The State Dependent Effectiveness of Hiring Subsidies

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Federal Reserve Board

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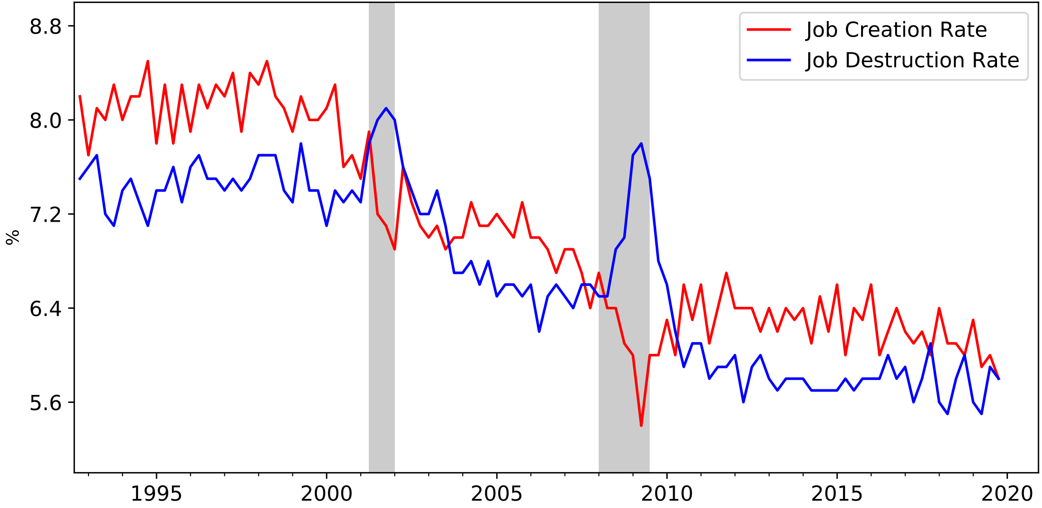
Job Creation and Destruction

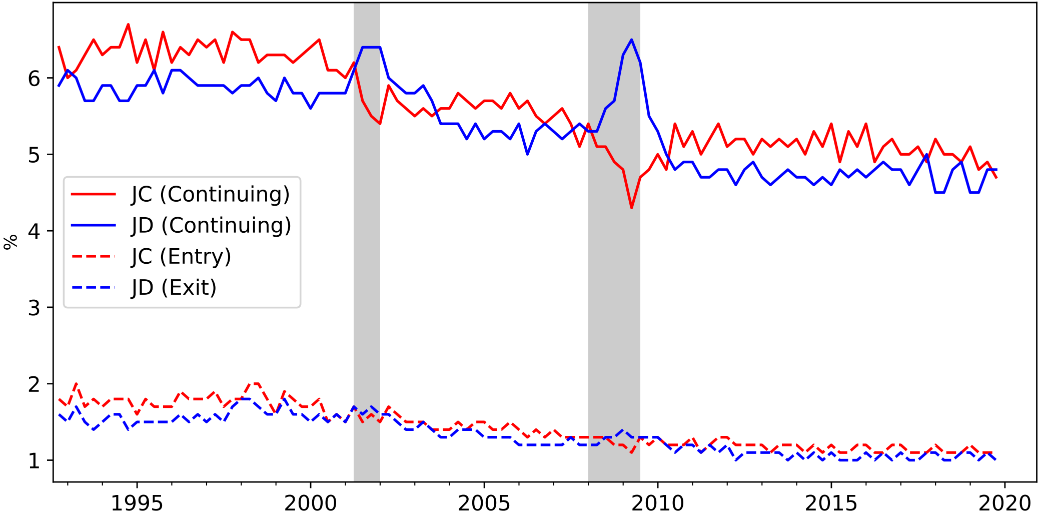
$$\text{Employment Growth} = \text{Job Creation} - \text{Job Destruction}$$

- Job Creation: Increase in employment from expanding or entering establishments
- Job Destruction: Decrease in employment from contracting or exiting establishments

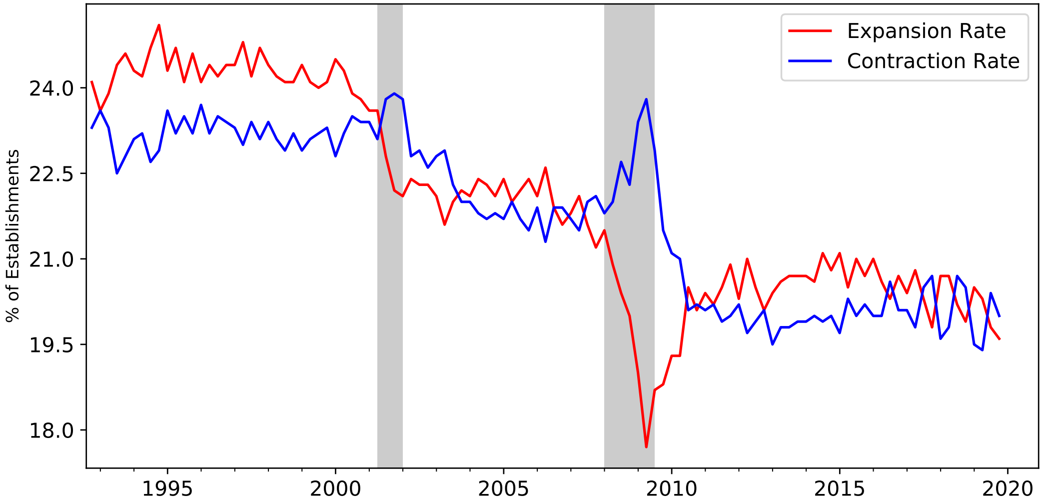
Job Creation and Destruction Rates



Job Creation and Destruction: Continuing vs Entry/Exit



Employment Adjustment is Lumpy



Research Questions

1. What impact do hiring frictions have on the responsiveness of job creation and destruction to aggregate shocks?
2. Does this have implications for the effectiveness of different labor market policies over the business cycle? Particularly those that target job creation vs job destruction.

Outline

1. New cross-sectional evidence on the time-varying responsiveness of job creation and destruction rates

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   - Baseline model replicates the time-varying responsiveness seen in the data
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3. Use the model to understand the aggregate implications of hiring frictions
   - Hiring subsidies significantly less effective in recessions
   - Policies that discourage job destruction most effective at these times

Empirical Evidence: Conditional Heteroskedasticity

- Do job creation, job destruction, or employment growth exhibit time-varying volatility?
- Panel Regressions:
$$|\Delta JC_{i,t}| = \alpha_i + \gamma_t + \beta g^N_{i,t-1} + \epsilon_{i,t}$$
where $\Delta JC_{i,t}$ refers to the change in the job creation rate and $g^N_{i,t-1}$ is the lagged value of employment growth.
- Annual state and industry level data from Census Bureau's Business Dynamics Statistics Database: 1977-2014

Conditional Heteroskedasticity: State Level

	$\lvert\Delta$Job Creation$\rvert$	$\lvert\Delta$Job Destruction$\rvert$	$\lvert\Delta$Employment Growth$\rvert$
Lagged Employment Growth	0.088 (0.020)	-0.079 (0.024)	0.028 (0.047)
$\log(\frac{\sigma_{95}}{\sigma_5})$	0.65	-0.45	0.11
Observations	1883	1883	1883
R^2	0.36	0.39	0.38

Notes: The second row quantifies the conditional heteroskedasticity by comparing volatility at the 5th and 95th percentiles of the lagged employment growth distribution (at the mean value of the fixed effects). Robust standard errors clustered at the state level in parentheses. The 5th and 95th percentiles of the annual state employment growth distribution at the state level are -3.4% and 6.5%.

Conditional Heteroskedasticity: Industry Level

	$\lvert\Delta$Job Creation$\rvert$	$\lvert\Delta$Job Destruction$\rvert$	$\lvert\Delta$Employment Growth$\rvert$
Lagged Employment Growth	0.111 (0.028)	-0.136 (0.019)	-0.009 (0.019)
$\log(\frac{\sigma_{95}}{\sigma_5})$	0.93	-0.97	-0.03
Observations	331	331	331
R^2	0.41	0.40	0.46

Notes: The second row quantifies the conditional heteroskedasticity by comparing volatility at the 5th and 95th percentiles of the lagged employment growth distribution (at the mean value of the fixed effects). Robust standard errors clustered at the industry level in parentheses. The 5th and 95th percentiles of the annual industry employment growth distribution at the state level are -4.9% and 8.7%.

Empirical Evidence: Time-Varying Responsiveness

- Do job creation, job destruction, or employment growth exhibit time-varying responsiveness to aggregate shocks?
- Use shocks to the excess bond premium (EBP) identified by Gilchrist & Zakrajsek (2012)
- Panel Regressions:

$$JC_{i,t+1} - JC_{i,t-1} = \alpha_i + \beta_0 g^N_{i,t-1} + \beta_1 e^{EBP}_t + \beta_2 e^{EBP}_t \times g^N_{i,t-1} + \epsilon_{i,t}$$

where $JC_{i,t+1} - JC_{i,t-1}$ is the change in the job creation rate between the year before and the year after the shock, e^{EBP}_t is the identified shock to the excess bond premium, and $g^N_{i,t-1}$ is the lagged value of employment growth

Time-Varying Responsiveness: State Level

	Job Creation	Job Destruction	Employment Growth
Lagged Employment Growth	-0.373	0.479	-0.852
	(0.017)	(0.022)	(0.028)
EBP Shock	-0.111	0.140	-0.250
	(0.024)	(0.021)	(0.029)
Lagged Employment Growth	-0.033	-0.056	0.022
$\times$ EBP Shock	(0.012)	(0.014)	(0.018)
Observations	1836	1836	1836
R^2	0.29	0.39	0.51

Notes: EBP Shock is a shock to the excess bond premium identified as in Gilchrist & Zakrajsek (2012). Robust standard errors clustered at the state level in parentheses.

Time-Varying Responsiveness: Industry Level

	Job Creation	Job Destruction	Employment Growth
Lagged Employment Growth	-0.310	0.528	-0.838
	(0.053)	(0.054)	(0.029)
EBP Shock	-0.155	0.142	-0.296
	(0.034)	(0.050)	(0.064)
Lagged Employment Growth	-0.045	-0.039	-0.006
$\times$ EBP Shock	(0.016)	(0.003)	(0.018)
Observations	324	324	324
R^2	0.32	0.41	0.48

Notes: EBP Shock is a shock to the excess bond premium identified as in Gilchrist & Zakrajsek (2012). Robust standard errors clustered at the industry level in parentheses.

Summary of Empirical Results

- Both methods lead to the same conclusion:
  - Job creation significantly *more* responsive at the peak of the business cycle than the trough
  - Job destruction significantly *less* responsive at the peak of the business cycle than the trough
- Next: Can these results be explained using a heterogeneous-firm model?

Model: Firms

- Continuum of firms produce output using labor:

$$y = A z_r z_i n^{\alpha}$$

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

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

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

Model: Firms

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

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

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

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

$$\mathbb{E}[\Lambda(\boldsymbol{S}, \boldsymbol{S'}) V_n(z_r', z_i', n'; \boldsymbol{S'})] = \kappa \text{ if } n' > n$$
$$\mathbb{E}[\Lambda(\boldsymbol{S}, \boldsymbol{S'}) V_n(z_r', z_i', n'; \boldsymbol{S'})] = 0 \text{ if } n' < n$$

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\end{aligned}
$$

Inaction if:

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

Caballero, Engel, & Haltiwanger (1997)

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:

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

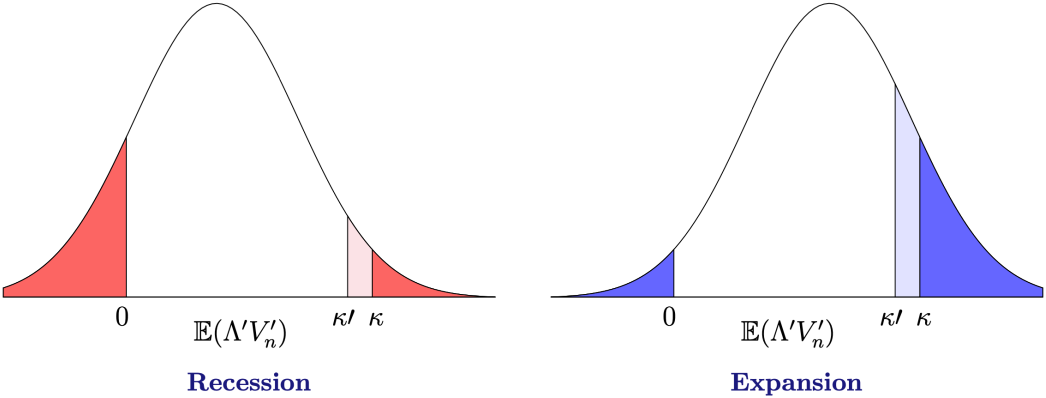
Model Calibration

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

Hiring Frictions 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:



Model Validation

I use simulated data from both versions of the model to repeat the time-varying volatility regressions conducted using state and industry level data:

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

Volatility Regressions: Baseline Model

	$\lvert\Delta$Job Creation$\rvert$	$\lvert\Delta$Job Destruction$\rvert$	$\lvert\Delta$Employment Growth$\rvert$
Lagged Employment Growth	0.059	-0.039	0.020
$\log(\frac{\sigma_{95}}{\sigma_5})$	0.68	-0.56	0.12

Notes: The second row of each panel quantifies the conditional heteroskedasticity by comparing volatility at the 5th and 95th percentiles of the lagged employment growth distribution (at the mean value of the fixed effects). Regressions use data simulated from 51 regions for a large number of periods. As the model does not include trend growth, for the 5th and 95th percentiles of the state-level employment growth distribution I use -5% and 5%, centering the values from the data.

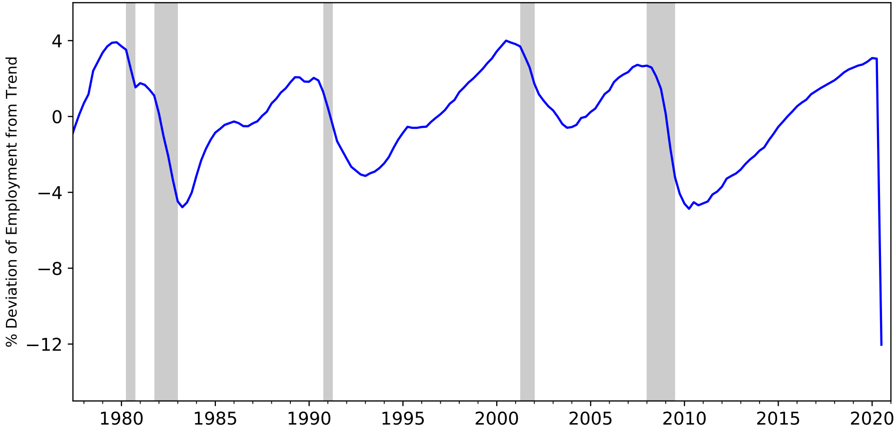
Volatility Regressions: Frictionless Model

	$\lvert\Delta$Job Creation$\rvert$	$\lvert\Delta$Job Destruction$\rvert$	$\lvert\Delta$Employment Growth$\rvert$
Lagged Employment Growth	0.016	-0.006	0.010
$\log(\frac{\sigma_{95}}{\sigma_5})$	0.08	-0.04	0.03

Notes: The second row of each panel quantifies the conditional heteroskedasticity by comparing volatility at the 5th and 95th percentiles of the lagged employment growth distribution (at the mean value of the fixed effects). Regressions use data simulated from 51 regions for a large number of periods. As the model does not include trend growth, for the 5th and 95th percentiles of the state-level employment growth distribution I use -5% and 5%, centering the values from the data.

Aggregate Implications

I find sequence $\{A_t\}$ such that the model matches de-trended US employment:



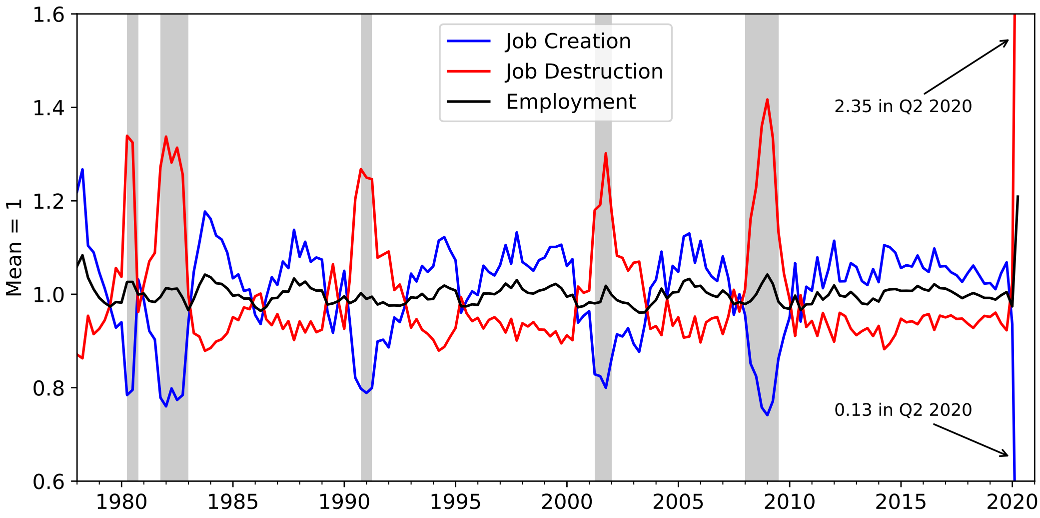
Details

Responsiveness Indices

What would be the impact on job creation, job destructon and aggregate employment growth of a one SD aggregate shock at each point in time:

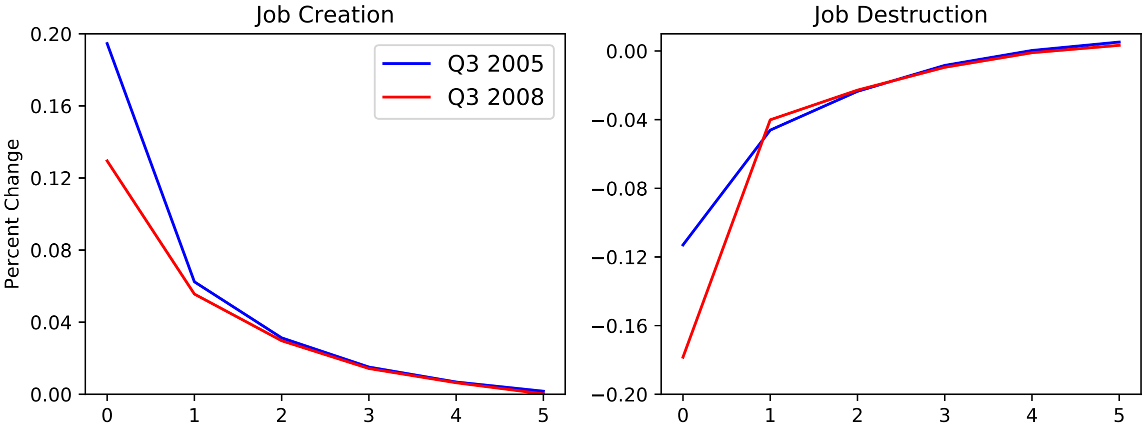
$$R_t^{JC} \equiv JC(exp(log(A_t) + \sigma_A), \mu_t) - JC(A_t, \mu_t)$$
$$R_t^{JD} \equiv JD(exp(log(A_t) + \sigma_A), \mu_t) - JD(A_t, \mu_t)$$
$$R_t^{N} \equiv N(exp(log(A_t) + \sigma_A), \mu_t) - N(A_t, \mu_t)$$

Responsiveness Indices: Baseline Model



Notes: Responsiveness indices show the impact on job creation, job destruction and employment of a one SD aggregate productivity shock. The mean response is normalized to one.

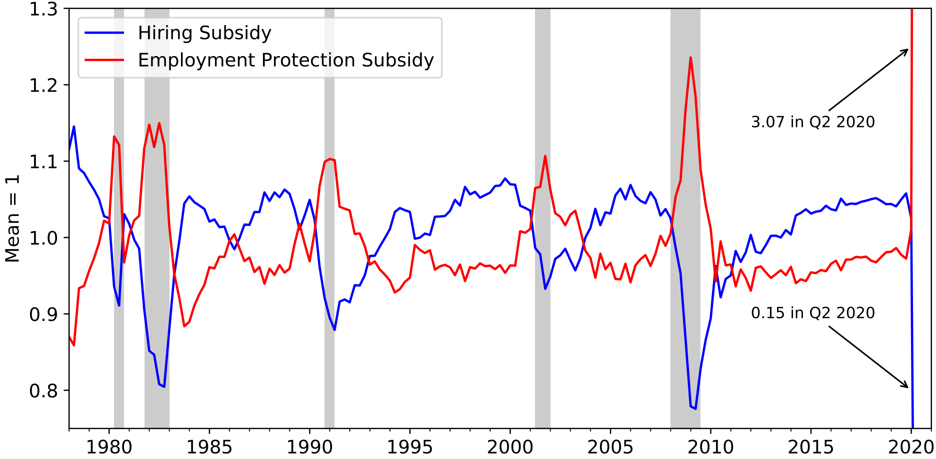
State Dependent Impulse Response Functions



Policy Implications

- This suggests that policies that target job creation (hiring subsidies) are significantly *less* effective in recessions
- Policies that target job destruction (short-time work schemes/PPP) are significantly *more* effective in recessions

Time-Varying Policy Effectiveness



Notes: Impact on employment of an unanticipated hiring subsidy or employment protection subsidy equal to 25% of the average quarterly wage. The mean response is normalized to one.

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**:
  - Bachmann, Caballero & Engel (2013) (Investment)
  - Berger & Vavra (2015) (Durable Consumption)

Conclusion

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

Computational Details

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

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

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

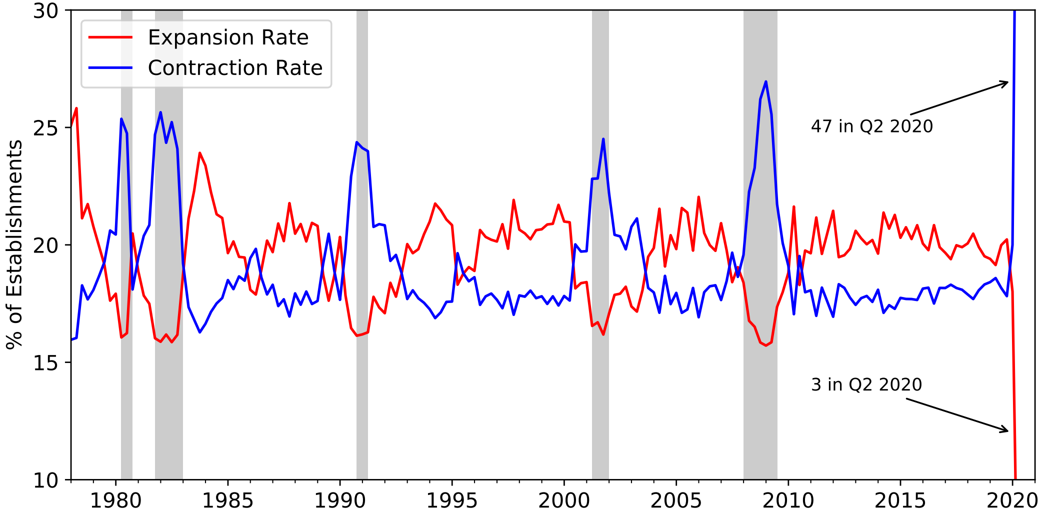
Krusell-Smith Accuracy Tests

	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.

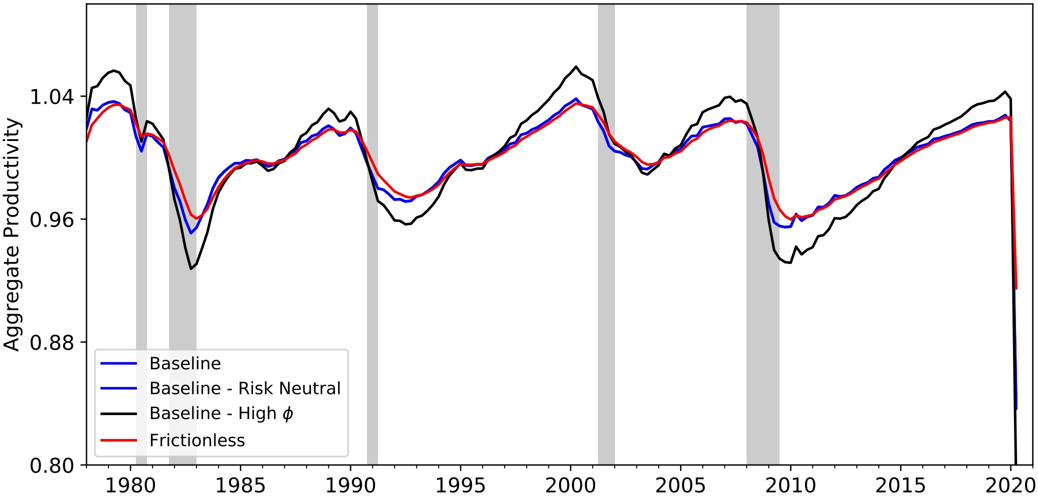
Back

Model-Implied Expansion/Contraction Rates



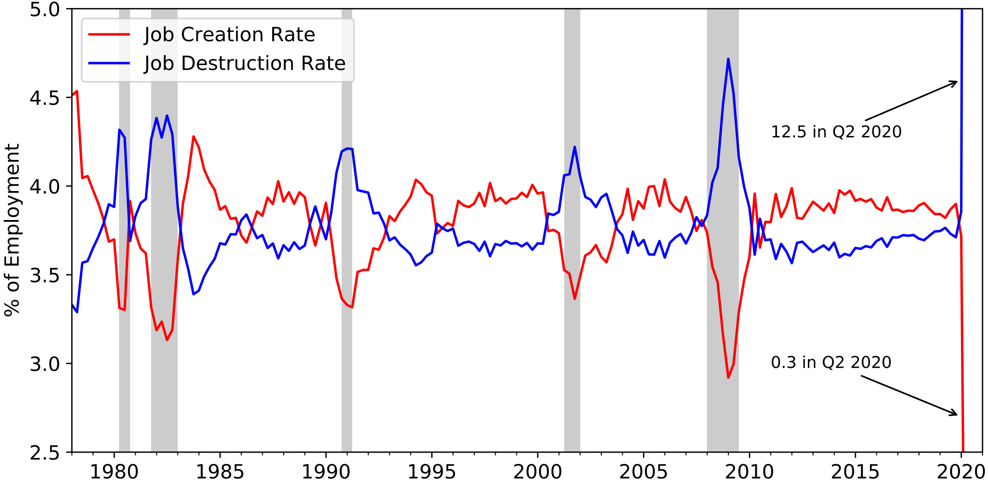
◂ Back

Model-Implied Aggregate Productivity Series



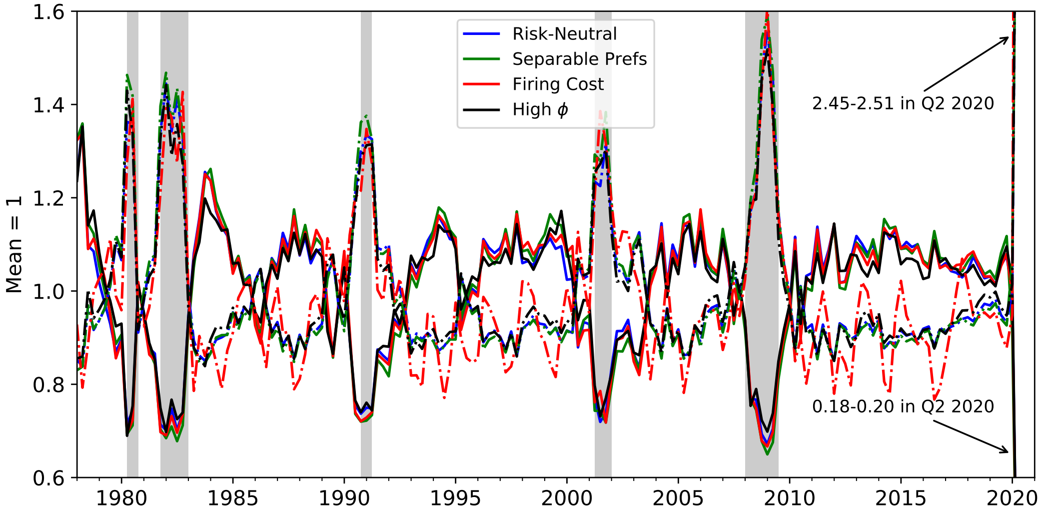
◂ Back

Model-Implied JC/JD Rates



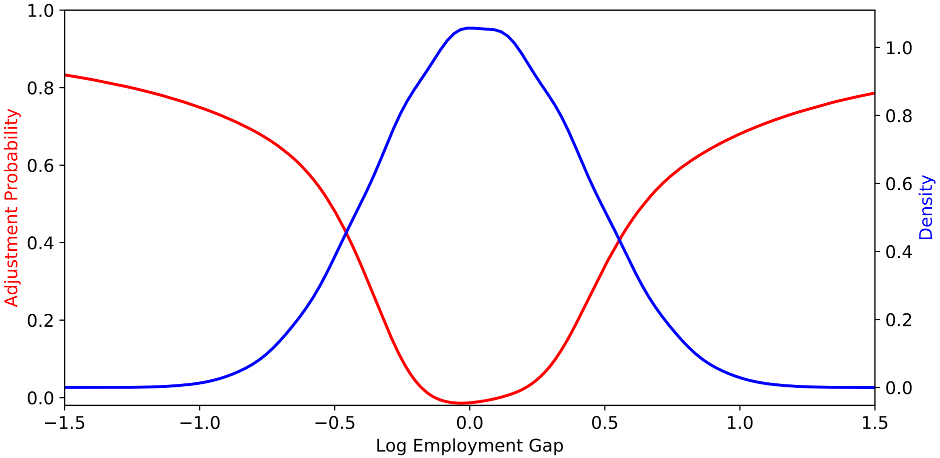
Back

Robustness

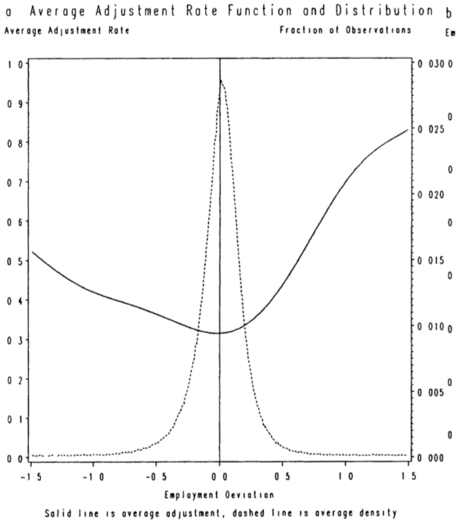


Back

Employment Gaps and Adjustment Probabilities



Caballero, Engel, & Haltiwanger (1997): Figure 1



Back