Government Procurement and Access to Credit: Firm Dynamics and Aggregate Implications

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  - Large fraction of economic activity (10-15% of GDP in EU-27 and U.S.)
  - It is spread across many industries of the economy
- Recurrent policy debate: *should governments target specific types of firms?*
  - Target big firms to build "national champions"
  - Target small firms to help them grow (e.g., U.S. Small Business Act or European Parliament)

What we do

- Study the effects of public procurement on firm outcomes and the macroeconomy
  - Focus on severity and type of firms' financial frictions
  - Show how allocation of contracts to firms can have first-order effects

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- Study the effects of public procurement on firm outcomes and the macroeconomy
  - Focus on severity and type of firms' financial frictions
  - Show how allocation of contracts to firms can have first-order effects
- New administrative data set and a model of firm dynamics with a government sector to analyze:
  - Firm *selection* into procurement
  - *Treatment* effect of procurement on firm dynamics

$\Rightarrow$ Quantify the *long-run macroeconomic consequences* of alternative procurement allocation systems in Spain

Data and Motivating Evidence

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1. Data on procurement contracts from **Spanish Central Government's Official Bulletin**
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2. Balance sheet of non-financial Spanish firms constructed by Bank of Spain
   - Annual frequency 2000–13 (85% of all firms)
3. Universe of loans at the firm-bank-month level
   - Including whether a loan features **posted (tangible) collateral**
   - Loan applications for "new" firm-bank relations

Summary stats

Motivating empirical evidence

1. Winning a procurement contract associated with higher credit growth Fact 1

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4. Consistent with earnings from the public sector being more pledgeable

4.a/ Procurement contract significant when controlling for future sales growth Fact 4

4.b/ Procurement associated with higher leverage growth ("structural", more below)

Model

Model's main ingredients

- Build on standard framework of firm dynamics with financial frictions (Midrigan and Xu, 2014)
  a. Exogenous differences in productivity across firms
  b. Firms can borrow and save
  c. Borrowing is subject to a financial constraint

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- Build on standard framework of firm dynamics with financial frictions (Midrigan and Xu, 2014)
  a. Exogenous differences in productivity across firms
  b. Firms can borrow and save
  c. Borrowing is subject to a financial constraint
- We extend this setting to allow for:
  d. Downward-sloping demands in both the private and public sectors
  e. Endogenous choice to compete for procurement projects
  f. Earnings-based borrowing constraints

Technology and Demand

- Two final goods
  - Private good (Y_p): used for private consumption, capital formation, procurement applications
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  - Public good only uses a subset $I_g \subset [0,1]$ of varieties (w/ measure m_g)

$$Y_p = \left(\int_{[0,1]} y_{ip}^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}} \quad \text{and} \quad Y_g = m_g^{\frac{1}{1-\sigma}} \left(\int_{I_g} y_{ig}^{\frac{\sigma-1}{\sigma}} di \right)^{\frac{\sigma}{\sigma-1}}$$

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- Each Intermediate good produced by a different firm, with CRS technology $y_i = s_i k_i$
- Firms compete independently in each sector facing the following demands

$$p_{ip} = B_p \left[y_{ip} \right]^{-1/\sigma}, \qquad \text{where} \quad B_p \equiv P_p Y_p^{1/\sigma}$$
$$p_{ig} = B_g \left[y_{ig} \right]^{-1/\sigma}, \qquad \text{where} \quad B_g \equiv P_g Y_g^{1/\sigma}$$

Public procurement

- Procurement allocation system:
  - Firms compete for contracts by preparing costly applications
  - Firms must invest $b_{it} > 0$ at t in order to obtain a procurement contract at $t+1$ ($d_{it+1} = 1$)
  - Better applications more likely to succeed, but there is always uncertainty

$$Pr\left(d_{it+1} = 1 \mid b_{it}\right) = 1 - e^{-\eta_0 b_{it}^{\eta_1}}$$

(with $\eta_0 > 0$ and $1 > \eta_1 > 0$ to ensure positive and diminishing returns)

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- Equilibrium
  - η_0 ensures that the fraction of firms obtaining a procurement project equals m_g

Households and their firms

First principles

- Firm i owned by entrepreneur i, w/ survival probability θ and preferences:

$$\sum_{t=0}^{\infty} (\beta\theta)^t \, \mathbb{E}\left[\frac{c_{it}^{1-\mu} - 1}{1-\mu}\right]$$

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- The amount of debt is limited by the constraint:

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- With the proper timing assumptions
  - We can re-write the problem in terms of firm's net worth $a_{it} \equiv k_{it} - l_{it}$
  - We can split the problem into a static production and a dynamic saving problems

Timing Equilibrium

Optimal solutions and model outcomes

Static problem:

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  - on profits π: *positive* and *increasing* in s and a (strictly if constrained)
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Dynamic problem:

- Entrepreneurs with lower levels of net worth ($a = k - l$) have
  - higher returns to asset accumulation (relax asset-based constraint),
  - lower returns of winning a procurement project

$\Rightarrow$ *Selection* into procurement by firms with high net worth

Calibration

Borrowing constraint

- We have 3 parameters in the borrowing constraint (φ_k, φ_p, φ_g)

$$l_t = \varphi_k k_t + \varphi_p p_{pt} y_{pt} + \varphi_g p_{gt} y_{gt}$$

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Regressions

- Asset-based parameter (φ_k)
  - Match aggregate credit to capital ratio: $\varphi_k = 0.54$

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Calibration Table

Results

Benchmark economy: Selection and treatment

- *Selection:* we match a 72% "ex-ante procurement premium" in $p_i y_i$ with
  - "ex-ante procurement premium" in $a = 53\%$
  - "ex-ante procurement premium" in $s = 36\%$

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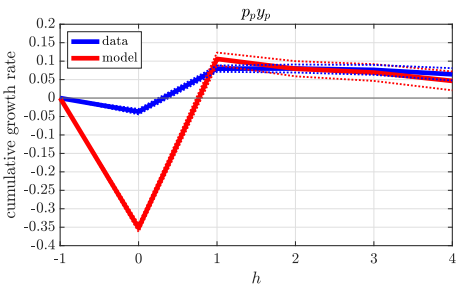
- *Treatment:*
  - Short-run crowding-out (scarce collateral split between two markets)
  - Long-run crowding-in (higher revenues accelerates self-financing channel)



Reforming the procurement allocation system

"set aside" policies

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  - → Decrease η_1 such that (ex-ante) procurement premium decreases from 72% to 50%

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  - → Change Y_g and η_0 such that $P_g Y_g$ and m_g remain constant
    - ⇒ Average project size remains constant

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Main Results

- The reform generates an increase in aggregate output

$$\underbrace{\frac{\Delta Y}{Y}}_{+2.07\%} = \underbrace{\frac{\Delta TFP}{TFP}}_{+0.29\%} + \underbrace{\frac{\Delta K}{K}}_{+1.88\%}$$

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a) TFP

- ↑ in the private sector (strengthening of the "self-financing" channel ⇒ less misallocation)
- ↓ in the procurement sector (entry of low s firms)

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- The reform generates an 8% increase in P_g/P_p
  - At same expenditure, lower provision of public goods.

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Three channels

1. *Short-run* $\Rightarrow$ **GDP** $\downarrow$ **by** 0.10%
   - Captures the aggregation of the (short-run) crowding out effect

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3. *"Full" GE long-run* $\Rightarrow$ **GDP** $\uparrow$ **by** 2.07%
   - Captures changes in savings decisions, changes in selection, and GE effects

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    (Current European Commission's strategy)

    $\Rightarrow$ GDP would $\downarrow$ by 2.68% (much bigger reduction in big firms' incentives to save)

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    $\Rightarrow$ GDP would $\downarrow$ by 2.68% (much bigger reduction in big firms' incentives to save)

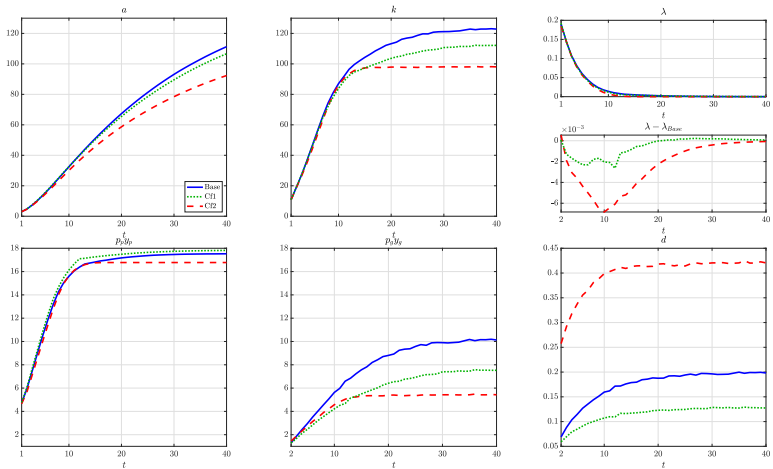
  - In a world in which $\phi_g \simeq \phi_p$

    $\Rightarrow$ Effects of policies much less expansionary (may lead to GDP losses)

Appendix

Reforming the procurement allocation system

Life cycle of firms: high productivity firms



Benchmark economy: Aggregates

- Modest levels of misallocation
  - TFP_p gains of reallocating capital across firms: 4.7%
  - TFP_g gains of reallocating capital across firms: 3.3%
- But sizeable output costs of financial frictions
  - GDP increase of setting $\phi_a \to \infty$: 12.0%
- More efficient provision of public than private goods
  - $P_g/P_p = 0.90 < 1$
  - Selection on s: higher productivity of procurement firms
  - Selection on a and $\phi_g > \phi_p$: less misallocation of capital across procurement firms

Summary statistics

- Types and size of procurement projects Go
  - A lot of procurement outside construction (>80% of projects outside construction)
  - High presence of relatively small contracts (median ≈ 0.35-0.70 M euro)
- Procurement *vs.* non-procurement firms Go Go'
  - Procurement firms are larger and older on average (but large overlap in the support of firm size)
  - Higher share of non-collateralized credit for procurement firms, despite larger net worth (86% vs. 71%)

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Number and size of projects

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Table: Value of Procurement projects (budget value in millions of euro), pool of years 2000–13

sector	mean	10th	25th	50th	75th	99th	obs.
Construction	5.28	0.13	0.23	0.74	4.00	70.84	22,549
Consulting	0.66	0.10	0.17	0.37	0.84	3.91	12,427
Services	1.22	0.11	0.20	0.42	1.05	13.47	44,581
Supplies	0.95	0.10	0.17	0.37	0.86	10.20	45,552
Others	1.99	0.09	0.15	0.35	0.99	38.18	5,524

Procurement across industries Back

Sector	Description	Firms (1)	Emp. (2)	Sales (3)	Assets (4)	Credit (5)
19	Manufacture of coke & refined petroleum prod.	0.150	0.332	0.315	0.310	0.243
21	Manufacturing of Pharmaceutical Products	0.149	0.240	0.225	0.231	0.288
42	Civil Engineering	0.093	0.260	0.324	0.366	0.386
80	Security and investigation activities	0.064	0.198	0.299	0.269	0.312
30	Manufacturing of Transport Equipment	0.052	0.176	0.177	0.205	0.180
94	Activities of membership organisations	0.051	0.069	0.127	0.037	0.018
36	Collection, purification and distribution of water	0.040	0.116	0.117	0.088	0.121
61	Telecommunications	0.038	0.217	0.192	0.189	0.207
51	Air transportation	0.033	0.054	0.049	0.078	0.142
81	Services of Buildings Maintenance	0.031	0.137	0.232	0.151	0.211
63	Information services	0.026	0.127	0.100	0.080	0.087
62	Programming, consultancy, other IT activities	0.025	0.151	0.193	0.157	0.214
26	Manufacturing of IT, electronic, & optical prod.	0.025	0.087	0.095	0.125	0.165
71	Technical services of architecture & engineering	0.024	0.152	0.159	0.084	0.103
2	Forestry and logging	0.019	0.069	0.068	0.033	0.080
6	Extraction of crude petroleum and natural gas	0.017	0.021	0.036	0.016	0.026
91	Libraries, archives, museums and cultural activities	0.016	0.061	0.051	0.021	0.017
29	Manufacture of motor vehicles and trailers	0.015	0.030	0.036	0.030	0.086
72	R&D activities	0.014	0.017	0.014	0.003	0.003
17	Paper industry	0.014	0.033	0.032	0.038	0.067

Procurement and non-procurement firms

	mean		25th		50th		75th	
	Proc	No.proc	Proc	No.proc	Proc	No.proc	Proc	No.proc
Age	20.42	10.95	12.00	5.00	17.00	10.00	24.00	15.00
Employment	73.56	12.75	16.00	3.00	45.00	6.00	155.0	12.00
Sales	8.96	1.19	1.14	0.10	4.22	0.28	16.89	0.86
Procurement/Sales	0.20	0.00	0.01	0.00	0.03	0.00	0.10	0.00
Fixed Assets	3.80	0.85	0.21	0.03	0.82	0.14	3.58	0.50
Credit	2.51	0.57	0.11	0.03	0.48	0.08	2.32	0.30
Coll. Credit (share)	0.14	0.29	0.00	0.00	0.00	0.00	0.14	0.74

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Fact 1: Credit growth and procurement

	All firms	Bidders only	
		First	Second
	(1)	(2)	(3)
$PROC_{it}$	0.055^a	0.073^a	-0.061
	(0.004)	(0.028)	(0.049)
$\log(Credit_{it-1})$	-0.410^a	-0.175^a	-0.229^a
	(0.001)	(0.043)	(0.044)
Observations	700,780	8,310	3,683
R-squared	0.786	0.360	0.458
Sector×quarter FE	Yes	No	No
Firm×year FE	Yes	Yes	Yes
Quarter FE	No	Yes	Yes
Auction FE	No	Yes	Yes

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Fact 2: Composition of credit growth and procurement

	All firms		Bidders only			
			First		Second	
	Collat.	NoCollat.	Collat.	NoCollat.	Collat.	NoCollat.
	(1)	(2)	(3)	(4)	(5)	(6)
$PROC_{it}$	0.001	0.070[a]	-0.011	0.080[b]	-0.019	-0.058
	(0.006)	(0.005)	(0.029)	(0.031)	(0.044)	(0.057)
Observations	224,011	557,873	2,690	8,110	1,423	3,606
R-squared	0.791	0.764	0.357	0.368	0.435	0.435
Sector×quarter FE	Yes	Yes	No	No	No	No
Firm×year FE	Yes	Yes	Yes	Yes	Yes	Yes
Quarter FE	No	No	Yes	Yes	Yes	Yes
Auction FE	No	No	Yes	Yes	Yes	Yes

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Fact 3: Probability of a new loan and procurement

	All firms	
	(1)	(2)
$PROC_{it}$	0.024^{a}	0.023^{b}
	(0.008)	(0.011)
Observations	36,857	26,924
R-squares	0.395	0.628
Firm×bank FE	Yes	Yes
Bank×quarter FE	No	Yes
Sector×quarter FE	No	Yes

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Fact 4: Credit growth and procurement, given future sales growth

	All firms		
	(1)	(2)	(3)
$PROC_{it}$	0.053^{a}	0.043^{a}	0.041^{a}
	(0.006)	(0.006)	(0.006)
Sales growth$_{it+1}$	0.107^{a}	0.027^{b}	0.024^{c}
	(0.020)	(0.011)	(0.011)
Observations	86,537	86,096	83,652
R-squared	0.051	0.282	0.330
Year FE	Yes	Yes	No
Firm FE	No	Yes	Yes
Sector×Year FE	No	No	Yes

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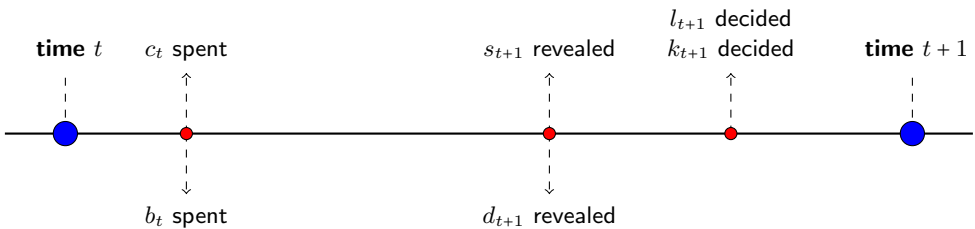
Timing in the model



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Preferences and constraints

Re-formulation

- Let $a_{it} \equiv k_{it} - l_{it}$ be the firm's net worth. We can re-write the constraints as:

$$\begin{aligned} c_{it} + b_{it} + a_{it+1} &\leq (1+r)a_{it} + (1-\tau)\underbrace{[p_{ipt}y_{ipt} + p_{igt}y_{igt} - (r+\delta)k_{it}]}_{\pi_{it}} \\ k_{it} &\leq \phi_a a_{it} + \phi_p p_{ipt} y_{ipt} + \phi_g p_{igt} y_{igt} \end{aligned}$$

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- The parameters in the borrowing constraint are re-defined as:

$$\phi_a \equiv \frac{1}{1-\varphi_k}, \quad \phi_p \equiv \frac{\varphi_p}{1-\varphi_k}, \quad \phi_g \equiv \frac{\varphi_g}{1-\varphi_k}$$

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- The problem can be split into:
  - Static production problem
  - Dynamic saving problem

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Static production problem

Set up

- The entrepreneur of type (s, a, d) chooses sizes $k_p(s, a, d)$ and $k_g(s, a, d)$:

$$\pi(s, a, d) = \max_{k_p, k_g \geq 0} \left\{ p_p y_p + p_g y_g - (r + \delta)(k_p + k_g) \right\}$$

subject to:

$$p_p y_p = B_p \left[s k_p \right]^{\frac{\sigma - 1}{\sigma}}$$

$$p_g y_g = B_g \left[s k_g \right]^{\frac{\sigma - 1}{\sigma}} \times d$$

$$k_p + k_g \leq \phi_k a + \phi_p p_p y_p + \phi_g p_g y_g$$

- There will be a multiplier $\lambda(s, a, d)$ associated to the financial constraint

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Dynamic problem

Set up

- Entrepreneur chooses consumption $c(s,a,d)$, savings $a'(s,a,d)$ and investment in proc. $b(s,a,d)$
- The *dynamic saving* problem can be written in recursive form,

$$V(s,a,d) = \max_{c,b,a'} \left\{ u(c) + \beta\theta \, \mathbb{E}_{s',d'|s,b} \left[V\left(s',a',d'\right) \right] \right\}$$

subject to:

$$c + b + a' = (1+r)\, a + (1-\tau)\, \pi(s,a,d)$$

$$a' \geq 0$$

$$\mathbb{E}_{s',d'|s,b} \left[V\left(s',a',d'\right) \right] = \mathsf{Pr}\left(d'=1|b\right) \mathbb{E}_{s'|s} V\left(s',a',1\right) + \mathsf{Pr}\left(d'=0|b\right) \mathbb{E}_{s'|s} V\left(s',a',0\right)$$

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Equilibrium conditions I

a) Entrepreneurs solve their optimization problem

b) The probability measure Γ is stationary

c) The market for the private good clears:

$$\int_{\mathbf{X}} p_p(a,s,d)\, u(a,s,d)\, y(s,a,d)\, d\Gamma = Y_p = \int_{\mathbf{X}} \left[b(s,a,d) + c(s,a,d) + \delta k(s,a,d) \right] d\Gamma$$

d) The market for the public good clears:

$$\int_{\mathbf{X}_1} p_g(a,s,1) \left[1 - u(a,s,1) \right] y(s,a,1)\, d\Gamma = P_g Y_g$$

e) The probability of obtaining procurement projects is consistent with the measure of goods bought by the public sector,

$$\int_{\mathbf{X}} Pr\left(d' = 1 \mid b(s,a,d) \right) d\Gamma = \int_{\mathbf{X}_1} d\Gamma = m_g$$

f) The budget constraint of the government holds

$$PgYg = rD + \tau \int_{\mathbf{X}} \pi(s,a,d)\, d\Gamma + (1-\theta) \left[\int_{\mathbf{X}} a'(s,a,d) d\Gamma - \int_{\mathbf{X}} a d\Gamma_0 \right]$$

g) By Walras law, the debt market clears.

$$D = \int_{\mathbf{X}} \left[k(s,a,d) - a(s,a,d) \right] d\Gamma$$

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Structural leverage regressions

	(1)	(2)	(3)
$\Delta p_{it} y_{it}/k_{it}$	0.425^{c}	0.543^{b}	0.419^{c}
	(0.227)	(0.257)	(0.229)
$\Delta p_{igt} y_{igt}/k_{it}$	0.682^{c}	0.797^{c}	1.047^{c}
	(0.391)	(0.478)	(0.588)
Observations	579	403	282
R-squared	0.391	0.437	0.421
Sector×year FE	Yes	Yes	Yes
Sample by age	$\leq$ 10 yrs	$\leq$ 9 yrs	$\leq$ 8 yrs

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Calibration parameter values

Panel A: parameters				Panel B: Moments	
		(1) Baseline	(2) $\phi_p = \phi_g$		
Block 1					
μ	CRRA coefficient	2.00	2.00		
σ_p	CES private sector	3.00	3.00		
σ_p	CES government	3.00	3.00	extscpredetermined	
β	Discount factor	0.94	0.94		
δ	Depreciation rate	0.10	0.10		
ρ_s	AR(1) correlation	0.80	0.80		
σ_s	AR(1) variance	0.30	0.30		
Block 2					Data = Model
ϕ_a	borrowing const. (a)	2.17	2.34	Credit/K	0.55
ϕ_p	borrowing const. ($p_p y_p$)	0.92	0.99	reg. coefficient (φ_p)	0.42
ϕ_g	borrowing const. ($p_g y_g$)	2.40	0.99	reg. coefficient ($\varphi_g - \varphi_p$)	0.68
Block 3					
η_0	probability function (level)	0.21	0.21	Consistency of $g(b)$ with m_g	–
η_1	probability function (slope)	0.53	0.55	Procurement premium	0.72
Y_g	demand shifter	0.83	0.63	Share of procurement in GDP	0.12
m_g	measure of procurement goods	0.038	0.038	Percentage of procurement firms	3.8%
Block 4					
D	Government lending	0.86	0.84	Interest rate	5%
$\bar{s}$	Productivity shifter	-6.51	-6.53	K/Y (aggregate)	3.88
$heta$	Survival probability	0.95	0.95	Exit rate	5%

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Treatment in benchmark economy

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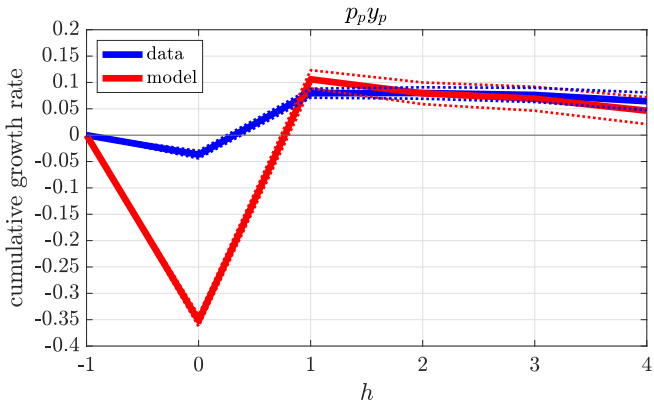
Crowding out of private sales: model vs. data (local projection)



- Small/constrained firm cuts private sales initially when receiving procurement
- As firm constraints become less binding expands sales to private sector