

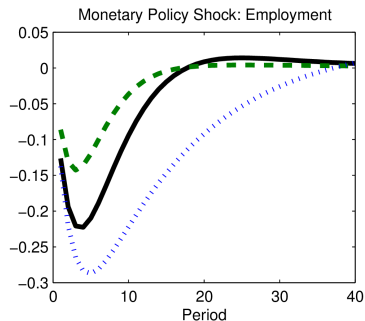
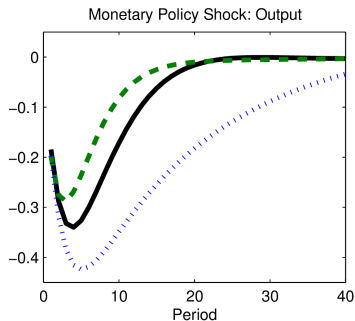
Policy Shocks and Wage Rigidities: Evidence from the Regional Impact of National Shocks¹

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Barcelona GSE Summer Forum - ADEMU

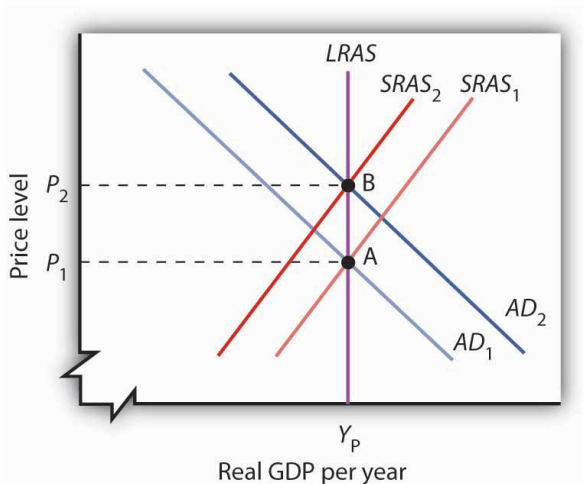
¹The views expressed in this paper are those of the authors and do not reflect those of the Federal Reserve Board.

Monetary Policy and Wage Rigidity



Impulse response to monetary policy shock in Smets and Wouters (2007)

Monetary Policy and Wage Rigidity



This Paper

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- Calculate **downward wage rigidity** by U.S. state
 - ▶ Micro data from Current Population Survey
 - ▶ Significant differences across states/over time
 - ▶ Increases with minimum wages, government size, mobility, firm size

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- Estimate state-level effect of **national shocks** conditional on rigidity
 - ▶ Monetary policy has large effects on output/unemployment in rigid states, almost neutral in flexible states
 - ▶ Mixed effects for taxation shocks

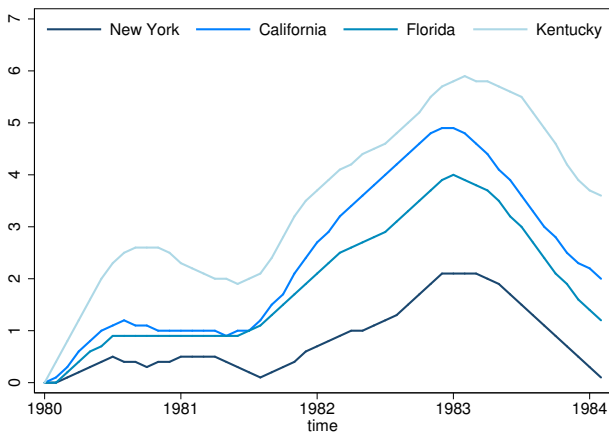
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 - ▶ Mixed effects for taxation shocks
- Impact of institutional variables
 - ▶ Effects of **minimum wages** and **union legislation** on shock impact

Motivation

Figure: Unemployment after Volcker Disinflation



This Paper

Our focus on the United States:

- States form a fiscal and monetary union
 - ▶ Ex-ante identical shocks through federal monetary and fiscal policy
 - ▶ Shocks likely exogenous to differences in state-level rigidity
 - ▶ Nominal depreciation does not form a channel of automatic stabilization within the union

This Paper

Our focus on the United States:

- States form a fiscal and monetary union
 - ▶ Ex-ante identical shocks through federal monetary and fiscal policy
 - ▶ Shocks likely exogenous to differences in state-level rigidity
 - ▶ Nominal depreciation does not form a channel of automatic stabilization within the union
- Less sensitive to omitted variable bias than cross-country analysis
 - ▶ Homogeneity: states have similar institutional and legislative framework
 - ▶ Data on wages collected the same way

Related Work

Effect of wage rigidity on business cycles:

- Wage rigidity and business cycle amplitude
 - ▶ Blanchard and Wolfers (2000): Interaction between common shocks and labor market institutions explains European unemployment.
 - ▶ E.g. Bauer et al. (2007), Ehrlich and Montes (2013), Kaur (2014), Gnocchi et al. (2015), Pischke (2016)

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- Rigidity and policy shocks:
 - ▶ Gorodnichenko and Weber (2016)
 - ▶ Bernanke (1995), Bernanke and Carey (1996)
 - ▶ Olivei and Tenreyro (2007) and (2010)

Contribution: **direct evidence** on the relevance of wage rigidity

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Contribution: **direct evidence** on the relevance of wage rigidity

Evidence of downward rigidity in wages: [Summary](#)

State-level analysis of monetary policy: e.g. Carlino & Defina (1998), Beraja et al. (2017)

Calculating Rigidity: Data

Micro data from Current Population Survey between 1979 and 2014

- Wage changes derived using panel structure:
 - ▶ Households randomly selected, legally required to respond
 - ▶ Rolling sample: MORG sample for year-on-year change CPS Structure
 - ▶ Validate matches using following Madrian and Lefgren (1999)

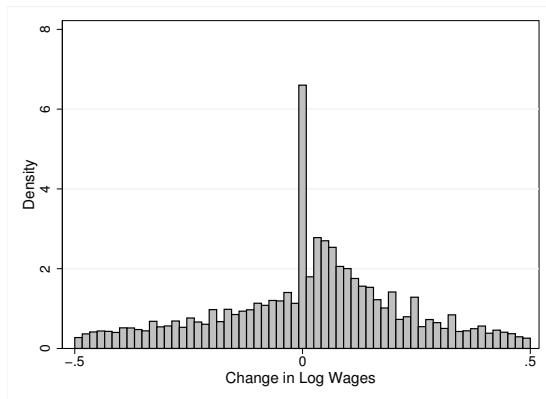
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 - ▶ Rolling sample: MORG sample for year-on-year change CPS Structure
 - ▶ Validate matches using following Madrian and Lefgren (1999)
- Resulting sample
 - ▶ Keep observations with wage observation in both years
 - ▶ 1.38 million observations of wage changes
 - ▶ Average of 838 per state per year

Calculating Rigidity: Distribution

Figure: Distribution of Wage Changes in CPS micro data 1980-2014



Calculating Rigidity: Measure

Measure taken from Dickens et al. (2007)

- Fraction of Wage Cuts Prevented (FWCP)
- Quantifies freeze-spike in nominal wage-change distribution
- The FWCP compares the number of nominal wage freezes to the number of nominal wage cuts:

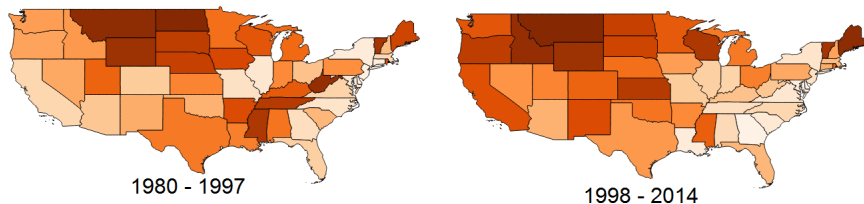
$$FWCP_{t,s}^n = \frac{f_{t,s}^n}{f_{t,s}^n + c_{t,s}^n}$$

- Has been frequently used in recent work
 - ▶ e.g. Holden and Wulfsberg (2008), Dias et al. (2013), Centeno and Novo (2012)

Downward Real Wage Rigidities

Calculating Rigidity: Results

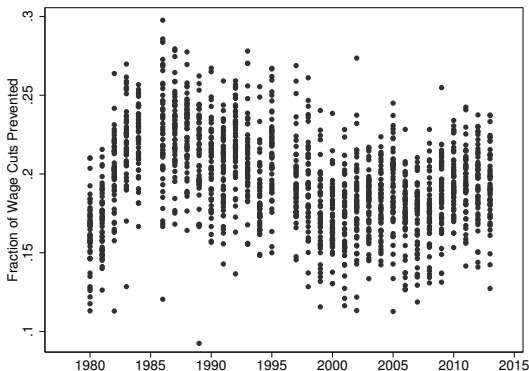
Figure: Relative Downward Nominal Rigidity Across States



Light: lowest rigidity in year. Dark: highest rigidity in year.

Calculating Rigidity: Over Time

Figure: Distribution of Downward Nominal Wage Rigidities, 1980-2014



Note: 1985 and 1996 are dropped due to missing panel identifiers.

Average DNWR by States

Table: Estimations Labor Market Institutions and Wage Rigidity

	(1)	(2)	(3)	(4)
Δ Mobility	-0.063*** (0.015)		-0.078*** (0.017)	-0.063*** (0.016)
Δ Firm Size	-0.002 (0.002)		0.001 (0.001)	-0.001 (0.002)
Minimum Wage	0.141*** (0.024)		0.077*** (0.022)	0.138*** (0.024)
Unionization	0.071*** (0.025)			0.067*** (0.025)
Union Power	0.010*** (0.002)			0.010*** (0.002)
Δ % Employment Services		0.202*** (0.039)	0.225*** (0.040)	0.023 (0.044)
Δ % Employment Government		0.187** (0.08)	0.186** (0.082)	0.008 (0.082)
Δ Education		-0.012 (0.009)	-0.012 (0.010)	-0.047*** (0.010)
Observations	1,122	1,581	1,479	1,122
R^2	0.071	0.018	0.042	0.084

Note: *, **, *** denote significance at the 10, 5, and 1%, respectively. Clustered standard errors (by state) in parentheses. Estimates obtained using Fixed Effects estimators.

Part II: Effect of Rigidity on Shock Impact

Now: relate wage rigidity to **impact of national policy shocks**

- Standardize the rigidity measure
 - ▶ Borrow methods from state-dependence literature
 - ▶ Highest rigidity in given year: 1
 - ▶ Lowest rigidity in given year: 0

Part II: Effect of Rigidity on Shock Impact

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- Standardize the rigidity measure
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 - ▶ Highest rigidity in given year: 1
 - ▶ Lowest rigidity in given year: 0
- Two types of shocks
 - ▶ Monetary policy shocks
 - ▶ Fiscal shocks: taxation

Monetary Policy: Estimation Equation

Main estimations:

- Local Projection Method (Jordá, 2005) in a panel STLPM:

$$y_{s,t+h} = F(z_{s,t})(\alpha_h^R + \beta_h^{R'} x_{s,t} + \gamma_h^R i_{s,t}) + (1 - F(z_{s,t}))(\alpha_h^F + \beta_h^{F'} x_{s,t} + \gamma_h^F i_{s,t}) + \phi_h' c_{s,t} + \eta_{s,t+h}, \quad (1)$$

- $y_{s,t}$ = economic activity (unemployment, coincident, GDP).
- $F(z_{s,t})$ = probability of being in rigid state $\in [0, 1]$.
- $i_{s,t}$ = Interest rate shock (percentage points)
- $x_{s,t}$ = controls: lags of $i_{s,t}$, $y_{s,t}$, FFR, labor market controls.

Monetary Policy Shocks

- Main shocks: Romer and Romer (2004)
 - ▶ Derive intended FFR changes from narrative minutes of FOMC meetings between 1981 and 2008
 - ▶ Regress intended changes on changes in internal (Greenbook) forecasts
 - ▶ Shocks: defined as divergence from standard response (errors in regressions)

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- Robustness: Announcement shocks
 - ▶ Gorodnichenko and Weber (2016): change in federal funds futures around FOMC press releases
 - ▶ Gertler and Karadi (2015): proxy regression approach, regress announcement on Greenbook forecast

Control Variables

Basic estimation controls for:

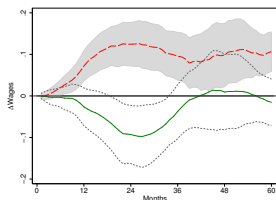
- Controls recommended by Ramey (2016)
 - ▶ Time trends, level of FFR, lagged shock
- State fixed effect
- Labour market control variables
 - ▶ unionization rate, employment in public and service sectors, firm size, etc.

Controls for financial frictions and mortgages added in robustness check

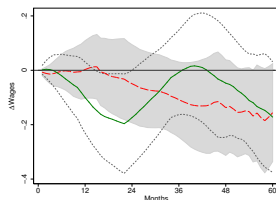
Response of Wages

Important validity check

- Response of wages to shocks should be largest in flexible states
- Difference in particular for **contractionary** shocks
- Response of median wage to Romer and Romer (2004) shock:



(a) All Shocks



(b) Expansionary Shocks

Note: Rigid state in red dashed line; Flexible state in green solid line. 90% intervals.

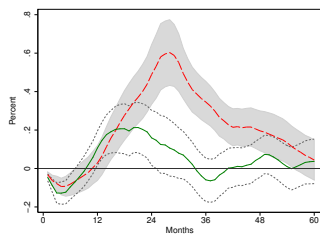
Main Results

Dependent variables:

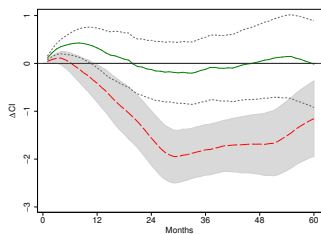
- Unemployment Rate
 - ▶ Local Area Unemployment Statistics
 - ▶ Seasonally adjusted
- Coincident Index
 - ▶ Only monthly indicator of state-level activity, from Philadelphia Fed
 - ▶ Seasonally adjusted
 - ▶ Combines 4 components in 1 index:
 - ★ Nonfarm payroll employment, avg. hours worked in manufacturing, unemployment rate, real salary disbursements
 - ▶ Highly correlated with BEA quarterly state GDP > 2004
- State GDP (annual)

Main Results

Figure: Monetary policy shocks in Rigid and Flexible States, 1980–2008



(a) Unemployment Rate



(b) Coincident Index

Note: Rigid state in red dashed line; Flexible state in green solid line. 90% intervals.

figures/Unconditional IRFs

Robustness Checks

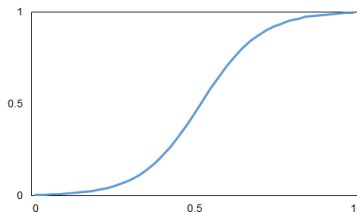
- Outlier treatment
- Dependent variable
 - ▶ Conditional effect monetary policy on state GDP
 - ▶ Problem: have to accumulate shocks annually
- Compare contractionary and expansionary shock
 - ▶ *Downward* rigidity should mainly effect *contractionary* shocks
- Additional control variables
 - ▶ Mortgage and financial friction controls
- Alternative monetary policy shocks

Robustness Checks: Outlier Treatment

- Follows Auerbach and Gorodnichenko 2012, Ramey and Zubairy, 2014:

$$F(z_{s,t-1}) = \frac{\exp\left[\xi \frac{z_{s,t-1} - c_z}{\sigma_z}\right]}{1 + \exp\left[\xi \frac{z_{s,t-1} - c_z}{\sigma_z}\right]}$$

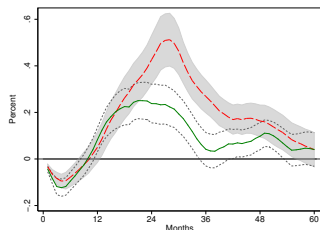
Figure: Shape of $F(z)$ in baseline, c = mean rigidity



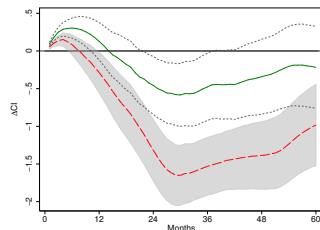
x axis: input rigidity. y axis: $F(z)$

Robustness Checks: Outlier Treatment

Figure: Monetary policy shocks in Rigid and Flexible States, 1980 -2008



(a) Unemployment Rate



(b) Coincident Index

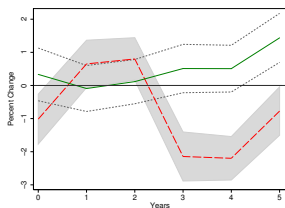
Note: Rigid state in red dashed line; Flexible state in green solid line. 90% intervals.

Robustness Checks

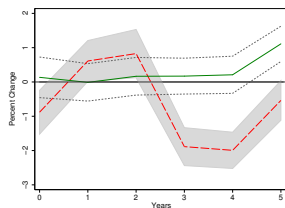
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Robustness Checks: Dependent Variable

Figure: Monetary policy shocks in Rigid and Flexible States: GDP, 1980–2006



(a) Standard transformation



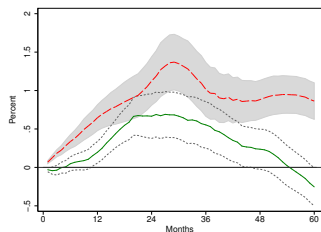
(b) Logit transformation

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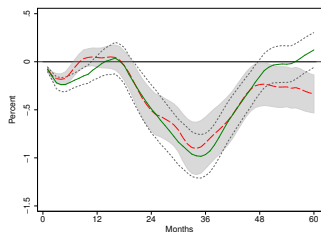
Robustness Checks

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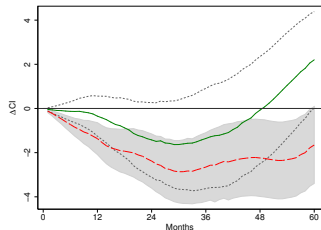
Robustness: Contractionary vs Expansionary



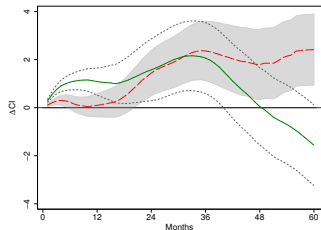
(a) Contractionary, UR



(b) Expansionary, UR



(c) Contractionary, CI

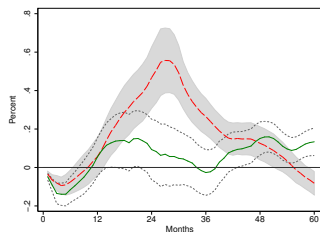


(d) Expansionary, CI

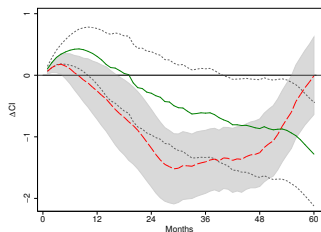
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- Alternative monetary policy shocks

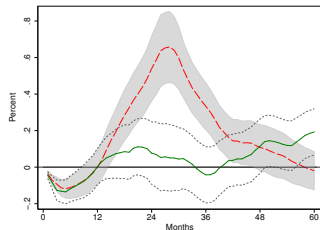
Robustness Checks: Additional Controls



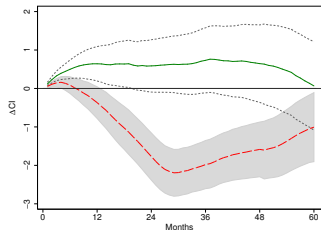
(e) Mortgage and CPI, UR



(f) Mortgage and CPI, CI



(g) Financial frictions, UR

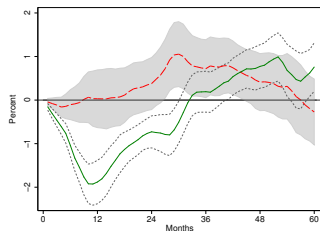


(h) Financial frictions, CI

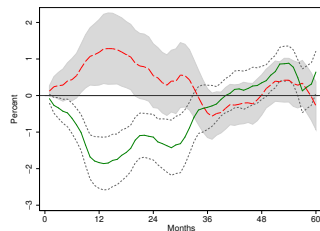
Robustness Checks

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- Additional control variables
 - ▶ Mortgage and financial friction controls
- **Alternative monetary policy shocks**

Robustness Checks: Announcement Shocks



(a) GW (2016), tight interval, 94-07



(b) GK (2015), FFR fut., 88-07

Institutional Factors

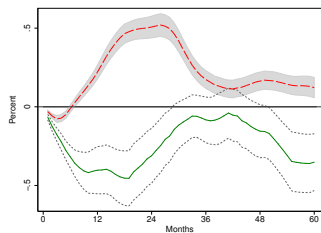
Measure of rigidity so far:

- Fraction of cuts prevented measured from wage-change distribution
- Potential bias from CPS sampling or mismeasurement wage changes

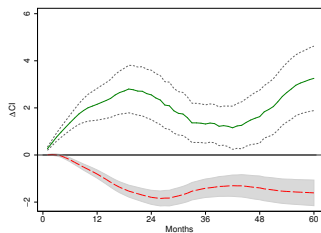
Alternative: legislative factors affecting wage rigidity

- Minimum wages (measured as minimum-to-median ratio)
- Right-to-work legislation (rigid if not in law)

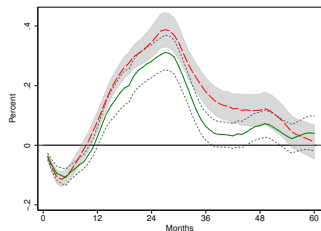
Institutional Factors: Results



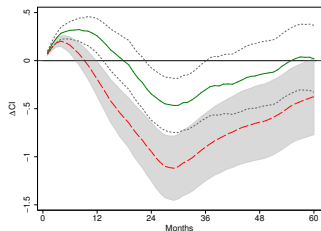
(a) Minimum wages, UR



(b) Minimum wages, CI



(c) Right-to-work legislation, UR



(d) Right-to-work legislation, CI

Fiscal Policy

Is the response to fiscal shock also larger in rigid states?

- Fiscal spending shocks are heterogeneous across states
- Use federal taxation shocks instead

Fiscal Policy

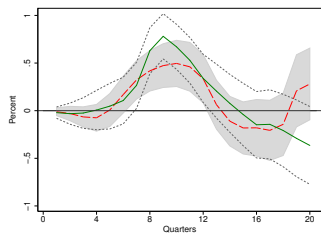
Is the response to fiscal shock also larger in rigid states?

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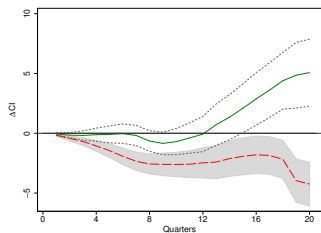
Shocks from Romer and Romer (2010)

- Quarterly exogenous tax shocks from narrative records (congressional speeches, presidential reports)
- Exogenous if not aimed at short-term growth
- Measure expected tax change as percentage of GDP

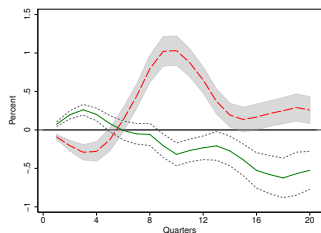
Fiscal Shocks: Romer and Romer (2010) ex. tax shocks



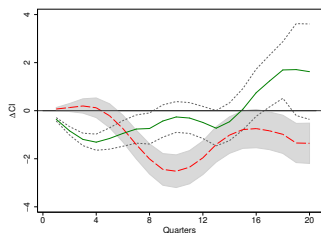
(a) Unemployment, Standard



(b) CI, Standard

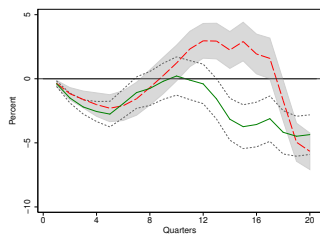


(c) Unemployment, Min. wage

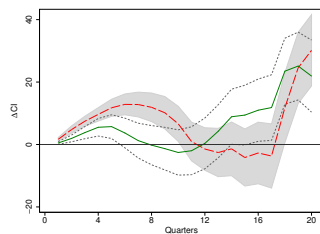


(d) CI, Min. wage

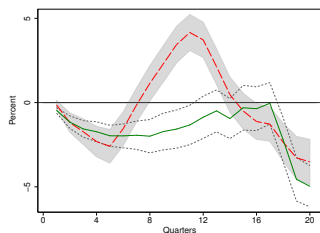
Fiscal Shocks: Leeper et al. (2012) tax exp. shocks



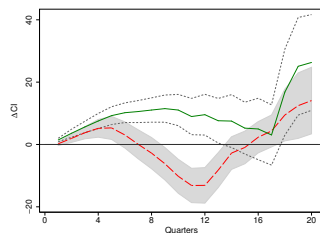
(a) Unemployment, Standard



(b) CI, Standard



(c) Unemployment, Min. wage



(d) CI, Min. wage

Conclusion

This paper:

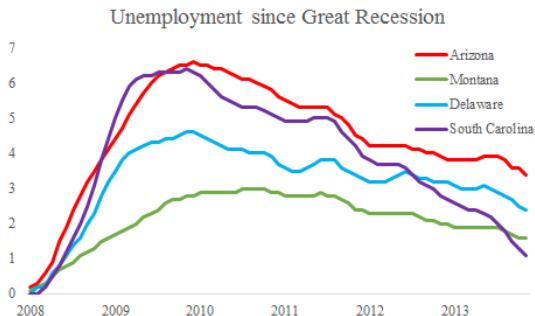
- Calculate downward nominal wage rigidity at U.S. state level
- Compare impact of national shocks at states with low and high rigidity
- Assess effect of legislation on minimum wages and union power

Results:

- Monetary policy shocks have significant effect on unemployment and output only if wages are rigid
- Result especially strong for contractionary shocks
- Similar results for minimum wages, right-to-work laws

Motivation

Figure: Unemployment since Great Recession



Back to [Presentation](#).

Current Population Survey

Table: Panel Dimension CPS

	Group A		Group B, etc.	
	Year 1	Year2	Year 1	Year 2
Jan			Start Cycle 1	Start Cycle 2
Feb	Start Cycle 1	Start Cycle 2	Included	Included
Mar	Included	Included	Included	Included
Apr	Included	Included	ORG Cycle 1	ORG Cycle 2
May	ORG Cycle 1	ORG Cycle 2		
Jun				
Jul				
Aug				
Sep				
Oct				
Nov				
Dec				

Back to [Presentation](#).

DNWR by State

Average	0.1949	KY	0.1954	OH	0.1967
AL	0.1918	LA	0.1865	OK	0.1965
AK	0.1992	ME	0.2153***	OR	0.2025
AZ	0.1915	MD	0.1717***	PA	0.1954
AR	0.2031	MA	0.1886	RI	0.2046*
CA	0.1963	MI	0.2031	SC	0.1858*
CO	0.1969	MN	0.2034	SD	0.2063**
CT	0.1832**	MS	0.2056**	TN	0.1944
DE	0.1636***	MO	0.1851*	TX	0.1972
DC	0.1512***	MT	0.2200***	UT	0.2027
FL	0.1899	NE	0.2055**	VT	0.2107***
GA	0.1743***	NV	0.1945	VA	0.1834**
HI	0.1981	NH	0.1929	WA	0.1992
ID	0.2080**	NJ	0.1740***	WV	0.2009
IL	0.1824**	NM	0.1998	WI	0.2087**
IN	0.1911	NY	0.1749***	WY	0.2117***
IA	0.2001	NC	0.1831**		
KS	0.2029	ND	0.2128***		

Note: *, ** and *** denote significance from average at the 10, 5, and 1% significance level, respectively. Estimates obtained using a mean-comparison t-test, two-sided.

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Table: Monetary Policy Shock and Fiscal Policy Shock Data Summary Statistics

	Mean	SD	Obs.	Min.	Max.	Source	Type
<i>Dependent Variables</i>							
Unemployment Rate	5.832	5.832	17,136	2.1	18.8	BLS	
Coincident Index	110.625	110.625	16,800	57.527	232.740	Phil. Fed	
Biannual State GDP Growth	5.384	5.148	1478	-12.82	33.50	BEA	
<i>Monetary policy shocks</i>							
Narrative: Monetary policy shocks	0.013	0.297	384	-3.259	1.885	RR (2004)	
Anncmt: tight window	-0.010	0.068	191	-0.438	0.163	GW (2016)	
Anncmt: wide window	-0.010	0.069	191	-0.463	0.152	GW (2016)	
Anncmt: current FFR futures	-0.017	0.062	257	-0.423	0.146	GK (2015)	
Anncmt: 3-month ahead FFR futures	-0.015	0.051	243	-0.290	0.092	GK (2015)	
Anncmt: year-ahead fut. Eurodollar dep.	-0.011	0.058	315	-0.381	0.213	GK (2015)	
<i>Fiscal policy shocks</i>							
Growth in Prime Military Sp. - State	0.024	0.023	1478	-5.111	3.979	NS (2014)	
Growth in Broad Military Sp. - State	0.027	0.026	1478	-5.092	3.991	NS (2014)	
Growth in Prime Military Sp. - National	0.004	0.003	29	-0.449	0.687	NS (2014)	
Growth in Broad Military Sp. - National	0.009	0.008	29	-0.534	0.808	NS (2014)	
<i>Control Variables</i>							
Mobility	0.287	0.046	1836	0.184	0.694	CBS	I(1)
Firm Size	18.75	3.240	1836	10.36	29.32	CBS	I(1)
Minimum Wage	0.424	0.062	1683	0.257	0.670	BLS	I(0)
Unionization	0.144	0.064	1224	0.008	0.348	CPS	I(0)
Union Power	0.562	0.496	1938	0	1	C (2014)	I(0)
% Services	0.684	0.051	1734	0.543	0.822	CPS	I(1)
% Government	0.056	0.027	1734	0.024	0.233	CPS	I(1)
Education	4.058	0.226	1734	3.000	4.547	CPS	I(1)

Related Work

Evidence of rigidity in wages (very incomplete):

- Dickens et al. (2007)
- Bewley (2002)
- Card and Hyslop (1999)
- Altonji and Devereux (1999)
- Lebow, Saks, Wilson (2003)
- Fehr and Goette (2007)
- Kahn (2007)
- Fallick, Lettau, Wascher (2016)

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DNWR and DRWR by State

	<i>FWCPⁿ</i>	<i>FWCP^r</i>		<i>FWCPⁿ</i>	<i>FWCP^r</i>		<i>FWCPⁿ</i>	<i>FWCP_r</i>
<i>Avg.</i>	0.1949	-0.0691	KY	0.1954	-0.1021	OH	0.1967	-0.0922
AL	0.1918	-0.1963***	LA	0.1865	-0.1918**	OK	0.1965	-0.1213
AK	0.1992	-0.1296	ME	0.2153***	-0.0218	OR	0.2025	0.0250
AZ	0.1915	0.0080**	MD	0.1717***	0.0152*	PA	0.1954	-0.0966
AR	0.2031	-0.1098	MA	0.1886	0.0081	RI	0.2046*	-0.0049
CA	0.1963	-0.0465**	MI	0.2031	-0.0806	SC	0.1858*	-0.1608*
CO	0.1969	-0.0013***	MN	0.2034	0.0656***	SD	0.2063**	-0.0235
CT	0.1832**	-0.0191	MS	0.2056**	-0.3255***	TN	0.1944	-0.2001***
DE	0.1636***	-0.0255	MO	0.1851*	-0.0359	TX	0.1972	-0.1154
DC	0.1512***	0.0485**	MT	0.2200***	-0.1162	UT	0.2027	0.0767***
FL	0.1899	-0.0235	NE	0.2055**	-0.0182	VT	0.2107***	0.0283**
GA	0.1743***	-0.1902	NV	0.1945	-0.1678**	VA	0.1834**	-0.0525
HI	0.1981	-0.2365	NH	0.1929	-0.0025	WA	0.1992	-0.0506
ID	0.2080**	-0.0368	NJ	0.1740***	-0.0099	WV	0.2009	-0.1893**
IL	0.1824**	-0.0744	NM	0.1998	0.0180*	WI	0.2087**	-0.0203
IN	0.1911	-0.0919	NY	0.1749***	-0.0546	WY	0.2117***	-0.1309
IA	0.2001	-0.0836	NC	0.1831**	-0.1208**			
KS	0.2029	0.0185*	ND	0.2128***	-0.0670			

*, ** and *** denote $p < 0.10$, 0.05 and 0.001% , respectively.

Estimates obtained using a mean-comparison t-test, two-sided.