The Search Costs of Inflation

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Motivation

- Longstanding question in macro: What are the costs of inflation π?
  - High levels of expected inflation will reduce welfare primarily through menu costs.
  - An unexpected, temporary inflationary shock will primarily influences welfare through redistribution.

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  - An unexpected, temporary inflationary shock will primarily influences welfare through redistribution.
- Menu cost models used widely by CBs imply that costs from inflation are "elusive" (Nakamura et al. (2018))

This Paper

- What is the cost of inflation in the labor market?
  - Workers perceive inflationary shocks as negative shocks to their real wages. (Shiller (1997),Stancheva (2024))
  - Workers may respond by intensifying their search for other jobs to obtain a wage adjustment. (Pilossoph and Ryngaert (2024))
  - Search comes at a cost.

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  - Search comes at a cost.
- We develop a model to quantify the costs of (unexpected) inflation in the labor market:
  - Much of the welfare loss faced by workers is redistributive
  - Intensification of job search leads to a loss of net loss of welfare
  - This is ameliorated slightly as workers reallocate up the job ladder.

Agents and Technologies (I)

- Exogenous aggregate productivity z, grows deterministically at rate g
- Exogenous price level p, grows deterministically at rate g_p (in balanced growth path)
- Exogenous unit mass of vacancies of type y, $F(y)$
- Output is $Y(z, y)$

Agents and Technologies (II)

- Unit mass of workers, $i \in \{e, u\}$ employed and unemployed
- Make search effort decisions $\bar{s}_i \in (0, \bar{s})$, determines contact rate with openings, $s + \lambda_i$.
  - real cost is $c(s, z) > 0$, with $c'(s, z) > 0$, $c''(s, z) \geq 0$
- Exogenous separation at rate δ
- Real value of unemployment $B(z)$

Wage Setting/Contracts

- Firms offer initial nominal hiring wage w that grows at rate $(1+g)(1+g_p)$
  - w depends on employment status and current wage
  - in absence of growth g, g_p, similar to bargaining over real wage, fixed over match
  - mimics COLA
- Renegotiated only by mutual consent
- Firms can make counteroffers, Bertrand competition ensues

Wage Setting/Contracts

- Values of unemployment and employment to worker and firm, $U(\cdot)$,$W(\cdot)$,$J(\cdot)$
- Firms make take-it-or-leave-it (TIOLI) offers to unemployed workers

Poaching and Contract Adjustments

- Consider worker currently with y_1 at nominal wage w when state is p, z, contacted by y_2. Bertrand outcome:
  1. no outbidding with same contract if $W\left(z'y_2, y_2, p', z'\right) \leq W\left(w', y_1, p', z'\right)$
  2. poaching firm hires worker if $y_1 < y_2$, new wage ϕ^{poach} satisfies $W\left(\phi^{\text{poach}}, y_2, p', z'\right) = W\left(z'y_1, y_1, p', z'\right)$
  3. incumbent firm keeps worker if $y_1 \geq y_2$, renegotiates new wage ϕ^{reneg} s.t. $W\left(\phi^{\text{reneg}}, y_1, p', z'\right) = W\left(z'y_2, y_2, p', z'\right)$

  where $p' = p(1+g_p)$, $z' = (1+g)$, $w' = w(1+g)\,(1+g_p)$
- Define $q\,(w', y, p', z')$, first firm that triggers contract change:

$$W\,(w', y, p', z') = W\,(z'q, q, p', z')$$

Status Quo Renegotiation Poaching

Figure 1: Offers Ranges for Status Quo, Renegotiation, and Poaching.

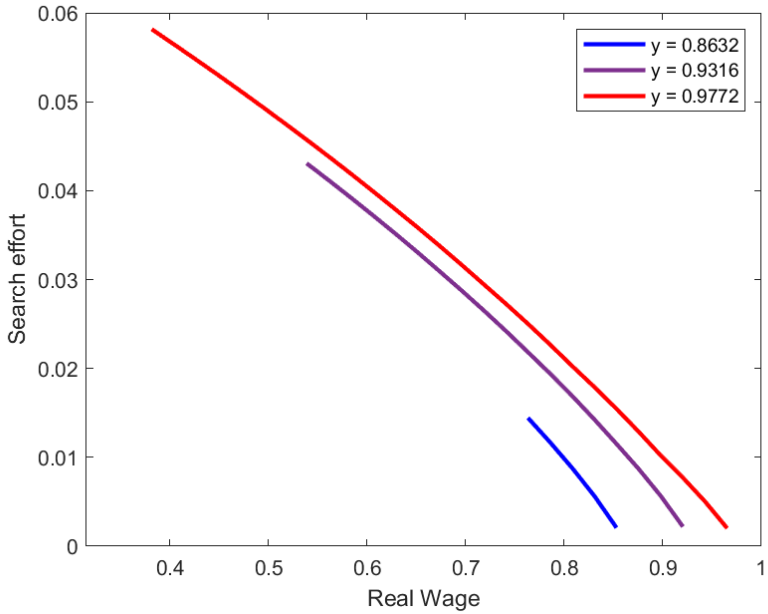
Value of Employment $W(w, y, p, z)$

$$
\begin{aligned}
W(w,y,p,z) = & \max_{s\in[0,\bar{s}]} \frac{w}{p} - c(s,z) + \beta\delta U\left(z(1+g)\right) \\
& + \beta(1-\delta)(s+\lambda_e)\int_{y}^{\bar{y}} W\left(\phi_w^{\text{poach}}\left(x,y,p',z'\right),x,p',z'\right) dF(x) \\
& + \beta(1-\delta)(s+\lambda_e)\int_{q(w',y,p',z')}^{y} W\left(\phi_w^{\text{reneg}}\left(y,x,p',z'\right),y,p',z'\right) dF(x) \\
& + \beta(1-\delta)\left[(s+\lambda_e)\int_{\underline{y}}^{q\left(w',y,p',z'\right)} dF(x) + 1 - s + \lambda_e\right] W\left(w',y,p',z'\right)
\end{aligned}
$$

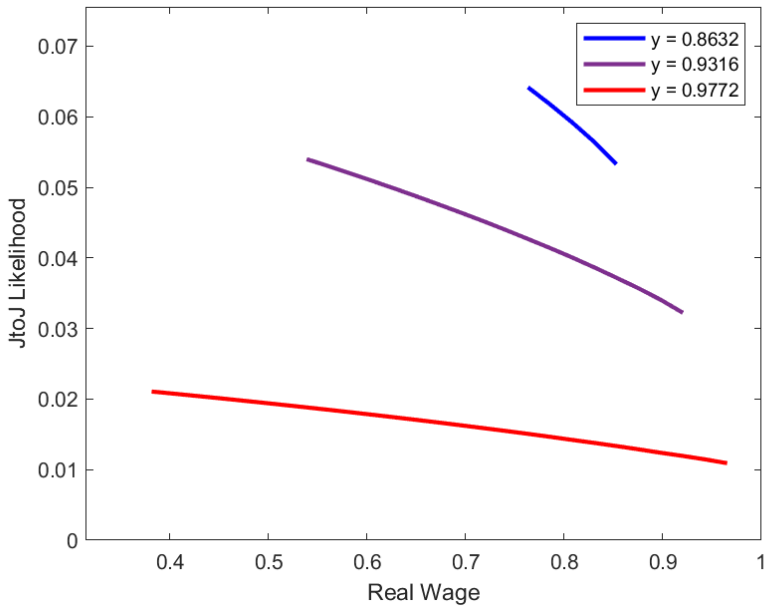
where

$$
\begin{aligned}
p' &= p(1+g_p) \\
z' &= (1+g) \\
w' &= w(1+g)(1+g_p)
\end{aligned}
$$

Search and J2J Transitions



(a) Search effort policy function



(b) Implied JtoJ likelihood

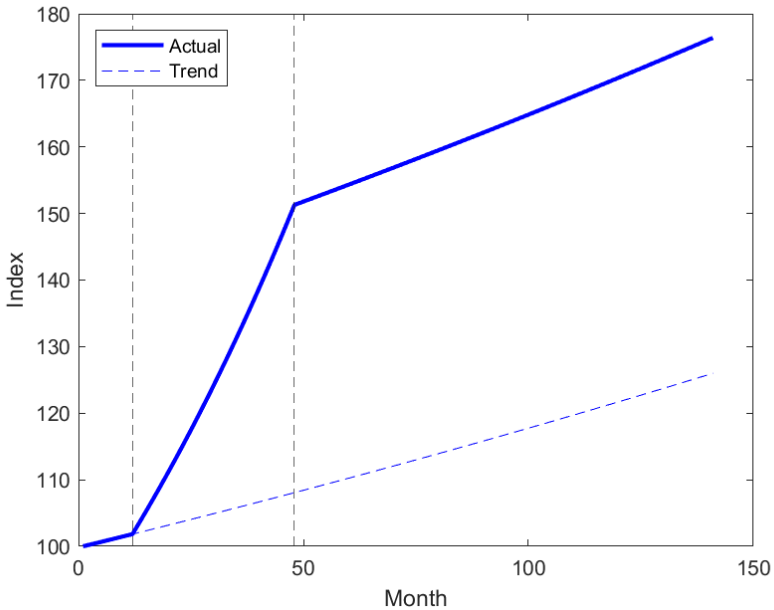
Measuring the Search Costs of Inflation

- Economy with $\left(g, g_p^1\right)$ same as $\left(g, g_p^2\right)$ with indexing
- Consider repeated, unanticipated shocks to the rate of inflation
- At some date τ, price level unexpectedly grows at rate $\hat{g}_p > g_p$
- Nominal wages already contracted to grow at rate $(1+g)(1+g_p)$, real wages grow at rate $\frac{(1+g)(1+g_p)}{1+\hat{g}_p} < 1+g$

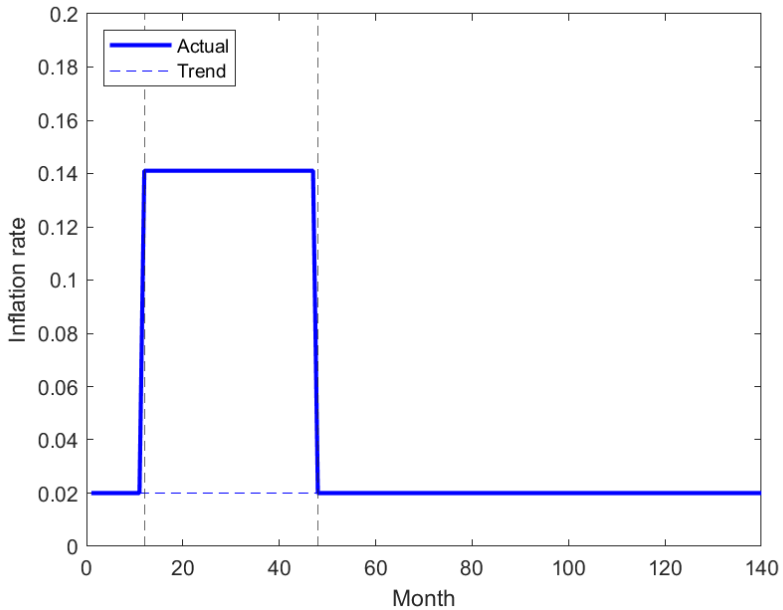
Unexpected Temporary Shock

- Implementation
  - begin economy in balanced growth path
  - at dates $t \in (\tau, \tau + T)$, unanticipated inflation change from g_p to $g_p\varepsilon$, > 1
  - at date $\tau + T + 1$, ε returns to 1
- Look at different outcomes:
  - real wages in existing/new matches
  - search effort among employed
  - worker/firm welfare relative to baseline

Unexpected Temporary Shock



(a) CPI



(b) Inflation rate

Comparison Real w Search effort EE rate Reneg. rate

Flow value losses

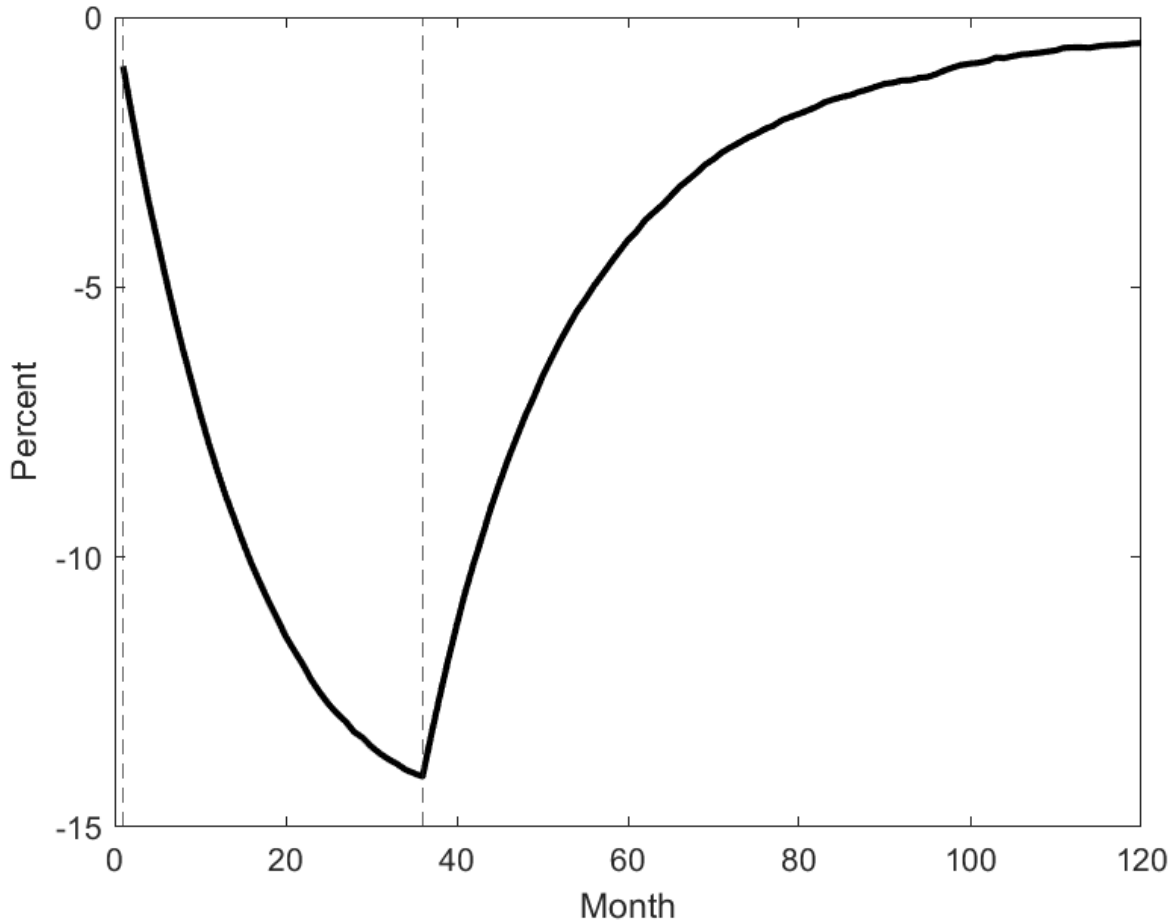
- Calculate flow value for each worker in case with inflation shock and case without inflation shock:

$$\tilde{w}_{i,t}^{case} = ((w_{i,t} - c(s_{i,t})) * 1[emp_{i,t} = 1] + b * 1[emp_{i,t} = 0]) \tag{1}$$

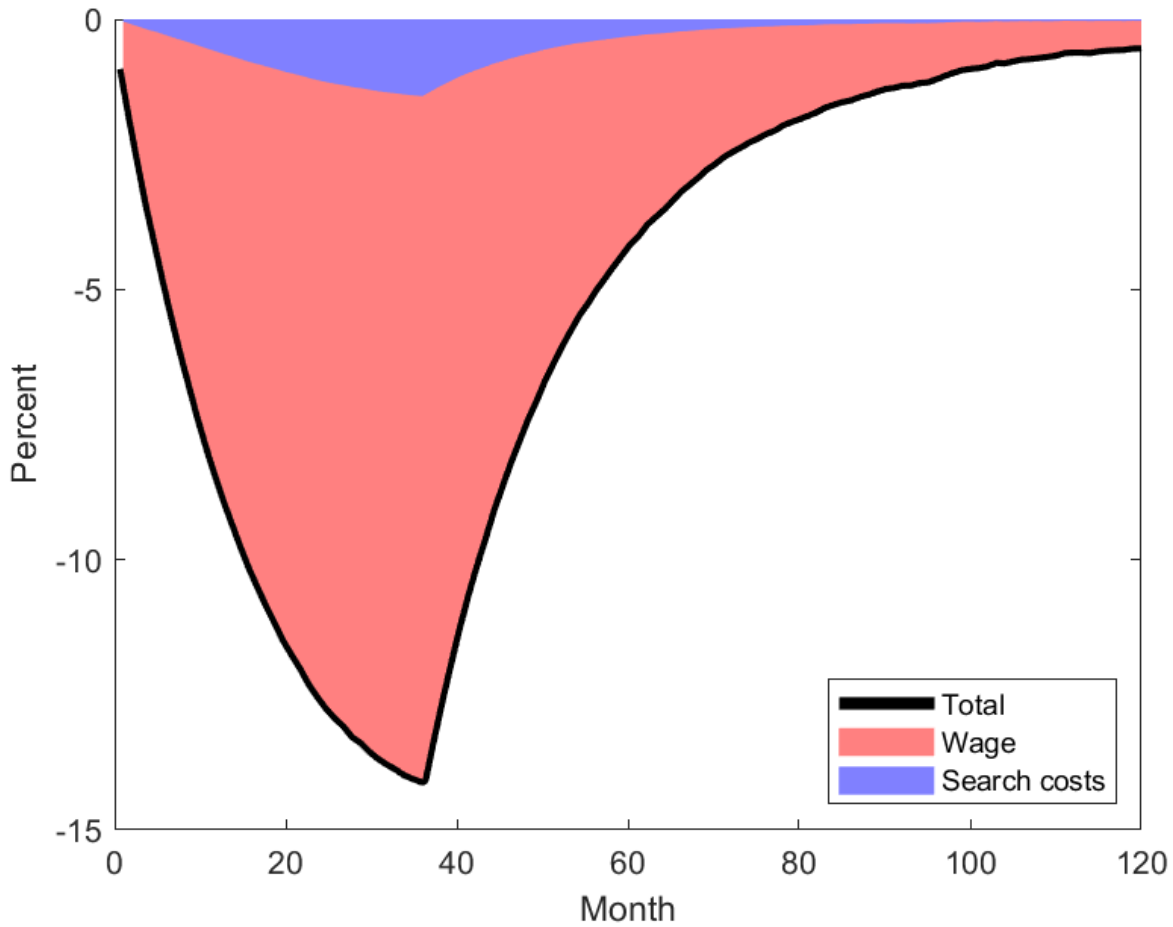
- Measure of average flow value losses caused by shock in given period:

$$\frac{\mathbb{E}[\tilde{w}_{i,t}^{shock} | t = \tau] - \mathbb{E}[\tilde{w}_{i,t}^{no\ shock} | t = \tau]}{\mathbb{E}[\tilde{w}_{i,t}^{no\ shock} | t = \tau]} \tag{2}$$

Unexpected Temporary Shock: Flow Value loss



Unexpected Temporary Shock: Decomposition of Flow Value loss



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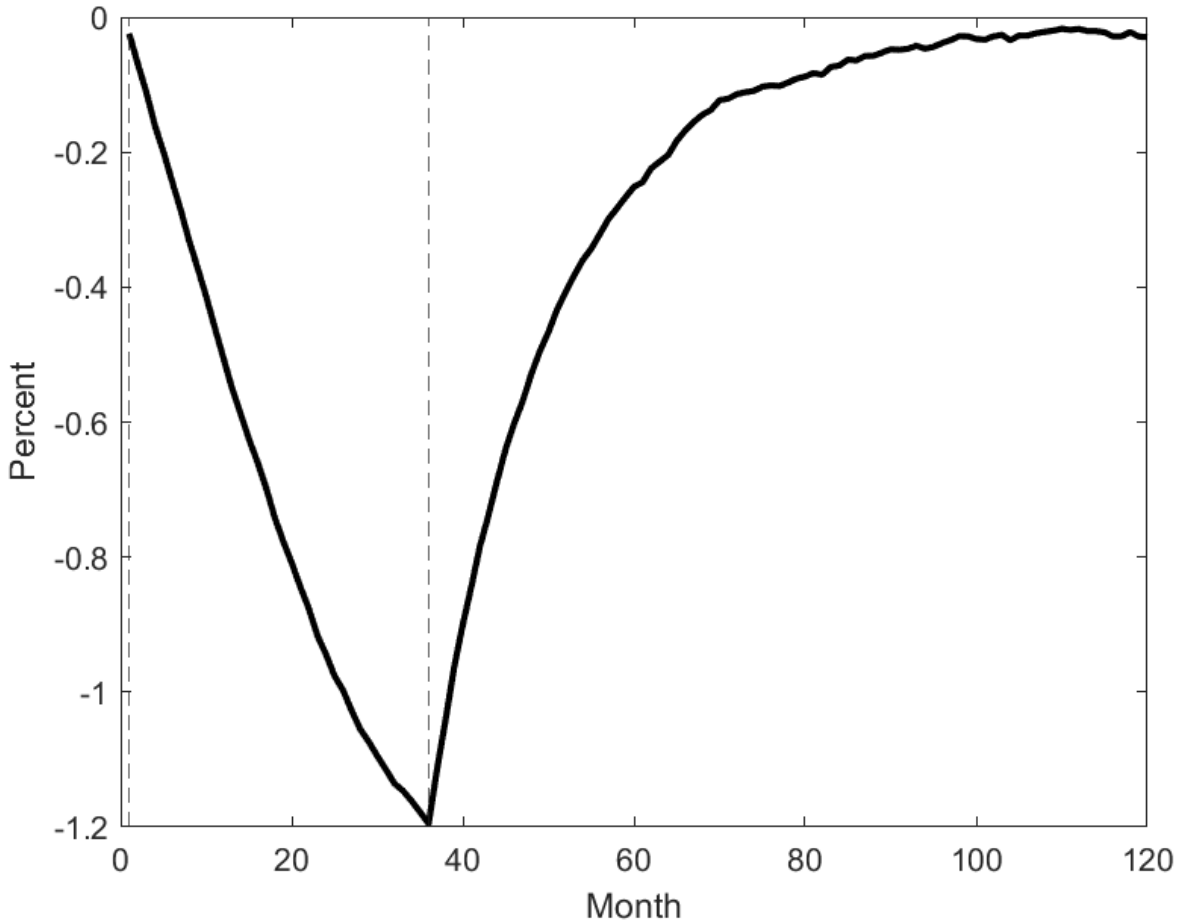

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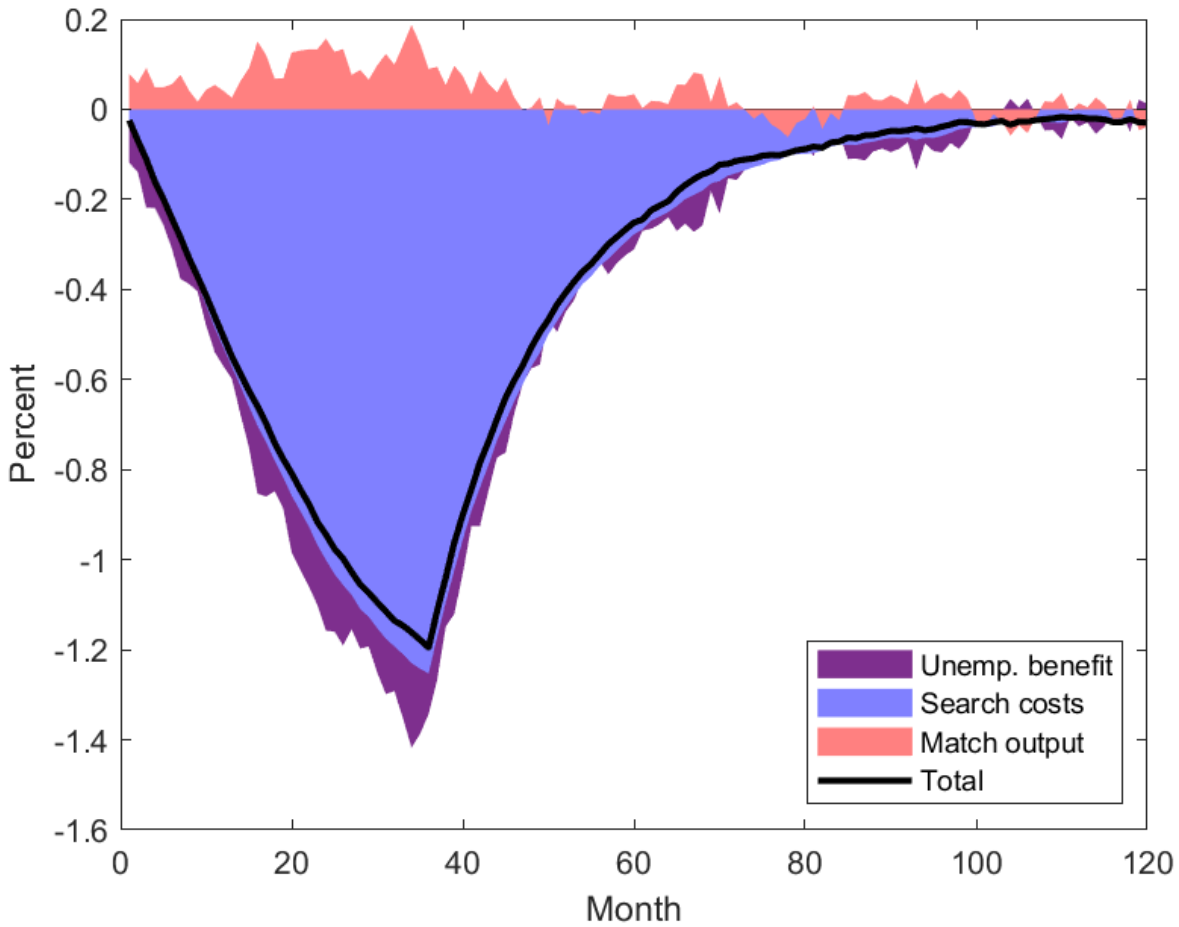


Conclusion

- We develop a model in which search is endogenous to the real wage and real wages are allowed to erode with inflation.
- Larger set of outside firms can prompt wage renegotiation.
- This prompts search effort
  - Net cost of inflation
  - Reduced somewhat by reallocation of workers up job ladder.

Nakamura, Emi, Jon Steinsson, Patrick Sun, and Daniel Villar, "The Elusive Costs of Inflation: Price Dispersion during the U.S. Great Inflation," *Quarterly Journal of Economics*, November 2018, *133*, 1933 – 1980.

Pilossoph, Laura and Jane Ryngaert, "Job Search, Wages, and Inflation," 2024.

Shiller, R.J., "Why do people dislike inflation," in "Reducing inflation: Motivation and strategy," University of Chicago Press, 1997, pp. 13–70.

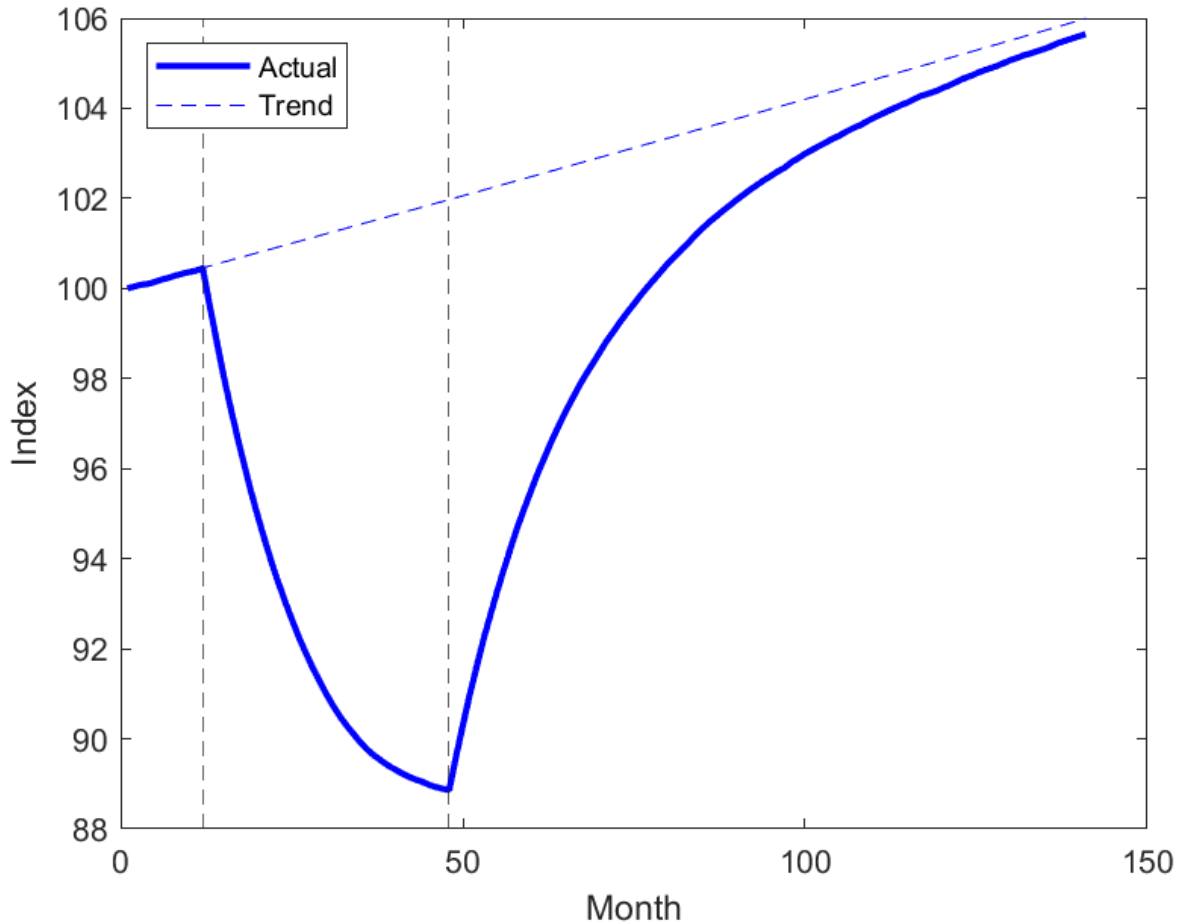
Stancheva, Stephanie, "Why do we dislike inflation?," 2024.

Historical inflation episodes

Past episodes	Beg	End	Cum. Price Δ		Avg. ann. inflation	
			Overall	Adj.	Overall	Adj.
COVID-19	Jan-21	Jan-23	14.4%	10.4%	6.9%	5.1%
OPEC Embargo	Jan-73	Jan-76	30.7%	24.6%	9.33%	7.6%
Late 1970s	Jan-78	Jan-81	39.1%	33%	11.6%	10%

Table 1: Comparison with Past Inflation Episodes

Average real wage



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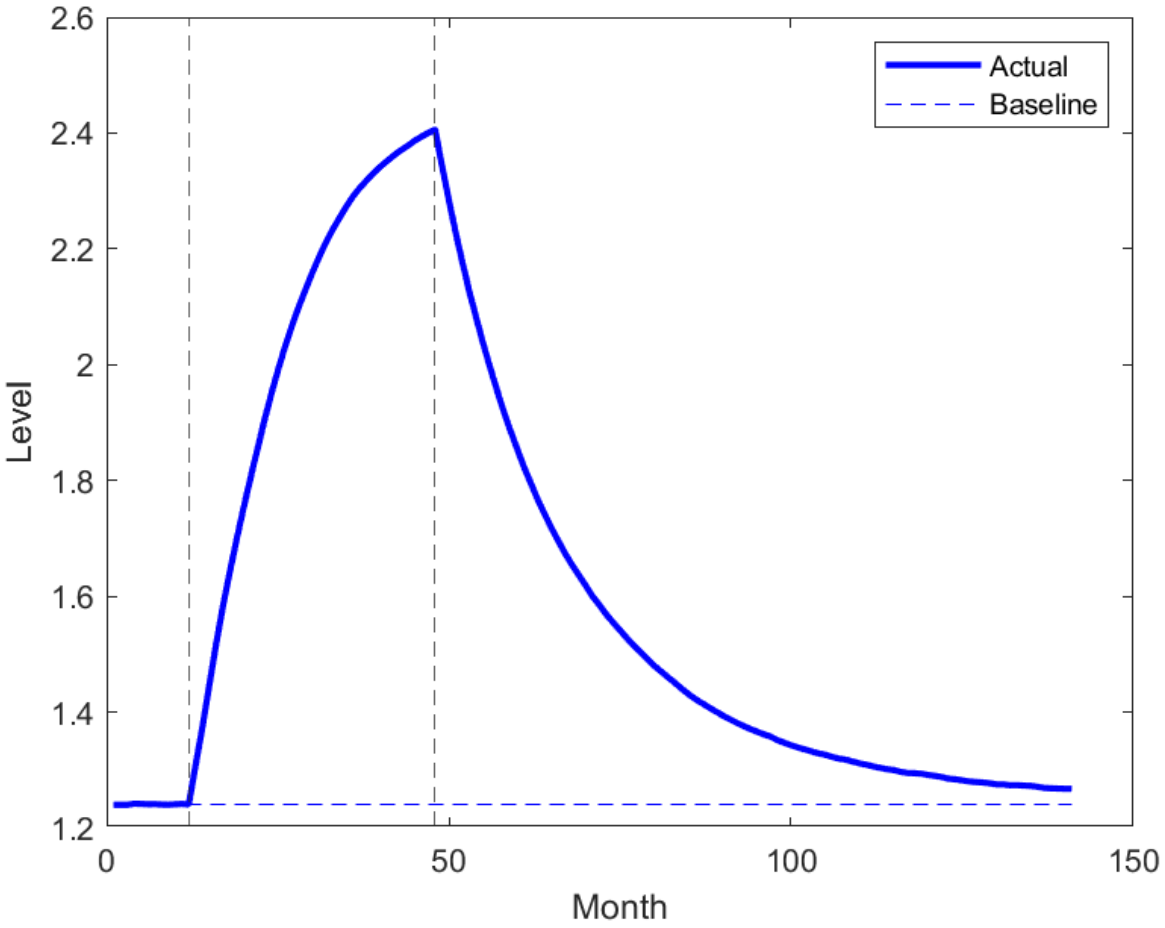
Search effort



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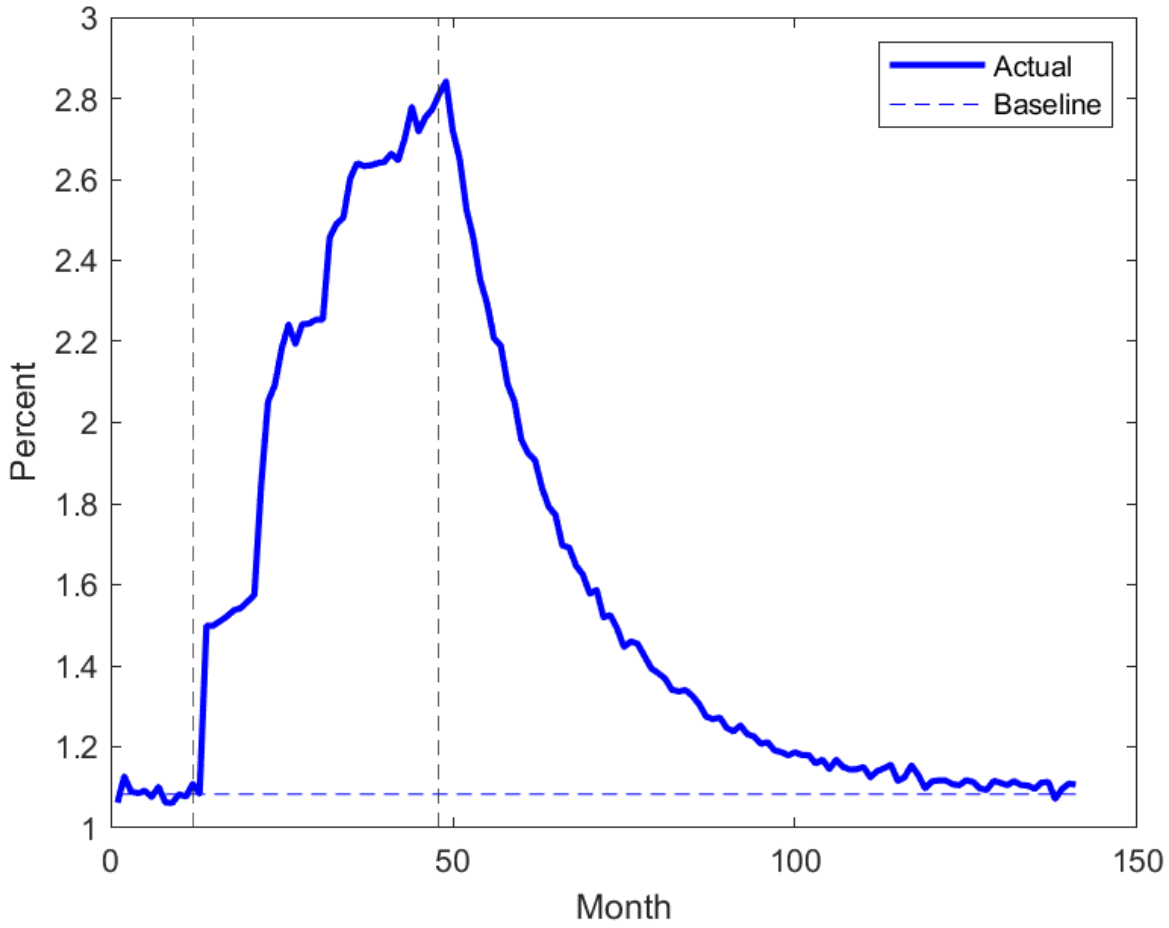
Renegotiation rate (counter-offers)



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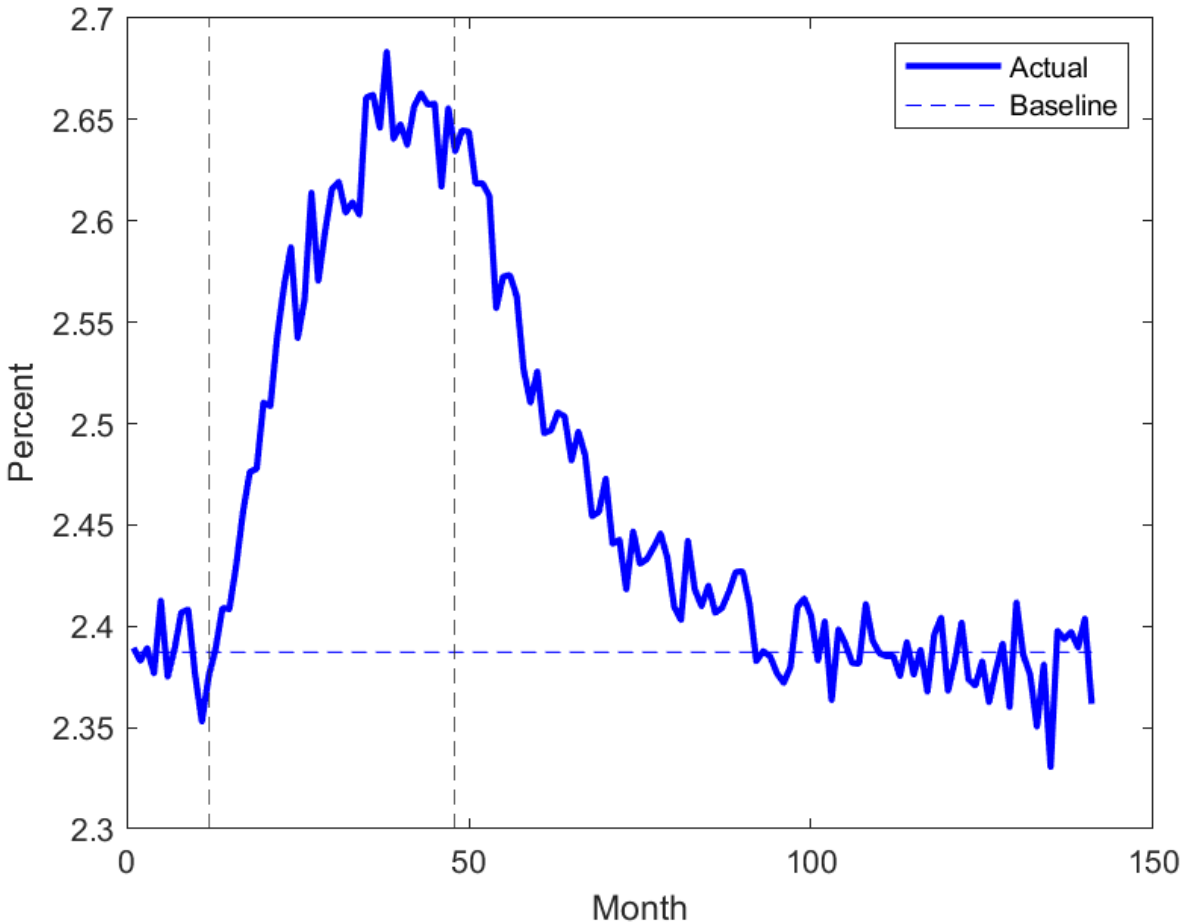
EE transition rate



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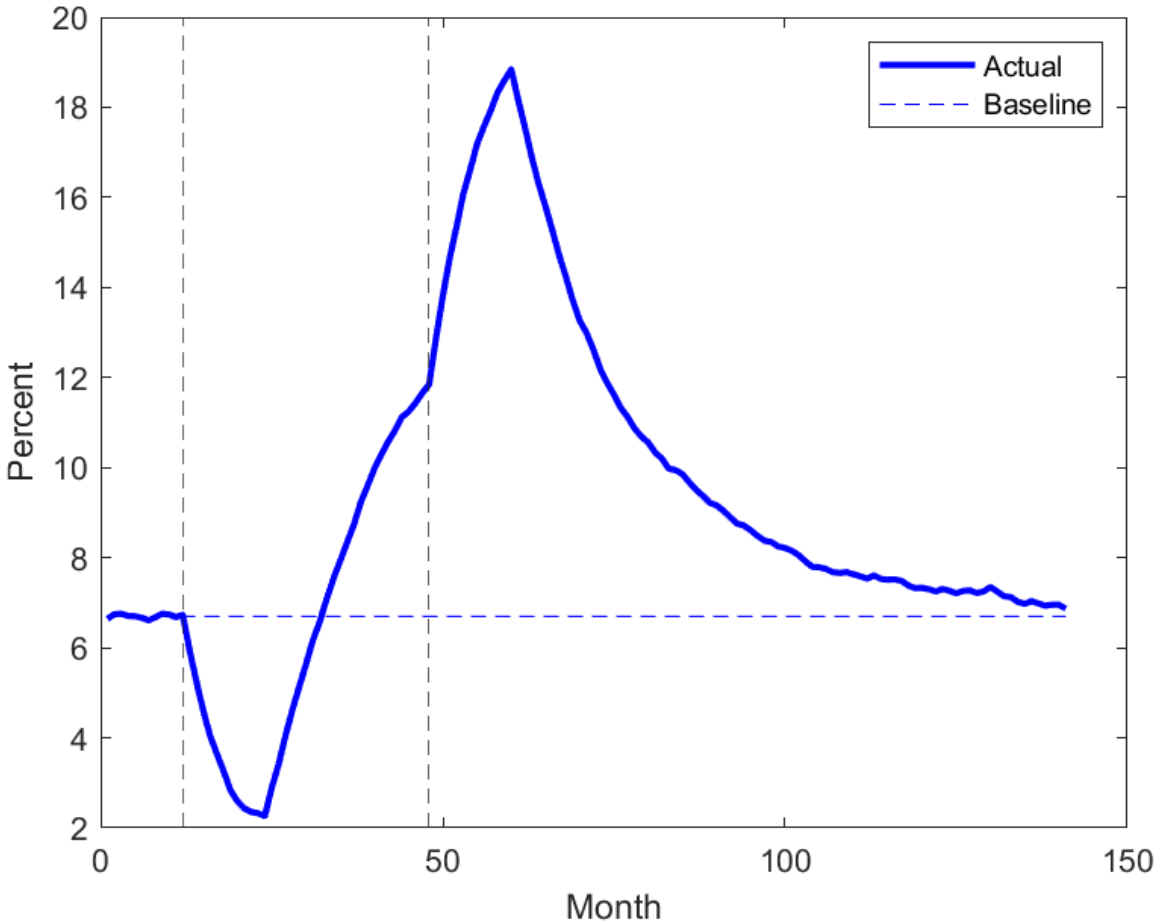
Average real wage growth - movers



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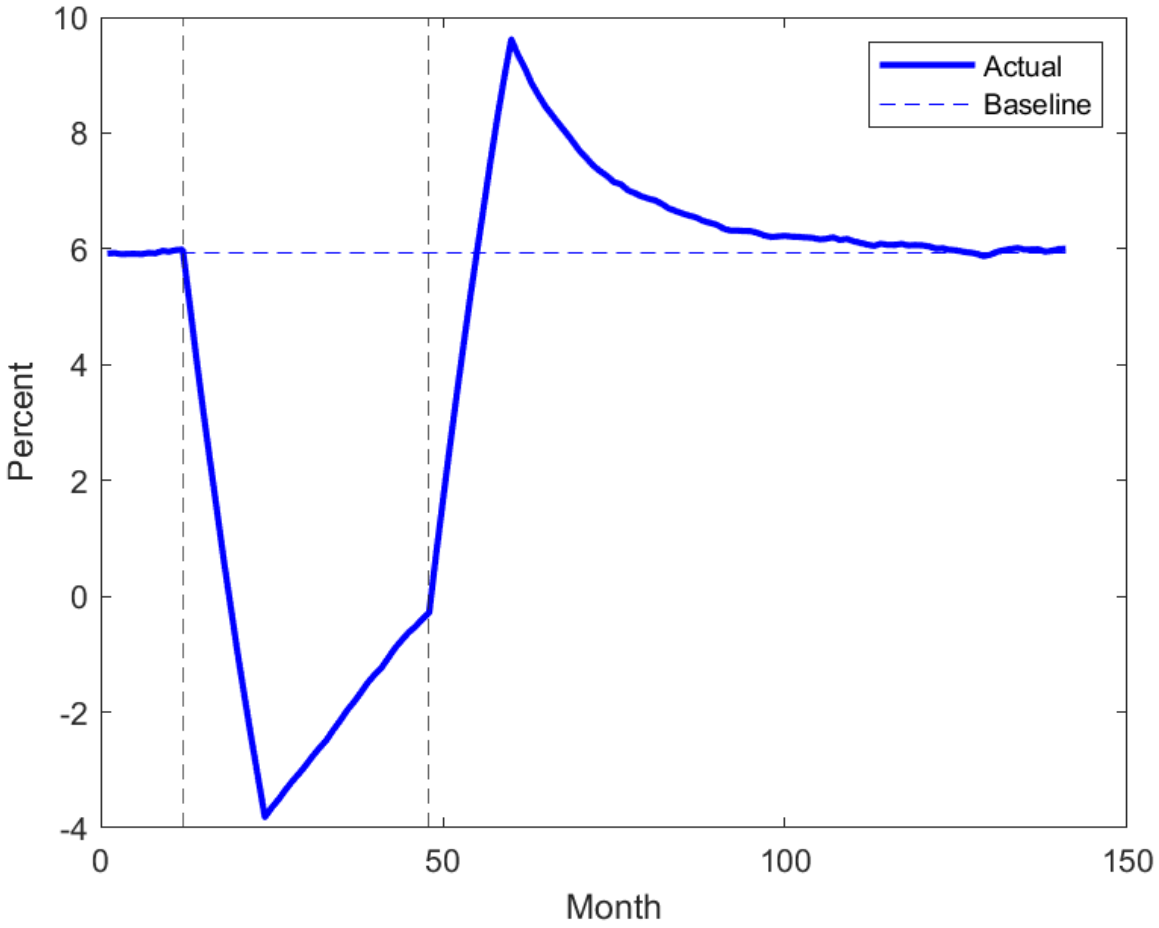
Average real wage growth - stayers



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Calibration

- Monthly calibration to pre-Covid US economy
- Set exogenously:
  - $\beta = .9964$, 5% annual interest rate
  - $g = .00042$, annual TFP growth 0.5%
  - $\lambda_u = 0.31$
- Functional form assumptions:
  - $Y(z, y) = z \cdot y$
  - $c(s, z) = z \cdot c_0 s^{\kappa}$
  - $B(z) = b \cdot z$
  - $y \sim \text{Beta}\left(\tilde{\alpha}, \tilde{\beta}\right)$ truncated between b and 1
- Allow for heterogeneity in job dest. rate: $\delta(y) = \delta_0 + \delta_1 y$

Fit

- Calibrate $\{b, c_0, \kappa, \lambda_e, \delta_0, \delta_1 \tilde{\alpha}, \tilde{\beta}\}$

Table 2: Parameters and Model Fit

Parameter	Value	Moment	Model	Data	Source
κ	2.15	$\frac{\partial s}{\partial \log \frac{w}{p}}$	-0.061	-0.063	FMST (2022)
c_0	60.79	$\frac{\lambda_e}{\lambda_u}$	0.229	0.237	FMST (2022)
λ_e	0.058	EE	0.0238	0.0241	FMPV (2021)
b	0.825	rep. rate	0.841	0.841	CK (2016)
δ_0	0.013	EU	0.014	0.013	BA (2021)
δ_1	-0.058	$\frac{\partial EU}{\partial \log \frac{w}{p}}$	-0.002	-0.0392	JK (2019)
$\tilde{\alpha}$	10.4	Δw_{stayer}	0.059	0.039	GHY (2021)
$\tilde{\beta}$	1.19	Δw_{mover}	0.068	0.08	GHY (2021)