Do Greasy Wheels Curb Inequality?

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Federal Reserve Board

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Introduction

Monetary Policy has distributional implications in the labor market

What is the mechanism?

- Direct: differential wage rigidity.
- Indirect: differential labor demands from sectors with differentially sticky prices.

I document evidence for and welfare consequences of differential wage rigidity.

Conceptual Framework for Measurement

What exactly does sticky mean?

Labor contracts are durable.

This implies that all sequences of remitted wages that yield the same present discounted values lead to the same allocations. Becker (1962)

This in turn implies that low wage volatility within employment spells is not necessarily indicative of allocative wage rigidity.
Elsby (2006); Rudanko (2009)

Measuring allocative wage rigidity requires evaluating the sensitivity of both new hire's wages *and* wage-tenure profiles.

Wages and allocations

The allocative wage is a user cost.

$$\textit{User Cost}_t = \overbrace{\mathbb{E}_t \sum_{j=0}^{\infty} \left[\beta^j (1-s)^j w_{t+j,t}\right]}^{PDV_t} - \overbrace{\mathbb{E}_t \sum_{j=1}^{\infty} \left[\beta^j (1-s)^j w_{t+j,t+1}\right]}^{PDV_{t+1}}$$

where $w_{t+j,t}$ is the remitted wage on $t+j$ in a contract formed on t.

(Kudlyak 2014)

Re-arranging for intuition

$$\textit{User Cost}_t = \underbrace{w_{t,t}}_{\substack{\textit{New Hires'} \\ \textit{Wage}}} + \underbrace{\mathbb{E}_t \sum_{j=1}^{\infty} \left[\beta^j (1-s)^j \left(w_{t+j,t} - w_{t+j,t+1}\right)\right]}_{\textit{Expected Wage Wedge}}$$

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Special case:

- Spot market: *user cost*$_t$=*new hires' wage*$_t$=*average wage*$_t$.

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Special case:

- Spot market: *user cost*$_t$=*new hires' wage*$_t$=*average wage*$_t$.

Empirical evidence that the spot market hypothesis fails:

- Beaudry & DiNardo (1991); Davis & von Wachter (2011); Oreopolous et al. (2012); Kudlyak (2014); Basu & House (2016); Schmieder, von Wachter & Heining (2018).

Representative agent: allocative wage more cyclical than remitted wages

Cyclical Indicator =	User Cost of Labor		New Hires' Wage		Ave. Hourly Earnings[c]	
log real GDP[a]	1.94***	(0.17)	0.74***	(0.09)	0.39***	(0.05)
unemployment rate[a]	-2.71***	(0.48)	-1.29***	(0.27)	-0.32**	(0.13)

Note: All regressions control for a quadratic time trend. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

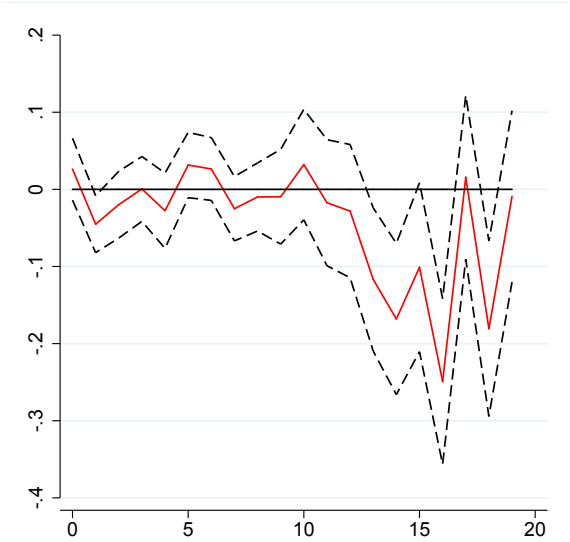
Source: National Longitudinal Study of Youth 1979 and author's calculations.

[a] Detrended using the Hodrick-Prescott filter. Replication using Hamilton (2018) filter.

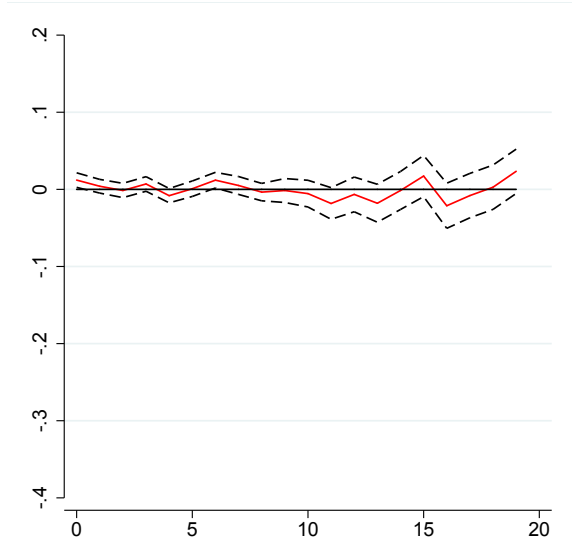
[b] Controlling for experience, industry fixed effects, and individual fixed effects.

Representative Agent: allocative wage most responsive to monetary policy shocks

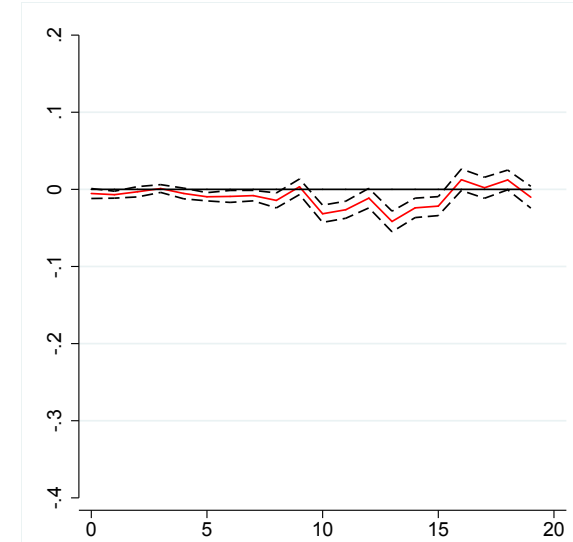
User Cost of Labor



New Hires' Wage



Average Hrly Earnings[a]



Note: 95% confidence interval.

Source: National Longitudinal Study of Youth 1979, Current Population Survey, Greenbooks as cleaned by Coibion et al. (2017), and author's calculations.

Monetary policy shocks identified as in Romer & Romer (2004).

[a] Controlling for experience, industry fixed effects, and individual fixed effects.

Differences across education?

Why should education matter?

More educated workers have more durable employment relationships: More educated workers have more durable employment relationships:

	Separation Rate (yearly)
All	0.29
$<$ High School	0.36
High School / Some College	0.29
$\geq$ Bachelors	0.24

Source: National Longitudinal Survey of Youth 1979 and author's calculations.

Thus, the expected wage wedge is a more consequential:

$$\textit{User Cost}_t = \underbrace{w_{t,t}}_{\substack{\textit{New Hires'} \\ \textit{Wage}}} + \underbrace{\mathbb{E}_t \sum_{j=1}^{\infty} \left[\beta^j (1-s)^j \left(w_{t+j,t} - w_{t+j,t+1}\right)\right]}_{\textit{Expected Wage Wedge}}$$

Measurement

Measuring the Cyclicality of the Allocative Wage

$$ln\ w^i_{t,\tau,E} = c_E + \zeta_E t + \Phi_E X^i_t + \sum_{d=0}^{T} \chi_{d,E} state\ at\ hiring^i_t * tenure^i_{d,t} + \gamma_{c,E} M^i_c + \gamma_{j,E} M^i_j + \alpha^i + \varepsilon^i_{t,E}$$

- α^i is an individual fixed effect,
- t is a linear time trend,
- X^i_t is a vector of time varying individual characteristics (including tenure dummies),
- M_c and M_j proxy for cyclical variation in match quality as in Hagedorn & Manovskii (2013).
- $state\ at\ hiring^i_t$ is equal to the state at hiring in a job spell that persists at time t.
- $tenure^i_{d,t}$ takes a value of 1 if the workers tenure is equal to d at time t.
- $E \in \{< \ high\ school, high\ school\ or\ some\ college, \geq \ college\}$ where education is coded as attainment at the time of hiring.

Measuring the Cyclicality of the Allocative Wage

The percent change in the allocative wage due to a change in the state at the time of hiring:

$$\frac{UC_{s,E} - UC_{n,E}}{UC_{n,E}} = \frac{\bar{w}_{0,s,E} + \sum_{d=1}^{7}\left[\beta^d(1-\bar{s}_E)^d(\bar{w}_{d,s,E} - \bar{w}_{d,n,E})\right] - \bar{w}_{0,n,E}}{\bar{w}_{0,n,E}}$$

$$= \sum_{d=0}^{7}\left[\beta^d(1-\bar{s}_E)^d \frac{\bar{w}_{d,s,E} - \bar{w}_{d,n,E}}{\bar{w}_{0,n,E}}\right]$$

$$= \sum_{d=0}^{7}\left[\beta^d(1-\bar{s}_E)^d \chi_{d,E}\right].$$

- $\bar{s}_E$ is the yearly separation rate within education group,
- and $\beta = 0.97$ is the discount rate, assumed to be independent of education.

Data: National Longitudinal Survey of Youth 1979

- Nationally representative sample of individuals who were between 14 and 21 in 1979.
- Surveyed yearly 1979-1994 and bi-yearly thereafter.
- NLSY constructed "hourly rate of pay" includes includes tips, overtime pay, and bonuses.
- Tenure and job cycle are measured to the week via retrospective diary.

Educational upgrading:

	Percent upgrading education on the job:			
	All years	1979-1988	1989-1998	1999-2008
Attain high school equivalent	1.81	3.35	0.52	0.52
Attain college degree	2.30	5.21	1.06	0.88

Source: National Longitudinal Survey of Youth 1979 and author's calculations.

Allocative Wage Cyclicality by Education

Allocative wage most cyclical for the highly educated

Cyclical Indicator = log real GDP[a]	User Cost of Labor		New Hire's Wage		Ave. Hourly Earnings[b]	
$<$ High School	0.24	(0.35)	0.17	(0.16)	0.16	(0.12)
High School / Some Coll.	1.04^{***}_{*}	(0.22)	0.26^{**}	(0.11)	0.12^{*}	(0.06)
$\geq$ College	1.81^{***}_{**}	(0.61)	0.43	(0.34)	0.17	(0.16)
Observations	55,315		55,315		55,315	

Cyclical Indicator = unemployment rate[a]	User Cost of Labor		New Hire's Wage		Ave. Hourly Earnings[b]	
$<$ High School	-0.37	(0.97)	-0.26	(0.53)	-0.27	(0.31)
High School / Some Coll.	-2.00^{***}	(0.59)	-1.00^{***}	(0.33)	-0.29^{*}	(0.16)
$\geq$ College	-4.29^{***}_{**}	(1.62)	-2.70^{***}_{**}	(0.90)	-0.78^{**}	(0.37)
Observations	53,737		53,737		54,941	

Note: Standard errors in parentheses. *** p$<$0.01, ** p$<$0.05, * p$<$0.1. Statistically different from $<$ High School: $_{**}$ at 5%, $_{*}$ at 10%.

Source: National Longitudinal Study of Youth 1979 and author's calculations.

[a] Detrended using the filter proposed by Hamilton (2018).

[a] Controlling for tenure, experience, industry fixed effects, and individual fixed effects.

Decomposition: Wage-Tenure Effects v.s. Separation Rates

Are differentials strategic or mechanical?

Already observed that highly educated are differentially exposed to the *Expected Wage Wedge*.

$$\textit{User Cost}_t = \underbrace{w_{t,t}}_{\substack{\textit{New Hires'} \\ \textit{Wage}}} + \underbrace{\mathbb{E}_t \sum_{j=1}^{\infty} \left[\beta^j (1-s)^j \left(w_{t+j,t} - w_{t+j,t+1}\right)\right]}_{\textit{Expected Wage Wedge}}$$

Two possibilities:

1. **Mechanical** All workers wage-tenure profiles are equally cyclically sensitive but sensitivity is relatively more important when s is smaller.
2. **Strategic** Lower s increases the efficacy of manipulating the wage-tenure profile in response to shocks.

Wage-Tenure Effects v.s. Separation Rates

Cyclical Indicator = log real GDP[a]	User Cost of Labor		Holding Constant: Separation Rate		Holding Constant: Wage-Tenure Effects	
$<$ High School	0.24	(0.35)	0.27	(0.39)	1.79***	(0.16)
High School / Some Coll.	1.04***	(0.22)	1.03***	(0.21)	1.95***	(0.18)
$\geq$ College	1.81***	(0.61)	1.53***	(0.53)	2.18***	(0.21)
Observations	55,315		55,315		55,315	

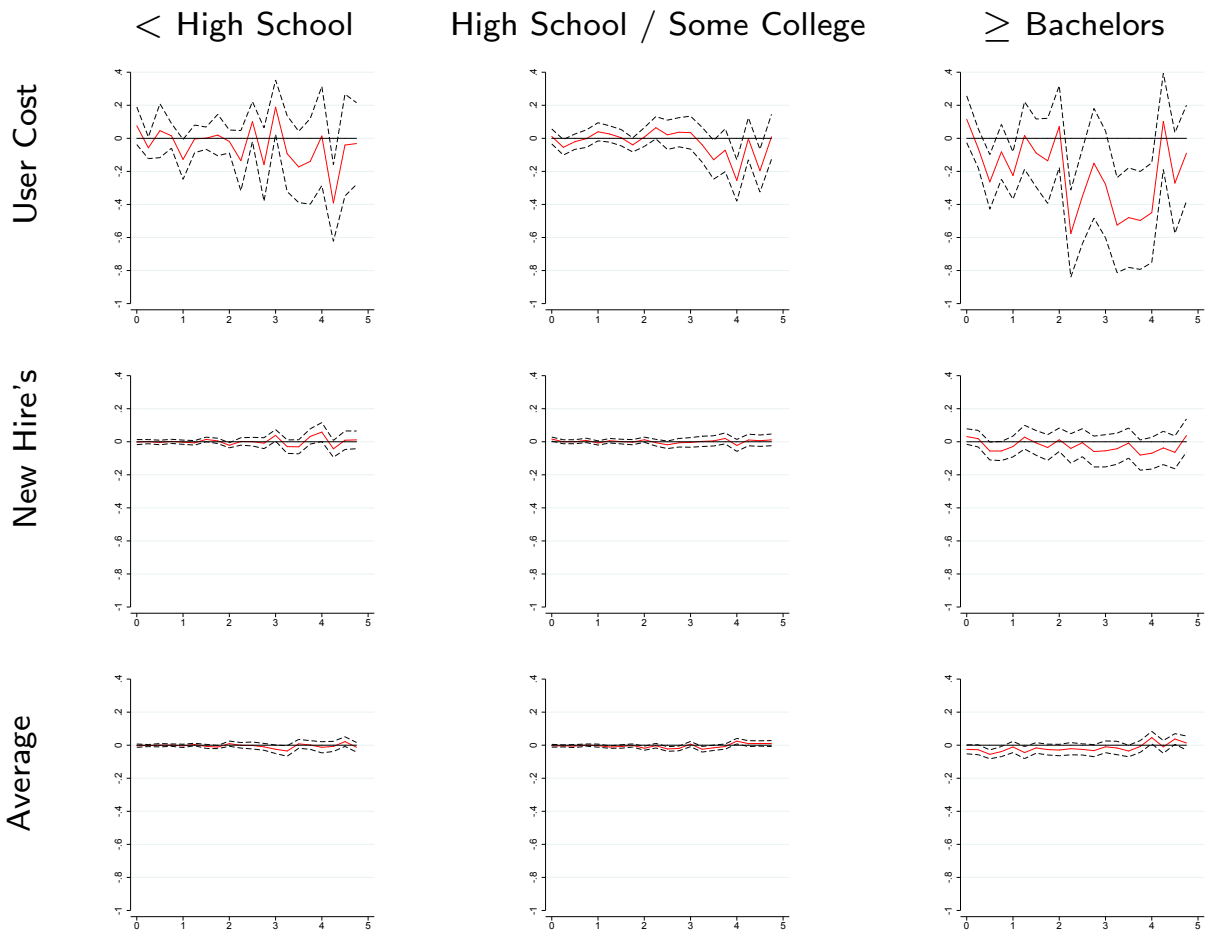
Cyclical Indicator = unemployment rate[a]	User Cost of Labor		Holding Constant: Separation Rate		Holding Constant: Wage-Tenure Effects	
$<$ High School	-0.37	(0.97)	-0.45	(1.12)	-2.50***	(0.43)
High School / Some Coll.	-2.00***	(0.59)	-2.00***	(0.59)	-2.73***	(0.49)
$\geq$ College	-4.29***	(1.62)	-3.98***	(1.40)	-3.05***	(0.58)
Observations	55,737		55,737		55,737	

Note: All regressions control for a quadratic time trend. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: National Longitudinal Study of Youth 1979 and author's calculations.

Response of Allocative Wages and Employment to Monetary Policy Shocks

Impulse Response: 100 b.p. Monetary Policy Contraction



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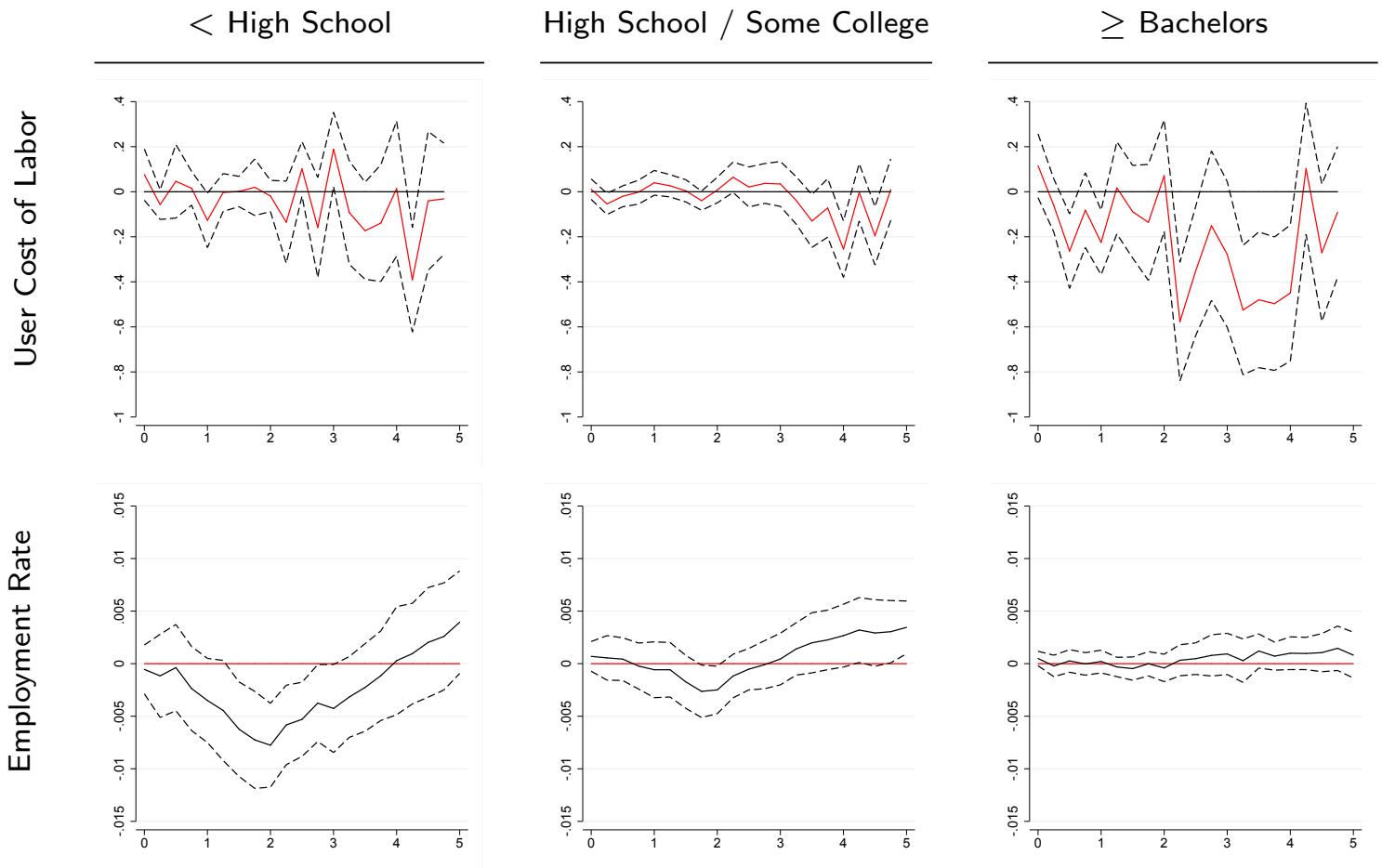

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Source: National Longitudinal Study of Youth 1979, Current Population Survey, Greenbooks as cleaned by Coibion et al. (2012), and author's calculations.

Punch line

Monetary loosening:

1. **decreases** employment inequality by increasing the employment of the less educated more than of the more educated.
2. **increases** inequality in the allocative wage by increasing the allocative wage of the highly educated more than of the less educated.

Remember, on average highly educated workers enjoy higher wages and higher rates of employment.

Earnings, Consumption & Welfare

Environment

A nearly standard New Keynesian framework:

- Both price and wage rigidity.
- Augmented to include heterogenous labor varieties.

Intermediate producers' technology:

$$y_t = z_t k_t^{\alpha} \left({l_{1,t}}^{\gamma} {l_{2,t}}^{(1-\gamma)} \right)^{(1-\alpha)},$$

where l_1 and l_2 are differentiated by the sensitivity of their respective wages to aggregate demand shocks.

Factor Demands and Earnings

Elasticity of demand for each labor variety wrt an aggregate demand shock:

$$\varepsilon_{L_1,y} = 1 + \Upsilon + \alpha\varepsilon_{R,y} + (1-\alpha)\left[\gamma\varepsilon_{W_1,y} + (1-\gamma)\varepsilon_{W_2,y}\right] - \varepsilon_{W_1,y}$$
$$\varepsilon_{L_2,y} = 1 + \Upsilon + \alpha\varepsilon_{R,y} + (1-\alpha)\left[\gamma\varepsilon_{W_1,y} + (1-\gamma)\varepsilon_{W_2,y}\right] - \varepsilon_{W_2,y}$$

$\Longrightarrow$ composition of employment varies.

Elasticity of earnings for all varieties wrt an aggregate demand shock:

$$\varepsilon_{E_1,y} = \varepsilon_{E_2,y} = 1 + \Upsilon + \alpha\varepsilon_{R,y} + (1-\alpha)\left[\gamma\varepsilon_{W_1,y} + (1-\gamma)\varepsilon_{W_2,y}\right],$$

$\Longrightarrow$ variation in earnings is identical!

Consumption

Suppose workers pool earnings within variety.

Variety-specific households solve the program:

$$\max_{C_{v,t},L_{v,t},S_{v,t}} E_0 \sum_{t=0}^{\infty} \beta^t \left[u(C_{v,t}) - \phi v_v(L_{v,t})\right]$$
$$s.t.\ P_t C_{v,t} + S_{v,t+1} \leq S_{v,t}(1+i_t) + \Pi_{v,t} + W_{v,t} L_{v,t}$$

$\implies$ if $\varepsilon_{\Pi_1,y} = \varepsilon_{\Pi_2,y}$ then $\varepsilon_{C_1,y} = \varepsilon_{C_2,y}$

Output-gap Equivalent Representative Worker

Elasticity of marginal cost wrt an aggregate demand shock:

$$\varepsilon_{mc,y} = \alpha\varepsilon_{R,y} + (1-\alpha)\left[\gamma\varepsilon_{W_1,y} + (1-\gamma)\varepsilon_{W_2,y}\right]$$

This suggests:

$$\varepsilon_{W_{rep},y} = \gamma\varepsilon_{W_1,y} + (1-\gamma)\varepsilon_{W_2,y}$$

Together with the equivalence of earnings elasticities, I have:

$$\varepsilon_{L_{rep},y} = \gamma\varepsilon_{L_1,y} + (1-\gamma)\varepsilon_{L_2,y}$$

$\Longrightarrow$ The output-gap equivalent representative worker has wage and labor supply elasticities that are a linear combination of the varieties with weights determined by the respective output elasticities.

Welfare

Result 1

$\varepsilon_{W_{rep},y}$ captures the stabilizing effects of wage rigidity, à la Galí (2013); the propagating effects of wage rigidity, á la Christiano, Eichenbaum and Evans (2005); ... etc.

Welfare

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Result 2

In the heterogenous worker economy:

- period utility is lower and
- the welfare costs of fluctuations are higher

than in the output-gap equivalent representative worker economy.

Welfare Costs of Fluctuations

Welfare costs of fluctuations can be measublue using data on only data on C, and L_v and the method of Galí et al. (2007).

To a second order approximation:

$$\textit{Welfare Cost} = \mathbb{E}\left[\frac{U(C,L_v)-U(\bar{C},\bar{L}_v)}{\bar{U}_C\bar{C}}\right] \approx \left(\frac{1-\sigma}{2}\right)\mathbb{V}[\tilde{c}] - (1-\Psi)\left(\frac{1+\phi}{2}\right)\mathbb{V}[\tilde{l}_v]$$

Note:

1. requires assuming that all output is consumed, and
2. requires calibrating the constant-gap wage and price markups.

Welfare Costs of Fluctuations (1976-2018)

	Frisch Elasticity $= 1$		*Frisch Elasticity* $= 5$	
	EIS $= 1$	$= 5$	*EIS* $= 1$	$= 5$
Heterogeneous Workers Economy				
Aggregate	0.0039	0.0590	0.0118	0.0669
	1	*1*	*1*	*1*
$<$ High School	0.0100	0.0650	0.0299	0.0850
	2.52	*1.10*	*2.52*	*1.27*
High Sch. / Some Coll.	0.0036	0.0587	0.0109	0.0659
	0.92	*0.99*	*0.92*	*0.99*
$\geq$ Bachelors	0.0006	0.0557	0.0019	0.0570
	0.16	*0.94*	*0.16*	*0.85*
Output-Gap Equivalent Representative Worker Economy				
	0.0034	0.0584	0.0102	0.0652
	0.86	*0.98*	*0.86*	*0.98*

Note: Italics report the ratio to the aggregate welfare cost of fluctuations in the heterogeneous workers economy.

Source: From the USECON database I use compensation per hour (LXNFC) and real and nominal output (LXNFO and LXNFI), which refer to the nonfarm business sector; Nondurable and services consumption (CNH + GSH), drawn from the respective NIPA series; and implicit price deflator (LXNFI). Unemployment and hours by educational attainment are constructed from the Current Population Survey Basic Monthly and Outgoing Rotation files respectively. Output elasticities are recoveblue using the NLSY data. Author's calculations following the method of Gali et al. (2007).

Conclusions

Conclusions

Allocative wages of highly educated are more flexible than those of less educated.

This implies that high educated employment is less responsive to shocks than lowly educated employment.

Monetary loosening decreases employment inequality but increases allocative wage inequality.

Welfare consequences wage rigidity are understated by more than 15 percent when heterogeneity is ignored.

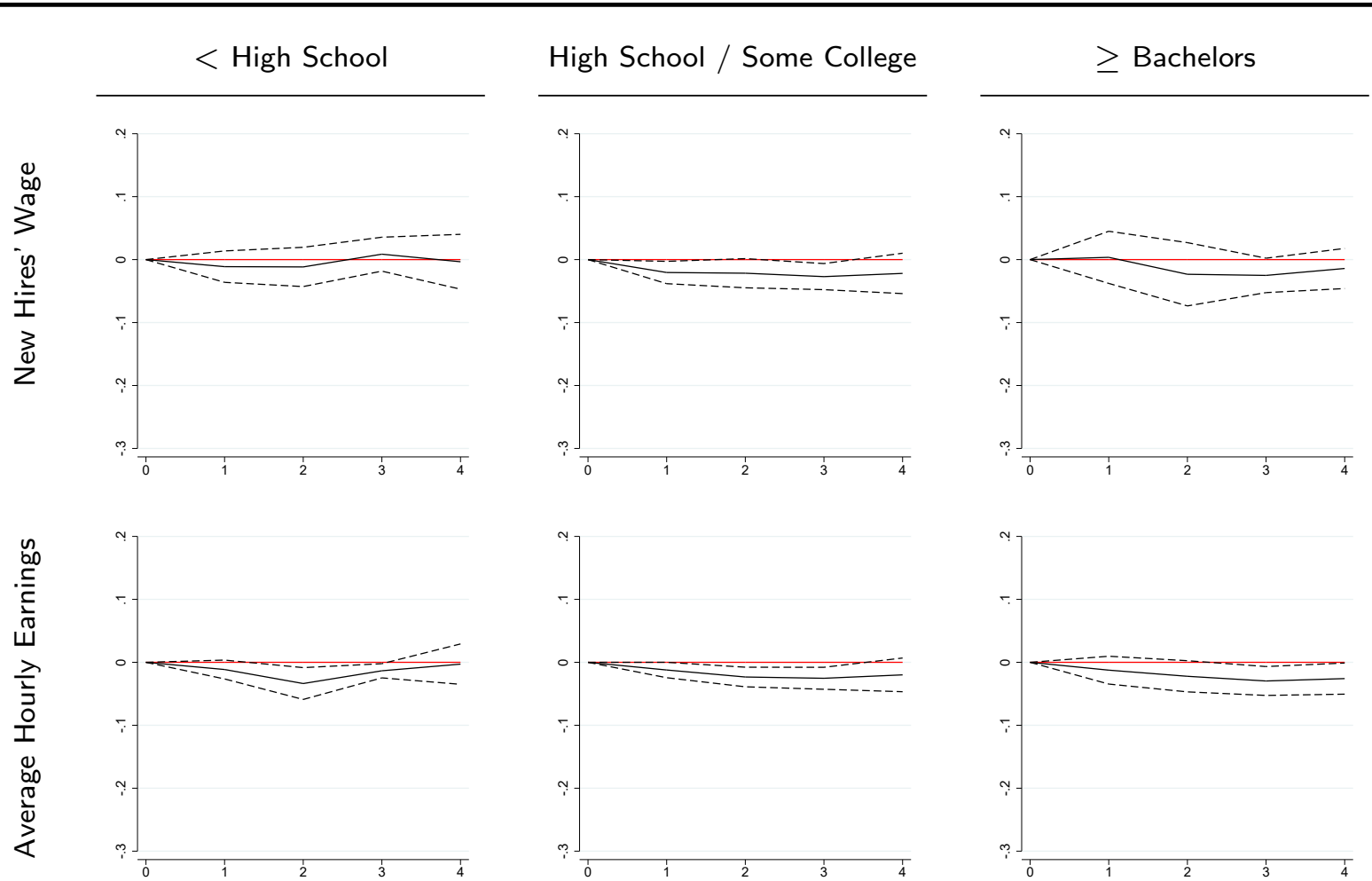
Appendix

Caveats & Agenda

All these results assume frictionless financial markets!

- What if this fails for workers?
- For firms?
- What does this mean for unconventional monetary policy?

Impulse Response: 100 b.p. Monetary Policy Contraction



Note: 95% confidence interval.

Source: National Longitudinal Study of Youth 1979, Current Population Survey, Greenbooks as cleaned by Coibion et al. (2017), and author's calculations.

Cyclicality of Wages: Hamilton (2018) Filter

Cyclical Indicator =	User Cost of Labor		New Hires' Wage		Ave. Hourly Earnings[b]	
log real GDP[a]	0.50	(0.53)	0.06	(0.27)	0.02	(0.21)
unemployment rate[a]	-3.90**	(1.49)	-1.95**	(0.75)	-1.43**	(0.60)
Observations	29		29		29	

Note: All regressions control for a quadratic time trend. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: National Longitudinal Study of Youth 1979 and author's calculations.

[a] Detrended using the Hamilton (2018) filter.

[b] Controlling for experience, industry fixed effects, and individual fixed effects.

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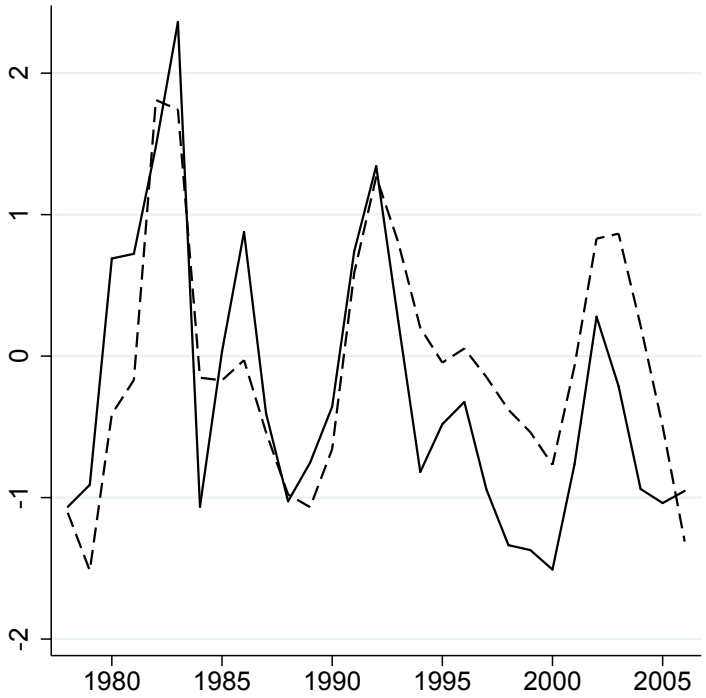
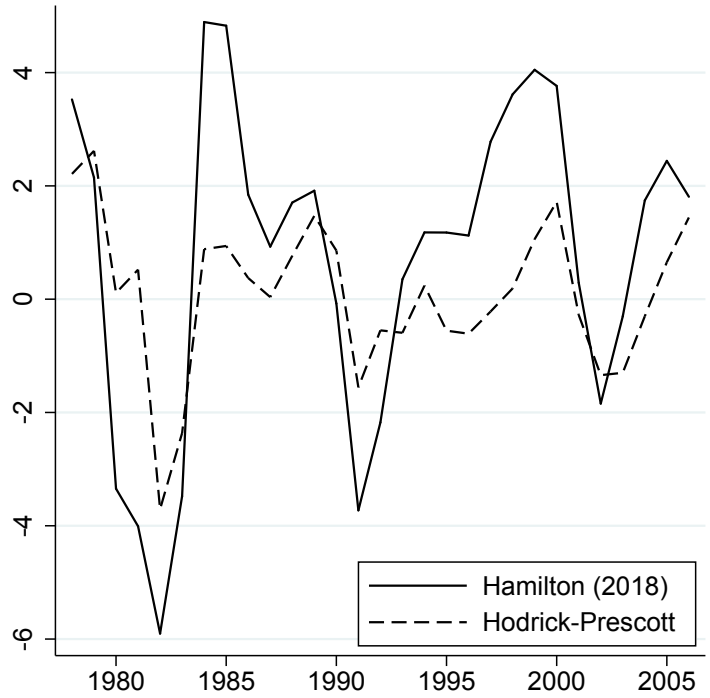
Hodrick-Prescott vs Hamilton (2018) Filter

Unemployment Rate



log(Real GDP)



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Is Higher Cyclicality due to Cyclical Match Quality?

Checking Robustness to Match Quality

I follow Hagedorn & Manovskii (2013) and proxy for match quality:

- M_c = cumulative labor market tightness job-cycle start to job start.
- M_j = cumulative labor market tightness during completed tenure.

$$ln\ w^i_{t,\tau,E} = c_E + \alpha^i_E + \zeta_E t + \Phi_E X^i_t + \sum_{d_0=1}^{T}\sum_{d=d_0}^{T} \chi_{d_0,d,E} D^i_{d_0,d} + \gamma_c M_c + \gamma_j M_j + \varepsilon^i_{t,E}$$

If match quality drives the result then all the χ should be nil when controlling for M_c and M_j.

Cyclicality of Wages: Without Controlling for Match Quality

Cyclical Indicator = log real GDP[a]	User Cost of Labor		New Hire's Wage		Ave. Hourly Earnings[b]	
$<$ High School	-0.26	(0.58)	-0.31	(0.25)	-0.26**	(0.14)
High School / Some Coll.	0.95*	(0.55)	-0.03	(0.27)	0.01	(0.21)
$\geq$ College	3.02*	(1.53)	1.28**	(0.49)	0.25	(0.31)
Observations	29		29		29	

Cyclical Indicator = unemployment rate[a]	User Cost of Labor		New Hire's Wage		Ave. Hourly Earnings[b]	
$<$ High School	0.06	(1.86)	-0.56	(0.82)	-0.15	(0.48)
High School / Some Coll.	-6.22***	(1.33)	-1.39*	(0.81)	-1.29**	(0.61)
$\geq$ College	-9.31*	(4.68)	-6.33***	(1.14)	-2.46***	(0.80)
Observations	29		29		29	

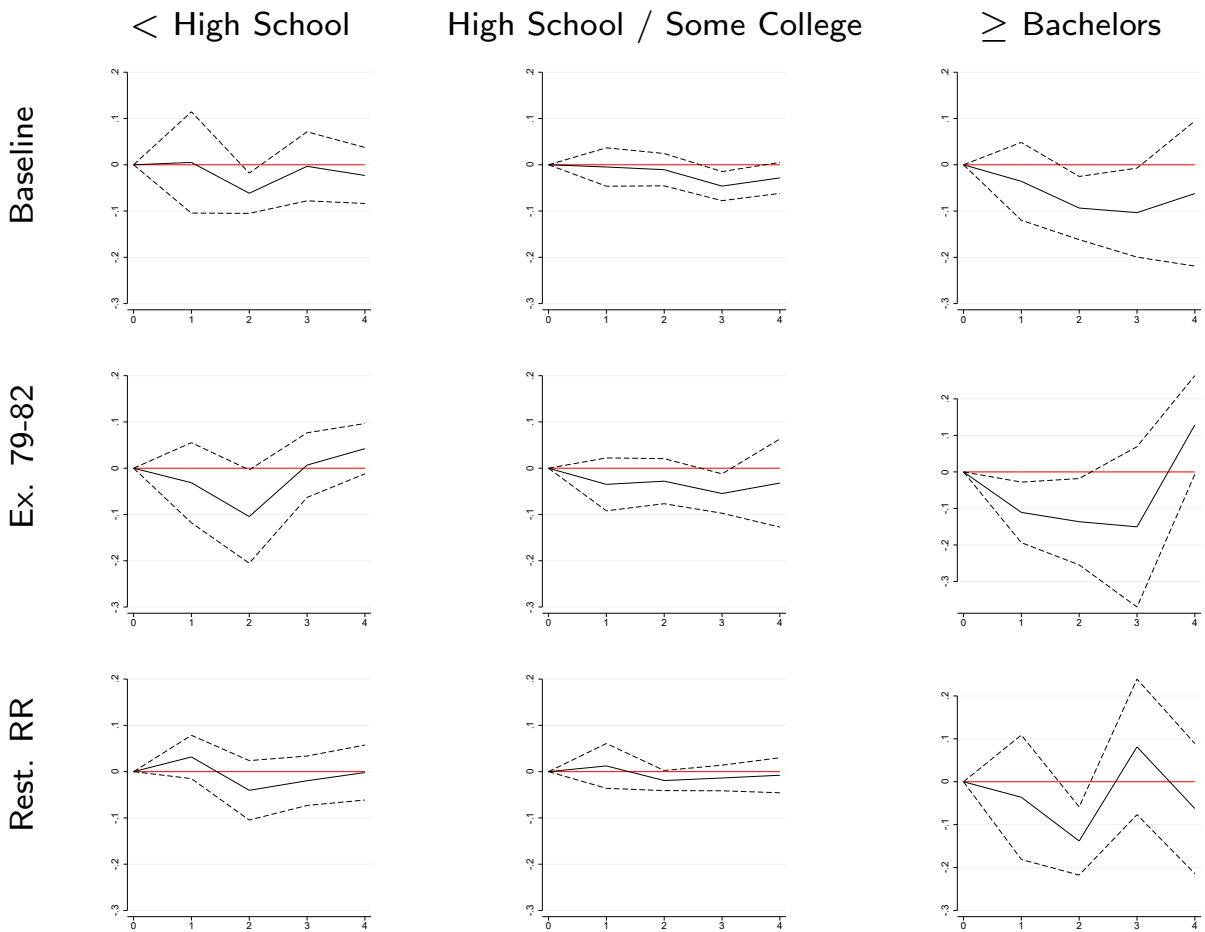
Note: All regressions control for a quadratic time trend. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Source: National Longitudinal Study of Youth 1979 and author's calculations.

[a] Detrended using the filter proposed by Hamilton (2018).

[b] Controlling for experience, industry fixed effects, and individual fixed effects.

Impulse Response (Robustness): Wages



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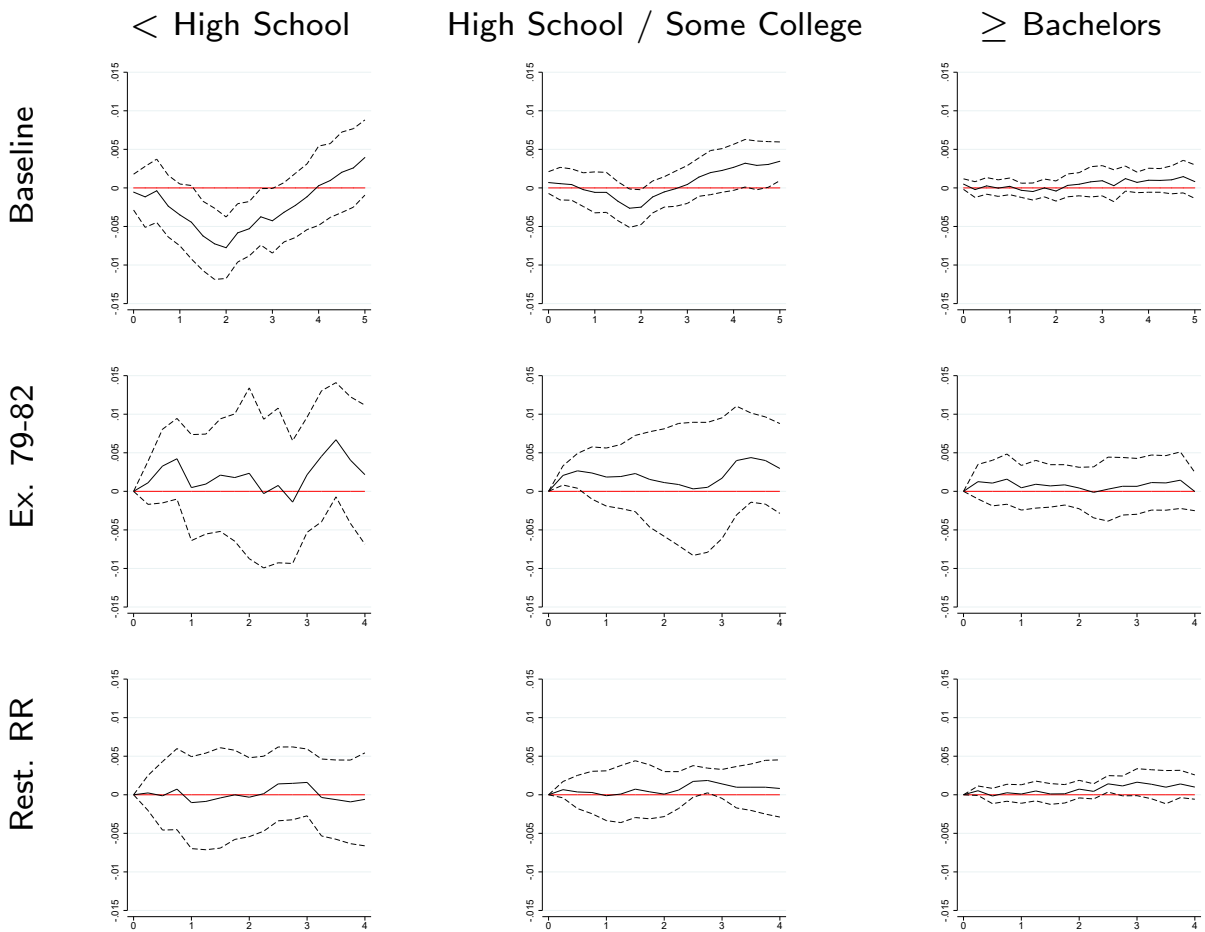
Impulse Response (Robustness): Employment



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Robustness

Sensitivity of wages to monetary policy shocks is robust to

- Excluding the Volcker Reform (1979-1982)
- Re-estimating the Romer & Romer (2004) shocks excluding the pre-1979 data.

As documented elsewhere, e.g. Coibion (2012), employment sensitivity is not.

- Zero response to shocks under above restrictions.

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Why?

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As documented elsewhere, e.g. Coibion (2012), employment sensitivity is not.

- Zero response to shocks under above restrictions.

Why?

Hypothesis:

- Increased reliance on forward guidance.

$$\textit{User Cost}_t = \underbrace{w_{t,t}}_{\substack{\textit{New Hires'} \\ \textit{Wage}}} + \underbrace{\mathbb{E}_t \sum_{j=1}^{\infty} \left[\beta^j (1-s)^j \left(w_{t+j,t} - w_{t+j,t+1}\right)\right]}_{\textit{Expected Wage Wedge}}$$