Government Investment and Q

Theory and Evidence

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A Puzzle of Local Booms

PRIVATE-SECTOR BOOM

Public finances improve

Tax revenue ↑
Borrowing cost ↓

Invest more?

Local input costs rise

Wages ↑
Land prices ↑

Invest less?

Which force dominates?

Texas Shale Boom: More Revenue, Less Operating Capacity

SHALE BOOM
Texas school districts, 2001–2014

$\approx 3\times$
local tax base

$+20\%$
teacher–private wage gap

Revenue windfall

Capital projects ↑ Debt service ↑
Extra teacher spending ≈ 0

Teacher turnover ↑
Inexperienced teachers ↑
Test scores ↓ **Attendance ↓**

Fiscal capacity ↑ **but** **operating capacity ↓**

Identification: cross-district shale geology × boom timing. *Source:* Marchand and Weber (2020), *JPAM* 39(1), 36–63.

An acre of land, two very different prices

An acre zoned for a data center in Loudoun County, VA:

$6.3 million

An acre of ordinary land nearby:

$125,000

In parts of Texas, similar parcels that traded for $20,000–$40,000 an acre a few years ago now sell above **$350,000**.

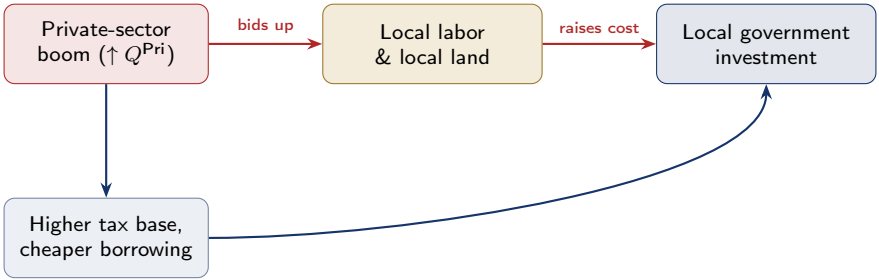
The same parcels a local government needs

To widen a road, site a school, or build a water-treatment plant — ordinary government investment.

It pays fair market value too. But when the private sector can outbid it several times over, land the government needs simply gets harder, and slower, to acquire.

Source: NAHB (2026).

The tension: a local boom cuts both ways for a government



Crowding-out channel
labor & land are locally fixed, shared inputs

Financing channel
higher revenue, cheaper municipal debt

The model does not resolve the tension by assumption — it lets the data decide the net sign.

This paper

1. Develop a **Q-theoretic model** of local public investment:
   - a government with **two** stocks of public capacity
   - physical capital (tangible) and operating capacity (intangible)
   - financed by taxes and defaultable municipal debt
   - competing with a private firm for local labor and land
2. Construct **new regional measures** of
   - government Q from **municipal bond prices** (à la Philippon, 2009)
   - private-sector Q from **firm-level Q**, mapped to regions
3. Test the model's two central predictions on a 1994–2022 panel of U.S. states.
4. Isolate the mechanism using **local labor- and land-market tightness**.

Summary of main results

Government investment rises with *government* Q

Consistent with canonical Q-theory: a higher marginal value of public capital means more investment.

Government investment falls with *private-sector* Q

The opposite of the standard prediction — crowding-out dominates financing, net.

- The two Q's are essentially **uncorrelated** in the cross-section.
- The negative relation is **concentrated in tight labor & land markets**.
- It **splits cleanly** across spending margins
- Labor tightness $\rightarrow$ current operations; land tightness $\rightarrow$ capital outlay
- A calibrated, simulated model reproduces the sign and relative magnitude

Selected references

Q-theory of investment

- Tobin (1969); Hayashi (1982)
- Philippon (2009) — bond-price Q
- Erickson & Whited (2000, 2012); Peters & Taylor (2017)

Public capacity & state capacity

- Oi (1962); Prescott & Visscher (1980)
- Eisfeldt & Papanikolaou (2013)
- Besley & Persson (2009)

Sovereign / municipal default

- Arellano (2008); Bi (2012)
- Bernanke, Gertler & Gilchrist (1999)
- Novy-Marx & Rauh (2012); Schwert (2017)

Public-sector labor markets

- Quadrini & Trigari (2007); Gomes (2015)
- Galí et al. (2007) — hand-to-mouth households
- Freeman (1987); Lamo, Pérez & Schuknecht (2012)

Fiscal policy & public investment

- Nakamura & Steinsson (2014); Ramey (2018)
- Leeper, Walker & Yang (2010)
- Chava, Kumar, Suraj & Xie (2024)

Regional Q construction

- Boguth, Duchin & Simutin (2022) — conglomerate Q
- Pierson, Hand & Thompson (2015) — Census data

Full bibliography in the paper.

A Q-theory of local public investment

An open economy the size of a state, annual frequency:

- a representative **household** (hand-to-mouth, local)
- a representative **private firm** — standard Hayashi (1982) economy
- a **local government** with *two* stocks of public capacity
- risk-neutral **national investors** who price local debt, β_N

Three exogenous AR(1) shocks:

$$a_t = \rho_A a_{t-1} + \sigma_A \varepsilon_t^A, \quad z_t = \rho_Z z_{t-1} + \sigma_Z \varepsilon_t^Z, \quad g_t = \rho_G g_{t-1} + \sigma_G \varepsilon_t^G$$

a_t	private productivity
z_t	household demand for public services
g_t	fiscal capacity (revenue unrelated to local activity)

Households and the public workforce

Household ranks private consumption and public services:

$$\mathbb{E}_0 \sum_{t \geq 0} \beta_L^t \big[u(C_t) + v(S_t)\big], \qquad C_t = (1-\tau)\big(w_t N_t^P + w_t^G N_t + \theta_D D_t\big)$$

Sluggish reallocation between public and private employment:

$$\log N_t = \rho_N \log N_{t-1} + (1-\rho_N)\log \bar{n} + \phi_N \log \frac{w_t^G}{w_t}$$

- ϕ_N: fraction of workforce moving per unit of log pay gap
- public pay w_t^G catches up to private pay w_t only **gradually** — costly to reopen pay scales
- total employment fixed: $N_t^P + N_t = 1$

This lag is what makes a private boom bite — without it, crowding-out would be weak.

The firm and private q

Standard neoclassical firm, public services enter as an input:

$$Y_t = \Gamma e^{a_t}(K_{t-1}^P)^{\alpha}(N_t^P)^{1-\alpha}(S_t)^{\xi}$$

Quadratic adjustment costs $\Rightarrow$ familiar Q-theory conditions:

$$q_t^P = 1 + \varphi_P\Big(\frac{I_t^P}{K_{t-1}^P} - \delta_P\Big), \qquad q_t^P = \beta_N \mathbb{E}_t\Big[(1-\tau_P)\alpha\frac{Y_{t+1}}{K_t^P} - \Phi_{K,t+1}^P + (1-\delta_P)q_{t+1}^P\Big]$$

Homogeneous of degree one $\Rightarrow V_t = q_t^P K_t^P$: **average** = **marginal** q.
The private $Q_t^P \equiv V_t/K_t^P$ is the sufficient statistic for investment.

Two stocks of public capacity

Physical capital K_t^G (tangible / capital outlay)

$$I_t^G = \varpi_G (N_t^G)^{1-\alpha_M} (M_t^c)^{\alpha_M}$$

- built from **construction labor** & materials
- roads, buildings, equipment
- low labor share: $1 - \alpha_M = 0.235$

Operating capacity O_t (intangible)

$$I_t^O = \varpi_O (N_t^O)^{1-\alpha_O} (M_t^o)^{\alpha_O}$$

- installed people & procedures
- public-sector **organizational capital**
- depreciates through turnover
- high labor share: $1 - \alpha_O = 0.75$

Both feed public services: $S_t = e^{z_t} (K_{t-1}^G)^{\alpha_G} (O_{t-1})^{1-\alpha_G} (1 - \ell H_t)$.
These enter household utility *and* firm output.

Each stock has its own marginal value: q_t^G and q_t^O.

The government's problem, and the bond-price q

The government maximizes household welfare subject to

$$T_t + q_t^B B_t = (1 - \bar{h} H_t) B_{t-1} + w_t^G N_t + M_t^c + M_t^o + \Phi_t^G + \Phi_t^O + \Phi_t^w$$

choosing investment in both stocks, the workforce split, new debt, and the posted wage.

Investors price default risk (a stochastic fiscal limit, à la Bi 2012):

$$q_t^B = \beta_N (1 - \bar{h} d_t), \qquad d_t = \Lambda\left(\psi_0 + \psi_1 \tfrac{B_t}{K_t^G + O_t} - \psi_2 g_t\right)$$

$Q_t^B \equiv q_t^B / \beta_N = 1 - \bar{h} d_t$ — the bond-market q (Philippon, 2009), for a government

- defaults are idiosyncratic across many small projects (à la BGG 1999) $\Rightarrow$ clean aggregation
- Q_t^B enters the government's *own* FOC for investment (not just correlated with it)

Two predictions

Each stock's investment rate depends only on its own true q:

$$\frac{I_t^G}{K_{t-1}^G} = \delta_G + \frac{p_t^G}{\varphi_G}(q_t^G - 1), \qquad \frac{I_t^O}{O_{t-1}} = \delta_O + \frac{p_t^O}{\varphi_O}(q_t^O - 1)$$

Neither q_t^G nor q_t^O is observable $\Rightarrow$ we use Q_t^B and Q_t^P as noisy proxies.

Prediction 1

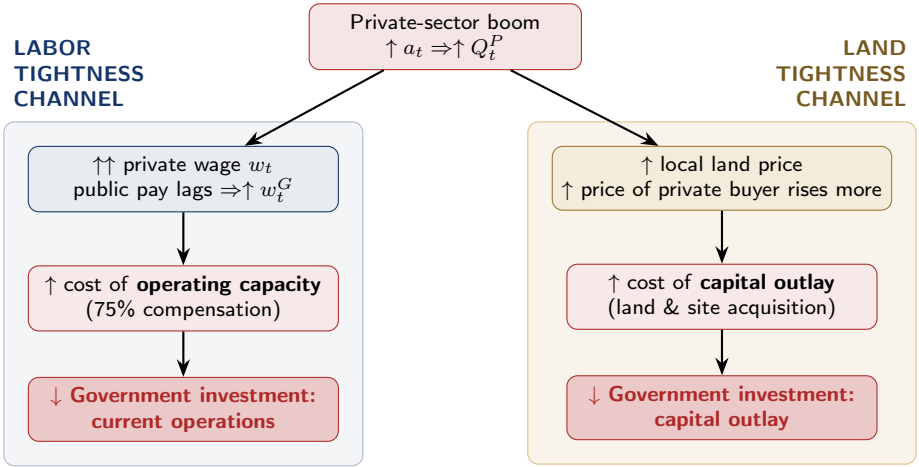
Government investment is **positively** related to government Q (canonical Q-theory).

Prediction 2

Government investment is **negatively** related to private-sector Q.

Channel: Public and private investment compete for the same local **labor and land**.

Mechanism: labor and land channels



Why the bond-price q is *not sufficient*

1. **Two margins, one price.** q_t^G, q_t^O react differently (labor shares 0.235 vs. 0.75).
2. **Fiscal vs. labor-cost signal.** Higher revenue $\Rightarrow$ debt paydown $\Rightarrow Q_t^B \uparrow$, even as $q_t^O \downarrow$.

Private Q_t^P captures what the bond price misses.

On impact, a 1-s.d. productivity shock:

	% change
Q_t^B	$+0.05$
q_t^G	$+0.11$
q_t^O	-0.65

Calibration (annual)

Preferences & technology

$\beta_N = 0.96$	national discount factor
$\alpha = 0.35,\ \delta_P = 0.08$	private capital share, depr.
$\xi = 0.07$	elasticity of services

Public investment

$s_{\text{cap}} = 0.123$	capital outlay share
$\alpha_M = 0.765,\ \alpha_O = 0.25$	purchased-input shares
$K^G/Y = 1.25$	phys. capacity / output

Labor market

$\varphi_w = 7$	pay-scale adj. cost
$\phi_N = 1.0,\ \rho_N = 0.9$	elasticity, persistence

Public finance & credit

$B/Y = 0.154,\ T/Y = 0.16$	debt, revenue ratios
$\bar{d} = 0.018$	s.s. default prob.
$\psi_2 = 2$	fiscal-capacity slope

Shocks

$\rho_A = \rho_Z = 0.9,\ \rho_G = 0.8$	persistence
$\sigma_A = 0.0226$	targets regression scale

Implied by steady state

$\beta_L = 0.9582$	gov't discount factor
$\bar{n} = 0.1399$	public employment share

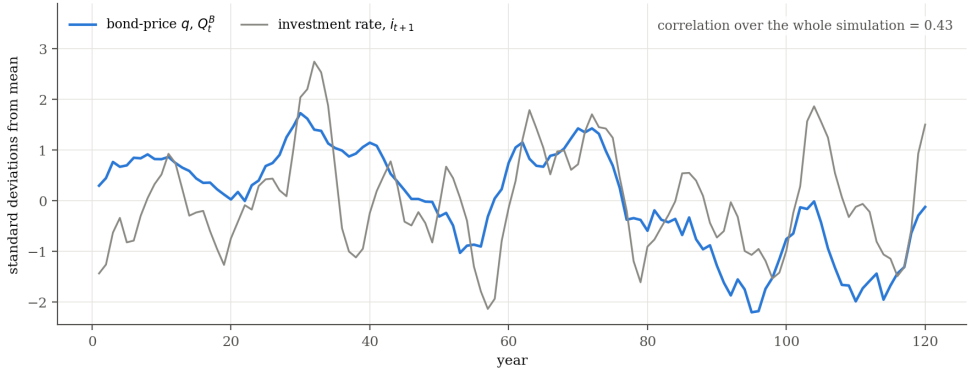
Simulated investment regressions

	(1)	(2)	(3) joint
A. Total investment i_{t+1}			
Bond-price q, Q_t^B	0.2666 [8.8]		0.2703 [8.8]
Private q, Q_t^P		−0.0627 [−4.5]	−0.0671 [−5.5]
B. Current operations			
Bond-price q	0.2322 [9.9]		0.2362 [10.2]
Private q		−0.0685 [−7.2]	−0.0723 [−9.1]
C. Capital outlay			
Bond-price q	0.5173 [5.5]		0.5187 [5.5]
Private q		−0.0149 [−0.4]	−0.0238 [−0.6]

Averages across 500 simulated panels of 45 localities × 29 years. Locality & year FE; mean t-statistics in brackets.

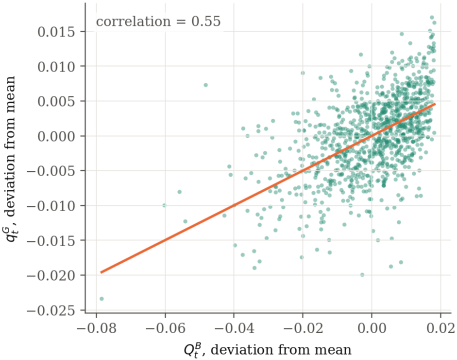
The model **reproduces both signs**: crowding-out wins even inside the model.
It concentrates in current operations (labor-intensive), not capital outlay.

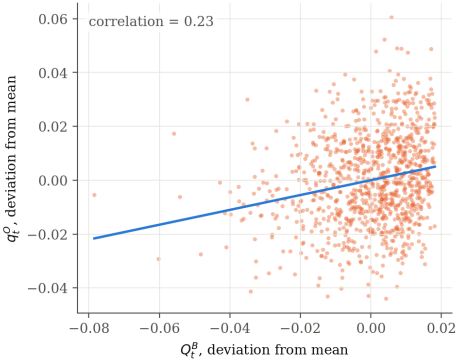
The bond price tracks next year's investment



Bond-price q vs. next-year investment rate (standardized). Corr. over the full simulation $= 0.43$.

...and each marginal q, imperfectly





q_t^G vs. Q_t^B (physical). Corr. $= 0.55$ ($R^2 = 0.43$). q_t^O vs. Q_t^B (operating). Corr. $= 0.23$ ($R^2 = 0.04$).

Informative about *both* margins, but sufficient for *neither* — especially operating capacity.

Constructing the two regional Q's

Government Q: municipal bonds

$$q^B_{j,t,n} = \frac{1/\text{Mat}_n + r_n}{1/\text{Mat}_n + \text{Yield}_n}$$

- akin to the inverse credit spread
- averaged across sub-state bonds, by region-year
- MSRB prices, Q4 of each year

Private-sector Q: firm $Q \rightarrow$ region

- firm value / sales, Compustat & CRSP
- multi-region firms: decompose by establishment
- weights: sales/employment (NETS)
- invert via median regressions (Boguth, Duchin & Simutin, 2022)

Government investment rate

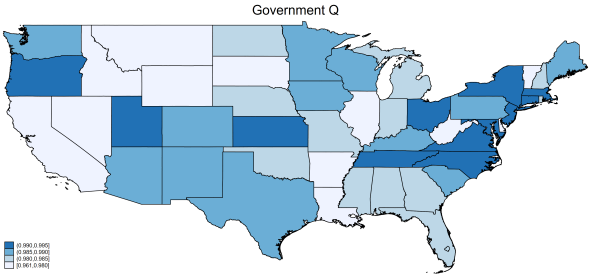
(current operations + capital outlay) / lagged government capital (perpetual inventory, $\delta = 10\%$). Census annual survey of state & local government finances, 1994–2022.

Summary statistics and regional patterns

	Mean	S.d.
Government Q	0.982	0.047
Private-sector Q	1.399	0.661
Gov't invest. rate (%)	13.34	1.71
Current ops. (%)	13.47	1.69
Capital outlay (%)	12.59	2.52
Debt / GDP	0.154	0.058
Revenue / GDP	0.232	0.074

Gov. Q lowest: WY, VT. Highest: CT, MA.
Priv. Q lowest: KY, SC. Highest: CA.

Corr(Gov. Q, Priv. Q) ≈ 0.016: uncorrelated.



Cross-sectional distribution of government Q

Main result: government investment and the two Q's

$$i_{j,t}^{\text{Gov}} = \alpha_j + \delta_t + \beta^{\text{Gov}} q_{j,t-1}^{\text{Gov}} + \beta^{\text{Pri}} q_{j,t-1}^{\text{Pri}} + \epsilon_{j,t}$$

	(1)	(2)	(3)	(4)	(5)	(6)
Government Q	0.749***		0.870***	0.601**		0.737***
	(3.18)		(3.51)	(2.40)		(2.75)
Private-sector Q		−0.171*	−0.186**		−0.144**	−0.157***
		(−1.92)	(−2.25)		(−2.43)	(−2.74)
Controls	No	No	No	Yes	Yes	Yes
State & Year FE	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.806	0.820	0.827	0.832	0.842	0.846

A 1-s.d. increase in government Q: **+0.87pp**. A 1-s.d. increase in private-sector Q: **−0.19pp**. Controls: log(GDP), debt/GDP, revenue/GDP. State-clustered t-stats. 1994–2022.

Splitting the margins: current operations vs. capital outlay

	Current operations		Capital outlay	
	(1)	(3)	(1)	(3)
Government Q	0.600***	0.691***	1.568***	1.853***
	(2.77)	(2.99)	(2.96)	(3.48)
Private-sector Q		−0.182**		−0.217*
		(−2.35)		(−1.72)
R^2	0.824	0.843	0.537	0.553

- **Government-Q sensitivity** 2–2.5× **larger** for capital outlay (purchased inputs vs. sticky pay).
- **Private-Q sensitivity** sharper for **current operations** (75% vs. 23.5% compensation).

Channel: labor-market tightness

$$+ \gamma \cdot \mathbf{1}\{\text{Tight Labor}\}_{j,t} \; + \; \theta \cdot \mathbf{1}\{\text{Tight Labor}\}_{j,t} \cdot q^{\text{Pri}}_{j,t-1}$$

	Total invest.	Current ops.	Capital outlay
Private-sector Q (uninteracted)	-0.079	-0.060	-0.180
$\mathbf{1}\{\text{Tight Labor}\} \times Q^{\text{Pri}}$	$\mathbf{-0.333}$**	$\mathbf{-0.331}$**	-0.319
	(-2.22)	(-2.49)	(-0.95)
Government Q	0.715**	0.573**	1.471**

- Negative private-Q relation is **concentrated almost entirely in tight labor markets**.
- Within tight markets, crowding-out is **almost entirely on current operations**.
- That's exactly where compensation dominates costs.
- Government-Q sensitivity is **unaffected** by labor tightness.
- Consistent with a financing channel through fiscal capacity, not the labor market.

Channel: land-market tightness

	Total invest.	Current ops.	Capital outlay
Private-sector Q (uninteracted)	-0.170	-0.191*	-0.060
$\mathbf{1}\{\text{Tight Land}\} \times Q^{\text{Pri}}$	0.012	0.079	**-0.368****
	(0.18)	(1.31)	(-2.30)
Government Q	0.785***	0.688***	1.440***

- Null on **total** investment matches the input-mix asymmetry.
- Land flows almost entirely through capital outlay.
- Splitting the outcome reveals the **mirror image** of the labor result.
- Land tightness crowds out **capital outlay** specifically, not current operations.
- Again, government-Q sensitivity is unaffected.
- The bond-price channel runs through fiscal capacity, not either factor market.

Conclusion

- We build a **Q-theoretic model** of local public investment.
- New measures: government Q from **bond prices**; private-sector Q from **firm valuations**.
- Government investment **rises** with government Q, **falls** with private-sector Q.
- The negative relation is concentrated in **tight local labor and land markets**.

Thank you

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Comments and questions welcome.