Firm Dynamics, Uncertainty and Business Cycles

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Riskiness, Endogenous Productivity Dispersion and Business Cycles

Motivation

Fact: Cross-sectional productivity dispersion is significantly countercyclical.

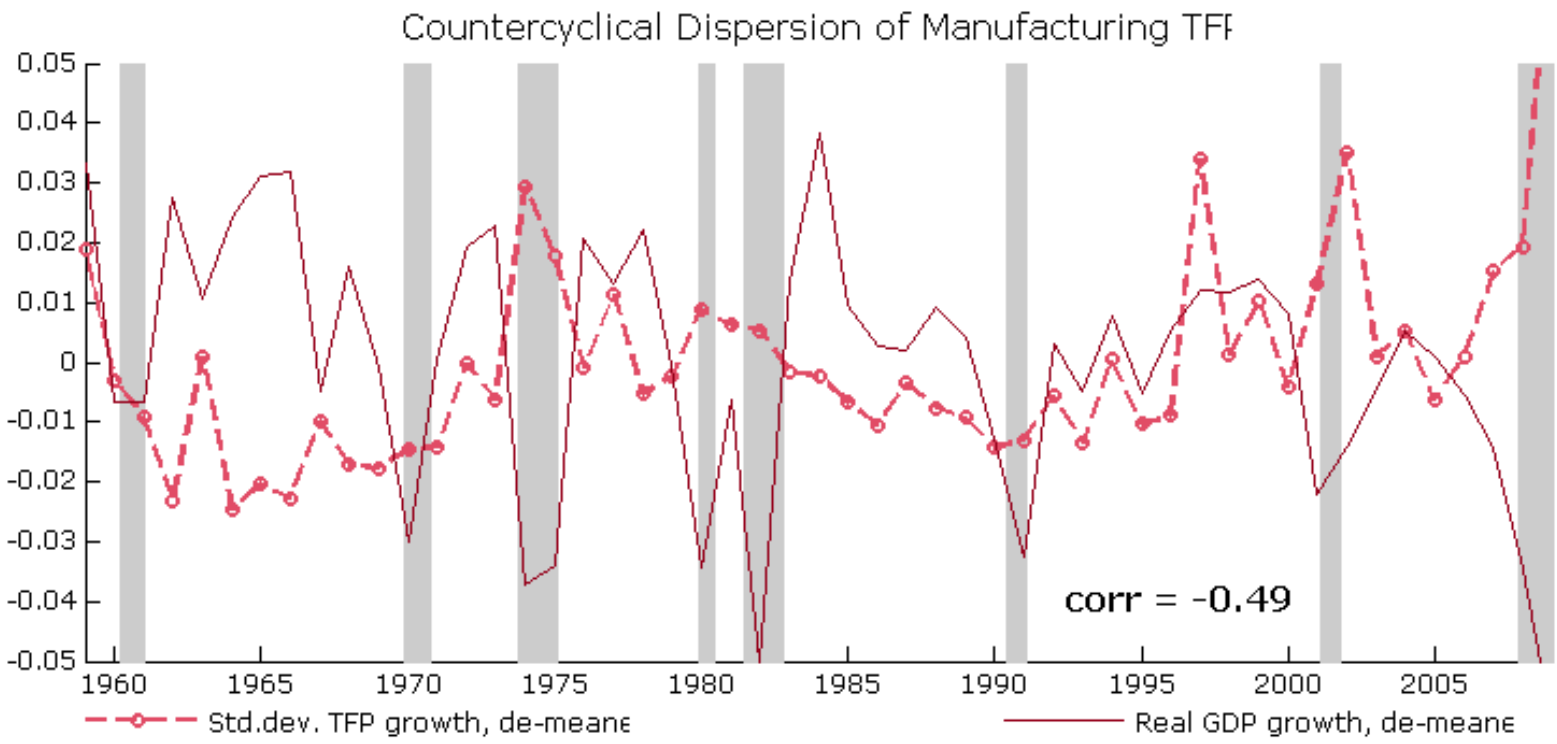


Figure : Countercyclical Dispersion in Productivity at Industry Level. Calculated using CES Manufacturing Industry Productivity Database.

More evidence... Estab Estab Firm All

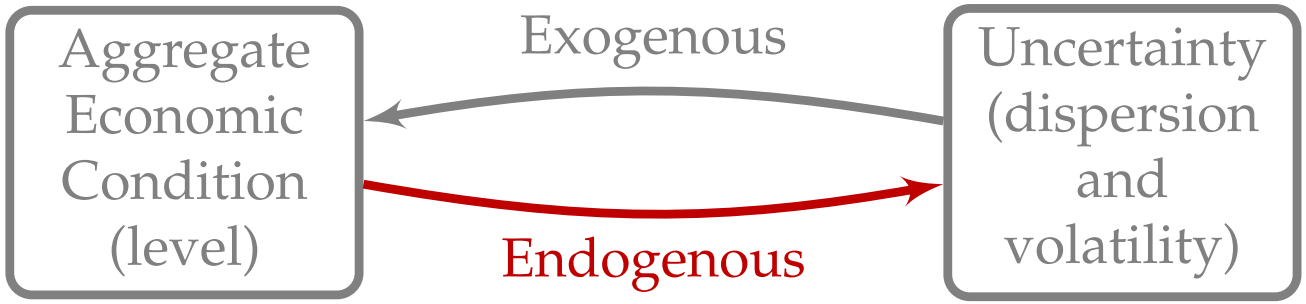
Motivation

So the question is:

What causes this countercyclicality?

Existing theories:

- "*Exogenous* uncertainty hypothesis"
  - Real option, "wait-and-see". Bloom (2009), Bloom et al. (2012)
  - Financial frictions. Arellano et al. (2010), Gilchrist et al. (2014), Christiano et al. (2014), Di Tella (2012).



- "*Endogenous* dispersion hypothesis"
  - Van Nieuwerburgh and Veldkamp (2006), Bachmann and Moscarini (2012), Decker et al. (2014).

Motivation

Evidence?

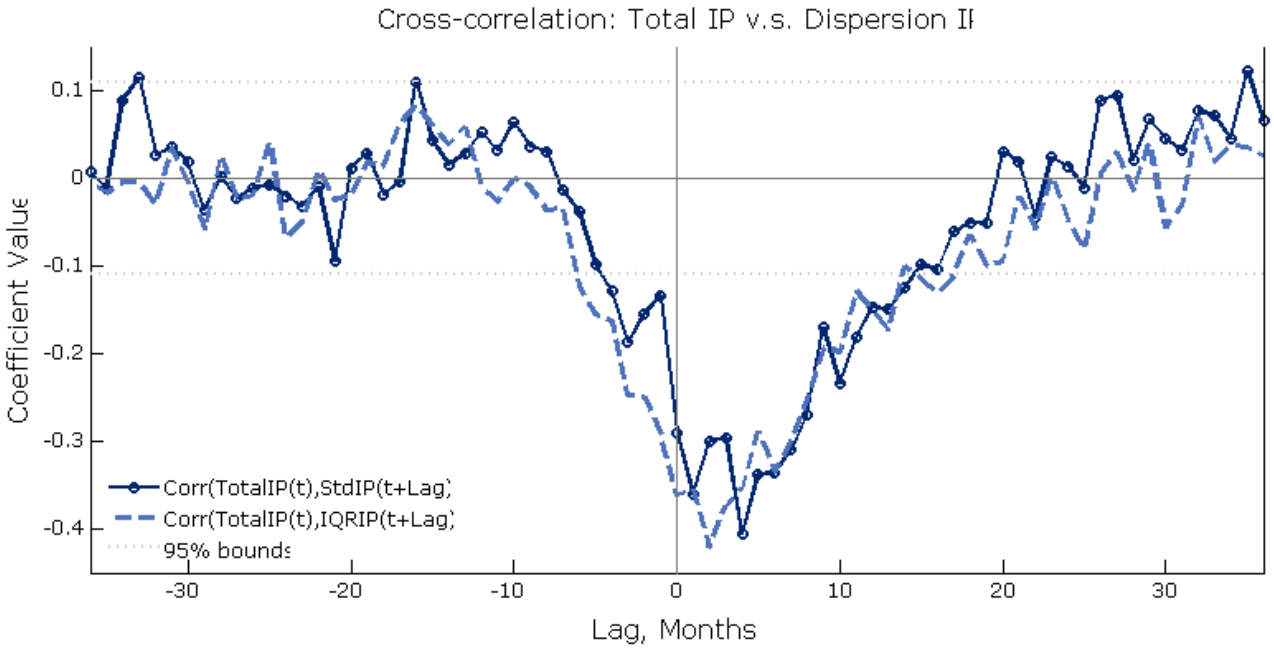


Figure : Level seems to lead dispersion: calculated using Industrial Production indices (1986-2013, monthly) from Fed Board.

Related evidence:

- Bachmann and Bayer (2013), Bachmann et al. (2013), Baker and Bloom (2013), Komaromi (2014), Chugh (2013).

Motivation

Also...

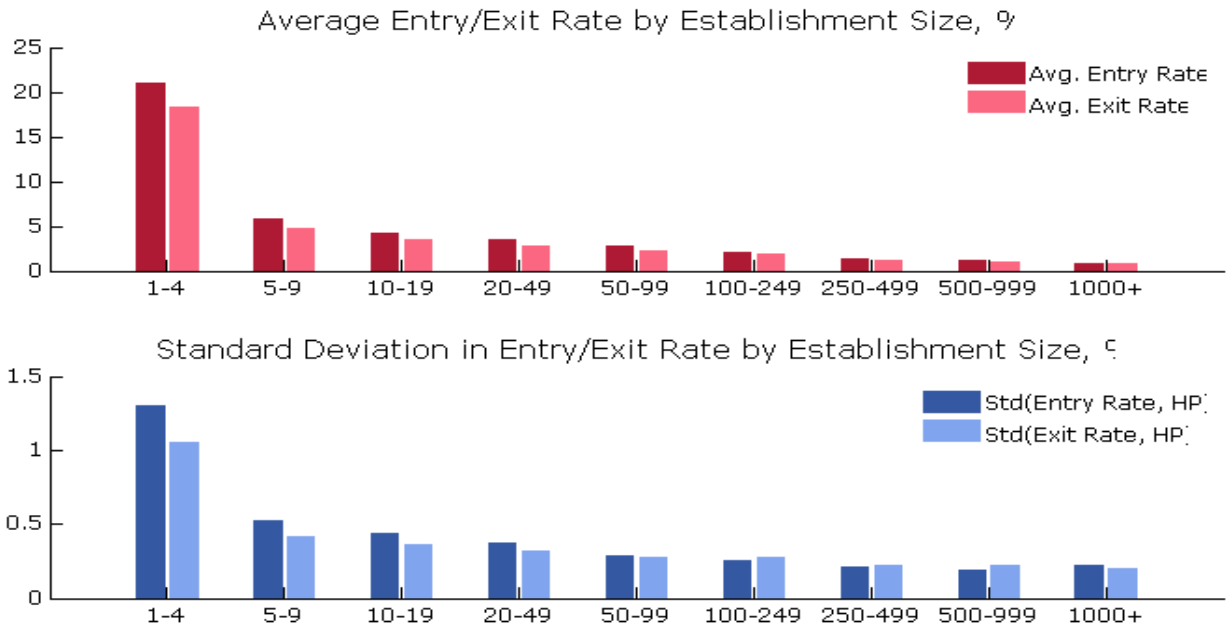


Figure : Establishment Entry and Exit Activity Decrease in Size in U.S.. Calculated using data from Business Dynamic Statistics (1977-2012, annually).

Entry/Exit patterns: Campbell (1998), Samaniego (2008), Lee and Mukoyama (2015), Clementi and Palazzo (forthcoming). Additional literature: Here

Overview: What I do

- Attempt to provide an explanation of the countercyclicality and to complement existing theories.
  - Heterogeneous-firm model derived from Hopenhayn (1992).
  - Aggregate and idiosyncratic fluctuations.
  - Endogenous entry and exit choice of firms.
  - Firms accumulate capital to produce.
  - Endogenous choice of riskiness level in contemporaneous productivity.

Road Map

- A Simple Model
  – three periods, to get analytical solutions to highlight the mechanism
- The Quantitative Model
  – infinite periods, for computation and simulation
- Calibration
- Quantitative Results

A Simple Model

- A simplified version of the quantitative model.
- Analytical solutions.
- To highlight the mechanism.

A Simple Model: Setup

A simplified three-period model to illustrate the mechanism...

- $t = 0, 1, 2$.
- Discount rate $\frac{1}{R}$.
- One good: capital and output
- A continuum of *risk-neutral* potential firms, each draws initial capital $k_0 \in [0, \bar{k}]$ and individual productivity component $z \in [\underline{z}, \bar{z}]$ at $t = 0$

$$k_0 \sim G^k(k_0) \text{ and } z \sim G^z(z)$$

- A constant common productivity component: $A > 0$
- Value of exiting and not entering: $V^0 > 0$
- Full depreciation of capital
- Internal financing only

A Simple Model: Setup

- Each firm can choose from two projects at $t = 0, 1$

$$p_t \in \{p, 1\} \text{ where } p \in (0, 1)$$

- Production outcome

$$y_{t+1} = AzB(p_t)k_t^{\alpha}, \alpha \in (0, 1)$$

where

$$B(p_t) = \begin{cases} 1/p_t & \text{w.p. } p_t, \quad \text{success,} \\ 0 & \text{w.p. } 1 - p_t, \quad \text{failure.} \end{cases}$$

- Same expected output: $\mathbb{E}(B(p_t)) = 1$
- Different levels of riskiness: $\sigma(B(p_t)) = \sqrt{\frac{1-p_t}{p_t}}$
  - Safe project: $p_t = 1$
  - Risky project: $p_t = p$

A Simple Model: Timing

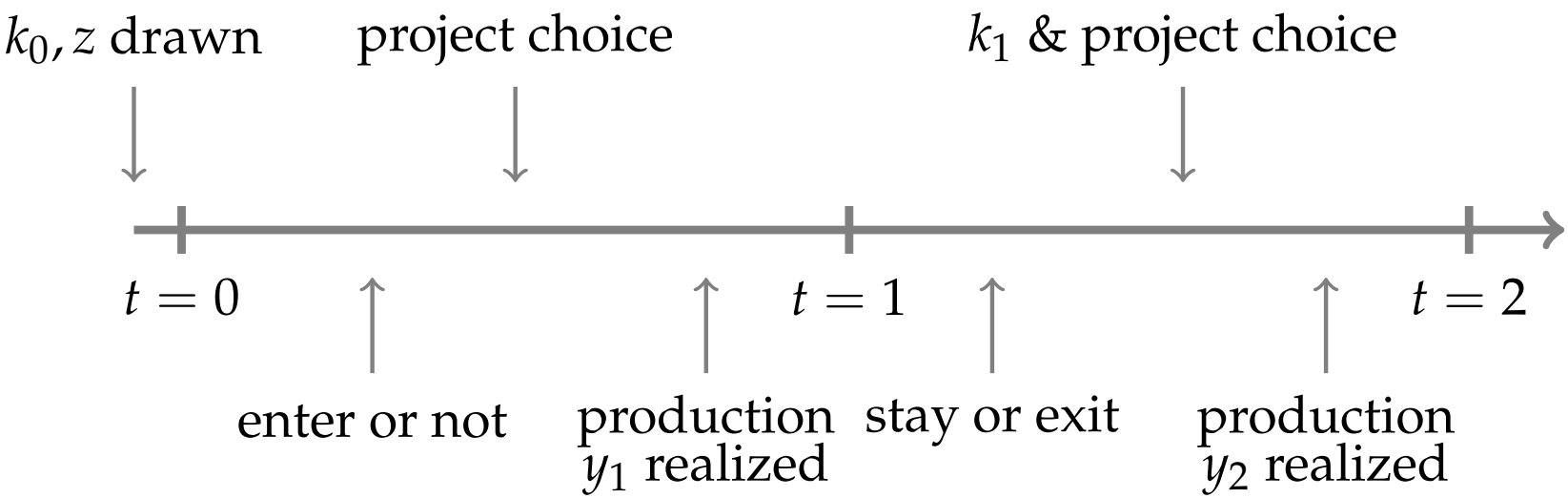


Figure : Timing of the Simple Model

A Simple Model: Analysis

- $t = 1$, choice between exiting or not

$$V_1(y_1, Az) = \max\{V^0, \overbrace{\max_{k_1 \leq y_1}\{y_1 - k_1 + \frac{1}{R} \underbrace{Azk_1^{\alpha}}_{V_2(Azk_1^{\alpha}, Az)}\}}^{V_1^{Stay}(y_1, Az)}\}$$

- $t = 0$, entering decision followed by project choice

$$V_0(k_0, Az) = \max\{V_0^{Enter}(k_0, Az), V^0\}, \text{ where}$$

$$V_0^{Enter}(k_0, Az) = \frac{1}{R} \max_{p_0 \in \{p,1\}} \{\underbrace{p_0 V_1\left(\frac{Az}{p_0} k_0^{\alpha}, Az\right)}_{success} + \underbrace{(1 - p_0) V_1(0, Az)}_{failure}\}$$

A Simple Model: Analysis

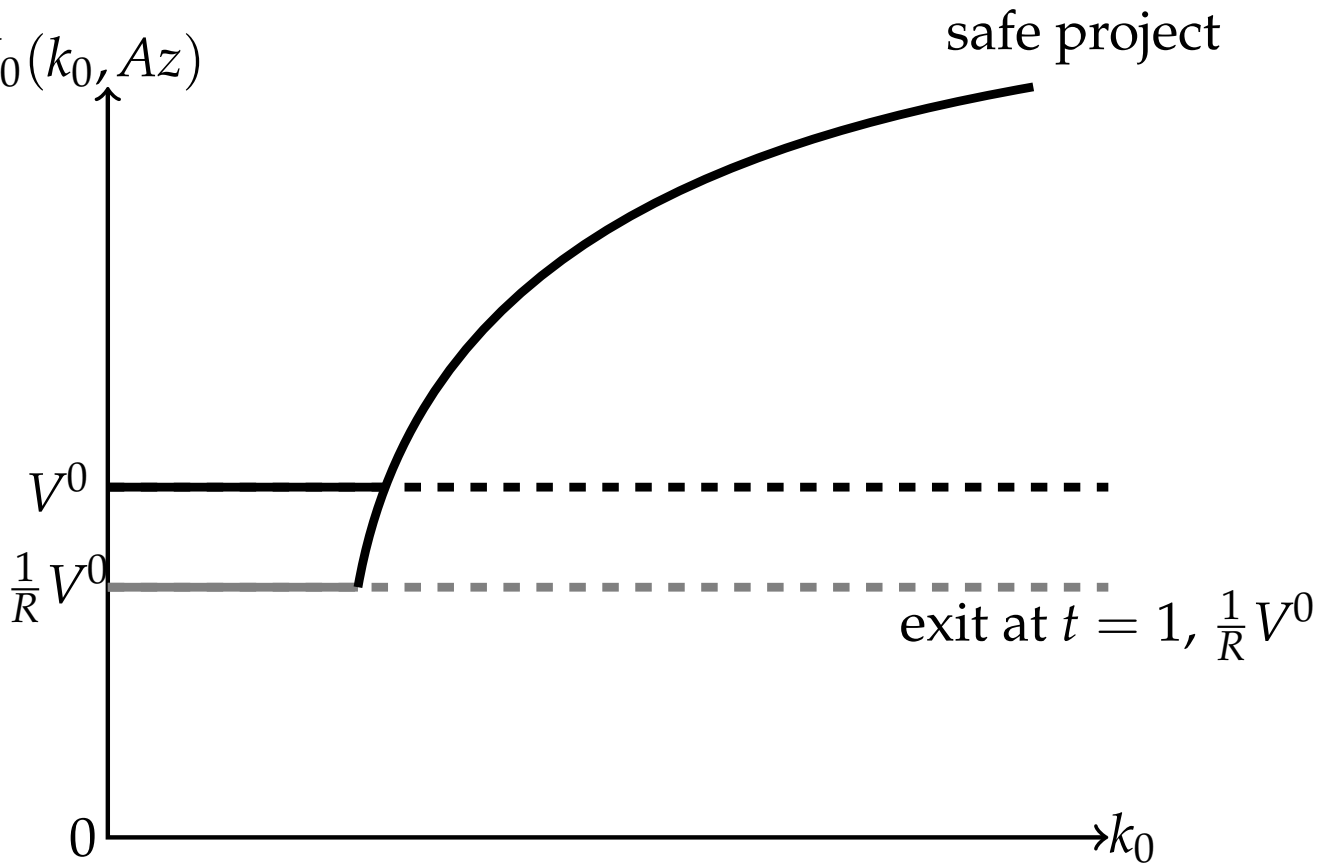


Figure : Value Function $V_0(k_0, Az)$ with fixed A, z, p.

Formally: Proposition.

A Simple Model: Analysis

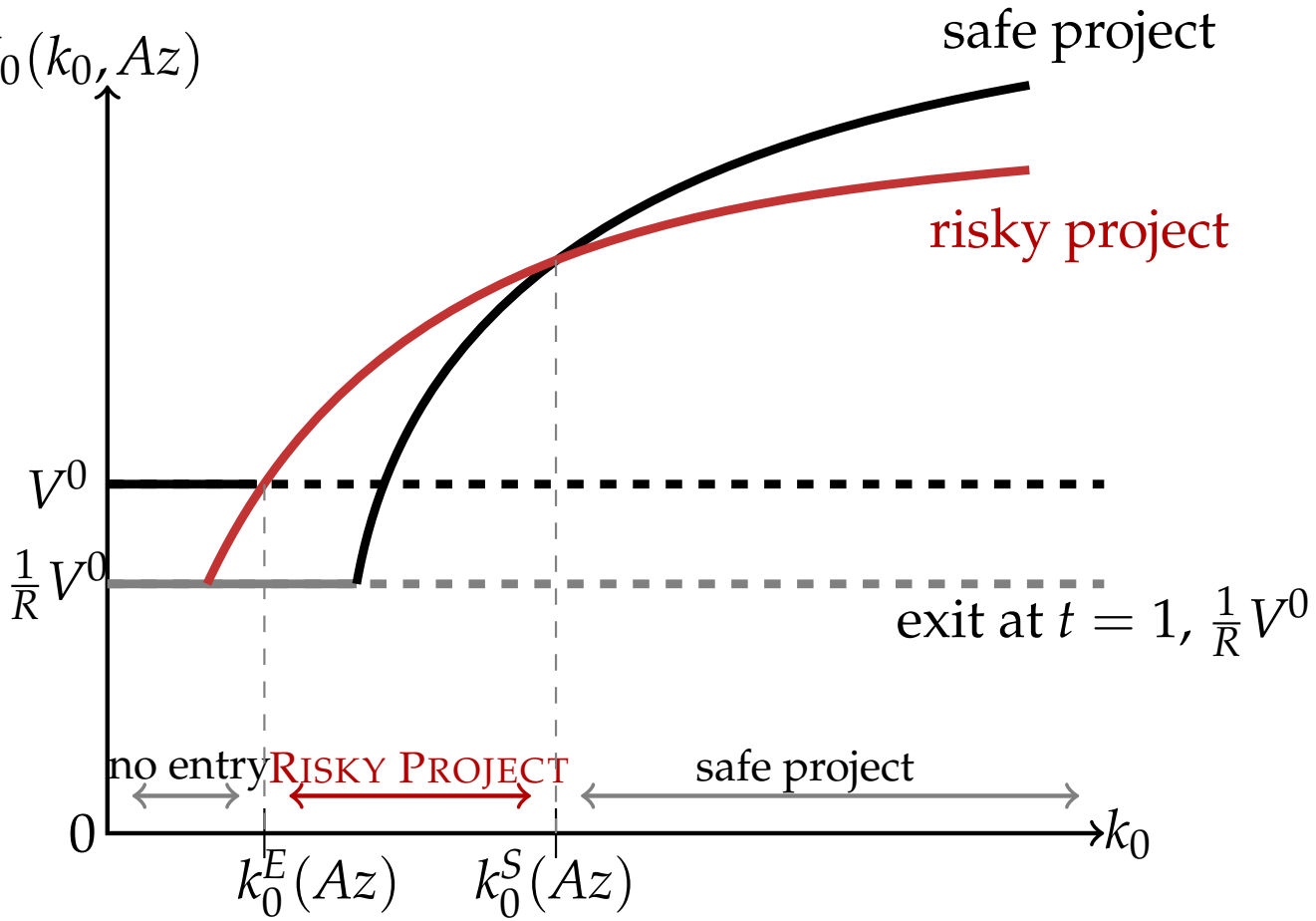


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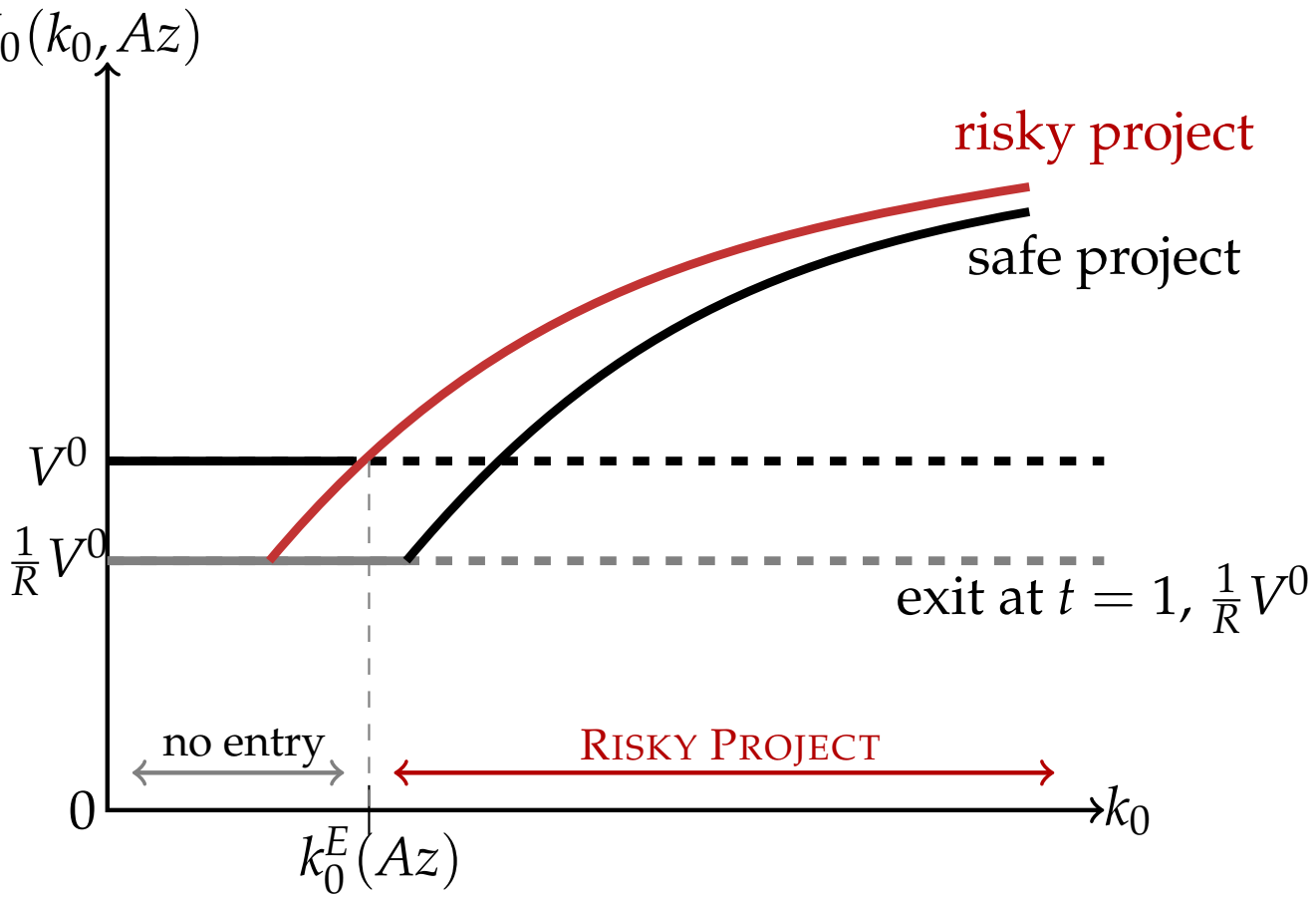


Figure : Value Function $V_0(k_0, Az)$ with fixed A, z, p.

Formally: Proposition.

A Simple Model: Comparative Statics

Proposition

The thresholds $k_0^E(Az)$ and $y_1^*(Az)$ are decreasing in Az, and so is $k_0^S(Az)$ when it exists. In addition, $k_0^S(Az) - k_0^E(Az)$ is also decreasing in Az when it exists.

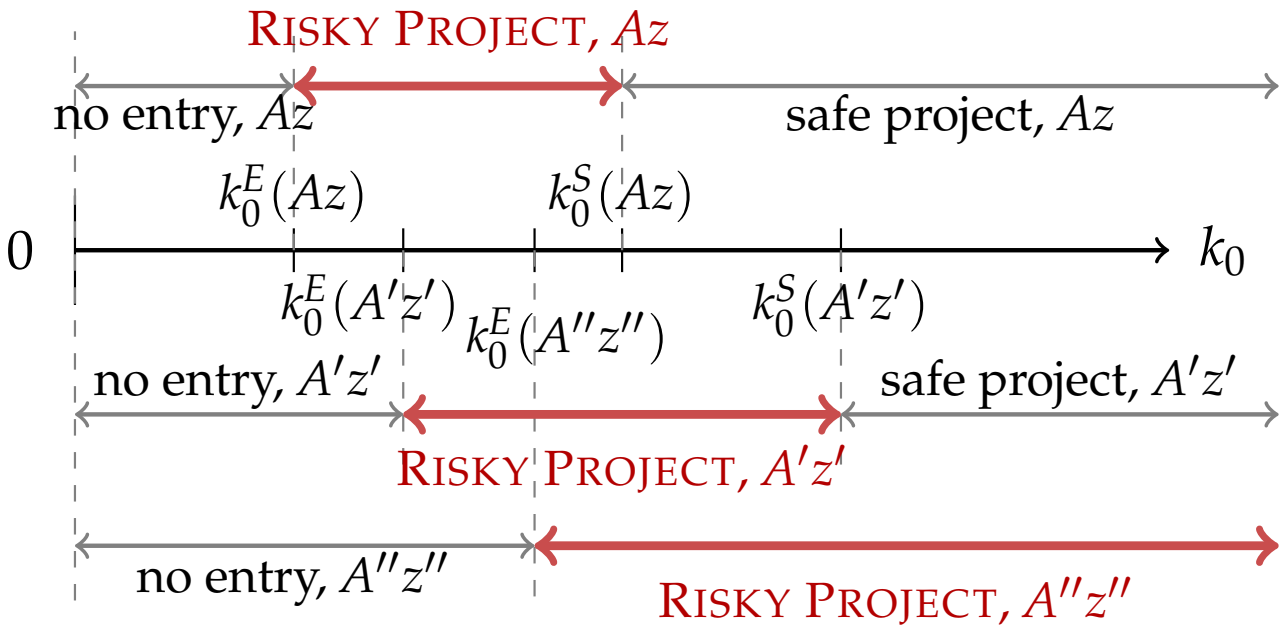


Figure : Change in entry threshold and risky region, $A''z'' < A'z' < Az$.

A Simple Model: Summary of Mechanism



- The same mechanism of the infinite-period quantitative model.
- Implications
  - Productivity dispersion and risk-taking increase in recessions
  - Differences in firm dynamics and risk-taking by size groups
    - Cross-sectional
    - Over-time
  - Fewer entrants and more exits in recessions

The Quantitative Model

- What remains:
  - Investment and riskiness choice each period
- What changes:
  - Infinite horizon
  - Aggregate and idiosyncratic fluctuations
  - Capital accumulation
  - Costly production, capital adjustment, and entry
  - Capital-dependent exiting value

Quantitative Model: Setup

- Infinite horizon $t = 0, 1, ...$
- Capital depreciates at rate $\delta > 0$
- At each t, each surviving firm chooses $p_t \in [\underline{p}, 1]$ and k_t simultaneously, so that the end-of-period revenue is:

$$y_t = A_t z_t B(p_t) k_t^{\alpha}, \text{ where } B(p_t) = \begin{cases} 1/p_t & \text{w.p. } p_t, \\ 0 & \text{w.p. } 1 - p_t. \end{cases}$$

  - $\mathbb{E}(B(p_t)) = 1, \sigma(B(p_t)) = \sqrt{(1-p_t)/p_t}$
  - For $p_t < p_t' \in [\underline{p}, 1]$, $B(p_t)$ is a mean-preserving spread of $B(p_t')$
  - Productivity dispersion at t: realized cross-sectional SD of $z_t B(p_t)$
- Production is costly
  - Fixed operating cost: $c_f > 0$
  - Partial irreversibility of capital: $\theta \in (0, 1)$

Quantitative Model: Setup

- Aggregate productivity A_t and idiosyncratic productivity z_t:

$$\begin{aligned} \ln A_t &= \rho_A \ln A_{t-1} + \sigma_A u_t^A, \quad & u_t^A &\sim N\left(-\sigma_A(1-\rho_A)/2, 1\right), \\ \ln z_t &= \rho_z \ln z_{t-1} + \sigma_z u_t^z, & u_t^z &\sim N\left(-\sigma_z(1-\rho_z)/2, 1\right). \end{aligned}$$

  Discretized a la Tauchen (1986) for computation.
- A constant mass $M > 0$ of potential entrant firms every period
- Each potential entrant draws $k_0 \sim G^k(k_0)$ and its initial $z_t \sim G^z(z_t)$
  - $G^k(k_0)$ and $G^z(z_t)$ are time-invariant
  - $G^k(\cdot)$ is Pareto with exponent ξ
  - $G^z(\cdot)$ is the stationary distribution of z_t,

$$\ln z_t \sim N\left(-\frac{1}{2}\frac{\sigma_z^2}{1-\rho_z^2}, \frac{\sigma_z^2}{1-\rho_z^2}\right)$$

- Each entering firm pays a setup cost: $c_e > 0$

Quantitative Model: Timing

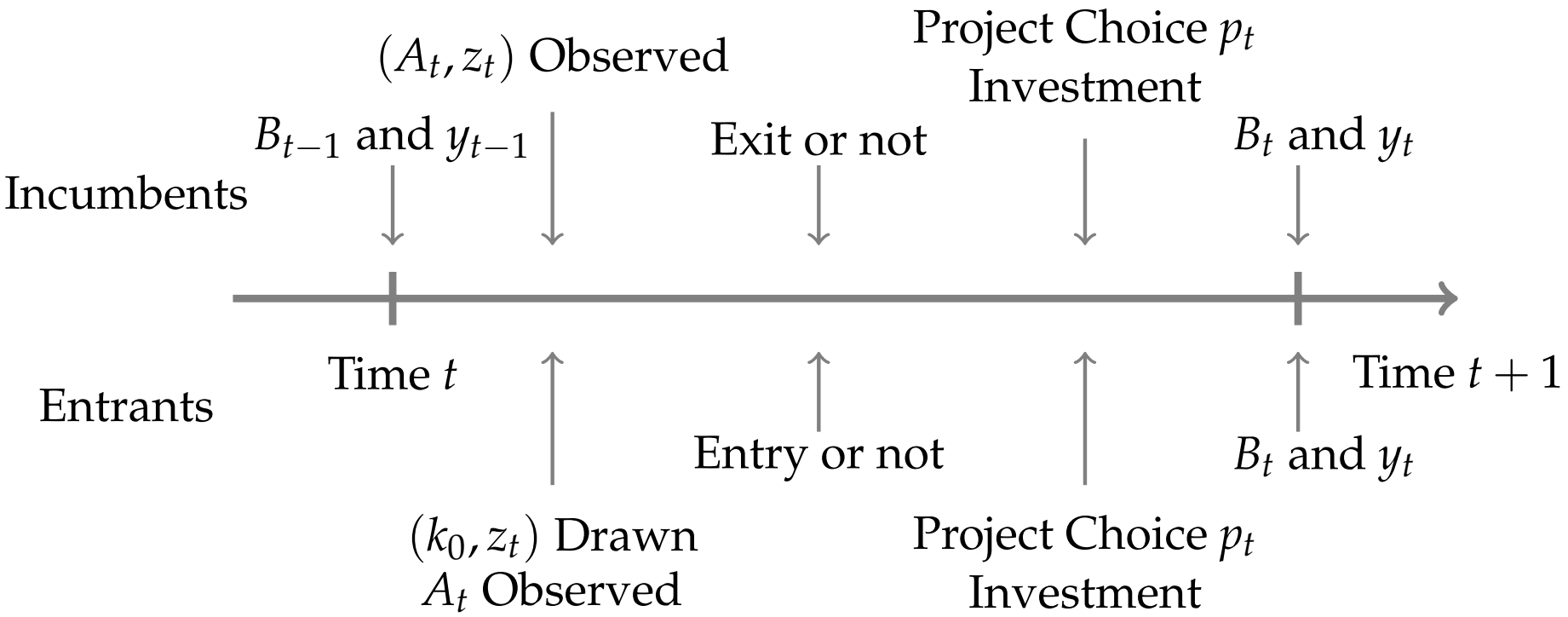


Figure : Timing of the Quantitative Model

Quantitative Model: Environment Summary

- Aggregate and idiosyncratic fluctuations.
- Heterogeneous firms, each *incumbent* characterized by

$$(Z_{t-1}, k_{t-1}, A_t, z_t)\,, \text{ where } Z_{t-1} = A_{t-1} z_{t-1} B(p_{t-1}) \in \left\{ \frac{A_{t-1} z_{t-1}}{p_{t-1}}, 0 \right\}$$

  at the beginning of time t, and each *potential entrant* by

$$(k_0, A_t, z_t)$$

- The distribution of firms evolves every period
- To reduce computation difficulty, focus on the aggregation of individual decisions
  - Resale price θ is time-invariant.
  - No need to include the distribution of firms, an infinite-dimension object, as state variables. No need to forecast future distributions.

Individual Decisions: An Incumbent

- Stay or exit

$$V\left(Z_{t-1}, k_{t-1}, A_t, z_t\right) = \max\left\{V^{Stay}(Z_{t-1}, k_{t-1}, A_t, z_t), V^X(Z_{t-1}, k_{t-1})\right\}$$

- Option value of exiting

$$V^X\left(Z_{t-1}, k_{t-1}\right) = \theta\left(Z_{t-1}k_{t-1}^{\alpha} + (1-\delta)k_{t-1}\right)$$

- Value of staying

$$V^{Stay}(Z_{t-1}, k_{t-1}, A_t, z_t)$$

$$= \max_{p_t \in [\underline{p}, 1], i_t} \left\{ \begin{array}{l} \underbrace{D(i_t; Z_{t-1}, k_{t-1})}_{\text{flow profit}} \\ + \frac{1}{R}\mathbb{E}^{p_t}\mathbb{E}^{A_{t+1}, z_{t+1}}\left[V(Z_t(p_t), k_t, A_{t+1}, z_{t+1}) | A_t, z_t\right], \end{array} \right\}$$

such that...

Individual Decisions: An Incumbent

- Time t operating profit

$$D(i_t; Z_{t-1}, k_{t-1}) = \begin{cases} Z_{t-1}k_{t-1}^{\alpha} - \theta i_t - c_f & \text{if } i_t < 0, \\ Z_{t-1}k_{t-1}^{\alpha} - i_t - c_f & \text{if } i_t \geq 0. \end{cases}$$

- Constraints faced by an incumbent

$$D(i_t; Z_{t-1}, k_{t-1}) \geq 0,\ k_t = (1-\delta)k_{t-1} + i_t \geq 0$$

- Expected future value

$$\mathbb{E}^{p_t}\mathbb{E}^{A_{t+1},z_{t+1}}\left[V(Z_t(p_t), k_t, A_{t+1}, z_{t+1})|A_t, z_t\right]$$

$$= \mathbb{E}^{A_{t+1},z_{t+1}}\left[\underbrace{p_t V\left(\frac{A_t z_t}{p_t}, k_t, A_{t+1}, z_{t+1}\right)}_{success} + \underbrace{(1-p_t)V(0, k_t, A_{t+1}, z_{t+1})}_{failure}\middle| A_t, z_t\right]$$

Individual Decisions: A Potential Entrant

- A time-t potential entrant with initial draw (k_0, z_t) and current-period A_t.
- Value of not entering

$$V_0^{Out}(k_0) = \theta k_0$$

- Value of entering

$$V_0^{Enter}(k_0, A_t, z_t) = V^{Stay}\left(0, \frac{k_0 - c_e}{1-\delta}, A_t, z_t\right)$$

- The firm enters if

$$V_0^{Enter}(k_0, A_t, z_t) > V_0^{Out}(k_0)$$

Calibration

- Two-stage calibration strategy
  - Stage I: simulation without aggregate fluctuation to find parameter values to match cross-sectional moments
  - Stage II: simulation with aggregate fluctuation to match aggregate time-series moments

Parameter Values

Table : Parameter Values

	Notation	Description	Value
Pre-determined	α	Capital scale	0.592
	R	Interest rate	1.04
	δ	Depreciation rate	0.1
	θ	Capital resale price	0.795
	M	Mass of potential entrants	100
	$\underline{p}$	Riskiness bound	0.5
	ρ_z	Persistence of idiosyncratic shock	0.885
Stage I	σ_z	Volatility of idiosyncratic shock	0.177
	$\mathbf{c_f}$	Fixed operating cost	4.0
	$\mathbf{c_e}$	Entry cost	10.8
	ξ	Pareto exponent	3.0
Stage II	ρ_A	Persistence of aggregate shock	0.95
	σ_A	Volatility of aggregate shock	0.0156

Targets

Table : Calibration Targets: Stationary

Statistic	Model	Data
Average investment rate	0.135	0.122
Standard deviation of investment rate	0.232	0.337
Entry rate	0.061	0.062
Exit rate	0.061	0.055
Relative size, entering	0.586	0.60
Relative size, exiting	0.463	0.49

Table : Calibration Targets: Aggregate Fluctuation

Statistic	Model	Data
Autocorrelation of HP-filtered real GDP	0.639	0.631
Standard deviation of real GDP growth	0.0194	0.0196

Quantitative Results

Countercyclical Productivity Dispersion

Can the calibrated quantitative model generate the observed countercyclicality of productivity dispersion?
– Moments calculated using simulated data.

Table : Generated Cyclicality

Correlations with Cyclical Indicators				
	Cyclical Indicators			
Variables of Interest	A_t	GDP_t	gdp_t^{HP}	Δgdp_t
Dispersion productivity				
$SD(z_{jt}B(p_{jt}))$	-0.712	-0.923	-0.388	-0.167
HP-log$(SD(z_{jt}B(p_{jt})))$	-0.500	-0.311	-0.665	-0.354
Entry rate	0.660	0.067	0.551	0.583
Exit rate	-0.885	-0.729	-0.682	-0.657

Entry and Exit

Can the model generate the decreasing entry and exit activity by size?

Table : Entry and Exit by Size Quartile

	Entry Rate, %		Exit Rate, %	
	Avg.	Vol.	Avg.	Vol.
First quartile	19.52	0.72	14.71	0.96
Second quartile	3.65	0.58	5.37	0.44
Third quartile	0.15	0.06	3.11	0.23
Fourth quartile	0.00	0.00	0.39	0.11

Countercyclical Productivity Dispersion

Which size group drives the countercyclicality, smaller ones or larger ones?

Table : Cyclicality of Productivity Dispersion by Size Group

	Coef. Var. (%)	Correlation with			
		A_t	GDP_t	gdp_t^{HP}	Δgdp_t
First quartile	0.92	-0.613	-0.923	-0.326	-0.076
Second quartile	1.91	-0.426	-0.573	-0.219	-0.044
Third quartile	3.33	-0.400	-0.289	-0.301	-0.193
Fourth quartile	1.13	-0.424	-0.254	-0.291	-0.133

The Role of Choice of Risk Level

How important is the choice of risk level?
– Comparing to an otherwise identical model but without such choice.

Table : Cyclicality: Without Risk Level Choice

Correlations with Cyclical Indicators				
	No Choice of Risk		Baseline Model	
Variables of Interest	A_t	gdp_t^{HP}	A_t	gdp_t^{HP}
Dispersion productivity	0.926	0.816	-0.712	-0.388
Entry rate	0.806	0.629	0.660	0.551
Exit rate	-0.828	-0.612	-0.816	-0.682

Investment Dispersion

The observed procyclicality of investment rate dispersion is preserved in the benchmark model.

Table : Cyclicality of Investment Rate Distribution

Correlation	Cyclical Indicators		
	I_t/K_t	A_t	gdp_t^{HP}
Aggregate investment rate (I_t/K_t)	1	0.854	0.700
Average investment rate	0.682	0.801	0.569
Standard deviation investment rate	0.675	0.796	0.520
Fraction of investment spikes ($\geq 20\%$)	0.681	0.446	0.496
Fraction of inaction ($\lvert i/k \rvert \leq 1\%$)	-0.696	-0.840	-0.555

Conclusion

- This paper proposes a mechanism where firms take more risks in recessions, which leads to the endogenous increase in the realized productivity dispersion.
- The model features
  - Firms heterogeneous in size and productivity
  - Choice of risk level
  - Endogenous entry and exit
  - (Infinitely) Costly financing
- The calibrated model is able to qualitatively capture
  - Countercyclical productivity dispersion
  - Cyclicality of entry and exit dynamics
  - Procyclical investment dispersion
- Future research: a general equilibrium version with
  - Price feedback effect
  - Implications on the labor market variables

On a related note...

- An intuitive prediction of Hopenhayn (1992)-type models with endogenous entry and exit decisions:

Entry rate:	procyclical
Exit rate:	countercycical

- In addition, my model predicts **decreasing-in-size** entry and exit activity and their cyclicality.
- Is that true in the data?
- Main source of data: Business Dynamic Statistics at Census Bureau, Annual Industry Accounts at BEA, FRED.

Establishment level: cyclicality of entry and exit by size group.

$$y_{ijt} = \gamma_i \times GDP_t^{HP} + (Controls) + \epsilon_{ijt}$$

Table : Regression Results by Establishment Size Group

	Dependent Variables			
Estabs Size	Entry Rate	Exit Rate	JCR Entry	JDR Exit
1 to 4	0.2460***	-0.1044*	0.2582**	-0.0720
5 to 9	0.0940***	0.0038	0.1753***	0.0021
10 to 19	0.0780***	0.0151	0.1439***	0.0304
20 to 49	0.0561***	0.0222	0.1110***	0.0497*
50 to 99	0.0457**	0.0233	0.0853**	0.0436
100 to 249	0.0392*	0.0392*	0.0739*	0.0847**
250 to 499	0.0281	0.0237	0.0622	0.0376
500 to 999	-0.1303	0.0003	-0.2758	-0.0029
1000+	-0.0855	0.0037	-0.1848	0.0001

Firm level: cyclicality of birth and death by size group.

$$y_{ijt} = \gamma_i \times GDP_t^{HP} + (Controls) + \epsilon_{ijt}$$

Table : Regression Results by Firm Size Group

	Dependent Variables	
Firm Size	Firm Birth Rate	Firm Death Rate
1 to 4	0.1924***	0.0038
5 to 9	0.0967***	-0.0067
10 to 19	0.0599***	-0.0014
20 to 49	0.0296**	-0.0020
50 to 99	0.0225	0.0012
100 to 249	0.0238	0.0226*
250 to 499	0.0118	0.0019
500 to 999	0.0008	0.0071
1000 to 2499	0.0017	0.0017

Figure : Establishment Entry/Exit Rates by Size Group, Raw Data: blue = entry, orange = exit.

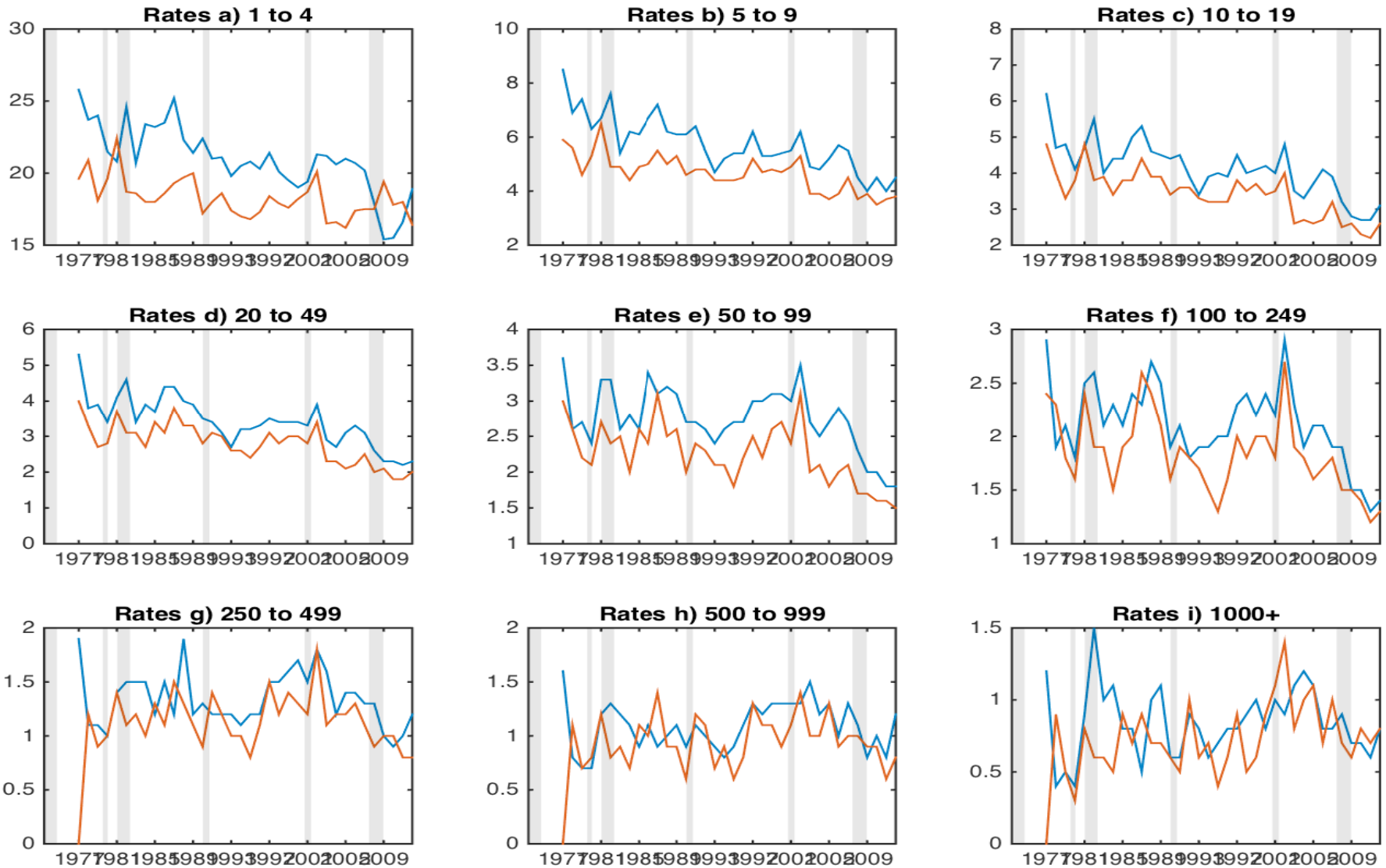
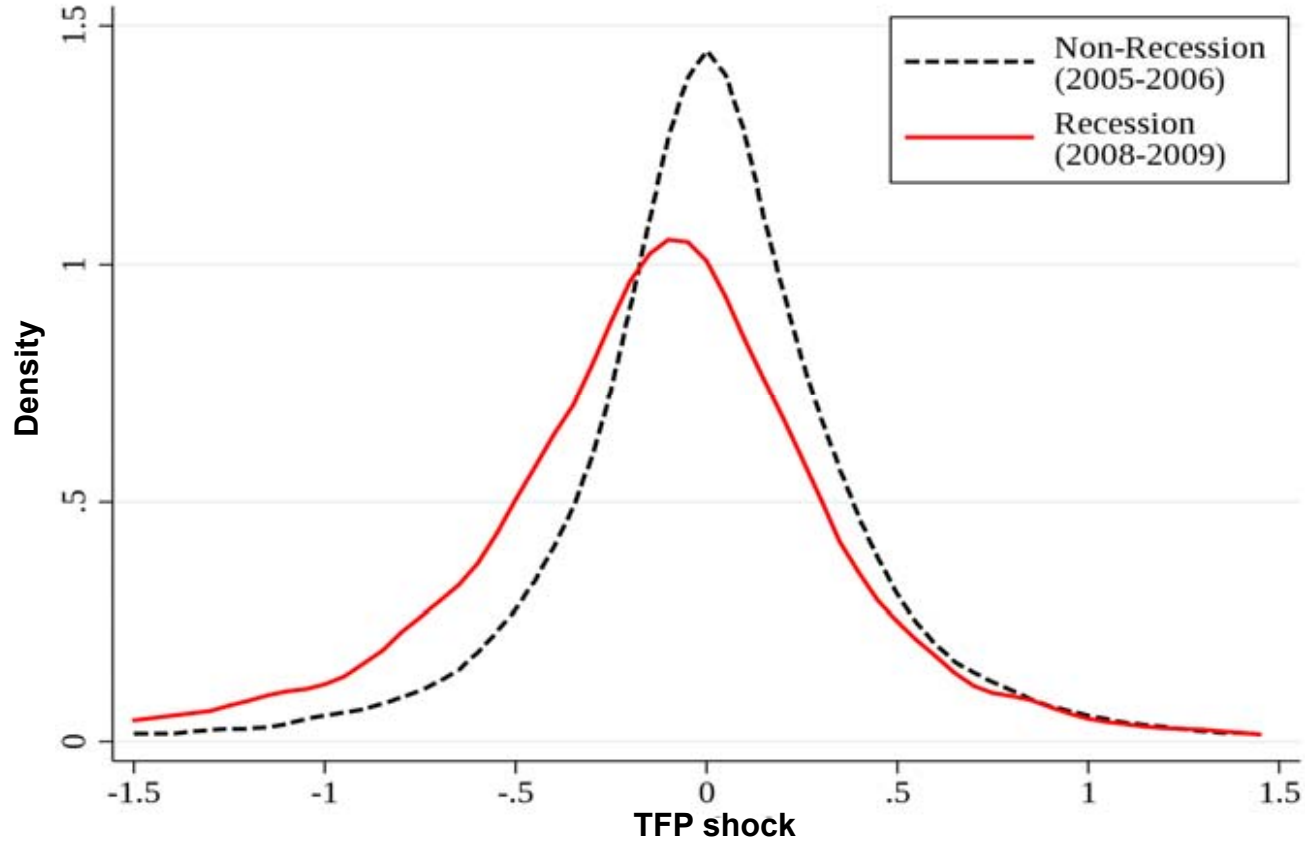


Table : Correlation Coefficients by *Parent Firm* Size

Parent Firm Size	Entry Rate (HP-100) GDP^{HP}	Entry Rate (HP-100) ΔGDP	Exit Rate (HP-100) GDP^{HP}	Exit Rate (HP-100) ΔGDP
1 to 4	0.3211**	0.2931*	-0.0134	-0.2518
5 to 9	0.0453	-0.1105	0.1125	-0.0672
10 to 19	-0.1256	-0.1645	0.0795	0.0384
20 to 49	-0.1734	-0.2202	0.0579	0.0219
50 to 99	-0.0221	-0.1141	0.1261	0.1062
100 to 249	0.2065	0.0312	0.1272	0.0696
250 to 499	0.2300	0.1035	0.0940	0.0556
500 to 999	0.3390**	0.1130	-0.0837	0.0447
1000 to 2499	0.4172***	0.0612	-0.2593	-0.0614
2500 to 4999	0.4408***	-0.0417	-0.0462	0.0191
5000 to 9999	0.3926**	0.0237	-0.0050	-0.0262
10000+	0.3057*	0.1281	-0.1093	0.1468

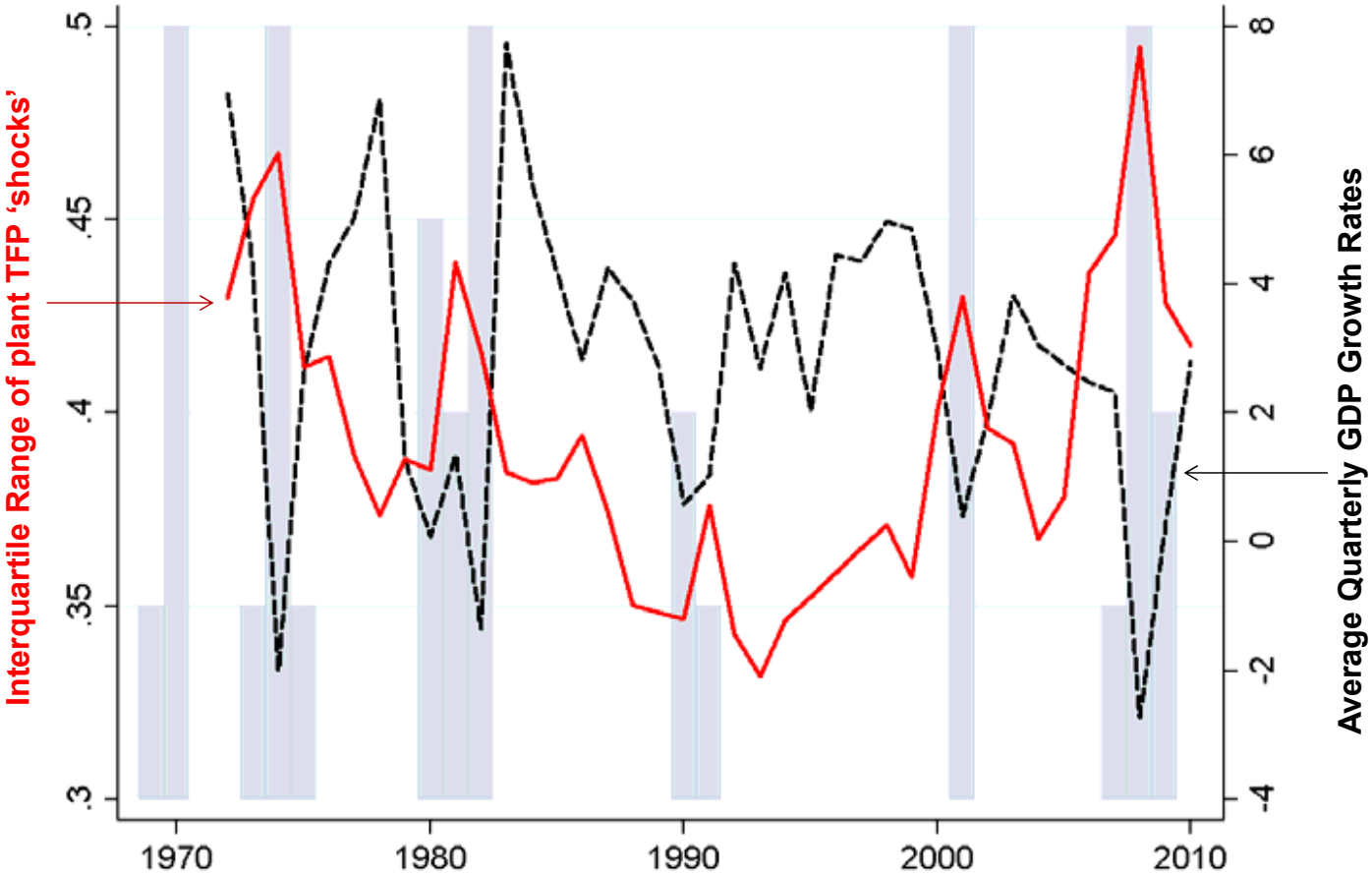
Figure 1: The variance of establishment-level TFP shocks increased by 76% in the Great Recession



Notes: Constructed from the Census of Manufactures and the Annual Survey of Manufactures using a balanced panel of 15,752 establishments active in 2005-06 and 2008-09. TFP Shocks are defined as residuals from a plant-level log(TFP) AR(1) regression that also includes plant and year fixed effects. Moments of the distribution for non-recession (recession) years are: mean 0 (-0.166), variance 0.198 (0.349), coefficient of skewness -1.060 (-1.340) and kurtosis 15.01 (11.96). The year 2007 is omitted because according to the NBER the recession began in 12/2007, so 2007 is not a clean "before" or "during" recession year.

Source: Bloom, Floetotto, Jaimovich, Saporta-Eksten and Terry (2015). BACK

Figure 3: TFP 'shocks' are more dispersed in recessions



Notes: Constructed from the Census of Manufactures and the Annual Survey of Manufactures establishments, using establishments with 25+ years to address sample selection. Grey shaded columns are the share of quarters in recession within a year.

Source: Bloom, Floetotto, Jaimovich, Saporta-Eksten and Terry (2015). BACK

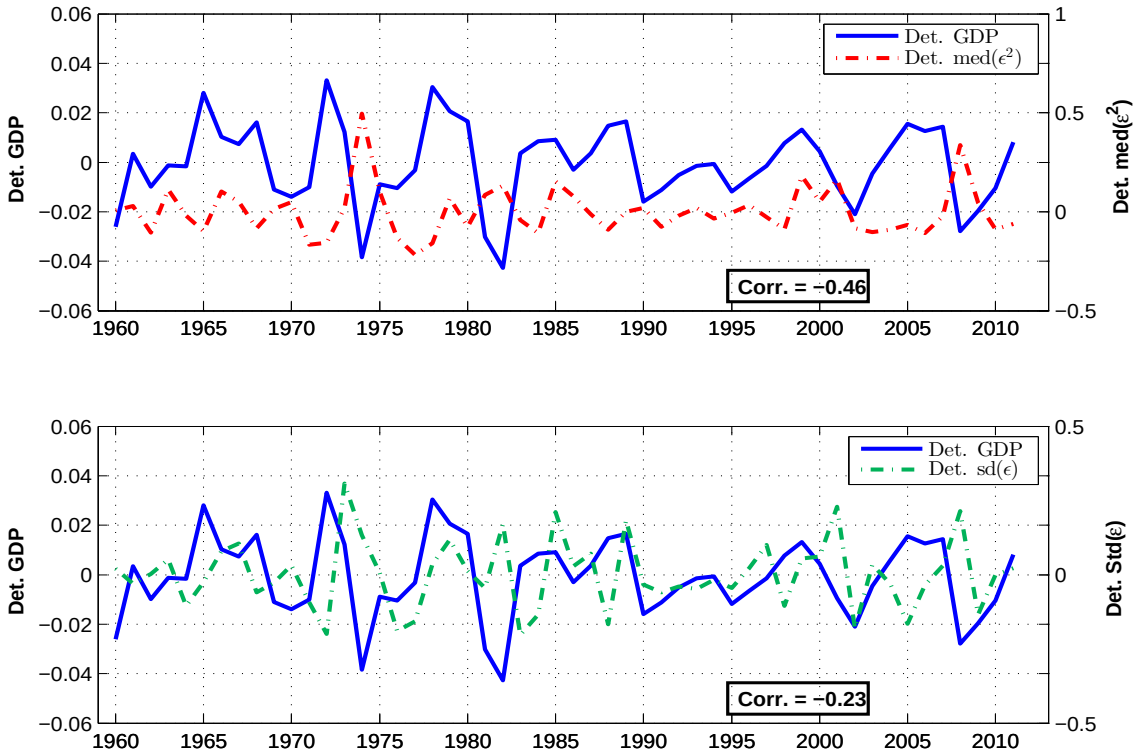
Table 1: Uncertainty is Higher During Recessions

Dependent Variable:	(1) S.D. of log(TFP) shock	(2) Skewness of log(TFP) shock	(3) Kurtosis of log(TFP) shock	(4) IQR of log(TFP) shock	(5) IQR of output growth	(6) IQR of sales growth	(7) IQR of stock returns	(8) IQR of industrial prod. Growth
Sample:	Plants (manufact.)	Plants (manufact.)	Plants (manufact.)	Plants (manufact.)	Plants (manufact.)	Public firms (all sectors)	Public firms (all sectors)	Industries (manufact.)
Recession	0.064***	-0.248	-1.334	0.061***	0.077***	0.032***	0.025***	0.044***
	(0.009)	(0.191)	(1.994)	(0.019)	(0.019)	(0.007)	(0.003)	(0.004)
Mean of Dep. Var.:	0.503	-1.525	20.293	0.395	0.196	0.186	0.104	0.101
Cor. GDP growth	-0.450***	0.143	0.044	-0.444***	-0.566***	-0.275***	-0.297***	-0.335***
Frequency	Annual	Annual	Annual	Annual	Annual	Quarterly	Monthly	Monthly
Years	1972-2011	1972-2011	1972-2011	1972-2011	1972-2011	1962:1-2010:3	1960-2010	1972-2010
Observations	39	39	39	39	39	191	609	455
Underlying sample	461,232	461,232	461,232	461,232	461,232	320,306	931,143	70,487

Notes: Each column reports a time-series OLS regression point estimate (and standard error below in parentheses) of a measure of uncertainty on a recession indicator. The recession indicator is the share of quarters in that year in a recession in columns (1) to (5), whether that quarter was in a recession in column (6), and whether the month was in recession in columns (7) and (8). Recessions are defined using the NBER data. In the bottom panel we report the mean of the dependent variable and its correlation with real GDP growth. In columns (1) to (5) the sample is the population of manufacturing establishments with 25 years or more of observations in the ASM or CM survey between 1972 and 2009, which contains data on 15,673 establishments across 39 years of data (one more year than the 38 years of regression data since we need lagged TFP to generate a TFP shock measure). We include plants with 25+ years to reduce concerns over changing samples. In column (1) the dependent variable is the cross-sectional standard deviation (S.D.) of the establishment-level 'shock' to Total Factor Productivity (TFP). This 'shock' is calculated as the residual from the regression of log(TFP) at year t+1 on its lagged value (year t), a full set of year dummies and establishment fixed effects. In column (2) we use the cross-sectional coefficient of skewness of the TFP 'shock', in column (3) the cross-sectional coefficient of kurtosis and in column (4) the cross-sectional interquartile range of this TFP 'shock' as an outlier robust measure. In column (5) the dependent variable is the interquartile range of plants' sales growth. In column (6) the dependent variable is the interquartile range of firms' sales growth by quarter for all public firms with 25 years (100 quarters) or more in Compustat between 1962 and 2010. In column (7) the dependent variable is the interquartile range of firms' monthly stock returns for all public firms with 25 years (300 months) or more in CRSP between 1960 and 2010. Finally, in column (8) the dependent variable is the interquartile range of industrial production growth by month for manufacturing industries from the Federal Reserve Board's monthly industrial production database. All regressions include a time trend and for columns (1) to (5) Census year dummies (for Census year and for 3 lags). Robust standard errors are applied in all columns to control for any potential serial correlation. *** denotes 1% significance, ** 5% significance and * 10% significance. Data available on-line at http://www.stanford.edu/~nbloom/RUBC.zip.

Source: Bloom, Floetotto, Jaimovich, Saporta-Eksten and Terry (2015). BACK

Figure 1: Idiosyncratic Dispersion and Business Cycles



Note: This figure shows the correlation between the detrended log-real GDP and the detrended cross-sectional standard deviation of ϵ_{ijt} and between the detrended log-real GDP and the median $\ln(\epsilon_{ijt}^2)$, where ϵ_{ijt} is the unexplained portion of sales growth from equation (1). All variables are detrended using the Hodrick-Prescott (H-P) filter with a parameter of 6.25. Sources: Firm-level data are from Compustat Fundamental. Log-real GDP data are from the Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis.

Source: Decker, D'Erasmo and Moscoso Boedo (forthcoming). BACK

Additional Literature

- Relevant theoretical framework
  - Hopenhayn (1992), Vereshchagina and Hopenhayn (2009).
- Cross-sectional differences by firm size
  - Fort et al. (2013), Haltiwanger et al. (2013), and Haltiwanger (2012); Hamilton (2000), Moskowitz and Vissing-Jorgensen (2002), Herranz et al. (2009), and Quadrini (2009).

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A Simple Model: Formal Proposition

Proposition

Consider the economy described by (A, p, V^0). Assume $R < \frac{1-p}{1-p^{1-\alpha}}$.

The decision of a potential entrant at $t = 0$ with initial draw (k_0, z) follows a cutoff rule.

- If $(\alpha^\alpha Az/R)^{1/(1-\alpha)} \geq V^0/(1-\alpha)$, then $\exists k_0^S(Az) > k_0^E(Az) > 0$ such that
  - no entry if $k_0(Az) < k_0^E(Az)$
  - entry with the risky project if $k_0^E(Az) \leq k_0 < k_0^S(Az)$
  - entry with the safe project if $k_0 \geq k_0^S(Az)$
- Otherwise, $\exists k_0^E(Az) > 0$ such that
  - no entry if $k_0 < k_0^E(Az)$
  - entry with the risky project if $k_0 \geq k_0^E(Az)$

At $t = 1$, $\exists y_1^*(Az) > 0$ such that an active firm with (y_1, z) exits if $y_1 < y_1^*(Az)$; and it stays and invests $\min\{y_1, (\alpha Az/R)^{1/(1-\alpha)}\}$ otherwise.

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