State Dependence in Labor Market Fluctuations and the Timing of Structural Reforms

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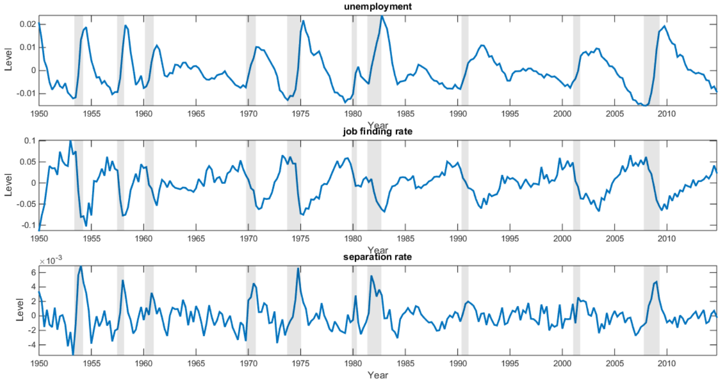
Motivation: Unemployment Rate, Job Finding Rate, Job Separation Rate



Questions

We condition the state dependence on productivity

- What does generate state dependence in labor market variables?
- How does state dependence play out for structural reforms?—i.e., transition dynamics and welfare.

Main Results

- State dependence in labor markets fluctuations
  - Large labor market fluctuations in states with low productivity
  - Unemployment and job separation rise fast above the mean in states with low productivity
  - Unconditional analysis: skewness in labor market variables
- DMP model with endogenous job separation and on-the-job search
  - Source of state dependency: distribution of idiosyncratic productivity and changes in the efficiency threshold
  - Two levels of state dependency: low vs. high productivity and contractionary vs. expansionary shock

Main Results (cont.)

- State dependency and structural reforms:
  - Transitional dynamics of eliminating firing taxes dependent on state of cycle
  - Increase in welfare from reform also higher in states with low productivity because search costs for new workers and OJS are lower

Relation to the literature

- Empirical differences across phases of business cycles
  - Seminal paper by Neftçi (1984), followed by Beaudry and Koop (1993), McKay and Reis (2008), Barattieri et. al (2014), Mumtaz and Surico (2016)
- State dependency in labor market fluctuations via search and matching
  - Abbritti and Fahr (2013), Petrosky-Nadeau and Zhang (2013), Sedlacek (2014)
- State dependency and economic policies
  - Michaillat (2014), Cacciatore and Fiori (2015), Ferraro (2016)

Our contribution: Identify state dependence in labor market fluctuations on aggregate productivity and investigate the effect for the timing of structural reforms.

Important state-dependency in the cyclical dynamics of labor market variables:

1. Magnitude of fluctuations: larger fluctuations of job finding rate, separation rate, and unemployment in states with low productivity.
2. Unconditional analysis: skewness. Right skewness in the separation rate and unemployment rate (in levels and growth rates). Left skewness in the job finding rate not significant (levels).

Larger fluctuations in all variables when cyclical component of productivity is below its median.

	Levels			Growth Rates		
	p$< 50^{th}$ percentile	p$> 50^{th}$ percentile	$\sigma_{<50}/\sigma_{>50}$	p$< 50^{th}$ percentile	p$> 50^{th}$ percentile	$\sigma_{<50}/\sigma_{>50}$
Unemployment	0.146	0.120	1.23	0.0829	0.0401	2.06
Job Finding Rate	0.037	0.034	1.07	0.0240	0.0192	1.25
Separation Rate	0.0021	0.0013	1.57	0.0575	0.0497	1.16
Employment	0.009	0.007	1.32	0.0051	0.0023	2.15
Output	0.022	0.016	1.34	0.0153	0.0090	1.71
Productivity	0.012	0.009	1.25	0.0099	0.0074	1.34

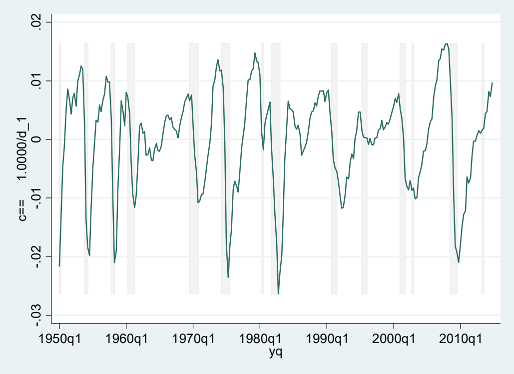
growth rates

Regressions

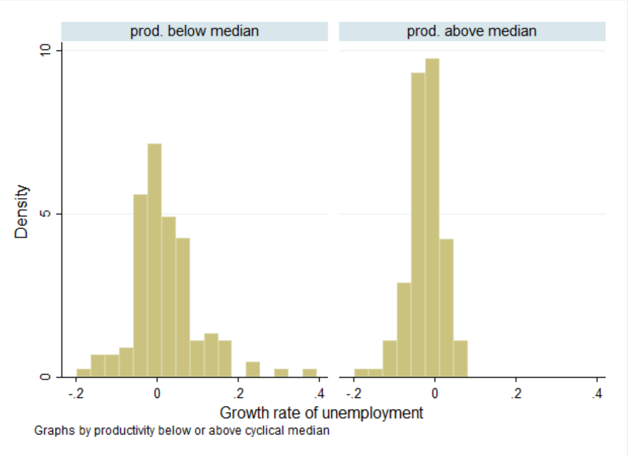
Variables	(1) log U_t	(2) JFR_t	(3) SR_t	(4) log E_t
log p_t	-4.121***	0.797***	-0.094***	0.240***
	(0.445)	(0.171)	(0.0126)	(0.0253)
High-p_t	-0.002	0.001	-0.000	-0.000
	(0.007)	(0.002)	(0.000)	(0.000)
log p_t*High-p_t	2.766***	-0.812***	0.073***	-0.173***
	(0.632)	(0.247)	(0.019)	(0.036)
log p_{t-1}	-0.214	0.349	0.0132	0.072**
	(0.009)	(0.003)	(0.000)	(0.000)
High-p_{t-1}	0.002	-0.002	0.000	0.000
	(0.631)	(0.248)	(0.018)	(0.035)
log p_{t-1}*High-p_{t-1}	0.393	0.0349	-0.0181	-0.0712**
	(0.559)	(0.215)	(0.016)	(0.032)
Lagged dependent	0.883***	0.777***	0.333***	0.876***
	(0.024)	(0.034)	(0.059)	(0.022)
Constant	-0.013**	0.003	-0.000	0.001***
	(0.006)	(0.002)	(0.000)	(0.000)
Observations	259	259	259	259
R-squared	0.890	0.767	0.470	0.911

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

States with low productivity: sharp changes in unemployment



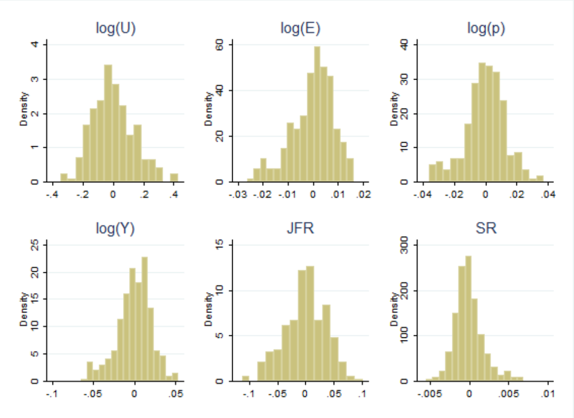
The distribution of the unemployment rate in states with high and low productivity



growth rates

Unconditional analysis: skewness, histograms

Histograms of quarterly averages for the period 1950:I-2014:IV.



growth rates

Unconditional analysis: skewness test

Positive skewness of unemployment and separation rate (in levels and growth rates) and negative skewness of job finding rate (in levels)

	Skewness	
	Levels	First Differences
Unemployment	0.403 (0.060)	1.385 (0.045)
Job Finding Rate	-0.292 (0.103)	-0.385 (0.160)
Separation Rate	0.772 (0.014)	0.478 (0.042)
Employment	-0.666 (0.005)	-1.214 (0.010)
Output	-0.509 (0.023)	-0.098 (0.356)
Productivity	-0.363 (0.052)	0.070 (0.270)

P-values for one-tailed Bai and Ng (2005) test in parenthesis. Series are HP-filtered with a smoothing parameter equal to 1,600.

DMP model, key features

- Standard DMP similar to Fujita and Ramey (2012)
- Households of mass 1, supply labor inelastically to firms
- Matching function that accounts for OJS
- Aggregate productivity: $\ln a_{t+1} = \rho \ln a_t + \epsilon_{t+1}$,
- Individual productivity: new hires draw $x \sim \mathsf{F}[x]$, incumbent workers get new x with probability λ each period
- Nash bargaining for wage: fraction ϕ of surplus goes to worker
- Job creation: firms post vacancies v_t to recruit for $t+1$
- Job destruction: exogenous with probability s and endogenous when $x < \underline{x(a_t)}$
- On-the-job search: workers can pay cost k^s to search for new job

The Matching Function

$$m_t = m(u_t + \psi_t, v_t) = \gamma v_t^{\eta}(u_t + \psi_t)^{1-\eta}, \quad 0 < \eta < 1$$

By CRS, defining $\theta_t = v_t/u_t$:

$$q(\theta_t) = \frac{m_t}{v_t} = m(\theta_t, 1)$$

$$p(\theta_t) = \frac{m_t}{u_t + \psi_t} = m(1, \theta_t)$$

Value Functions

The value of unemployment is:

$$U(a_t) = b + \beta \mathbb{E}_{a_{t+1}|a_t} \Big\{ U(a_{t+1}) + p(\theta_t) \phi \int_{x_L}^{x_H} S(a_{t+1}, x') \mathsf{dF}[x'] \Big\}, \tag{1}$$

The value of a vacancy is:

$$V(a_t) = -k + \beta \mathbb{E}_{a_{t+1}|a_t} \Big\{ V(a_{t+1}) + q(\theta_t)(1-\phi) \int_{x_L}^{x_H} S(a_{t+1}, x') \mathsf{dF}[x'] \Big\}. \tag{2}$$

Job Creation Condition

$V(a_t) = 0$, for all t, the job-creation condition:

$$\frac{k}{q(\theta_t)} = \beta(1-\phi)\mathbb{E}_{a_{t+1}|a_t}\Big\{\int_{x_L}^{x_H} S(a_{t+1}, x')\mathsf{dF}[x']\Big\}. \qquad (3)$$

OJS

$$S(a_t, x) = \max\{S^{n,c}(a_t, x), S^{s,c}(a_t, x), 0\},$$

Continuing surplus without OJS

$$S^{n,c}(a_t, x) = a_t x - b + \beta \mathbb{E}\Big\{(1-s)\Big((1-\lambda)S(a_{t+1}, x) + \lambda \int_{x_L}^{x_H} S(a_{t+1}, x') dF[x']\Big) - p(\theta_t)\phi \int_{x_L}^{x_H} S(a_{t+1}, x') \mathsf{dF}[x']\Big\},$$

OJS

Continuing surplus with OJS

$$
\begin{aligned}
S^{s,c}(a_t, x) = {} & a_t x - k^s - b \\
& + \beta \mathbb{E}\Big\{ \Big(1 - p(\theta_t)\overline{F[\underline{x_{t+1}}]}\Big)(1-s)\Big[(1-\lambda)S(a_{t+1}, x) \\
& \qquad + \lambda \int_{x_L}^{x_H} S(a_{t+1}, x') dF[x']\Big]\Big\}.
\end{aligned}
$$

On-the-job search

$$
S^{n,c}(a_t, x^s(a_t)) \leq S^{s,c}(a_t, x^s(a_t))
$$

Productivity threshold

Threshold for endogenous separation pins down $\underline{x(a_t)}$:

$$S^{s,c}(a_t, \underline{x(a_t)}) = 0$$

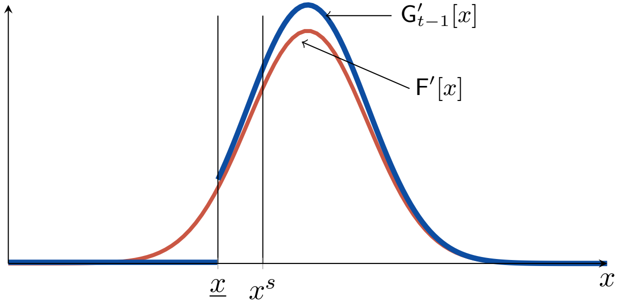
Negative relation between a_t and $\underline{x(a_t)}$.

Free-entry condition for job creation pins down θ_t:

$$\frac{k}{q(\theta_t)} = (1-\phi)\beta\mathbb{E}_t\Big\{\int_{x_L}^{x_H} S(a_{t+1}, x')\mathsf{dF}[x']\Big\}$$

Theoretical mechanism for state dependence

Comparison between $\mathsf{F}'[x]$ and $\mathsf{G}'_t[x]$



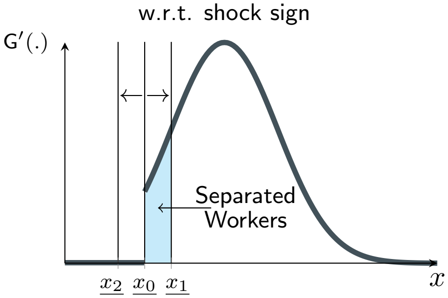
$\mathsf{F}'[x]$ (red line) is the the p.d.f. of the distribution of idiosyncratic productivity among new matches. $\mathsf{G}'_t[x]$ (blue line) is the time-variant p.d.f. of idiosyncratic productivity among incumbent workers.

Model predictions on state dependence

- Job separation rate and unemployment are more responsive to *negative shocks* than to positive shocks.
- Job separation rate and unemployment are more responsive to productivity shocks in *states with low productivity*.

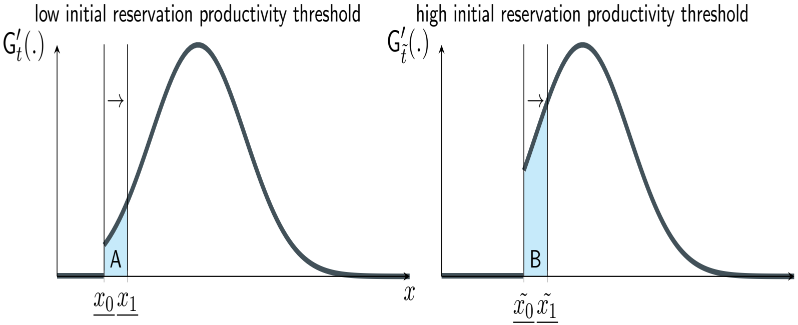
State dependence in the DMP model, sign of the shock

State dependence with the sign of the shocks



State dependence in the DMP model, level of economic activity

State dependence with the level of aggregate productivity



Main results

- Solve the model non-linearly calibration
- Aggregate simulated moments in line with conventional performance of search models details
- Volatility of unemployment larger in states with low productivity and negative shocks
- Skewness of growth rates comparable to data
- State dependence important for the effect of labor market protection policies

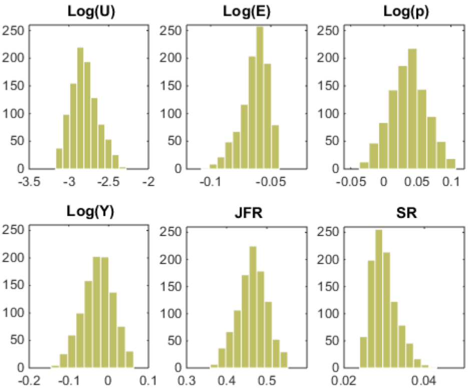
State dependence in the magnitude of labor fluctuations

Simulated series and state dependence in labor market variables

	Levels			Growth Rates		
	p$< 50^{th}$ percentile	p$> 50^{th}$ percentile	$\sigma_{<50}/\sigma_{>50}$	p$< 50^{th}$ percentile	p$> 50^{th}$ percentile	$\sigma_{<50}/\sigma_{>50}$
Unemployment	0.0921	0.0792	1.17	0.0657	0.0578	1.14
Job Finding Rate	0.0237	0.0222	1.08	0.0188	0.0174	1.08
Separation Rate	0.0017	0.0012	1.41	0.0017	0.0012	1.47
Employment Rate	0.0079	0.0051	1.58	0.0056	0.0035	1.62
Output	0.0188	0.0164	1.16	0.0144	0.0126	1.14
Productivity	0.0112	0.0116	0.978	0.0091	0.0093	0.980

Unconditional distribution in the model

Simulated distribution of labor market variables



The distributions are computed from a simulation of 12,000 weekly periods aggregated into 1,000 quarterly observations.

Skewness of quarterly averages in simulated variables.

	Skewness	
	Levels	First Differences
Unemployment	0.180	0.159
Job Finding Rate	-0.082	-0.023
Separation Rate	0.519	0.400
Employment	-0.579	-0.195
Output	-0.175	-0.048
Productivity	0.035	0.017

Calibration Aggregate moments

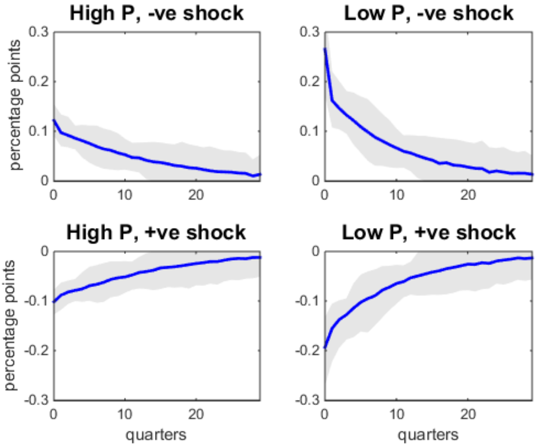
Sources of state dependency

The model identifies two mechanisms for state-dependent labor market fluctuations:

1. Larger response of labor market variables to shocks in the state with low productivity
2. Larger response of the job separation rate and unemployment rate in response to a contractionary shock

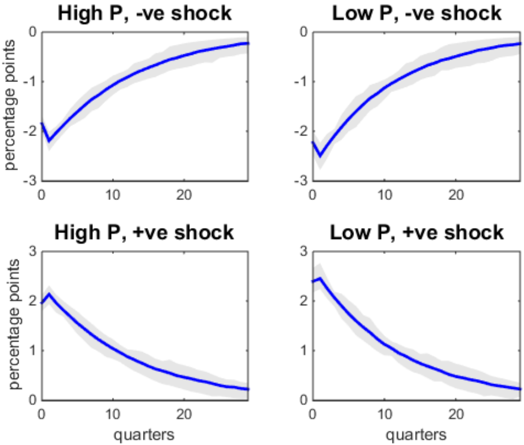
Generalized IRF's: Separation rate

Response of the unemployment to a one-standard-deviation shock:
High-P$=95^{th}$ percentile, Low-P$=5^{th}$ percentile IRF details



Generalized IRF's: Job finding rate

Response of the unemployment to a one-standard-deviation shock:
High-P$=95^{th}$ percentile, Low-P$=5^{th}$ percentile IRF details



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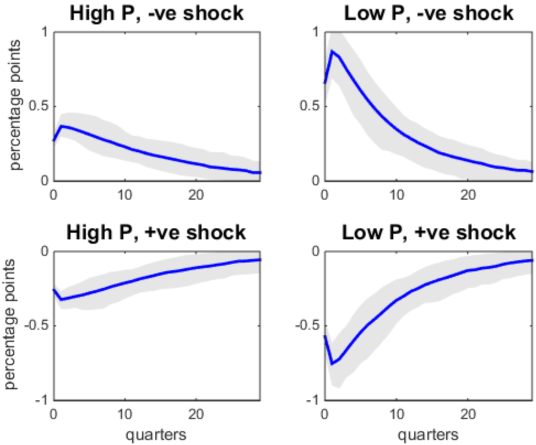


State dependence and structural reforms

- Include a distortionary firing tax in the economy : $\tau = 0.15 \rightarrow 5\%$ of average quarterly wage
- Establish the long-run effect of the layoff tax
- What is the effect of eliminating it during a recession vs. during a boom?
- Compute the transition of the economy if the firing tax is abolished when productivity is 90^{th} and 10^{th} percentiles
- Does welfare improvement of the reform vary with the business cycle?

- Surplus of an old match S^O will differ from that of a new match S^N
- $S^N(a,x) \neq S^O(a,x)$ because new matches don't need to be fired
- Reservation productivity levels will also differ: $\underline{x^N} > \underline{x^O}$
- Tax creates wedge between threshold of new and existing workers
- Inefficiency: The firm retains existing workers that otherwise will be fired and does not employ new workers that otherwise will be hired

Surplus from continuing employment without OJS

$$S^{N,n}(a_t,x) = a_t x - b + \beta \mathbb{E}\Big\{(1-s)\Big((1-\lambda)S^{O}(a_{t+1},x) + \lambda \int_{x_L}^{x_H} S^{O}(a_{t+1},x')dF[x']\Big) - \tau - p(\theta_t)\phi \int_{x_L}^{x_H} S^{N}(a_{t+1},x')dF[x']\Big\},$$

$$S^{O,n}(a_t,x) = S^{N,n}(a_t,x) + \tau,$$

Surplus from continuing employment with OJS

$$S^{N,s}(a_t, x) = a_t x - k^s - b + \beta \mathbb{E}\Big\{ \Big(1 - p(\theta)\overline{F[\underline{x_{t+1}}]}\Big)(1-s)\Big((1-\lambda)S^O(a_{t+1}, x) + \lambda \int_{x_L}^{x_H} S^O(a_{t+1}, x')dF[x']\Big) - \tau \Big\},$$

$$S^{O,s}(a_t, x) = S^{N,c}(a_t, x) + \tau.$$

The long-run effect of labor protection

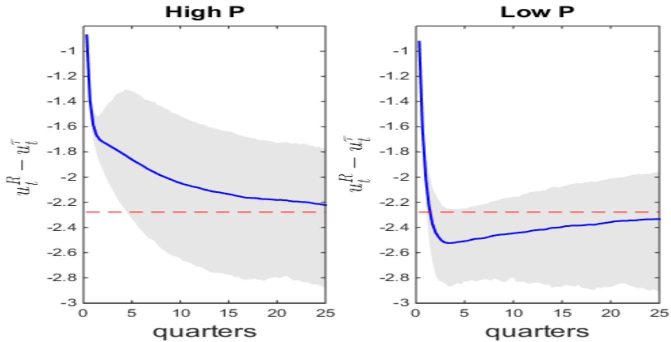
- Lower threshold for incumbent workers $\underline{x}^O$ discourages separations
- Higher recruiting standard $\underline{x}^N$ lowers recruiting AND discourages OJS:
  - Firm lower vacancies $\rightarrow$ further fall in JFR
  - Fewer workers escape separation by finding new job, which offsets the direct effect of τ on the job separation rate
- Job creation falls sharply, job separation remains constant

Long-run levels

Long-run mean of key labor market variables in the baseline model and in the model with firing taxes

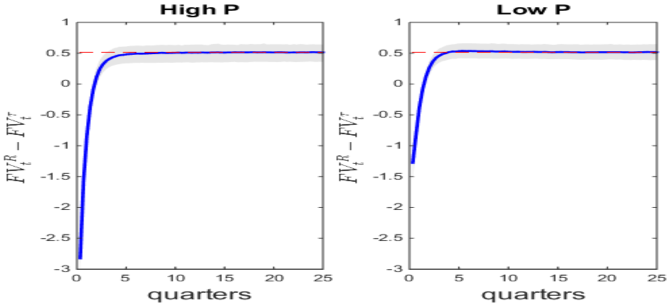
	Baseline $\tau = 0$ (1)	Layoff tax $\tau = 0.15$ (2)
Unemployment rate	0.068	0.087
Job finding rate	0.445	0.324
Separation Rate	0.030	0.030
Job to job rate	0.032	0.012
On the job search	0.066	0.034
Employment Rate	0.932	0.913
Vacancies	0.179	0.158
V/U	2.832	1.919
Productivity	1.000	1.004

Unemployment: effect of unannounced elimination of the tax



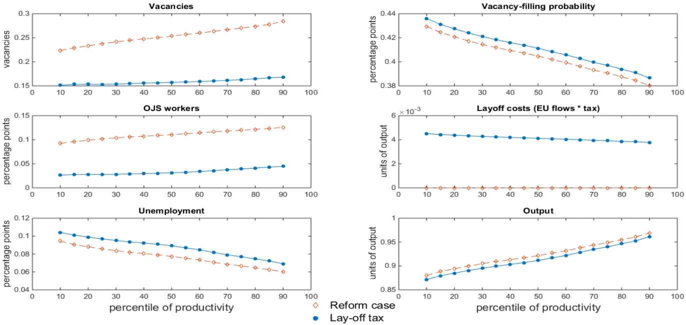
transition rates vacancies

Welfare: effect of un-announced elimination of the tax



$$\Delta \mathrm{FV}_t = \left(a_t \int_{x_L}^{x_H} x \ \mathrm{d}e_t^R(x) + bu_t^R - kv_t^R - k^s \phi_t^R\right)$$
$$- \left(a_t \int_{x_L}^{x_H} x \ \mathrm{d}e_t^\tau(x) + bu_t^\tau - kv_t^\tau - k^s \phi_t^\tau - EU_t^\tau \tau\right)$$

Total mass of job seekers and percentage of OJS workers among job seekers across the simulated distribution of average labor productivity.



Lower short-run welfare fall in bad times due to lower rise in vacancies, lower tightness, and lower share of OJS workers.

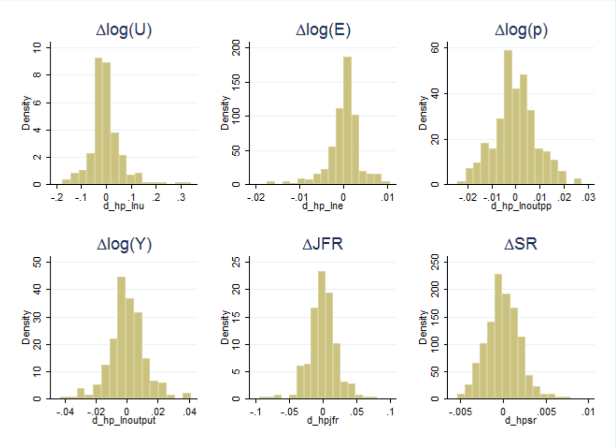
Conclusion

- Labor market variables display important state dependence:
  - Magnitude and persistence of fluctuations larger in states of low aggregate productivity
- DMP model with idiosyncratic productivity and OJS isolates important sources of state dependence
  - Key mechanism based on changes in the job separation rate
  - Two sources of time dependence: low vs. high productivity and contractionary vs. expansionary shock
- Structural reforms: if done in states with low aggregate productivity faster decrease in unemployment and lower short-term costs

Thank you!

Empirical state dependence: stylized facts I

Histograms of quarterly first differences 1950:I-2014:IV.



back

Counter-cyclical volatility: growth rates

	Levels			Growth Rates		
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Unemployment	0.146	0.120	1.23	0.0829	0.0401	2.06
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Output	0.022	0.016	1.34	0.0153	0.0090	1.71
Productivity	0.012	0.009	1.25	0.0099	0.0074	1.34

back

Based on the job destruction and creation conditions we can compute:

- The history-dependent measure $e_t(x)$ of incumbent workers over individual productivity x; back
- The job separation rate (SR_t) and job finding rates (JFR_t).

Productivity distribution among incumbent workers

History-dependent measure $e_t(x)$ of incumbent workers:

$$e_{t+1}(x) = p(\theta_t)(1-e_t(x_H))(F[x]-F[\underline{x}_{t+1}])+p(\theta_t)(F[x]-F[\underline{x}_{t+1}])e_t(x_t^s \ldots$$
$$+ (1-s)\Big[\lambda(F[x]-F[\underline{x}_{t+1}])\Big(e_t(x_H) - p(\theta_t)\overline{F[\underline{x}_{t+1}]}e_t(x_t^s)\Big)$$
$$+ (1-\lambda)\Big(e_t(x) - e_t(\underline{x}_{t+1})\Big)\Big(1 - p(\theta_t)\overline{F[\underline{x}_{t+1}]}\Big)\Big].$$

For the non-searching workers, with $x > x_t^s$:

$$e_{t+1}(x) = p(\theta_t)(1-e_t(x_H))(F[x]-F[\underline{x}_{t+1}])+p(\theta_t)(F[x]-F[\underline{x}_{t+1}])e_t(x_t^s \ldots$$
$$+ (1-s)\Big[\lambda(F[x]-F[\underline{x}_{t+1}])\Big(e_t(x_H) - p(\theta_t)\overline{F[\underline{x}_{t+1}]}e_t(x_t^s)\Big)$$
$$+(1-\lambda)\Big(e_t(x)-e_t(x_t^s)+(1-p(\theta_t)\overline{F[\underline{x}_{t+1}]})(e_t(x_t^s)-e_t(\underline{x}_{t+1}))\Big)\Big].$$

back

History-dependent distribution $G_t(x)$ of incumbent workers:

$$G_t(x) = \text{Pr}\Big(X < x \Big| h(a^t)\Big) = \frac{e_t(x)}{e_t(x_H)}$$

back

Calibration summary

Consistent with literature, mostly follows Fujita and Ramey (2012) (use λ and σ_x to match autocor. and st.dev. of SR).

Parameter	Description	Value
β	Discount factor	$0.953^{(1/12)}$
κ	Vacancy cost	0.17
κ_s	OJS cost	0.128
b	Flow value of unemployment	0.71
η	Elasticity of matching with respect to vacancies	0.5
γ	Matching function efficiency parameter	0.445
ϕ	Worker's bargaining power	0.5
s	Exogenous job separation rate	0.0105
λ	Arrival rate of individual productivity shocks	0.24
x_L	Lower bound of individual productivity shocks	0
x_H	Upper bound of individual productivity shocks	1.55
μ_x	Mean of log individual productivity shocks	-0.087
σ_x	Standard deviation of individual productivity shocks	0.17
ρ	Persistence parameter of aggregate productivity	0.973
σ	Standard deviation of aggregate productivity shocks	0.0068

simulated moments back

Second Moments and Correlations

back

Table: Labor market statistics in the data and the model

Data	**p**	**U**	**JFR**	**SR**	**E**	**V**	**V/U**	**Y**
σ_x	0.013	0.137	0.089	0.055	0.009	0.138	0.262	0.021
Corr(p_t,x_t)	1.000	-0.229	0.212	-0.556	0.232	0.394	0.316	0.661
Corr(x_t,x_{t-1})	0.763	0.891	0.840	0.535	0.899	0.907	0.905	0.843
Model	**p**	**U**	**JFR**	**SR**	**E**	**V**	**V/U**	**Y**
σ_x	0.013	0.101	0.063	0.055	0.008	0.040	0.137	0.021
Corr(p_t,x_t)	1.000	-0.970	0.978	-0.951	0.929	0.927	0.991	0.991
Corr(x_t,x_{t-1})	0.769	0.822	0.781	0.647	0.821	0.586	0.778	0.794

Notes: U is the unemployment rate, JFR is the job finding rate, SR is the separation rate, E is the employment rate, Y is output, p is labor productivity. The moments are computed as the means of 1,000 simulations of 3,320 weekly. After discarding the first 200 observations in each simulation, the remaining series are aggregated at quarterly frequency and have the same length as the period 1950:I-2014:IV.

Generalized Impulse-Response Functions

- Simulate model 10,000 periods
- Obtain all $[p_t,\ u_t,\ e_t(x)]$ at 90$^{\text{th}}$ and 10$^{\text{th}}$ percentiles of simulated productivity distribution
- Non-linear IRFs: 1,000 simulations

- Draw from chosen sample, and draw a sequence of future p_t
- Positive vs. negative productivity shock

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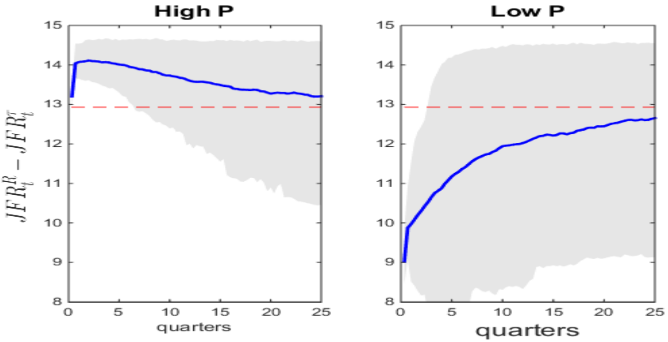
JFR: effect of un-announced elimination of the tax



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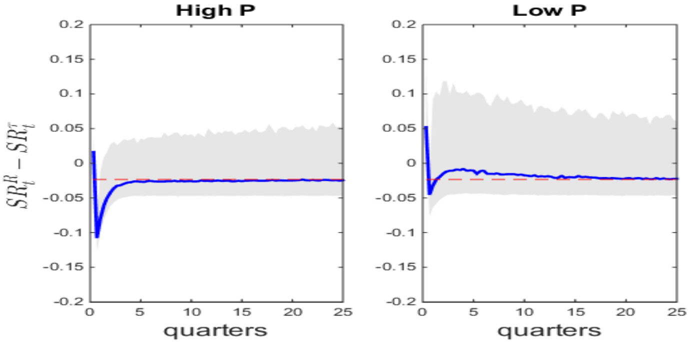
SR: effect of un-announced elimination of the tax



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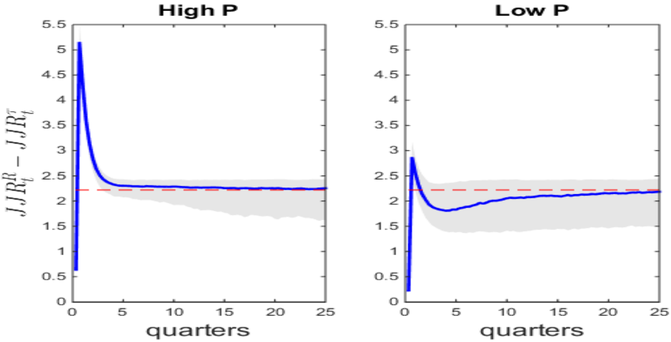
JJR: effect of un-announced elimination of the tax



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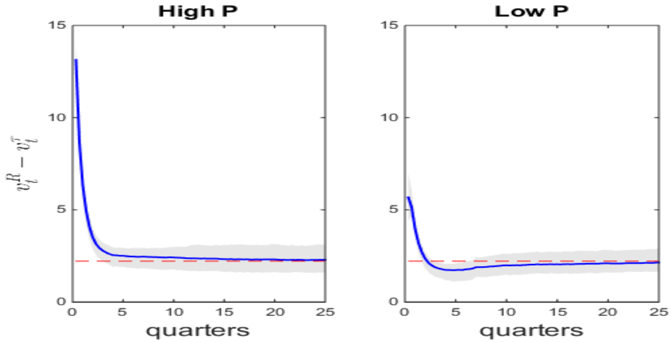
Vacancies: effect of un-announced elimination of the tax



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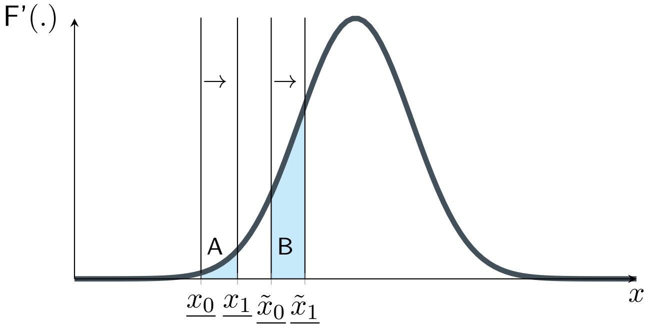
Illustrative diagram of mechanism driving state dependence with respect to level



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