Who Built the Service Economy?

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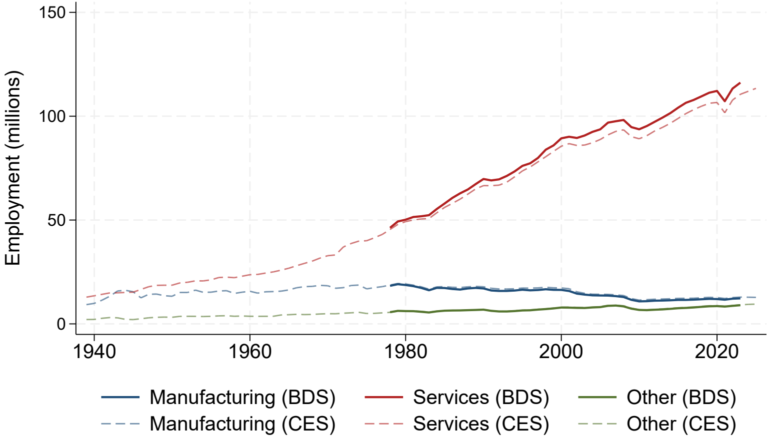
LAEF-UConn Conference 2026

Outline

Sectoral transformation (ST)



Our questions

1. How did this large reallocation of labor come about?
2. Rise of new service firms, or expansion of large incumbents?
3. Did incumbents expand existing establishments or open new ones?

We take a firm dynamics perspective on ST: which firms grew, and how?

Preview of results

Empirics: ST is an incumbent scaling phenomenon

- net entry plays a minor role in both sectors
- reallocation is concentrated among large, mature incumbents
- large service incumbents expand by opening new establishments

Model: two-sector Hopenhayn–Rogerson with multi-establishment firms

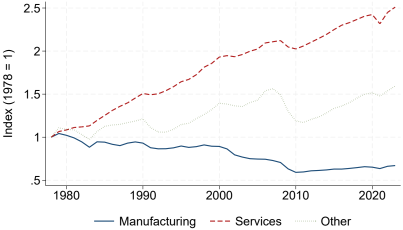
- replication costs: the cost of opening and coordinating establishments
- **mnf productivity growth** leaves the firm-size distribution unchanged
- **lower replication costs** disproportionately expand large firms

Quantitatively, 1979 to 2023

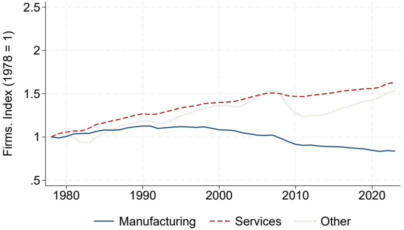
- jointly, the two forces account for **52%** of sectoral reallocation
- lower replication costs alone account for **1/3** of the joint effect

Outline

Service employment up 2.5x, firm count only 1.6x

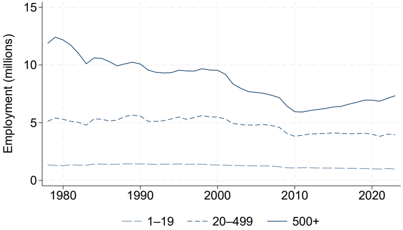


Employment (1978 = 1)

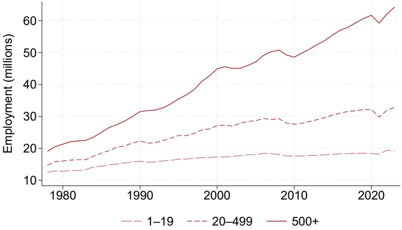


Number of firms (1978 = 1)

Employment share of large service firms increased

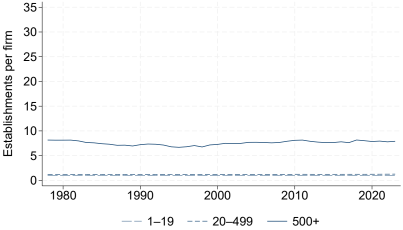


Manufacturing

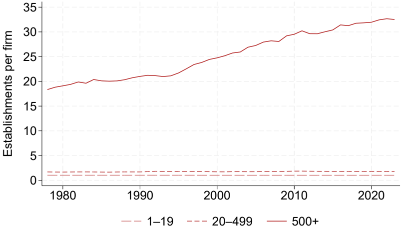


Services

Large service firms grew through establishment birth



Manufacturing



Services

But...

- "...isn't this just health care?" No. ▸ Service subsector levels ▸ Service employment gains
- "...what about entry and exit?" Falling until mid 2010s. ▸ Emp. share ▸ Rates
- "...what about firm age?" Similar picture. ▸ Firm age
- "...new establishments, or acquired ones?" New. ▸ Births
- "...is this driven by a few service industries?" No. ▸ By industry
- "...did establishments get bigger?" Not in services. ▸ Emp. per estab.
- "...did you formally decompose ΔE?" Yes. ▸ Decomposition

Related literature

Structural transformation and multisector growth

Herrendorf, Rogerson & Valentinyi (2014); relative prices: Ngai & Pissarides (2007), Herrendorf et al. (2015); income effects: Kongsamut, Rebelo & Xie (2001), Buera & Kaboski (2012), Comin, Lashkari & Mestieri (2021)

- This paper: makes the firm-level margin of ST explicit

Spatial expansion and multi-establishment firms

Hsieh & Rossi-Hansberg (2023), Oberfield et al. (2024), Kleinman (2025), Cao et al. (2022); enabling technologies: Lashkari et al. (2024), Brynjolfsson et al. (2025), Argente et al. (2025), Gumpert et al. (2022)

- This paper: cheaper replication reallocates employment across sectors

Firm dynamics

Hopenhayn (1992), Hopenhayn & Rogerson (1993), Luttmer (2007); entry: Hopenhayn et al. (2022), Karahan et al. (2024), Peters & Walsh (2026), Hopenhayn et al. (2025); scope: Klette & Kortum (2004), Bernard et al. (2010), Aghion et al. (2023), Xi (2023)

- This paper: establishment scope as a margin of incumbent growth

Outline

A standard firm dynamics model fails to match the facts

ST is usually modeled at the sector level, with representative firms

- extend standard Hopenhayn and Rogerson (1993) model to two sectors
- add CES preferences over M & S goods with a low elasticity
- increase manufacturing productivity

✓ generates fall in M employment share

✗ no reallocation toward large service firms

✗ no service establishment growth

What we do

We extend Hopenhayn and Rogerson (1993) to two sectors:

- two final-goods sectors $j \in \{M, S\}$, linked by non-homothetic CES demand
- multi-establishment firms with convex establishment-replication costs

Two aggregate driving forces (1979 vs. 2023):

- higher manufacturing productivity $a_M \rightarrow$ drives sectoral reallocation
- lower replication cost $\eta \rightarrow$ incumbents scale via establishments

What we find:

- productivity alone matches the aggregate shift but misses the micro facts
- cheaper replication delivers the large-firm, multi-establishment growth
- . . . and contributes to ST itself: **1/3** of the reallocation the two forces generate

Households

Representative household:

- supplies labor $\bar{L}$ inelastically
- income $I_t = W_t \bar{L} + \Pi_t$ (wages plus rebated firm profits)
- maximizes $\mathbb{E}_0 \sum_t \beta^t \ln C_t$ over a CES composite of M & S

Non-homothetic demand:

- a manufacturing subsistence level $\bar{c}_M$ is purchased first
- only the remaining (supernumerary) spending is split across M & S
- as income rises, the manufacturing share of spending falls
- needed so demand shifts toward services, beyond relative prices

Firms and establishments

Each establishment uses a DRS technology:

$$q = a_j \, z \, \ell^{\alpha_j}, \qquad \alpha_j \in (0,1)$$

A firm runs $m \geq 1$ identical establishments s.t. replication costs:

$$G(m) = c_{m,j} \, \frac{m^{1+\eta_j} - 1}{1+\eta_j}$$

Firm's flow profit in sector j:

$$\Pi_j(z) = \max_{m \geq 1, \, \ell \geq 0} \; m[p_j \, a_j \, z \, \ell^{\alpha_j} - W \, \ell] - P \cdot G(m) - P \cdot f_j$$

- free entry, endogenous/exogenous exit ▸ Entry & exit ▸ Stationary equilibrium

Extensive margin of firm growth

Establishment-level optimization: decreasing returns ($\alpha_j < 1$)

$$\ell^*(z) = \left(\frac{p_j\, \alpha_j\, a_j\, z}{W}\right)^{\frac{1}{1-\alpha_j}}, \qquad \pi_v(z) \propto z^{\frac{1}{1-\alpha_j}}$$

- a single establishment cannot grow without bound

Optimal number of establishments per firm:

$$m^*(z) = \max\left\{1,\ \left(\frac{\pi_v(z)}{P\, c_{m,j}}\right)^{1/\eta_j}\right\}$$

- intensive margin: bigger establishments (ℓ^*); extensive: more of them (m^*)
- only firms with $\pi_v(z) > P\, c_{m,j}$ replicate; convexity η_j sets how fast

Effective returns to scale

Effective firm-level RTS exceeds establishment-level RTS:

$$L(z) = m^*(z)\,\ell^*(z) \propto z^{\frac{1}{1-\alpha_{\mathrm{eff},j}}}, \qquad \alpha_{\mathrm{eff},j} = \frac{1+\eta_j\alpha_j}{1+\eta_j} \in (\alpha_j, 1)$$

- $\eta_j \to \infty: \ \alpha_{\mathrm{eff}} \to \alpha_j$ (single establishment)
- $\eta_j \to 0: \ \alpha_{\mathrm{eff}} \to 1$ (CRS)

Same % decline in η: larger response where m^* is already large

- higher α_j: bigger establishments, not more of them $\Rightarrow$ fewer m^*
- we estimate $\alpha_M > \alpha_S \Rightarrow$ same % $\eta\downarrow$ does more in S (as in data)

Where does a lower η come from? Three recent models

Hsieh & Rossi-Hansberg (2023): units are markets

- a firm pays a fixed cost for a technology that raises its productivity
- the gain shows up in every market, so firms with many markets adopt

Brynjolfsson et al. (2025): units are establishments

- IT lets a firm run all of its branches the way its best branch runs
- the more branches a firm has, the more it gains, so large chains expand

Argente et al. (2025): units are products

- when demand rises, it pays to standardize know-how shared by all products
- productive firms standardize the most, so new products are cheap for them

Isomorphic to a lower η:

- large firms gain more from each change because they have more units
- that is what a lower η does: m^* rises mostly at the top of the distribution

Outline

Parameterization

Assigned outside the model

- β, ε at standard values; exit rates from BDS, $p_S\,/\,p_M$ from BEA

Household

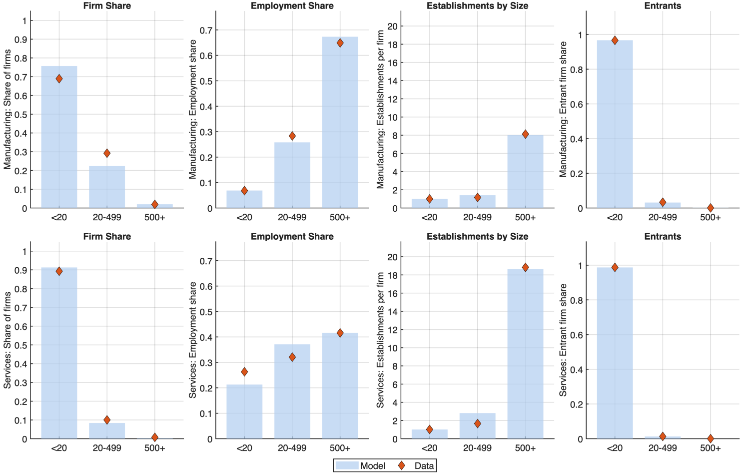
- $\bar{c}_M$ and μ: goods expenditure share and manufacturing employment share

Firms: sector by sector, 1979 BDS moments

▸ Table

- productivity and entrant parameters: firm-size distribution, young-firm growth
- α_j: average establishment size
- $(c_{m,j}, \eta_j)$: establishments per firm, overall and large relative to small

Initial (1979) steady-state fit



▸ Untargeted: fit by firm age

Quantitative experiments

Goal: capture the two forces behind ST

1. manufacturing productivity growth: $a_M \uparrow$
2. organizational change, cheaper replication: $\eta \downarrow$, proportionally in both sectors

Discipline: 1979 steady state vs. a counterfactual 2023 steady state

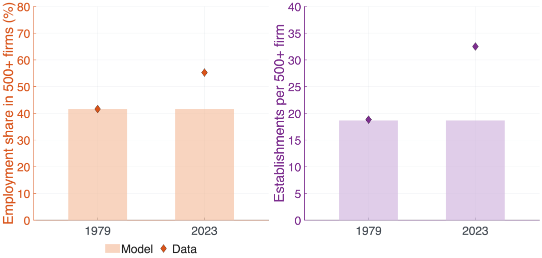
- a_M matches the 1979–2023 change in the relative price of services
- η matches the rise in establishments per firm, large vs. small service firms
- all other primitives fixed; employment share of large service firms untargeted

What we do:

- **Experiment 1**: $a_M \uparrow$ only, the standard ST mechanism
- **Experiment 2**: $a_M \uparrow$ and $\eta \downarrow$ together, our main experiment
- also consider an experiment with labor-force growth

Experiment 1: raise manufacturing productivity (a_M) only

Raise a_M ($\times 1.55$) to match the M vs. S relative price change



- ✓ generates ST: M employment share $28.0\% \to 19.9\%$ (44% of decline)
- ✗ firm-size distribution barely moves: $a_M\uparrow$ offset by $p_M\downarrow$ (invariance)
- ✗ no shift to large service firms (41.6% vs. 55.3% in data), no estab. growth

Experiment 2: a_M rises and replication gets cheaper $\eta\downarrow$

$a_M\uparrow$ accompanied by lower replication costs:

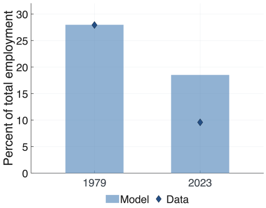
- lower η makes it less costly to add establishments
- η falls by the same proportion in both sectors
- analytically, the resulting rise in m is larger for higher-productivity firms
- large service firms run the most establishments, so they respond most

Some suggestive evidence ▸ Details

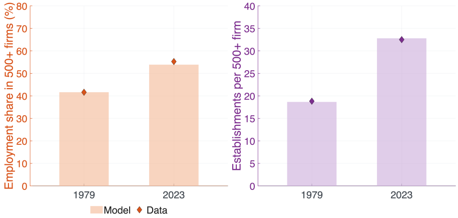
- IT capital per worker $\uparrow$, office & admin. share $\downarrow$
- the fall is linked to more establishments per firm
- ...and especially pronounced in *large* firms

Experiment 2: model fit

$a_M \times 1.57$, $\eta \times 0.80$ (both sectors): matches the micro facts



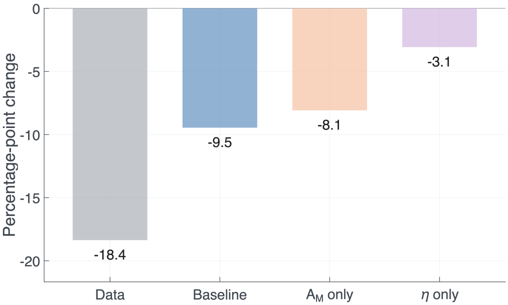
M employment share



Large (500+) service firms

- ✓ generates ST: M employment share 28.0% → 18.5% (52% of decline)
- ✓ establishments per large service firm 18.7 → 32.8 (targeted)
- ✓ emp. share of large service firms 41.6% → 53.9% (untargeted; data 55.3%)

Each force alone: decline in M employment share



- a_M only: 44% of the decline, but no shift toward large service firms
- η only: 1/3 of the ST the model accounts for
- the two do not sum to 52%: each triggers its own price adjustment

Adding labor-force growth

Main experiment with labor supply scaled by 1.88 (BDS, 1979–2023)

- estimated changes in a_M and η are unchanged
- firm-level predictions for services are unchanged as well

	Main experiment	$+$ labor growth	Data
M employment share, 2023 (%)	18.5	14.8	9.6
Share of decline explained (%)	51.5	71.8	—
Emp. share of large service firms (%)	53.9	53.9	55.3
Establishments per large service firm	32.8	32.8	32.5

Labor-force growth matters for the aggregate, not for the firm-level facts

- the model now accounts for 72% of the manufacturing employment decline

Next steps: implications and robustness

Implications (in progress)

- concentration: model explains much of the rising 500+ employment share
- welfare: the fall in η matters more than the rise in a_M
- one establishment per firm: how much of the aggregate shift is lost?

Robustness

- endogenous exit: results essentially unchanged; does the entry rate fall?
- non-homothetic CES demand: results change little
- convex entry costs instead of free entry: to do

Conclusion

Structural transformation through the lens of firm dynamics

- the reallocation toward services is not primarily an entry phenomenon
- large incumbent service firms expand, mainly along the extensive margin
- manufacturing declines through large incumbents that gradually shrink

Implications for modeling

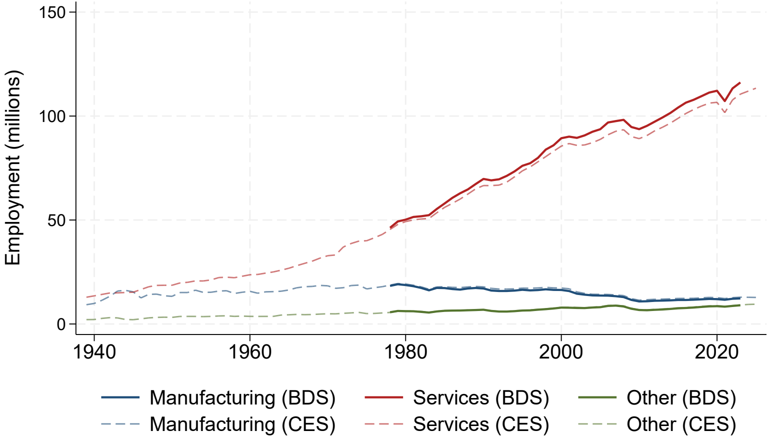
- treating sectors as representative firms misses a key margin of adjustment
- multi-establishment firms: model explains half of the M share decline
- lower replication costs alone deliver 1/3 of the ST the model explains

Who built the service economy?

- existing firms that learned to replicate themselves across markets

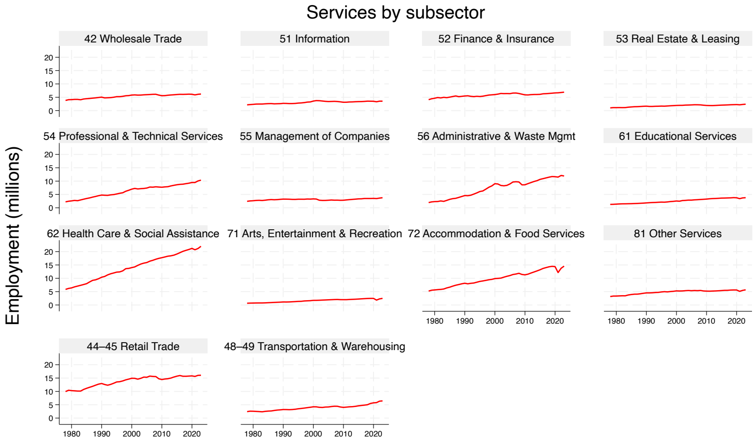
Appendix

Long-Run Sectoral Employment



Service Employment by Subsector

Back



Service Employment Gains by Subsector

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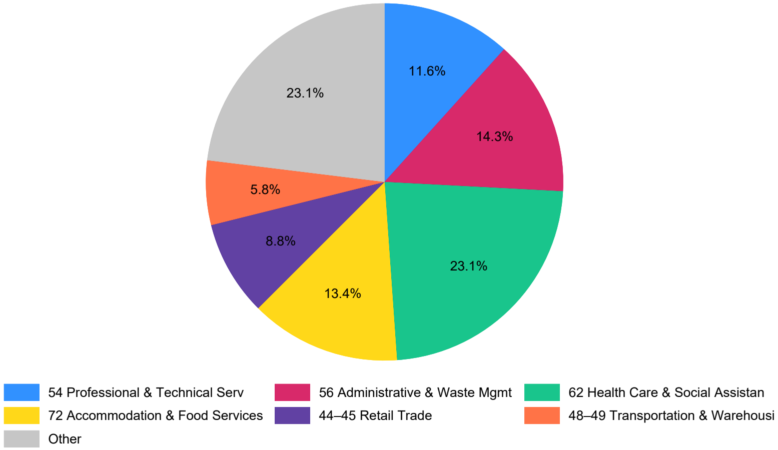
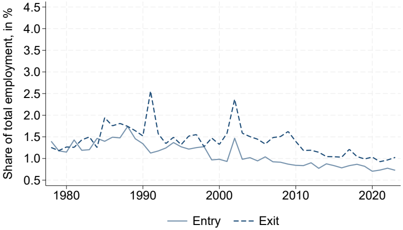
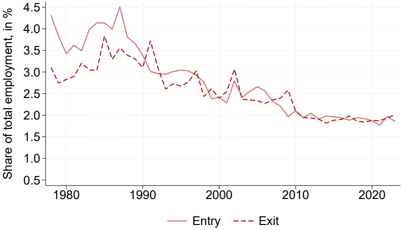


Entry and Exit Employment Shares

Back



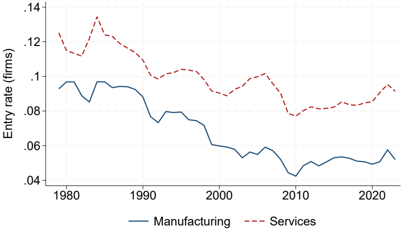
Manufacturing



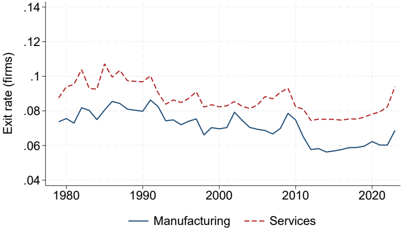
Services

Entry and Exit Rates

Back



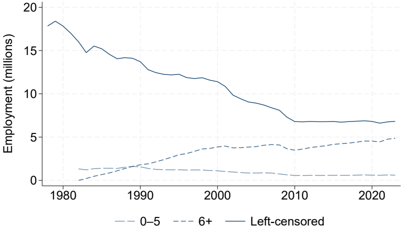
Entry rates



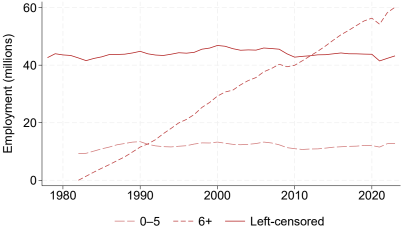
Exit rates

Employment by Firm Age

Back



Manufacturing



Services

New establishments, not acquisitions

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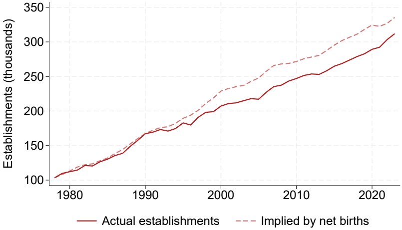
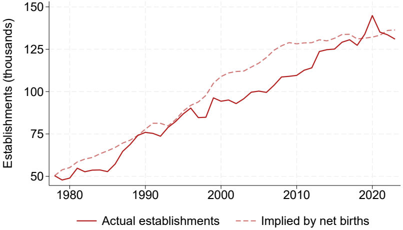


Firms with 500–2,499 employees



Firms with 2,500–4,999 employees

- dashed line: 1978 stock plus cumulative net establishment births
- births are new openings, so the gap captures acquisitions

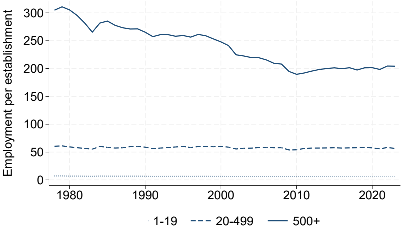
Establishments per firm, by service industry

Back

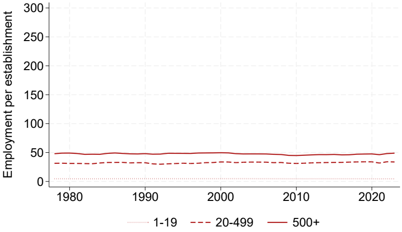
- 500+ firms add establishments in nearly every two-digit service industry

Employment per establishment, by firm size

Back



Manufacturing



Services

- services: stable, so large firms grow by opening establishments
- manufacturing: employment falls mainly within establishments

Firm dynamics: exit and entry

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Incumbent firm's value, with exogenous exit probability p_{exit}:

$$V_j(z) = \Pi_j(z) + \beta\,(1 - p_{\text{exit}})\,\max\left\{0,\ \mathbb{E}\left[V_j(z') \mid z\right]\right\}$$

- conditional on surviving, the firm chooses whether to continue
- endogenous exit when $\mathbb{E}[V_j(z') \mid z] < 0$

Free entry: entrants pay $c_{e,j}$, draw $z \sim \pi_{e,j}$:

$$\mathbb{E}_{\pi_{e,j}}[V_j(z)] = P\,c_{e,j}$$

Stationary equilibrium

Stationary equilibrium

Back

Objects $\{V_j, \ell_j^*, m_j^*, \mathrm{exit}_j, \mu_j, \Pi, W, p_M, p_S, P, C_j, \phi_j, M_j, B\}$ such that:

- normalization: μ_j per unit entrant flow; active firms $= M_j \int d\mu_j$
- households satisfy the non-homothetic demand system ($\bar{c}_M$ first, then CES)
- $\{V_j, \ell_j^*, m_j^*, \mathrm{exit}_j\}$ solve the firm problem
- free entry in each sector: $\mathbb{E}_{\pi_{e,j}}[V_j(z)] = P\, c_{e,j}$
- expenditure shares: $\phi_j = \omega_j \big(p_j / P\big)^{1-\varepsilon}$, $\omega_M = \mu$, $\omega_S = 1 - \mu$

Stationary equilibrium (cont.)

Back

Market clearing and consistency:

- firms' cost demand: $B = \sum_j M_j \big(\int [f_j + G(m_j)] \, d\mu_j + c_{e,j} \big)$
- goods markets (C_M incl. $\bar{c}_M$): $M_j \int Y_j(z) \, d\mu_j = C_j + \phi_j \, (P / p_j) \, B$
- labor market clears: $\sum_j M_j \int \ell_j(z) \, m_j(z) \, d\mu_j = \bar{L}$
- aggregate dividends: $\Pi = \sum_j M_j \big(\int \Pi_j(z) \, d\mu_j - P \, c_{e,j} \big)$
- μ_j stationary: consistent with productivity, exit, and entrant flow

Employment Accounting Decomposition

Back

$$\Delta E_{s,t} = \underbrace{\left(JC_{s,t}^{\text{birth},f=0} - \text{FirmDeathEmp}_{s,t}\right)}_{\text{Net firm entry}} \quad + \quad \underbrace{\left(JC_{s,t}^{\text{cont}} - JD_{s,t}^{\text{cont}}\right)}_{\text{Net within-establishment expansion of incumbents}}$$

$$+ \underbrace{\left(JC_{s,t}^{\text{birth},f\geq 1} - \left(JD_{s,t}^{\text{death}} - \text{FirmDeathEmp}_{s,t}\right)\right)}_{\text{Net establishment expansion within incumbent firms}}.$$

- $JC^{\text{birth},f=0}$: job creation by startups
- JC^{cont}, JD^{cont}: job creation/destruction by continuing establishments
- $JC^{\text{birth},f\geq 1}$: new establishments within incumbent firms

Decomposition of Emp. Changes, 1978–2023

◂ Back

Component	Δ Emp. (m)	Share (%)
Manufacturing		
Net entry	-2.07	37.7
Net expansion	-0.60	11.0
Net estab. expansion of incumbents	-2.82	51.3
Total	-5.48	**100.0**
Services		
Net entry	4.88	6.8
Net expansion	37.60	52.6
Net estab. expansion of incumbents	29.00	40.6
Total	71.48	**100.0**

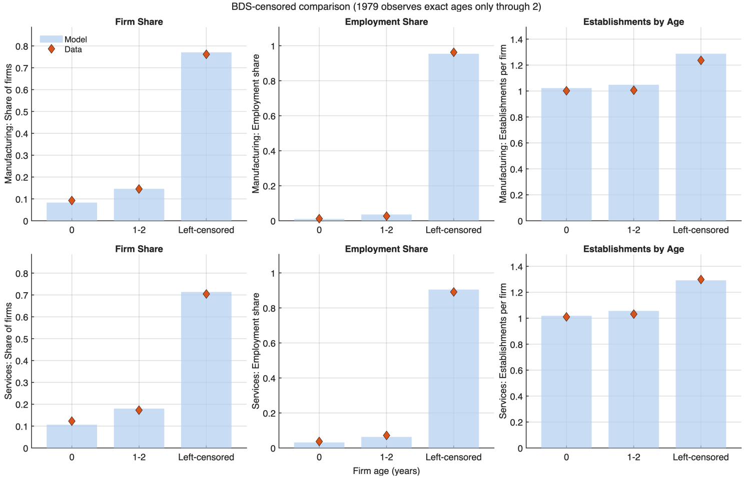
Calibration to the 1979 economy

Back

Parameter	Description	Value	Target	Data	Model
			Parameters assigned outside the model		
β	Discount factor	0.96			
ε	Substitution elasticity	0.40	Desmet and Rossi-Hansberg (2014)		
a_M, a_S	Sectoral TFP	1.00	Normalization		
δ_M	Exogenous exit rate	0.08	Average firm entry and exit rate		
δ_S	Exogenous exit rate	0.11	Average firm entry and exit rate		
p_S / p_M	Relative price of services	0.64	BEA value-added price indexes		
			Household		
$\bar{c}_M$	Manufacturing subsistence	0.32	Goods-share slope wrt log PCE per capita	-0.23	-0.23
μ	CES preference weight	0.09	Manufacturing employment share	0.28	0.28
			Manufacturing		
μ^z_M	Mean log productivity	1.81	Average firm size	73.21	74.16
σ_M	Productivity volatility	0.44	Employment share, firms with 500+	0.65	0.67
$\mu^z_{e,M}$	Mean log entrant productivity	0.27	Average entrant size	9.04	9.03
$\sigma_{e,M}$	Entrant productivity dispersion	0.88	Entrant firm share with 20+	0.03	0.03
ρ_M	Productivity persistence	0.69	Age 1–5 firm share with 20+	0.15	0.15
α_M	Establishment returns to scale	0.53	Average establishment size	61.72	60.21
$c_{m,M}$	Replication-cost level	52.87	Average establishments per firm	1.19	1.23
η_M	Replication-cost convexity	0.87	Estab./firm: 500+ relative to <20	8.10	8.00
$c_{e,M}$	Entry cost	386.56	Free-entry condition	—	—
			Services		
μ^z_S	Mean log productivity	0.14	Average firm size	16.43	16.43
σ_S	Productivity volatility	0.18	Employment share, firms with 500+	0.42	0.42
$\mu^z_{e,S}$	Mean log entrant productivity	1.95	Average entrant size	4.90	4.90
$\sigma_{e,S}$	Entrant productivity dispersion	0.24	Entrant firm share with 20+	0.01	0.01
ρ_S	Productivity persistence	0.99	Age 1–5 firm share with 20+	0.06	0.06
α_S	Establishment returns to scale	0.47	Average establishment size	13.46	13.46
$c_{m,S}$	Replication-cost level	14.12	Average establishments per firm	1.22	1.22
η_S	Replication-cost convexity	0.85	Estab./firm: 500+ relative to <20	18.44	18.44
$c_{e,S}$	Entry cost	94.86	Free-entry condition	—	—

Untargeted: 1979 fit by firm age

Back



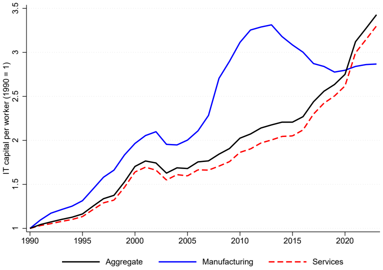
BDS firm-age panel starts in 1977: in 1979 only ages 0 and 1–2 are observed; firms aged 3+ pooled (model and data).

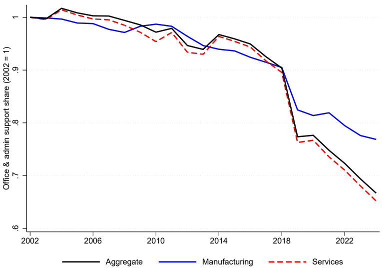
Suggestive evidence: replicability cost has fallen

Back

Two proxies for the cost of operating extra establishments

- IT capital per worker (BEA, 1990–2023): up-front, then cheap to replicate
- office & admin. share (BLS, 2002–2023): codifiable back-office tasks





IT capital per worker ↑

office & admin. share ↓

Suggestive evidence

Back

Industry panel: $\ln Y_{ist} = \beta X_{it} + \gamma X_{it} \cdot 1\{\text{large}\} + \alpha_i + \alpha_s + \delta_t$

- $+1$ SD IT-intensity growth: $+0.088$ log estab./firm, large vs. small (col. 4)
- $+1$ SD fall in office/admin share: same $+0.088$, large vs. small
- no robust link to firm count or employment per establishment

	ln(firms)		ln(estab/firm)		ln(emp/estab)	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: $X = \Delta \log(IT/emp)$						
X	0.010	0.017	0.017^{***}	-0.037	0.000	-0.030^{*}
	(0.006)	(0.033)	(0.004)	(0.026)	(0.004)	(0.016)
$X\times$ large		0.009		0.088^{**}		0.055^{***}
		(0.043)		(0.035)		(0.021)
Industry FE	Y	Y	Y	Y	Y	Y
Size FE		Y		Y		Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	1782	3539	1782	3539	1782	3539
Panel B: $X = \Delta(\text{office \& admin share})$						
X	0.007^{**}	0.020	-0.004^{***}	0.043^{**}	0.003	0.012
	(0.003)	(0.021)	(0.002)	(0.017)	(0.002)	(0.010)
$X\times$ large		-0.027		-0.088^{***}		-0.021
		(0.028)		(0.023)		(0.013)
Industry FE	Y	Y	Y	Y	Y	Y
Size FE		Y		Y		Y
Year FE	Y	Y	Y	Y	Y	Y
Observations	1565	3118	1565	3118	1565	3118