Firm Wage Setting and On-the-Job Search Limit Wage-Price Spirals[1]

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[1] The views expressed in this paper are those of the authors and do not necessarily reflect the position of the Federal Reserve Bank of New York or the Federal Reserve System.

Do Cost of Living Shocks Pass Through to Wages?

During COVID, both inflation and nominal wage growth surged.

- **Question**: are wages responding to inflation, or reflect tight labor markets?
- Concern about 1970's style wage-price spiral:

  shock to specific sector → increased wage demands → generalized inflation

Sticky wage macroeconomic models: union wage setting (Erceg et al., 2000; Lorenzoni and Werning, 2023) or ad-hoc real wage rigidity (Gagliardone and Gertler, 2023)

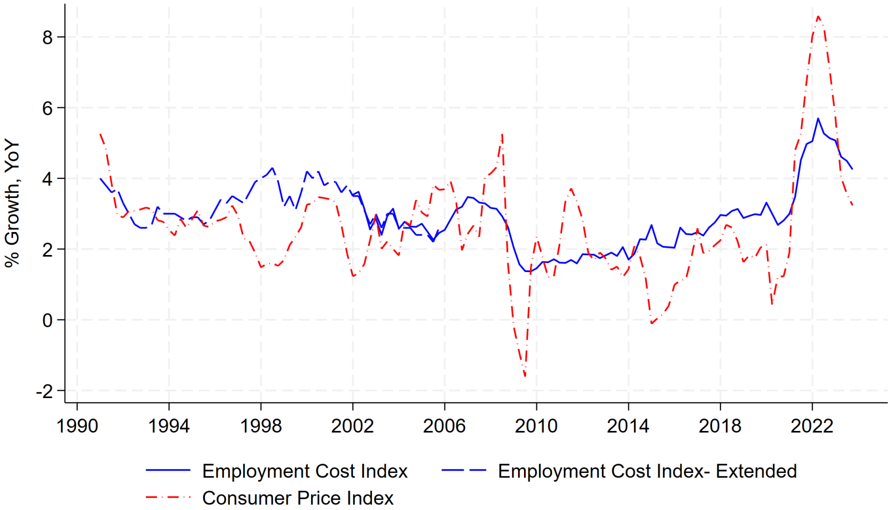
- Micro evidence: wage posting is dominant form of wage determination in the US. (Lachowska et al., 2022; Di Addario et al., 2023)

Big Question

If firms set wages, how do wages respond to shocks to cost-of-living?

- "Cost-of-living shock": raises price of consumption bundle, no direct effect on physical marginal product of labor.
- Example: labor intensive services (haircuts), endowment good (food).

Inflation and wage growth: weak correlation at high frequencies, both surge post-COVID



Wage Posting, OTJ Search: Weak Cost of Living → Wages

Firms set (post) wages (Lachowska et al., 2022; Di Addario et al., 2023), post (costly) vacancies.

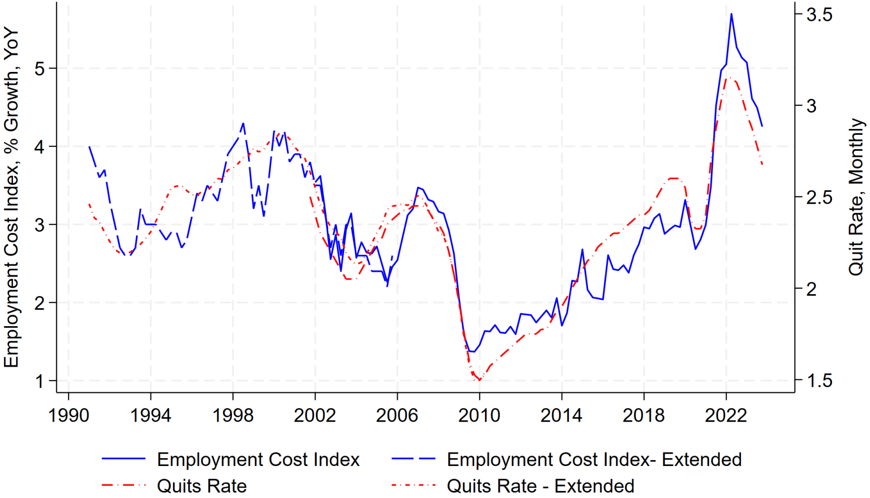
- Optimal wage setting trades off wage costs and turnover costs.
- Cost of living shock affects wages only to the extent that recruiting or retaining workers is harder (i.e., quits or vacancies matter for wage growth).

Workers search on the job, experience workplace preference shocks.

- Cost-of-living shocks affect relative value of working vs. nonemployment
- But: unemployment is rarely a credible threat.
  - Weak effect of unemployment benefit level on wages (Jäger et al., 2020).
- Firms primarily concerned with job-to-job quits:

On-the-job search dramatically dampens pass-through!

Quits Rate Captures Labor Market "Tightness"



Extends results by, e.g., Faberman and Justinian (2015) and Moscarini and Postel-Vinay (2017), through COVID shock and recovery. Unemployment

Model

Consumption Goods

Perfectly-competitive final good producers bundle services Y_t and endowment good X_t into final consumption:

$$C_t = \left(\alpha_Y^{\frac{1}{\eta}} Y_t^{\frac{\eta-1}{\eta}} + \alpha_X^{\frac{1}{\eta}} X_t^{\frac{\eta-1}{\eta}} \right)^{\frac{\eta}{\eta-1}},$$

Endowment shock
(Cost-of-living shock)

with price index:

$$P_t = \left(\alpha_Y P_{y,t}^{1-\eta} + \alpha_X P_{x,t}^{1-\eta} \right)^{\frac{1}{1-\eta}}$$

X_t appears each period:

- Each (identical) household receives the same amount
- Competitively & flexibly priced.

Y_t built from intermediates Y_t^j by a perfectly-competitive retail firm:

$$\begin{aligned} Y_t &= \left(\int \left(Y_t^j \right)^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}}, \\ P_{y,t} &= \left(\int \left(P_{y,t}^j \right)^{1-\epsilon} dj \right)^{\frac{1}{1-\epsilon}}. \end{aligned}$$

Households

Maximize the present discounted sum of members' utility,

$$\sum_{t=0}^{\infty} \left(\frac{1}{1+\rho} \right)^t \left[U_t \ln(C_t^u) + \int_0^{1-U_t} \ln\left(C_t(i, j(i)) \right) di \right].$$

by choosing C_t^u (unemployment benefits) and linear tax/subsidy on employed workers, who consume all labor income after tax:

$$C_t(i, j(i)) = \tau_t \frac{W_{j(i)t}}{P_t}$$

subject to the budget constraint

$$U_t C_t^u = \frac{D_t}{P_t} - \frac{B_t}{P_t} + \frac{(1 + i_{t-1}) B_{t-1}}{P_t} + (1 - \tau_t) \int_0^{1-U_t} \frac{W_{j(i)t}}{P_t} di.$$

Consumption Sharing + Euler Equation

We assume an *ad hoc* consumption sharing rule

$$\frac{\bar{C}_t^e}{C_t^u} = \xi,$$

where $\xi \geqslant 1$ and $\bar{C}_t^e \equiv \frac{1}{1-U_t} \int_0^{1-U_t} C_t(i, j(i)) di$ is the average consumption of employed (Chodorow-Reich and Karabarbounis, 2016).

In a symmetric equilibrium with $W_{jt} = W_t$, household optimality requires

$$(C_t)^{-1} = \frac{1}{1+\rho}(1 + r_{t,t+1})(C_{t+1})^{-1}.$$

Workers' Discrete-Choice Problem 1/2

1. At start of period t, firms post wages W_{jt} and vacancies V_{jt}
2. Fraction s of workers are exogenously separated.
3. Total searchers includes some employed workers and all the unemployed:
$$\mathcal{S}_t \equiv \lambda_{EE}(1 - U_{t-1}) + U_{t-1}$$
4. Matches happen; workers choose to accept offers and/or quit: with
    - $V_t \equiv \int_0^1 V_{jt} dj$, $\theta_t \equiv \frac{V_t}{\mathcal{S}_t}$.

   The probability that:
    - Searching worker meets a firm's vacancy:
$$f(\theta_t) = \frac{M(V_t, \mathcal{S}_t)}{\mathcal{S}_t}$$
    - Searching firms meet a worker:
$$g(\theta_t) = \frac{M(V_t, \mathcal{S})}{V_t}$$
    - Employed worker can consider quitting to unemployment: $\lambda_{EU} \in (0, 1)$
5. N_t is determined; production happens.

Workers' Discrete-Choice Problem 2/2

Each worker i is **myopic**, making choices to maximize

$$\mathcal{V}_t(i,j) = \underbrace{\ln(C_t(i,j(i)))}_{=\begin{cases}\ln\left(\frac{\tau_t}{P_t}W_{j(i)t}\right), \text{ if employed}\\ \ln\left(\frac{\tau_t}{P_t}\frac{\bar{W}_t}{\xi}\right), \text{ if unemployed}\end{cases}} + \underbrace{\iota_{ijt}}_{\text{Matching taste}}$$

Where ι_{ijt} is Type-1 extreme value with scale parameter γ^{-1} over workplaces drawn each period

- Why myopic?: simplifies the problem $\longrightarrow$ Adding dynamics to workers leads to dynamic inconsistency

- Supplementary Appendix F in Bloesch, Lee and Weber (2024) Forward-looking

Individual Recruiting Probabilities

The probability a vacancy attracts a matched searcher from other firms:

$$\underbrace{r_{kj}(W_{kt}, W_{jt})}_{\substack{\text{Probability } j \text{ poaches} \\ \text{matched worker from } k}} = \frac{\left(\cancel{\mathcal{T}_t}\frac{W_{jt}}{\cancel{P_t}}\right)^{\gamma}}{\left(\cancel{\mathcal{T}_t}\frac{W_{kt}}{\cancel{P_t}}\right)^{\gamma} + \left(\cancel{\mathcal{T}_t}\frac{W_{jt}}{\cancel{P_t}}\right)^{\gamma}}$$

Recruiting from unemployed:

$$\underbrace{r_{uj}\left(\frac{\bar{W}_t}{\xi}, W_{jt}\right)}_{\substack{\text{Probability } j \text{ recruits} \\ \text{matched unemployed worker}}} = \frac{\left(\cancel{\mathcal{T}_t}\frac{W_{jt}}{\cancel{P_t}}\right)^{\gamma}}{\left(\cancel{\mathcal{T}_t}\frac{\bar{W}_t}{\xi \cancel{P_t}}\right)^{\gamma} + \left(\cancel{\mathcal{T}_t}\frac{W_{jt}}{\cancel{P_t}}\right)^{\gamma}},$$

where recall $C_t(i,j) = \frac{\tau_t}{P_t} W_{jt}$ and $C_t^u = \frac{\tau_t}{P_t}\frac{\bar{W}_t}{\xi}$.

- These determine firm j's recruiting rates $R(W_{jt} | \{W_{kt}\}_{k \neq j})$.

Separation

Intermediate Services Firms

Vacancy cost
(convex)

Firm j maximizes profits facing to Rotemberg (1982) style adjustment costs:

$$\max_{\substack{\{P^j_{y,t}\},\{Y^j_t\},\\ \{N_{jt}\},\{W_{jt}\},\{V^j_t\}}} \sum_{t=0}^{\infty}\left(\frac{1}{1+\rho}\right)^t \Bigg(P^j_{y,t}Y^j_t - W_{jt}N_{jt} - c\left(\frac{V_{jt}}{N_{j,t-1}}\right)^{\chi} V_{jt}W_t$$

$$-\frac{\psi}{2}\left(\frac{P^j_{y,t}}{P^j_{y,t-1}}-1\right)^2 Y^j_t P^j_{y,t} - \frac{\psi^w}{2}\left(\frac{W_{jt}}{W_{j,t-1}}-1\right)^2 W_{jt}N_{jt}\Bigg)$$

subject to the law of motion on employment:

$$N_{jt} = (1 - S(W_{jt}))N_{j,t-1} + R(W_{jt})V_{jt}.$$

Service firms produce using only labor

$$Y^j_t = N_{jt}$$

with demand from a retail firm

$$\frac{Y^j_t}{Y_t} = \left(\frac{P^j_{y,t}}{P_{y,t}}\right)^{-\epsilon}.$$

Equilibrium conditions

Parameters in the Monthly Benchmark New Keynesian Model

Parameter	Value	Meaning	Reason
λ_{EE}	.14	OTJ search probability	Match EE rates
λ_{EU}	.30	Opportunity to quit	Match voluntary EU rate, Qiu (2022)
ξ	2	Consumption ratio: C_t^e/C_t^u	See text
s	.01	Exogenous separation rate	Match JOLTS separations
γ	6	Variance^{-1} of pref. shock	Match $\varepsilon_{R,W} - \varepsilon_{S,W}$
ϵ	10	EOS of intermediates Y_{jt}	
ψ	100	Price adjustment cost	
ψ^w	100	Wage adjustment cost	
η	1	EOS of Y_t vs. X_t	
α_X	.2	X_t's share in C_t	
χ	1	Convexity of vacancy costs	Bloesch et al. (2024)
c	30	Hiring cost shifter	Targeting U
ρ	.004	Discount Rate	Monthly model

Selected Model Moments and Data in Steady State

Moment	Meaning	Model	Data	Source
U	Unemployment rate	.044	.044	BLS
S	Monthly separation rate	.036	.036	JOLTS
$\varepsilon_{R,W} - \varepsilon_{S,W}$	Recruiting-Separation Elasticity	4.4	4.2	Bassier et al. (2022)

Log-Linear Wage Phillips Curves

Leveraging the full structure of the model leads to:

$$\check{\Pi}_t^w = \beta_Q \underbrace{\check{Q}_t}_{\text{Quits}} + \beta_U \overbrace{\check{U}_{t-1}}^{\text{Unemployment}} + \frac{1}{1+\rho}\check{\Pi}_{t+1}^w, \tag{1}$$

1. $\beta_Q > 0$ and $\beta_U \simeq 0$ with $|\phi_Q| > |\phi_U|$

Given monetary policy stabilizing $\check{V}_t$ (or $\check{Q}_t$) and $\check{U}_t$, no pass through

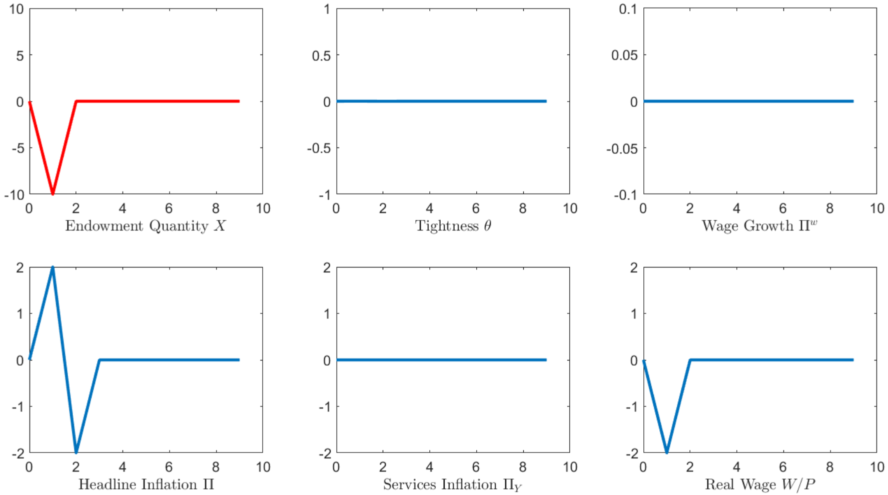
Table: Structural Wage Phillips Curve Coefficients vs. OLS Coefficients

Representation: Quits Q_t and Unemployment U_{t-1}		
Source	β_Q	β_U
Baseline Model ($\chi = 1$)	2.48	0.09
OLS using ECI 1990-Present	1.00***	-0.02
	(0.16)	(0.07)

Standard errors in parentheses (Newey-West; 4 lags)
*** p<0.01, ** p<0.05, * p<0.1

Pass Through in Our Baseline Model is Zero

Benchmark: relative desirability of unemployment remains the same



Inflation-Indexed Unemployment Benefit

In the benchmark model: recruiting rate from the unemployed:

$$\underbrace{r_{uj}\left(\frac{\bar{W}_t}{\xi}, W_{jt}\right)}_{\substack{\text{Probability } j \text{ recruits} \\ \text{matched unemployed worker}}} = \frac{\left(\cancel{\mathcal{T}_t}\frac{W_{jt}}{\cancel{P_t}}\right)^{\gamma}}{\left(\cancel{\mathcal{T}_t}\frac{\bar{W}_t}{\xi \cancel{P_t}}\right)^{\gamma} + \left(\cancel{\mathcal{T}_t}\frac{W_{jt}}{\cancel{P_t}}\right)^{\gamma}},$$

Question: what if now

$$\underbrace{r_{uj}\left(\frac{\bar{W}_t}{\xi}, W_{jt}\right)}_{\substack{\text{Probability } j \text{ recruits} \\ \text{matched unemployed worker}}} = \frac{\left(\frac{W_{jt}}{P_t}\right)^{\gamma}}{b^{\gamma} + \left(\frac{W_{jt}}{P_t}\right)^{\gamma}},$$

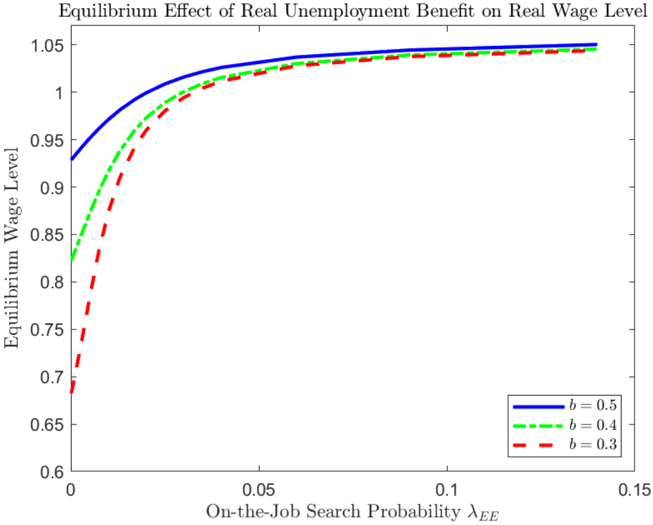
Indexed benefit

- Higher $P_t \longrightarrow$ relative desirability of non-working$\uparrow$ $\longrightarrow$ wage$\uparrow$

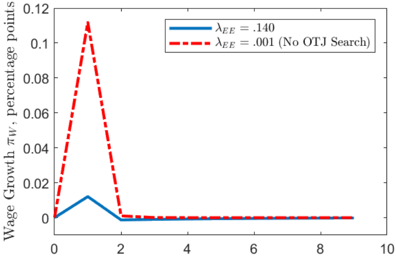
Wage Phillips curve

On-the-Job Search Kills Effect of Unemployment Benefit on Wages and Wage-Price Spirals

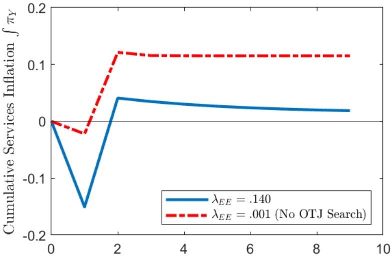
Extension: fixed real unemployment benefit



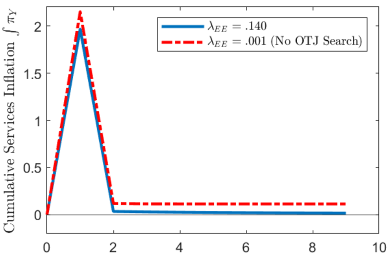
(a) Nominal Wage Growth Π_w



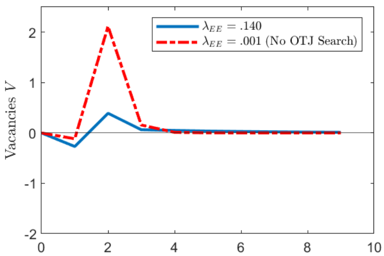
(b) Cumulative Services Price Inflation



(c) Cumulative Headline Inflation



(d) Vacancies V



Conclusion

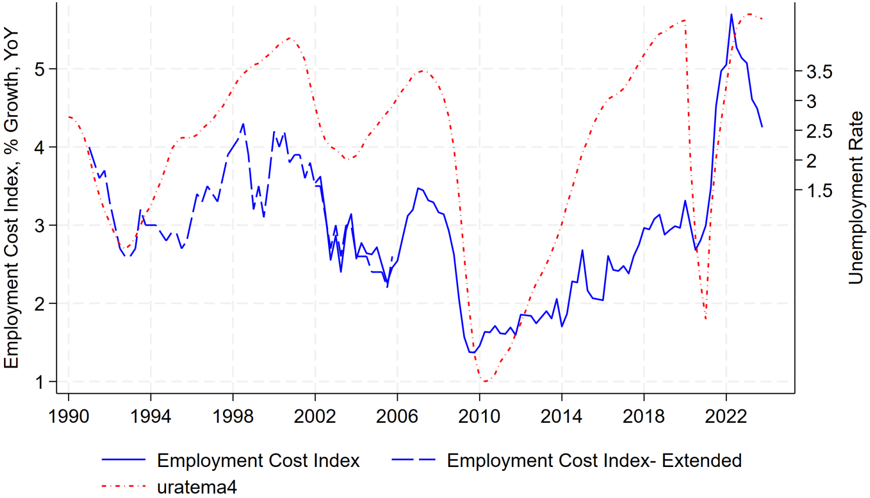
We develop a tractable New Keynesian model with wage-posting firms and on-the-job search consistent with a range of micro evidence.

- Wage posting → wage setting trades off wage costs vs. turnover costs.
- Wage growth is mostly driven by quits, not unemployment.
- On-the-job search dramatically dampens pass-through of cost of living shocks to wages.
- Bernanke and Blanchard (2024): "catch-up" effect, the tendency of workers to press for compensation for earlier unexpected price increases, appears limited in practice, with the estimated coefficient on the catch-up variable in the wage equation close to zero in most countries.

Implication: COVID-era surge in wage growth will revert as labor market tightness reverts

Thank you very much!
(Appendix)

Unemployment: Less So



Go back

Individual Separation Probabilities

Separation probabilities $s()$ for a worker matching with an outside job:

$$\underbrace{s_{jk}\left(W_{jt}, W_{kt}\right)}_{\substack{\text{Probability } j \text{ loses} \\ \text{worker matched to } k}} = \frac{W_{kt}^{\gamma}}{W_{kt}^{\gamma} + W_{jt}^{\gamma}}$$

Voluntary separation into unemployment:

$$\underbrace{s_{ju}\left(W_{jt}, \frac{\bar{W}_t}{\xi}\right)}_{\substack{\text{Probability } j \text{ loses} \\ \text{worker to unemployment}}} = \frac{\left(\frac{\bar{W}_t}{\xi}\right)^{\gamma}}{\left(\frac{\bar{W}_t}{\xi}\right)^{\gamma} + W_{jt}^{\gamma}},$$

- These determine firm j's separation rates $S(W_{jt} | \{W_{kt}\}_{k \neq j})$.

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Equilibrium Recruiting and Separation Rates

Define the probability a matched worker is employed or unemployed:

$$\phi_{E,t} \equiv \frac{\lambda_{EE}(1-U_{t-1})}{\mathcal{S}_t}$$

$$\phi_{U,t} \equiv \frac{U_{t-1}}{\mathcal{S}_t} = 1 - \phi_{E,t}$$

In a symmetric equilibrium where $W_{jt} = W_t \ \forall j$, $R(\cdot)_t$ and $S(\cdot)_t$ becomes

$$\begin{aligned} R_t &= g(\theta_t)\left(\phi_{E,t}\frac{1}{2} + \phi_{U,t}\left(\frac{\xi^\gamma}{1+\xi^\gamma}\right)\right) \\ S_t &= s + (1-s)\left(\lambda_{EE} f(\theta_t)\frac{1}{2} + \lambda_{EU}\left(\frac{1}{1+\xi^\gamma}\right)\right) \end{aligned}$$

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Closing the Model & Equilibrium

We close the model with a simple Taylor rule, with a potentially persistent policy shock $\varepsilon_{i,t}$:

$$\ln(1 + i_t) = \phi_\Pi \ln(\Pi_{Y,t}) + \log(1 + \varepsilon_{i,t})$$

A symmetric equilibrium consists of sequences of all endogenous prices and quantities such that:

1. Firms choose identical sequences such that $W_{jt} = W_t$, $N_{jt} = N_t$, $V_{jt} = V_t$, $P^j_{yt} = P_{y,t}$, for all t,
2. Workers and households maximize utility,
3. Firms maximize profits,
4. Product markets clear,
5. Labor market flows add up.

We linearize these necessary conditions around a non-stochastic steady state, and solve for the unique solution in e.g. Dynare.

Go back

Extension: Log-Linear Wage Phillips Curves

Leveraging the full structure of the model leads to:

$$\check{\Pi}_t^w = \beta_Q \check{Q}_t + \beta_U \check{U}_{t-1} + \beta_{\tilde{w}} \check{\tilde{w}}_t + \frac{1}{1+\rho} \check{\Pi}_{t+1}^w, \qquad (2)$$

"Catch-up" term

where $\tilde{w}_t = \sum_{s=0}^{t-1} \Pi_s^w - \sum_{s=0}^{t} \Pi_s$ is a (last period) real wage term under the realized price inflation in period t.

1. $\beta_Q > 0$ and $\beta_U \simeq 0$ with $|\beta_Q| > |\beta_U|$

2. $\beta_{\tilde{w}} < 0$: unemployment becomes more attractive when cost of living$\uparrow$ $\longrightarrow$ $\exists$pass through

Go back

Table: Structural Wage Phillips Curve Coefficients vs. OLS Coefficients

Representation: Quits Q_t and Unemployment U_{t-1}			
Source	β_Q	β_U	$\beta_{\tilde{w}}$
Baseline Model ($\chi = 1$)	2.48	0.09	0
Baseline Model ($\chi = 0$)	2.13	-0.11	0
Real Unemployment Benefit Model ($\chi = 1$)	2.48	0.09	.0426
OLS using ECI 1990-Present	1.11***	-0.04	-.021***
	(0.16)	(0.07)	(.007)

Standard errors in parentheses (Newey-West; 4 lags)
*** p<0.01, ** p<0.05, * p<0.1

Go back

Forward-Looking Workers

What if workers are forward-looking? 1/4 Go back

Under commitments, firm j has an incentive to

1. Reduce initial wage W_{j0} at $t = 0$ and commit higher wages W_{jt} in the future periods $t \geqslant 1$, which helps them recruit

2. And then renege in the future

Dynamic inconsistency problem: initial wage W_{j0} becomes special

- Optimlaity condition for W_{j0} $\neq$ optimality conditions for W_{jt} for $t \geqslant 1$

Note: other optimality conditions remain unchanged

What if workers are forward-looking? 2/4 Go back

Reoptimization at $t = 0$

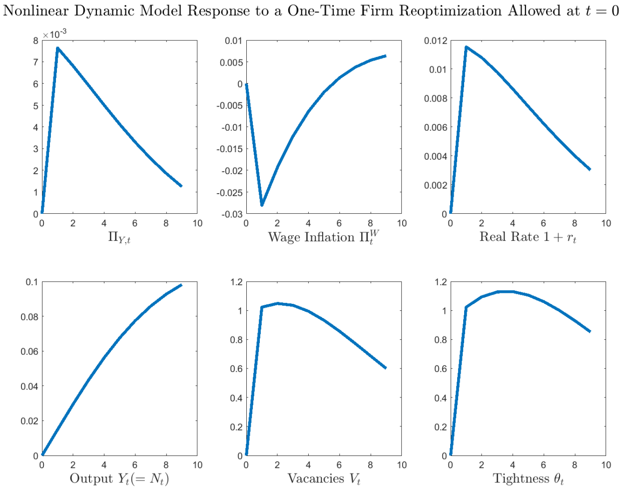

Figure: The effects of allowing firms to reoptimize and choose new paths for wages and all other choice variables, which they then commit to following forever. All impulse responses are shown as percent deviations from the long-run steady state.

What if workers are forward-looking? 3/4 Go back

Dynamic inconsistency issue → '*timeless*' solution

- Only respect the first-order condition for wages for $t \geqslant 1$

In response to the same cost-of-living shock:

Model with forward-looking workers $\simeq$ model with myopic workers

What if workers are forward-looking? 4/4 Go back

With Taylor rules