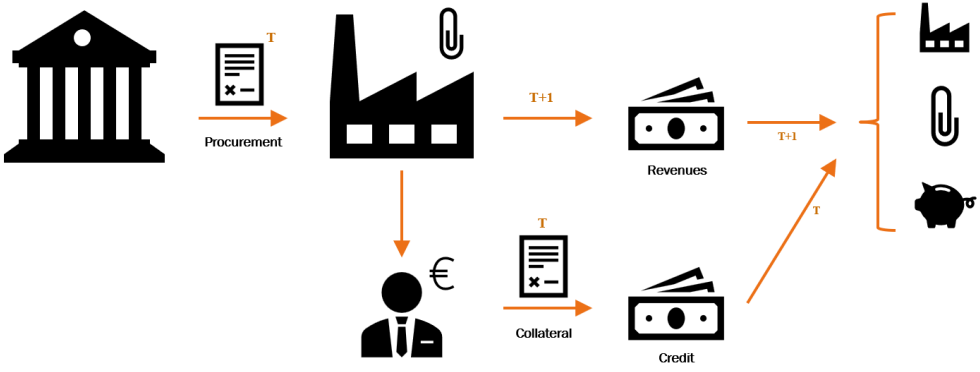
Award Diagram

Back Back



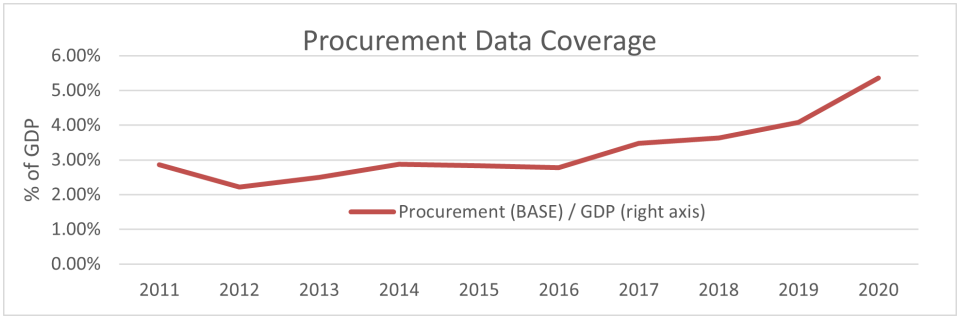
Mechanism Diagram

Back



Decent coverage of procurement in Portugal

Back



Public Contests as important as Direct Awards

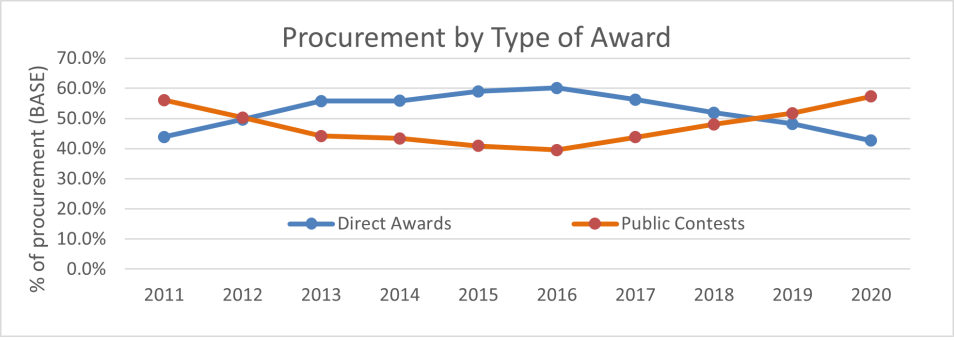


Table 1: Who received procurement contracts in 2019?

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?

		2019		2018
CPV	Description	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.

Contracts Summary Statistics

Back

	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.

Summary Statistics

Back

	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**.

Procurement sample decomposition

Back

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 tax information	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!

Back Back

	Winners		Losers			
	Mean	Median	Mean	Median	T-test	Obs
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.

Conditional Random Assignment Test within Public Contests

Back Back

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
FE	✓
R-squared	0.5789
Observations	33,940
Lagged Firm Characteristics	
F-statistic	2.3
P-value	0.21

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

This table examines the effect of the procurement award on corporate credit at the firm level. The key dependent variable Winner$_{z,j,t}$ is a dummy variable taking value 1 if the firm j won a *competitive* procurement contract in period t. Under the null hypothesis of random assignment, the variables determined before the contest should not have any predictive power, conditional on the auction fixed effects. The reported p-value is from the test of the joint significance for all independent variables which I can't reject. Standard errors are clustered at the firm level. ***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.

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**:

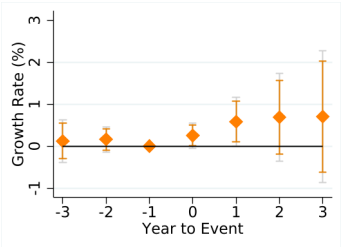
$$d(i,j) = \sqrt{(\mathbf{x}_i - \mathbf{x}_j)\Sigma^{-1}(\mathbf{x}_i - \mathbf{x}_j)}$$

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

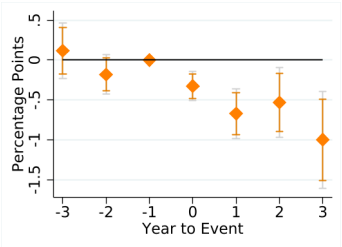
$$\frac{y_{z,i,t+k} - y_{z,i,t-1}}{y_{z,i,t-1}} = \beta^k \mathcal{I}(Winner_{z,i,t}) + \alpha_z^k + \delta_t^k + \gamma_j^k \mathbf{X}_{z,i,t-1} + \epsilon_{z,i,t}^k \quad \text{for } k \in \{-3, ..., 3\}$$

Percentage point difference between winner and runner-up

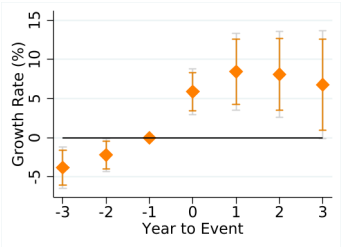
Back



(a) Credit (2,063 contracts)



(b) Interest Rates (2,063 contracts)

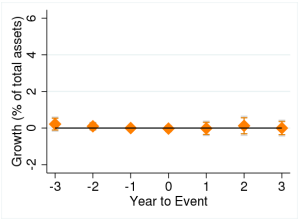


(c) Turnover (3,279 contracts)

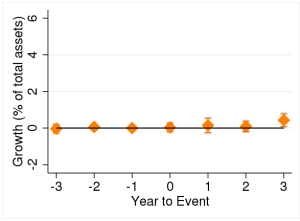
Notes: This figure displays the estimated coefficient β for each horizon k relative to the year of the award $k = 0$ from equation (14). The boxplot displays the coefficient estimate $\diamond$ and the corresponding 95% (grey) and 90% (orange) confidence bands for the response of firm credit relative to total assets in the previous year to winning a procurement contract. The estimation includes firm and industry$\times$year fixed effects. All standard errors are clustered at the firm level.

Cash-flow based lending ≈ 80%

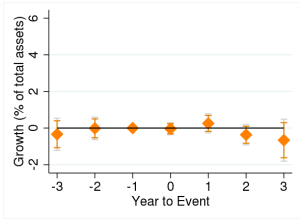
Back



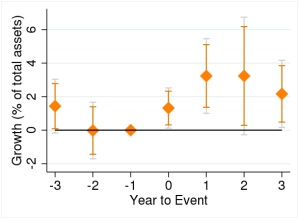
(a) Real collateral mortgaged



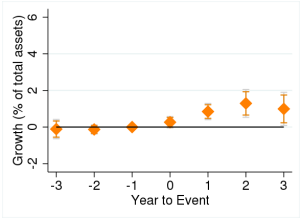
(b) Real collateral not mortgaged



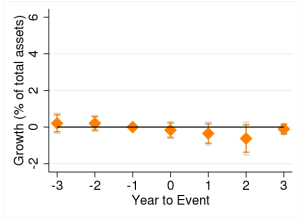
(c) Financial collateral



(d) Firm guarantees



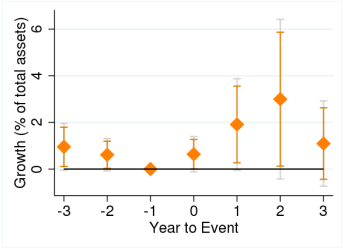
(e) State guarantees



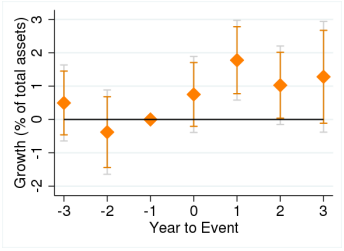
(f) Other guarantees

Credit maturity of new loans and non-performing credit

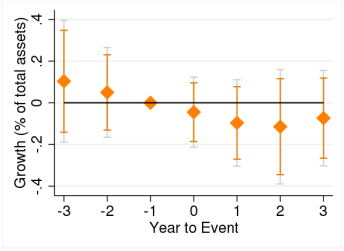
Back



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



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



(c) Non-performing credit

Measuring Financial Constraints

Back

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

Further heterogeneous effects on corporate credit

Back

	Credit Growth								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Award	5.47***	4.12***	2.34***	4.01***	4.58***	2.16***	8.95	5.03***	3.65***
	(1.97)	(1.33)	(0.74)	(1.56)	(1.56)	(0.82)	(6.41)	(1.67)	(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

The interaction of award and credit is more correlated to investment

Back

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

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

The unit of observation is the firm-year level. 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. The outcome variable is the growth rate of firm i's investment weighted by lagged total assets from year $t-1$ to year $t+1$. The key independent variable is the total contractualized amount of procurement contracts in period t received by firm i also scaled by lagged assets. Standard errors are clustered at the firm level and the dependent variable was winsorized at percentiles 1 and 99. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively.

Further heterogeneous effects of investment

Back

	Firm Investment								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Award	10.78***	8.84***	7.16***	7.66***	12.97**	8.75***	41.10***	9.46***	6.35***
	(2.67)	(1.90)	(1.49)	(2.03)	(19.10)	(3.27)	(3.02)	(1.97)	(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

Heterogeneous effects

Back

	Investment				Employment			
	Impact	1 Year	2 Years	3 Years	Impact	1 Year	2 Years	3 Years
Panel A: Baseline Specification								
Elasticity	3.52***	7.39***	9.51***	12.32***	19.42***	31.10***	30.44***	30.88**
	(0.82)	(1.32)	(2.50)	(4.40)	(4.93)	(7.89)	(10.19)	(12.63)
Panel B: Small versus Big Firms								
Small Firms	4.34***	9.22**	10.46**	11.17*	22.12***	35.27**	36.45*	36.98*
	(1.83)	(4.69)	(5.20)	(6.66)	(8.75)	(17.71)	(19.33)	(20.67)
Big Firms	1.50*	1.23	0.50	- 0.05	3.94***	4.50*	2.27	1.80
	(0.89)	(1.38)	(1.47)	(1.96)	(1.76)	(2.44)	(2.31)	(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

Notes: The unit of observation is the firm-year level i, t. The sample period is 2009-2019. In Panel A, I present the baseline results for the coefficient β^h for each horizon $h = 0, 1, 2, 3$. β^h can be interpreted as the **cumulative** response of either investment in non-current assets (first 4 columns) or total credit (last 4 columns) from period $t + h$ relative to period $t - 1$. In Panel B, I study the differences in the same two dependent variables between small and big firms defined as firms being below or above the median in terms of total assets across the entire sample. Robust standard errors clustered at the firm-level are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively.

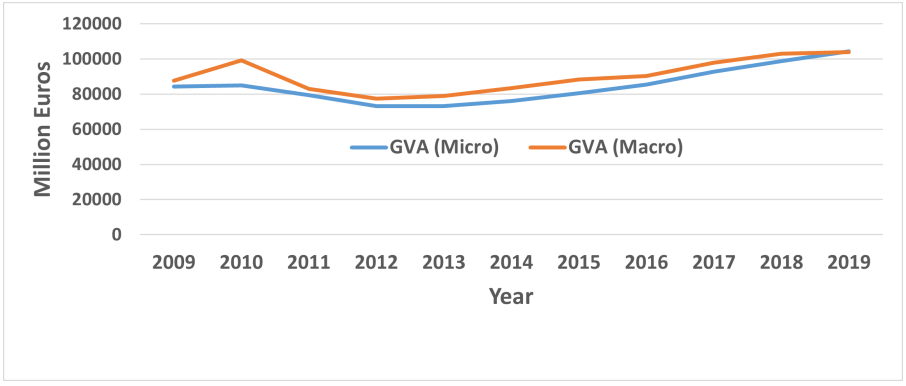
Discussion on the heterogeneous effects

Different investment and credit responses can be rationalized together:

- hard to measure financial constraints (Farre-Mensa and Ljunqvist 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 credit against procurement contracts alleviates constraints

Aggregating GVA by firm headquarters' location

Back



GVA (Macro) = output - intermediate consumption

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

Figure 11: Procurement (per capita €)

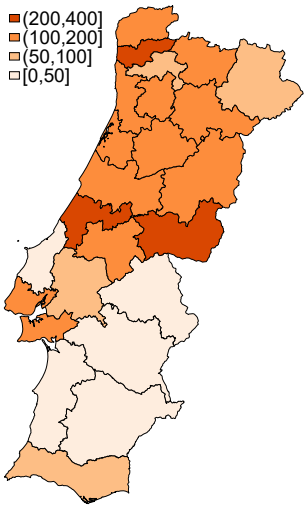
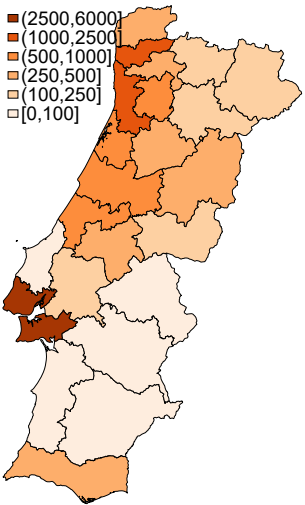


Figure 12: Procurement (mio. €)



Aggregate effects by spending location

Back

	Horizon (Year)			
	Impact	1 Year	2 Years	3 Years
Proc	1.23	1.29**	1.78**	1.83***
	(0.79)	(0.58)	(0.75)	(0.55)
Spillover	0.25	0.38	0.47	0.40
	(0.3)	(0.3)	(0.4)	(0.5)
Controls	✓	✓	✓	✓
FE	✓	✓	✓	✓
Observations	150	150	150	150

Notes: The unit of observation is the region-year level i, t. In Panel A, I estimate Equation (20). I present the results for the coefficient β^h for each horizon $h = 0, 1, 2, 3$. β^h can be interpreted as the response of regional production (proxied by gross value added) from period $t + h$ relative to period $t - 1$ to regional procurement spending aggregated at the headquarter location. In Panel B, I estimate Equation (23) and present the estimates for the coefficients β^h and γ^h. I use a matched sample period from 2010 to 2016 (25 regions $\times$ 6 years) so that changes in the estimate can't be associated to sample changes. Robust standard errors clustered at the region-level are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level for the typical null hypothesis that $\beta^h = 0$, however colored cells indicate whether the coefficient is statistically significantly different from one at the 10% level.

Further macroeconomic effects of public procurement

Back

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

Notes: The unit of observation is the region-year level i, t. β^h can be interpreted as the response of different dependent variables from period $t + h$ relative to period $t - 1$ to regional procurement spending aggregated at the headquarter location. Dependent variables are private sector expenditure on R&D (GERD); total factor productivity (TFP); number of active workers (Employment); total labour compensation; total granted credit (Credit); consumer price index (CPI). I use a matched sample period from 2010 to 2016 (25 regions $\times$ 6 years) so that changes in the estimate can't be associated to sample changes. Robust standard errors clustered at the region-level are in parentheses. *** , ** , and * denote statistical significance at the 1%, 5%, and 10% level.

GDP Decomposition by aggregation method

Back

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

Notes: I estimate Equation $\frac{\text{GDPc}_{i,t+h} - \text{GDPc}_{i,t-1}}{\text{GDP}_{i,t-1}} = \alpha_i + \delta_t + \beta^h \frac{\text{Proc}^{Agg}_{i,t}}{\text{GDP}_{i,t-1}} + \psi^h \mathbf{X}_{i,t-1} + \varepsilon_{i,t+h}$ for Agg $\in$ {HQ; LOC}.

The unit of observation is the region-year level i, t. I present the baseline results for the coefficient β^h for each horizon $h = 0, 1, 2, 3$ when regional procurement spending is aggregated at the headquarter location (first 4 columns) or at the spending location (last 4 columns). I use a matched sample period from 2010 to 2016 (25 regions $\times$ 6 years). Robust standard errors clustered at the region-level are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Spillover effects of public procurement by aggregation method

Back

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

Notes: I estimate Equation $\frac{\text{GVA}_{i-w,t+h}-\text{GVA}_{i-w,t-1}}{\text{GVA}_{i,t-1}} = \alpha_i + \delta_t + \beta^h \frac{\text{Proc}_{i,t}}{\text{GVA}_{i,t-1}} + \psi^h \text{Controls}_{i,t-1} + \varepsilon_{i,t+h}$.

The unit of observation is the region-year level i, t. I present the baseline results for the coefficient β^h for each horizon $h = 0, 1, 2, 3$. β^h can be interpreted as the response of regional production (proxied by GVA excluding the winning firms' GVA denoted by $-w$) from period $t + h$ relative to period $t - 1$ to an increase in procurement spending when aggregated by the winning firms' headquarter location (first 4 columns) and when aggregated by the spending location (last 4 columns). The sample period is 2010-2016 and rectangularized (25 regions $\times$ 6 years). Robust standard errors clustered at the region-level are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

State-Dependent Responses

Other results | Back

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

Notes: The unit of observation is the region-year level i, t. In the first row, I repeat the baseline estimates. In the second panel, I test whether regions differ when the share of procurement spending allocated to small firms is above median. The HAC Test presents the p-value of the difference between states using the heteroskedastic autocorrelated adjusted test. The sample period is 2010-2016 and rectangularized (25 regions × 6 years). Robust standard errors clustered at the region-level are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.

Other State-Dependent Responses

Back

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

Notes: The unit of observation is the region-year level i, t. In the first panel, I show state dependencies for the contract maturities. Precisely, I define that a region is in a longer maturity state when the average contract length in a particular year is above the median. In the second panel, I compare periods when procurement spending is allocated more to government investment than consumption. The HAC Test presents the p-value of the difference between states using the heteroskedastic autocorrelated adjusted test. The sample period is 2010-2016 and rectangularized (25 regions × 6 years). Robust standard errors clustered at the region-level are in parentheses. ***, **, and * denote statistical significance at the 1%, 5%, and 10% level.