Public Procurement, the Nature of Innovation, and Growth: Firm-Level Evidence from Germany

Johar Arrieta[1] Jorge Zavala[2]

[1]University of Michigan

[2]WZB Berlin / Humboldt University

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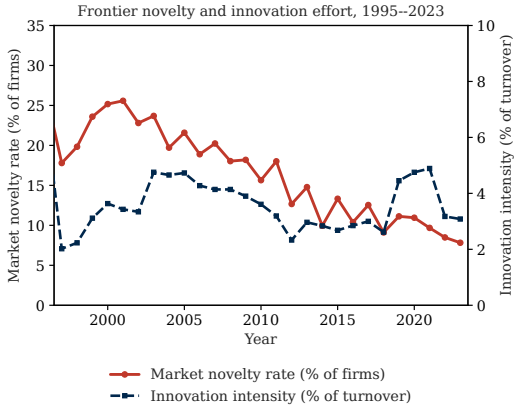
German firms invest in R&D — but fewer reach the frontier



Market novelty = firm introduces a product new to the market.

Innovation intensity = innovation expenditure / turnover.

The puzzle is not a collapse in R&D effort. It is a shift away from frontier novelty.

Public Procurement as a Demand Explanation

German public procurement $\approx 15\%$ of GDP. Contracts reward compliance — not novelty:

Sector	Procurement-favored margin
Medical equipment	certifiability over diagnostic frontier
IT services	backward compatibility over new architecture
Transport vehicles	proven capacity over novel technology

Higher exposure $\Rightarrow$ fewer market-novel products, more revenue from existing lines.

This Paper

1. Document that procurement shifts innovation composition

- Higher exposure $\Rightarrow$ less market novelty, more existing-product revenue.
- Strongest in supplies/services and central-government procurement.

2. Extend a quality-ladder model with innovation composition choice

- Firms choose effort and frontier share; procurement reduces novelty payoff.
- The estimated model asks whether scale gains offset the composition loss.

3. Procurement design has measurable growth costs

- R&D tax-credit redirect: $+12$ bp/yr, $+3.2\%$ welfare.
- Specification realignment: $+2.8$ bp/yr at zero fiscal cost.

Outline

Data Sources

- **MIP** (Mannheim Innovation Panel) — annual innovation survey, 80k firm-years, 21 industries. ZEW Mannheim, 2009–2023
  - product & process innovation, R&D expenditure and personnel, revenue shares by product type, public subsidies received; R&D inputs

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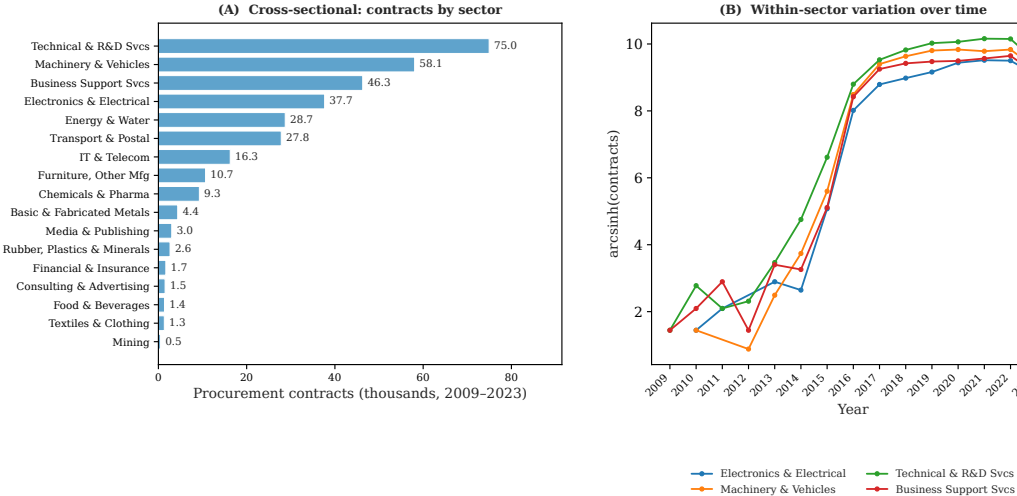
- **TED** (Tenders Electronic Daily) — EU contract award notices from German public buyers. European Commission, 2009–2023
  - $+270$k matched to MIP industries; sector-level contract volume per year
  - Buyer category (central / regional / local / utilities), contract type (supplies, services, works), procedure type (open, restricted, negotiated)

Procurement Exposure Varies Across Sectors and Over Time



Panel A: total awarded contracts by MIP-covered industry, 2009–2023. Panel B: arcsinh(contracts) by year for the four largest sectors. Substantial within-sector time variation identifies β.

Empirical Strategy

$$Y_{ist} = \alpha_i + \delta_t + \beta \underbrace{\operatorname{arcsinh}(\text{contracts}_{s,t})}_{\approx \ln(\text{contracts}),\ \text{defined at zero}} + \varepsilon_{ist}$$

Outcomes Y_{ist} (MIP, 2009–2023):

- **Market novelty** — did the firm introduce a product *new to the market*?
- **Existing-product revenue** — share of turnover from unchanged lines

Parameters:

- α_i: firm FE — absorbs permanent selection into public procurement
- δ_t: year FE — absorbs aggregate shocks common to all firms
- $\hat{\beta}$: within-firm association as *sector-level* exposure varies over time

Main Results: Procurement Changes *What* Firms Innovate

	(1) Mkt novelty mean: 16.2%	(2) Exist.-prod. rev. mean: 84.5%	(3) Process innov.	(4) Cost-red. rev.
Proc. exposure	-0.199^{*}	$+0.379^{**}$	$+0.101$	-0.047^{*}
	(0.101)	(0.137)	(0.169)	(0.024)

Firm + year FEs. 21 industries clusters. $N = 66{,}980$.

Procurement changes *what* firms innovate, not *whether* they innovate.

The Composition Shift Is Strongest Where Specifications Matter

	(1) Market novelty	(2) Exist.-prod. rev.
Contract type		
Supp. & services	-0.211^{**}	$+0.393^{***}$
	(0.099)	(0.137)
Works	-0.010	$+0.180$
	(0.142)	(0.120)
Buyer category		
Central government	-0.291^{**}	$+0.518^{**}$
	(0.131)	(0.194)
Regional / local	-0.043	$+0.232$
	(0.137)	(0.148)

Firm + year FEs. 21 MIP sector clusters. $N = 66{,}980$.

Winner Outcomes: Scale Without Productivity

Procurement winners grow — but only in size, not in efficiency:

	(1) Employment	(2) Turnover	(3) Labor prod.	(4) Return on capital
Contracts won	$+0.025^{***}$	$+0.028^{***}$	$+0.007$	$+0.001$
	(0.002)	(0.007)	(0.007)	(0.001)

Within-firm FEs. Matched ORBIS panel, 2009–2023.

Scale channel: Winners expand without becoming more productive.

Outline

Why a Model?

- The reduced-form evidence shows a composition shift: higher exposure $\Rightarrow$ less market novelty, more existing-product revenue.
- Aggregate outcome is ambiguous: procurement may also expand firm scale.
- The model separates two forces:
  - **Scale:** more demand raises the value of operating product lines.
  - **Composition:** procurement shifts payoffs toward incremental lines.

Model in One Slide

- Firms hold portfolios of product lines, as in Klette–Kortum (2004).
- Each period, firms choose innovation effort x and frontier orientation μ:

$$\underbrace{x}_{\text{how much}} \qquad\qquad \underbrace{\mu}_{\text{frontier share}} \quad .$$

- Successful innovation creates either:

$$q \to \lambda_I q \quad \text{or} \quad q \to \lambda_F q, \qquad \lambda_F > \lambda_I > 1.$$

- Costs (in labor, valued at wage w) discipline the two margins:

$$w\left(c_x x^{\zeta} + \frac{\kappa}{\eta}\mu^{\eta}\right), \qquad \text{entry cost } wh_E.$$

What Procurement Changes

Procurement demand $G \geq 0$ rewards specification-compliant incremental lines:

$$\pi_I(G) = \bar{\pi}_I(1+G), \qquad \pi_F(G) = \bar{\pi}_F.$$

So the frontier premium falls with procurement:

$$\pi_F(G) - \pi_I(G) = (\bar{\pi}_F - \bar{\pi}_I) - \bar{\pi}_I G.$$

Procurement does not directly reduce R&D effort. It changes the relative payoff to frontier innovation.

Firm Choice: Procurement Lowers Frontier Orientation

$$G \uparrow \quad \Rightarrow \quad \pi_I(G) \uparrow \quad \Rightarrow \quad v_F(G) - v_I(G) \downarrow \quad \Rightarrow \quad \mu^* \downarrow$$

$$v_F(G) - v_I(G) = \frac{\bar{\pi}_F - \bar{\pi}_I(1+G)}{r+\tau}$$

The firm does not stop innovating. It redirects innovation away from frontier lines.

General Equilibrium

- **Households** supply labor inelastically and consume output; discount at rate r.
- **Firms** choose (x^*, μ^*) each period:
  - Effort x^*: equates marginal R&D cost to expected value gain
  - Frontier share μ^*: equates direction cost to value gap, $\kappa(\mu^*)^{\eta-1} = x^*[v_F(G) - v_I(G)]$
- **Free entry** pins creative destruction τ: expected line value $=$ entry cost wh_E.
- **Labor market** clears at wage w.

Procurement raises scale ($x^* \uparrow$) while lowering frontier orientation ($\mu^* \downarrow$).

Growth: The Key Tradeoff

Balanced-growth rate:

$$g = x\left[(1-\mu)\log\lambda_I + \mu\log\lambda_F\right], \qquad \lambda_F > \lambda_I.$$

Procurement affects growth through two channels:

- **Scale channel:** $G \uparrow \Rightarrow\ x \uparrow \Rightarrow\ g \uparrow$ ORBIS: winners grow in employment and turnover
- **Composition channel:** $G \uparrow \Rightarrow\ \mu \downarrow \Rightarrow\ g \downarrow$ MIP: fewer market-novel products

Outline

Estimation

We estimate four structural parameters $(\lambda_F, \lambda_I, \kappa, h_E)$ using five moments from data:

Moment	Data	(SE)	Model
Frontier share among product innovators	0.427	(0.005)	0.441
Frontier revenue share among new products	58.249	(0.548)	59.141
Large-firm share ($n \geq 5$ products)	0.104	(0.003)	0.090
Creative destruction rate	0.051	($<$0.001)	0.051
R&D personnel share	0.029	(0.001)	0.037

Overidentified GMM; firm-clustered $\hat{\Sigma}$.

Estimated Parameters: Frontier Steps Are Much Larger

Parameter	Estimate	(SE)	Interpretation
λ_F	1.210	(0.003)	frontier innovation raises quality by 21%
λ_I	1.093	(0.002)	incremental innovation raises quality by 9%
κ	0.070	(0.004)	cost of directing innovation to the frontier
h_E	1.600	(0.010)	labor cost of entry / creative destruction
$\bar{G}$	0.117	calibrated: economy-wide procurement share of output	

These estimates imply:

$$\bar{\pi}_F = 17.4\%, \qquad \bar{\pi}_I = 8.5\%, \qquad \bar{\pi}_F - \bar{\pi}_I = 8.9 \text{ pp.}$$

Benchmark Procurement Compresses the Frontier Premium

The frontier premium in the model:

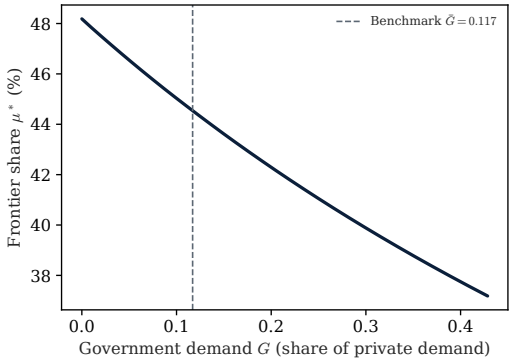
$$\pi_F(G) - \pi_I(G) \;=\; \underbrace{(\bar{\pi}_F - \bar{\pi}_I)}_{\text{quality gap}} \;-\; \underbrace{\bar{\pi}_I\, G}_{\text{procurement wedge}}$$

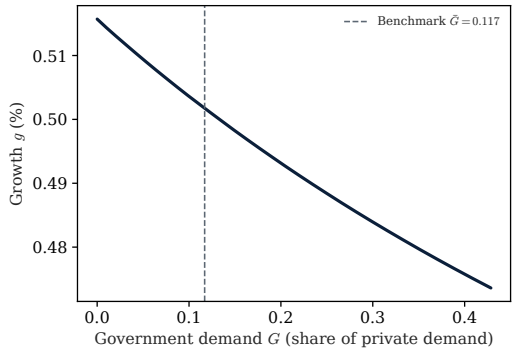
Evaluating at $G = 0$ (no procurement) and $\bar{G} = 0.117$ (benchmark):

	No procurement ($G = 0$)	Benchmark ($\bar{G} = 0.117$)
Quality gap	8.9 pp	8.9 pp
Procurement wedge ($\bar{\pi}_I G$)	0	1.0 pp
Frontier premium	**8.9 pp**	**7.9 pp**

Procurement does not reduce R&D — it changes its direction. A 1 pp smaller reward for frontier innovation is enough to redirect firms toward incremental lines.

Comparative Statics: Composition Dominates





Dashed: benchmark $\bar{G} = 0.117$. Left: frontier share μ^* falls as procurement rises. Right: growth g declines despite higher effort — composition dominates.

Policy Scenarios

- **R&D tax credit:** Remove the procurement demand wedge and redirect the fiscal envelope — $\approx 6\%$ of output — to subsidize firm R&D at rate $s = 14.1\%$.
  - German policy, 2020: a 25% credit on eligible R&D labor costs, available to all firms regardless of size or sector. [Hall & Van Reenen 2000; Bloom et al. 2002]
- **Specification realignment:** Same spending; awards proportional to innovation mix. Wedge removed at zero fiscal cost.
  - Product-specific requirements lock firms into incremental improvements. Functional specs ask for *performance objectives* instead — opening space for novel solutions. [Howell et al. 2025; Edquist & Zabala 2020]

Counterfactuals

Scenario	$\Delta\mu^*$	Δg (bp/yr)	CEV (%)
R&D tax credit	$+0.093$	$+12.33$	$+3.21$
Specification realignment	$+0.072$	$+2.81$	$+0.70$

Decomposing the R&D credit CEV:

- Growth channel: $\Delta g/\rho = 12.33\,\text{bp}/0.04 = +3.08\%$
- Level channel (lower lump-sum tax): $\Delta \log C_0 \approx +0.13\%$
- Total CEV: $3.08 + 0.13 \approx 3.21\%$

Almost all the welfare gain is from higher growth, not the fiscal transfer.

Putting the Numbers in Context

- García-Macía, Hsieh & Klenow (2019): US composition drift explains 16 of 34 bp of TFP growth lost between the 1980s and 2000s. The R&D credit recovers $+12.33$ bp — same order, same margin.

- Rewriting *how* government buys — not cutting *how much* — recovers $+2.81$ bp at zero fiscal cost. Howell et al. (2025) show that more open award formats can raise innovation relative to specification-heavy procurement.

Procurement **design** — not volume — is the policy margin. Changing what government buys matters as much as how much it spends.

Outline

Next Steps

- **Firm-level exposure** — ZEW match links individual MIP firms to contract awards; enables event-study identification and separates winners from non-participants.

- **International comparison** — extend to comparable OECD procurement markets to assess generalizability of the composition mechanism.

Thanks! You can send me any comments or suggestions at joharav@umich.edu