

The State Dependent Effectiveness of Hiring Subsidies

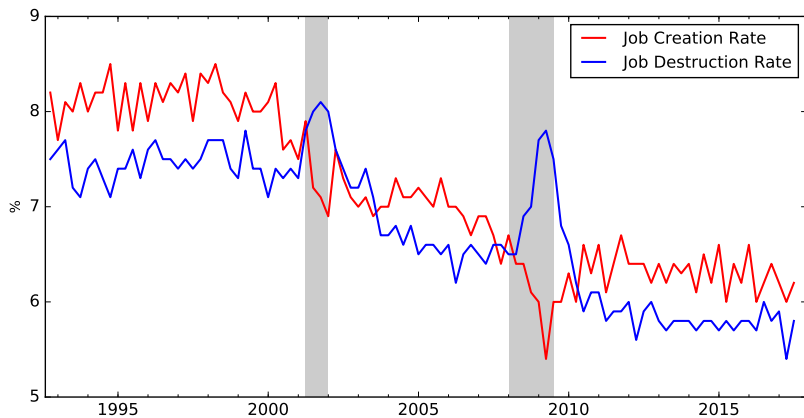
Sebastian Graves
New York University

Job Creation and Destruction Rates

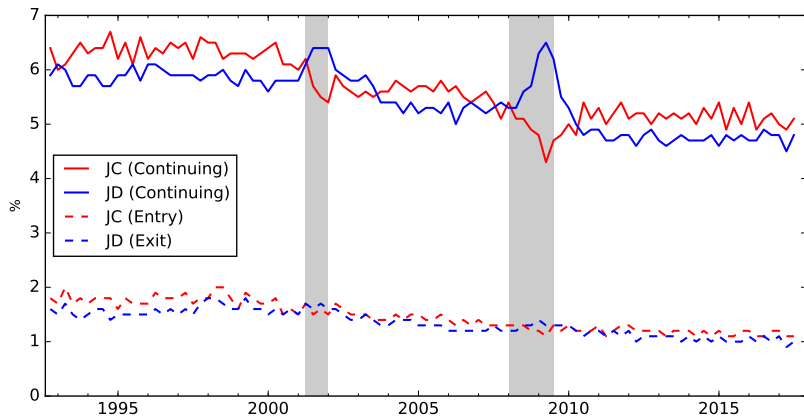
Employment Growth = Job Creation Rate – Job Destruction Rate

- ▶ Job Creation: Increase in employment from continuing and entering establishments
- ▶ Job Destruction: Decrease in employment from continuing and exiting establishments

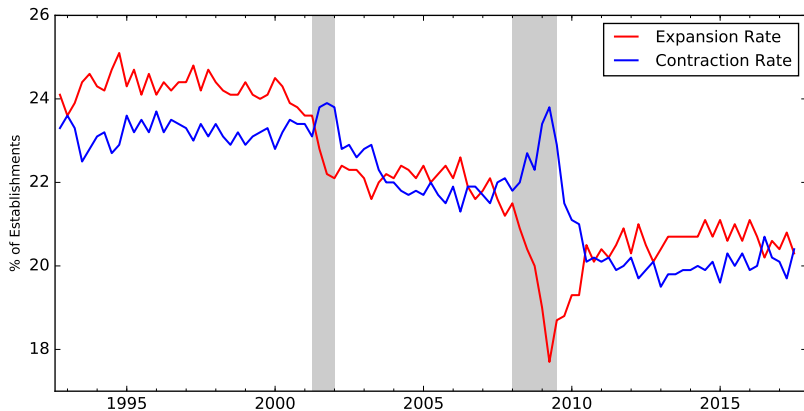
Job Creation and Destruction Rates



Job Creation and Destruction: Continuing vs Entry/Exit



Employment Adjustment is Lumpy



Motivation

- ▶ What impact does lumpy employment adjustment have on the responsiveness of job creation and destruction to aggregate shocks?
- ▶ Does lumpy adjustment have implications for the effectiveness of different labor market policies over the business cycle?

Outline

1. Significant evidence of time-varying responsiveness of job creation and destruction rates:
 - ▶ Job creation rate significantly *more* responsive when employment growth is high.
 - ▶ Job destruction rate significantly *less* responsive when employment growth is high.
2. Heterogeneous-firm model with lumpy employment adjustment can replicate these facts.
3. Policy implications: hiring subsidy is less effective in downturns, while firing tax is more effective.

Empirical Evidence: Bartik Approach

- ▶ Construct predicted employment growth following Bartik (1991):

$$B_{i,t} = \sum_{k=1}^K \varphi_{i,k,\tau} g_{-i,k,t}^N$$

- ▶ $\varphi_{i,k,\tau}$ = employment share of industry k in state i in base year
 $\tau = 1990$
- ▶ $g_{-i,k,t}$ = national employment growth in industry k *excluding* state i in year t

Empirical Evidence: Bartik Approach

- ▶ Does response to predicted employment growth vary over time?
- ▶ Panel Regressions:

$$\Delta Y_{i,t} = \alpha_i + \gamma_t + \beta_0 B_{i,t} + \beta_1 B_{i,t} \cdot g_{i,t-1}^N + \Gamma' Z_{i,t-1} + \epsilon_{i,t}$$

- ▶ Annual state-level JC/JD data: 1977-2014
- ▶ Annual state-industry 3-digit employment data: 1990-2016

Empirical Evidence: Bartik Approach

	$\Delta g_{i,t}^N$	$\Delta JC_{i,t}$	$\Delta JD_{i,t}$
$B_{i,t}$	0.99*** (0.20)	0.40*** (0.13)	-0.59*** (0.14)
$B_{i,t} \cdot g_{i,t-1}^N$	-0.003 (0.017)	0.025** (0.010)	0.027*** (0.010)
$\hat{\beta}_0 + \hat{\beta}_1 \bar{g}^N$	0.99	0.45	-0.532
$\hat{\beta}_0 + \hat{\beta}_1 (\bar{g}^N + 1\text{SD})$	0.98	0.54	-0.44
$\log(\frac{\sigma_{95}}{\sigma_5})$	-0.03	0.60	-0.55
Observations	1173	1173	1173
R^2	0.415	0.305	0.369

Notes: Standard errors clustered by state. Asterisks denote significance levels (***) = 1%, ** = 5%, * = 10%). The mean and standard deviation of state-level employment growth are 2.1% and 3.3%. The 5th and 95th percentiles of the state-level employment growth distribution are -3.4% and 7.1%.

Empirical Evidence: Volatility Approach

- ▶ Do job creation, job destruction, or employment growth exhibit time-varying volatility?
- ▶ Panel Regressions:

$$|\Delta Y_{i,t}| = \alpha_i + \gamma_t + \beta_0 |\Delta Y_{i,t-1}| + \beta_1 g_{i,t-1}^N + \epsilon_{i,t}$$

- ▶ Annual state-level JC/JD data: 1977-2014

Empirical Evidence: Volatility Approach

	$ \Delta g_{i,t}^N $	$ \Delta JC_{i,t} $	$ \Delta JD_{i,t} $
$g_{i,t-1}^N$	0.015 (0.028)	0.080*** (0.013)	-0.101*** (0.024)
$ \widehat{\Delta Y_{i,t}}(\bar{g}^N) $	2.46	1.41	1.70
$ \widehat{\Delta Y_{i,t}}(\bar{g}^N + 1SD) $	2.50	1.68	1.37
$\log(\frac{\sigma_{95}}{\sigma_5})$	0.06	0.63	-0.64
Observations	1836	1836	1836
R^2	0.17	0.06	0.16

Notes: Standard errors clustered by state. Asterisks denote significance levels (***) = 1%, ** = 5%, * = 10%). The 5th and 95th percentiles of the annual employment growth distribution at the state level are -3.4% and 7.1%.

Model: Firms

- ▶ Continuum of firms, mass normalized to 1, operating production function:

$$y = Az_r z_i n^\alpha$$

- ▶ Idiosyncratic (z_i), regional (z_r), and aggregate (A) productivity follow independent AR(1) processes:

$$\log A' = \rho_A \log A + \sigma_A \epsilon'_A, \quad \epsilon'_A \sim N(0, 1)$$

$$\log z'_r = \rho_r \log z_r + \sigma_r \epsilon'_r, \quad \epsilon'_r \sim N(0, 1)$$

$$\log z'_i = \rho_i \log z_i + \sigma_i \epsilon'_i, \quad \epsilon'_i \sim N(0, 1)$$

- ▶ Each period, firms choose employment level for the following period, subject to a linear hiring cost, κ .

Model: Representative Household

- ▶ Representative household with utility function:

$$U(C, N) = \frac{1}{1-\gamma} \left(C - \psi \frac{N^{1+\phi}}{1+\phi} \right)^{1-\gamma}$$

- ▶ SDF:

$$\Lambda(\mathbf{S}, \mathbf{S}') = \beta \left(\frac{C(\mathbf{S}') - \psi \frac{N(\mathbf{S}')^{1+\phi}}{1+\phi}}{C(\mathbf{S}) - \psi \frac{N(\mathbf{S})^{1+\phi}}{1+\phi}} \right)^{-\gamma}$$

- ▶ FOCs of intra-temporal problem provide aggregate wage:

$$w(\mathbf{S}) = -\frac{U_N(C, N)}{U_C(C, N)} = \psi N(\mathbf{S})^\phi$$

Model: Firm's Recursive Problem

$$V(z_r, z_i, n; \mathbf{S}) = \max_{n'} Az_r z_i n^\alpha - w(\mathbf{S})n - \kappa \Delta n' \mathbb{1}\{n' > n\} \\ + \mathbb{E} [\Lambda(\mathbf{S}, \mathbf{S}') V(z'_r, z'_i, n'; \mathbf{S}')]]$$

Aggregate state: $\mathbf{S} = (A, \mu)$

Model: Firm's Recursive Problem

$$V(z_r, z_i, n; \mathbf{S}) = \max_{n'} A z_r z_i n^\alpha - w(\mathbf{S})n - \kappa \Delta n' \mathbb{1}\{n' > n\} \\ + \mathbb{E} [\Lambda(\mathbf{S}, \mathbf{S}') V(z'_r, z'_i, n'; \mathbf{S}')]]$$

Aggregate state: $\mathbf{S} = (A, \mu)$

Hiring \rightarrow region of inactivity. The FOCs conditional on hiring/firing:

$$\mathbb{E}[\Lambda(\mathbf{S}, \mathbf{S}') V_n(z'_r, z'_i, n'; \mathbf{S}')] = \kappa \text{ if } n' > n \\ \mathbb{E}[\Lambda(\mathbf{S}, \mathbf{S}') V_n(z'_r, z'_i, n'; \mathbf{S}')] = 0 \text{ if } n' < n$$

Model: Firm's Recursive Problem

$$V(z_r, z_i, n; \mathbf{S}) = \max_{n'} A z_r z_i n^\alpha - w(\mathbf{S})n - \kappa \Delta n' \mathbb{1}\{n' > n\} \\ + \mathbb{E} [\Lambda(\mathbf{S}, \mathbf{S}') V(z'_r, z'_i, n'; \mathbf{S}')]]$$

Aggregate state: $\mathbf{S} = (A, \mu)$

Hiring \rightarrow region of inactivity. The FOCs conditional on hiring/firing:

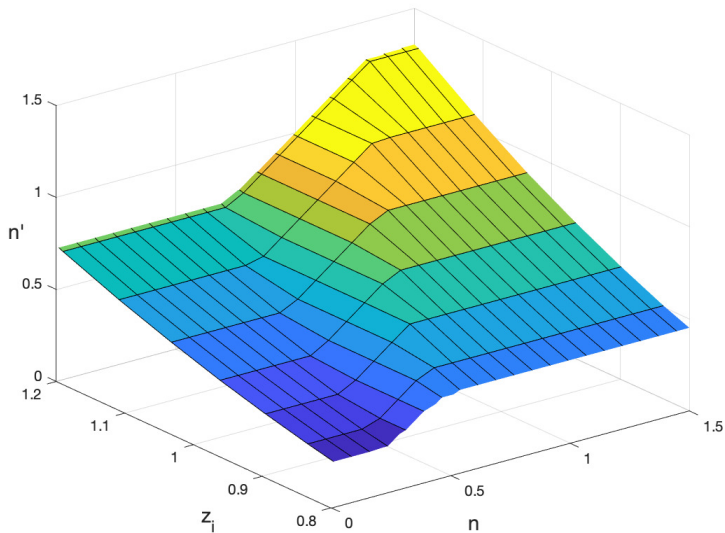
$$\mathbb{E}[\Lambda(\mathbf{S}, \mathbf{S}') V_n(z'_r, z'_i, n'; \mathbf{S}')] = \kappa \text{ if } n' > n$$

$$\mathbb{E}[\Lambda(\mathbf{S}, \mathbf{S}') V_n(z'_r, z'_i, n'; \mathbf{S}')] = 0 \text{ if } n' < n$$

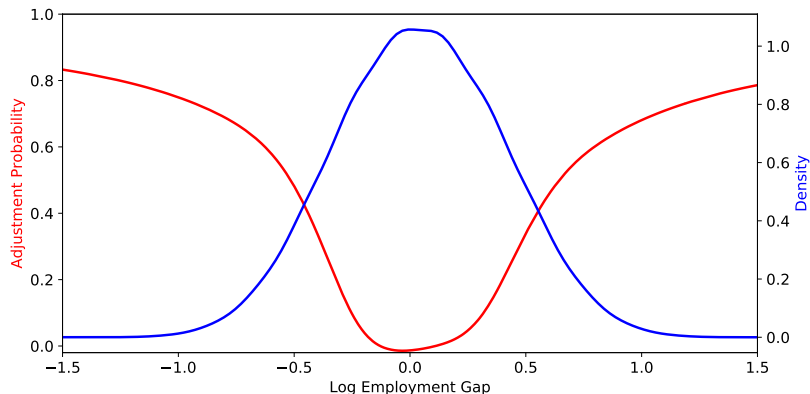
Inaction if:

$$0 \leq \underbrace{\mathbb{E}[\Lambda(\mathbf{S}, \mathbf{S}') V_n(z'_r, z'_i, n; \mathbf{S}')] }_{MB} \leq \kappa$$

Policy Function: Lumpy Employment Adjustment



Employment Gaps and Adjustment Probabilities



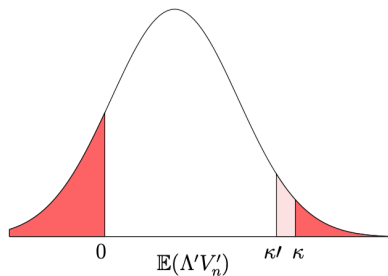
Calibration and Computation

Parameter		Baseline	Frictionless
Hiring cost	κ	0.47	0
Regional shock volatility	σ_r	0.0045	0.0025
Idiosyncratic shock volatility	σ_i	0.10	0.079
Regional productivity persistence	ρ_r	0.97	0.97
Idiosyncratic productivity persistence	ρ_i	0.97	0.97
Aggregate shock volatility	σ_A	0.0049	0.0039
Aggregate productivity persistence	ρ_A	0.974	0.984
Decreasing returns to scale	α	0.65	0.65
Discount factor	β	0.99	0.99
Risk Aversion	γ	1	1
Elasticity of labor supply	$\frac{1}{\phi}$	2	2
Disutility of labor supply	ψ	0.78	0.73

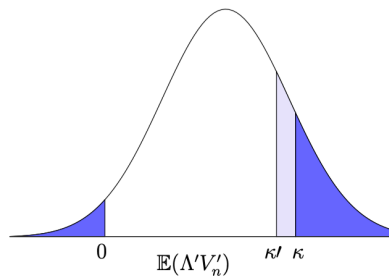
► Computational Details

Lumpy Adjustment and Time-Varying Responsiveness

The distribution of $\mathbb{E}[\Lambda(\mathbf{S}, \mathbf{S}')V_n(z'_r, z'_i, n; \mathbf{S}')]]$ varies over time:



(a) Recession



(b) Boom

Model Validation

I use simulated data from both versions of the model to repeat the experiments conducted using state-level data:

- ▶ Baseline model: time-varying responsiveness quantitatively close to that estimated in the data
- ▶ Frictionless model: no time-varying responsiveness

Model Validation: Bartik Regressions

	Baseline			Frictionless		
	$\Delta g_{i,t}^N$	$\Delta JC_{i,t}$	$\Delta JD_{i,t}$	$\Delta g_{i,t}^N$	$\Delta JC_{i,t}$	$\Delta JD_{i,t}$
$B_{i,t}$	1.05 (0.97,1.14)	0.59 (0.54,0.63)	-0.46 (-0.50,-0.43)	1.00 (0.93,1.07)	0.54 (0.50,0.58)	-0.45 (-0.49,-0.42)
$B_{i,t} \cdot g_{i,t-1}^N$	0.006 (-0.02,0.03)	0.028 (0.01,0.04)	0.022 (0.01,0.04)	0.000 (-0.02,0.02)	0.002 (-0.01,0.01)	0.001 (-0.01,0.01)
$\hat{\beta}_0 + \hat{\beta}_1 \bar{g}^N$	1.05	0.59	-0.46	1.00	0.54	-0.45
$\hat{\beta}_0 + \hat{\beta}_1 (\bar{g}^N + 1SD)$	1.07	0.68	-0.39	1.00	0.54	-0.45
$\log(\frac{\sigma_{95}}{\sigma_5})$	0.06	0.50	-0.50	0.01	0.03	-0.03

Notes: 90% confidence intervals in parenthesis, calculated using 500 simulations of the model for 1200 periods. In the model mean employment growth is zero. I use the standard deviation of state employment growth of 3.3% estimated in the data. For the 95th and 5th percentiles of the employment growth distribution I use -5.2% and 5.2% (re-centering the values of -3.4% and 7.1% from the data).

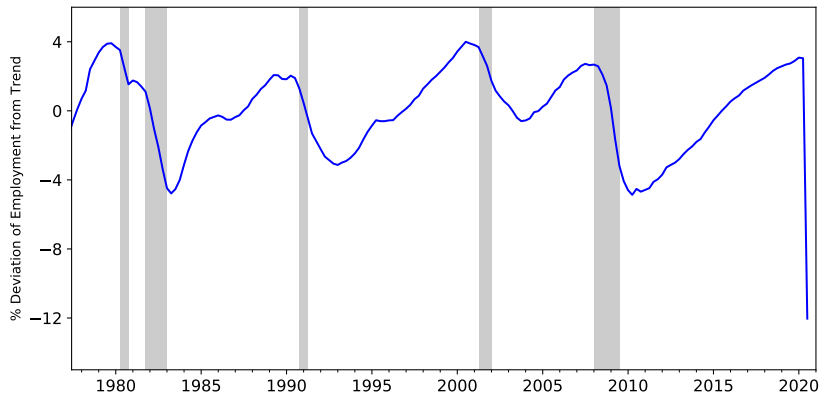
Model Validation: Volatility Regressions

	Baseline			Frictionless		
	$ \Delta g_{i,t}^N $	$ \Delta JC_{i,t} $	$ \Delta JD_{i,t} $	$ \Delta g_{i,t}^N $	$ \Delta JC_{i,t} $	$ \Delta JD_{i,t} $
$g_{i,t-1}^N$	0.02 (-0.01,0.05)	0.069 (0.05,0.09)	-0.049 (-0.06,-0.03)	0.006 (-0.04,0.05)	0.012 (-0.01,0.04)	-0.005 (-0.02,0.01)
$ \widehat{\Delta Y_{i,t}} (\bar{g}^N)$	1.99	1.11	0.88	3.78	2.05	1.72
$ \widehat{\Delta Y_{i,t}} (\bar{g}^N + 1SD)$	2.06	1.35	0.72	3.80	2.10	1.71
$\log(\frac{\sigma_{95}}{\sigma_5})$	0.10	0.67	-0.59	0.02	0.06	-0.03

Notes: 90% confidence intervals in parenthesis, calculated using 500 simulations of the model for 1200 periods. In the model mean employment growth is zero. I use the standard deviation of state employment growth of 3.3% estimated in the data. For the 95th and 5th percentiles of the employment growth distribution I use -5.2% and 5.2% (re-centering the values of -3.4% and 7.1% from the data).

Aggregate Implications

To understand the aggregate implications, I find sequence $\{A_t\}$ such that log deviation of employment from SS value is equal to detrended log US employment:



Responsiveness Indices

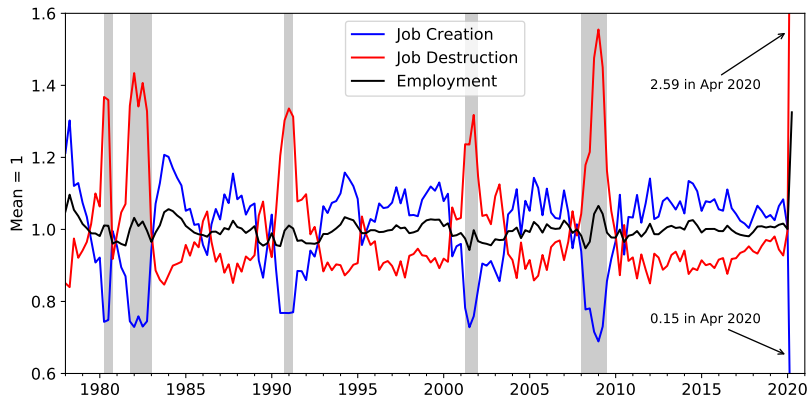
At each point in time, the “responsiveness” of job creation, job destruction and employment is:

$$R_t^{JC} \equiv JC(\exp(\log(A_t) + \sigma_A), \mu_t) - JC(A_t, \mu_t)$$

$$R_t^{JD} \equiv JD(\exp(\log(A_t) + \sigma_A), \mu_t) - JD(A_t, \mu_t)$$

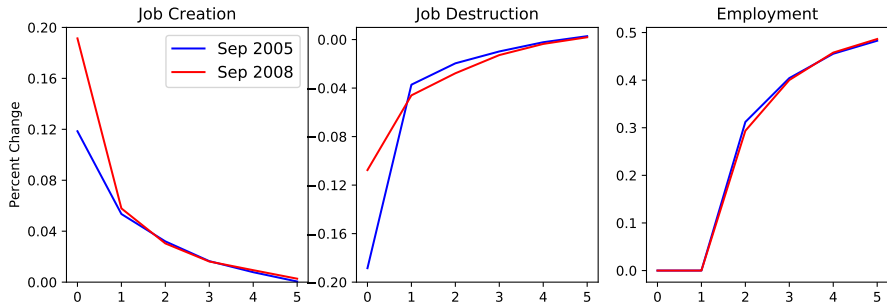
$$R_t^N \equiv N(\exp(\log(A_t) + \sigma_A), \mu_t) - N(A_t, \mu_t)$$

Responsiveness Indices: Baseline Model



► Robustness

State Dependent Impulse Response Functions



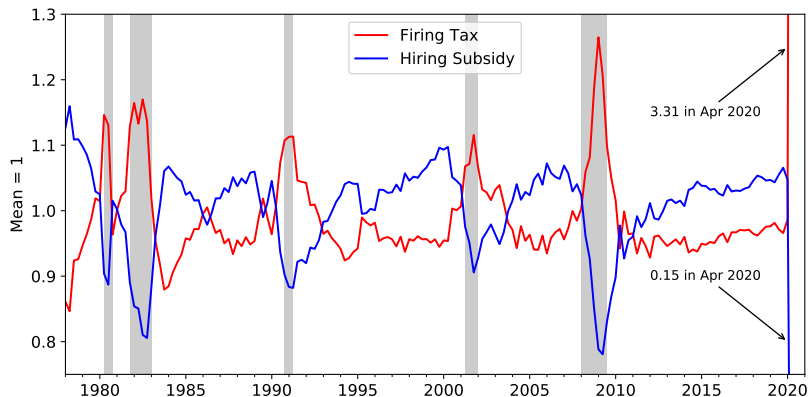
Policy Implications

Employment stabilization policies in Great Recession fell into two categories:

1. Policies promoting job creation
 - ▶ e.g. Social security contribution relief on new hires: France, Portugal, Spain
2. Policies discouraging job destruction
 - ▶ e.g. Short-Time Work schemes: Germany, Italy, Belgium

Time-Varying Policy Effectiveness

Impact on employment of hiring subsidy/firing tax equal to 25% of average quarterly wage:



Relation to the Literature

- ▶ **Lumpy employment adjustment:**
 - ▶ Bentolila & Bertola (1990)
 - ▶ Hopenhayn & Rogerson (1993)
 - ▶ Caballero, Engel, & Haltiwanger (1997)
 - ▶ Campbell & Fisher (2000)
 - ▶ Elsby & Michaels (2013)
 - ▶ Fujita & Nakajima (2016)
 - ▶ Cooper, Meyer, & Schott (2017)
- ▶ **Lumpy adjustment and time-varying responsiveness:**
 - ▶ Caballero & Engel (2013) (Investment)
 - ▶ Berger & Vavra (2015) (Durable Consumption)

Conclusion

- ▶ Job creation and destruction rates exhibit time-varying responsiveness:
 - ▶ Job creation is more responsive when employment growth is high.
 - ▶ Job destruction is more responsive when employment growth is low.
- ▶ Heterogeneous-firm model with linear hiring costs can explain these facts.
- ▶ Targeting the job destruction margin is likely to be the most effective policy during recessions.

Computational Details

- ▶ Model solved using Krusell-Smith algorithm.
- ▶ Firm's problem:

$$V(z_r, z_i, n; A, N) = \max_{n'} p \{ A z_r z_i n^\alpha - w(N)n - \kappa \Delta n' \mathbb{1}\{n' > n\} \}$$

$$+ \beta \mathbb{E}[V(z'_r, z'_i, n'; A', N')]$$

subject to

$$\log N' = \delta_N^0 + \delta_N^1 \log N + \delta_N^2 \log A$$

$$\log p = \delta_N^0 + \delta_N^1 \log N + \delta_N^2 \log A$$

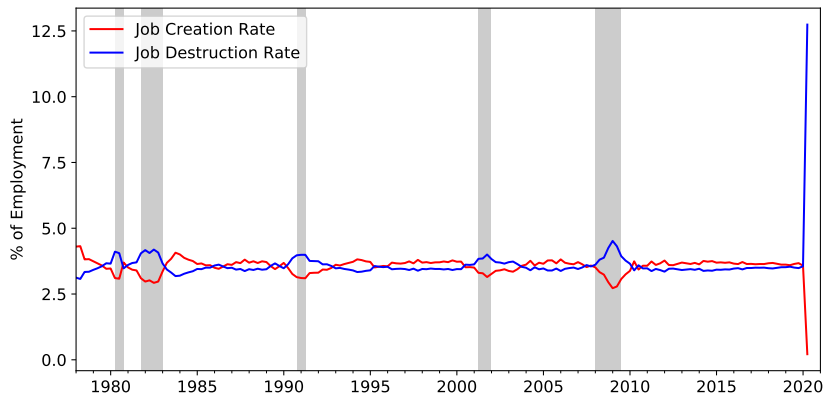
- ▶ N is pre-determined, and wage only depends on N . Therefore, each period only need to do market clearing on p .

Krusell-Smith Accuracy Tests

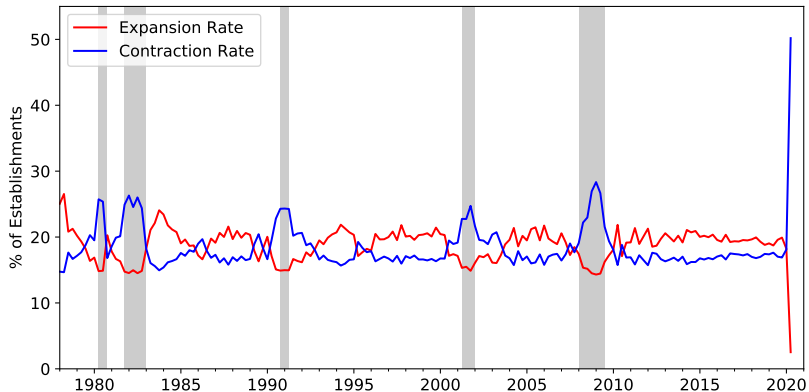
	Baseline	Frictionless
a_N	0.001	-0.004
b_N	0.515	0.000
c_N	0.555	1.170
a_p	0.365	N/A
b_p	-0.184	N/A
c_p	-1.569	N/A
R_N^2	0.99982	0.99999
R_p^2	0.99997	N/A
Max Error N(%)	0.17	0.11
Mean Error N (%)	0.04	0.10
Max Error p (%)	0.11	N/A
Mean Error p (%)	0.04	N/A

Notes: Mean/maximum errors constructed by simulating the model for 5000 periods and comparing p and N series from the model with those from the forecasting rules.

Model-Implied JC/JD Rates

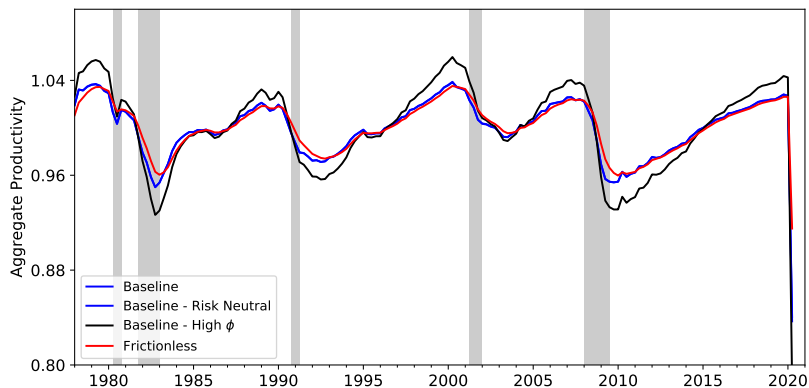


Model-Implied Expansion/Contraction Rates



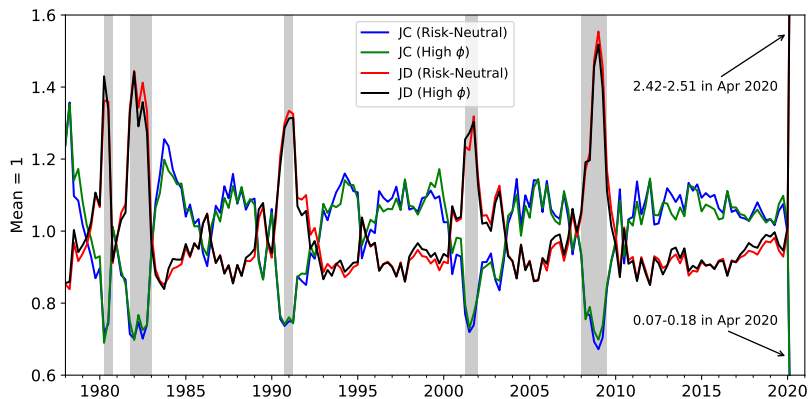
[◀ Back](#)

Model-Implied Aggregate Productivity Series



◀ Back

Robustness



← Back

Caballero, Engel, & Haltiwanger (1997) Figure 1

