Recent Changes in Firm Dynamics and the Nature of Economic Growth

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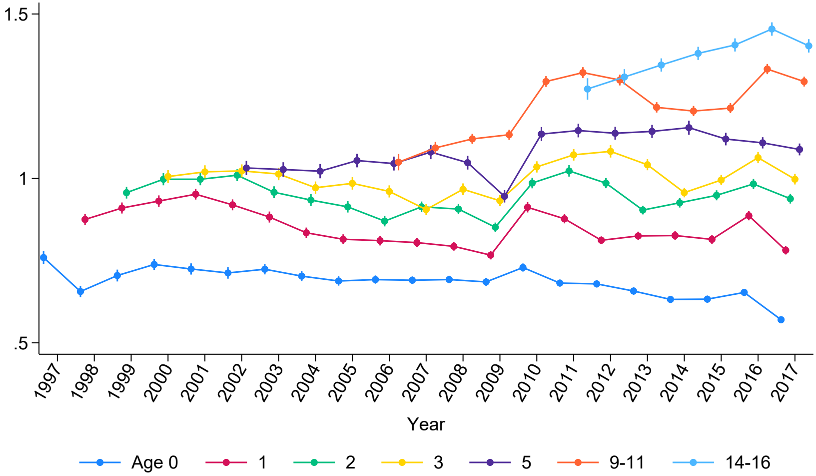
Introduction

- Recent trends in the U.S. economy
  - Increase in industry concentration
  - Decline in firm entry
  - Decline in aggregate productivity growth
- Similar trends observed in many advanced economies worldwide
- New insights into trends, based on a novel finding in high-quality Swedish registry data
- **Systematic changes in the size growth of firms since the late 1990s**

Avg. firm size (log employment) conditional on firm age in Sweden



Notes: 95% confidence intervals shown.

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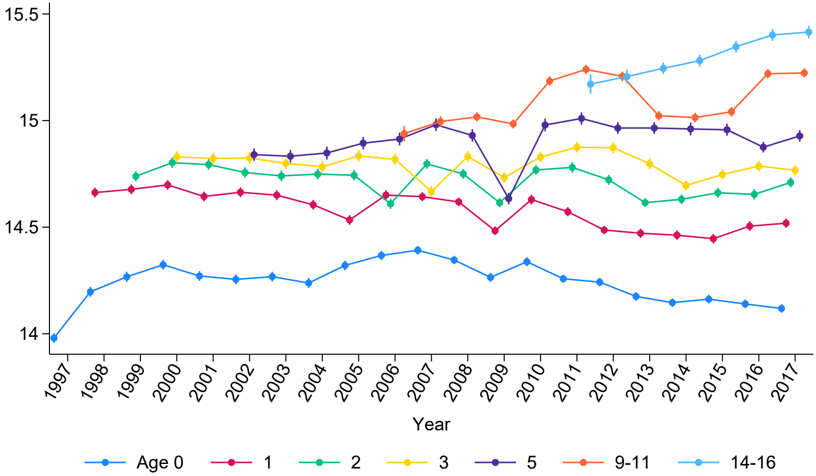


Notes: nominals sales deflated to 2017-SEK. 95% confidence intervals shown.

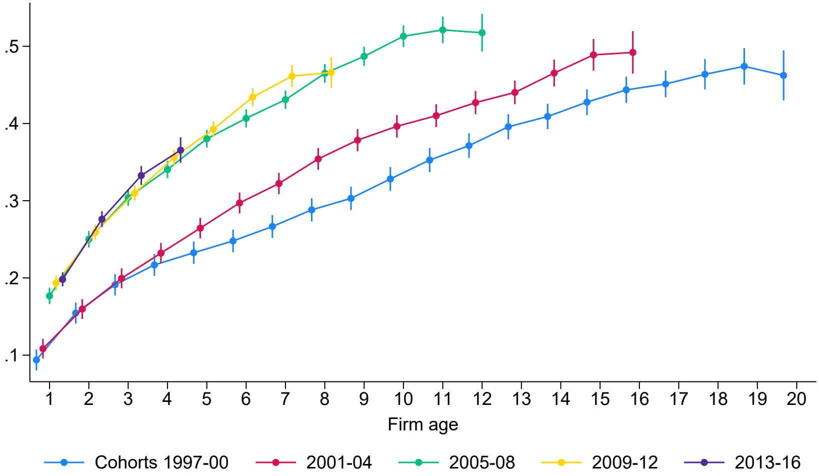
Size growth over the firm's life cycle

- Quantify size growth over the firm's life cycle using regression framework
- Non-parametric estimation of life cycle profile of firm j

$$\ln \text{Size}_{j,t} = \gamma_0 + \sum_{a_f=1}^{20} \gamma_{a_f} \mathbb{1}_{\text{Age}_{j,t}=a_f} + \theta_c + \theta_k + \epsilon_{j,t}$$

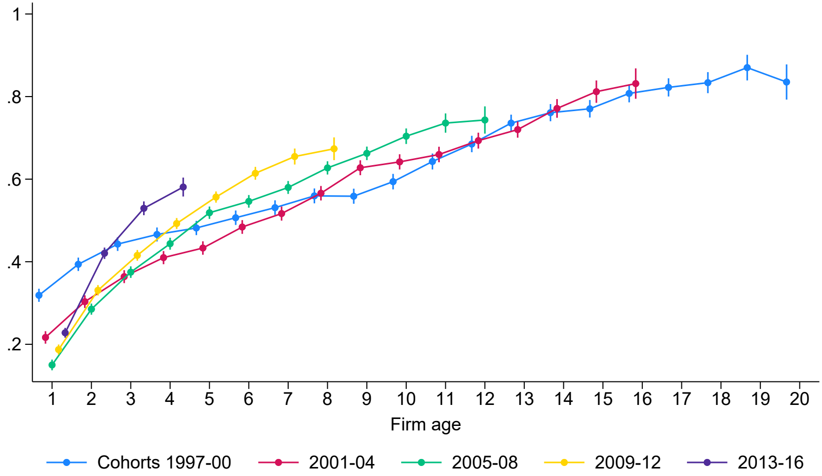
  - Size $\in$ {Employment, Sales}
  - $\mathbb{1}_{\text{Age}_{j,t}=a_f}$ age dummies
  - θ_c cohort fixed effect
  - θ_k 5-digit industry fixed effect
- γ_{a_f} capture the log differences in firm size between ages a_f and zero (γ_0)

Cumulative size growth (log employment) over the firm's life cycle



Notes: graph shows γ_{a_f} indicating the difference in log employment between age a_f and zero. 95% confidence intervals shown.

Cumulative size growth (log sales) over the firm's life cycle



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This paper

- Economic theory suggests that firm and agg. productivity growth are directly linked
- Models of endogenous growth through creative destruction
  - Business stealing through innovation
  - Business stealing associated with firm size growth
  - Innovation contributes to agg. productivity growth
- Exploit the link between firm and agg. productivity growth through a structural model

What can we infer about recent trends in agg. prod. growth from the changes in firm growth?

Related literature

- Trends in firm size (growth)
  - Sterk, Sedlácek and Pugsley (2021), Karahan, Pugsley and Sahin (2022), Hopenhayn, Neira and Singhania (2022)
- Explaining recent macroeconomic trends
  - Davis (2017), Gutiérrez and Philippon (2018), Bloom, Jones, Van Reenen and Webb (2020), Liu, Mian and Sufi (2022), Olmstead-Rumsey (2022), Peters and Walsh (2022), Akcigit and Ates (2023), Aghion, Bergeaud, Boppart, Klenow and Li (2023), De Ridder (2024), . . .
- Quantifying the sources of economic growth
  - Akcigit and Kerr (2018), Garcia-Macia, Hsieh and Klenow (2019), Peters (2020)
- Macroeconomic implications of reallocation
  - Restuccia and Rogerson (2008), Hsieh and Klenow (2009), Song, Storesletten and Zilibotti (2011), Acemoglu, Akcigit, Alp, Bloom and Kerr (2018)

Outline

Model

Explaining changes in firm growth across BGPs

Long-run macroeconomic implications

Transition dynamics

Robustness and discussion

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Model overview

The model features the following three elements

- Link b/w firm dynamics and economic growth in spirit of Schumpeterian growth models
- Two types of innovation: horizontal and vertical (internal) innovation as in Peters (2020)
  - Internal innovation as a source of markup growth
  - Allows for differential trends in sales and employment growth
- Innate (ex-ante) heterogeneity across firms
  - Changes in sales and employment growth vary across firms that differ in fundamentals
  - With reallocation effects across firms that matter for economic aggregates

Aggregate economy

- Household preferences

$$U = \int_0^\infty \exp(-\rho t) \ln C_t dt$$

- Final good production

$$Y_t = \exp\left(\int_0^1 \ln\left(q_{it} y_{it}\right) di\right)$$

q_{it} denotes the quality of product i.

- Firms increase q_{it} through innovation

Market structure within product markets

- Firm j produces in product market i with

$$y_{ijt} = \varphi_j L_{ijt}$$

- Innate heterogeneity in firm productivity φ_j as in Aghion et al. (REStud, 2023)

$$\varphi_j \in \{\varphi^h, \varphi^\ell\}$$

- Firms compete in prices (Bertrand competition)

  $\rightarrow$ firm with the highest quality adjusted productivity is producing in market i

Market structure within product markets

- Incumbent in market i sets price according to

$$p_{ijt} = \frac{q_{ijt}}{q_{ij't}} \frac{w_t}{\varphi_{j'}}$$

- Incumbent in market i sets markup according to

$$\mu_{ijt} \equiv \frac{p_{ijt}}{w_t / \varphi_j} = \frac{q_{ijt}}{q_{ij't}} \frac{\varphi_j}{\varphi_{j'}}$$

$\Longrightarrow$ Internal innovation increases markup

$\Longrightarrow$ More productive incumbent charges higher markup

Dynamic firm problem, high-productivity firm

Firm chooses its internal (vertical) and expansion (horizontal) R&D efforts (I_k,x_k)

$$r_t V_t^h(n, \boldsymbol{\mu}, S_t) - \dot{V}_t^h(n, \boldsymbol{\mu}, S_t) =$$

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$$\sum_{k=1}^{n} \underbrace{\pi(\mu_k)}_{\text{Flow profits}} +$$

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$$\sum_{k=1}^{n} \underbrace{\pi(\mu_k)}_{\text{Flow profits}} + \sum_{k=1}^{n} \underbrace{\tau_t \left[V_t^h \left(n-1, \boldsymbol{\mu}_{-k}, S_t \right) - V_t^h(n, \boldsymbol{\mu}, S_t) \right]}_{\text{Agg. creative destruction}}$$

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$$+ \max_{[I_k, x_k]} \left\{ \sum_{k=1}^{n} \underbrace{I_k \left[V_t^h \left(n, \left[\boldsymbol{\mu}_{-k}, \mu_k \times \lambda \right], S_t \right) - V_t^h(n, \boldsymbol{\mu}, S_t) \right]}_{\text{Internal R\&D}} \right.$$

Dynamic firm problem, high-productivity firm

Firm chooses its internal (vertical) and expansion (horizontal) R&D efforts (I_k,x_k)

$$
\begin{aligned}
r_t V_t^h(n, \boldsymbol{\mu}, S_t) - \dot{V}_t^h(n, \boldsymbol{\mu}, S_t) = \\
& \sum_{k=1}^{n} \underbrace{\pi(\mu_k)}_{\text{Flow profits}} + \sum_{k=1}^{n} \underbrace{\tau_t \left[V_t^h \left(n-1, \boldsymbol{\mu}_{-k}, S_t \right) - V_t^h(n, \boldsymbol{\mu}, S_t) \right]}_{\text{Agg. creative destruction}} \\
& + \max_{[I_k, x_k]} \Bigg\{ \sum_{k=1}^{n} \underbrace{I_k \left[V_t^h \left(n, \left[\boldsymbol{\mu}_{-k}, \mu_k \times \lambda \right], S_t \right) - V_t^h(n, \boldsymbol{\mu}, S_t) \right]}_{\text{Internal R\&D}} \\
& + \sum_{k=1}^{n} \underbrace{x_k \left[S_t V_t^h \left(n+1, [\boldsymbol{\mu}, \lambda], S_t \right) + (1 - S_t) V_t^h \left(n+1, \left[\boldsymbol{\mu}, \lambda \times \varphi^h / \varphi^\ell \right], S_t \right) - V_t^h(n, \boldsymbol{\mu}, S_t) \right]}_{\text{Expansion R\&D}}
\end{aligned}
$$

S_t is the share of product lines operated by high-productivity firms

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& \qquad - \underbrace{w_t \Gamma \left([I_i, x_i]; n, \boldsymbol{\mu} \right)}_{\text{R\&D costs}} \Bigg\}
\end{aligned}
$$

S_t is the share of product lines operated by high-productivity firms

R&D costs

- R&D costs in labor units

$$\Gamma\left([x_i, I_i]; n, [\mu_i]\right) = \sum_{k=1}^{n} \left[\mu_k^{-1} \frac{1}{\psi_I} (I_k)^{\zeta} + \frac{1}{\psi_x} (x_k)^{\zeta} \right]$$

ζ innovation cost curvature, ψ_I and ψ_x internal and expansion R&D efficiency

- ψ_I and ψ_x discipline firm markup, sales and employment life cycle growth

Analytical characterization

Firm entry and exit

- Entrants improve the quality of a random product line
- Productivity type is revealed after paying a fixed cost of entry w_t/ψ_z
- ψ_z governs the entry efficiency
- Entrants get assigned the high productivity type with probability p^h
- Free entry condition

$$p^h \times E\left[V^h(1, \mu, S)\right] + (1 - p^h) \times E\left[V^\ell(1, \mu, S)\right] = \frac{w_t}{\psi_z}$$

- Firm becomes inactive when losing its last product to competitors

Value of a product line

Proposition

Along a BGP, the value of a product line of firm productivity type $d \in \{h, \ell\}$ is

$$V_t^d(1, \mu_i, S) = \frac{1}{\rho + \tau}\left[\underbrace{Y_t\left(1 - \frac{1}{\mu_i}\right)}_{\textit{Profits}} + \underbrace{\frac{\zeta - 1}{\psi_x}(x^d)^\zeta w_t}_{\textit{Continuation value expansion R\&D}} + \underbrace{\frac{\zeta - 1}{\psi_I} I^\zeta w_t \mu_i^{-1}}_{\textit{Continuation value internal R\&D}}\right]$$

where $I \equiv I^h = I^\ell$ and $x^h > x^\ell$.

More productive firms

- charge higher markups and enjoy greater profits per product (on average)
- choose higher expansion R&D rates, $x^h > x^\ell$

BGP definition

Stationary distribution of productivity types

Proposition

Along a BGP, the constant share of product lines operated by high-productivity incumbents is

$$S = \frac{zp^h}{(1-S)(x^\ell - x^h) + z}$$

- Given firm entry, z, difference in expansion R&D rates determines S
- Firm entry crucial for stationary distribution of productivity types across product lines

Growth rate of the economy

Proposition

Along a BGP, the constant growth rate of the economy is

$$g = (I + \tau) \times \ln(\lambda) = \Bigg(\underbrace{I}_{\text{Incumbent internal R\&D}} + \underbrace{Sx^h + (1 - S)x^\ell}_{\text{Incumbent expansion R\&D}} + \underbrace{z}_{\text{Entry}} \Bigg) \times \ln(\lambda)$$

- Share of product lines operated by each productivity type affects aggregate growth rate

Outline

Explaining changes in firm growth across BGPs

- What do the changes in firm growth suggest about recent trends in agg. prod. growth?
  - Rationalize changes in sales and employment growth across two BGPs (*this section*)
  - Quantify the implications for economic aggregates (*next section*)
- Estimate model twice
  - Initial BGP reflects firm dynamics and macro-econ. conditions during the late 1990s
  - New BGP reflects changes in sales and employment life cycle growth wrt. 2010s
- Parameters subject to change: entry and internal R&D efficiency (ψ_z, ψ_I)

Initial BGP: moments and estimated parameters

	Data	Model
Moments		
Sales growth by age 8 in % (cohorts 1997–2000)	55.9	55.8
Employment growth by age 8 in % (cohorts 1997–2000)	28.8	28.8
Cross-sectional SD of log labor shares across entrants (1997–2005)	0.053	0.053
TFP growth g in % (1997–2005; FRED)	3.02	3.02
Entry rate in % (1997–2005)	14.3	14.3
Agg. markup μ in % (Sandström, 2020; De Loecker and Eeckhout, 2018)	7.5	7.5
Parameters		
ψ_I *Internal R&D efficiency*		0.144
ψ_x *Expansion R&D efficiency*		0.282
ψ_z *Entry R&D efficiency*		1.483
λ *Step size of innovation*		1.136
φ^h/φ^ℓ *Productivity gap*		1.091
p^h *Share of high type firms among entrants*		0.683
Set exogenously		
ρ *Discount rate*		0.02
ζ *R&D cost curvature*		2

New BGP: moments and estimated parameter changes

	Data (%)	Model (%)	ΔBGPs (pp)
Moments			
Sales growth by age 8 (cohorts 2009–2012)	67.4	67.4	+11.5
Employment growth by age 8 (cohorts 2009–2012)	46.6	46.6	+17.8
Parameters			
ψ_I *Internal R&D efficiency* (Δ in %)			-51.0
ψ_z *Entry R&D efficiency* (Δ in %)			-22.0

Estimation points towards

- Rising entry costs (Davis, 2017; Gutiérrez and Philippon, 2018)
- Rising (internal) R&D costs (Bloom et al., 2020)

New BGP: changes in R&D efforts

	Initial BGP	$\psi_I \downarrow$ (%)	$\psi_z \downarrow$ (%)	$\psi_I \downarrow, \psi_z \downarrow$ (%)
x^h	0.1187	+1.0	+32.8	+35.0
x^ℓ	0.0439	-5.9	+1.3	-11.5
I^h, I^ℓ	0.0367	-49.4	+13.8	-41.9

Notes: $\psi_I \downarrow$ denotes the 51% fall in the internal R&D efficiency and $\psi_z \downarrow$ the 22% fall in the entry efficiency.

- Falling internal R&D efficiency, ψ_I, decreases internal R&D rates
  - Markup growth $\downarrow$ Employment relative to sales growth $\uparrow$
- Falling entry efficiency, ψ_z, increases expansion R&D rates (value of product line $\uparrow$)
  - Sales growth $\uparrow$ Employment growth $\uparrow$

New BGP: changes in R&D efforts

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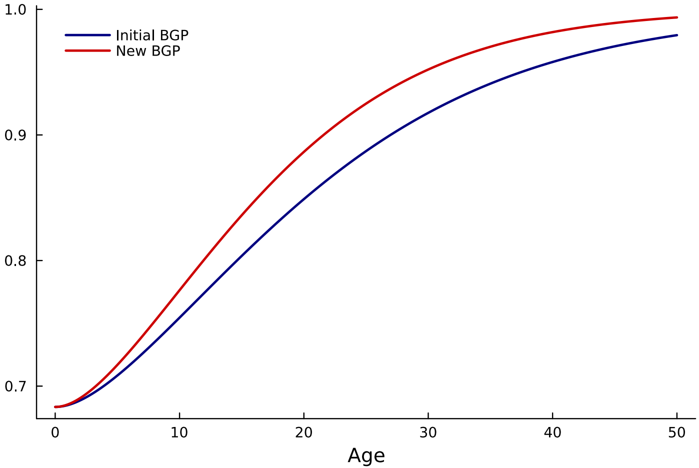
  - Sales growth $\uparrow$ Employment growth $\uparrow$
- Falling internal R&D and entry efficiency increase x^h relative to x^ℓ
  - **Acceleration in firm growth is due to faster growth by more productive firms!**

Share of high-productivity firms conditional on age



- Share of high-productivity firms conditional on age increases
- Their share in the cross-section of firms increases by 12pp.

Outline

Model

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Long-run macroeconomic implications

Transition dynamics

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Long-run macroeconomic implications

	Initial BGP (in %)	ΔBGPs
Entry rate	14.3	-8.1pp.
Concentration, S	80.6	+17.1pp.
Agg. growth rate, g	3.02	-0.6pp.
Avg. productivity, $\left(\varphi^h/\varphi^\ell\right)^{S_{new}-S_{initial}}$		+1.5%

Notes: Initial BGP shows levels, ΔBGPs shows changes in percentage points (pp) or in percent wrt. to the initial BGP.

- Changes in firm growth consistent with entry rate $\downarrow$, concentration $\uparrow$, agg. growth rate $\downarrow$
- Fall in entry rate (agg. growth rate) accounts for 80% (60%) of that in the data
- Opposing level and growth effects on agg. output. Change in welfare ambiguous
- $S\uparrow$ aligns with Kehrig & Vincent (2021), Baqaee & Farhi (2020), De Loecker et al. (2020)

Decomposing the long-run fall in the agg. growth rate

- Write the agg. growth rate g as

$$g = Sg^h + (1-S)g^\ell + g^z,$$

where $g^h \equiv (I + x^h)\ln(\lambda)$, $g^\ell \equiv (I + x^\ell)\ln(\lambda)$ and $g^z \equiv z\ln(\lambda)$.

- Shift-share decomposition of $\Delta g \equiv g_{new} - g_{old}$

$$\Delta g = \underbrace{S_{old}\Delta g^h + (1-S_{old})\Delta g^\ell}_{\Delta\text{Within}} + \underbrace{g^h_{old}\Delta S - g^\ell_{old}\Delta S}_{\Delta\text{Between}} + \underbrace{\Delta g^h \Delta S - \Delta g^\ell \Delta S}_{\Delta\text{Cross}} + \underbrace{\Delta g^z}_{\Delta\text{Entry}}$$

  - ΔWithin: changes in incumbents' innovation rates
  - ΔReallocation = ΔBetween + ΔCross: reallocation across productivity types
  - ΔEntry: changes in the entry rate

Decomposing the long-run fall in the agg. growth rate

	$\psi_I \downarrow, \psi_z \downarrow$	$\psi_I \downarrow$	$\psi_z \downarrow$
ΔWithin	+0.22	-0.23	+0.47
ΔReallocation	+0.27	+0.01	+0.20
ΔEntry	-1.10	-0.11	-0.93
Δg (in pp.)	-0.62	-0.33	-0.26

- Incumbents' innovation rates increased
  - Contrasting effects of falling internal R&D and entry efficiency
- Reallocation matters for the long-run growth rate (Acemoglu et al., 2018)
  - Reallocation effects absent with ex-ante homogeneous firms
  - Reallocation effects driven by rising entry costs
- Slowdown in economic growth (since late 1990s) driven by falling entry

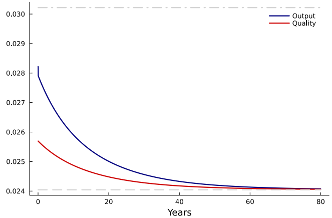
Outline

Transition dynamics

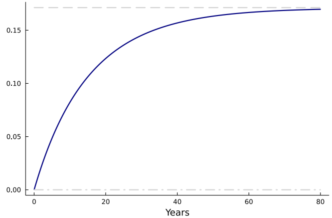
- Economy converges to a new BGP with a lower growth rate of aggregate output
- Reallocation to more productive incumbents increases aggregate productivity
- These two forces have opposing effects on short-run output growth
- What are the welfare effects associated with the changes in firm growth?

Transition dynamics

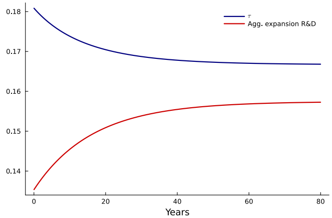
(a) Output and quality growth



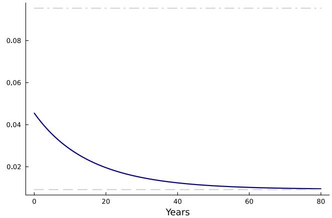
(b) Change in concentration, $S_t - S_{\text{initial}}$



(c) Rate of creative destruction, τ_t



(d) Rate of entry, z_t



Welfare effects

- Perm. consumption change that yields indifference b/w initial and transition to new BGP
- Transition to new BGP equivalent to permanent 23.3% consumption loss in initial BGP
- Welfare loss sizable
  - Caveat: interpreted high-growth period of late 1990s as initial BGP
  - Transition is quick and no further burst in growth (consistent with data)

Outline

Robustness and discussion

- Alternative comparative statics estimation
- Firm productivity and firm size growth in the data
- Potential causes behind rising entry and internal R&D costs

Conclusion

Empirical finding

- Firm sales and employment growth over the life cycle accelerated in Swedish registry data
- Disproportionate rise in employment growth

Structural model of firm dynamics with markup growth and ex-ante firm heterogeneity

- Rising entry and internal R&D costs quantitatively account for the changes in firm growth
- Changes in firm growth consistent with entry $\downarrow$, concentration $\uparrow$ and economic growth $\downarrow$
- Rising entry and internal R&D costs favor the expansion of ex-ante more productive firms

  $\Longrightarrow$ Observed acceleration in firm growth driven by productive incumbents

  $\Longrightarrow$ Positive reallocation effects on aggregate productivity and long-run economic growth
- Falling economic growth since the late 1990s is due to declining firm entry

– Backup Slides –

Data

- Universe of Swedish firms 1997–2017
- Information from balance sheets and profit and loss statements
- Restrict to firms in the private economy with at least one employee
- Birth year defined as year when firm hires its first employee

Data: summary statistics

	25th Pct.	50th Pct.	75th Pct.	Mean	SD	Obs.
*Sales**	1.2	2.7	7.8	27.8	568.2	4,918,996
*Value added**	0.5	1.1	2.9	7.6	142.3	4,918,996
Employment	1	2	5	9.9	131.1	4,918,996
*Wage bill**	0.2	0.6	1.6	3.7	53.0	4,918,996
*Capital stock**	0.04	0.2	1.1	9.3	277.0	4,918,996
*Intermediate Inputs**	0.4	0.9	2.6	10.8	270.0	4,918,996

Note: variables marked with * are in units of million 2017-SEK (1 SEK $\approx$ 0.1 US dollars). The capital stock is defined as fixed assets minus depreciation.

Balanced growth path definition

Definition

A balanced growth path (BGP) is a set of allocations $[x_{it}, l_{it}, \ell_{it}, z_t, S_t, y_{it}, C_t]_{it}$ and prices $[r_t, w_t, p_{it}]_{it}$ such that firms choose $[x_{it}, l_{it}, p_{it}]$ optimally, the representative household maximizes utility choosing $[C_t, y_{it}]_{it}$, the growth rate of aggregate variables is constant, the free-entry condition holds, all markets clear and the distribution of quality and productivity gaps is stationary.

Back

Characterization of firm dynamics

- Life cycle of markups (high and low productivity firms)

$$E\left[\mu_f^h|\text{firm age} = a_f, \varphi^h\right] = \underbrace{\ln\lambda \times \left(1 + I \times E[a_P^h|a_f]\right)}_{\text{Quality improvements}} + \underbrace{(1-S)\times\ln\left(\varphi^h/\varphi^l\right)}_{\text{Productivity advantage}}$$

$$E\left[\mu_f^l|\text{firm age} = a_f, \varphi^l\right] = \underbrace{\ln\lambda \times \left(1 + I \times E[a_P^l|a_f]\right)}_{\text{Quality improvements}} + \underbrace{S\times\ln\left(\varphi^l/\varphi^h\right)}_{\text{Productivity disadvantage}}$$

- Sales growth productivity type $j \in \{h, l\}$

$$E\left[\ln npy|a_f, \varphi^j\right] - E\left[\ln npy|0, \varphi^j\right] = \underbrace{g \times a_f}_{\text{Aggregate growth}} + \underbrace{\sum_{n=1}^{\infty}\ln n \times f^j\,(n|a_f)}_{\text{Firm's product growth}}$$

- Employment growth productivity type $j \in \{h, l\}$

$$E[\ln l_f|a_f, \varphi^j] - E[\ln l_f|0, \varphi^j] = \underbrace{E\left[\ln n|a_f, \varphi^j\right]}_{\text{Firm's product growth}} - \underbrace{\left(E\left[\ln \mu_f|a_f, \varphi^j\right] - E\left[\ln \mu_f|0, \varphi^j\right]\right)}_{\text{Firm's markup growth}}$$

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Alternative comparative statics

- Aghion et al. (2023): $\varphi^h/\varphi^\ell \uparrow$ as a driver behind rising concentration and falling growth
- Estimate alternative new BGP where φ^h/φ^ℓ (instead of ψ_z) and ψ_I are subject to change
- Estimated fall in internal R&D efficiency almost identical to before (-54% vs. -51%)
- Increase in productivity gap *qualitatively* consistent with changes in firm growth

	ΔData (pp)	ΔModel (pp)
Moments		
Sales growth by age 8 (cohorts 2009–2012)	+11.5	+2.1
Employment growth by age 8 (cohorts 2009–2012)	+17.8	+7.4
Parameters		
ψ_I *Internal R&D efficiency* (Δ in %)		-54
φ^h/φ^ℓ *Productivity gap* (Δ in %)		+6

Alternative comparative statics

- Long-run macroeconomic implications in line with recent trends
  - The aggregate growth rate g falls by 0.49pp (0.42pp in Aghion et al., 2023)
  - The entry rate falls by 3pp
  - Concentration S rises
- Decomposing the fall in the growth rate g as before

	$\psi_I \downarrow, \varphi^h/\varphi^\ell \uparrow$	$\psi_I \downarrow$	$\varphi^h/\varphi^\ell \uparrow$
ΔWithin	-0.13	-0.24	+0.11
ΔReallocation	+0.18	+0.01	+0.13
ΔEntry	-0.53	-0.12	-0.35
Δg (in pp.)	-0.49	-0.35	-0.11

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Firm productivity and firm growth in the data

- Permanently more productive firms choose higher expansion R&D rates x
  - Firm life cycle trajectories determined by ex-ante factors (Sterk et al., 2021)
- Model suggests that permanent firm productivity captured by markup at entry
- Test relation between permanent firm productivity and firm growth in the data

$$\ln \text{Size}_{\text{Age}_{j,t}=a_f} - \ln \text{Size}_{\text{Age}_{j,t}=0} = \beta_0 + \beta_1 \log \left(\frac{py}{wl}\right)_{\text{Age}_{j,t}=0} + \theta_c + \theta_k + \epsilon_{j,t}$$

Firm productivity and employment growth in the data

	Δ ln $\text{Size}_{\text{Age}=8}$	Δ ln $\text{Size}_{\text{Age}=8}$	Δ ln $\text{Size}_{\text{Age}=8}$	Δ ln $\text{Size}_{\text{Age}=8}$
$\log\left(\frac{py}{wl}\right)_{\text{Age}=0}$	0.130	0.198	0.222	0.237
	(0.006)	(0.005)	(0.005)	(0.006)
$\log K_{\text{Age}=0}$			-0.041	0.003
			(0.003)	(0.003)
$\log M_{\text{Age}=0}$				-0.107
				(0.004)
Cohort fixed effects	✓	✓	✓	✓
Industry fixed effects	✓	✓	✓	✓
$\log\left(\frac{py}{wl}\right)_{\text{Age}=0} > 0$		✓	✓	✓
N	66,817	65,875	60,950	60,832
R^2	0.06	0.08	0.08	0.10

1% more productive firms associated with 0.24pp faster size growth over first 8 years

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Potential causes behind rising entry and internal R&D costs

Increasingly difficult to enter and compete with incumbent firms

- Rising complexity of regulatory requirements and the tax system
- Rising lobbying expenditures
- Rising importance of intangible capital
- Davis (2017), Gutiérrez and Philippon (2018), De Ridder (2024)

Potential causes behind rising entry and internal R&D costs

Rising costs of (internal) R&D

- Falling R&D output relative to R&D inputs in the U.S. (Bloom et al., 2020)
  - Model points to rising internal rather than expansion R&D costs
    - $\varphi_I \downarrow$ consistent with trends in firm growth, entry, concentration, agg. growth
    - $\varphi_x \downarrow$ would counterfactually slow firm growth and reduce concentration
  - Aghion et al. (2023): falling costs of spanning multiple product markets
- Structural transformation to service economy
  - Swedish manufacturing firms increasingly offer services
    - Volvo offering car maintenance, insurance, leasing, car sharing
    - H&M offering clothing repair and recycling, clothing rentals ...
    - Agg. level: workforce employed in services from 72% to 79% (1997–2012)
  - Harder to distance competitor within product markets in services than manufacturing

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