Title: Productivity, Job Creation and Entrepreneurship

Lecture Notes for NBER Entrepreneurship Bootcamp

July 2014

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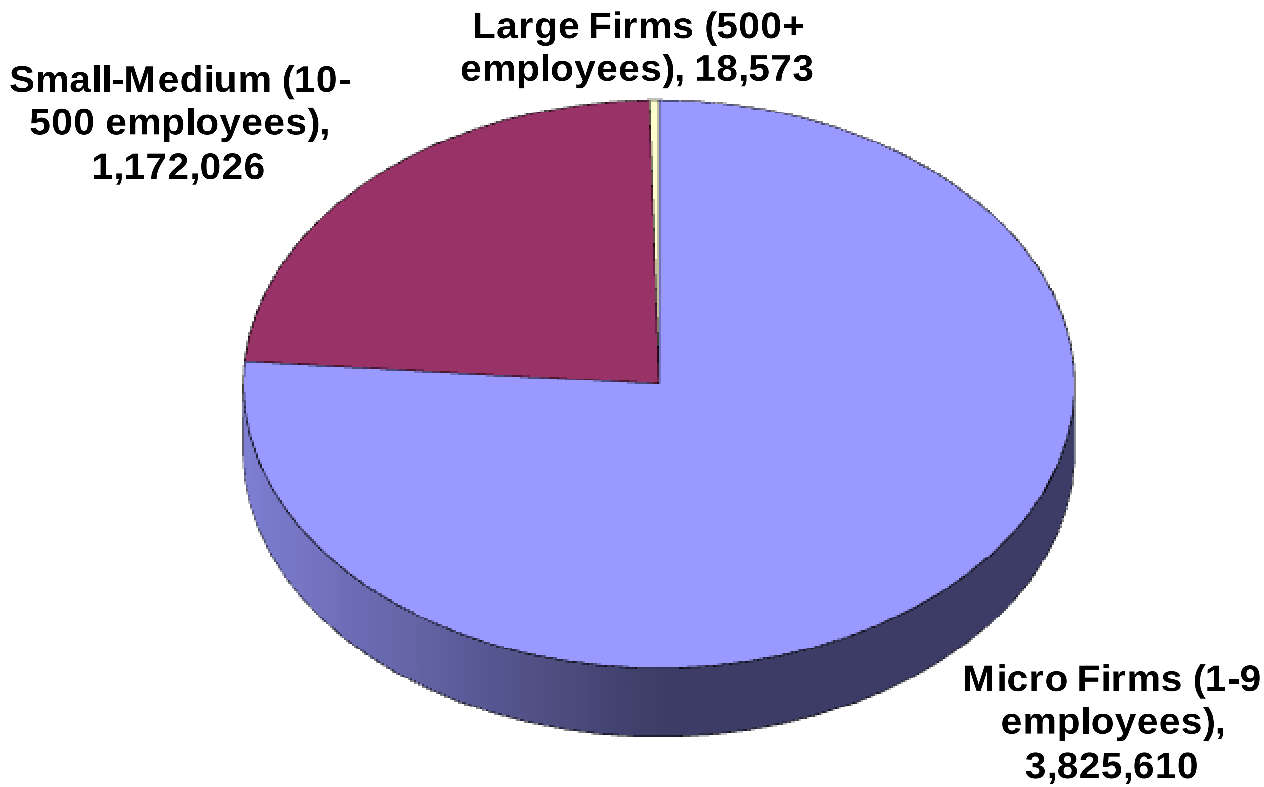
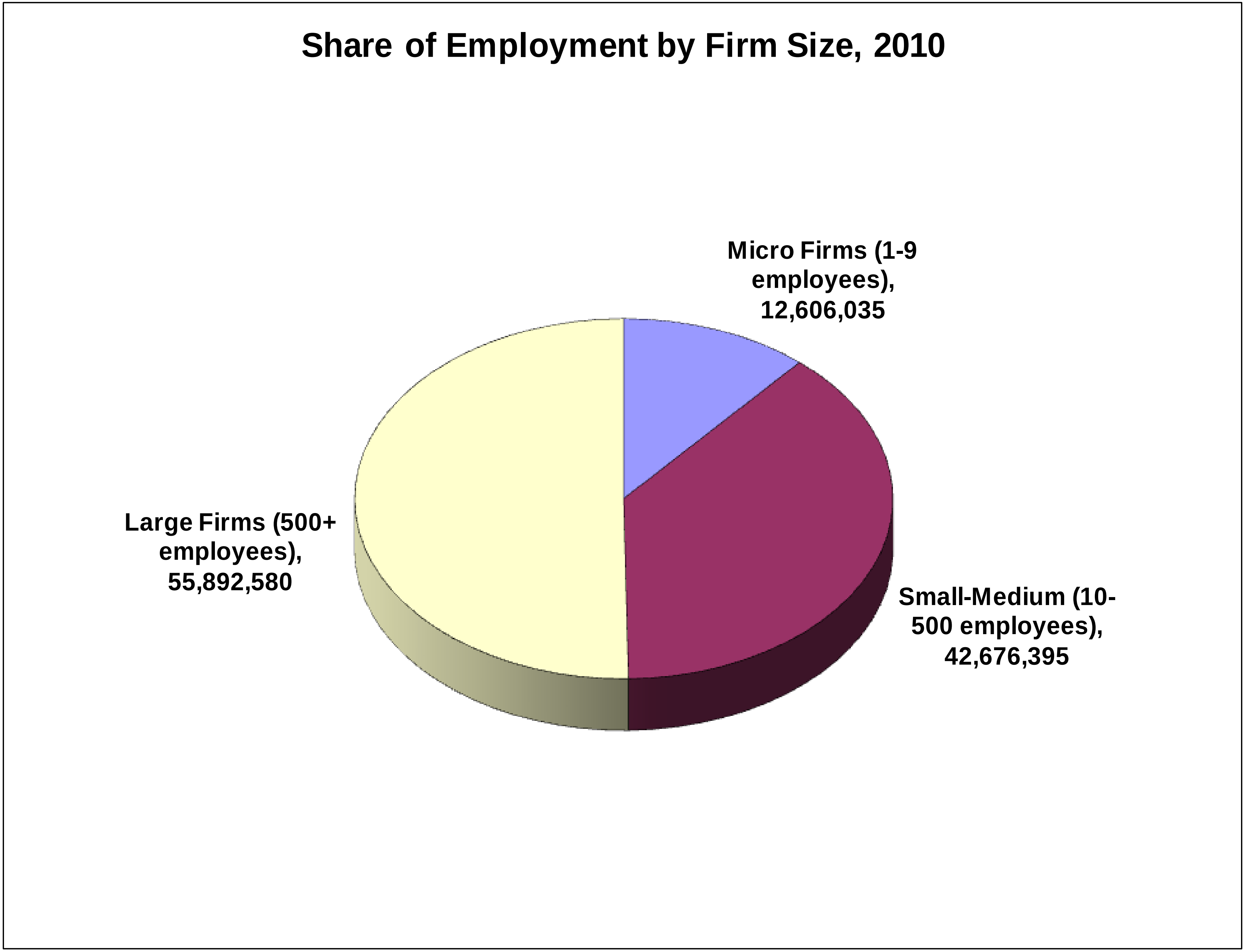
University of Maryland and NBER

Share of Firms by Firm Size, 2010




Share of Employment by Firm Size, 2010
Micro Firms (1-9 employees), 12,606,035
Large Firms (500+ employees), 55,892,580
Small-Medium (10-500 employees), 42,676,395

CHRYSLER

Ford

GM

kmart

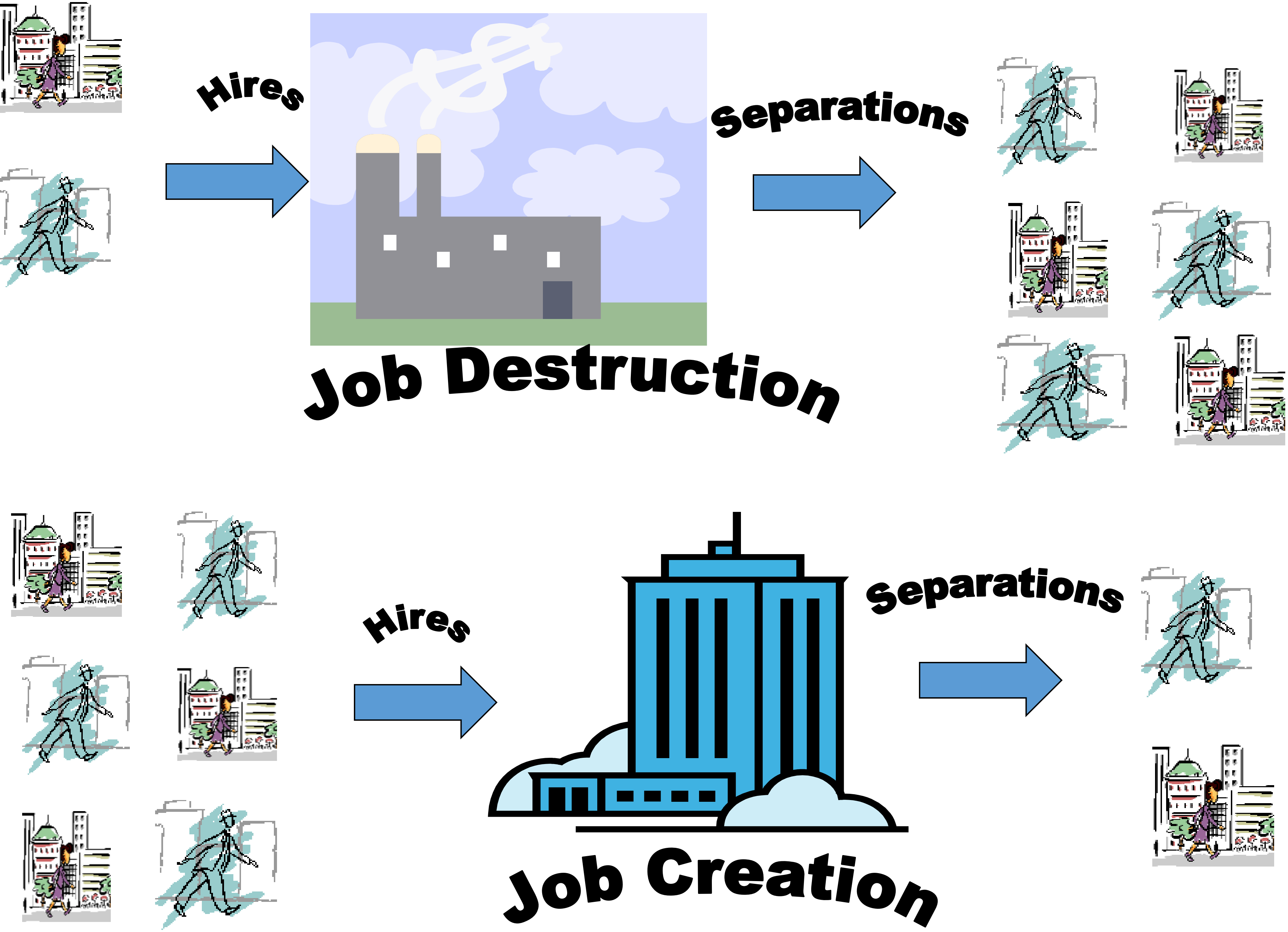
USS

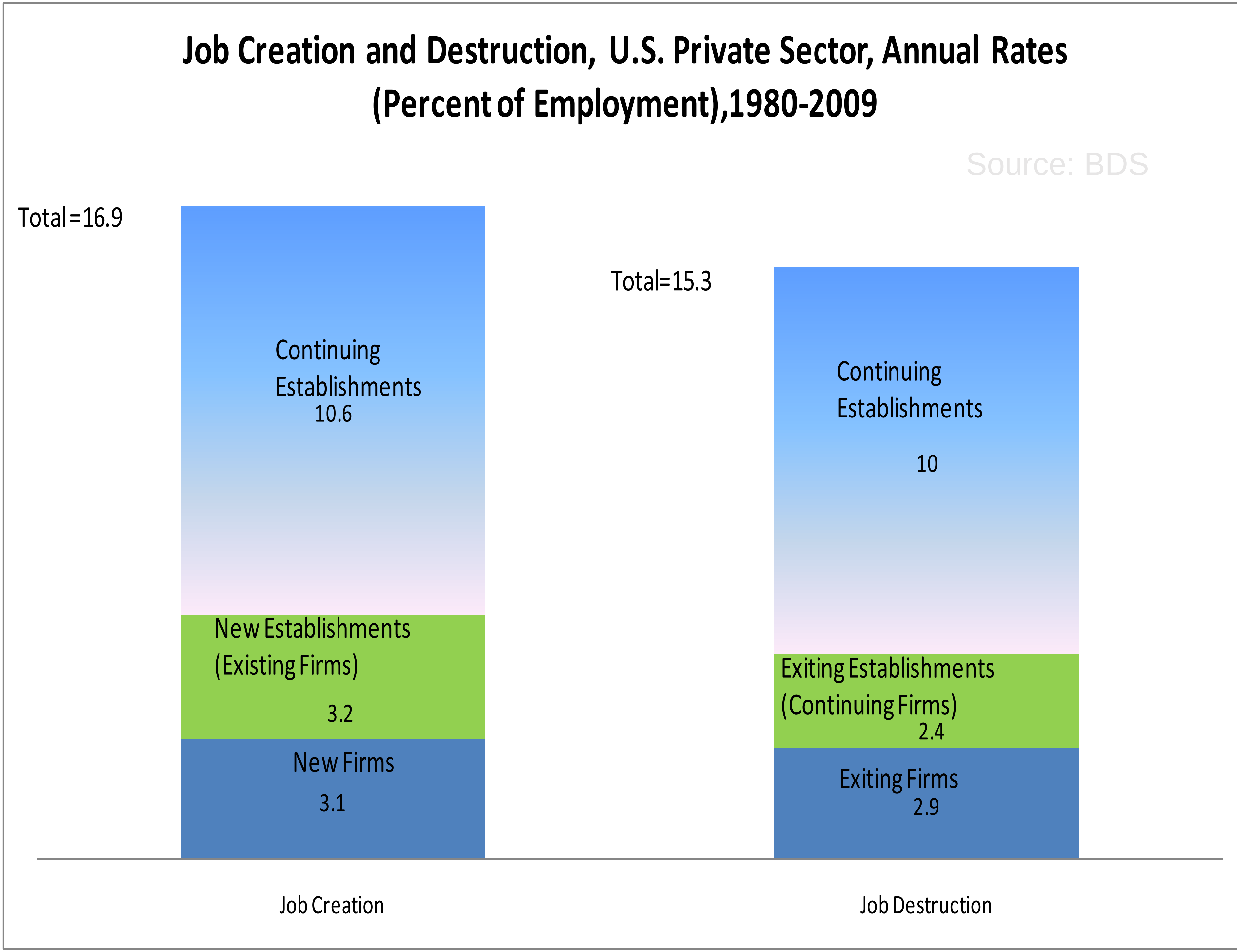
TOYOTA

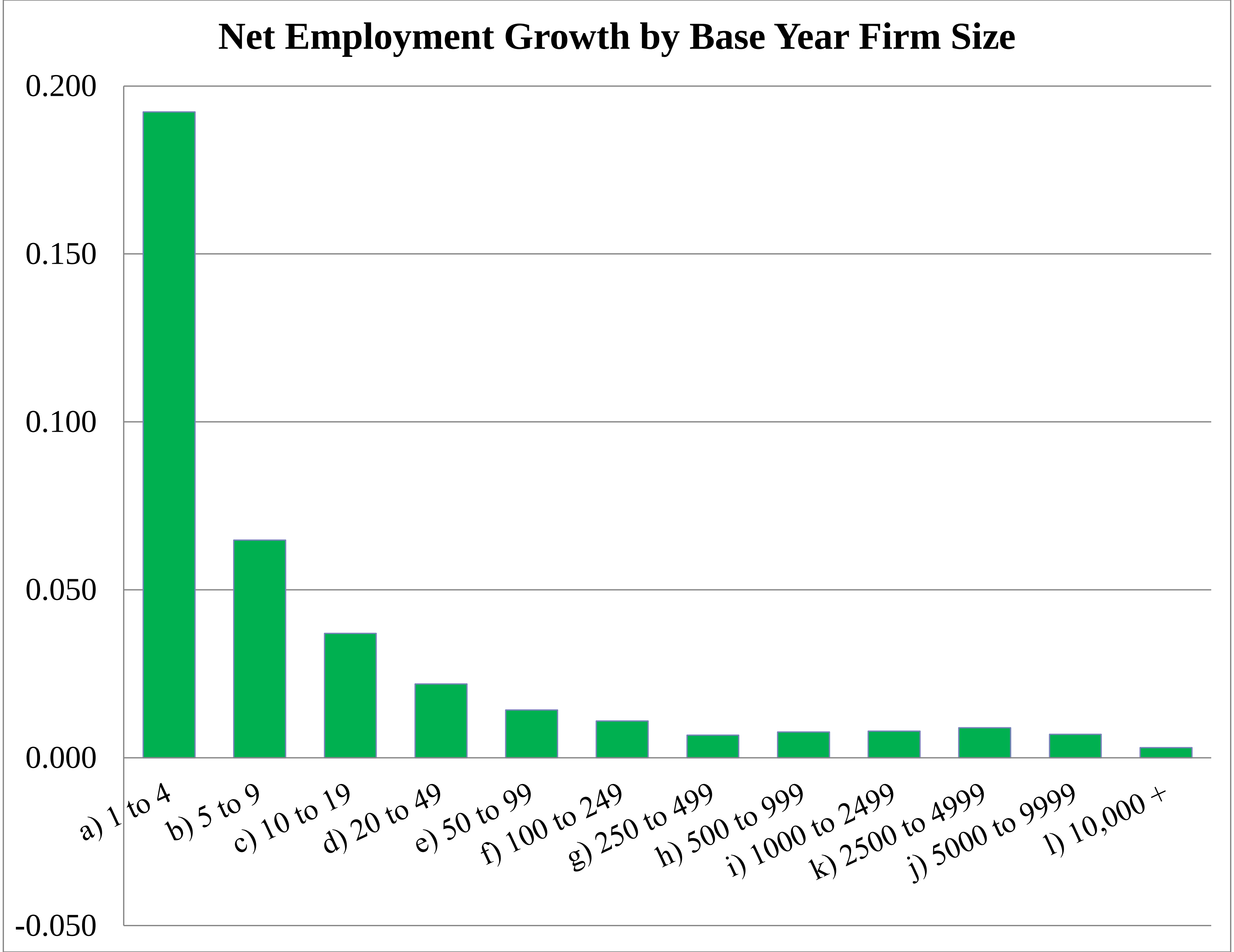
Google

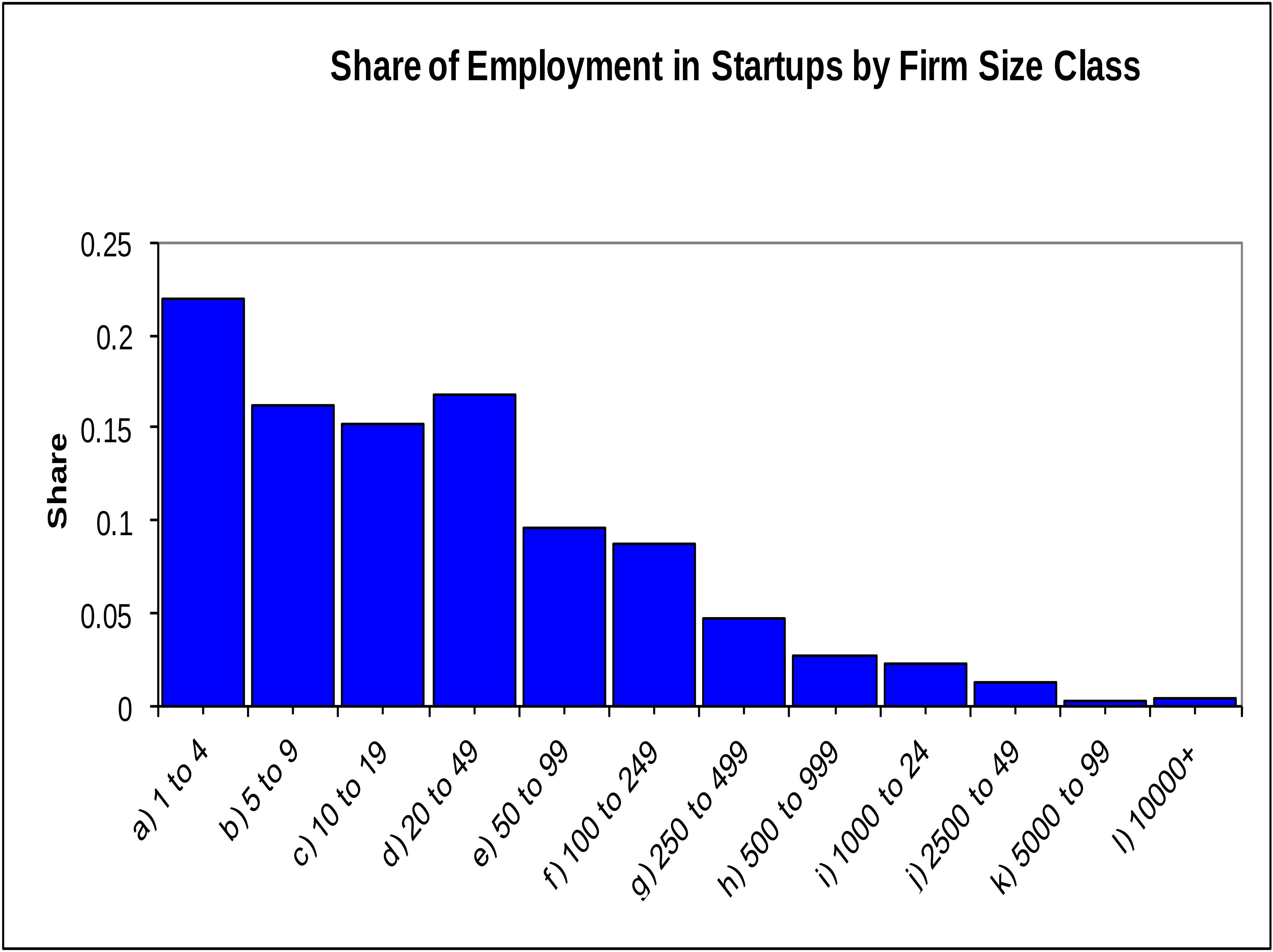
HONDA

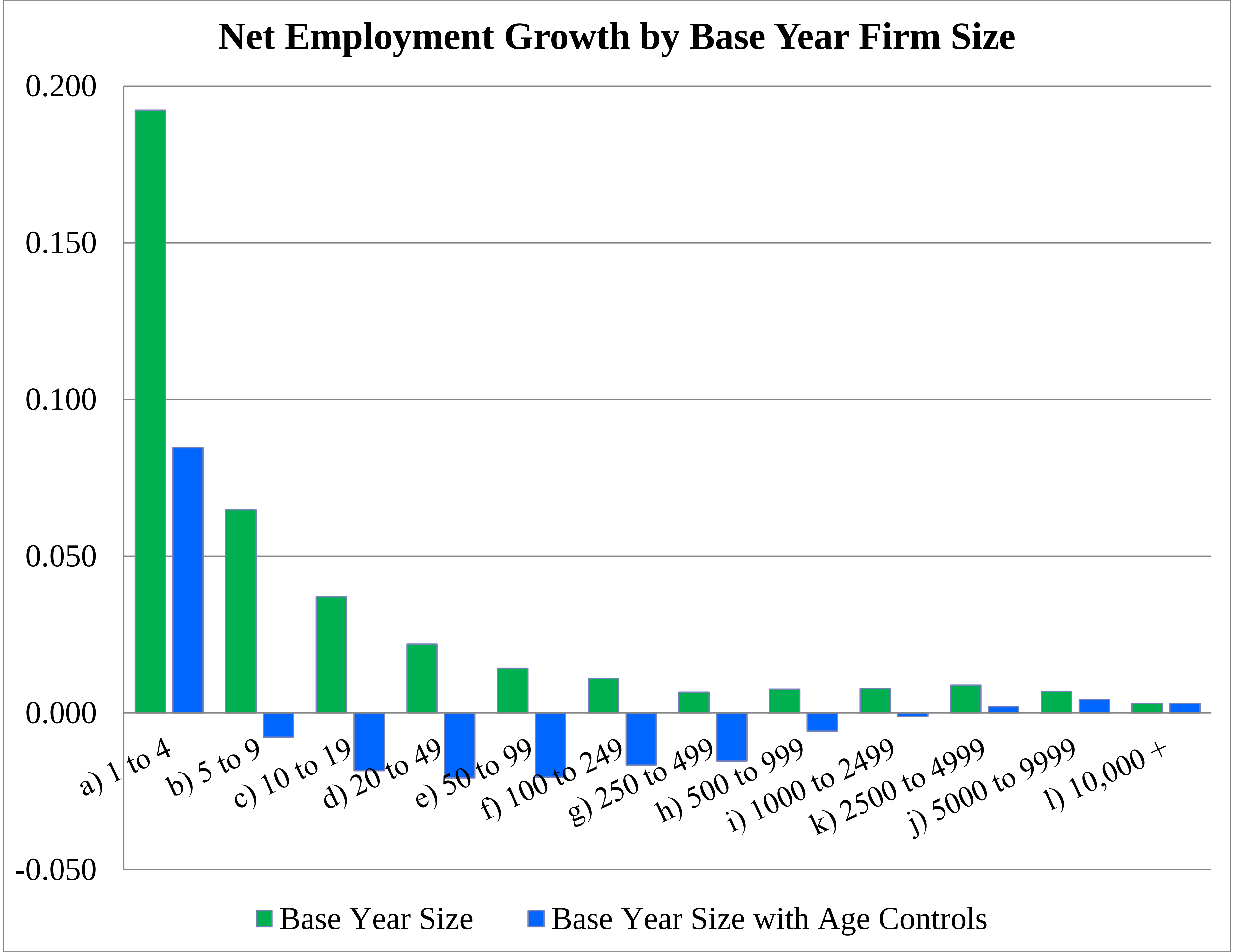
STARBUCKS COFFEE


Hires
Separations
Job Destruction
Hires
Separations
Job Creation

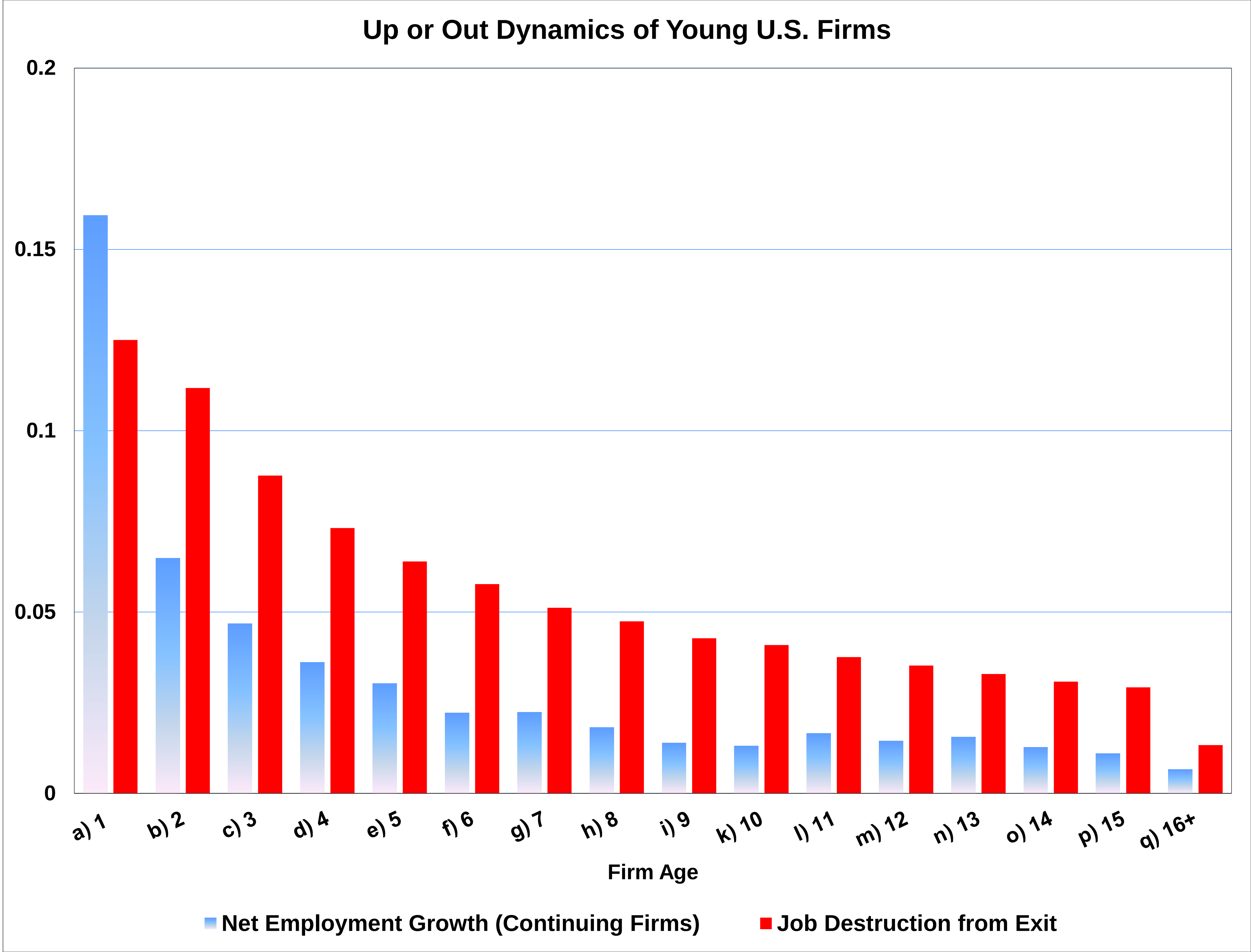

Job Creation and Destruction, U.S. Private Sector, Annual Rates
(Percent of Employment),1980-2009
Source: BDS
Total=16.9
Continuing Establishments
10.6
New Establishments (Existing Firms)
3.2
New Firms
3.1
Total=15.3
Continuing Establishments
10
Exiting Establishments (Continuing Firms)
2.4
Exiting Firms
2.9
Job Creation
Job Destruction


Net Employment Growth by Base Year Firm Size
0.200
0.150
0.100
0.050
0.000
-0.050
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 2499
k) 2500 to 4999
j) 5000 to 9999
l) 10,000 +


Share of Employment in Startups by Firm Size Class
Share
0.25
0.2
0.15
0.1
0.05
0
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 24
j) 2500 to 49
k) 5000 to 99
l) 10000+

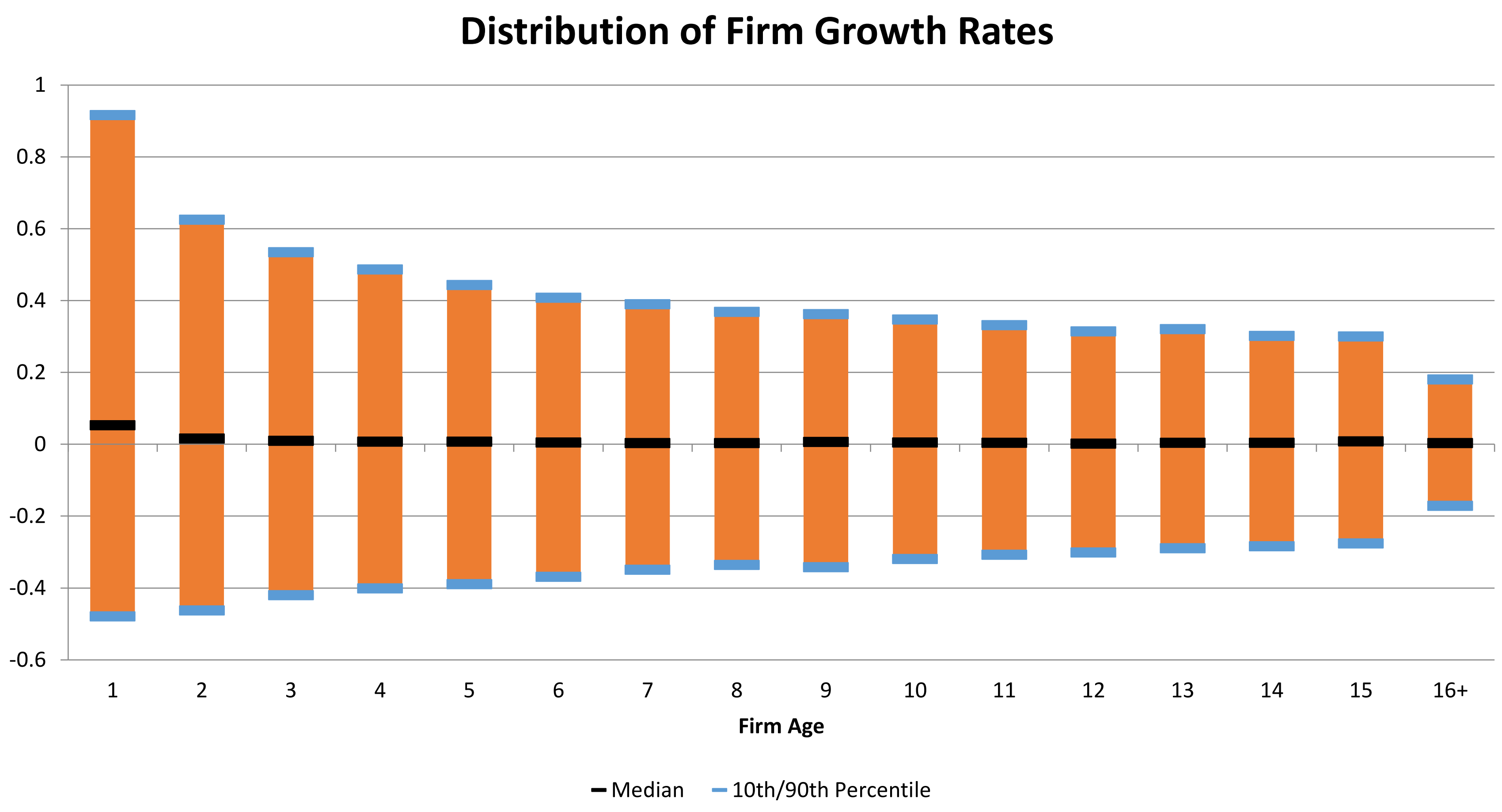


Net Employment Growth by Base Year Firm Size
0.200
0.150
0.100
0.050
0.000
-0.050
a) 1 to 4
b) 5 to 9
c) 10 to 19
d) 20 to 49
e) 50 to 99
f) 100 to 249
g) 250 to 499
h) 500 to 999
i) 1000 to 2499
k) 2500 to 4999
j) 5000 to 9999
l) 10,000 +
Base Year Size
Base Year Size with Age Controls

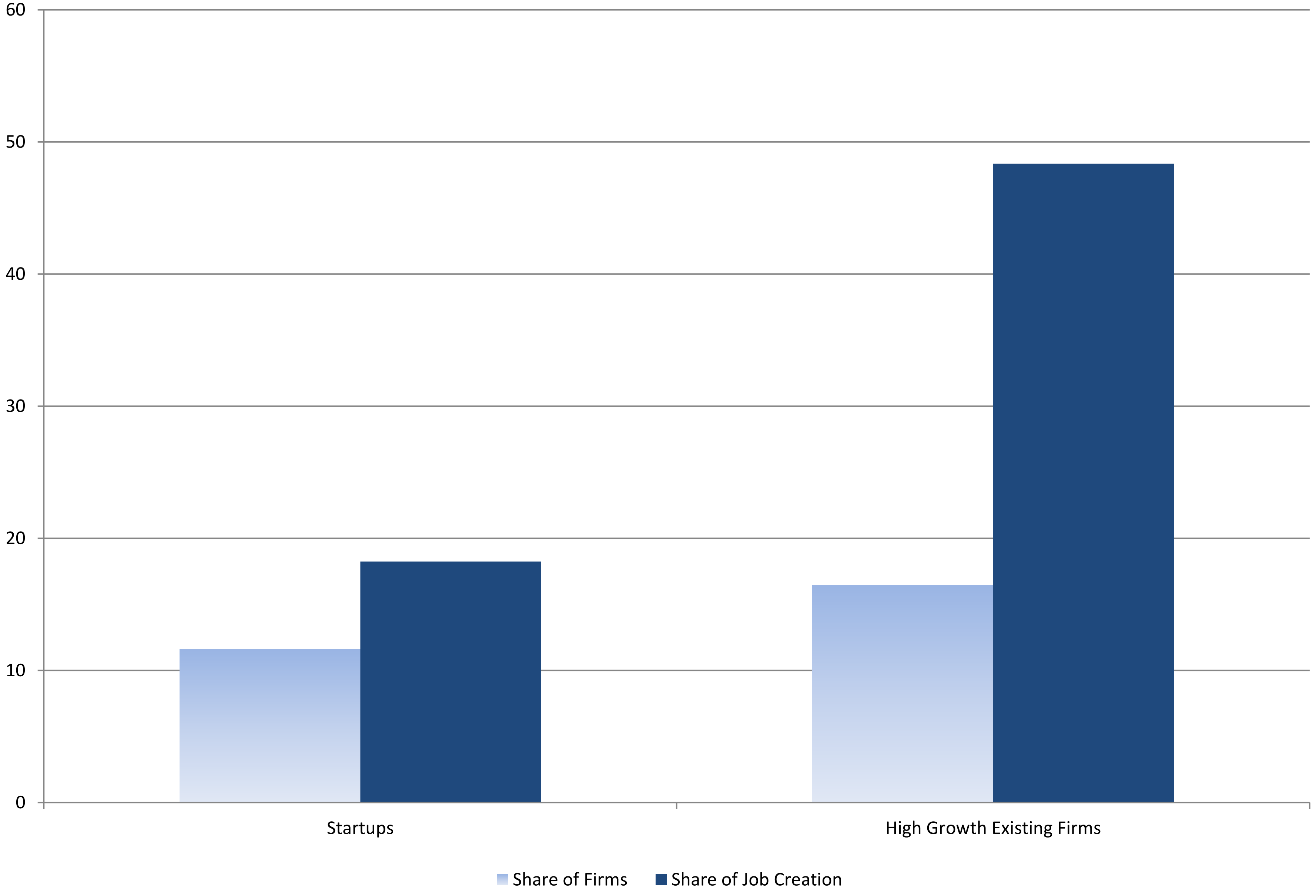


Up or Out Dynamics of Young U.S. Firms
0.2
0.15
0.1
0.05
0
a) 1
b) 2
c) 3
d) 4
e) 5
f) 6
g) 7
h) 8
i) 9
k) 10
l) 11
m) 12
n) 13
o) 14
p) 15
q) 16+
Firm Age
Net Employment Growth (Continuing Firms)
Job Destruction from Exit

Skewness of young continuing firms underlies high mean net growth of young firms



Startups and High Growth (Annual Growth>25 percent) Existing Firms Disproportionately Create Jobs, U.S. Private Sector

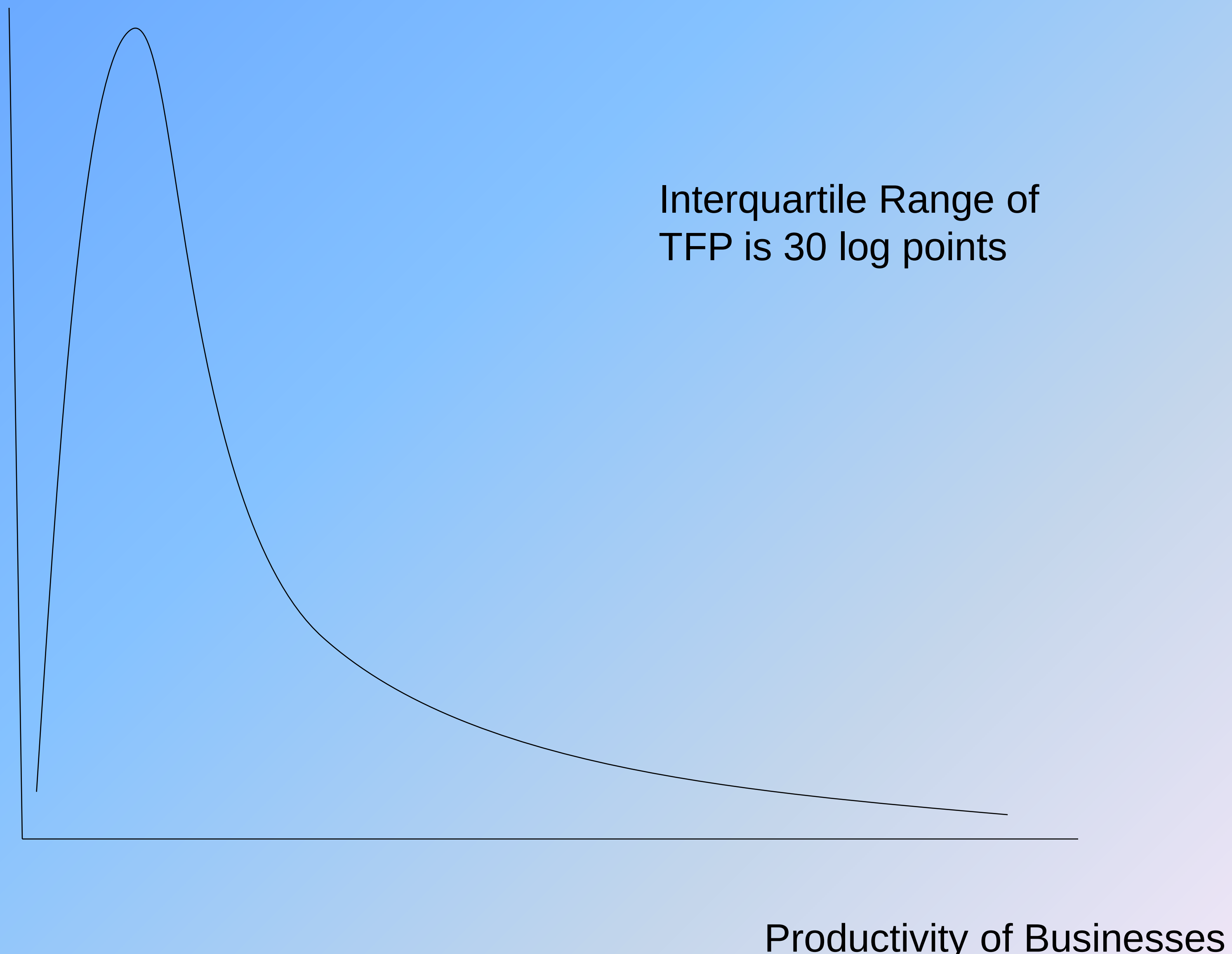


Source: Tabulations from Firm-Level Data Used in Haltiwanger, Jarmin and Miranda (

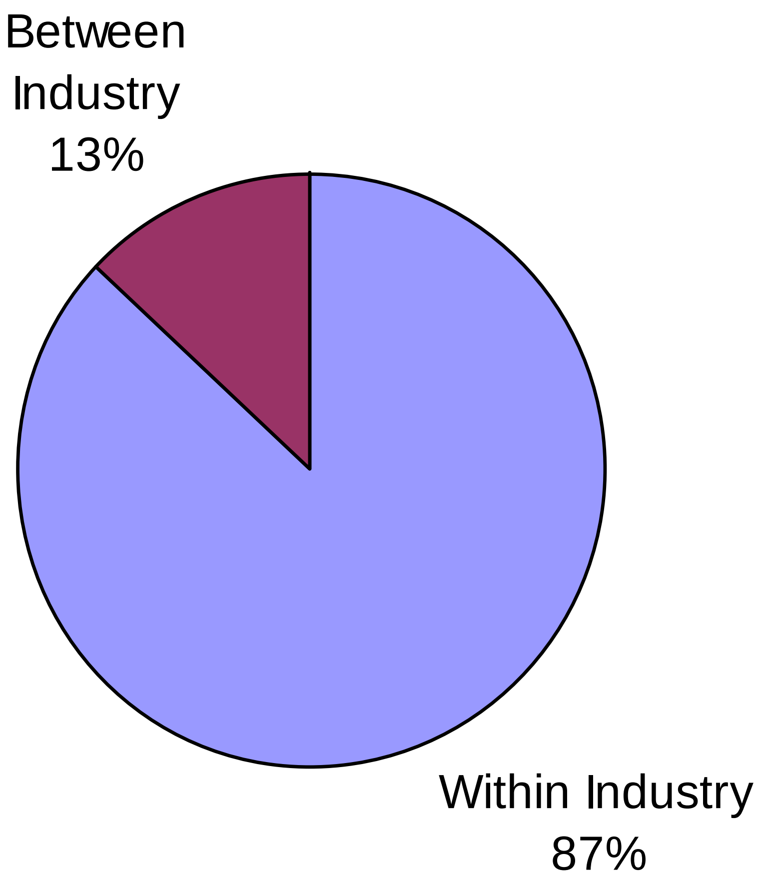
What accounts for cross sectional and dynamic patterns?

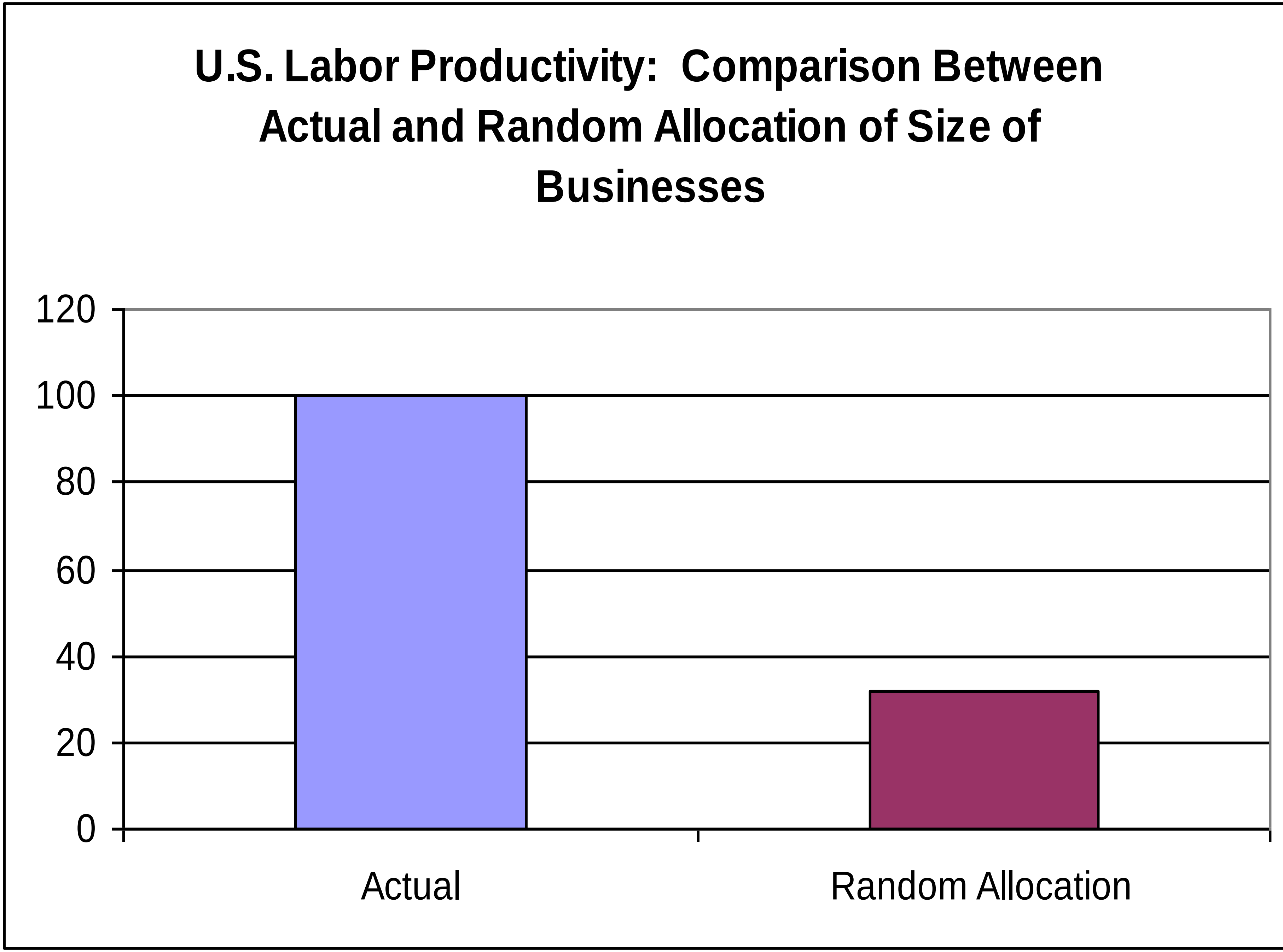
- Very skewed size distribution
- Constant state of churning
  - Wave of entering firms contributes substantially to job creation each year
  - Most exit
  - Conditional on survival, young businesses grow quickly
  - Even amongst large, mature businesses high pace of churning of jobs and businesses

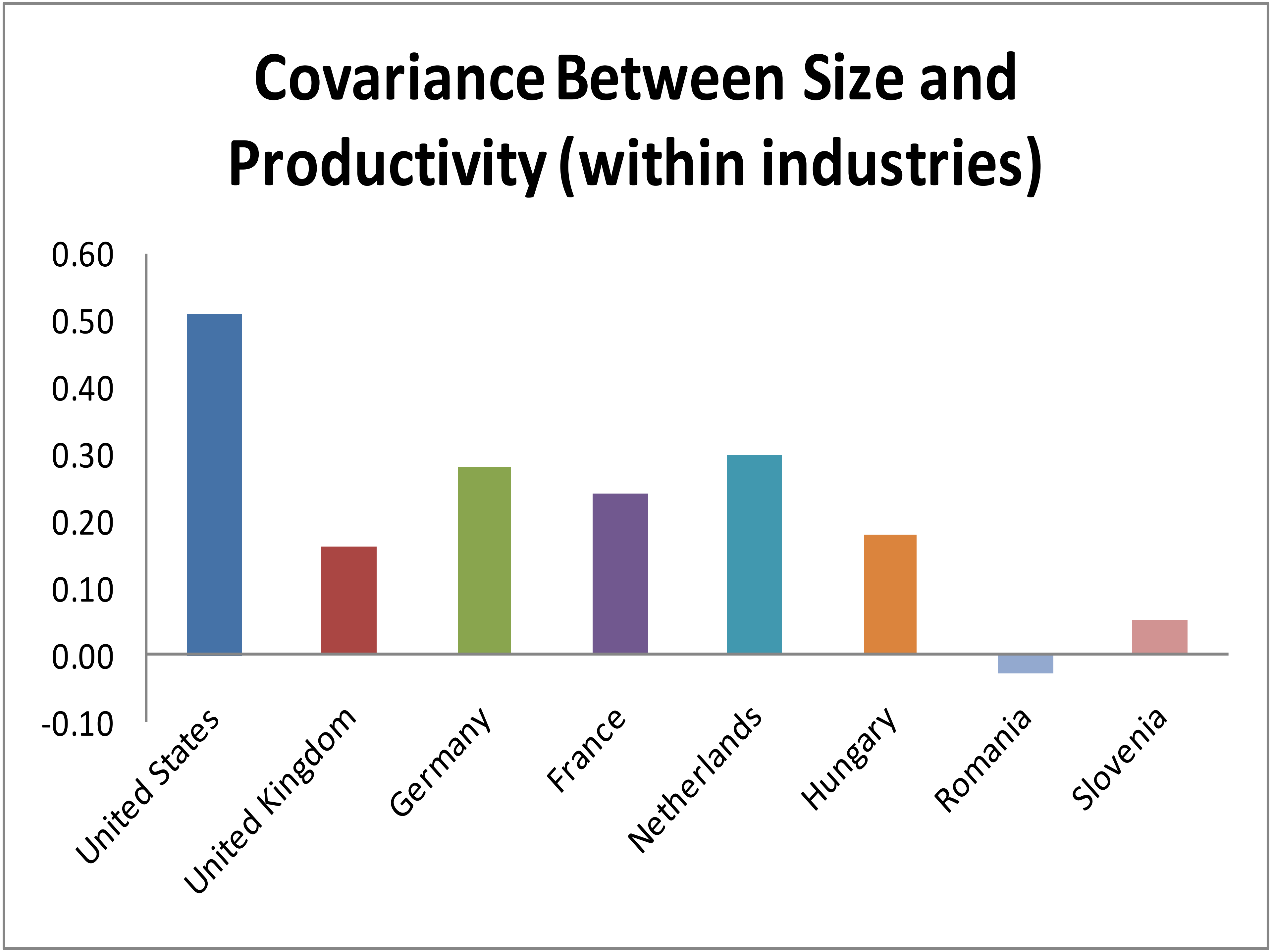
Productivity Distribution Within Narrowly Defined Industries



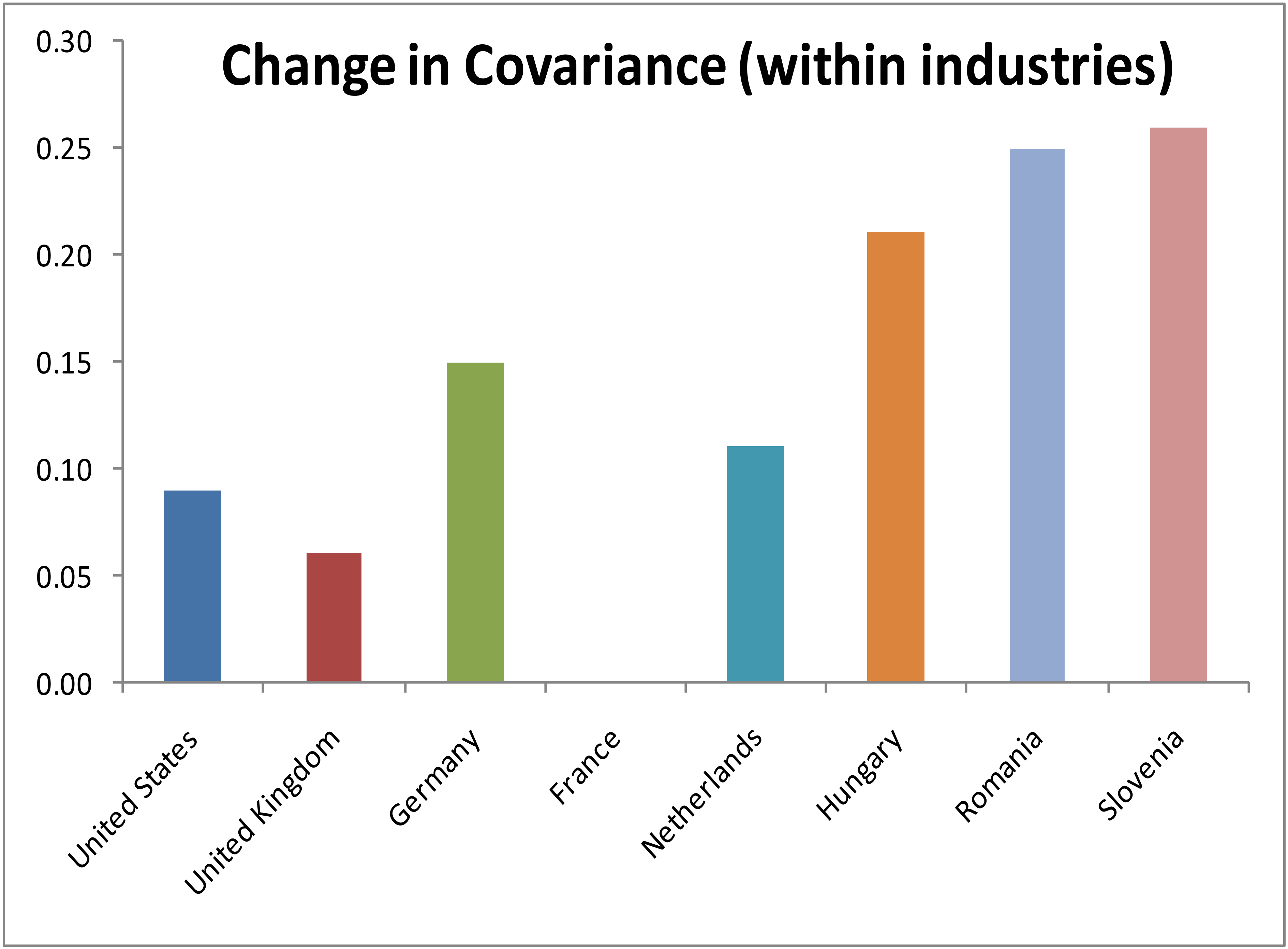
Share of Reallocation Between and Within Detailed Industries



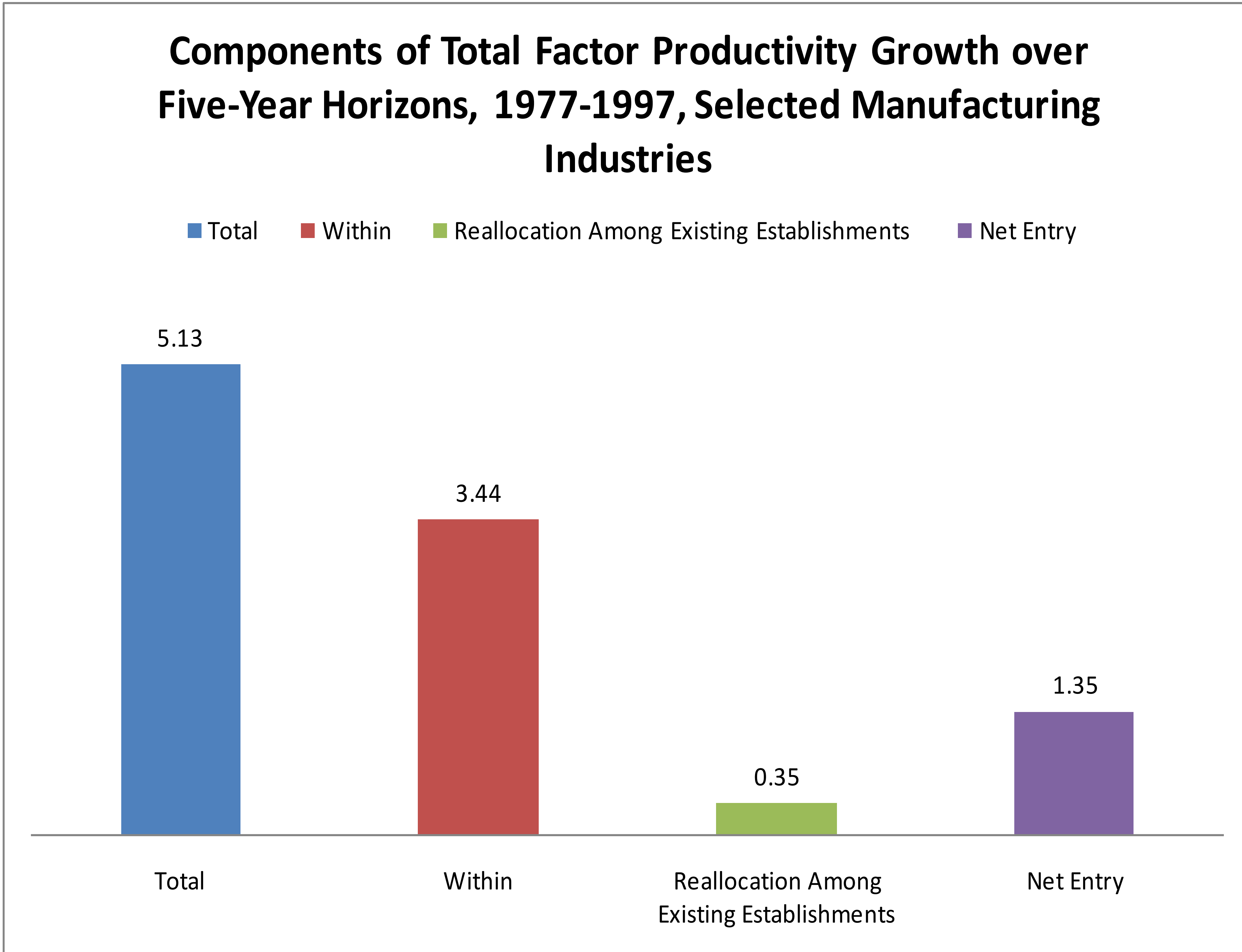

U.S. Labor Productivity: Comparison Between Actual and Random Allocation of Size of Businesses
120
100
80
60
40
20
0
Actual
Random Allocation

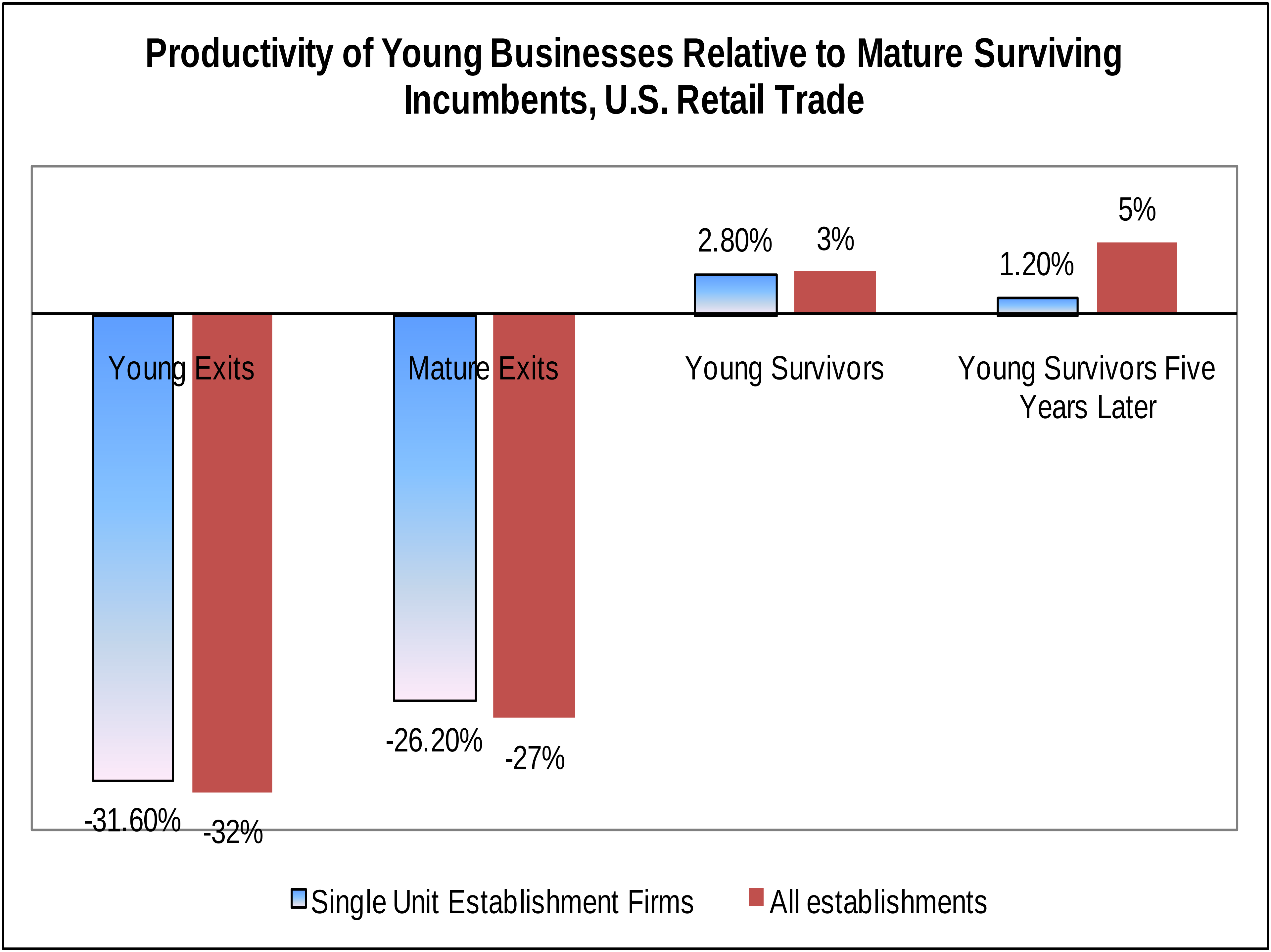


Covariance Between Size and Productivity (within industries)
0.60
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
United States
United Kingdom
Germany
France
Netherlands
Hungary
Romania
Slovenia



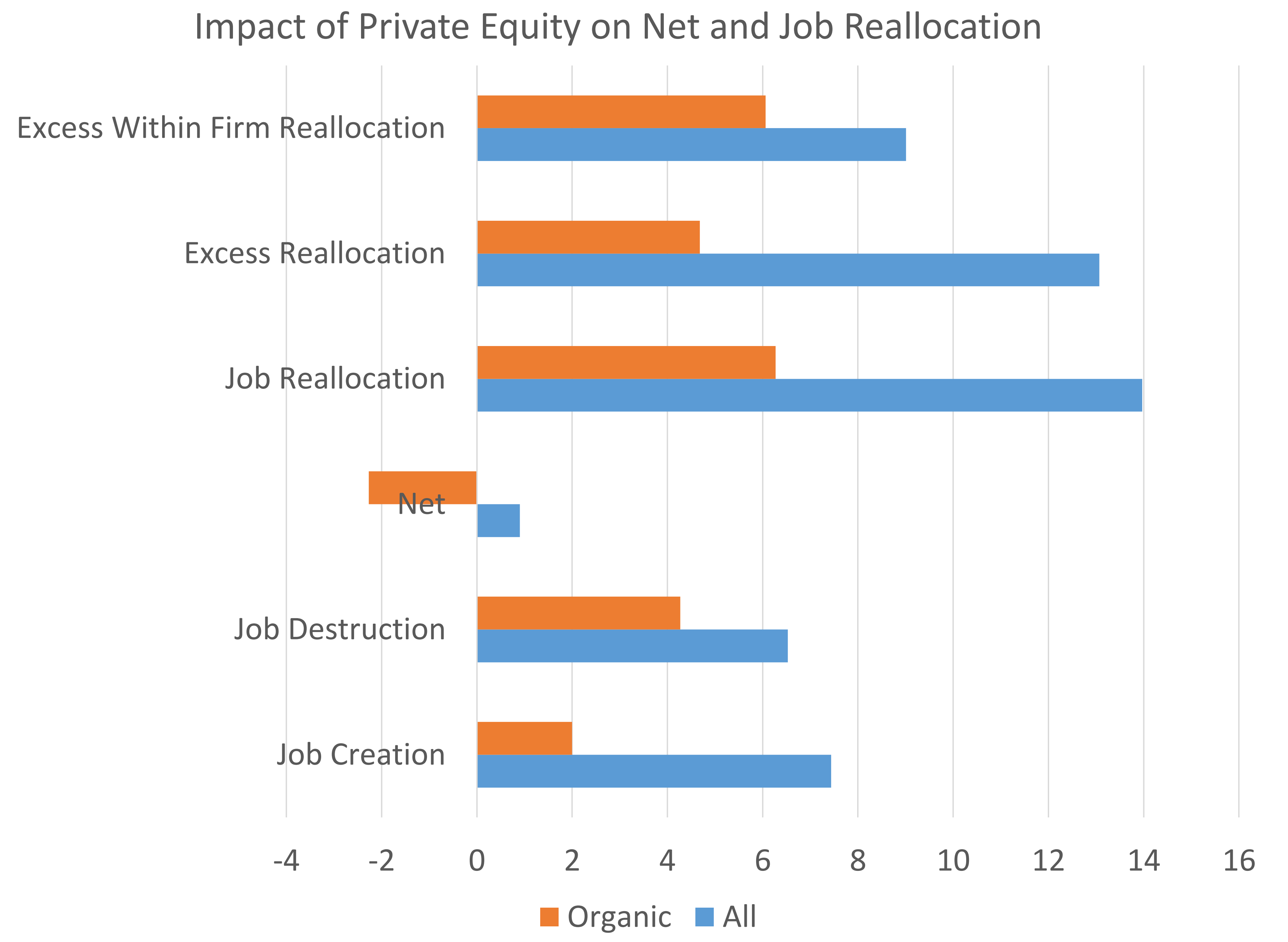
Change in Covariance (within industries)
0.30
0.25
0.20
0.15
0.10
0.05
0.00
United States
United Kingdom
Germany
France
Netherlands
Hungary
Romania
Slovenia


Components of Total Factor Productivity Growth over Five-Year Horizons, 1977-1997, Selected Manufacturing Industries
Total
Within
Reallocation Among Existing Establishments
Net Entry
5.13
3.44
0.35
1.35
Total
Within
Reallocation Among Existing Establishments
Net Entry

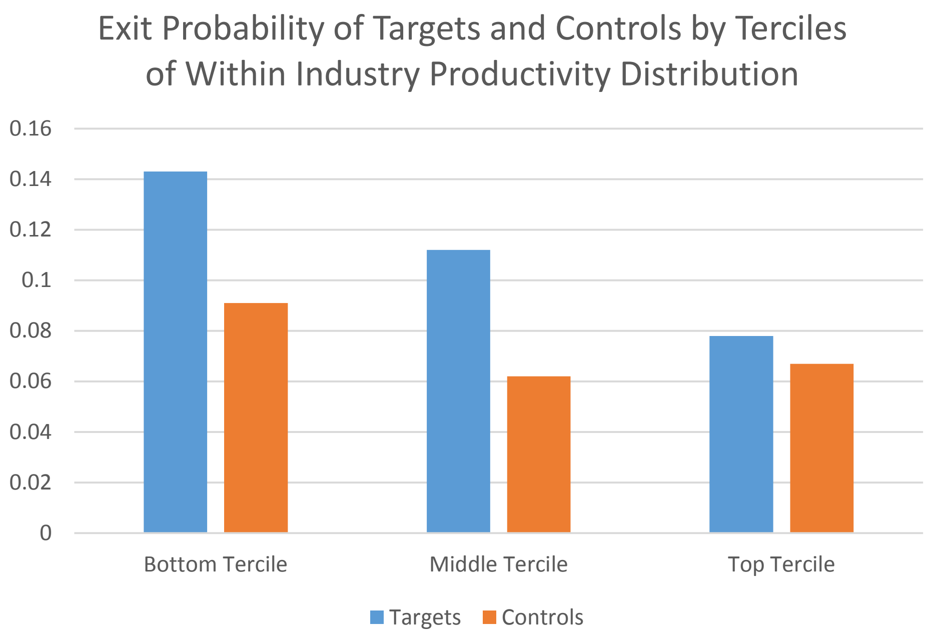

Productivity of Young Businesses Relative to Mature Surviving Incumbents, U.S. Retail Trade
2.80%
3%
1.20%
5%
Young Exits
Mature Exits
Young Survivors
Young Survivors Five Years Later
-31.60%
-32%
-26.20%
-27%
Single Unit Establishment Firms
All establishments

Ownership Change, Management, Financing…

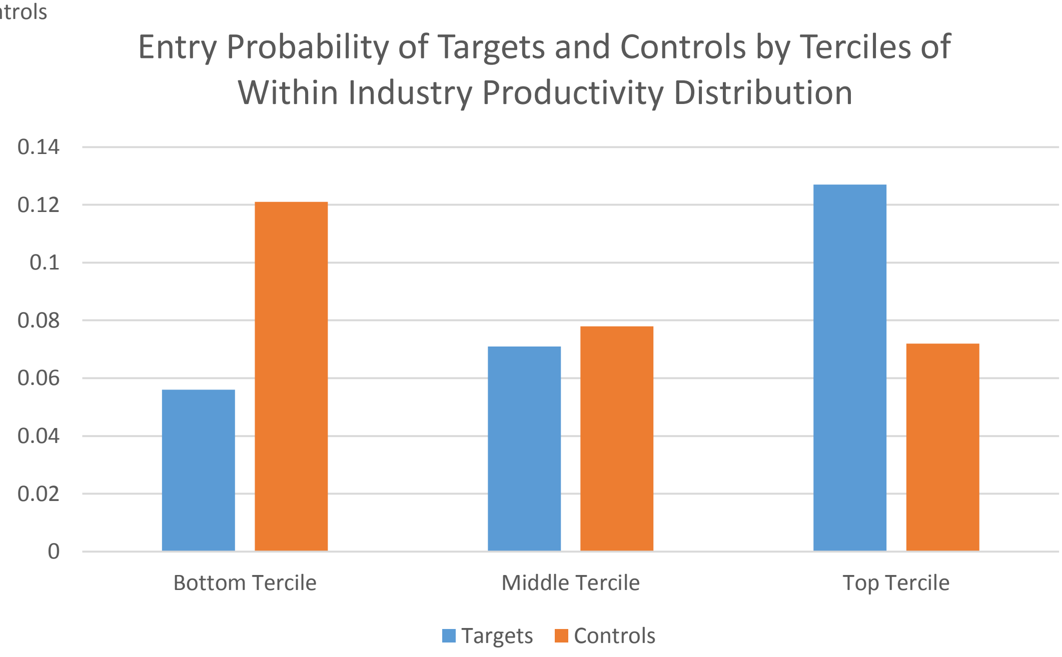
- Many factors underlie the ongoing restructuring and reallocation of businesses
- For allocative efficiency, financial markets need to be facilitating the reallocation of resources to the most productive businesses
- Ownership/management practices and changes are part of these dynamics.
- Example: Private Equity



Impact of Private Equity on Net and Job Reallocation
Excess Within Firm Reallocation
Excess Reallocation
Job Reallocation
Net
Job Destruction
Job Creation
-4
-2
0
2
4
6
8
10
12
14
16
Organic
All



Exit Probability of Targets and Controls by Terciles of Within Industry Productivity Distribution
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Bottom Tercile
Middle Tercile
Top Tercile
Targets
Controls



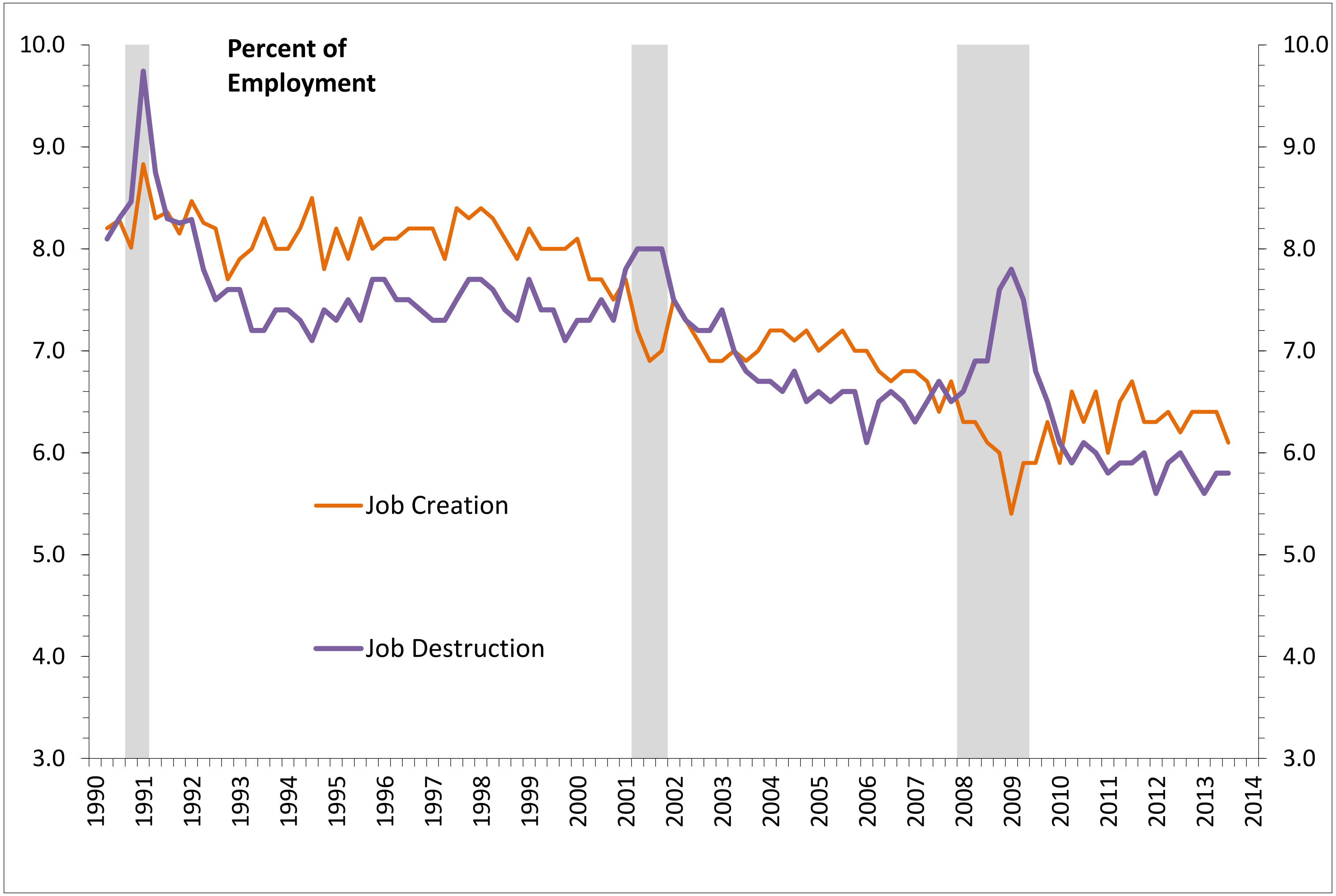
Entry Probability of Targets and Controls by Terciles of Within Industry Productivity Distribution
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
Bottom Tercile
Middle Tercile
Top Tercile
Targets
Controls

Two Year Productivity Growth Impact From Private Equity

Total Productivity Growth Differential	2.09
Excluding Acquisition/Divestiture	1.96
Share of Total from:	
Continuing Establishments	0.20
Net Entry	0.74
Net Acquisition	0.06

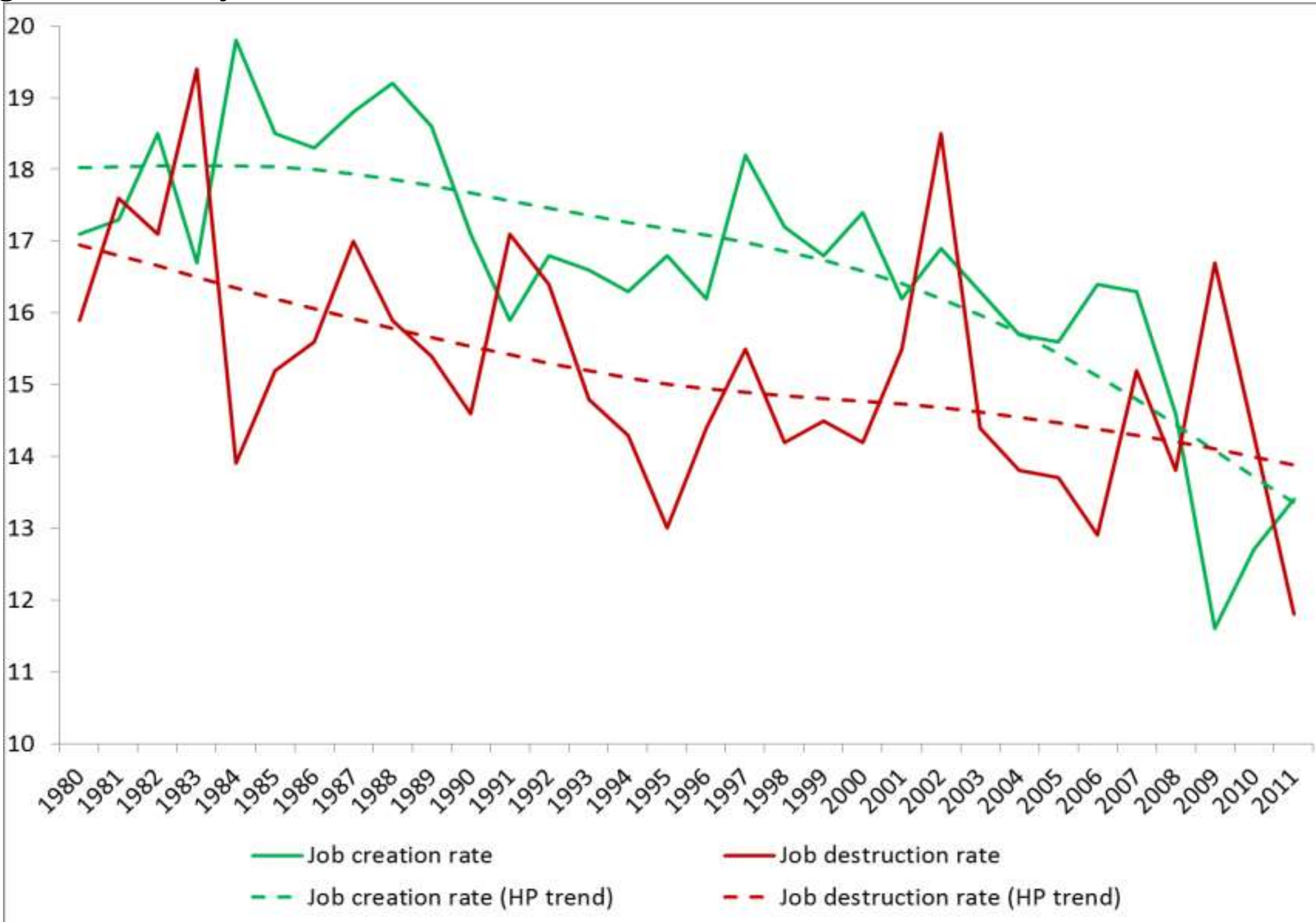
Some Disturbing Trends?

Declining Pace of Creation and Destruction in BED



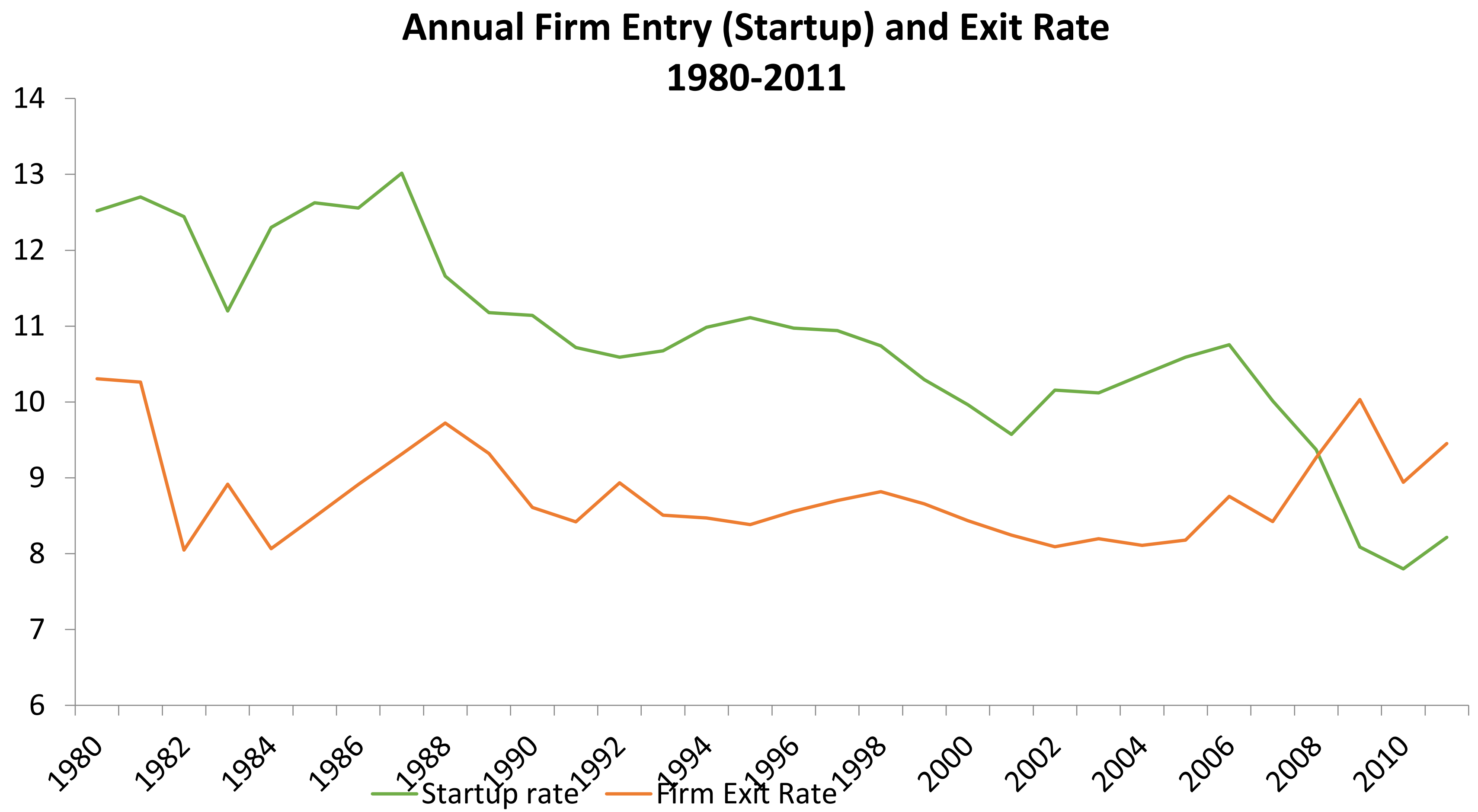
Source: BLS BED DATA

Figure 1: Annual job creation and destruction rates, 1980-2011



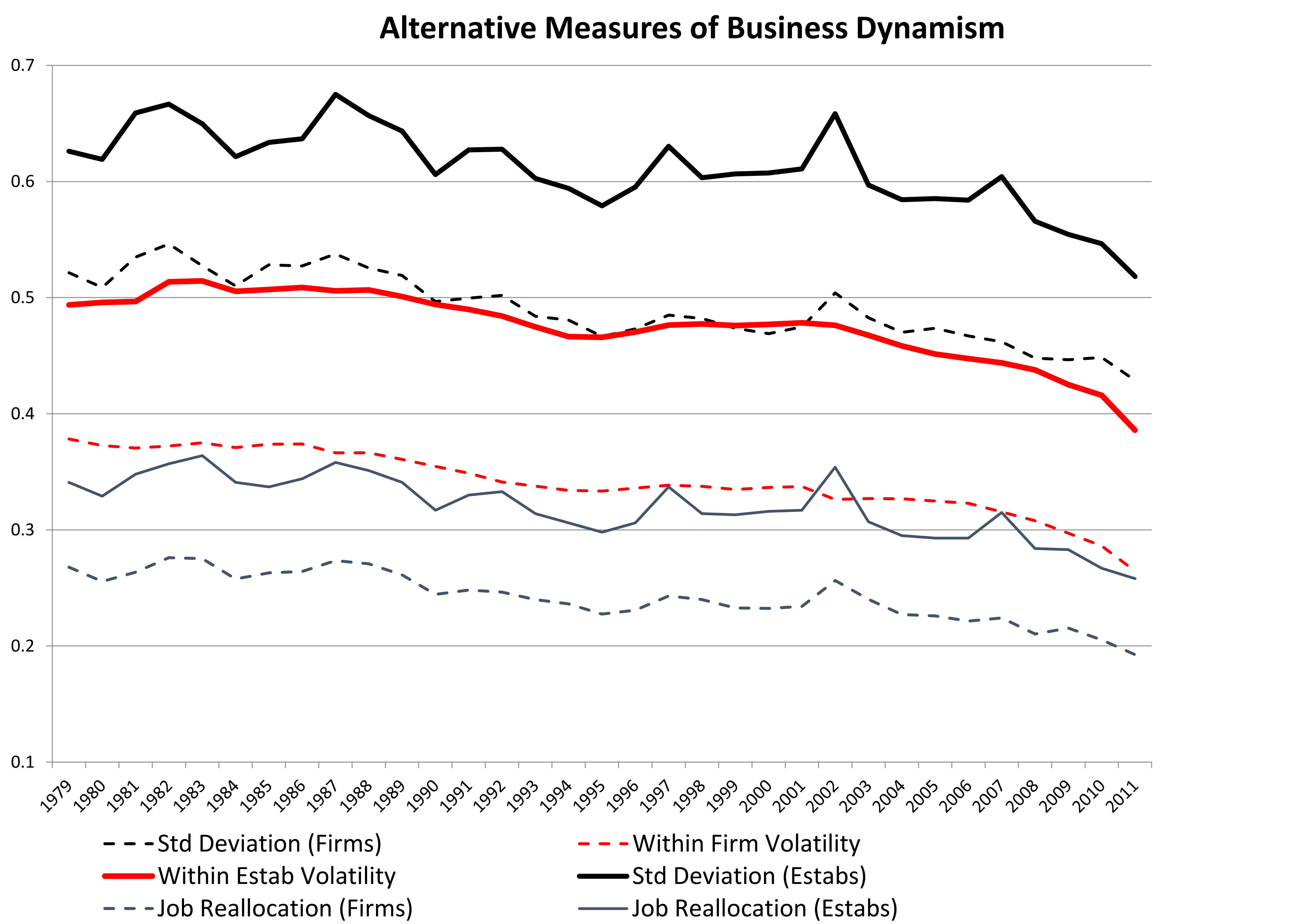
Notes: Author calculations from the U.S. Census Bureau's Business Dynamics Statistics. Filter is Hodrick-Prescott with multiplier 400. Vertical axis does not begin at zero.

Falling entry rates but not exit rates…



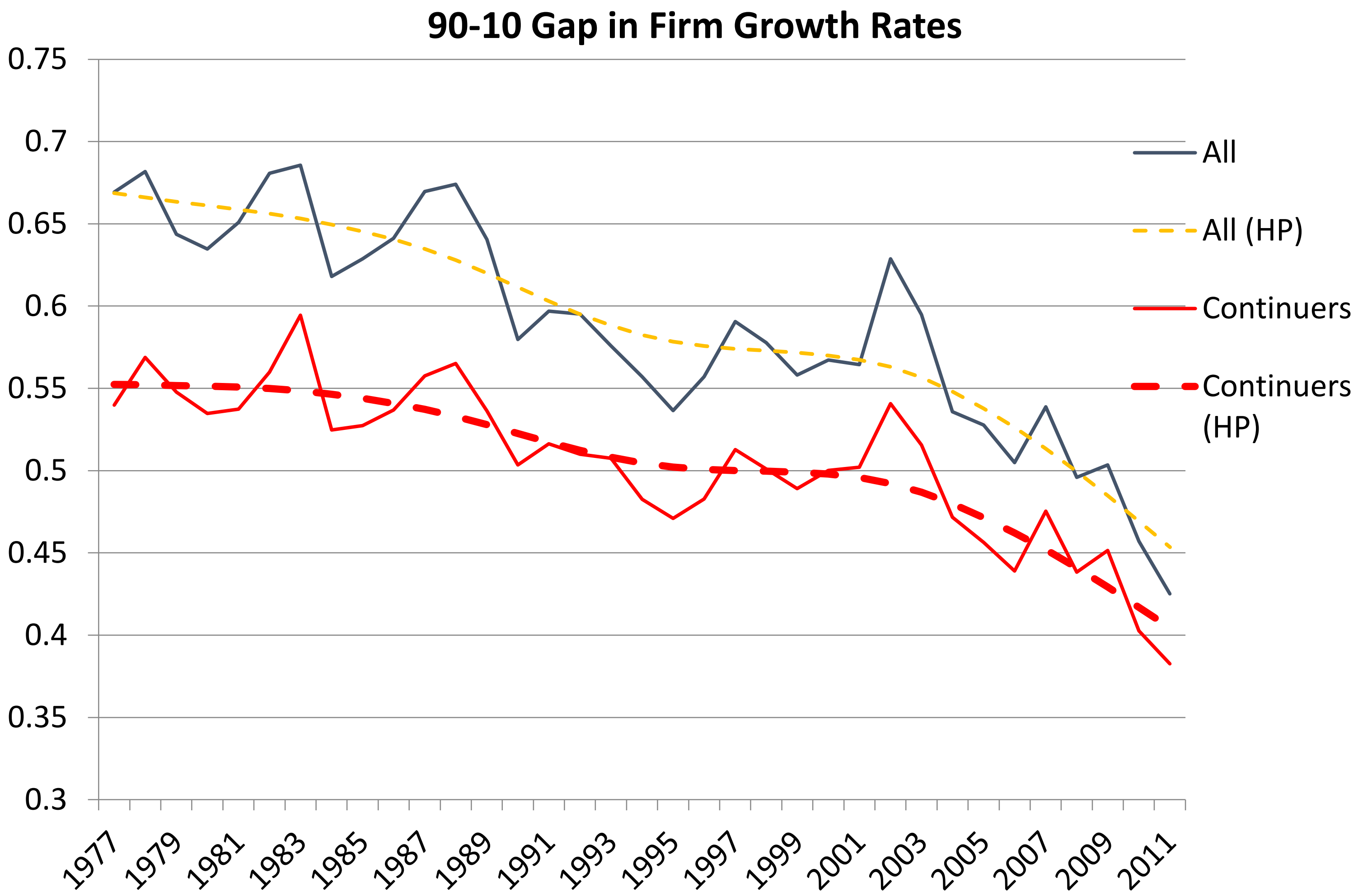
Note: Left axis does not begin at zero.

Declining startups yields secular decline in share of activity in young firms (<5)…



Alternative Measures of Business Dynamism
0.7
0.6
0.5
0.4
0.3
0.2
0.1
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
Std Deviation (Firms)
Within Firm Volatility
Within Estab Volatility
Std Deviation (Estabs)
Job Reallocation (Firms)
Job Reallocation (Estabs)

Declining Dispersion



Source: Census LBD Da

$\lambda = 100$ for HP, Similar Results if we use 3-year or 5-year MA.

Broad motivating questions:

- Does the decline in dynamism reflect a less flexible, less entrepreneurial, less innovative, and therefore more sclerotic economy?
  - Hopenhayn and Rogerson (1993) – increased frictions lead to less dynamism and lower productivity.
  - Acemoglu et. al. (2013) – distortions that support incumbents yield lower innovation and productivity growth.
- Alternatively, does the decline in dynamism reflect U.S. businesses able to adapt and innovate without so much churning of jobs and workers?
  - Retail Trade Evidence (Jarmin et. al. (2005), Foster et. al. (2006), Davis et. al. (2007)) provides support for decline in dynamism from decline in role of "Mom and Pop" entrepreneurs. The "Wal-Martization" of America.
  - Evidence suggests this has been productivity enhancing.
- How do we reconcile with evidence of rising volatility of publicly traded firms (Comin and Philippon (2005) and Davis et. al. (2007))? How does this fit in with the above broad questions?

What types of businesses have exhibited declines in dynamism?

- What types of startups/entrepreneurs have declined?
  - Schoar (2010) "transformational" vs. "subsistence"?
    - In U.S. context, "subsistence" = "Mom and Pop"?
  - Hurst and Pugsley (2012) – entrepreneurs for personal reasons.
  - Reality likely more nuanced.
- How to identify?
  - Sector?
  - Our approach: Skewness in the Growth Rate Distribution.
    - The presence of transformational entrepreneurs in a sector/time period manifests itself into highly skewed growth rate distributions.
  - Our main finding: Sharp Decline in Skewness in the post 2000 period (essentially eliminated by 2011)

Decline in shocks or decline in responsiveness to shocks?

- Canonical firm dynamic models (e.g., Hopenhayn (1992), Hopenhayn and Rogerson (1993), Ericson and Pakes (1995)) imply decline should be from either:
  - A decline in the volatility of idiosyncratic shocks.
  - A decline in the response to such shocks.
- We find no evidence of a decline in the volatility of idiosyncratic shocks but a notable decline in the response to such shocks.
  - Analysis is restricted to the manufacturing sector

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What do we know already about the decline in dynamism from the recent literature?

- Composition effects only account for a relatively small fraction of decline in measures of dynamism (Davis et. al. (2007), Hyatt and Spletzer (2013), Decker et. al. (2014))
  - Firm Age Effects Play an Important Role (about 30 percent of the decline)
  - Industry Effects Work in the Opposite Direction (about -15 percent of the decline)
  - Together (with other effects like firm size) account for only 15 percent of the decline.
- Mostly a within cell decline – but some cells with much larger declines than others.
  - Starting point for us – what types of businesses have exhibited the largest declines? How does this relate to the questions of interest?

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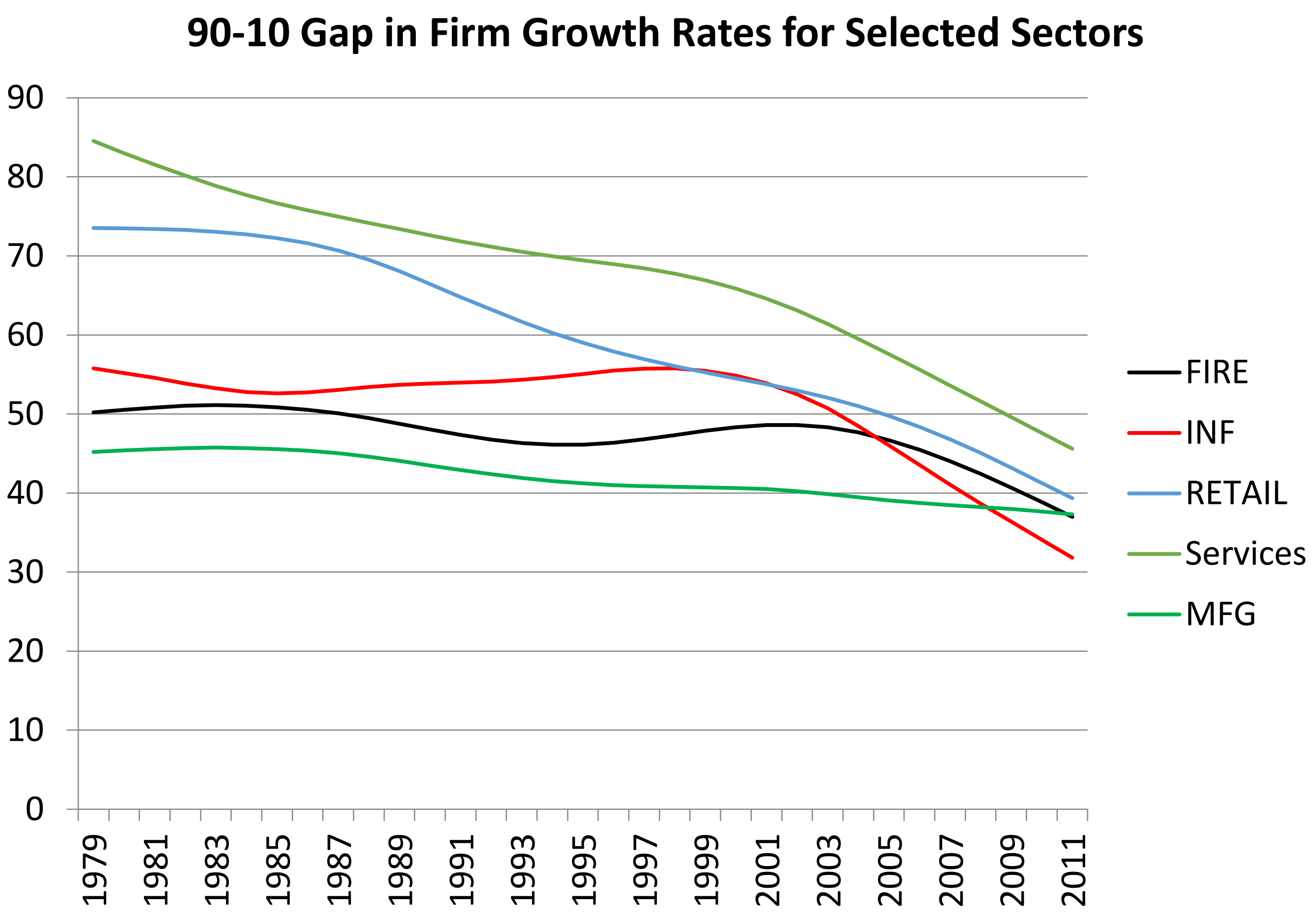
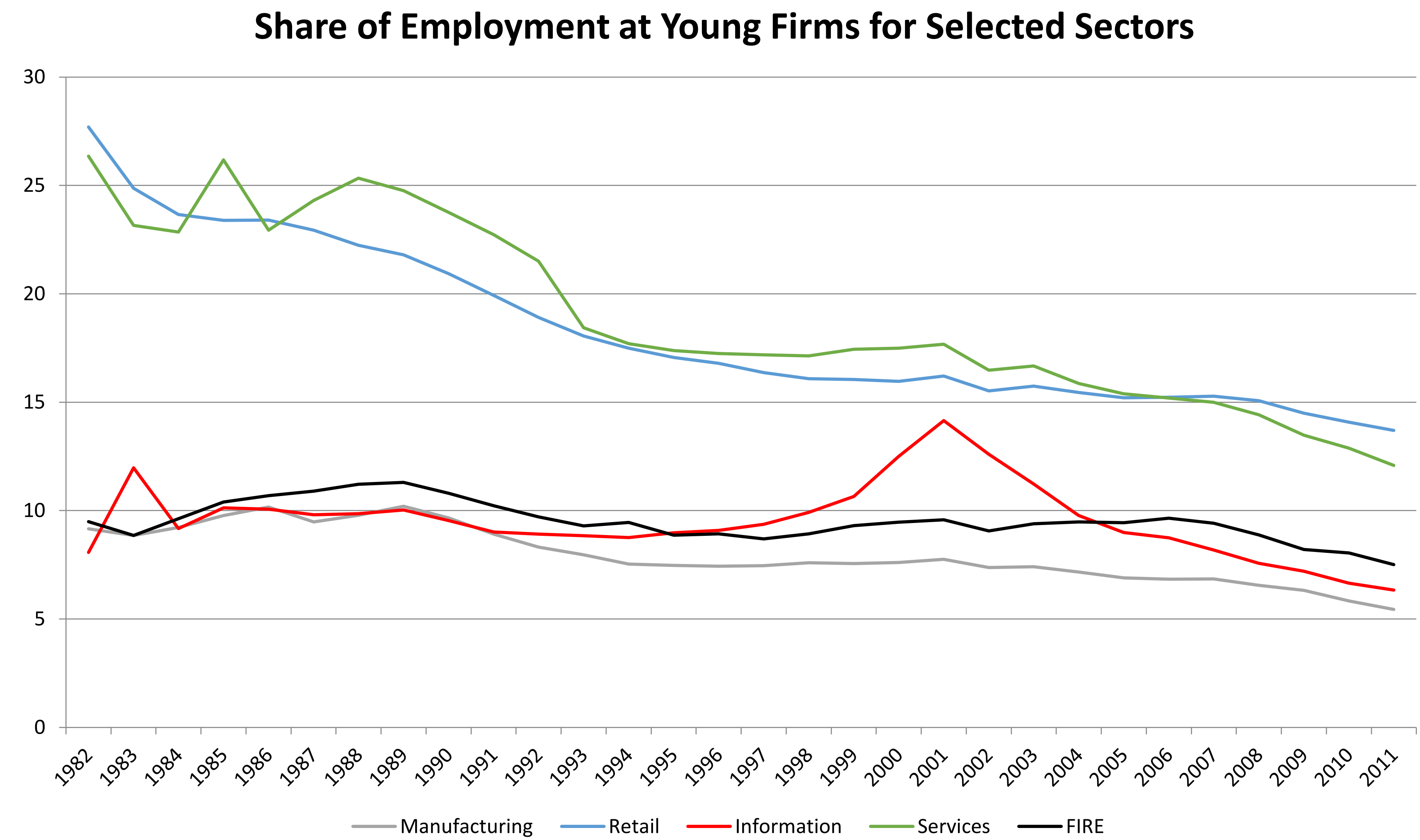
Sectoral Differences in Decline in Dispersion



Showing HP Trends

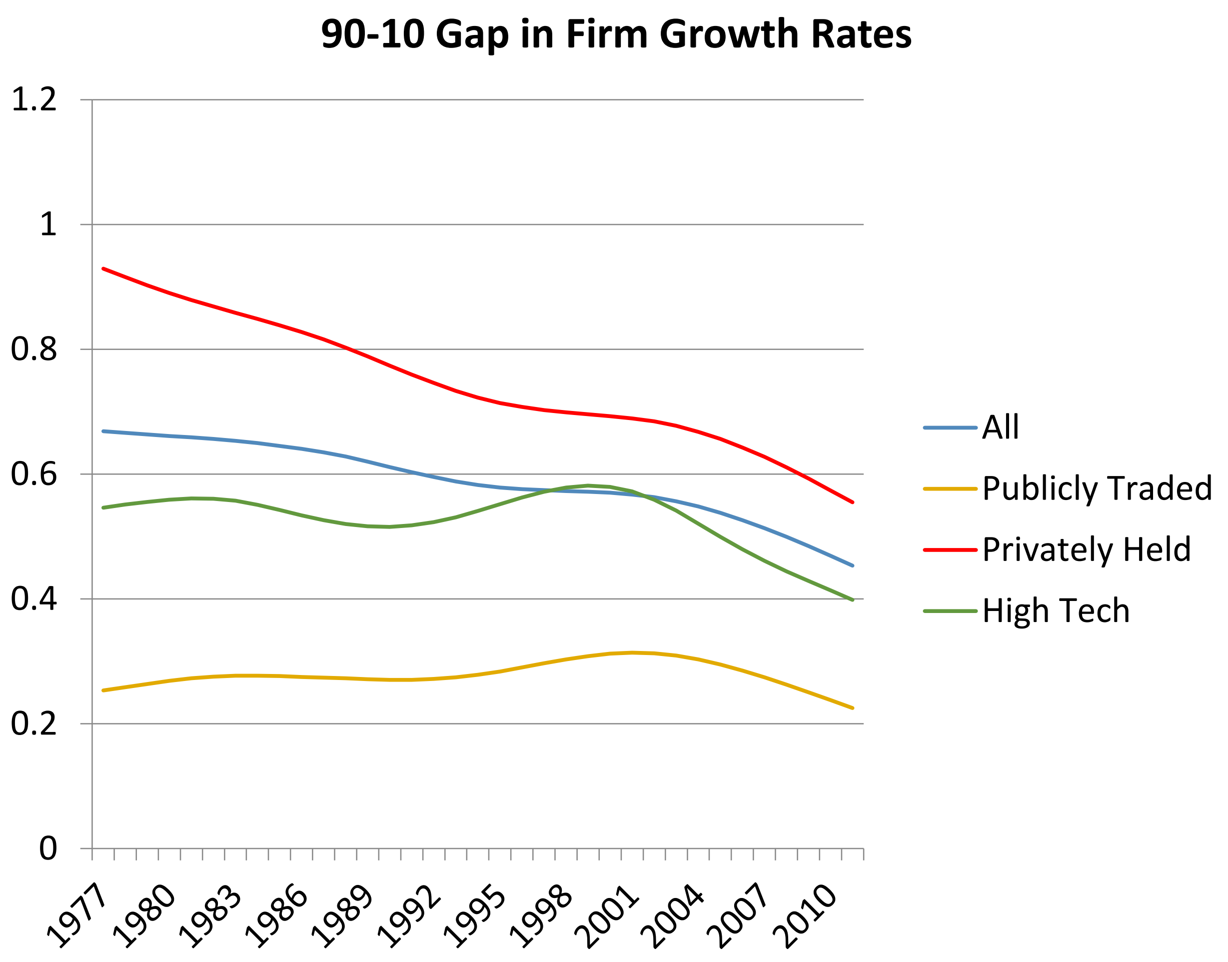
Sectoral Differences in Entrepreneurship Patterns…



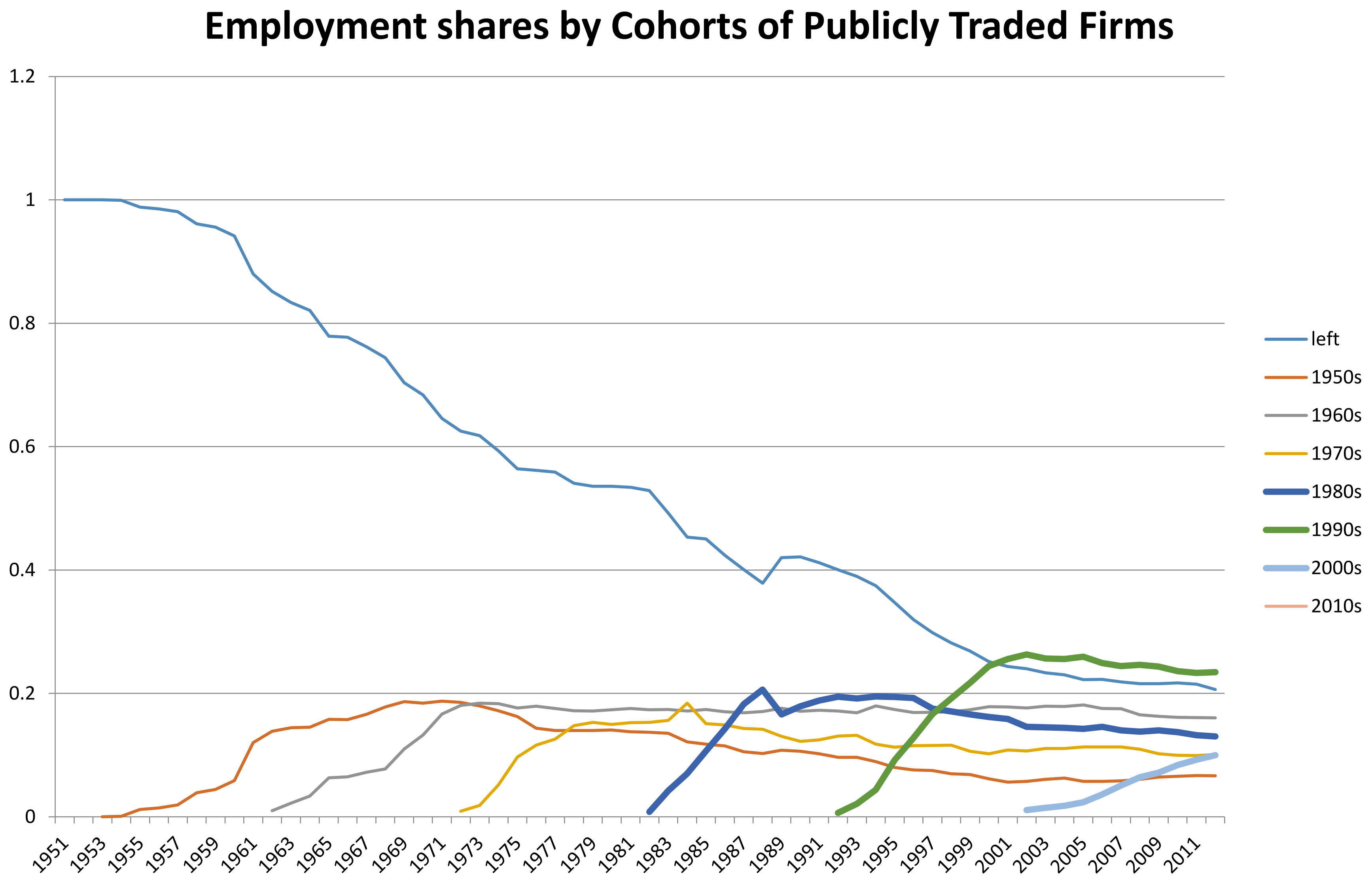
High Tech 4-digit NAICS sectors

NAICS Code	Industry
Information and Communications Technology (ICT) High-Tech	
3341	Computer and peripheral equipment manufacturing
3342	Communications equipment manufacturing
3344	Semiconductor and other electronic component manufacturing
3345	Navigational, measuring, electromedical, and control instruments manufacturing
5112	Software publishers
5161	Internet publishing and broadcasting
5179	Other telecommunications
5181	Internet service providers and Web search portals
5182	Data processing, hosting, and related services
5415	Computer systems design and related services
Miscellaneous High-Tech	
3254	Pharmaceutical and medicine manufacturing
3364	Aerospace product and parts manufacturing
5413	Architectural, engineering, and related services
5417	Scientific research-and-development services

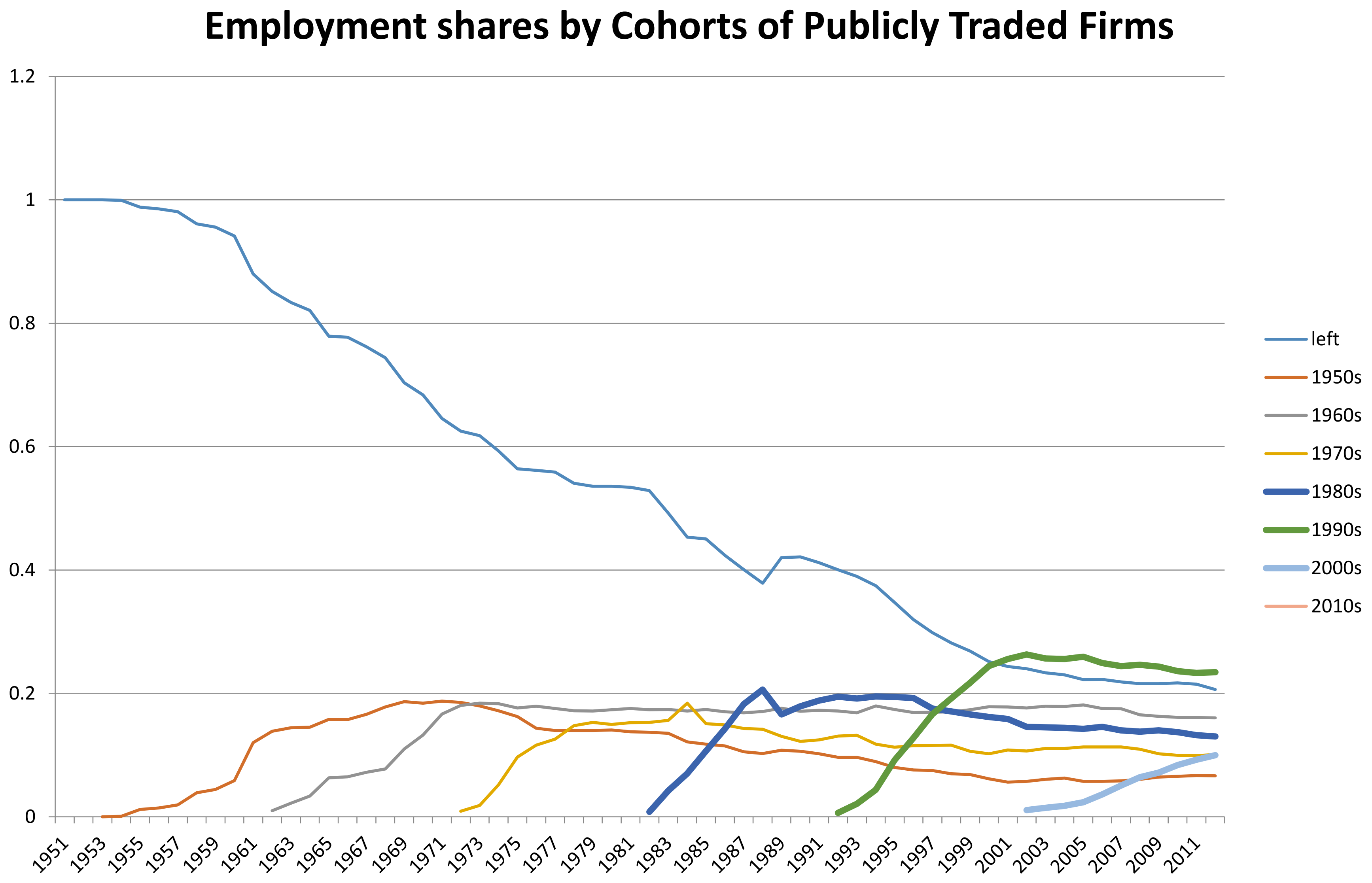
High Tech and Publicly Traded Both Exhibit Increases in Dispersion through 2000 and then declines thereafter…



Showing HP Trends



Source: COMPUSTAT – LBD shows similar patterns post 1980



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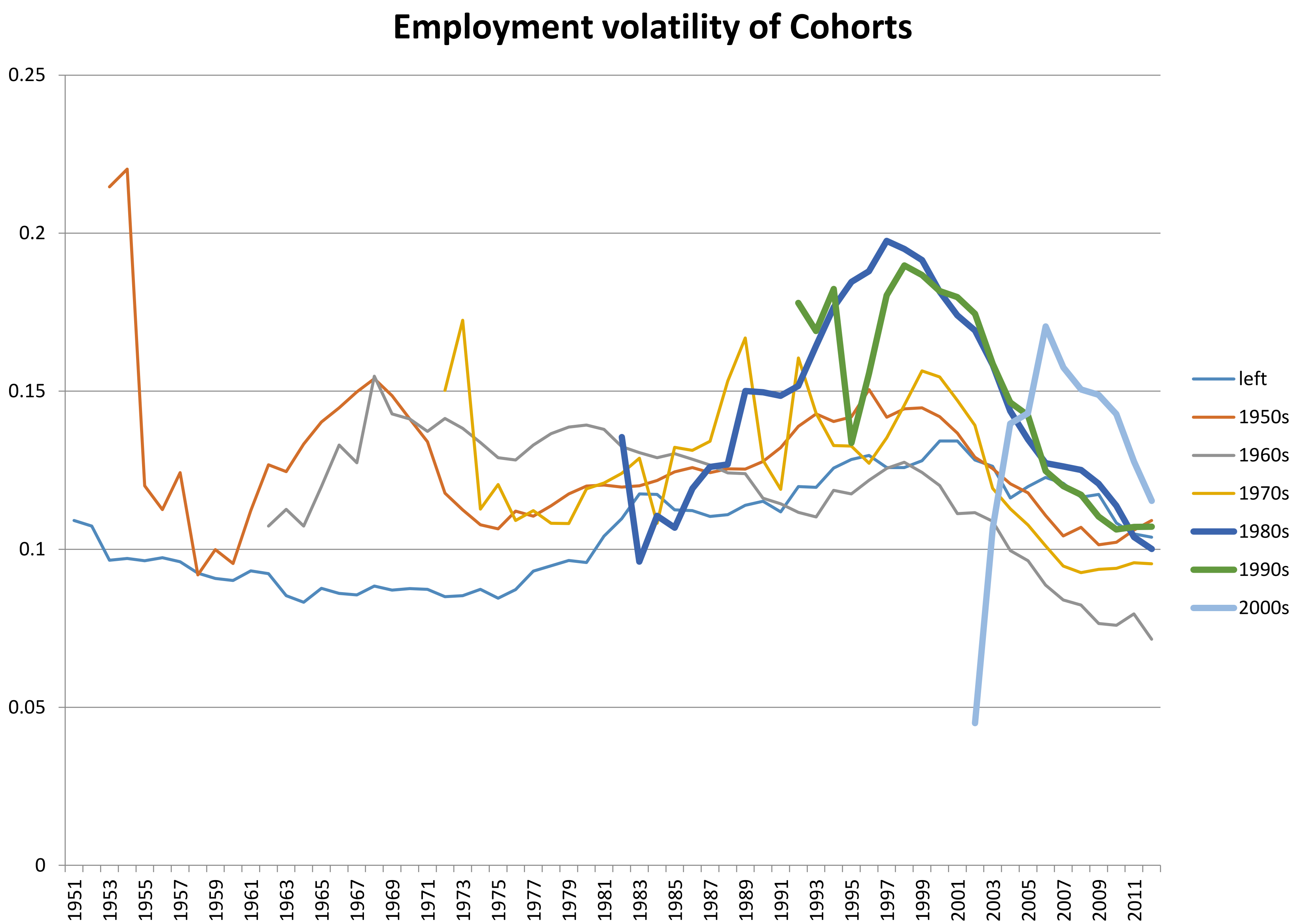
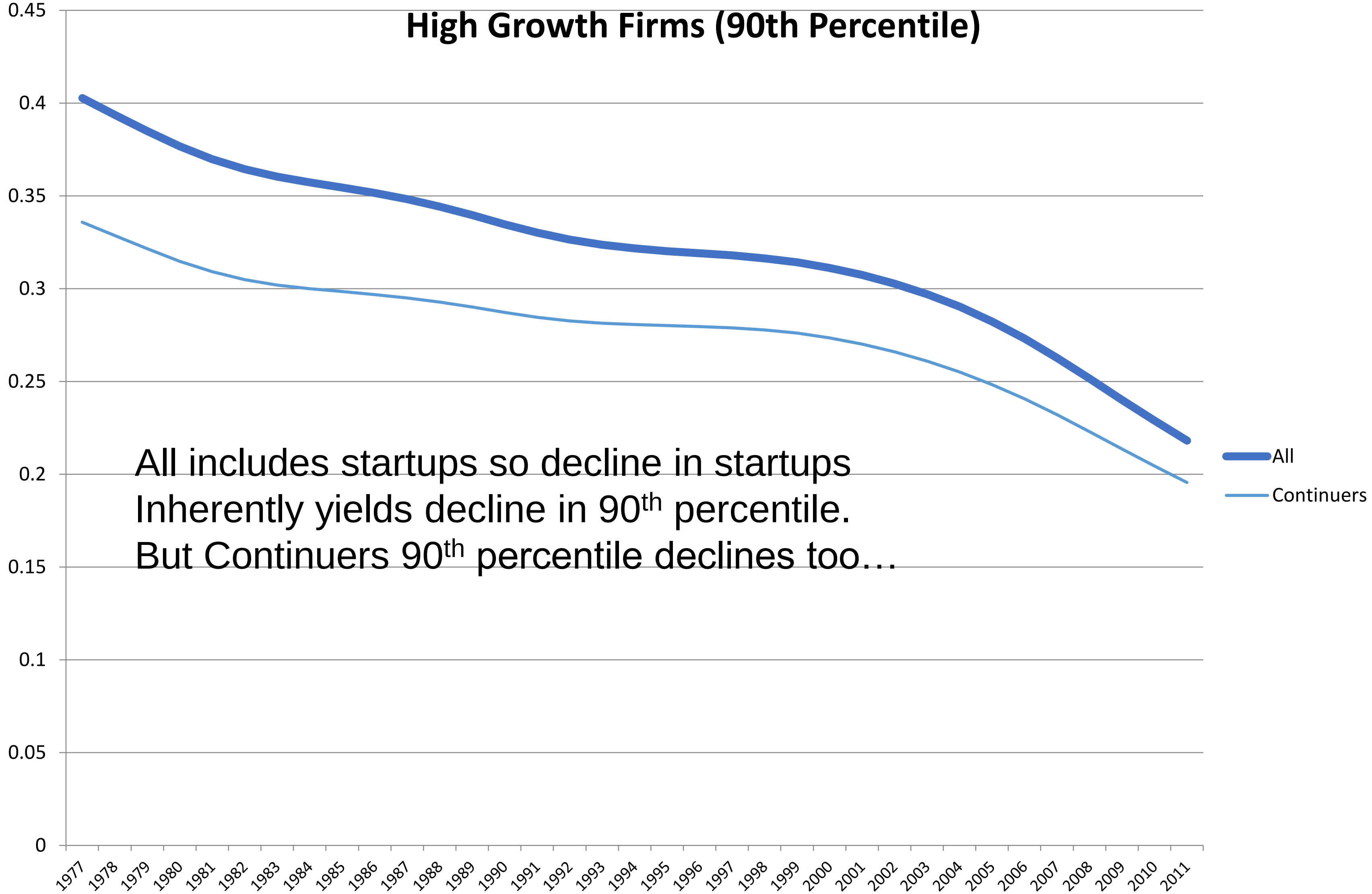
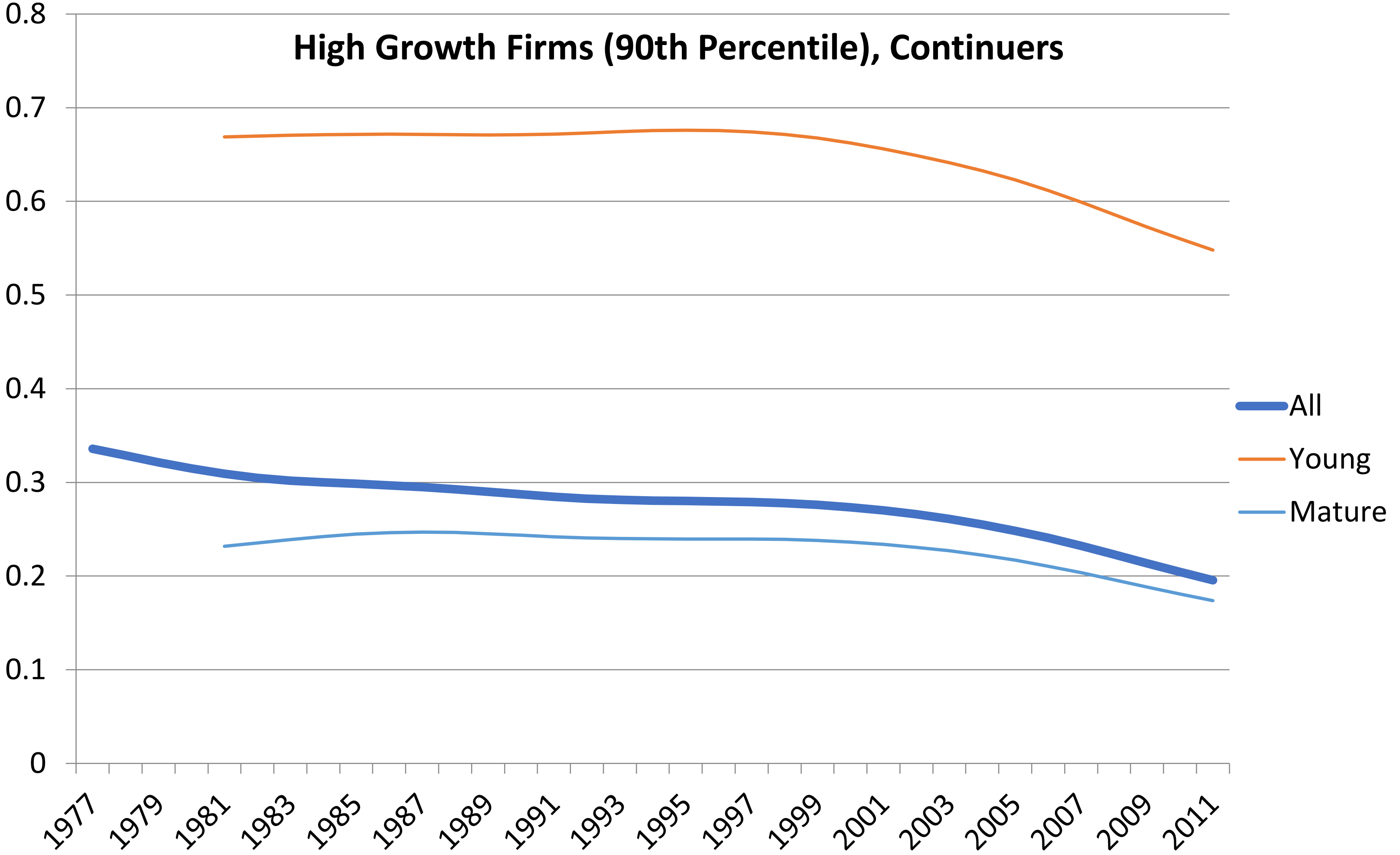

Employment volatility of Cohorts
0.25
0.2
0.15
0.1
0.05
0
1951
1953
1955
1957
1959
1961
1963
1965
1967
1969
1971
1973
1975
1977
1979
1981
1983
1985
1987
1989
1991
1993
1995
1997
1999
2001
2003
2005
2007
2009
2011
left
1950s
1960s
1970s
1980s
1990s
2000s

High growth firms for the U.S. private sector



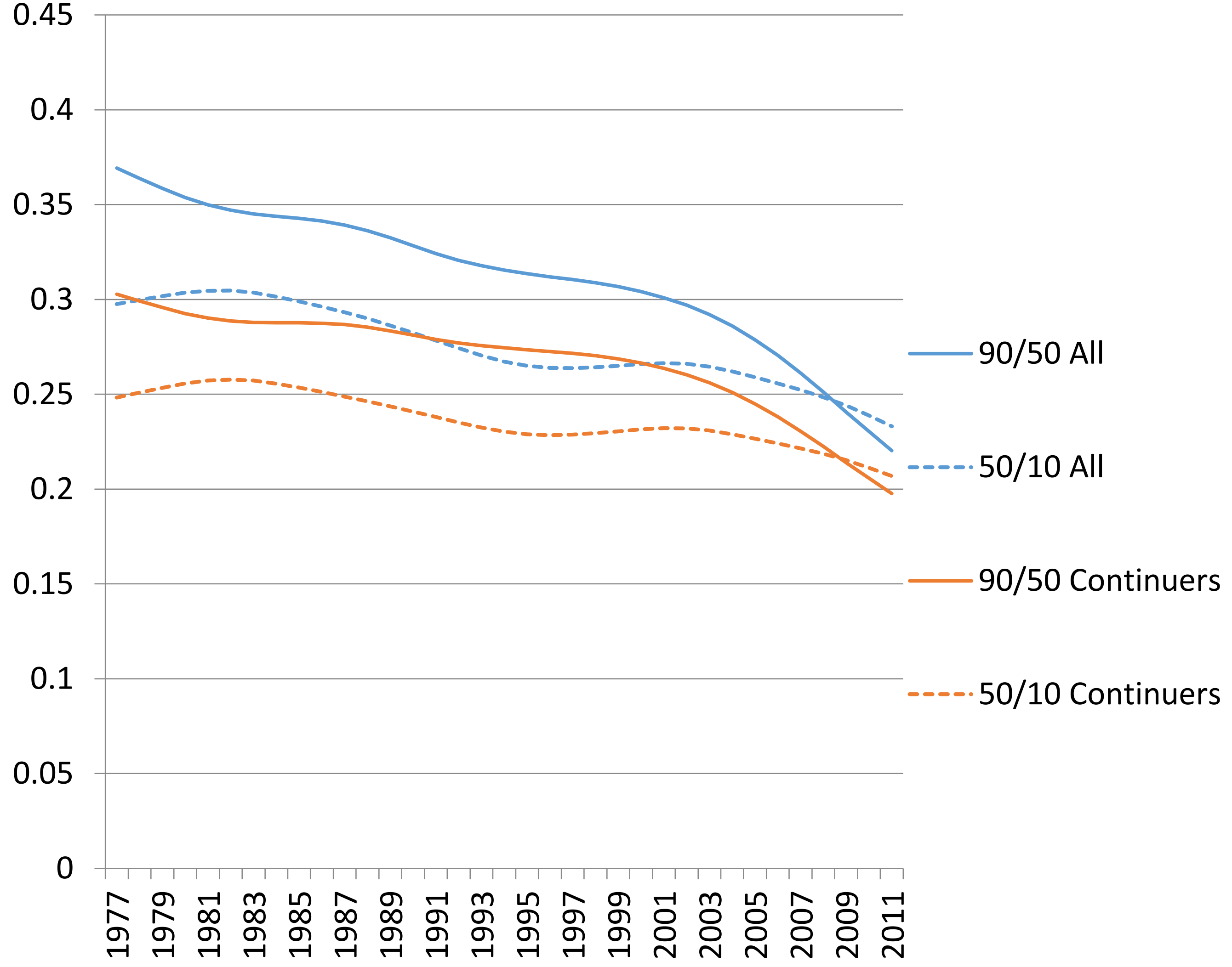
Showing HP Trends

Decline in continuers 90th percentile is composition effect due to declining share of young firms and then within young after 2000…



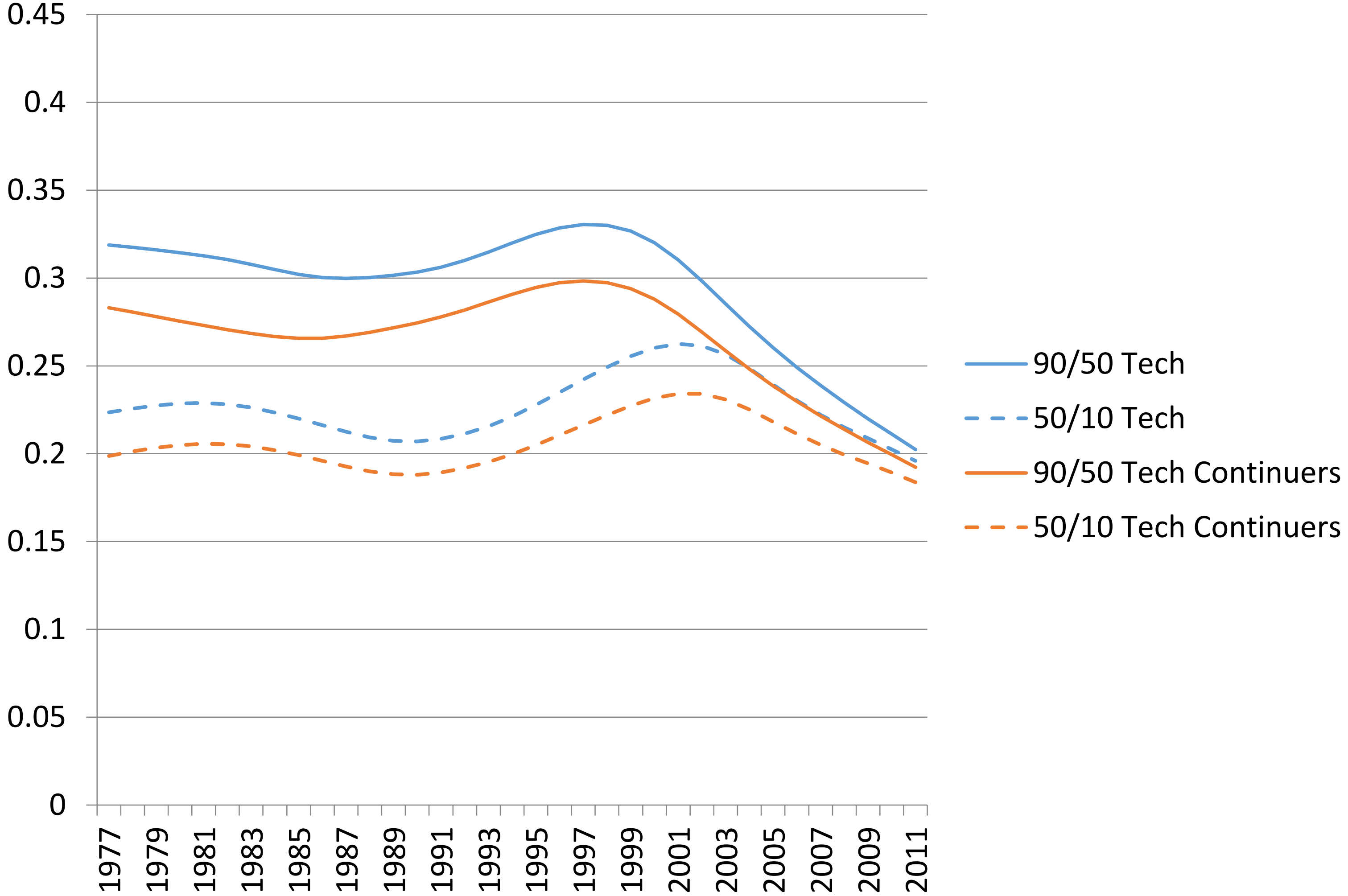
Showing HP Trends

Sharp Decline in Skewness post 2000



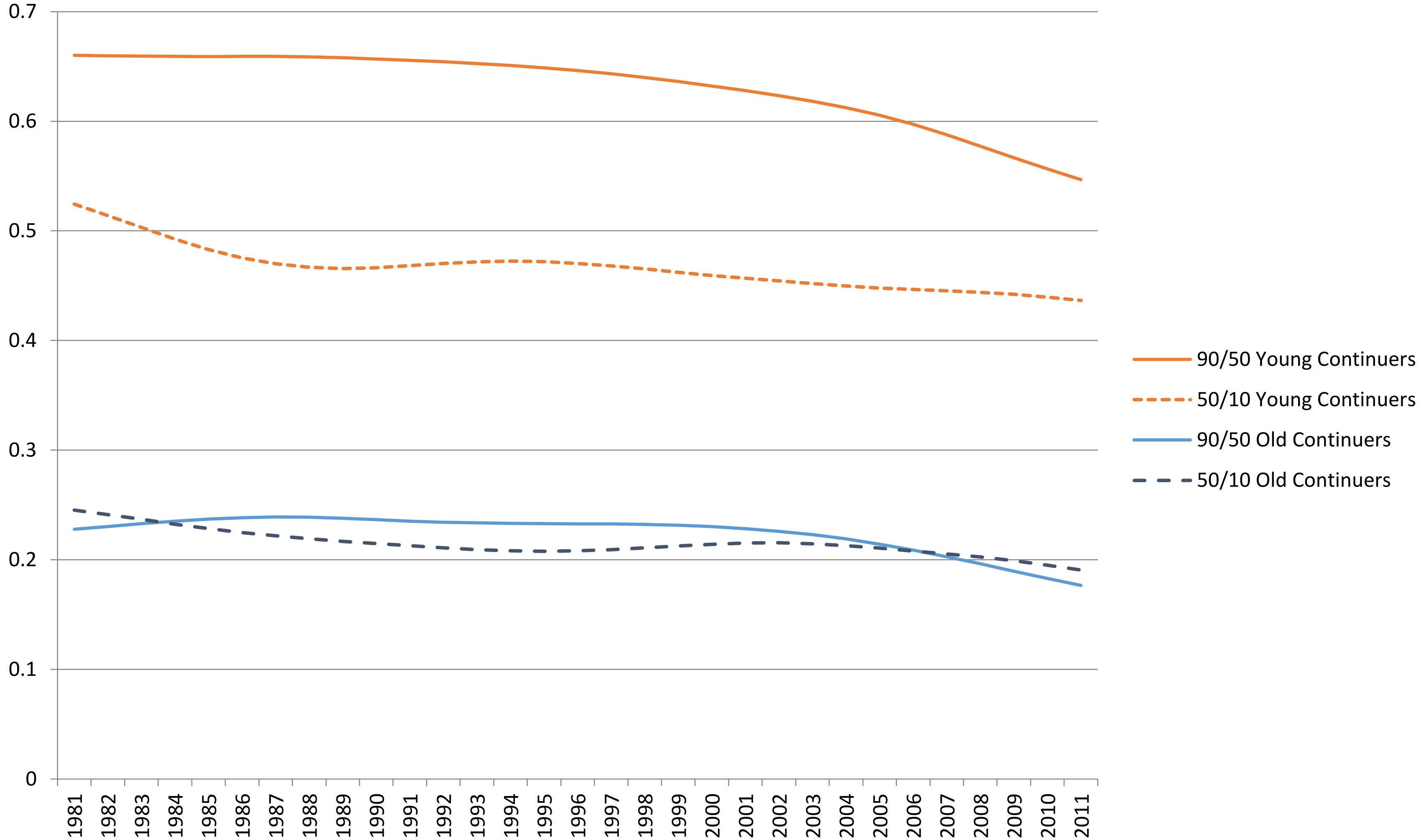
Showing HP Trends

Very High Skewness in High Tech…until the 2000s



Showing HP Trends

Declining skewness also for young firms post 2000…



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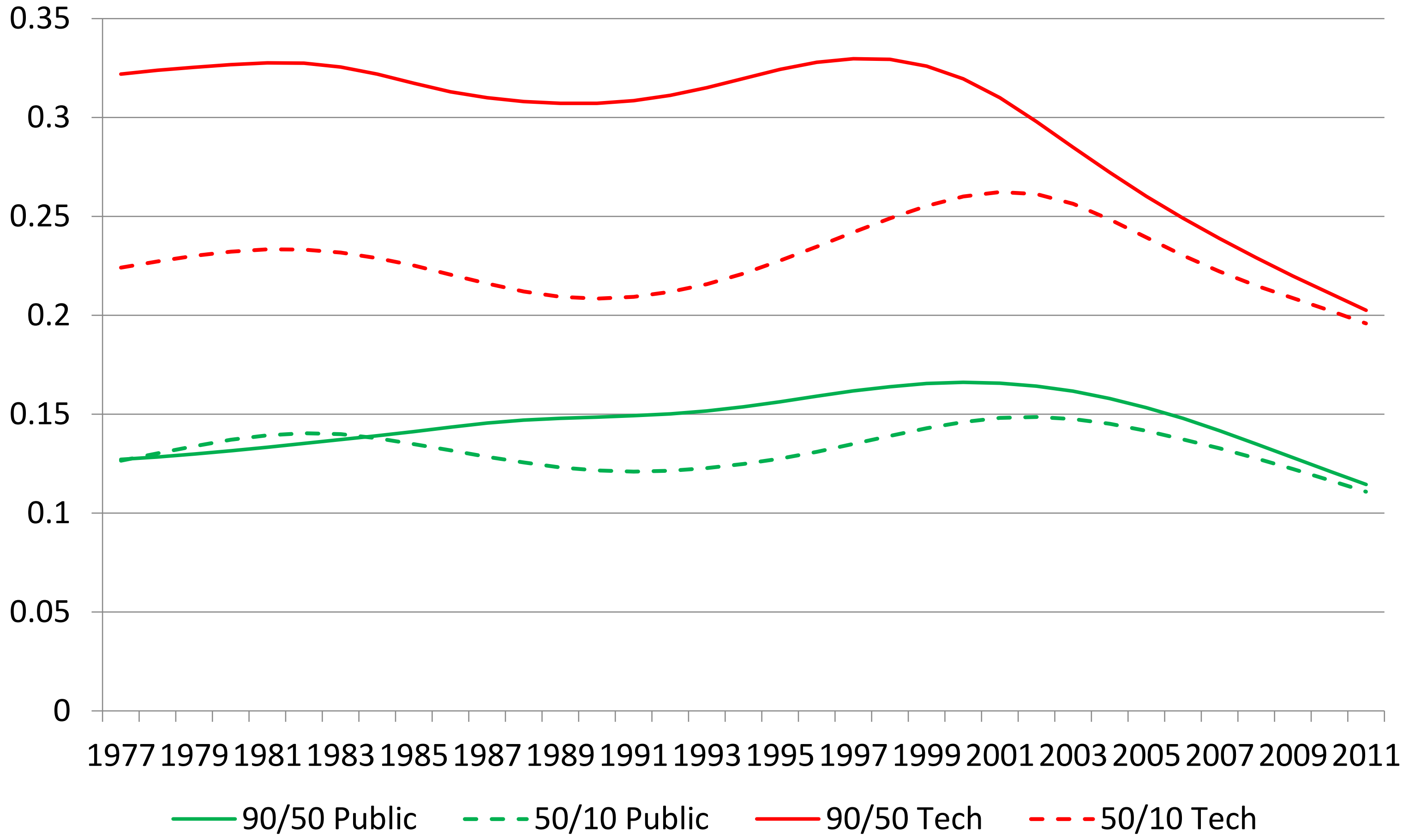
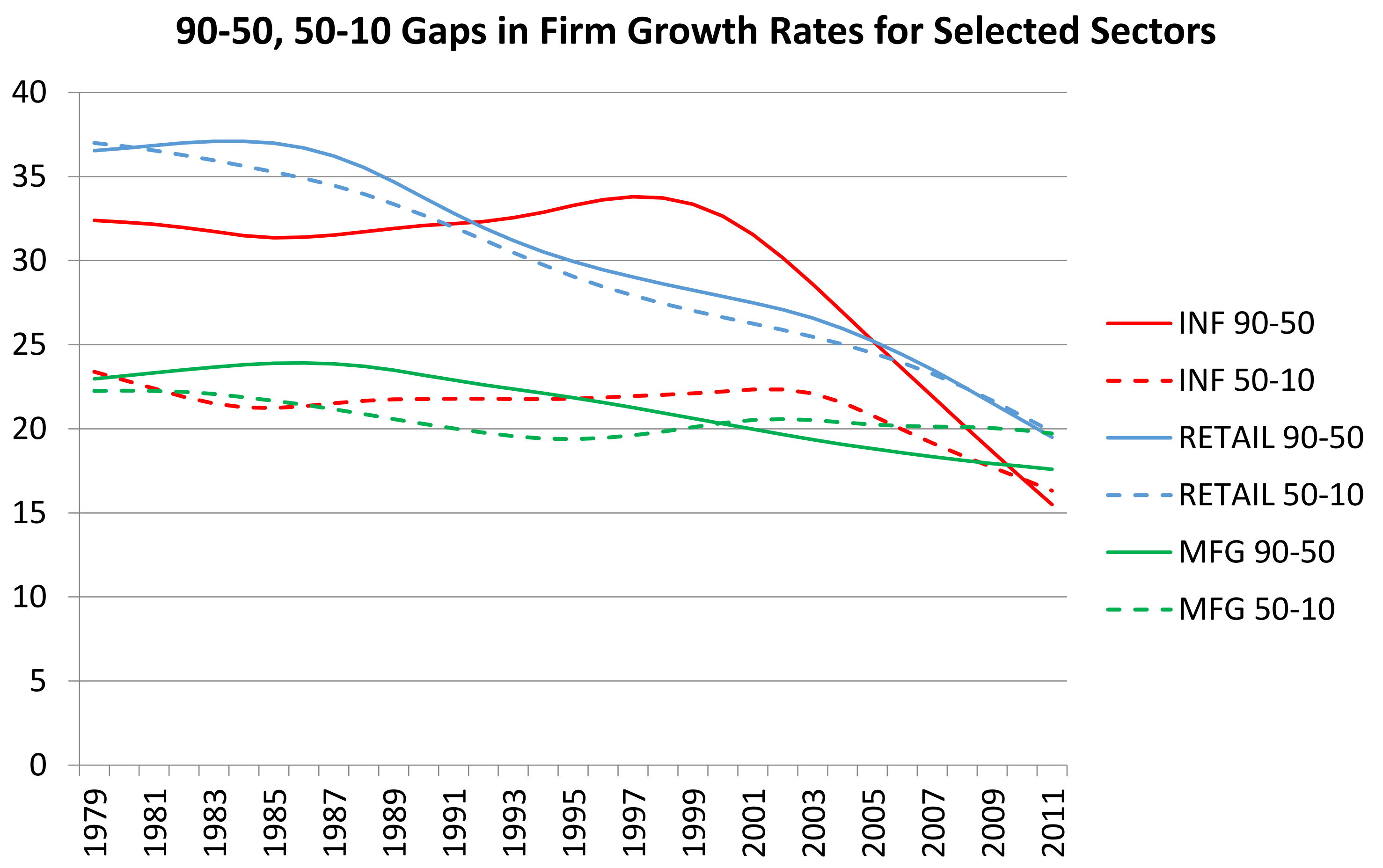
High Tech and Publicly Traded both exhibit declines in skewness post 2000

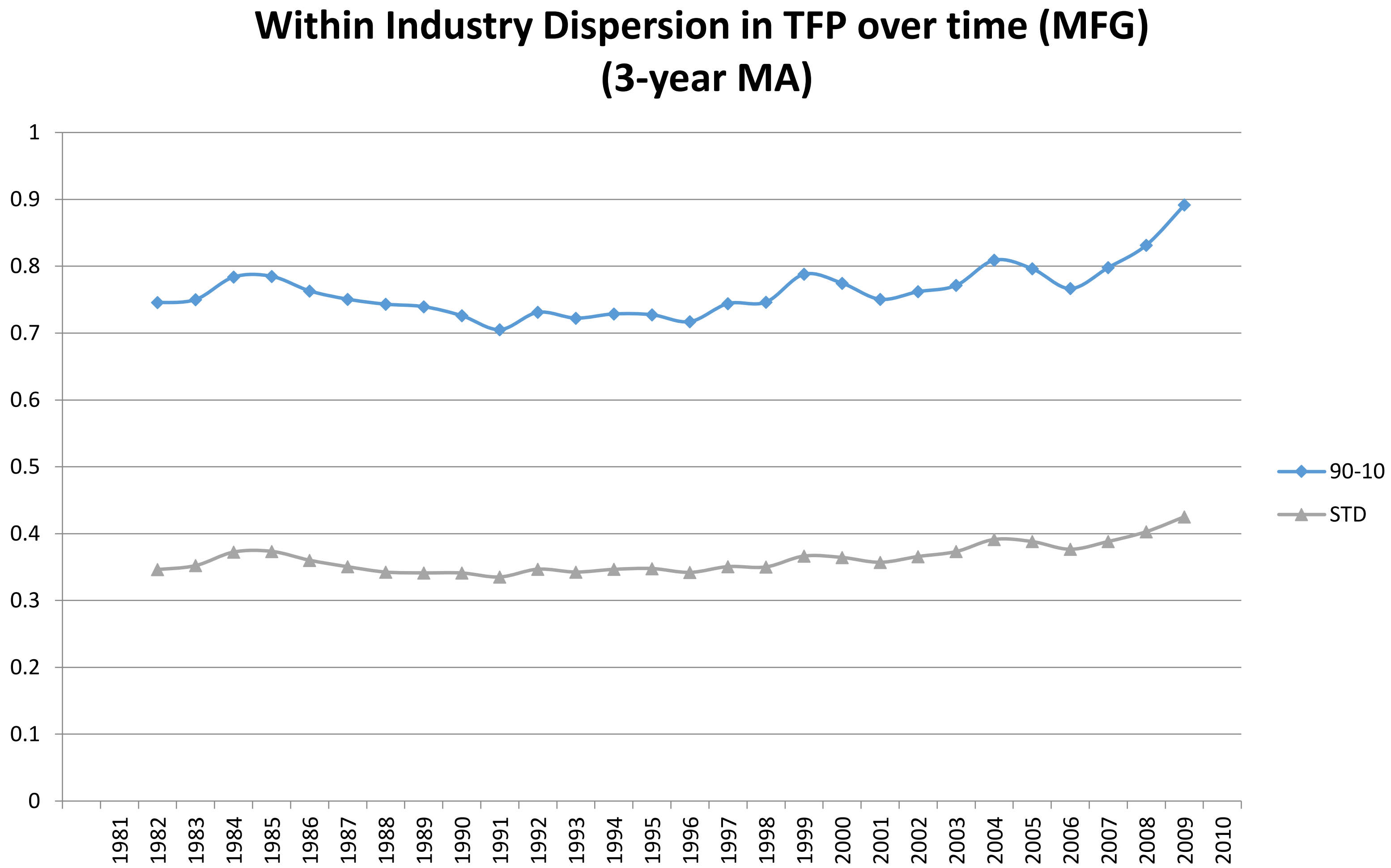


Showing HP Trends

In contrast, almost no skewness in retail trade – mostly decline in dispersion…contrasting to information (and high tech and publicly traded)

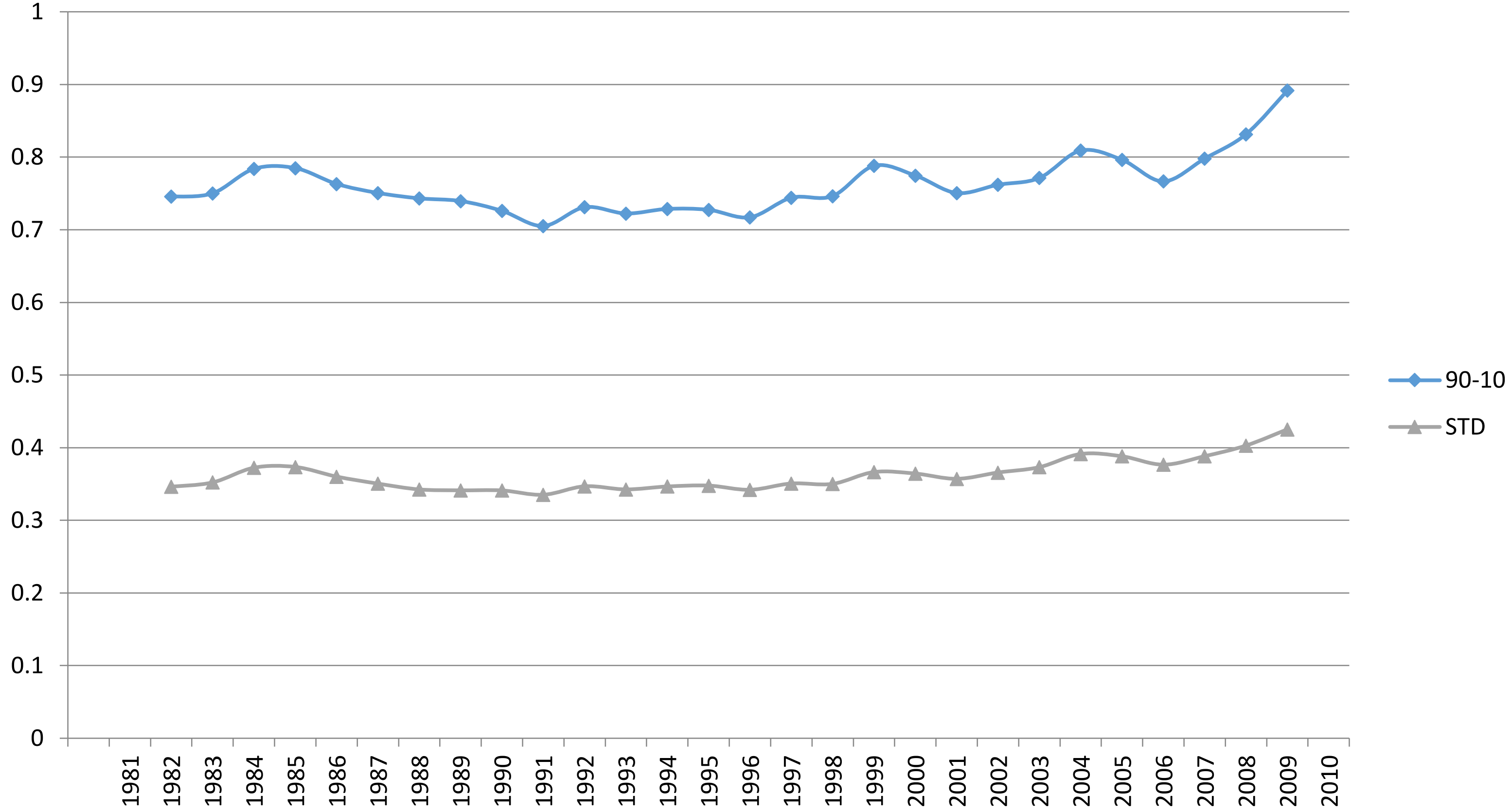


Showing HP Trends



AR1 coefficient for continuers: 0.63, Ratio of Std(Innov)/Std(TFP) = 0.83

Within Industry Dispersion in TFP over time (MFG) (3-year MA)



AR1 coefficient for continuers: 0.63, Ratio of Std(Innov)/Std(TFP) = 0.83

Analysis of Changing Response to Shocks

Estimating simple specifications such as:

$$Y_{e,t+1} = \lambda_{t+1} + \beta * TFP_{et} + \delta * TFP_{et} * Trend_{t+1} + X'_{et}\Theta + \varepsilon_{e,t+1}$$

e = establishment,
Y (outcome) = overall growth (or components) from *t* to *t*+1 from *t* to *t*+1
Trend = simple time trend
TFP = log TFPR at the establishment level (deviated from industry*year mean)
X includes establishment and firm level controls, cyclical controls including interactions with TFP (FGH (2013))

Changing Responsiveness of Plant-Level Growth from t to t+1 to (log) TFP in t

	Overall Growth Rate (Continuers + Exiters)	Exit	Conditional Growth Rate (Continuers Only)
TFP	0.1878***	-0.0629***	0.0698***
	(0.0024)	(0.0010)	(0.0014)
TFP*Trend	-0.0021***	0.0002***	-0.0020***
	(0.0001)	(0.00006)	(0.00009)

* p < 0.10, ** p < 0.05, *** p < 0.01. Note all specifications have over 2 million observations. Controls include year effects, size effects, state effects, cyclical indicators at the state level interacted with TFP. This holds for all the regressions below.

Changing Responsiveness of Plant-Level Growth from t to t+1 to (log) TFP in t

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Changing Responsiveness of Plant-Level Growth from t to t+1 to (log) TFP in t

Overall Growth Rate

	All	Young	Mature
TFP	0.1878***	0.3176***	0.1518***
	(0.0024)	(0.0056)	(0.0027)
TFP*Trend	-0.0021***	-0.0057***	-0.0009***
	(0.0001)	(0.0003)	(0.0002)

See notes above. Note that the Young and Mature coefficients are estimated from a pooled specification with both young and mature that permits all of the TFP terms to be interacted with age indicator and the age indicators are in the set of additional controls as well.

Table 4. Changing Responsiveness of Plant-Level Growth from t to t+1 to (log) TFP in t

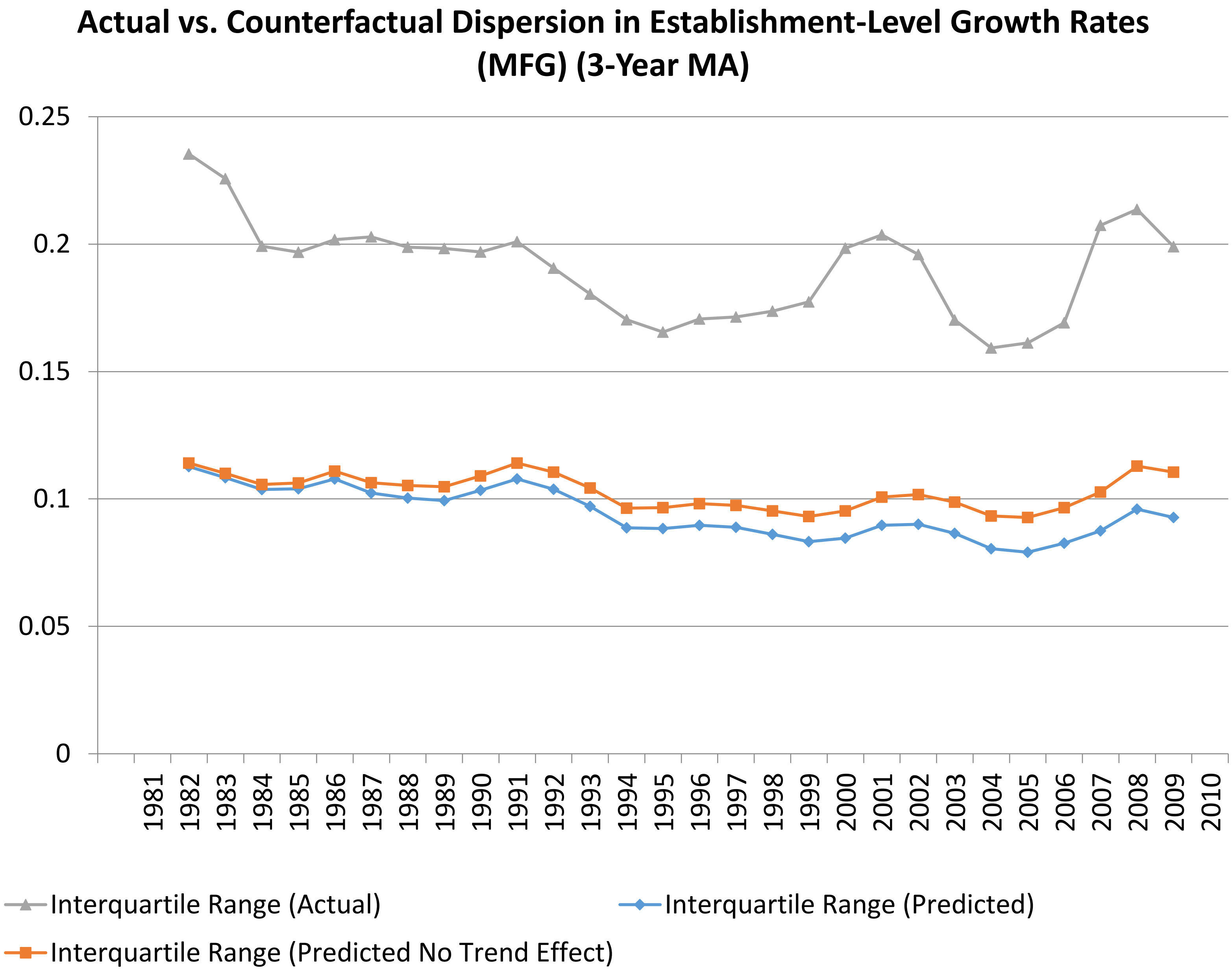
Overall Growth Rate

	All	**Young**	**Mature**
TFP	0.1818***	0.2850***	0.1537***
	(0.0030)	(0.0070)	(0.0033)
TFP*Trend	-0.0011***	-0.0016***	-0.0012***
	(0.0003)	(0.0006)	(0.0003)
TFP*Trend*Post2000	-0.0008***	-0.0036***	0.0002
	(0.0002)	(0.0005)	(0.0002)

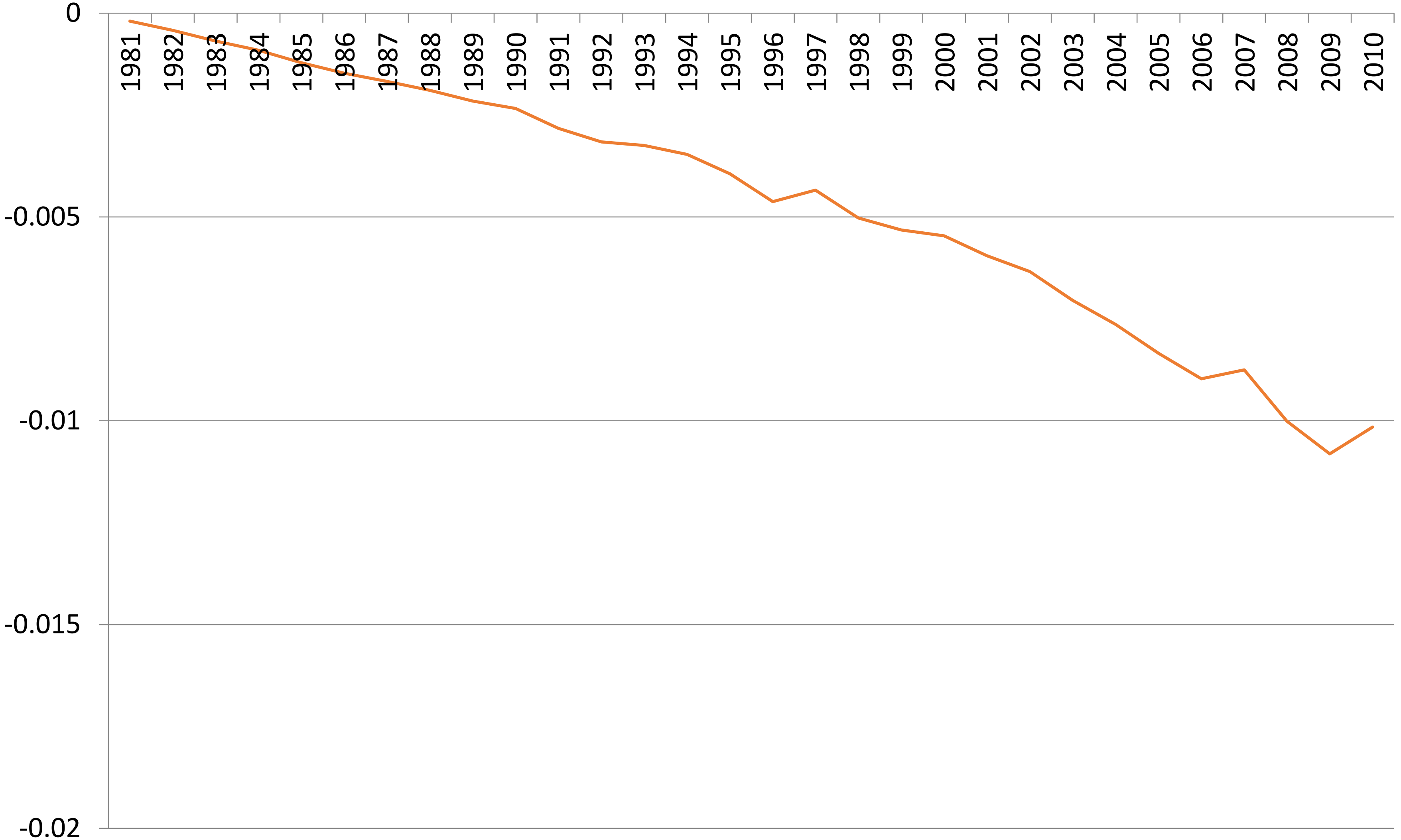
See notes above. Note that the Young and Mature coefficients are estimated from a pooled specification with both young and mature that permits all of the TFP terms to be interacted with age indicator and the age indicators are in the set of additional controls as well.

Declining trend in response…

- Evidence shows that response of growth to TFP has fallen systematically over the 1981-2010 period.
  - Impact more on continuing establishments than on exit – but present for latter as well.
  - Impact more on establishments from young firms.
- What is quantitative significance?
  - Consider two related counterfactuals:


Actual vs. Counterfactual Dispersion in Establishment-Level Growth Rates (MFG) (3-Year MA)
0.25
0.2
0.15
0.1
0.05
0
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Interquartile Range (Actual)
Interquartile Range (Predicted)
Interquartile Range (Predicted No Trend Effect)

Diff-in-Diff Counterfactual Reduction in Productivity Due to Declining Trend Response



Declining Trend in Response

- For Manufacturing, we estimate a quantitatively significant decline in the responsiveness of plant-level growth to TFP shocks.
- Why?
  - Increase in adjustment costs?
  - Change in technology that is less flexible and/or yields more within establishment restructuring?
    - Greater role for within plant productivity growth?

Remarks about Decline

- Decline in startups and young firms plays an important role in declining dynamism
  - Subsistence vs. Transformational?
    - Mixed evidence:
      - Retail Trade, pre-2000 mostly “Mom and Pop”
      - Sharp Decline in Skewness in the Firm Growth Rate Distribution after 2000 especially in High Tech Sector.
- Much of the decline is within cells:
  - Decline in volatility of shocks or response to shocks?
    - Evidence for manufacturing suggests it is declining response.
    - Partial equilibrium counterfactuals imply non-trivial adverse impact on productivity.

NUTS AND BOLTS of PRODUCTIVITY MEASUREMENT

Measurement of Plant-level Productivity

$$tfp_i = y_i - \alpha_l l_i - \alpha_k k_i - \alpha_m m_i - \alpha_e e_t$$

All variables in logs, difficult measurement Issues on outputs and inputs and factor elasticities

Typical to assume Cobb-Douglass or to have Divisia index approach approximation

Measurement issues

- Factor inputs:
  - Labor quality
  - Capital stock (book value vs. perpetual inventory)
- Factor elasticities:
  - Cost shares, estimated elasticities using OLS, IV, proxy methods
  - All typically estimate factor elasticities at the industry level
    - Time invariant with estimated approach typically given Cobb-Douglass assumptions
  - Estimates vary in literature but measures of TFP highly correlated across these methods. Other issues (below) appear to matter more.
- Plant-level heterogeneity in output and input prices
- Plant-level heterogeneity in factor elasticities

More Basic Measures of Productivity Are Often Used

- Labor productivity Measures at the Establishment (or Firm level)
  - Real Value Added Per Worker

$$RLP_{et} = (VA_{et} / TE_{et}) = (Y_{et} - M_{et}) / TE_{et}$$

Where Y_{et} = Real Gross Output
M_{et}= Real Materials (including energy)
Te_{et}= Total Employment
Use detailed industry output and material price deflators

Often best available measure is real gross output per worker – comparable within industries

Example of proxy method

$$y_{jt} = \beta_0 + \beta_k k_{jt} + \beta_a a_{jt} + \beta_l l_{jt} + \omega_{jt} + \eta_{jt} \quad (24)$$

$$i_{jt} = i(k_{jt}, a_{jt}, \omega_{jt}, \Delta_t) = i_t(k_{jt}, a_{jt}, \omega_{jt}). \quad (27)$$

$$\omega_{jt} = h_t(k_{jt}, a_{jt}, i_{jt}). \quad (28)$$

$$y_{jt} = \beta_0 + \beta_k k_{jt} + \beta_a a_{jt} + \beta_l l_{jt} + h_t(k_{jt}, a_{jt}, i_{jt}) + \eta_{jt}. \quad (29)$$

$$y_{jt} - \beta_l l_{jt} = \beta_0 + \beta_k k_{jt} + \beta_a a_{jt} + \omega_{jt} + \eta_{jt}. \quad (33)$$

$$\begin{aligned} y_{jt} &- \beta_l l_{jt} \\ &= \beta_0 + \beta_k k_{jt} + \beta_a a_{jt} + g(\omega_{jt-1}) + \xi_{jt} + \eta_{jt} \quad (34a) \\ &= \beta_0 + \beta_k k_{jt} + \beta_a a_{jt} + g(\phi_{jt-1} - \beta_0 - \beta_k k_{jt-1} - \beta_a a_{jt-1}) + \xi_{jt} + \eta_{jt} \\ &= \beta_k k_{jt} + \beta_a a_{jt} + \tilde{g}(\phi_{jt-1} - \beta_k k_{jt-1} - \beta_a a_{jt-1}) + \xi_{jt} + \eta_{jt}, \quad (34b) \end{aligned}$$

Depends critically on the invertibility amongst other assumptions

$$Y = AK^{\alpha}L^{1-\alpha}$$

$$Y = \frac{D^{\varepsilon-1}}{P^{\varepsilon}}$$

$$\frac{rK}{wL} = \frac{\alpha}{1-\alpha}$$

$$APK = \frac{PY}{K} = \frac{\varepsilon}{\varepsilon-1}\frac{r}{\alpha}$$

$$APL = \frac{PY}{L} = \frac{\varepsilon}{\varepsilon-1}\frac{w}{1-\alpha}$$

$$TFPR = PA = \frac{\varepsilon}{\varepsilon-1}\left(\frac{w}{1-\alpha}\right)^{1-\alpha}\left(\frac{r}{\alpha}\right)^{\alpha}$$

$$TFPQ = A$$

Cobb-Douglas Technology, CRS
Isoelastic Demand, No Frictions,
Price takers in factor markets

No dispersion in factor cost share ratio, Revenue average product of capital, revenue average product of labor, TFPR

Even though there is dispersion
In TFPQ

Why is there so much dispersion in productivity across businesses in narrowly defined sectors?

- Background facts:
  - Interquartile range of log of Revenue TFP (TFPR) is 0.29
  - Interquartile range of log of Revenue Labor Productivity (RLP) is 0.65
  - Dispersion in TFPQ, TFPR, and output price within narrow product classes (7-digit) in U.S. (Source: FHS (2008)):
    - Std. Dev of log(TFPQ) is: 0.26
    - Std. Dev of log(TFPR) is: 0.22
    - Std. Dev of log(RLP) is: 0.65
    - Std. Dev of log(P) is: 0.18
    - Std. Dev of log(Q) is: 1.05
    - Corr(log(TFPQ),log(P)) is: -0.54
    - Corr(log(TFPQ),log(Q)) is: 0.28
    - Corr(log(TFPQ),log(TFPR)) is: 0.75
    - Corr(log(TFPQ),log(RLP)) is: 0.56

Frictions + Distortions

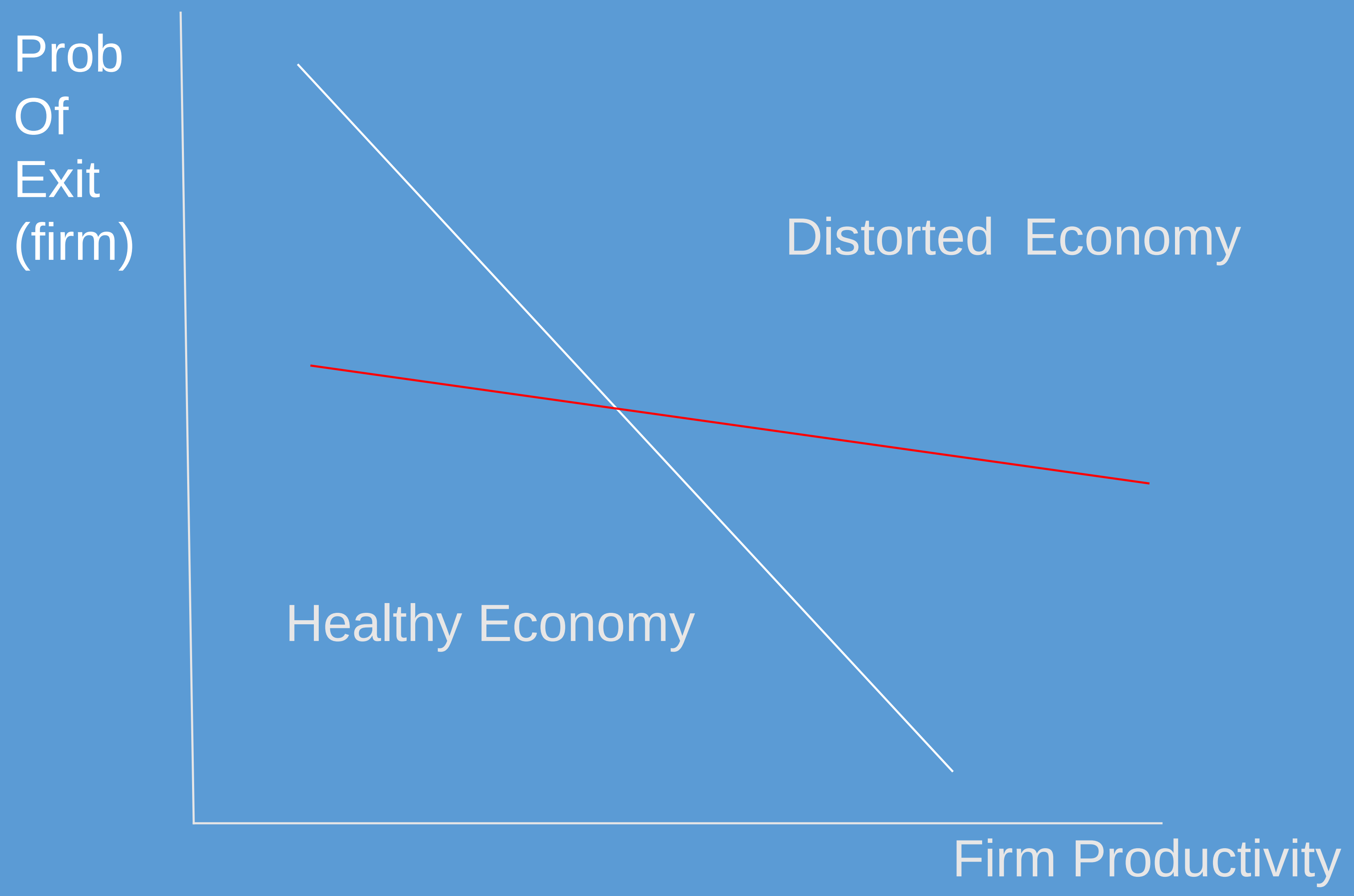
- Costs of Entry (and exit)
  - Including costs of entering new markets
  - Hopenhayn (1992), Melitz (2003), Melitz and Ottaviano (2005)
- Learning (initial conditions and after changing products/processes)
  - Jovanovic (1982) and Ericson and Pakes (1998)
  - Experimentation
- Adjustment costs for factors of production (capital, labor, intangible capital)
  - Convex vs. Nonconvex
- Economies of scope and control
- Product Differentiation:
  - Horizontal (e.g., spatial) vs. Vertical
- Output and input price dispersion and determination
- Imperfections in product, labor, capital, credit markets
- Distortions to all of the above + market institutions
  - Idiosyncratic distortions as in Banerjee and Duflo (2003), Restuccia and Rogerson (2008), Hsieh and Klenow (2009), Bartelsman, Haltiwanger and Scarpetta (2013)

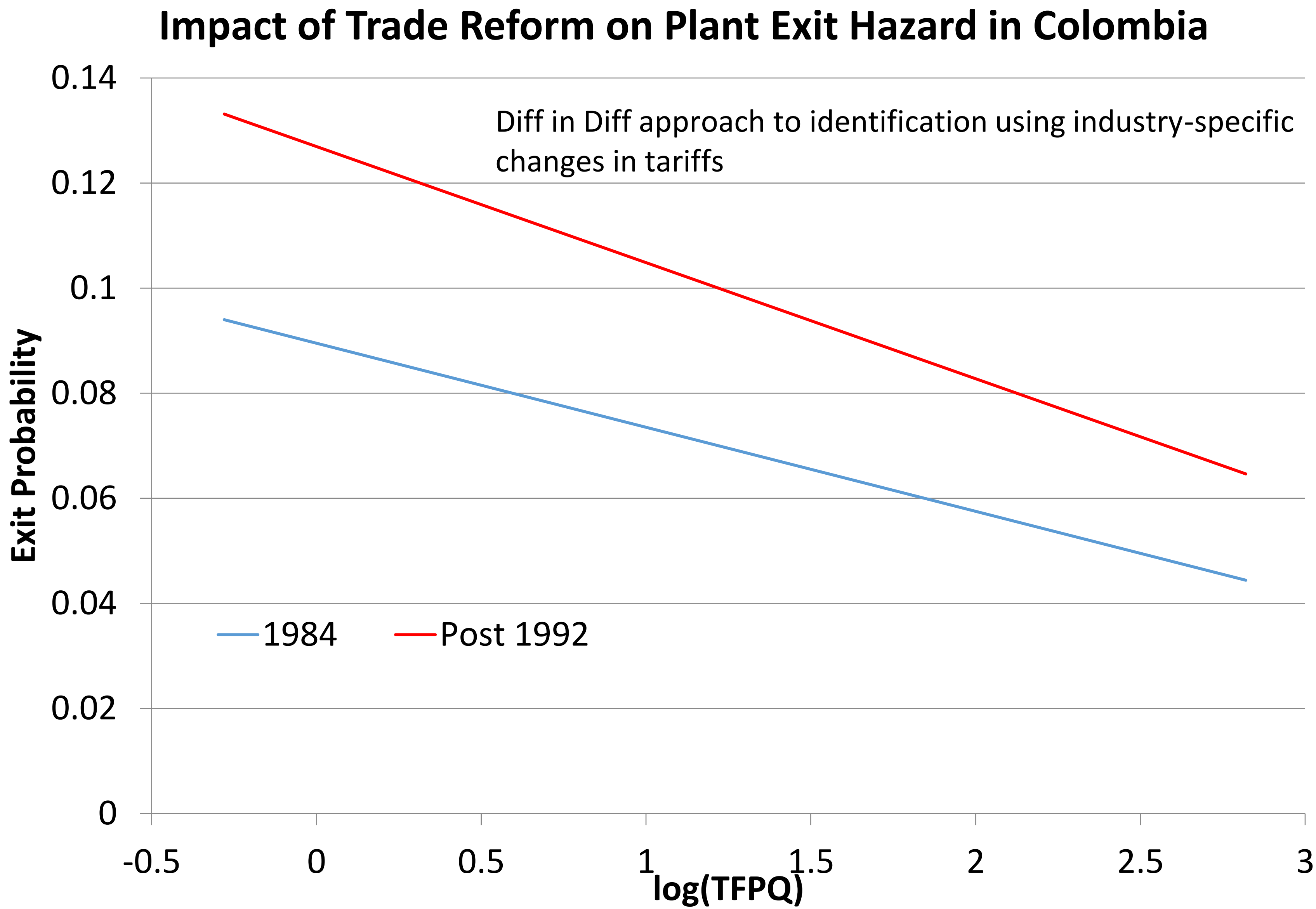
What frictions matter the most?

- Many studies showing evidence of entry costs, labor adjustment costs, capital adjustment costs, trade costs, product differentiation, and so on.
- Many open questions and issues:
  - Not practical to include all frictions in all models – but caution about identification since we are all using same data
  - How do frictions vary across advanced vs. emerging vs. transition?
- Important to distinguish between those frictions that yield some plants persistently higher productivity than others as opposed to adjustment dynamics

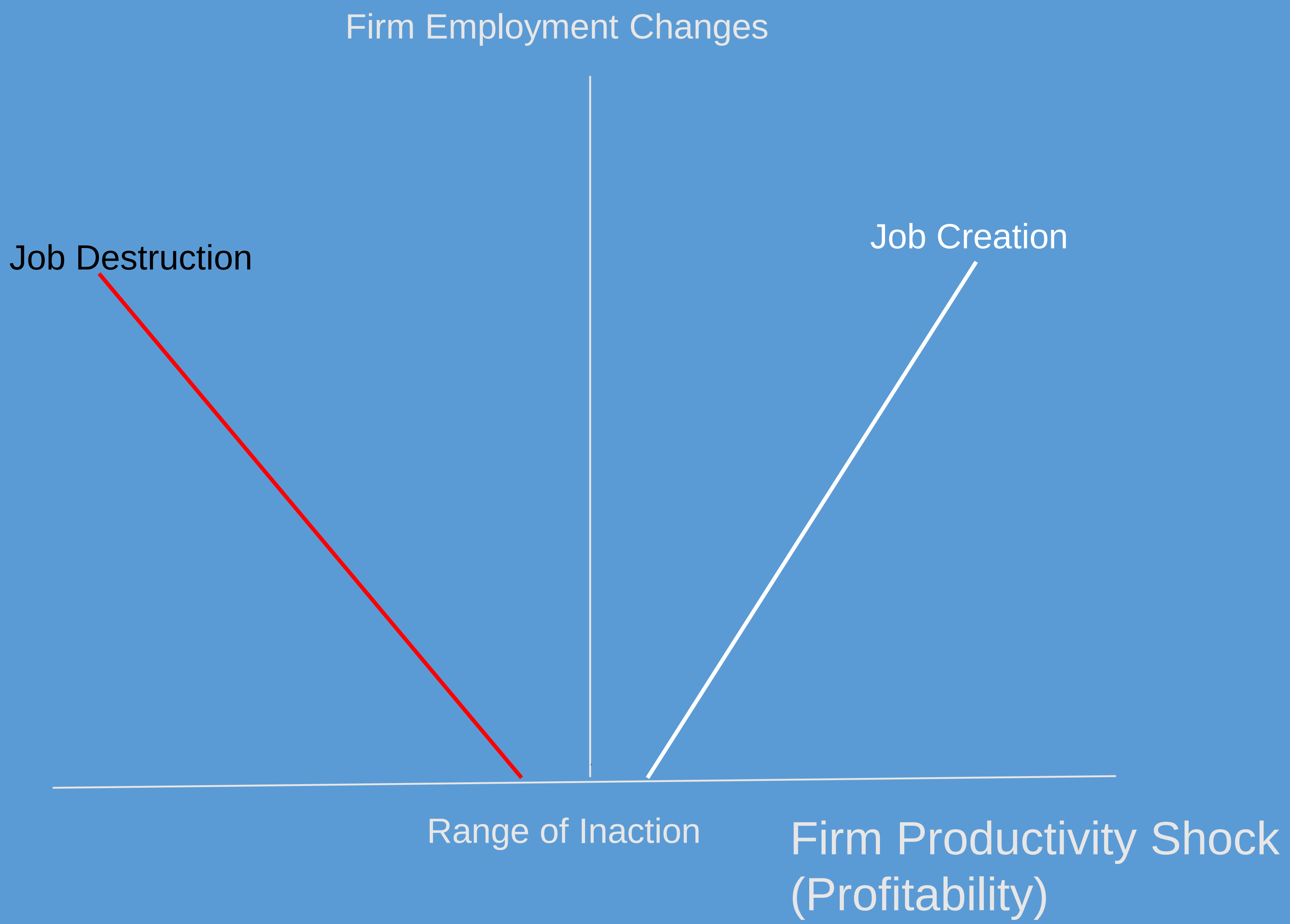
Lots of margins for distortions…

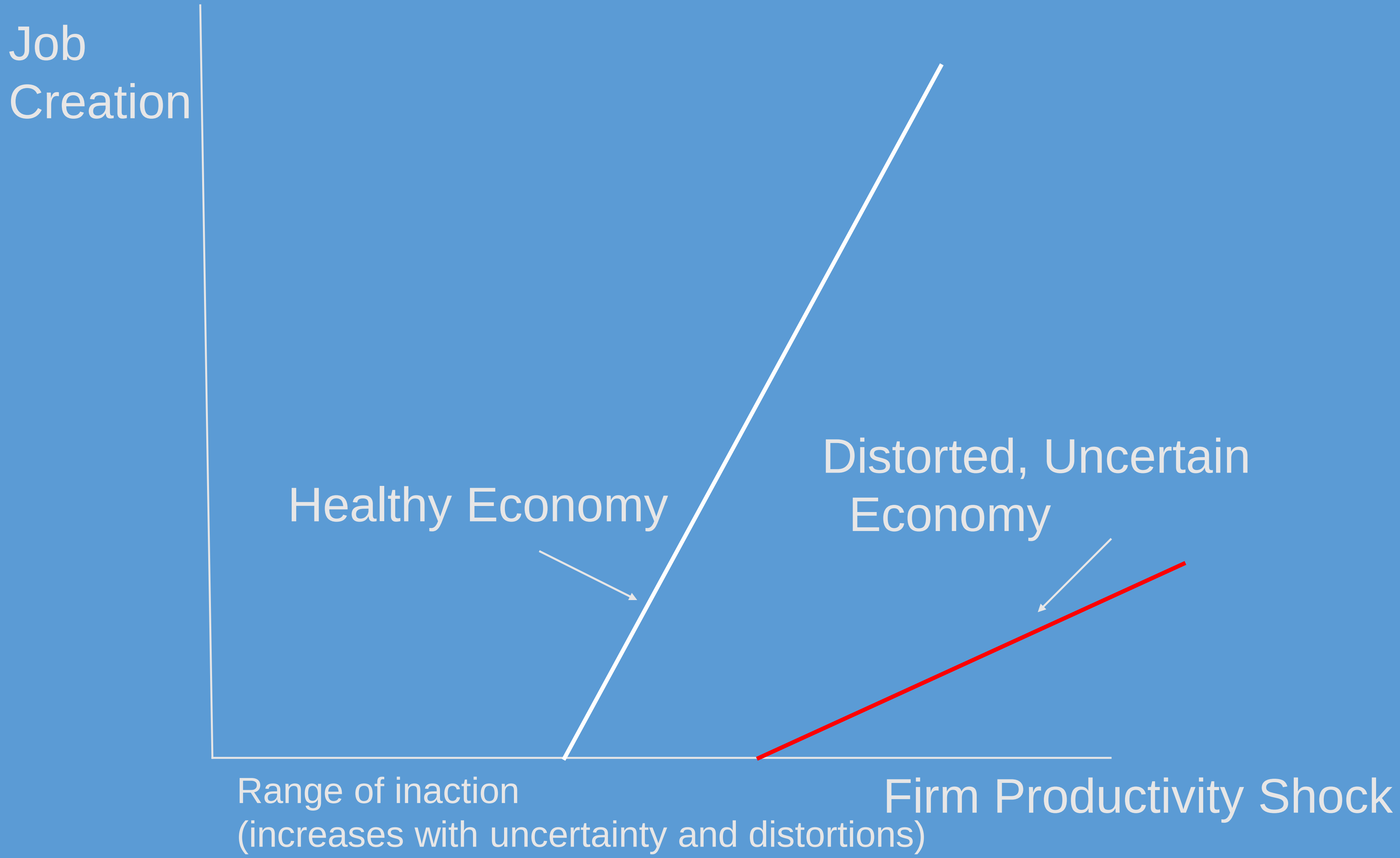
- Cross sectional misallocation
- Dynamic distortions:
  - Startups
  - Post-entry up or out dynamic
  - Creative Destruction
- Secular vs. Cyclical Distortions

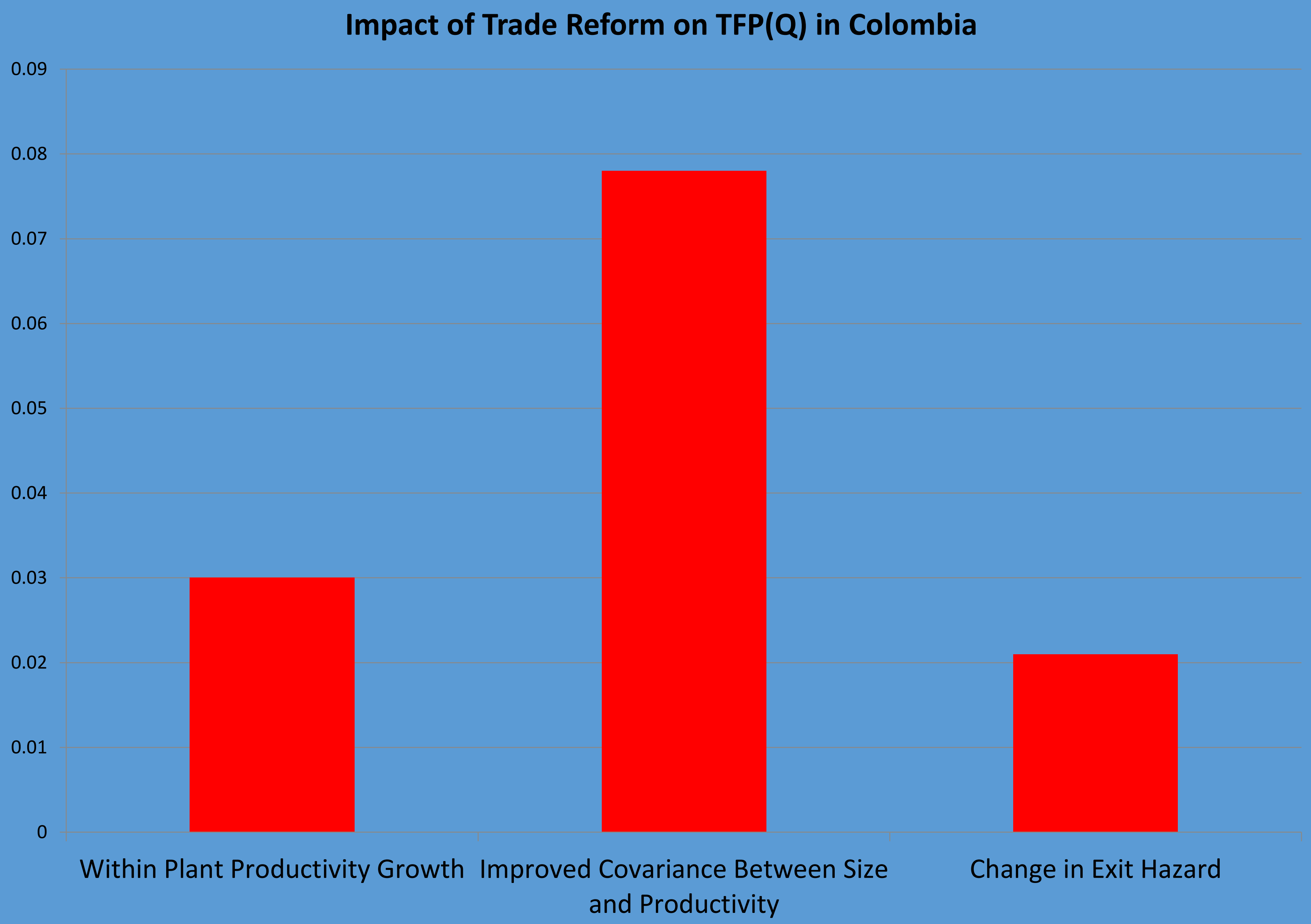

Prob
Of
Exit
(firm)
Distorted Economy
Healthy Economy
Firm Productivity



Source: Eslava, Haltiwanger, Kugler and Kugler (2012)


Firm Employment Changes
Job Destruction
Job Creation
Range of Inaction
Firm Productivity Shock
(Profitability)


Job
Creation
Healthy Economy
Distorted, Uncertain
Economy
Range of inaction
(increases with uncertainty and distortions)
Firm Productivity Shock



Source: Eslava, Haltiwanger, Kugler and Kugler (2012)

Taking Stock

- High pace of churning of businesses within narrowly defined industries
- Startups and young businesses play an important role in these dynamics
- Up or out dynamics
- These dynamics connected to productivity (and demand) dynamics at the micro level
- Identifying the frictions and how they vary across industry, time, and country ongoing activity
- But what about before entry?

How Do We measure the CONTRIBUTION OF REALLOCATION?

Size/productivity relationship within industries

$$\Omega_t = \sum_i s_{it}\omega_{it}$$

$$= (1/N_t)\sum_i \omega_{it} + \sum_i (s_{it} - (1/N_t)\sum_i s_{it})(\omega_{it} - (1/N_t)\sum_i \omega_{it}))$$

Olley and Pakes (1996) decomposition

$$\Delta\Omega_t = \sum_i s_{it}\omega_{it} - \sum_i s_{it-1}\omega_{it-1}$$

$$= \sum_{i\in C} \overline{s_{it}}\Delta\omega_{it} + \sum_{i\in C}\Delta s_{it}(\overline{\omega_{it}} - \overline{\Omega_t}) + \sum_{i\in N} s_{it}\left(\omega_{it} - \overline{\Omega_t}\right) - \sum_{i\in X} s_{it-1}\left(\omega_{it-1} - \overline{\Omega_t}\right)$$

$$= within \quad + \quad reallocation \quad + \quad entry \quad - \quad exit$$

Modified Baily, Hulten and Campbell (1992) and Griliches and Regev (1995) decomposition

Comments on Decomposition in Literature

- Some questions about how to interpret industry-level index defined in this manner
  - Typical check (e.g., BHC and FHK) to see how this index performs relative to standard aggregate ***industry*** measures
    - Common result – magnitudes very similar and correlations high in most studies
    - Cautions:
      - These measures very sensitive to measurement error since depend on measuring within industry productivity (log) level dispersion accurately
      - Not appropriate for decompositions that exploit between industry variation (measurement and index problems)
  - Standard decomposition summarizes changes in activity weighted micro distribution
  - Decompositions more closely tied to aggregate welfare and productivity have been developed (Petrin and Levinsohn (2008), Basu and Fernald (2002)
  - Alternatively, these decompositions can be used as moments to match in a calibration or indirect inference approach (see, e.g., Bartelsman, Haltiwanger and Scarpetta (2009)

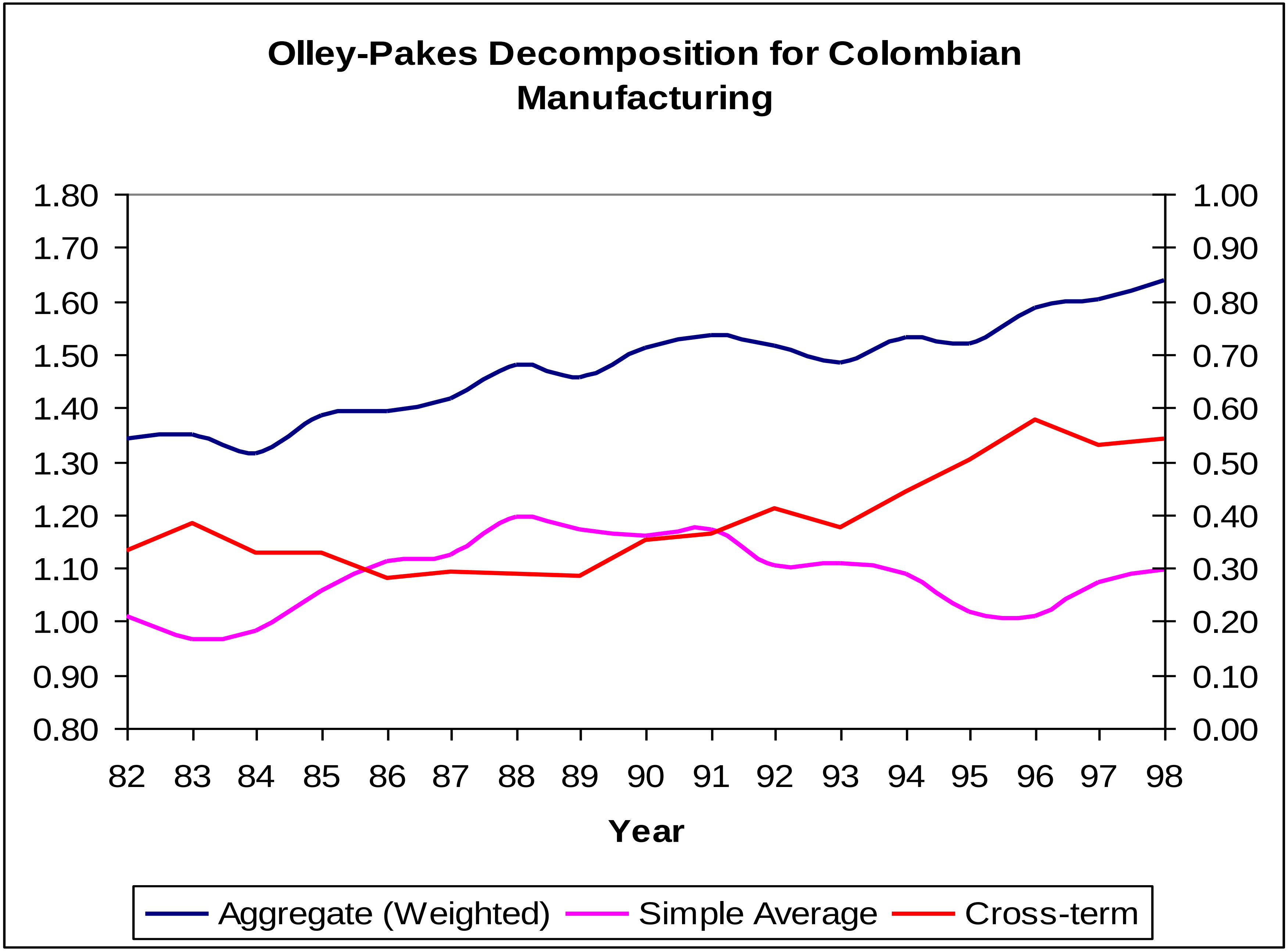
Olley and Pakes (1996) results for Telecommunications equipment

TABLE XI

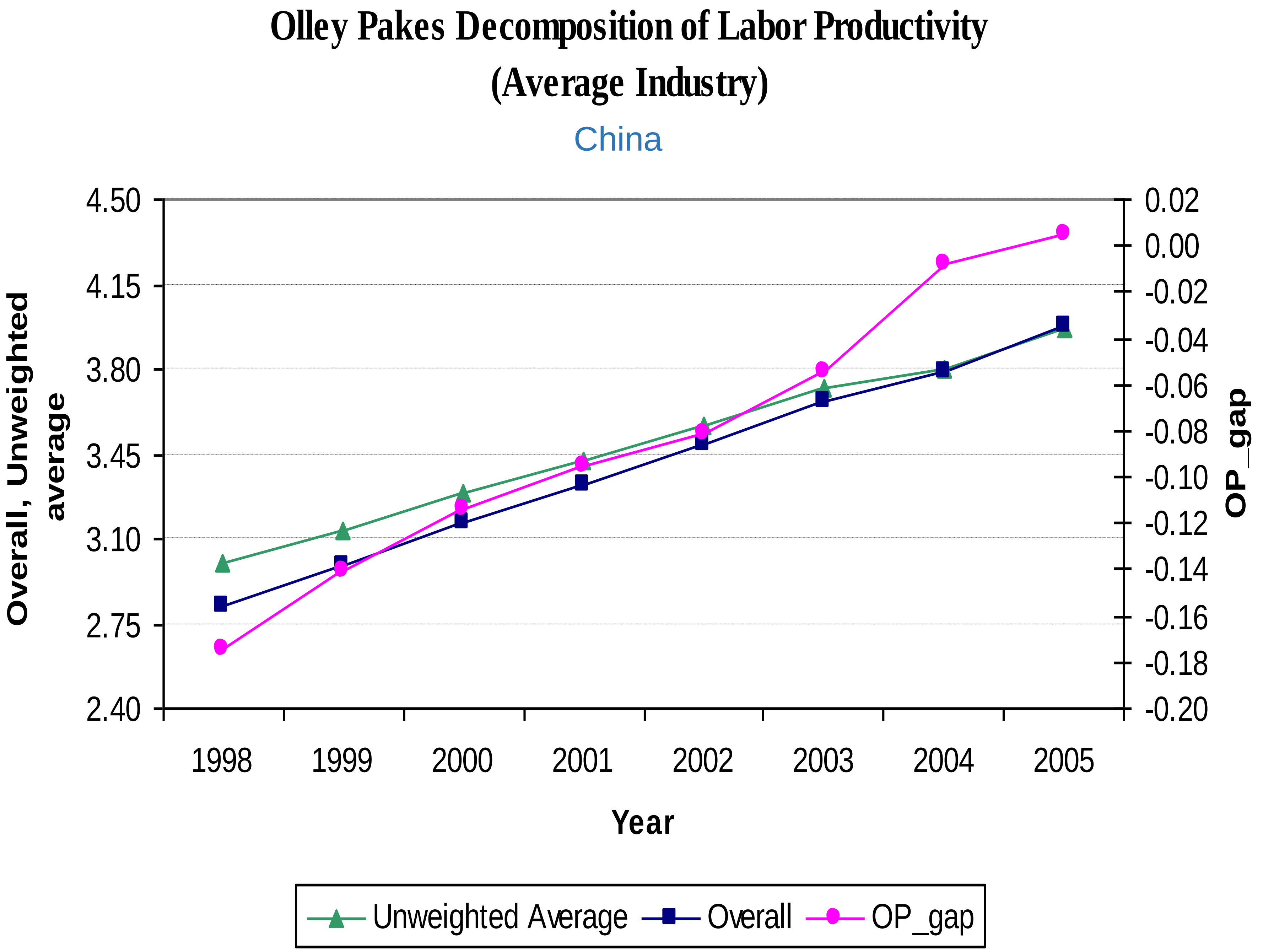
DECOMPOSITION OF PRODUCTIVITY[a]
(EQUATION (16))

Year	p_t	$\bar{p}_t$	$\Sigma_i \Delta s_{it} \Delta p_{it}$	$\rho(p_{t}, k_t)$
1974	1.00	0.90	0.01	−0.07
1975	0.72	0.66	0.06	−0.11
1976	0.77	0.69	0.07	−0.12
1977	0.75	0.72	0.03	−0.09
1978	0.92	0.80	0.12	−0.05
1979	0.95	0.84	0.12	−0.05
1980	1.12	0.84	0.28	−0.02
1981	1.11	0.76	0.35	0.02
1982	1.08	0.77	0.31	−0.01
1983	0.84	0.76	0.08	−0.07
1984	0.90	0.83	0.07	−0.09
1985	0.99	0.72	0.26	0.02
1986	0.92	0.72	0.20	0.03
1987	0.97	0.66	0.32	0.10

[a]See text for details.



Source: Eslava et al. (2005)



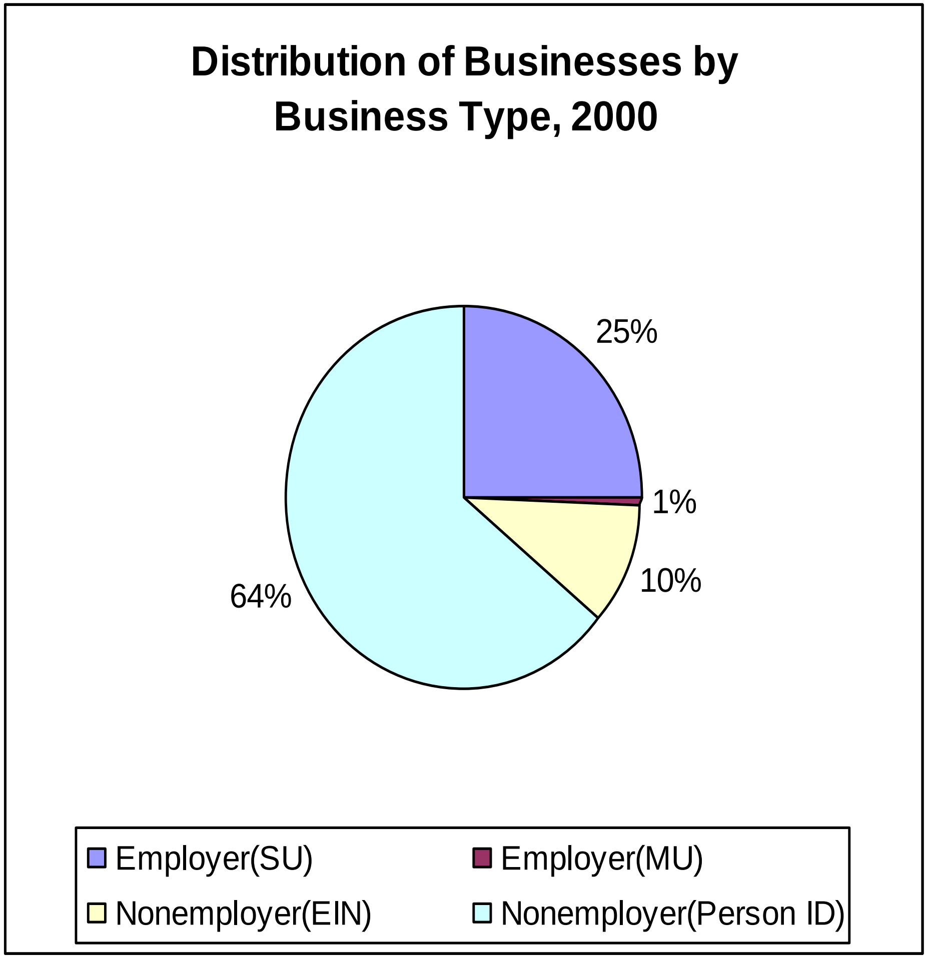
Olley Pakes Decomposition of Labor Productivity
(Average Industry)
China
4.50
4.15
3.80
3.45
3.10
2.75
2.40
0.02
0.00
-0.02
-0.04
-0.06
-0.08
-0.10
-0.12
-0.14
-0.16
-0.18
-0.20
Overall, Unweighted average
OP_gap
1998
1999
2000
2001
2002
2003
2004
2005
Year
Unweighted Average
Overall
OP_gap

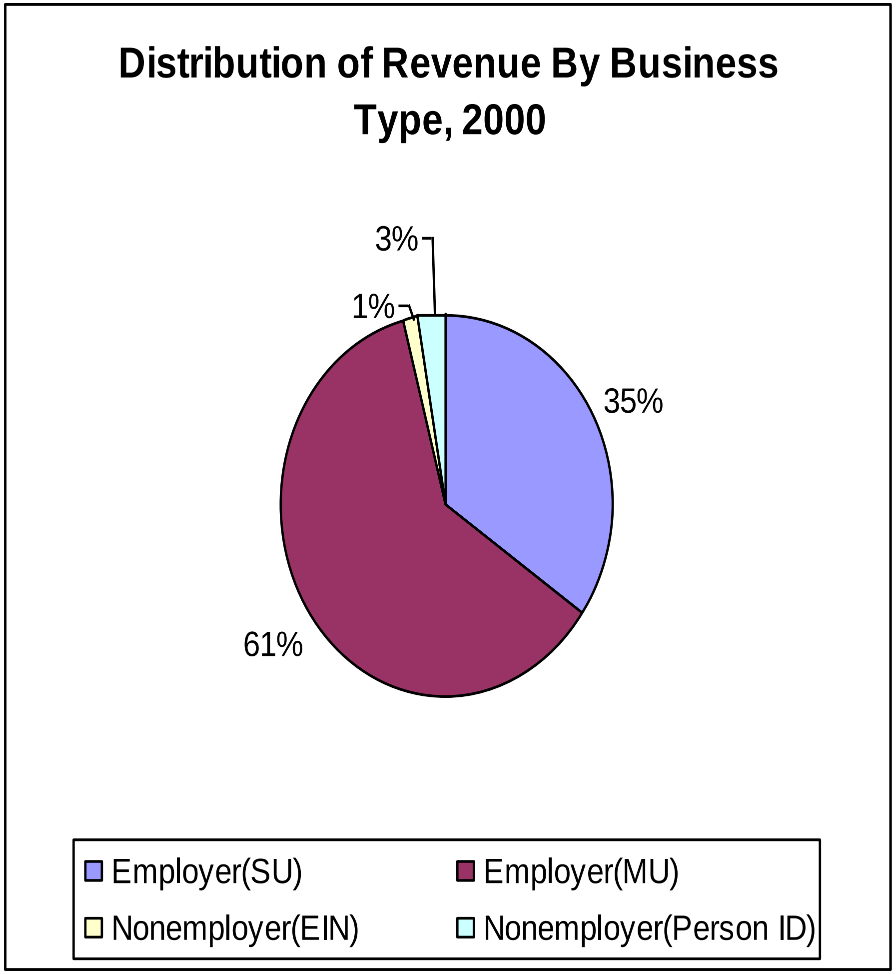
Pre-Entry History of entrepreneurs

“Before” Entry….

- Entrepreneurial dynamics starts at micro business level
- Entrepreneurs start with an idea – often while employed elsewhere
- New longitudinal databases at U.S. Census Bureau tracking this process
  - ILBD: Nonemployers (e.g., sole props without employees) + Employers
  - LEHD/SED: Tracking transitions from W&S jobs to self-employed jobs

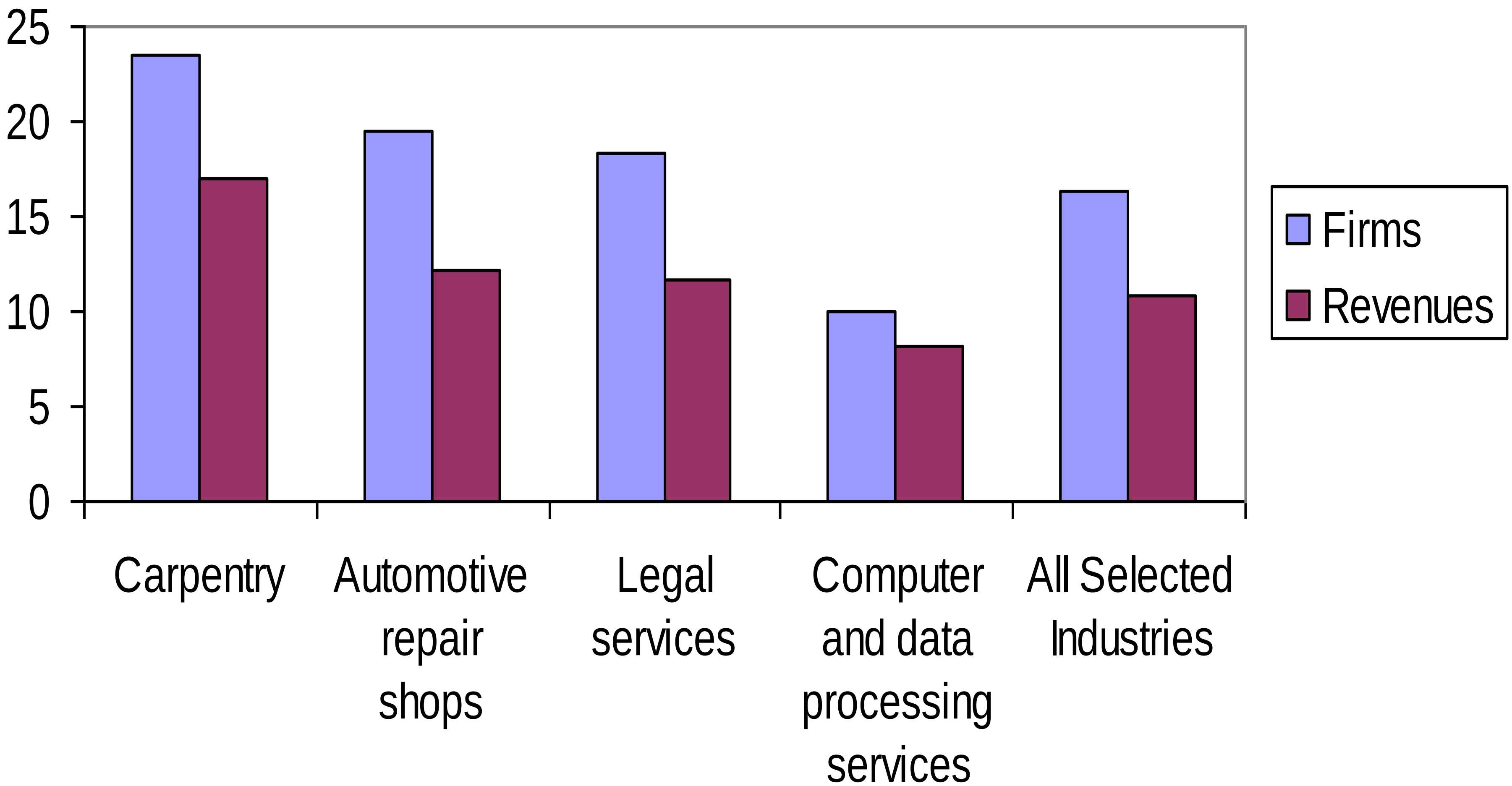
Micro Businesses constitute a large share of businesses and a small share of revenue…





Source: Davis et. al. (2008)

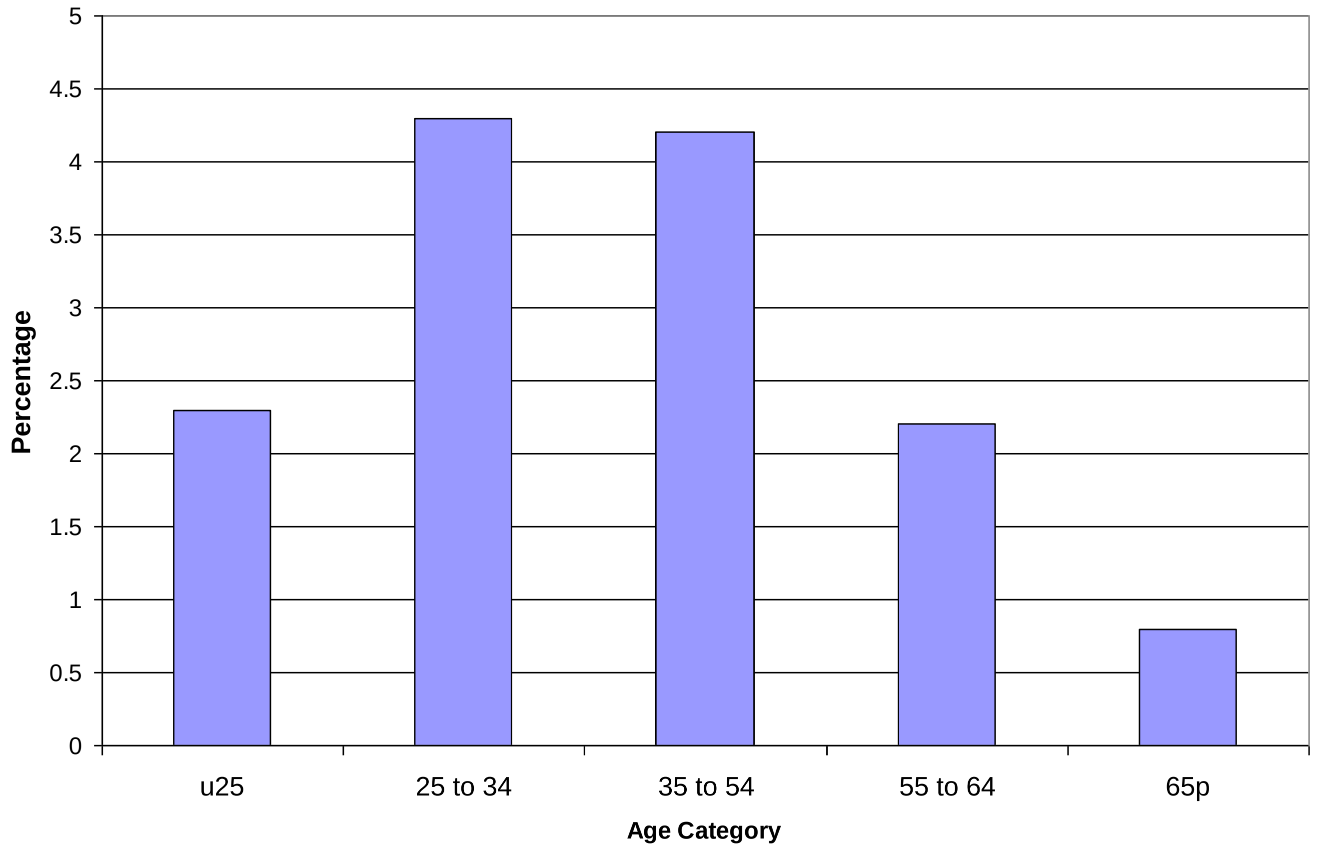
Shares of New Employer Businesses in 1997 with Pre-History as Nonemployer Businesses



Source: Davis et al. (2008)

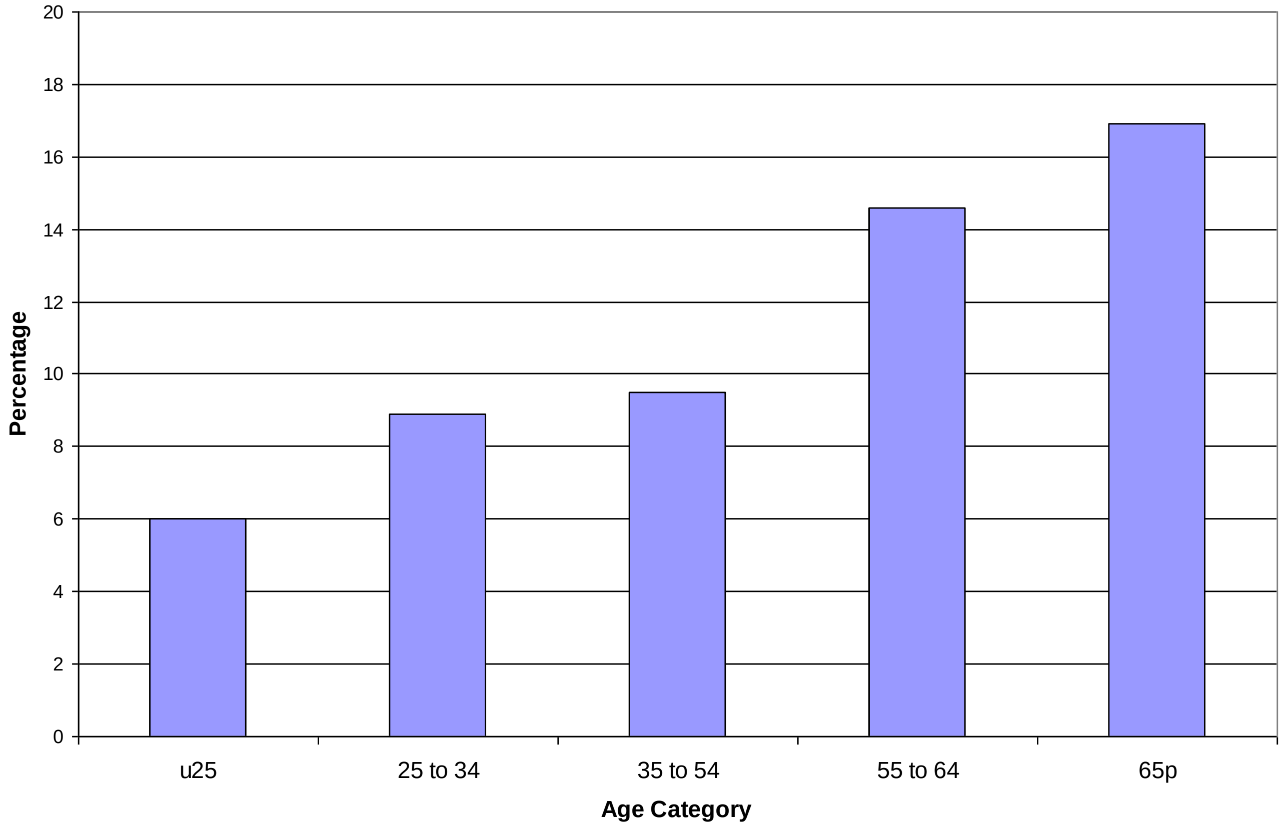
Propensity to Diversify in Labor Market Varies in Important Ways Across Worker Life Cycle

Percent of 1992 Wage and Salary Earners moving to Partial Self-Employment by 1997: By Age Category

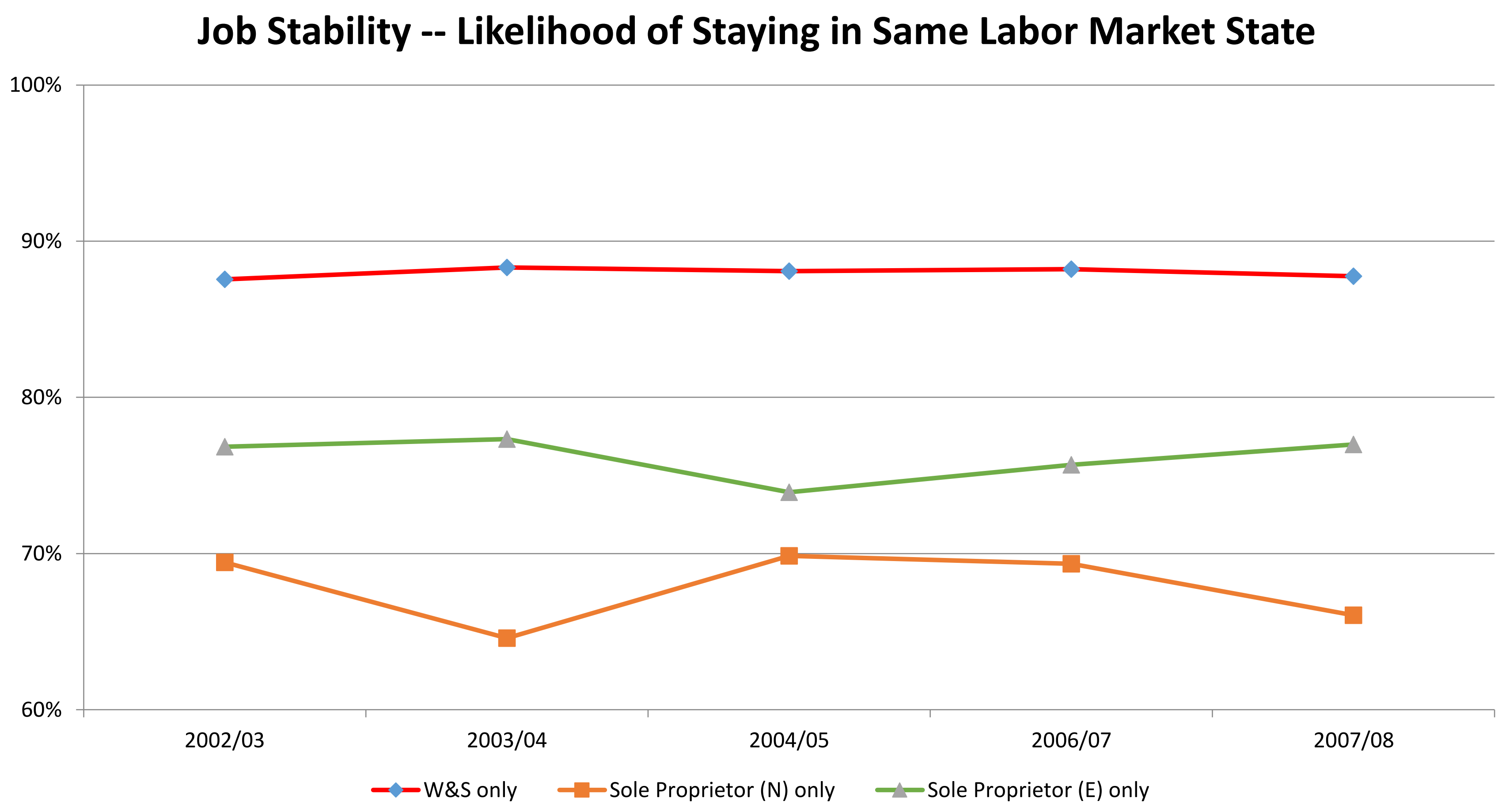


Propensity to Diversify in Labor Market Varies in Important Ways Across Worker Life Cycle

Percent of 1992 Partially Self-Employed moving to Full Self-Employment by 1997: By Age Category



Small Businesses With and Without Paid Employees Differ in Fundamental Ways



Data

- Tracking U.S. Business Dynamics
  - The Longitudinal Business Database
    - 1975-2005 (08) – long time series permits analysis by firm age
    - Private Non Farm Economy
    - Establishment level with Firm identifiers
    - High quality establishment links to identify entry/exit
      - Need both firm and establishment level data to get dynamics right
    - Firm Size: constructed by aggregating employment up to firm
    - Firm Age: constructed from age of oldest establishment at time of firm birth
    - Other: Payroll, Industry, Location (Lat/Lon possible)
    - Can be integrated with data from Economic Censuses and Annual Surveys as well as external data (COMPUSTAT, Venture Capital, Private Equity)

Micro Productivity Data in U.S.

- Manufacturing:
  - Annual Survey of Manufactures and Census of Manufactures
    - Nominal revenue and expenditures
    - Can construct measures of real outputs and inputs
    - Five year panel rotation so longitudinal analysis possible (but requires careful treatment of data)
    - Selected products have physical quantities
- Retail Trade
  - Census of Retail Trade
    - Nominal revenue so a gross output per store measure feasible

New data on micro businesses

- ILBD:
  - Tracks all nonemployer and employer businesses including transitions
- LEHD:
  - Tracks all employer-employee matches in U.S.
  - Can be integrated with ILBD
  - Enables tracking of transitions between W&S, an owner of nonemployer business and owner of employer business

Availability of data

- Public domain tabulations available at:

http://www.ces.census.gov/index.php/bds/bds_home

- Census NSF/RDC access at:

http://www.ces.census.gov/index.php/ces/researchguidelines

- Sensitive data:
  - Must work in enclave (NBER, NYCRDC, Washington, D.C., Chicago Fed, Duke, UCLA, UC-Berkeley, Univ. of Michigan, Cornell, Stanford , Univ. of Minn., Atlanta, …)
  - Predominant purpose must benefit U.S. Census

Extra Slides on Firm Dynamics model

Standard Heterogeneous-Producer Industry Models

The Workhorse:

- Producers i differ in a profitability component ω_i, usually taken to represent costs/productivity
- Profits depend on ω_i and industry state S: $\pi_i = \pi_i(\omega_i, S) \quad \omega_i \sim G(\omega)$
- There is some critical ω^* such that producers with $\omega_i < \omega^*$ have NPVs below outside option and therefore exit the industry
- Industry state S typically depends on endogenously determined distribution of ω_i among producers (add'l free entry assumption)
- Examples: Jovanovic (1982), Hopenhayn (1992), Melitz (2003), Asplund and Nocke (2007)

Closely Related Issue – Size Distribution of Activity

- $\pi_i = \pi_i(\omega_i, S)$ has curvature either from decreasing returns (e.g., Lucas (1978)) or product differentiation (e.g., Melitz (2003))
- Curvature pins down the size distribution of activity and permits studying the evolution of the size distribution of activity
- In healthy market economies, most productive plants are the largest – allocative efficiency
- Active literature attempting to explain cross country differences in productivity (e.g., Hsieh and Klenow (2009)) using distortions on this margin

Model: Melitz/Ottaviano (2005) and FHS (2008)

Industry is comprised of a continuum of producers of measure N.
Each produces a single variety (indexed by i) of industry product.
Representative consumer's utility function

$$U = y + \int_{i\in I} (\alpha + \delta_i) q_i di - \frac{1}{2}\eta\left(\int_{i\in I} q_i di\right)^2 - \frac{1}{2}\gamma \int_{i\in I} q_i^2 di$$

$$= y + \alpha \int_{i\in I} q_i di - \frac{1}{2}\left(\eta + \frac{\gamma}{N}\right)\left(\int_{i\in I} q_i di\right)^2 + \int_{i\in I} \delta_i q_i di - \frac{1}{2}\gamma \int_{i\in I} (q_i - \overline{q})^2 di$$

$\alpha > 0$, $\eta > 0$, and $\gamma \geq 0$.
y = numeraire good
δ_i = variety-specific, mean-zero taste shifter
q_i = quantity of good i consumed

$$\overline{q} = \frac{1}{N} \int_{i\in I} q_i di$$

The implied demand curve:

$$q_i = \frac{1}{\eta N + \gamma}\alpha - \frac{1}{\gamma}\frac{\eta N}{\eta N + \gamma}\overline{\delta} + \frac{1}{\gamma}\frac{\eta N}{\eta N + \gamma}\overline{p} + \frac{1}{\gamma}\delta_i - \frac{1}{\gamma} p_i$$

Model: Supply

Production Function: $q_i = \omega_i x_i$

Producers face (potentially idiosyncratic) factor price w_i

$\Rightarrow$ marginal cost = w_i/ω_i

Profits:

$$\pi_i = \left(\frac{1}{\eta N + \gamma}\alpha - \frac{1}{\gamma}\frac{\eta N}{\eta N + \gamma}\bar{\delta} + \frac{1}{\gamma}\frac{\eta N}{\eta N + \gamma}\bar{p} + \frac{1}{\gamma}\delta_i - \frac{1}{\gamma}p_i \right)\left(p_i - \frac{w_i}{\omega_i} \right)$$

Profit-maximizing price (constant marginal cost c_i):

$$p_i = \frac{1}{2}\frac{\gamma}{\eta N + \gamma}\alpha - \frac{1}{2}\frac{\eta N}{\eta N + \gamma}\bar{\delta} + \frac{1}{2}\frac{\eta N}{\eta N + \gamma}\bar{p} + \frac{1}{2}\delta_i + \frac{1}{2}\frac{w_i}{\omega_i}$$

Deviation from industry-average price:

$$p_i - \bar{p} = \frac{1}{2}\left(\delta_i - \bar{\delta}\right) + \frac{1}{2}\left(\frac{w_i}{\omega_i} - \overline{\left(\frac{w}{\omega}\right)} \right)$$

Maximized profits:

$$\pi_i = \frac{1}{4\gamma}\left(\frac{\gamma}{\eta N + \gamma}\alpha - \frac{\eta N}{\eta N + \gamma}\bar{\delta} + \frac{\eta N}{\eta N + \gamma}\bar{p} + \delta_i - \frac{w_i}{\omega_i} \right)^2$$

Model: Equilibrium

Equilibrium Condition 1: The marginal producer in the industry makes zero profits

Define "profitability index" $\phi_i \equiv \delta_i - \frac{w_i}{\omega_i}$. Then marginal producer has index equal to:

$$\phi^* = -\frac{\gamma}{\eta N + \gamma}\alpha + \frac{\eta N}{\eta N + \gamma}\bar{\delta} - \frac{\eta N}{\eta N + \gamma}\bar{p}$$

Profits can be rewritten in terms of this marginal profitability level

$$\pi_i = \frac{1}{4\gamma}(\phi_i - \phi^*)^2$$

Profits increase in demand (δ_i) and efficiency (ω_i), decrease in factor price (w_i)

Equilibrium Condition 2: Potential entrants decide whether to pay sunk entry cost s to learn δ_i, ω_i, w_i. Expected value of entry is 0.

$$V^e = \int_0^{w_u}\int_{\omega_l}^{\omega_u}\int_{\phi^* + \frac{w}{\omega}}^{\delta_e} \frac{1}{4\gamma}(\phi_i - \phi^*)^2 f(\delta, \omega, w)\, d\delta\, d\omega\, dw - s = 0$$

Selection effect:

- Only high-profitability producers operate in equilibrium
- Low types exit

Sunk costs, market power and dispersion:

- Sunk costs make entry costly
- Curvature yields equilibrium size distribution

Many models of selection also include fixed costs of operating each period

Model: Empirical Implications

Output-based productivity:

$$TFPQ_i = \frac{q_i}{x_i} = \frac{\omega_i x_i}{x_i} = \omega_i$$

Revenue-based productivity (literature standard):

$$TFPR_i = \frac{p_i q_i}{x_i} = p_i \omega_i = \frac{1}{2}\frac{\gamma\alpha}{\eta N + \gamma}\omega_i + \frac{1}{2}\frac{\eta N}{\eta N + \gamma}\left(\overline{p} - \overline{\delta}\right)\omega_i + \frac{1}{2}\delta_i \omega_i + \frac{1}{2} w_i$$

Plant price deviation from industry deflator depends on both demand (enters positively into profits) and costs (enter negatively):

$$p_i - \overline{p} = \frac{1}{2}\left(\delta_i - \overline{\delta}\right) + \frac{1}{2}\left(\frac{w_i}{\omega_i} - \overline{\left(\frac{w}{\omega}\right)}\right)$$

Comparative Statics:

- $\frac{d\phi^*}{d\gamma} < 0$: Lower substitutability (higher γ) lowers ϕ^*
- $\frac{d\phi^*}{ds} < 0$: Higher sunk entry cost lowers ϕ^*

Start with Foster, Haltiwanger and Syverson (2008)

- Source data: Census of Manufactures
  - High quality coverage
  - Limited number of products with physical quantity data

Correlations								
Variables	Trad'l. Output	Revenue Output	Physical Output	Price	Trad'l. TFP	Revenue TFP	Physical TFP	Capital
Traditional Output	1.00							
Revenue Output	0.99	1.00						
Physical Output	0.98	0.99	1.00					
Price	-0.03	-0.03	-0.19	1.00				
Traditional TFP	0.19	0.18	0.15	0.13	1.00			
Revenue TFP	0.17	0.21	0.18	0.16	0.86	1.00		
Physical TFP	0.17	0.20	0.28	-0.54	0.64	0.75	1.00	
Capital	0.86	0.85	0.84	-0.04	0.00	-0.00	0.03	1.00
Standard Deviations								
Standard Deviations	1.03	1.03	1.05	0.18	0.21	0.22	0.26	1.14

Measuring Plant-Level Demand

Estimate product demand curves; plant-specific residual is idio. demand

$$\ln q_{it} = \alpha_o + \alpha_1 \ln p_{it} + \alpha_2 \ln(INCOME_{mt}) + \sum_t \alpha_t YEAR_t + \eta_{it}$$

q_{it}—physical output of plant i in year t
p_{it}—plant unit price
$INCOME_{mt}$—average income in the plant's local market m
$YEAR_t$—year dummy
η_{it}—plant-year disturbance term

Plant demand:

$$\hat{\delta}_{it} = \hat{\eta}_{it} + \hat{\alpha}_2 \ln(INCOME_{mt}) = \ln q_{it} - \hat{\alpha}_o - \hat{\alpha}_1 \ln p_{it} - \sum_t \hat{\alpha}_t YEAR_t$$

I.e., residual is plant quantity sold that can't be accounted for by unit price or local income differences

- Use $TFPQ_{it}$ to instrument for prices (captures production costs)

	IV Estimation			OLS Estimation	
Product	Price Coefficient (α_1)		Income Coefficient (α_2)	Price Coefficient (α_1)	Income Coefficient (α_2)
Boxes	-3.02		-0.03	-2.19	-0.03
	0.17	[0.61]	*0.02*	*0.12*	*0.02*
Bread	-3.09		0.12	-0.89	0.07
	0.42	[0.33]	*0.05*	*0.15*	*0.04*
Carbon Black	-0.52		-0.21	-0.57	-0.21
	0.38	[0.50]	*0.11*	*0.21*	*0.11*
Coffee	-3.63		0.22	-1.03	0.20
	0.98	[0.41]	*0.14*	*0.32*	*0.13*
Concrete	-5.93		0.13	-0.83	0.15
	0.36	[0.10]	*0.01*	*0.09*	*0.01*
Hardwood Flooring	-1.67		-0.20	-0.87	-0.24
	0.48	[0.61]	*0.18*	*0.47*	*0.18*
Gasoline	-1.42		0.23	-0.16	0.23
	2.72	[0.20]	*0.07*	*0.80*	*0.07*
Block Ice	-2.05		0.00	-0.63	0.16
	0.46	[0.32]	*0.11*	*0.20*	*0.07*
Processed Ice	-1.48		0.18	-0.70	0.16
	0.27	[0.37]	*0.03*	*0.13*	*0.03*
Plywood	-1.21		-0.23	-1.19	-0.23
	0.14	[0.89]	*0.10*	*0.13*	*0.10*
Sugar	-2.52		0.76	-1.04	0.72
	1.01	[0.15]	*0.13*	*0.55*	*0.12*

	Five-Year Horizon		Implied One-Year Persistence Rates	
Dependent Variable	Unweighted Regression	Weighted Regression	Unweighted Regression	Weighted Regression
Traditional TFP	0.249 *0.017*	0.316 *0.042*	0.757	0.794
Revenue TFP	0.277 *0.021*	0.316 *0.042*	0.774	0.794
Physical TFP	0.312 *0.019*	0.358 *0.049*	0.792	0.814
Price	0.365 *0.025*	0.384 *0.066*	0.817	0.826
Demand Shock	0.619 *0.013*	0.843 *0.021*	0.909	0.966

Variable	Plant Age Dummies			
	Exit	Entry	Young	Medium
Unweighted Regressions				
Traditional TFP	-0.0211	0.0044	0.0074	0.0061
	0.0042	*0.0044*	*0.0048*	*0.0048*
Revenue TFP	-0.0220	0.0133	0.0075	0.0028
	0.0044	*0.0047*	*0.0051*	*0.0053*
Physical TFP	-0.0186	0.0128	0.0046	-0.0039
	0.0050	*0.0053*	*0.0058*	*0.0062*
Price	-0.0034	0.0005	0.0029	0.0067
	0.0031	*0.0034*	*0.0038*	*0.0042*
Demand Shock	-0.3466	-0.5557	-0.3985	-0.3183
	0.0227	*0.0264*	*0.0263*	*0.0267*

Determinants of Market Selection

Specification:	[1]	[2]	[3]	[4]	[5]	[6]	[7]
Traditional TFP	-0.073						
	0.015						
Revenue TFP		-0.063					
		0.014					
Physical TFP			-0.040			-0.062	-0.034
			0.012			*0.014*	*0.012*
Prices				-0.021		-0.069	
				0.018		*0.021*	
Demand Shock					-0.047		-0.047
					0.003		*0.003*

Note: Much greater dispersion in demand shocks than physical TFP

Establishment-level Productivity Empirical Patterns

- Dispersion (large), persistence (high) evolution (consistent with learning and selection)
- Selection
  - Lower productivity plants exit
  - Other determinants of productivity matter
  - Open questions: Impact of distortions on selection?
    - Models like Melitz (2003) and Restuccia and Rogerson (2007) imply reduced distortions will improve selection
    - Eslava et. al. (2009) find evidence that trade liberalization improves market selection
- These patterns both support basic models and can be used to test and estimate models
- One other approach has to been to explore the covariance between size and productivity within industries.
  - Basic prediction of virtually all models is positive correlation between size and profitability/productivity

Within Industry Dynamic Decomposition Applied to FHS (2008) data

		Components of Decomposition (GR)				
		Within	Between	Entry	Exit	Net Entry
Traditional	2.30	1.40	0.18	0.44	0.27	0.72
Revenue	5.13	4.03	0.16	0.55	0.39	0.94
Physical	5.13	3.82	-0.05	1.04	0.32	1.36

Extra Slides

Growth Identities: Establishment

$$g_{it} = (E_{it} - E_{it-1}) / X_{it}$$

where

$$X_{it} = .5 * (E_{it} + E_{it-1})$$

Then

$$JC_{it} = \max(g_{it}, 0)$$

$$JD_{it} = \max(-g_{it}, 0)$$

From Entry/Exit

$$JC_{it} = \max(g_{it}, 0) * I\{g_{it} = 2\}$$

$$JD_{it} = \max(-g_{it}, 0) * I\{-g_{it} = 2\}$$

Growth Identities: Aggregate Measures (any level)

$$JC_t = \sum_i (X_{it} / X_t) \max\{g_{it}, 0\} \qquad JD_t = \sum_i (X_{it} / X_t) \max\{-g_{it}, 0\}$$

$$JC\_Entry_t = \sum_i (X_{it} / X_t) I\{g_{it} = 2\} \max(g_{it}, 0)$$

$$JD\_Exit_t = \sum_i (X_{it} / X_t) I\{g_{it} = -2\} \max(-g_{it}, 0)$$

$$g_t = JC_t - JD_t$$

$$JC_t = JC\_Cont_t + JC\_Entry_t$$

$$JD_t = JD\_Cont_t + JD\_Exit_t$$