Declining Responsiveness at the Establishment Level: Sources and Productivity Implications

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Main questions:

- Why have indicators of business dynamism been on the decline in the U.S. in recent decades?
  - Decline in reallocation, entrepreneurship and responsiveness to shocks (see Decker et. al. (2014,2016,2020)) (DHJM)
  - DHJM illustrate alternative mechanisms but don't estimate a structural model to identify sources
- Why should we care? Understanding structural changes and Implications for productivity

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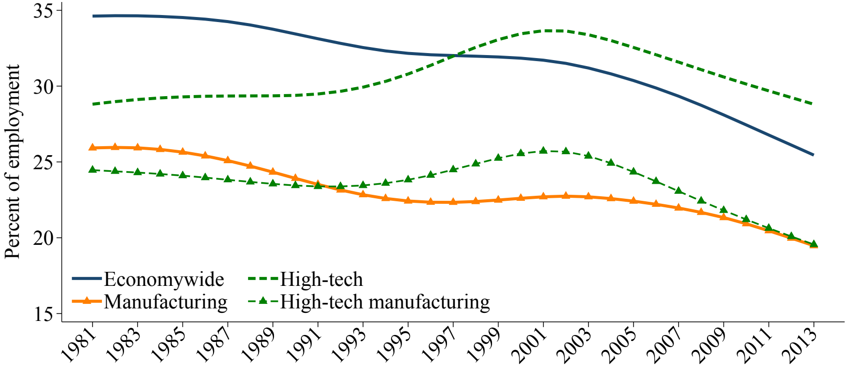
- Why should we care? Understanding structural changes and Implications for productivity

This paper

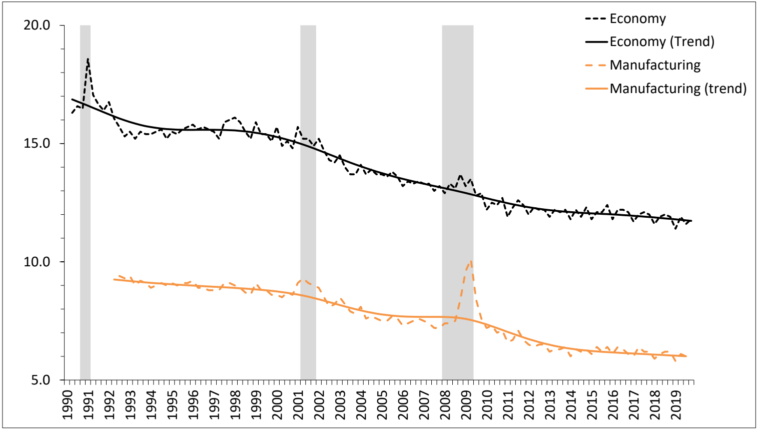
- estimates a structural model of dynamic labor demand to determine source of reduced responsiveness
- candidate changes are: adjustment costs, shock process, revenue curvature, discount rates

Job Reallocation Declining – Pervasive After 2000



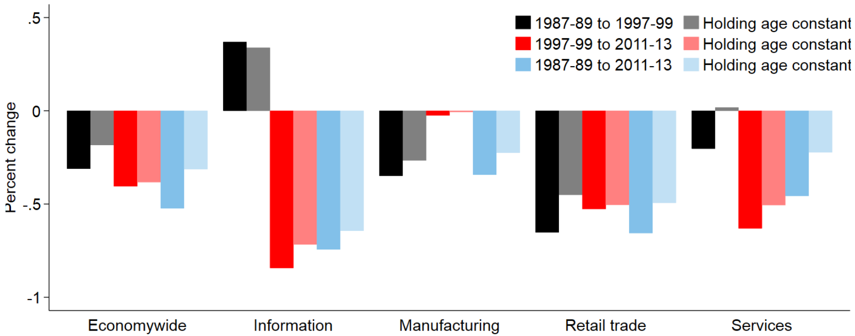
Source: DHJM (2020).

Decline in Job Reallocation Persists through 2019



Source: Business Employment Dynamics (BED) for U.S. private and manufacturing sectors (quarterly).

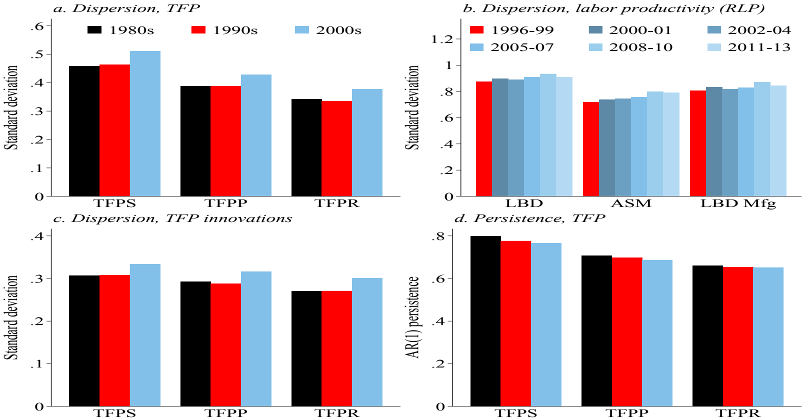
Most of the decline in Job Reallocation is within firm age groups



Note: Sectors are defined on a consistent NAICS basis. Source: LBD.

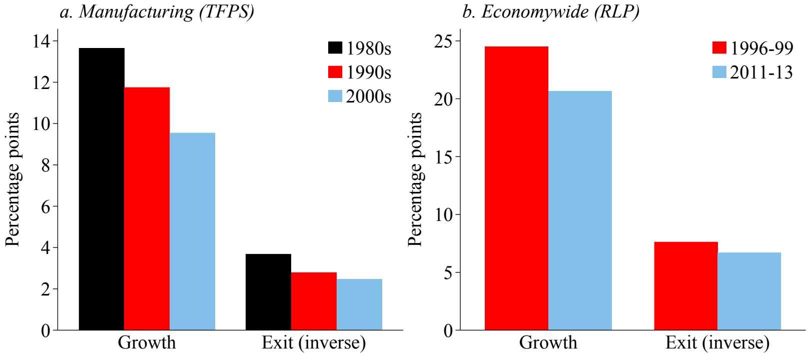
Source: DHJM (2020)

Within-Industry Productivity Dispersion Has Risen



Source: DHJM (2020). TFPS and TFPP are TFP (profit) shocks under CES demand and Cobb-Douglas production.

Job Growth and Exit Have Become Less Responsive to Productivity



Source: DHJM (2020).

Moments Used in Our Structural Estimation

Motivated by DHJM, Ilut et. al. (2018), Kehrig and Vincent (2017) and Cairo (2013)

$$g_{it} = \zeta_0 + \zeta_1 log(\varepsilon_{it}) + \zeta_2 log(\varepsilon_{it})^2 + \zeta_3 lemp_{i,t-1} + \eta_{it}. \tag{1}$$

$$exit_{it} = \xi_0 + \xi_1 log(A_{i,t-1}) + \xi_2 lemp_{i,t-1} + \mu_{it} \tag{2}$$

where g_{it} is growth for continuing plants, ε_{it} is innovation to productivity shock A_{it}

- Additional moments beyond $\zeta_1, \zeta_2, and \xi_1$:
  - Inaction: $-0.025 \leq \frac{\Delta e}{e} \leq 0.025$
  - Exit rate
  - Dispersion and persistence of TFP shocks
  - Median establishment size
  - OLS estimate of log(revenue) on log employment
- All moments annual (vary by decade).

Table: Data Moments

Inact	xrat	ζ_1	ζ_2	ξ_1	emp	$\tilde{\alpha}$	$\tilde{\rho}$	$\tilde{\sigma}$
1980s								
0.197	0.100	0.113	-0.054	-0.081	10.100	0.977	0.687	0.368
2000s								
0.243	0.083	0.064	-0.035	-0.059	8.900	0.959	0.682	0.408

The moments here are: Inact $= 0.025 > \frac{\Delta e}{e} > -0.025$ xrat $=$ exit rate, $(\zeta_1, \zeta_2)=$ linear and quadratic response of employment growth to innovation to profitability shock; $\xi_1=$ response of plant-level exit to profitability shock; **emp** is average firm size. $(\tilde{\alpha}, \tilde{\rho}, \tilde{\sigma})$ are the OLS estimates of revenue curvature, serial correlation of profitability shock, std of innovation to profitability.

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NOTE: Responsiveness Falls on All Dimensions

Explaining the Decline in Responsiveness

- Shock Processes: less persistence implies less responsiveness
- Adjustment Costs: increases in these costs imply less responsiveness
- Curvature: Increased market power reduces the curvature and the responsiveness
- Discount Factors: Responsiveness falls if firms are less patient.

Approach

- structural model of dynamic labor demand (Missing capital dynamics)
- estimate using SMM for 1980s and 2000s.
  - Manufacturing Plants
  - Include responsiveness in moments
- Determine which of the above factors changed across decades
- Study productivity implications

Dynamic Labor Demand

$$V(A, e_{-1}) = max(V^c(A, e_{-1}), 0)$$

$$V^c(A, e_{-1}) \;=\; \max_e R(A, e) - \Gamma - \omega(e) - C(e, e_{-1}) + \beta E_{A'|A} V(A', e)$$

- A is profitability shock, $R(\cdot)$ is revenue, Γ is fixed overhead cost, $\omega(\cdot)$ is compensation, $C(\cdot)$ represents adjustment costs
- Assume no adjustment costs for capital
- Labor employed immediately, no hours variation
- No explicit capital market frictions

Dynamic Labor Demand

Optimization decisions

- Exit decision: Decide whether it is worth it to pay the Γ to continue operations or whether it is better to shut to down (no cost to close doors)
- Employment decision: Decide whether or not to adjust employment, and if so, by how much
  - Exits replaced by entrant with random draw from profit shock distribution

Dynamic Labor Demand

- Revenue function: $R(A, e) = Ae^{\alpha}$
- Compensation function: $\omega(e) = w_0 \times e$
- Adjustment costs: $C(e, e_{-1}) =$

$$\begin{aligned} \frac{\nu}{2}\left(\frac{e - e_{-1}}{e_{-1}}\right)^2 e_{-1} \quad &+ \quad [\gamma_P (e - e_{-1}) + F_p] I(e - e_{-1} > 0) \\ -[\gamma_M (e - e_{-1}) \quad &- \quad F_m] I(e - e_{-1} < 0) \end{aligned} \tag{3}$$

- Policy function: $e = \phi_{\Theta}(A, e_{-1})$, where Θ is a parameter vector

Key parameters

- $\beta \rightarrow$ discount factor
- $\nu \rightarrow$ quadratic employment adjustment cost
- $F_P \rightarrow$ fixed cost for job creation
- $F_M \rightarrow$ fixed cost for job destruction
- $\Gamma \rightarrow$ fixed overhead cost
- $\omega_0 \rightarrow$ compensation parameter
- $\alpha \rightarrow$ revenue curvature
- $(\rho,\sigma) \rightarrow$ shock process

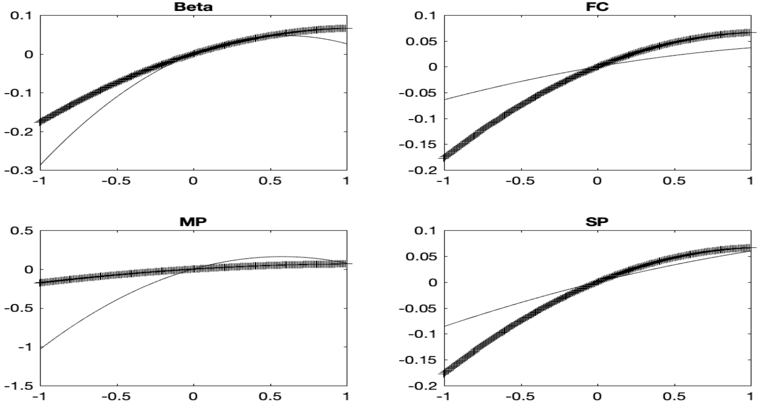
Key Channels

Table: Illustrative Parameters and Moments

Case	Parameters						Moments			
	β	ν	f_P	f_M	α	ρ	ζ_1	ζ_2	ξ_1	inact
Base	0.980	1.857	0.055	1.050	0.700	0.665	0.122	-0.055	-0.078	0.274
β	0.985	1.857	0.055	1.050	0.700	0.665	0.157	-0.131	-0.095	0.271
AC(Q)	0.980	1.952	0.055	1.050	0.700	0.665	0.065	-0.047	-0.082	0.275
AC(F)	0.980	1.857	0.058	1.098	0.700	0.665	0.050	-0.014	-0.080	0.279
MP	0.980	1.857	0.055	1.050	0.650	0.665	0.622	0.621	-0.110	0.382
SP	0.980	1.857	0.055	1.050	0.700	0.632	0.073	-0.013	-0.041	0.255

The parameters here are: β = discount factor, ν= quadratic adjustment cost, (f_P, f_M)=fixed hiring and firing costs as a fraction of average revenue, Γ = fixed production cost as a fraction of average revenue, ω_0=base wage, (α, ρ, σ)=curvature of revenue functions, serial correlation of profitability shocks and the standard deviation of the innovation to profitability shocks. Throughout: $(\Gamma = 0.474, \omega_0 = 0.656, \sigma = 0.355)$. The moments are from the responsiveness regressions.

Illustrative Job Growth Response to Innovations



Y-axis is job growth. X-axis is innovations. Beta=Discount factor, FC=Fixed costs MP=Curvature,SP=Persistence. In each panel, the dark curve comes from the baseline. The lighte curve is the treatment.

SMM Approach

- Parameter Estimates Solve an Optimization Problem:

$$J = min_{(\Theta)} \left(M^s(\Theta) - M^d \right)' W \left((M^s(\Theta) - M^d) \right). \qquad (4)$$

- Estimate using both 1980s and 2000s moments
- Moments Calculated in Simulated Data exactly as in Actual Data
  - Model solved quarterly and time aggregated to annual to compute simulated moments.
- Simulated Panel of 100,000 Plants and 400 Quarters
- $W = I$

Table: Moments

	Inact	xrat	ζ_1	ζ_2	ξ_1	emp	$\tilde{\alpha}$	$\tilde{\rho}$	$\tilde{\sigma}$
					1980s				
Data	0.197	0.100	0.113	-0.054	-0.081	10.100	0.977	0.687	0.368
Linear	0.087	0.127	0.124	-0.054	-0.094	10.163	0.789	0.923	0.219
Fixed	0.274	0.112	0.122	-0.055	-0.078	9.686	0.758	0.762	0.240
					2000s				
Data	0.243	0.083	0.064	-0.035	-0.059	8.900	0.959	0.682	0.408
Linear	0.022	0.185	0.067	-0.036	-0.090	8.946	0.771	0.922	0.146
Fixed	0.290	0.108	0.065	-0.035	-0.062	9.23	0.757	0.752	0.241

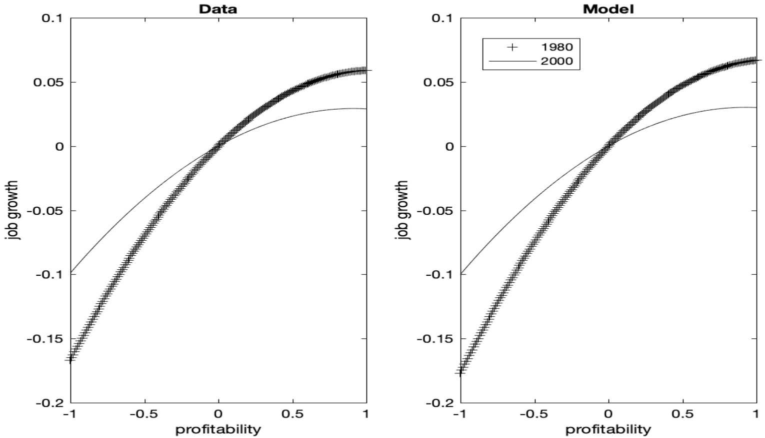
The moments here are: Inact $= 0.025 > \frac{\Delta e}{e} > -0.025$ xrat $=$ exit rate, $(\zeta_1, \zeta_2) =$ linear and quadratic response of employment growth to profitability shock; $\xi_1 =$ response of plant-level exit to profitability shock innovation; **emp** is median plant size. $(\tilde{\alpha}, \tilde{\rho}, \tilde{\sigma})$ are the OLS estimates of revenue curvature, serial correlation of profitability shock, std of innovation to profitability.

Table: Parameter Estimates

	β	ν	γ_P	γ_M	f_P	f_M	Γ	ω_0	α	ρ	σ	J
1980s												
Linear	0.973	0.649	4.995	9.443	na	na	0.413	0.864	0.739	0.610	0.307	0.743
Fixed	0.980	1.857	na	na	0.055	1.050	0.474	0.656	0.700	0.665	0.355	0.359
2000s												
Linear	0.992	5.880	0.978	1.345	na	na	0.383	0.749	0.722	0.340	0.251	3.208
Fixed	0.982	2.196	na	na	0.063	1.113	0.464	0.633	0.701	0.654	0.356	0.357

The parameters here are: β = discount factor, ν= quadratic adjustment cost, (γ_P, γ_M) =linear hiring and firing costs,(F_P, F_M)=are the fractions of revenue lost from fixed hiring and firing costs, Γ = fixed production cost as a fraction of average revenue, ω_0=base wage, (α, ρ, σ)=curvature of revenue functions, serial correlation of profitability shocks and the standard deviation of the innovation to profitability shocks, J= fit.

Job Growth Response to Innovations: Data and Model



. The left (right) panel is based upon coefficients from the responsiveness regression on actual (simulated) data.

Key Findings

- Parameters
  - Convex and (asymmetric) non-convex costs required to match moments.
  - Increases in all of these costs to match changes from 1980s to 2000s.
  - β, α did not change much
  - ρ is lower in 2000s
- Moments
  - close match with intensive and extensive responses
  - simulated moments consistent with reduced responsiveness
  - miss OLS estimates: endogenous omitted variable bias

Which changes were most important

- simulate using 1980s estimates for a subset of key parameters; use 2000s estimates for all others
- report moments and fit
- Clearly changes in adjustment costs are key for understanding intensive margins
- Extensive margin impacted by shock processes and discount factor

Table: Simulated Moments: Lower Panels Hold Row Parameter(s) at 1980s value(s)

	Inact	xrat	ζ_1	ζ_2	ξ_1	emp	$\tilde{\alpha}$	$\tilde{\rho}$	$\tilde{\sigma}$	J
2000s										
Data	0.243	0.083	0.064	-0.035	-0.059	8.900	0.959	0.682	0.408	na
Baseline	0.290	0.108	0.065	-0.035	-0.062	9.23	0.757	0.752	0.241	0.357
β	0.288	0.111	0.064	-0.041	-0.065	9.229	0.757	0.754	0.241	0.408
$C(\cdot)$	0.269	0.097	0.202	-0.158	-0.064	9.091	0.757	0.749	0.244	17.187
α	0.290	0.108	0.067	-0.034	-0.062	9.166	0.757	0.751	0.241	0.359
(ρ, σ)	0.293	0.107	0.065	-0.041	-0.074	9.304	0.757	0.756	0.241	0.447
ν	0.287	0.105	0.125	-0.062	-0.050	9.372	0.757	0.753	0.244	1.841
F_P	0.289	0.106	0.095	-0.059	-0.049	9.436	0.757	0.752	0.243	1.026
F_M	0.282	0.105	0.111	-0.086	-0.079	9.277	0.758	0.756	0.241	3.108

The moments here are: Inact $= 0.025 > \frac{\Delta e}{e} > -0.025$ xrat = exit rate, (ζ_1, ζ_2) = linear and quadratic response of employment growth to innovation to profitability shock; ξ_1= response of plant-level exit to profitability shock; **emp** is median plant size. $(\tilde{\alpha}, \tilde{\rho}, \tilde{\sigma})$ are the OLS estimates of revenue curvature, serial correlation of profitability shock, std of innovation to profitability.

Table: Lower panel targets **responsiveness** moments with row parameter(s)

	Targeted				UnTargeted						
Case	ζ_1	ζ_2	ξ_1	$\pounds_{targ}$	Inact	xrat	emp	$\tilde{\alpha}$	$\tilde{\rho}$	$\tilde{\sigma}$	$\pounds_{all}$
Baseline 1980s	0.122	-0.055	-0.078	1.254	0.274	0.112	9.686	0.758	0.762	0.240	1.627
Data 2000	0.064	-0.035	-0.059	na	0.243	0.083	8.900	0.959	0.682	0.408	na
Baseline 2000s	0.065	-0.035	-0.062	0.003	0.290	0.108	9.229	0.757	0.752	0.241	0.357
β	0.074	-0.034	-0.077	0.115	0.264	0.126	9.172	0.758	0.768	0.238	0.629
AC	0.063	-0.035	-0.055	0.006	0.274	0.120	9.207	0.758	0.762	0.239	0.451
MP	0.120	-0.031	-0.074	0.846	0.278	0.113	9.147	0.757	0.750	0.239	1.224
SP	0.062	-0.034	-0.079	0.119	0.273	0.124	9.669	0.759	0.766	0.237	0.616

The moments here are: Inact $= 0.025 > \frac{\Delta e}{e} > -0.025$ xrat $=$ exit rate, $(\zeta_1, \zeta_2) =$ linear and quadratic response of employment growth to innovation to profitability shock; $\xi_1 =$ response of plant-level exit to profitability shock; **emp** is median plant size. $(\tilde{\alpha}, \tilde{\rho}, \tilde{\sigma})$ are the OLS estimates of revenue curvature, serial correlation of profitability shock, std of innovation to profitability.

Table: Productivity Implications

Case	AggProd	$Std(\frac{R}{e})$	$c(A, \frac{e}{\sum e})$
		1980s	
Data			
Model	48.937	10.134	0.300
		2000s	
Data			
Model	47.343	10.217	0.288

The statistics are computed from simulated data with best fit parameters from estimation. Frequency is quarterly.

- Actual productivity in U.S. Manufacturing increased by 29 percent from 1980s to 2000s.
- Results imply that without rising adjustment costs it would have risen by 33.5 percent.

Potential Implications for Measured Markups

Production (ratio) approach for measuring markups:

$$\mu_{it} = \theta_{it}/ls_{it} \tag{5}$$

where μ_{it} is the markup, θ_{it} is the output elasticity of labor and ls_{it} is the share of total revenue that is paid to labor.

- This approach assumes no adjustment costs for labor.
- With adjustment costs, measured markups variation will reflect adjustment frictions even in the absence of variation in actual markups.
- Are the patterns highlighted in DEU (2020) potentially driven by adjustment frictions?

Potential Implications for Measured Markups

Table: Moments of Measured Markups Using Production (Ratio) Approach

Year	Mean μ	Median μ	$P90$ μ	$Corr(\mu, \frac{R}{\sum R})$	$Corr(\mu, A)$
			1980s		
Data	1.55	1.40	2.40		
Model	1.55	1.59	1.85	0.12	0.56
			2000s		
Data	1.80	1.65	3.20		
Model	1.56	1.61	1.85	0.13	0.58

The empirical markup measures are taken from DEU(2020). Here $P90$ is the 90th percentile. The model moments are computed from simulated data with best fit parameters from estimation. Frequency is quarterly.

- Increase in adjustment costs by themselves insufficient to account for increase in revenue weighted measured markups.
- However, adjustment costs yield considerable dispersion and positive relationship between measured markups and revenue.
- Combined with rising concentration (potentially from other factors – e.g., Autor et. al (2020) superstars) can yield rising revenue-weighted measured markups even without any variation in actual markups.

Summary

- We explore the mechanisms underlying the finding of the decline in firms' responsiveness to shocks
  - Adjustment costs (both convex and nonconvex) have increased substantially.
  - Little change in discount factor, curvature or shock innovation.
  - Small decline in persistence.
- Implications:
  - Drag on Aggregate Productivity
  - Increase in Revenue Labor Productivity Dispersion
  - Decline in Covariance between TFP and Employment
  - Dispersion in measured markups (using production approach) positively related to revenue market share.
- Next Steps: Beyond Manufacturing. Less informative moments but dramatic declines in reallocation.