The Rise of Long Run Losses, Intangible Deepening, and Demand Shifting Investment

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Secular Trends Among US Firms

Motivated by trends in universe of US Public Firms:

1. Sales concentration has risen
2. Firms are spending more on R&D and Sales&Marketing, less on traditional capital
3. Firms are taking longer to turn a profit $\rightarrow$ average loss spell 0.8 to 1.7 years

These trends are also correlated *across sectors*, which leads us to ask:

> Can we rationalize these trends with a single, estimated mechanism?

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This Paper

Empirically, we document a change in the revenue production function:

- Estimate the revenue production function including accumulated R&D (knowledge capital) and accumulated sales and marketing (customer capital)
- Document intangible deepening: revenue elasticities of knowledge and customer capital have risen, while elasticities of traditional inputs are flat

Develop a model of firms investing in physical, knowledge, and customer capital:

- Production with knowledge capital X that is non-rival in use across customers
- Customer capital M expands customer base, which (1) shifts effective demand curve and (2) expands measure over which knowledge capital is shared

Preview of Results

By matching estimated changes in revenue elasticities, we match secular trends:

- Investment recomposes: physical investment $\downarrow 1.3\%$, R&D and S&M $\uparrow 1.62\%, 0.45\%$
- Firms take longer to profit: $8\% \rightarrow 10\%$ of firms never profitting by age 5

Macro implication: top 1% sales share $\uparrow 5.5\%$, which raises TFP by $\uparrow 5.1\%$

When production become more knowledge intensive...

1. Returns to knowledge capital X *and customer capital* M rise: less expensive to expand customer base when more production inputs are shared across them
2. Productive firms grow *larger* for *longer*, delaying positive cash flow and raising sales concentration

Related Literature and Contributions

1. Secular changes in US firms
   (Crouzet et al. 2022, Peters and Taylor 2017, Kwon, Ma, and Zimmermann 2024, Autor et al. 2020, Denis and McKeon 2016)
   - Novel set of trends including *rise of long run losses*. Novel explanation for rise in sales concentration.
2. Estimating changes in firm-level production
   (Chiavari 2026, Chiavari and Goraya 2025, De Ridder, Grassi, and Morzenti 2026, Ackerberg, Caves, and Frazer 2015)
   - Structurally estimate time-varying revenue elasticities *including customer capital*. Map to path of output elasticities in model.
3. Modeling knowledge and customer capital
   (Gourio and Rudanko 2014, Afrouzi, Drenik, and Kim 2025, Crouzet et al. 2026, Hubmer and Nord 2026)
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Empirical

Data and Estimation Details

Data: Compustat + Sales and Marketing (He, Mostrom, and Sufi 2024)

- First direct measure of sales and marketing spending (**imputed pre 1997**)
- Profits = Sales - COGS - SG&A - R&D - CapEx (robust to other definitions)
- Knowledge and Customer Capital stocks constructed using perpetual inventory method on R&D and S&M respectively (Eisfeldt and Papanikolaou 2014)

Revenue Function Estimation: Ackerberg, Caves, and Frazer 2015 (ACF)

- Endogeneity problem: unobserved productivity correlated with *static input* choices
- "Control function" approach, using lagged inputs as instruments for static inputs

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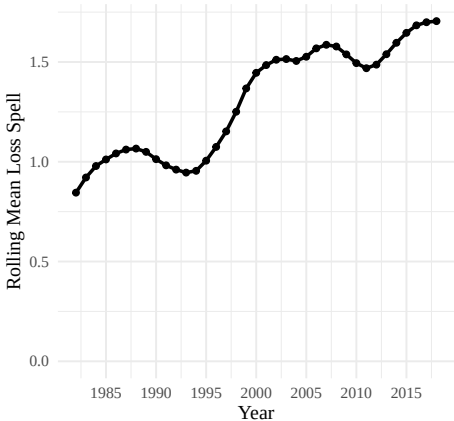
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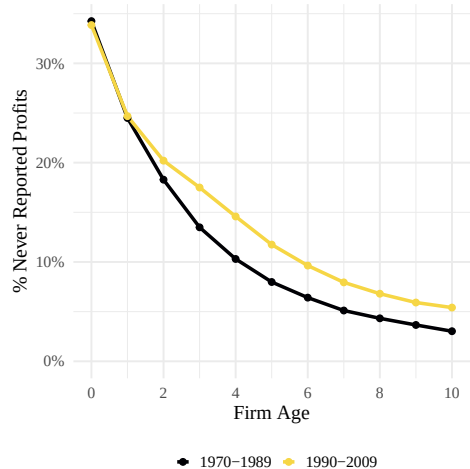
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The Rise of Long Run Losses



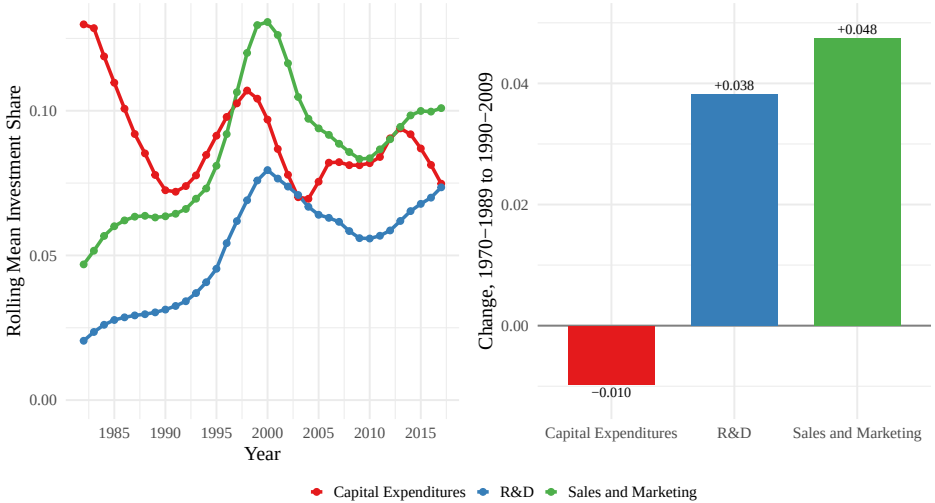


Long Run Losses, Investment, and Growth

- Losses have become less correlated with bankruptcies, more correlated with sales growth: rise due to longer growth Sales Growth and Bankruptcies
- Firms reporting losses spend more on on R&D and S&M (+11% and +10%), less on COGS and CapEx (-9%, -13%) Loss Firm Spending Composition
- Persistent losses positively correlated with R&D and S&M spending across industries; uncorrelated with traditional CapEx Loss Persistence and Investment
- Rise in long run losses accompanied by rise in *sales concentration* Compustat Top 100 Share

Age/Sector Composition | Persistence Across Cohorts | Corporate Income Tax Rate | True Age (Ritter)

Investment Recomposition



Sales and Marketing, R&D, and Physical Capital

- Across sectors, S&M and R&D are positively correlated, and negatively correlated with CapEx (He, Mostrom, and Sufi 2024) Cross-Sector Spending Correlations
- Sectors with high R&D and S&M intensity make up larger share of enterprise value (He, Mostrom, and Sufi 2024) Top S&M Industries Top R&D Industries
- R&D and S&M investment decays at slower rate by age Spending Decay by Age

Why has firm spending recomposed? Test returns to investment across time.

- Construct firm-year stocks of accumulated R&D spending and S&M spending via perpetual inventory ("knowledge capital" and "customer capital")
- Estimate revenue elasticities alongside variable input (COGS) and physical capital (PPEGT) using ACF methodology: control function proxies for unobserved productivity, under assumption of at least one proxy input

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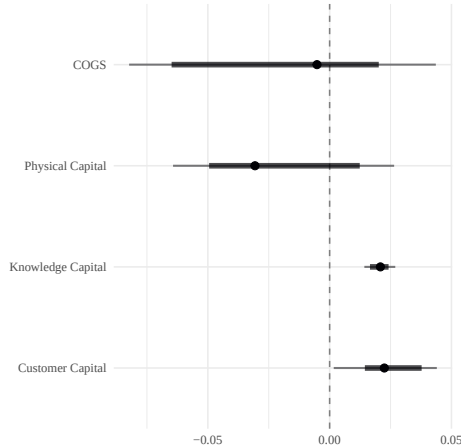
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Intangible Deepening in Revenue Elasticities

- Knowledge and Customer capital rise by .021 and .0225; significant at 90%
- COGS and Physical Capital fall under point estimates, but noisy
- "Intangible deepening": coefficients on intangible stocks larger relative to traditional inputs

Cross-Sector Elasticities and Spending Ratios



Elasticity Change, 1970-1989 vs. 1990-2009

Theoretical

Household

- Unit continuum of HH members and firms producing differentiated goods
- HH members, indexed by j, maximize a CES aggregator of goods, indexed by i
- *Household members only consume goods they are "customers" of*, i.e. $j \in \tilde{M}_{it}$, the customer base of firm i (measure and set)

$$C_t = \left(\int_0^1 \int_0^1 \mathbf{1}_{j \in \tilde{M}_{it}} C_{ijt}^{\frac{\sigma-1}{\sigma}} \, dj \, di \right)^{\frac{\sigma}{\sigma-1}}; \quad C_{ijt} = \mathbf{1}_{j \in \tilde{M}_{it}} C_t P_{it}^{-\sigma} \rightarrow C_{it} = C_t \tilde{M}_{it} P_{it}^{-\sigma}$$

- Share parameters endogenized as customers *in fixed aggregate supply*. Intensive demand depends on price, extensive demand depends on customer base.

Evolution of Customer Base

- Firms accumulate customer capital M, according to standard capital dynamics

$$M_i' = (1 - \delta_M)M_i + i_{M,i},$$

- Customer capital translates to customer relationships with *decreasing returns to scale* η and a *business-stealing externality* $\bar{M}$

$$\tilde{M}_i = \frac{(M_i')^\eta}{\bar{M}}, \qquad \bar{M} \equiv \int_0^1 (M_j')^\eta \, dj, \qquad 0 < \eta < 1$$

- Discrete choice intuition: $\tilde{M}_i$ is continuum-logit choice density where HH members value relationship at customer capital M_i plus a taste shock Logit Microfoundation

Firm Production Technology

- Production per-customer is Cobb-Douglas. Physical capital and labor are spread across customers, while *the entire knowledge capital stock serves every customer*.

$$Y_{ij} = Z_i K_{ij}^{\gamma_k} X_i^{\gamma_x} L_{ij}^{\gamma_l}, \quad \int_{j \in \tilde{M}_i} K_{ij} dj = K_i, \quad \int_{j \in \tilde{M}_i} L_j dj = L_i$$

- With symmetric allocation ($K_{ij} = \frac{K_i}{\tilde{M}_i}, L_{ij} = \frac{L_i}{\tilde{M}_i}$) + CRS technology, the total output for firm i is...

$$\int_{j \in \tilde{M}_i} Y_{ij} dj = Z_i K_i^{\gamma_k} X_i^{\gamma_x} L_i^{\gamma_l} \left(\frac{M_i^{\eta}}{\tilde{M}} \right)^{(1-\gamma_k-\gamma_l)} \propto Z_i \, K_i^{\gamma_k} (M_i^{\eta} X_i)^{\gamma_x} L_i^{\gamma_l}$$

- Firm-level output is CRS in production inputs, but non-rivalry in use of knowledge capital across customer production makes it IRS in (L_i, K_i, X_i, M_i)

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Firm Problem

- Given production technology and post acquisition customer base M_i', firms choose output/labor to solve *static* profit maximization problem.

$$\pi(M_i', K_i, X_i, Z_i) = \max_{Y_i} P(Y_i, M_i')Y_i - C(Y_i, M_i', K_i, X_i, Z_i)$$

- K and X also have standard accumulation dynamics; quadratic adjustment costs, paid in labor. Standard dynamic investment problem with Bellman equation:

$$V = \max_{a_i,\, i_{k,i},\, i_{x,i}} \left\{ \pi(M_i', K_i, X_i, Z_i) - W(L_{k,i} + L_{x,i} + L_{a,i}) + \tilde{\beta}\, \mathbb{E}[V(M_i', K_i', X_i'; Z_i')] \right\}$$

$$\text{s.t. } K_i' = (1-\delta_k)K_i + i_{K,i}, \quad X_i' = (1-\delta_x)X_i + i_{X,i}, \quad M_i' = (1-\delta_M)M_i + i_{M,i}$$

- Add exogenous exit/entry, and solve for stationary distribution fixing $C, W, \bar{M}$.

Firm Profit Elasticities

- Can solve for profit elasticities analytically ($\kappa \equiv (1-\gamma_I)\sigma + \gamma_I$)

$$\epsilon_Z = \frac{\sigma - 1}{\kappa}, \quad \epsilon_K = \frac{\gamma_k(\sigma-1)}{\kappa}, \quad \epsilon_X = \frac{\gamma_x(\sigma-1)}{\kappa}, \quad \epsilon_M = \frac{\eta(1+\gamma_x(\sigma-1))}{\kappa}$$

- Non-rivalry means raising knowledge intensity of production raises returns to knowledge *and customer* capital. Aligns with cross-sector correlations. S&M and R&D
- Also implies raising γ_X raises returns to scale of profits: as production becomes less rival, RTS of production rise, and lessens concavity in profits

$$h = \epsilon_K + \epsilon_X + \epsilon_M; \quad \partial h/\partial \gamma_X > 0 \text{ for any } \gamma_K, \gamma_L \downarrow$$

- Means rise in knowledge output elasticity γ_X can account for all three trends

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Simple Model

Simplify with permanent productivity Z_i drawn from a lognormal distribution and shared investment cost and depreciation parameters. Two key results:

1. Relative investment rates equal relative profit elasticities:

$$\frac{\text{S\&M}}{\text{CapEx}} = \frac{\epsilon_M}{\epsilon_K} = \frac{\eta}{\gamma_k}\left(\gamma_x + \frac{1}{\sigma - 1}\right), \qquad \frac{\text{R\&D}}{\text{CapEx}} = \frac{\epsilon_X}{\epsilon_K} = \frac{\gamma_x}{\gamma_k}$$

2. A firm's optimal customer base size is log-linear in its productivity, with a coefficient *increasing in intangible intensity*:

$$\ln \tilde{M}_i^* = \Psi \ln Z_i - \frac{1}{2}\Psi^2\sigma_z^2, \text{ where } \Psi = \frac{\eta\epsilon_Z}{1-h} \text{ and } \frac{\partial \Psi}{\partial \gamma_X}\Big|_{CRS} = \Psi^2$$

Optimal Size Derivation | Size Gap Intuition | Loss Persistence Result

Quantitative

Exercise and Solution Method

- Simulate estimated production technology change, and examine effect on stationary distribution of firms:
  1. Calibrate and solve stationary distribution for 1970-1990
  2. Map revenue elasticity changes to output elasticities, under CRS
  3. Solve for stationary distribution for 1990-2010, varying only output elasticities
- Central challenge is solving (normalized) firm problem fast. Use time iteration:
  1. Given V_K, V_X, V_M, solve policies M', K', X'
  2. Plug policies into envelope conditions to update V_K, V_X, V_M
- Using grid $(N_Z, N_K, N_X, N_M) = (20, 50, 50, 50)$, 2.5 million grid points. Three root-finding problems on a high-dimensional grid are costly, *but parallelizable*.

Calibration

- Set parameters to (1) standard values, (2) ACF estimates in baseline year
- Calibrate others to match investment shares in baseline year
- Solve for output elasticity shifts that best fit revenue elasticity shifts

Fixed Parameters

Parameter	**Value**
Set Exogenously	
Discount factor β	0.96
Depreciation $\delta_K, \delta_X, \delta_M$	0.10, 0.15, 0.15
Estimated (Pre)	
Elasticity of substitution σ	8.71
Labor elasticity γ_L	0.83
Capital elasticity γ_K	0.15
Knowledge elasticity γ_X	0.021
Exit rate ξ	0.036

Calibration

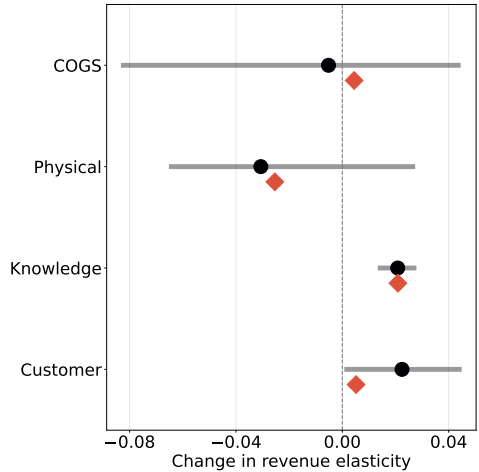
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Targeted and Untargeted Moments

Moment	**Data**	**Model**
Targeted Moments		
Top 1% sales share (IRS) (Pre)	67.66	67.71
Never profitable, age 0 (Pre)	0.343	0.336
Never profitable, age 5 (Pre)	0.080	0.090
Never profitable, age 0 (Post)	0.339	0.344
Never profitable, age 5 (Post)	0.117	0.106
Calibrated		
Customer-capital elasticity η	0.25	
Adjustment cost ϕ_M	4.76	
Adjustment cost ϕ_K (held)	1.00	
Adjustment cost ϕ_X	10.36	
Entrant/median incumbent s_0	1.33	
Productivity process (σ, ρ)	0.036, 0.99	

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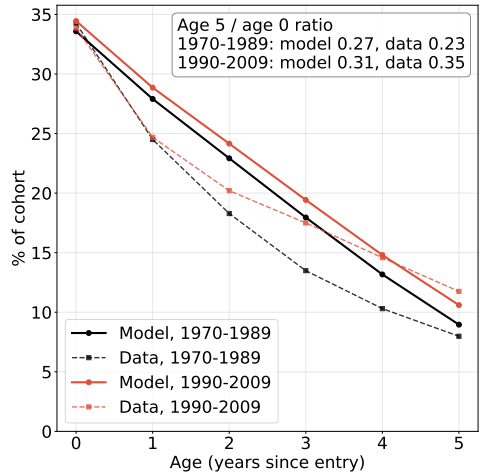
Fitted Revenue Elasticity Shifts

Matching Trends

- Given estimated production technology change, model gets...
- Loss persistence rise
- Spending recomposition
- Increase in sales concentration

Matching Trends

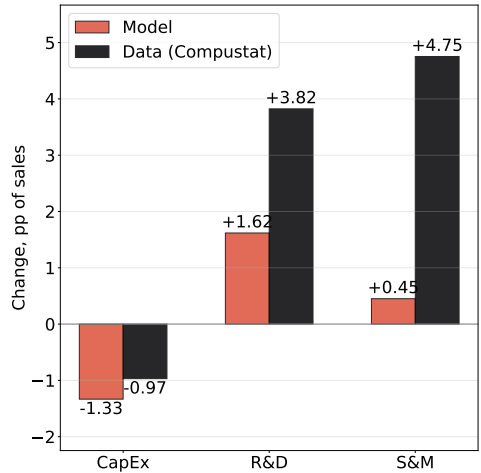
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Losses in Lifecycle

Matching Trends

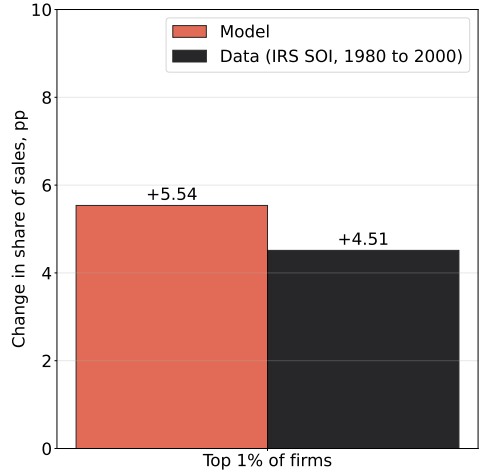
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Investment Recomposition (Untargeted)

Matching Trends

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Sales Concentration (Untargeted)

Aggregate Implications of Sales Concentration

Sales Concentration: Good or Bad?

- Rising sales concentration often perceived as bad. But not here!
- Our model rationalizes rise in sales concentration that is *independent of market power*: customer capital means concentration not bound by demand curve
- Can write aggregate production function with endogenous TFP determined by allocation of inputs across firms:

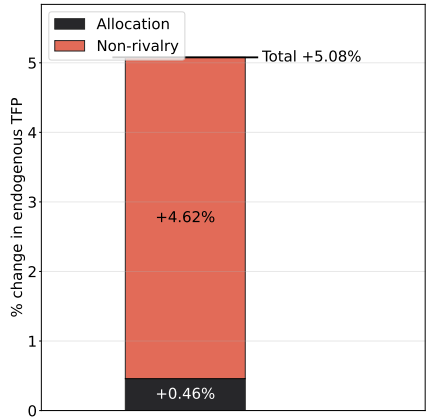
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- Rise in sales concentration increases TFP in our model: customers concentrate with productive firms, increase non-rivalry of aggregate production function

Intangible Deepening Raises Endogenous TFP

- Output elasticity change between periods raises $\mathcal{Z}$ by 5.1%
- About 90% of that is from non-rivalry: customers concentrate, raising effective X as γ_x doubles

Derivation



% Change in Endogenous TFP

Conclusion

In this paper, we...

- Document correlated secular trends among US Public Firms: increased sales concentration, investment recomposition, and longer run losses
- Estimate revenue production function with R&D and Sales&Marketing
- Develop model with knowledge and customer capital, connected via non-rivalry
- Examine aggregate implications of intangible deepening: increased TFP

Next steps:

1. Do real dynamics: get perfect foresight transition path (Auclert et al. 2021)
2. Move from CES to Kimball. Kimball Mark-up Dispersion Cost
3. Formal tests of complementarity between customer capital and knowledge capital.

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Appendix

(Informal) Gut Check

What I think is good

1. Simple trends: delayed profits (robust), rise in *different* "intangible investments"
2. *Knowledge capital non-rival in use across customers*. Very simple mechanism that can drive a lot of interesting results! And in line with corporate finance folks

What scares me

1. Headline macro implications + cleaner earnings delay/sales inequality (doable)
2. ACF estimation is always finnicky, want better empirical exercise
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Appendix: Corporate Income Tax Rate

Table 1: Corporate Income Tax Rate Regression

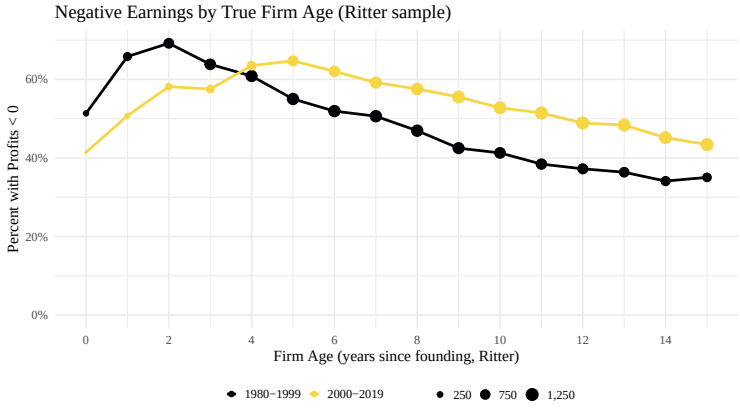
	Neg. Profits	Neg. Spell
Tax Rate	−0.00	−0.01*
	(0.00)	(0.01)
Num. obs.	171021	171021

$^{***}p < 0.001$; $^{**}p < 0.01$; $^{*}p < 0.05$

State Corporate Income tax is from Robinson and Tazhitdinova 2025. Controlling for firm and sector:year fixed effects.

Back

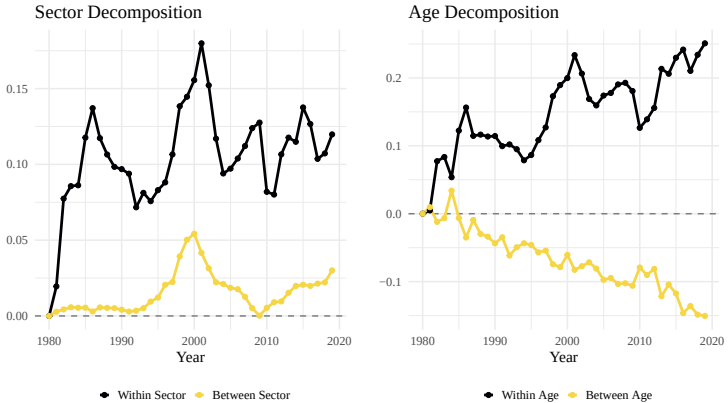
Appendix: Negative Earnings by True Firm Age



Delayed Profits (Ritter Founding Dates)

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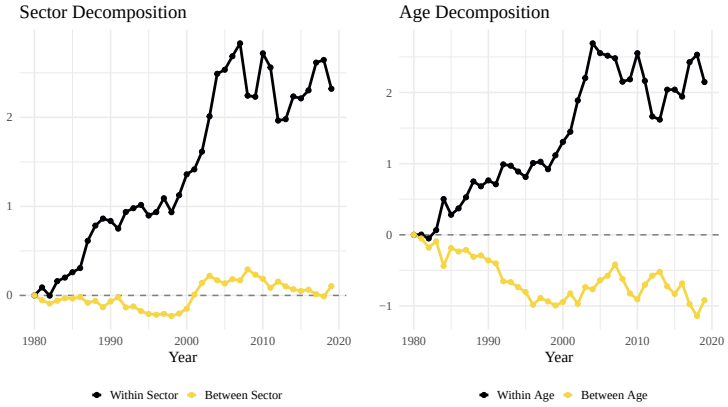
Appendix: Rise Not Driven by Age/Sector Composition



Decomposing Rise in Losses

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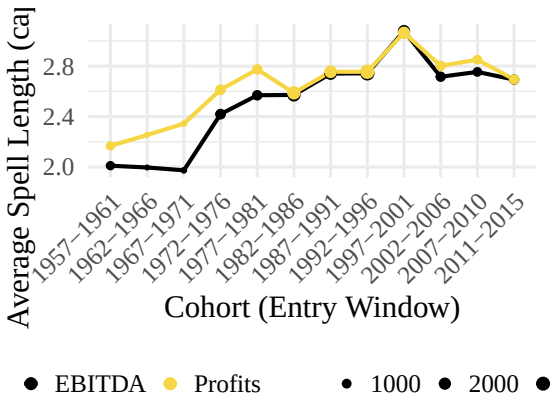
Appendix: Rise Not Driven by Age/Sector Composition



Decomposing Rise in Spell

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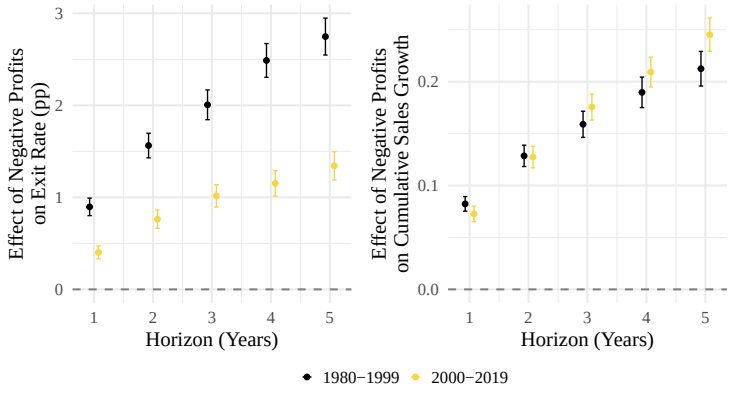
Appendix: Increased Persistence Across Cohorts



Increased Persistence of Losses Across Cohorts

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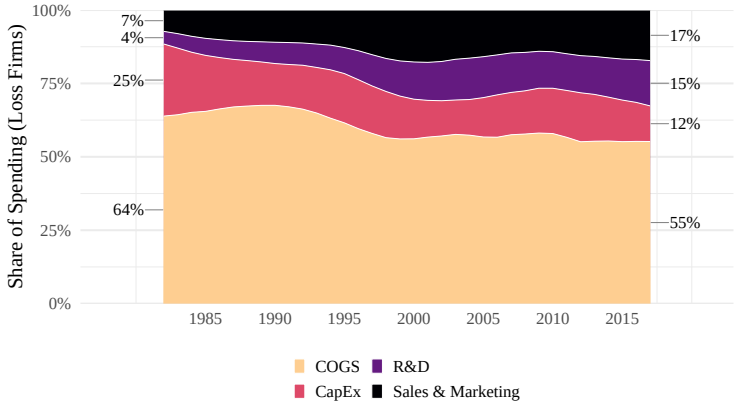
Appendix: Losses, Sales Growth and Bankruptcies



Losses, Sales Growth and Bankruptcies

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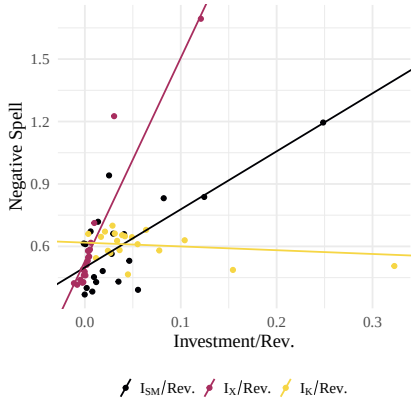
Appendix: Spending Composition of Firms Reporting Losses



Spending Composition of Firms with Neg. Profits (5-Year Rolling Mean)

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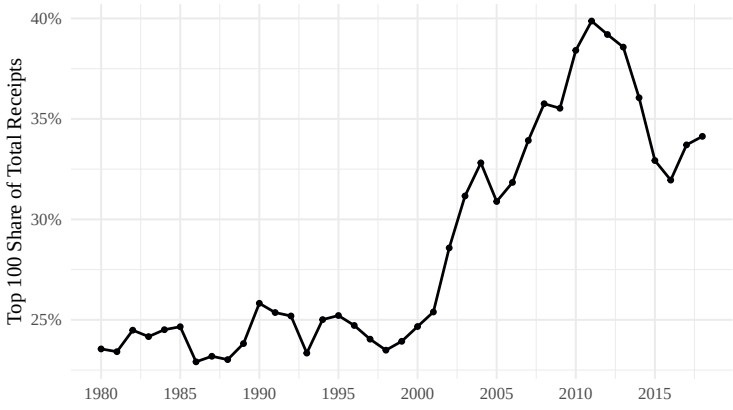
Appendix: Loss Persistence and Investment



Loss Persistence and Investment

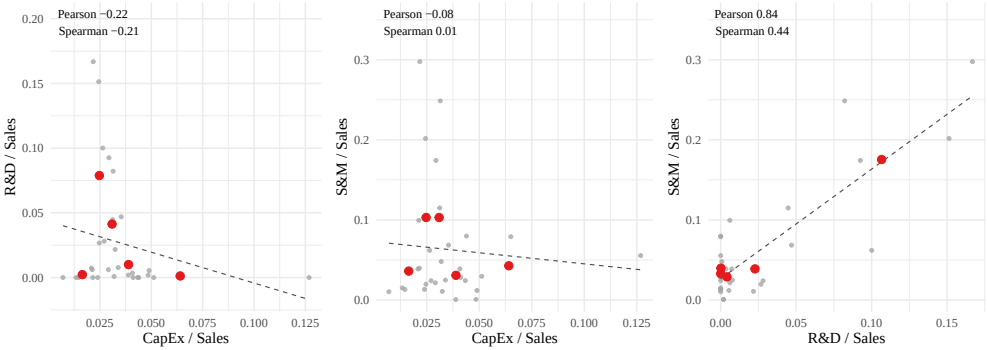
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Appendix: Compustat Top 100 Share



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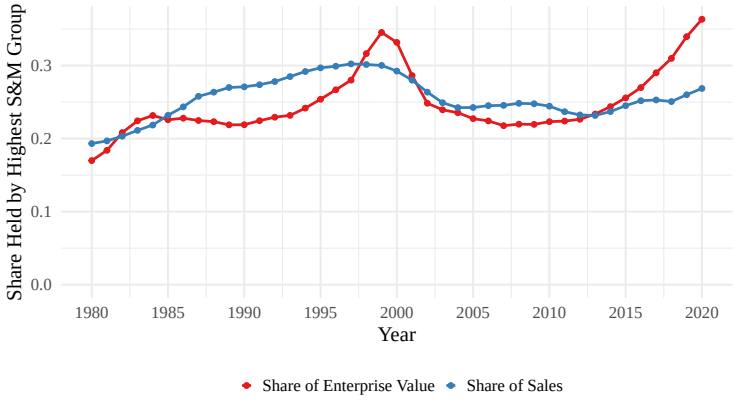
Appendix: Cross-Sector Correlation of S&M, R&D, and CapEx Spending



Sector medians of S&M, R&D, and CapEx spending rates (share of sales), 2000–2019

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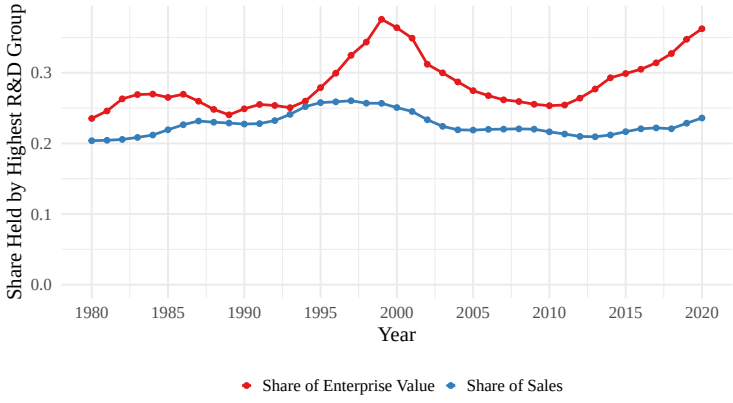
Appendix: Top Sales and Marketing Industries



Rise of S&M Sectors

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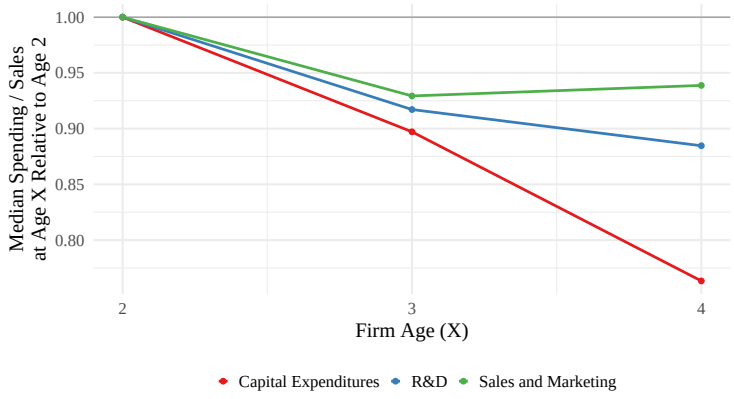
Appendix: Top R&D Industries



Rise of R&D Sectors

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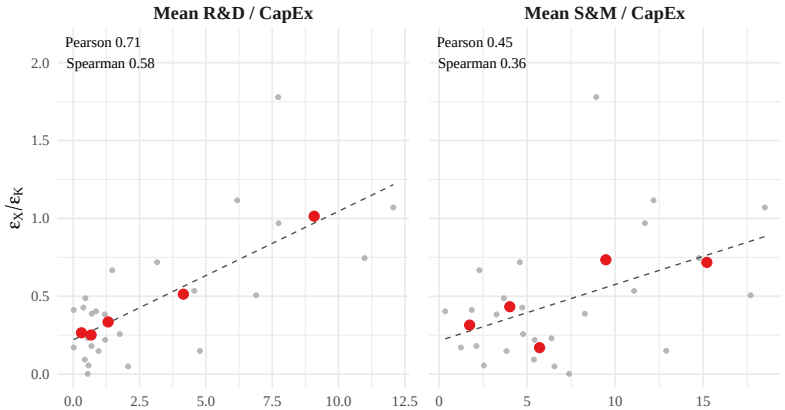
Appendix: Spending Decay by Firm Age



Spending Decay

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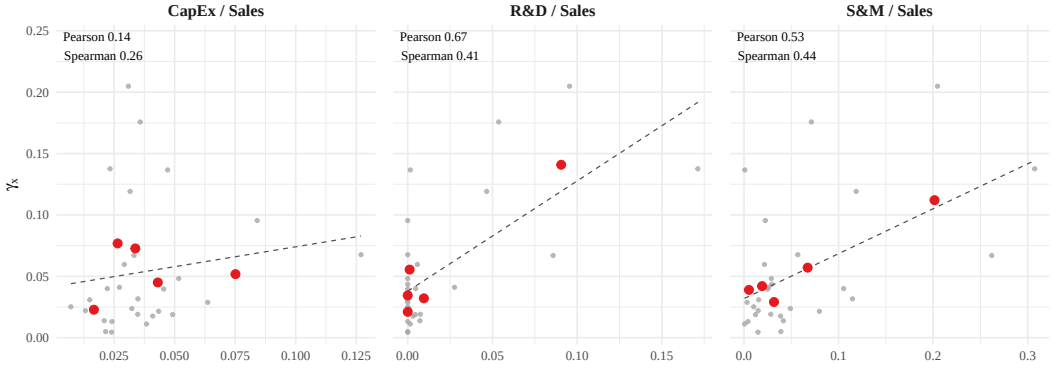
Appendix: Cross-Sector Knowledge-to-Capital Elasticity Ratio and Spending



Cross-Sector Correlation of Spending Ratios and Estimated Elasticities

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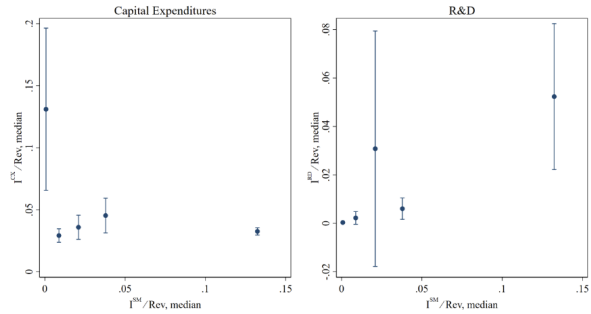
Appendix: Cross-Sector Correlation of Estimated γ_x and Spending Rates



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Appendix: Correlation R&D and Sales and Marketing

Figure 5: Comparison of I^{SM} with Capital Expenditures and R&D



Bin-scatter plots at the industry level for capital expenditures ($I^{CX}/_{Rev}$, left panel) and R&D ($I^{RD}/_{Rev}$, right panel) against sales and marketing expense ($I^{SM}/_{Rev}$), all scaled by revenue. Confidence bars are at the 90% level. See Appendix Figure A4 for full industry scatter plots.

Cross-Sector Sales and Marketing Correlation

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Appendix: Correlation Negative Profits and Sales and Marketing Spending

Cross-Sector Correlation with Sales and Marketing Spending

	EBITDA		
	Avg. Pct. Neg.	Avg. Neg. Spell	Std. Dev.
I^{SM}/Rev. (He et. al. 2025)	0.69***	2.79***	3.04***
	(0.04)	(0.21)	(0.43)
Num. obs.	2514	2514	2514

***$p < 0.001$; **$p < 0.01$; *$p < 0.05$

- Negative earnings and earnings/sales spread positively correlated with sales and marketing spending across sectors, in each year (controlling for year fixed effects)

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Appendix: Optimal Customer Base Size

- With $\tilde{M}_i = M_i^{\eta}/\bar{M}$, profits are $\pi_i = \tilde{\pi}\, Z_i^{\epsilon_Z} K_i^{\epsilon_K} X_i^{\epsilon_X} M_i^{\epsilon_M}$, with returns to scale $h \equiv \epsilon_K + \epsilon_X + \epsilon_M$
- At the stationary point, marginal profit equals a user cost ω common to all stocks: $\omega S_i = \epsilon_S\, \pi_i$, $S \in \{K, X, M\}$
- Substituting back, a solution exists iff profits are concave ($h < 1$):

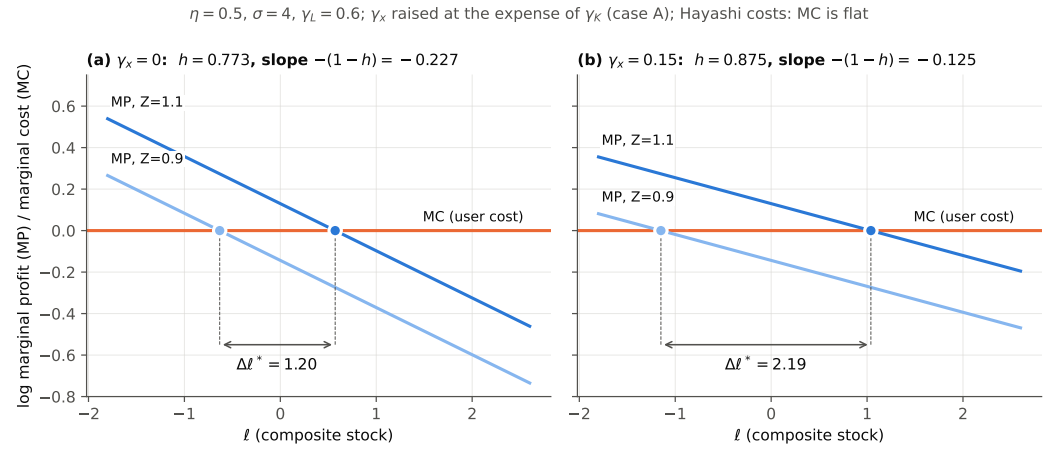
$$\pi_i = \tilde{\pi}\, \Lambda\, Z_i^{\epsilon_Z}\, \pi_i^h \;\Rightarrow\; \ln \pi_i^* = \frac{\ln(\tilde{\pi}\Lambda) + \epsilon_Z \ln Z_i}{1-h}, \qquad \Lambda \equiv \textstyle\prod_S (\epsilon_S/\omega)^{\epsilon_S}$$

- $M_i^* \propto \pi_i^*$, so $\ln \tilde{M}_i^* = \eta \ln M_i^* - \ln \bar{M} = c + \Psi \ln Z_i$, with $\Psi = \frac{\eta\, \epsilon_Z}{1-h}$
- With $\ln Z_i \sim N(0, \sigma_z^2)$, customer market clearing $\int_0^1 \tilde{M}_i\, di = e^{c + \frac{1}{2}\Psi^2 \sigma_z^2} = 1$ gives $c = -\frac{1}{2}\Psi^2 \sigma_z^2$
- Under CRS, $\kappa(1-h) = (1-\eta) - \eta(\sigma-1)\gamma_x$, so

$$\Psi = \frac{\eta(\sigma-1)}{(1-\eta) - \eta(\sigma-1)\gamma_x}, \qquad \left.\frac{\partial \Psi}{\partial \gamma_x}\right|_{CRS} = \Psi^2 > 0$$

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Appendix: Why Intangible Intensity Spreads Firm Size



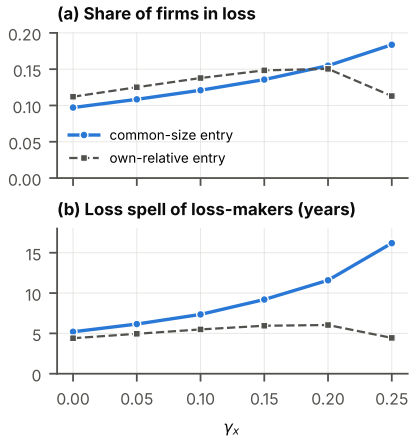
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Appendix: Simple Model, Loss Persistence Rises with γ_X

Entrants draw Z_i and are born at a *common* size, so entrant i starts at $s_0 Z_i^{-\Psi}$ of its own stationary point.

- All firms ride one saddle path; loss spell $T(Z_i) = \left[\mathcal{T}_h(\bar{s}_h) - \mathcal{T}_h(s_0 Z_i^{-\Psi})\right]^+$ is non-decreasing in Z_i ($\mathcal{T}_h(s)$: time from zero size to s; $\bar{s}_h$: break-even size)
- $\gamma_X \uparrow$: $\Psi \uparrow$ and $\bar{T}_h \uparrow \Rightarrow$ losses concentrate in productive firms, which lose for longer

$\chi = .027$, $\gamma_X : 0 \to .2$: share in loss $.10 \to .16$, mean spell of loss-makers $5.2 \to 11.6$ years



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Appendix: Customer Base as Continuum-Logit Choice Density

- Each period, after customer investment, every HH member j forms a relationship with one firm $i \in [0,1]$:

$$\max_i \; u_{ji} = \ln M_i' + \tfrac{1}{\eta}\varepsilon_{ji}, \qquad \tfrac{1}{\eta} : \text{dispersion of tastes over firms}$$

- Continuous logit: choices over the firm continuum have density

$$\tilde{M}_i = \frac{e^{\eta \ln M_i'}}{\int_0^1 e^{\eta \ln M_j'}\, dj} = \frac{(M_i')^\eta}{\bar{M}}, \qquad \Pr(j \text{ chooses a firm in } A) = \int_A \tilde{M}_i \, di$$

- $\tilde{M}_i$ is a density: $\int_0^1 \tilde{M}_i \, di = 1$, and $\tilde{M}_i > 1$ for above-average firms. Limit of the N-firm logit as $N \to \infty$
- Members re-choose every period, so persistence comes from the stock M

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Appendix: Endogenous TFP

- Aggregate inputs $K = \int K_i$, $X = \int X_i$, $L_Y = \int L_i$ (production labor), firm shares $k_i = K_i/K$, x_i, l_i. Substituting firm output into the CES aggregator ($r \equiv \frac{\sigma-1}{\sigma}$):

$$C = \mathcal{Z}\, K^{\gamma_k} X^{\gamma_x} L_Y^{\gamma_l}, \qquad \mathcal{Z} = \Big(\int_0^1 \underbrace{\tilde{M}_i^{\frac{1}{\sigma}} \left(Z_i\, k_i^{\gamma_k} x_i^{\gamma_x} l_i^{\gamma_l}\right)^r}_{A_i:\ X \text{ rival}} \underbrace{\tilde{M}_i^{\gamma_x r}}_{\text{non-rivalry}} \, di \Big)^{\frac{1}{r}}$$

- $\mathcal{Z}$ depends only on the allocation of inputs and customers across heterogeneous firms. Uniform allocation ($k_i = x_i = l_i = \tilde{M}_i = 1$): $\mathcal{Z}^{\text{unif}} = \mathbb{E}\big[Z^r\big]^{\frac{1}{r}} \approx 1$
- Take logs and pull out the non-rival term, weighting by $\omega_i \equiv A_i / \int A_j$ (sales shares if X were rival), with $\mathcal{Z}^{\text{rival}} \equiv \left(\int A_i\right)^{1/r}$:

$$\ln \mathcal{Z} = \underbrace{\ln \mathcal{Z}^{\text{unif}}}_{\approx 0} + \underbrace{\ln \frac{\mathcal{Z}^{\text{rival}}}{\mathcal{Z}^{\text{unif}}}}_{\text{allocation}} + \underbrace{\frac{1}{r} \ln \int_0^1 \omega_i\, \tilde{M}_i^{\gamma_x r}\, di}_{\text{non-rivalry} \;\approx\; \gamma_x \mathbb{E}_\omega[\ln \tilde{M}_i]}$$

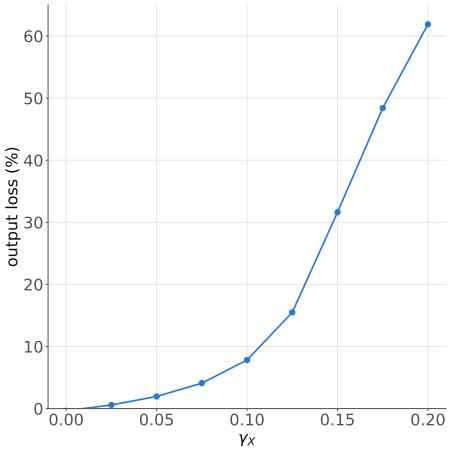
- Weights matter: unweighted, $\int \tilde{M}_i^{\gamma_x r} \leq \left(\int \tilde{M}_i\right)^{\gamma_x r} = 1$. Non-rivalry raises TFP because customers concentrate in the firms that carry the most weight

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Appendix: Intangible Deepening Raises Market Power's Cost

- In simple model (productivity fixed), rise in intangible intensity dramatically raises costs of mark-up dispersion
- Reason: technology now permits productive firms to be even larger (IRS in production + ability to shift demand curve)
- Makes restricted size due to optimizing mark-up much costlier

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Cost of Mark-up Dispersion (SIMPLE MODEL)

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