A Theory of How Workers Keep Up with Inflation

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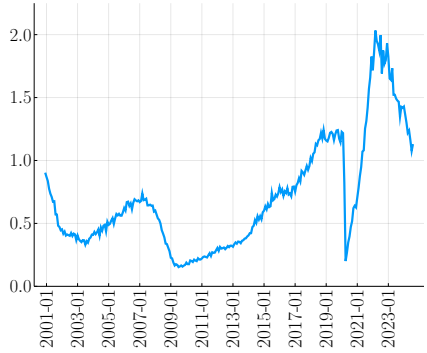
Recent Inflation Period: Market Tightness

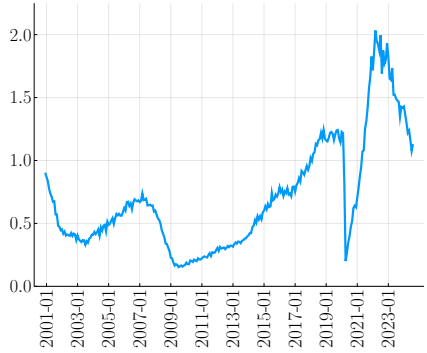


Vacancy-to-Unemployment

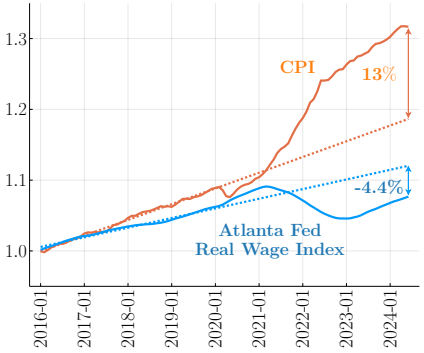
- Prevailing narrative: High V-to-U ratio $\Rightarrow$ "Hot" labor market $\Rightarrow$ Inflation rise

"*the broader picture is of an overheated labor market where demand substantially exceeds supply*", Powell, 11/02/2022

Recent Inflation Period: Market Tightness and Wage Growth



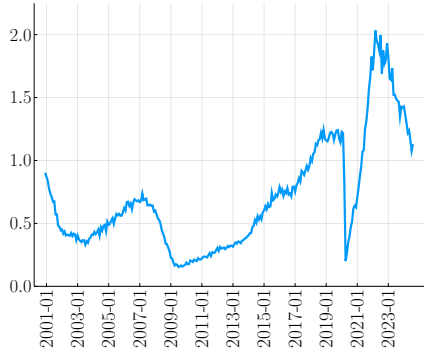
Vacancy-to-Unemployment



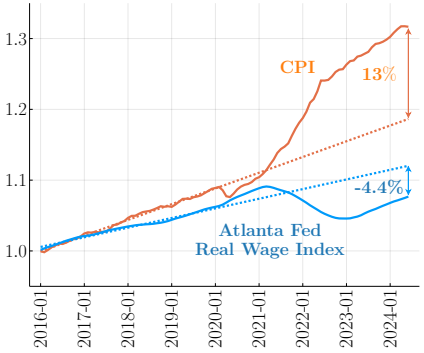
Real Wages: 2016-2024

- Main issue: Real wages fell and continue to be below their trend

Recent Inflation Period: Market Tightness and Wage Growth



Vacancy-to-Unemployment



Real Wages: 2016-2024

- Then, why is labor market so tight during the recent surge in inflation?
- Our idea: Inflation lower real wages triggering on-the-job search (high V/U)

What We Do

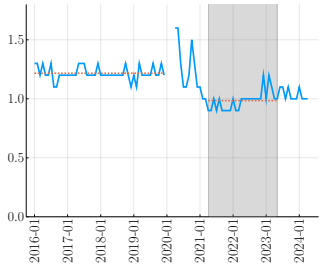
- **A new framework for frictional labor markets:**
  1. Infrequent wage adjustment and lack of commitment
  2. Endogenous flows (quits, layoffs, renegociate, and costly on-the-job search)
  3. Worker heterogeneity
- **Main result:**
  - Higher labor market tightness from an isolated increase in inflation (2021-2024)

    $1 \implies$ Inflation lowers real wages

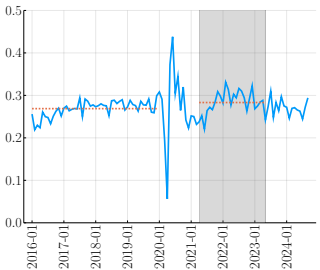
    $+2 \implies$ Workers increase on-the-job search intensity ($\Uparrow$ labor market tightness)
- Inflation reduces workers' welfare in 1K
- Verify shifts in the Beveridge curve during inflationary episodes
- Within the model, "hot labor markets" struggle to match wages and flows

Some Facts About the Labor Market

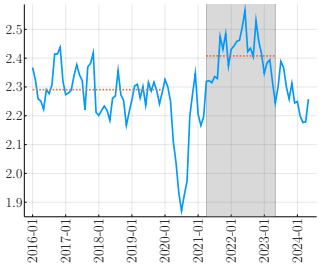
Aggregate Labor Market Flows



Layoff Rate



U-E Rate



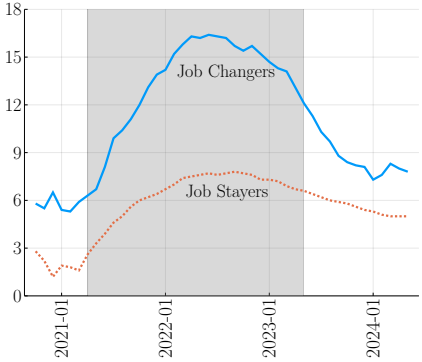
E-E Rate

- Decline in layoffs
- Small change in U-E flows

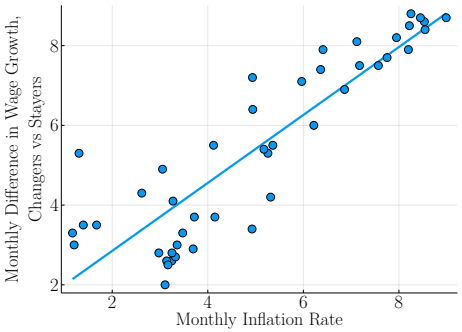
  $\Longrightarrow$ **Unemployment dynamics are largely driven by separations**

- Large increase in E-E flows

Nominal Earnings Growth: Switchers and Stayers



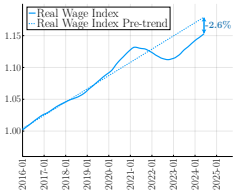
ADP Wage Growth,
By Switching Status



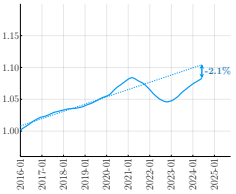
Changer-Stayer Difference
vs. Inflation Rate

- Nominal wage growth rose sharply for job switchers compared to stayers

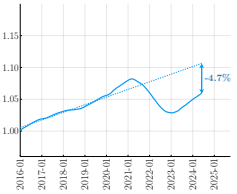
Evolution of Wages: Heterogeneity



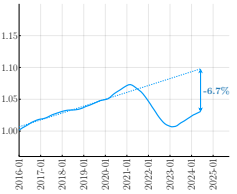
Real Wages (Q1)



Real Wages (Q2)



Real Wages (Q3)



Real Wages (Q4)

- The recovery is more slowly for workers at the top of the wage distribution

Summary of Facts to Keep in Mind

With higher inflation:

- E-E transitions increase, but U-E transitions remain roughly constant
- Real wages of job changers rise more than those of job stayers
- Real wages decline initially and recover gradually (more slowly for high earners)
- Vacancies increase while unemployment remains relatively stable

$\Longrightarrow$ Outward shift in the Beveridge curve (V/U increases for a given U)

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Hypothesis:

A model with frictional labor markets and sticky nominal wages can replicate these patterns in response to an inflation shock

Model

Model Overview

- Search and matching labor market model with:
  - Frictions in nominal wage adjustments
  - Lack of commitment on the part of workers and firms
  - Non-zero-sum game between workers and firms with stopping times
- Endogenous worker flows: quits to unemployment, layoffs, job-to-job flows
- Heterogeneous workers in productivity, job posting costs, home-production
- Homogeneous employers

Goal: Not to explain causes of inflation, but how inflation affects the labor market

Environment: Demography and Technology

- Time is continuous and is indexed by $t \geq 0$
- A unit measure $i \in [0, 1]$ of heterogeneous workers engage in directed search
  - Die with i.i.d. probability $\chi \, \mathrm{d}t$
  - **Worker's state** E_{it}: Employed (h_{it}) or unemployed (u_{it})
- Employed workers produce with productivity AZ_{it}
- Unemployed workers with productivity Z_{it} produce $B \times Z_{it}^{\phi_B}$
  - ϕ_b captures how home production scale with productivity
  - $\phi_b < 1 \implies$ low-productivity employed workers closer to outside option
- Endogenous measure of homogeneous firms post vacancies at cost $K \times Z_{it}^{\phi_K}$
  - ϕ_k captures how hiring costs scales with productivity
  - $\phi_k > 1 \implies$ relatively more expensive for firms to hire more productive workers

Environment: Preferences and Exogenous Shocks

- **Worker's Preferences:** $\mathbb{E}_t \left[\int_t^\infty e^{-(\rho+\chi)(s-t)} \left((C_{is} - S_{is})\, ds - dR_{is} \right) \right]$ where
  - $C_{it} = BZ_{it}^{\phi_b}$ if unemployed and $C_{it} = W_{it}$ if employed
  - $S_{it} = Z\eta(E_{it})^{1/\phi_s} s_{it}^{1+1/\phi_s}/(1+1/\phi_s)$ search cost ($\eta_e > \eta_u$)
    - s_{it} : search intensity
  - R_{it} : fixed cost associated with renegotiating wages (in utility terms)
- **Worker's Productivity Shocks:** $Z_{it} = \exp(\bar{z}_i + \hat{z}_{it})$
  - $\bar{z}_i \sim \mathcal{N}(0, \sigma_{z0})$: permanent productivity drawn at birth
  - $\hat{z}_{it}$: worker idiosyncratic productivity shocks:

$$d\hat{z}_{it} = \begin{cases} \gamma_e dt + \sigma d\mathcal{W}_{it} \\ \gamma_u dt + \sigma d\mathcal{W}_{it} \end{cases}, \quad \text{where } \mathcal{W}_{it} \sim \text{Wiener process and } \gamma_e > \gamma_u$$

Environment: Job-creation and Destruction

- **Markets:** Indexed by $(z; w)$, w is real (log) wage and $z = \ln(Z)$
  - Free entry: $K \times Z^{\phi_K} =$ firm's expected value of finding a worker
- **Matching function:** $m(\mathcal{V}, \mathcal{S}) = \mathcal{S}^{\alpha}\mathcal{V}^{1-\alpha}$, $\alpha \in (0, 1)$
  - Average search intensity: $\mathcal{S}(z; w) = \int_0^1 \tilde{s}_i(z; w)di$
  - Model market tightness: $\theta(z; w) = \mathcal{V}(z; w)/\mathcal{S}(z; w)$
  - Worker's matching rate: $s_i f(\theta(z; w)) = s_i\theta(z; w)^{1-\alpha}$
  - Firm's matching rate: $q(\theta(z; w)) = \theta(z; w)^{-\alpha}$

"Data" market tightness: $\frac{\text{aggregate vacancies}}{\text{aggregate unemployment}}$

- Matches can be **unilaterally** dissolved either by firm (layoff) or worker (quit)
- **Exogenous separations** with i.i.d. probability $\delta(Z)\,dt$

Environment: Within-Job Wage Dynamics

- **Inflation rate**: $d\ln(P_t) = \pi dt$
- **Real wage** (in logs): $w_{it} = \ln(W_{it}/P_t)$ (between wage changes, $dw_{it} = -\pi dt$)
- **New hire wages are perfectly flexible**
- **Renegotiation opportunities**: Nash bargaining (outside option $\sim$ unemployment)
  - With probability $\beta_{\pi^*}\mathrm{d}t$, free wage increase within exogenous $[0, 12 \times \bar{\pi}^*]$
  - With probability $\beta^+\mathrm{d}t$ + random utility renegotiation cost $\Psi^+(\psi)$ to increase wage
  - β^- and $\Psi^-(\psi)$ for wage decreases
  - Worker weight $\tau = \alpha$

Agents' Values and Decisions

- $U(z)$: Value of an unemployed worker with (log) productivity z →
  - w_u : target entry wage, s_u : search intensity
- $H(z, w)$: Value of an employed worker with productivity z and real wage w
  - w_{jj} : target wage for on-the-job search with s_e intensity
  - Pays a cost to renegotiate wages to $w_b(z)$
  - Quits their job if $w < w_q(z)$
- $J(z, w)$: Value of a firm with a worker of productivity z and real wage w →
  - Lays off the worker if $w > w_l(z)$
- $\theta(z, w)$: market tightness in the (z, w) submarket →

Employed Worker Value if no Quit and no Layoff

$$(\rho+\chi)H(z,w) = e^w + \underbrace{\partial_z H(z,w)\gamma_e + \frac{\sigma^2}{2}\partial_z^2 H(z,w) - \partial_w H(z,w)\pi^*}_{\text{Law of motion of } (z,w) \text{ during employment}}$$

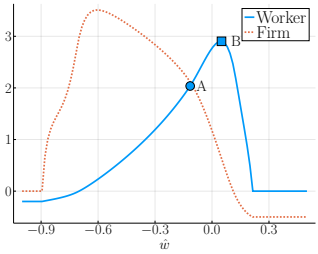
$$- \underbrace{\delta(H(z,w)-U(z))}_{\text{Exogenous Separation}} + \underbrace{\beta_{\pi^*}\left(H(z,w^*_{\pi^*}(w,z)) - H(z,w)\right)}_{\text{Value of free wage adjustment}}$$

$$+ \underbrace{\beta^+ \mathbb{I}_{\{w_b^*(z,w)>w\}} \int \max\left\{H(z,w_b^*(z,w)) - H(z,w) - \psi e^z, 0\right\} \Psi^+(d\psi)}_{\text{Net value of costly upward wage adjustment}}$$

$$+ \underbrace{\beta^- \mathbb{I}_{\{w_b^*(z,w)\leq w\}} \int \max\left\{H(z,w_b^*(z,w)) - H(z,w) - \psi e^z, 0\right\} \Psi^-(d\psi)}_{\text{Net value of costly downward wage adjustment}}$$

$$+ \underbrace{\max_{s_e, w_{jj}} \left\{ s_e f(\theta(z,w_{jj}))\left(H(z,w_{jj}) - H(z,w)\right) - \eta_e^{1/\phi_s} e^z \frac{s_e^{1+1/\phi_s}}{1+1/\phi_s} \right\}}_{\text{Expected net value of on-the-job search}},$$

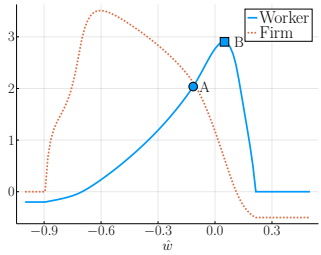
Inflation Effect on a Single Employed Worker



Values

Markdown: $\hat{w} := w - z$, Worker=$H(z, w - z) - U(z)$ and Firm=$J(z, w - z)$,

Inflation Effect on a Single Employed Worker

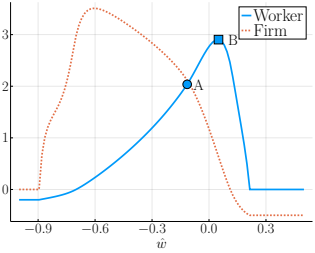


Values

Markdown: $\hat{w} := w - z$, Worker=$H(z, w-z) - U(z)$ and Firm=$J(z, w-z)$,

A=$\hat{w}_u^*(z) = \hat{w}_b^*(z)$, B=$\hat{w}_H^*(z)$

Inflation Effect on a Single Employed Worker



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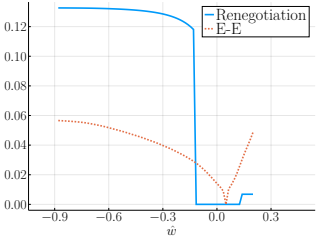
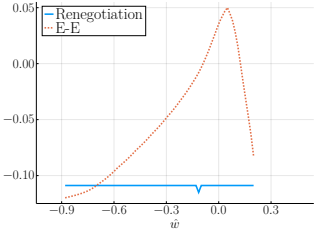
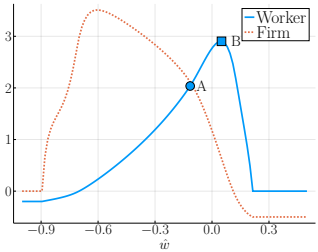


Hazard Rates



Target Wage Markdown

Inflation Effect on a Single Employed Worker



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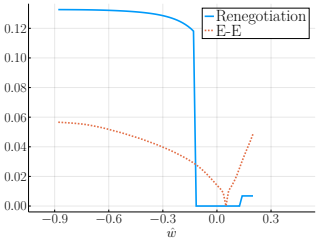
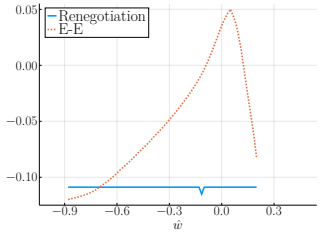


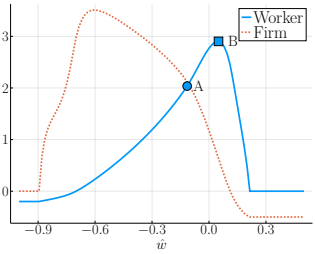
Hazard Rates



Target Wage Markdown

On-the-job search: $s_e(z, \hat{w}) f(z, \hat{w}^*_{jj}(z, \hat{w}))$ increasing in $|\hat{w} - \hat{w}^*_H(z)|$

Inflation Effect on a Single Employed Worker



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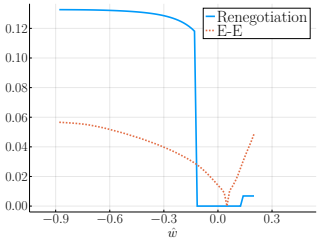

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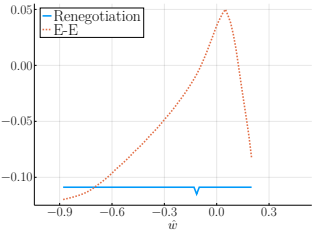


Target Wage Markdown

Vacancies in new submarket following inflation (if $\hat{w} < \hat{w}^*_H(z)$):

$$\Uparrow\Uparrow \mathcal{V}(z, \Downarrow \hat{w}) \propto \left(\Uparrow \hat{J}(z, \Downarrow \hat{w}^*_{jj}(z, \Downarrow \hat{w})) \right)^{1/\alpha} \Uparrow s(z, \Downarrow \hat{w})$$

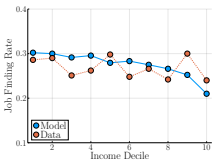
Parametrization & Equilibrium Policies: an Overview

Parametrization

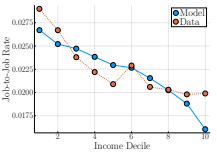
- Target features of U.S. labor market during 2016-2019
- Average earnings growth over life cycle, variance of wages at age 25 and over life cycle, average earnings loss during unemployment $(\gamma_e, \gamma_u, \sigma, \sigma_{z0})$
- Frequency and distribution of $+$ and $-$ wage changes $(\beta^{\pm}, \Phi^{\pm})$

  (Grigsby, Hurst, Yildirmaz, 2021)
- Elasticity of search effort to wage (ϕ_s)

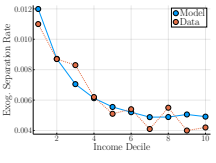
  (Faberman, Mueller, Sahin, and Topa, 2022)
- Flows across income distribution: EE rates, UE rates, EU $(B, K, \phi_k, \phi_b, \delta(Z))$ rates



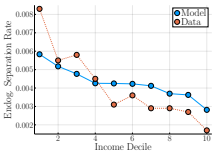
U-E Rate



E-E Rate



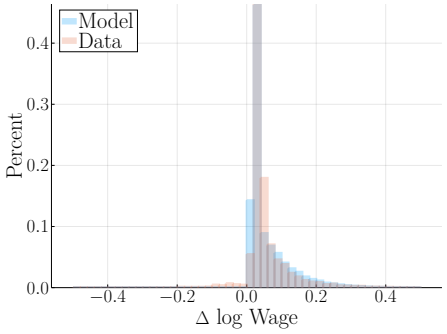
Exog. E-U Rate



End. E-U Rate

Comparison of (un)targeted moments

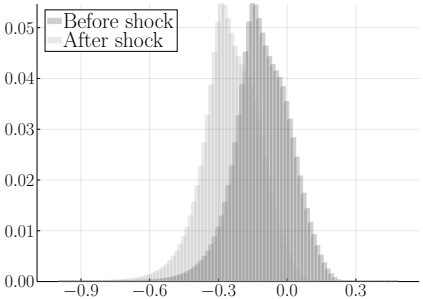
Moment	Data	Model
Frequency of neg. Δw_b	0.004	0.0
Frequency of pos. Δw_b	0.063	0.061
Share $\Delta w_b \in (0, 6)/(0, \infty)$	0.73	0.69
Share $\Delta w_b \in [6, 11)/(0, \infty)$	0.14	0.15
Share $\Delta w_b \in [11, \infty)/(0, \infty)$	0.13	0.16
Search effort-wage elasticity	-0.52	-0.5
P90/P50 real wages (age 25)	2.12	2.09
P90/P50 real wages (ages 25-55)	2.57	2.53
Avg. 30-year wage growth	0.7	0.72
Elasticity New wage-U length	-0.006	-0.006



(Non-zero) Wage Changes

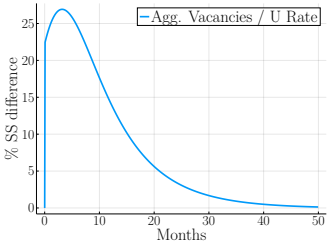
Experiment I

- From SS with 2% annual inflation, price level unexpectedly increases by 13%
  Experiment II: sequence of MIT shocks that match realized inflation [in the paper]

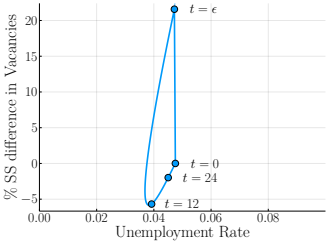


- Distribution of markdowns shift to the left after the inflation shock
- Workers are closer to quit margin and farther away from layoff margin

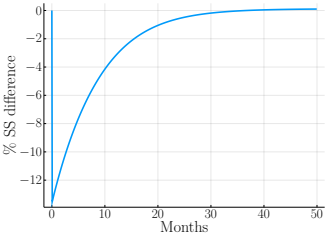
Aggregate Dynamics: Hot or Cold?



(a) Agg. V/U ratio



(b) Beveridge Curve Dynamics



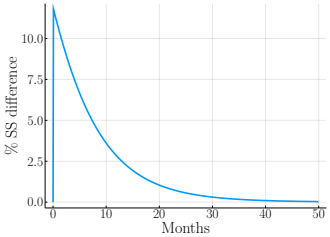
(c) Real Wage by Prod. Quartile

Hot Surge in market tightness V/U

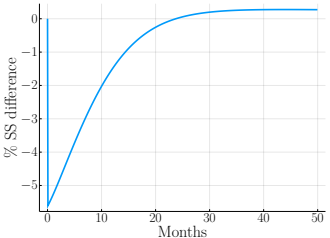
Hot Beveridge Curve shifts upward: V increase with little effect on U

Cold Real wages persistently lower

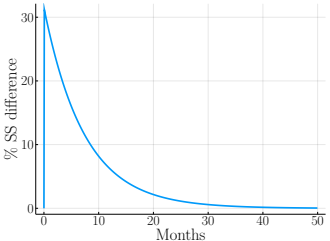
On-the-job Search and E-E Flows



(a) Search Intensity of Employed



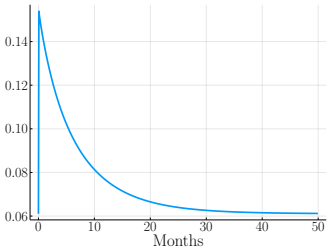
(b) Starting Markdown of Job-Changers



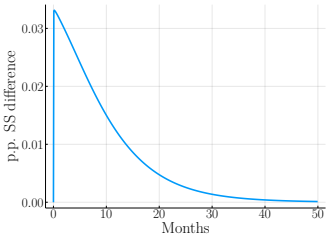
(c) E-E Rate

- Increase in intensity
- Workers search for jobs positioned lower on the job ladder

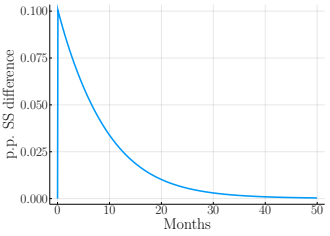
Wage-adjustment Within and Across Jobs



(a) Monthly freq. wage increases



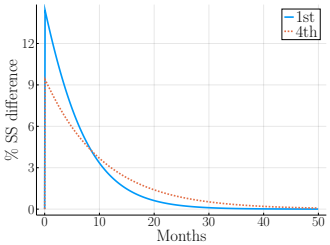
(b) Δw Stayers



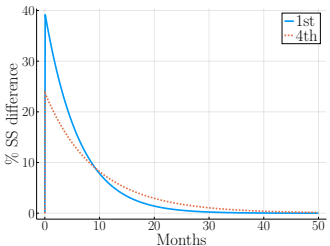
(c) Δw Switchers

- Wage change of job-changers much higher than job-stayers

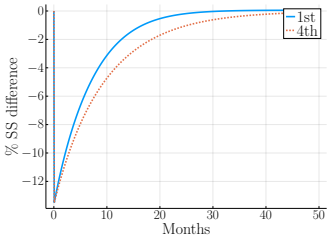
Heterogeneous Effects of Inflation



(a) Job search by productivity quartile



(b) E-E rate by productivity quartile

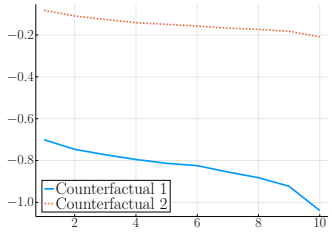


(c) Real wage by productivity quartile

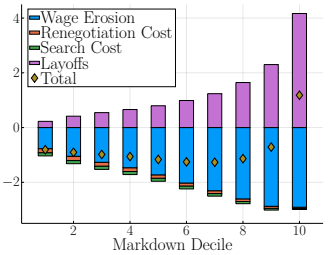
- Higher E-E response at bottom of income distribution

$\Rightarrow$ faster wage recovery at the bottom due to costly effort

Welfare: No Wonder Workers Dislike Inflation



(a) Δ welfare by income



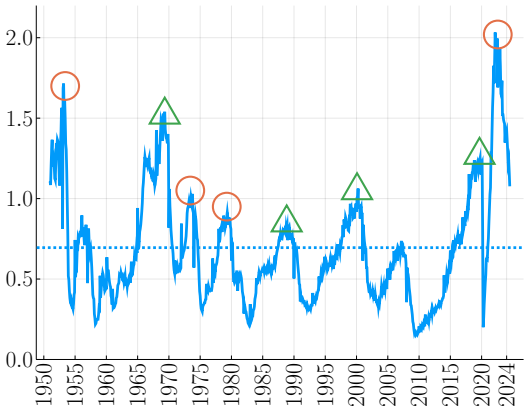
(b) Welfare decomposition

- Average welfare losses:
  - Experiment I: 80% of monthly income
  - Experiment II: 20% of monthly income
- Workers lose through erosion, bargaining & search (20% of net effect), . . .

  . . . but gain through layoffs

Additional Historical Evidence

Vacancy-to-Unemployment Rate Over Time



- Vacancy data from Barnichon (2010) for 1951-2000
- 9 periods with spikes in the V/U rate since 1950

△: Traditional Beveridge curve periods (low inflation and declining unemployment)

◯: Periods of very high inflation and non-declining unemployment

- Regression results show that inflation is systematically related to higher V/U and shifts Beveridge curve upward [in the paper]

Conclusion

- **Main Contribution:**

  A model of frictional labor markets to study business cycles

  - Reproduces qualitative labor market dynamics (2021-2023)
  - Reconciles survey evidence from workers
  - Highlights heterogeneity in welfare losses across worker types
  - Decomposes welfare losses into distinct channels

- **Takeaway:**

  Understanding how inflation distorts traditional labor market indicators (e.g., market tightness) is crucial for policy analysis

Appendix

Literature

- Evidence on the effects of inflation on the labor market and workers
  Blanco, Drenik, Zaratiegui (2024), Autor, Dube and McGrew (2023), Pilossoph and Ryngaert (2023), Guerreiro, Hazell, Lian, and Patterson (2024)

- Households dislike inflation, especially for its effect on their labor income:
  Shiller (1997), Stancheva (2024), Afrouzi, Dietrich, Myrseth, Priftis, and Schoenle (2024)

- Matching models of labor market with inflation and/or search heterogeneity
  Barro (1977), Erceg, Henderson, and Levin (2000), Krause, Lopez-Salido and Lubik (2008); Christiano, Gertler and Trigari (2009), Eichenbaum and Trabandt (2016), Schmitt-Grohé and Uribe (2016, 2023), Hurst, Kehoe, Pastorino, and Winberry (2023), Benigno and Eggertsson (2023), Blanco and Drenik (2023), Pilossoph, Ryngaert and Wedewer (2024), Blanco, Drenik, Moser, and Zaratiegui (2024)

- Importance of EE vs. UE transitions for inflation/labor market interaction:
  Moscarini and Postel-Vinay (2023)

Unemployed Worker Value

Return

$$(\rho+\chi)U(z) = Be^{\phi_b z} + \underbrace{\gamma_u \partial_z U(z) + \frac{\sigma^2}{2}\partial_z^2 U(z)}_{\text{Law of motion of } z \text{ during unemployment}}$$

$$+ \underbrace{\max_{s_u, w_u} \left\{ s_u f(\theta(w_u, z)) \left(H(z, w_u) - U(z)\right) - \eta_u^{1/\phi_s} e^z \frac{s_u^{1+1/\phi_s}}{1+1/\phi_s} \right\}}_{\text{Expected value of searching for a job}},$$

Firms Value if no Quit and no Layoff

Matched Firm:

$$\rho J(z,w) = \underbrace{e^z - e^w}_{\text{Flow profit}} + \underbrace{\partial_z J(z,w)\gamma_e + \frac{\sigma^2}{2}\partial_z^2 J(z,w) - \partial_w J(z,w)\pi^*}_{\text{Drift and diffusion in } (z,w)}$$
$$+ \underbrace{\beta(z,w)\left(J(w_b^*(z,w),z) - J(z,w)\right) + \beta_{\pi^*}\left(J(z,w_{\pi^*}^*(z,w)) - J(z,w)\right)}_{\text{Wage adjustments}}$$
$$- \underbrace{\left(\delta + \chi + s_e(z,w_{jj}^*(z,w))f(\theta(z,w_{jj}^*(z,w)))\right)}_{\text{Separations}} J(z,w).$$

Free entry:

$$0 = -Ke^{\phi_k z} + q(\theta(z,w))J(z,w)$$

Parametrization

Return

	Description	Value
Productivity Process		
γ_e	Productivity drift for employed	0.002
γ_u	Productivity drift for unemployed	-0.006
σ	Std. dev. of productivity shock	0.033
σ_{z0}	Std. of initial productivity	0.559
Labor Market Flows		
B	Non-employment production	1.087
ϕ_b	Elast. of unemp. income wrt. z	0.722
K	Vacancy cost	9.71
ϕ_k	Elast. of vacancy cost wrt. z	1.453
η_e	Search cost scale when employed	5.405
ϕ_s	Elast. of search cost	0.095

	Description	Value
Exogenous Separations		
δ_0	Exog. separation rate function	0.005
δ_1	Exog. separation rate function	0.019
δ_2	Exog. separation rate function	-2.295
Nominal Wage Adjustment		
β_{π^*}	Prob. of free wage adjustment	0.083
β_+	Prob. of positive wage renegotiation	0.184
β_-	Prob. of negative wage renegotiation	0.007
λ	Prob. mass at zero for menu cost dist.	0.864
ζ	Rate parameter of menu cost dist.	0.647