The State Dependent Effectiveness of Hiring Subsidies

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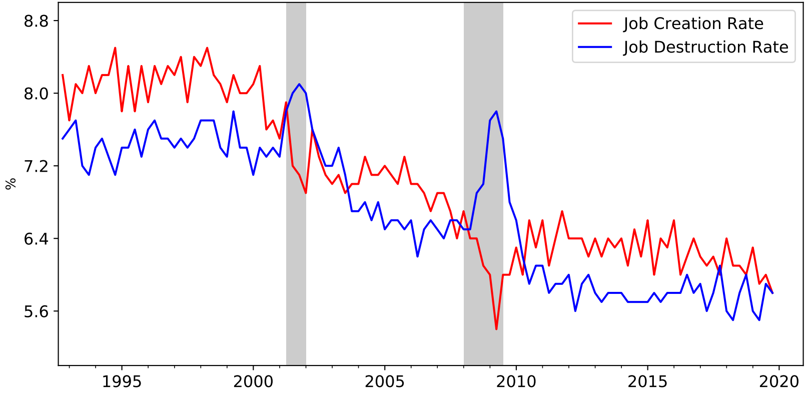
Job Creation and Destruction Rates

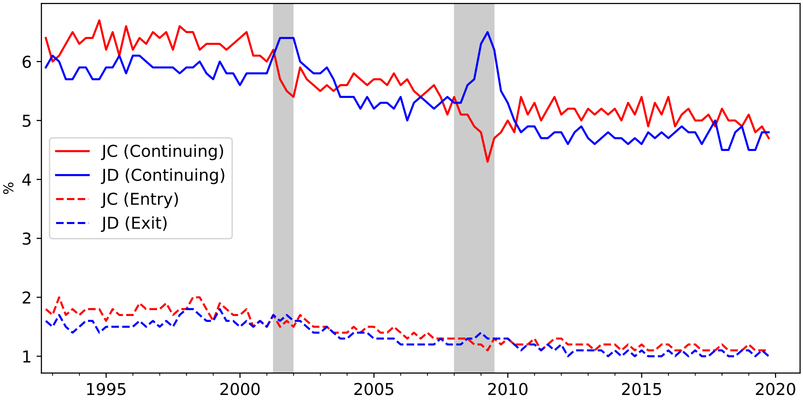
$$\text{Employment Growth} = \text{Job Creation Rate} - \text{Job Destruction Rate}$$

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

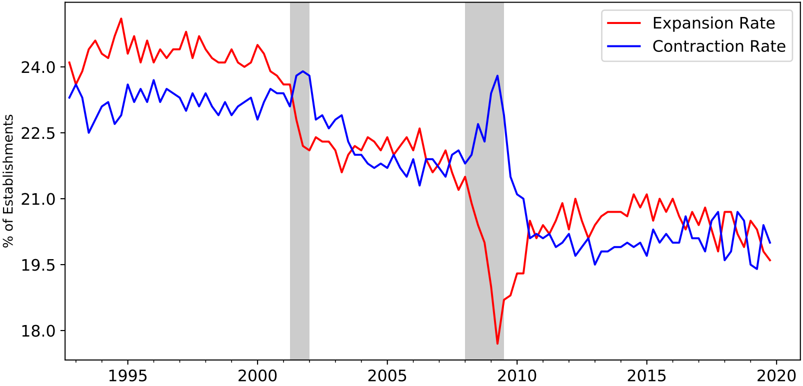
Job Creation and Destruction Rates



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):

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

  - $\varphi_{i,k,\tau}$ = 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***	0.40***	-0.59***
	(0.20)	(0.13)	(0.14)
$B_{i,t} \cdot g_{i,t-1}^N$	-0.003	0.025**	0.027***
	(0.017)	(0.010)	(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:

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

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

Empirical Evidence: Volatility Approach

	$\lvert\Delta g^N_{i,t}\rvert$	$\lvert\Delta JC_{i,t}\rvert$	$\lvert\Delta JD_{i,t}\rvert$
$g^N_{i,t-1}$	0.015	0.080***	-0.101***
	(0.028)	(0.013)	(0.024)
$\lvert\widehat{\Delta Y_{i,t}}(\bar{g}^N)\rvert$	2.46	1.41	1.70
$\lvert\widehat{\Delta Y_{i,t}}(\bar{g}^N + 1\text{SD})\rvert$	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:

$$\begin{aligned}
\log A' &= \rho_A \log A + \sigma_A \epsilon'_A, & \epsilon'_A &\sim N(0,1) \\
\log z'_r &= \rho_r \log z_r + \sigma_r \epsilon'_r, & \epsilon'_r &\sim N(0,1) \\
\log z'_i &= \rho_i \log z_i + \sigma_i \epsilon'_i, & \epsilon'_i &\sim N(0,1)
\end{aligned}$$

- 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:

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

- FOCs of intra-temporal problem provide aggregate wage:

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

Model: Firm's Recursive Problem

$$
\begin{aligned}
V(z_r, z_i, n; \boldsymbol{S}) = \max_{n'} & A z_r z_i n^{\alpha} - w(\boldsymbol{S}) n - \kappa \Delta n' \mathbb{1}\{n' > n\} \\
& + \mathbb{E}\left[\Lambda(\boldsymbol{S}, \boldsymbol{S'}) V(z_r', z_i', n'; \boldsymbol{S'})\right]
\end{aligned}
$$

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

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$$

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

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

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

Model: Firm's Recursive Problem

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$$+ \mathbb{E}\left[\Lambda(\boldsymbol{S}, \boldsymbol{S'}) V(z_r', z_i', n'; \boldsymbol{S'})\right]$$

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

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

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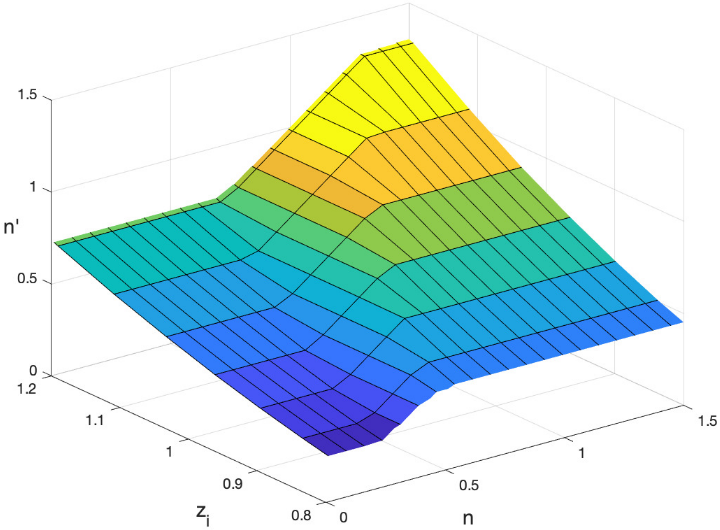
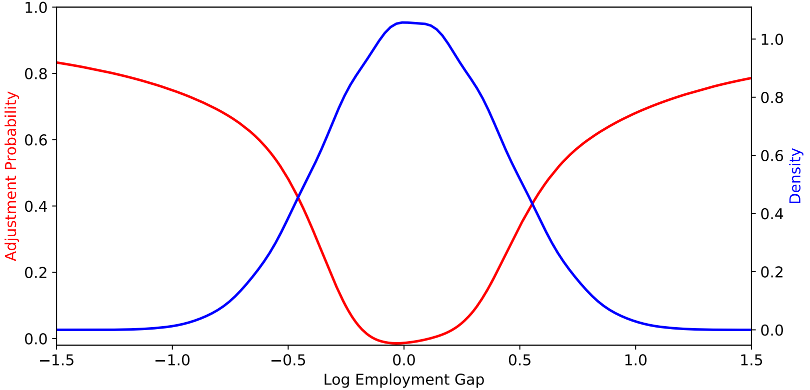
Inaction if:

$$0 \leq \underbrace{\mathbb{E}[\Lambda(\boldsymbol{S}, \boldsymbol{S'}) V_n(z_r', z_i', n; \boldsymbol{S'})]}_{MB} \leq \kappa$$

Policy Function: Lumpy Employment Adjustment



Employment Gaps and Adjustment Probabilities



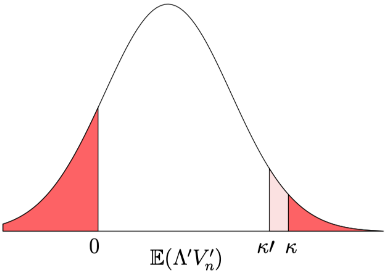
Calibration and Computation

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

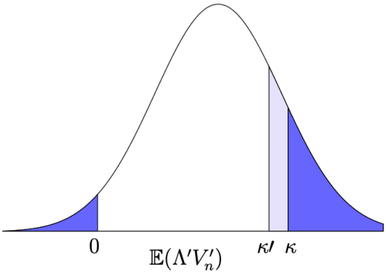
Computational Details

Lumpy Adjustment and Time-Varying Responsiveness

The distribution of $\mathbb{E}[\Lambda(\boldsymbol{S}, \boldsymbol{S'}) V_n(z_r', z_i', n; \boldsymbol{S'})]$ 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		
	$\Delta g^N_{i,t}$	$\Delta JC_{i,t}$	$\Delta JD_{i,t}$	$\Delta g^N_{i,t}$	$\Delta JC_{i,t}$	$\Delta JD_{i,t}$
$B_{i,t}$	1.05	0.59	-0.46	1.00	0.54	-0.45
	(0.97,1.14)	(0.54,0.63)	(-0.50,-0.43)	(0.93,1.07)	(0.50,0.58)	(-0.49,-0.42)
$B_{i,t} \cdot g^N_{i,t-1}$	0.006	0.028	0.022	0.000	0.002	0.001
	(-0.02,0.03)	(0.01,0.04)	(0.01,0.04)	(-0.02,0.02)	(-0.01,0.01)	(-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
$\hat{\beta}_0 + \hat{\beta}_1(\bar{g}^N + 1\text{SD})$	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).

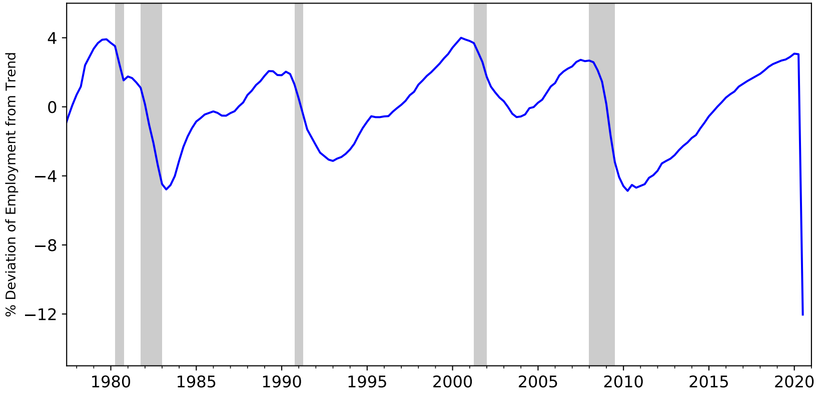
Model Validation: Volatility Regressions

	Baseline			Frictionless		
	$\lvert\Delta g^N_{i,t}\rvert$	$\lvert\Delta JC_{i,t}\rvert$	$\lvert\Delta JD_{i,t}\rvert$	$\lvert\Delta g^N_{i,t}\rvert$	$\lvert\Delta JC_{i,t}\rvert$	$\lvert\Delta JD_{i,t}\rvert$
$g^N_{i,t-1}$	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)
$\lvert\widehat{\Delta Y_{i,t}}\rvert(\bar{g}^N)$	1.99	1.11	0.88	3.78	2.05	1.72
$\lvert\widehat{\Delta Y_{i,t}}\rvert(\bar{g}^N + 1SD)$	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:



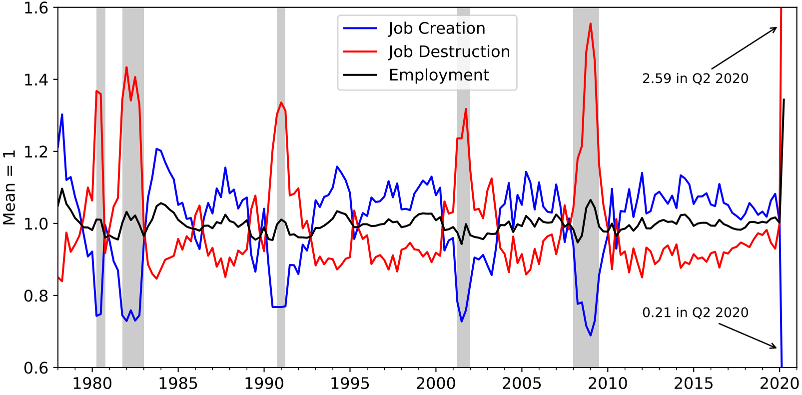
▸ Details

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

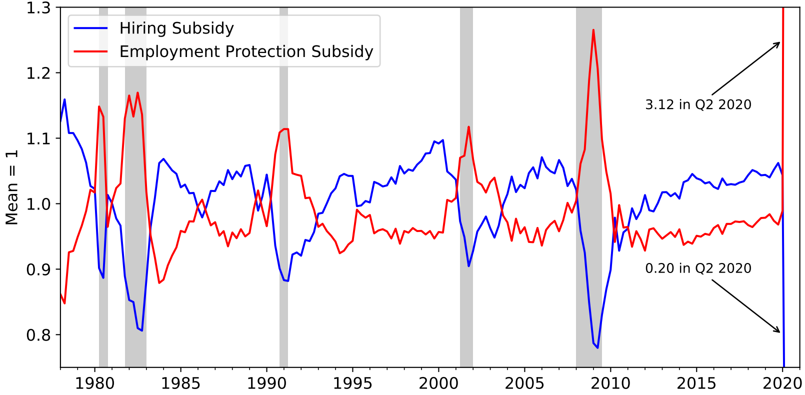
Policy Implications

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:

$$
\begin{aligned}
V(z_r, z_i, n; A, N) &= \max_{n'} p\{Az_r z_i n^{\alpha} - w(N)n - \kappa \Delta n' \mathbb{1}\{n' > n\}\} \\
&\quad + \beta \mathbb{E}[V(z_r', z_i', n'; A', N')] \\
&\text{subject to} \\
\log N' &= \delta_N^0 + \delta_N^1 \log N + \delta_N^2 \log A \\
\log p &= \delta_N^0 + \delta_N^1 \log N + \delta_N^2 \log A
\end{aligned}
$$

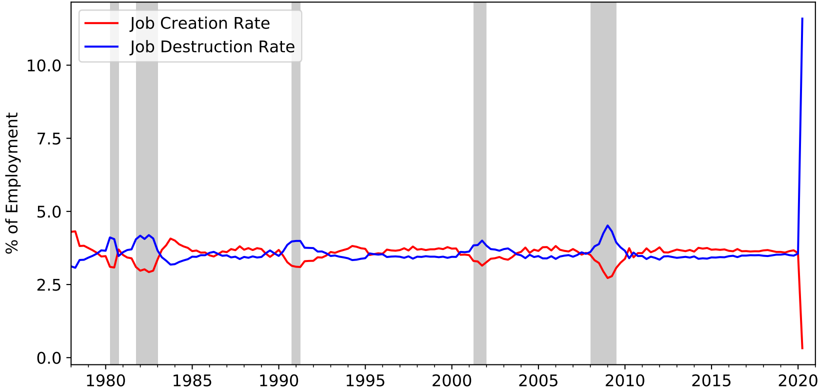
- N is pre-determined, and wage only depends on N. Therefore, each period only need to do market clearing on p.

Krusell-Smith Accuracy Tests

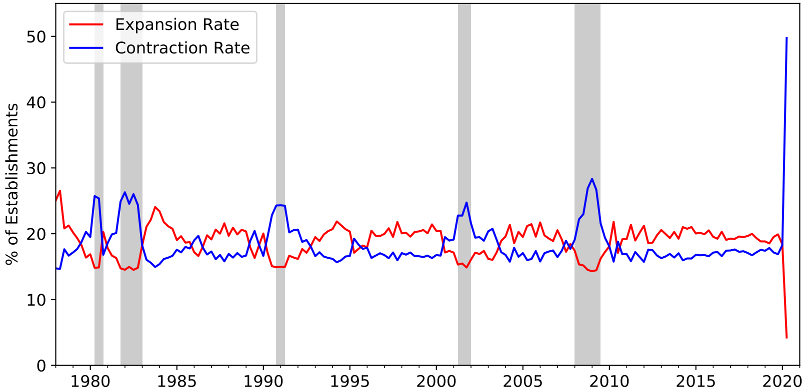
	Baseline	Frictionless
a_N	0.001	-0.004
b_N	0.515	0.000
c_N	0.555	1.170
a_p	0.365	N/A
b_p	-0.184	N/A
c_p	-1.569	N/A
R_N^2	0.99982	0.99999
R_p^2	0.99997	N/A
Max Error N(%)	0.17	0.11
Mean Error N (%)	0.04	0.10
Max Error p (%)	0.11	N/A
Mean Error p (%)	0.04	N/A

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



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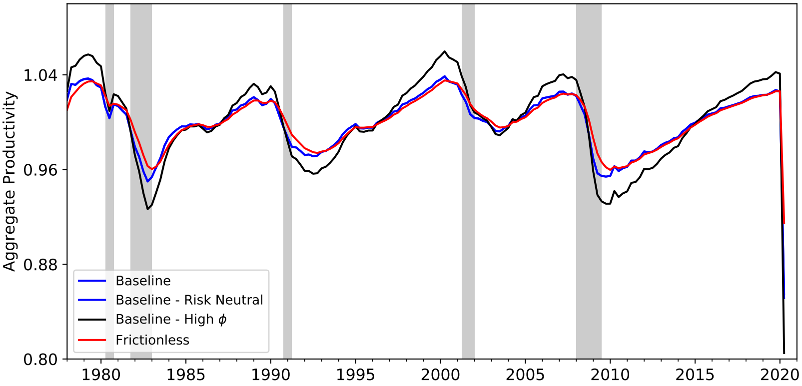
Model-Implied Aggregate Productivity Series



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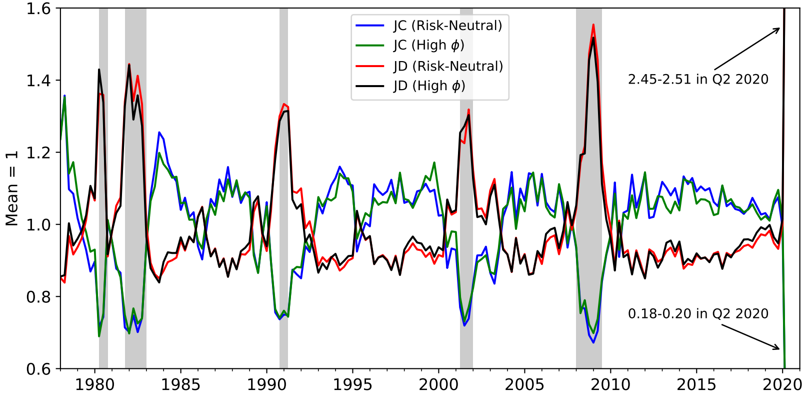
Robustness



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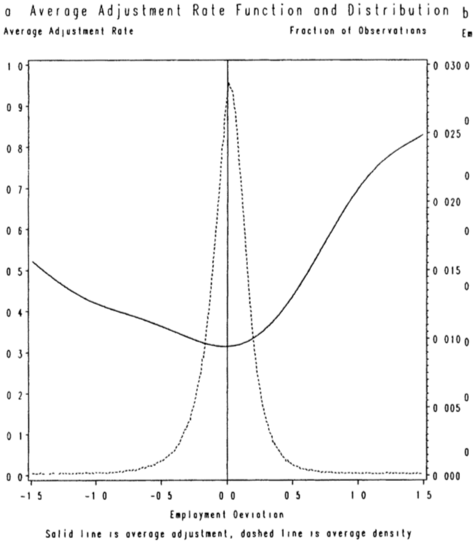
Caballero, Engel, & Haltiwanger (1997) Figure 1



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