The Search Costs of Inflation in the Labor Market

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  - workers **search more** under higher expected future π,
  - ... belief that **real earnings will fall** with current employer
- Suggests new cost operating in labor market: **search and moving costs** (Afrouzi, Blanco, Drenik, and Hurst (ABDH, 2024), Guerreiro, Hazell, Lian, and Patterson (GHLP, 2024))

This Paper

- Extend the cannonical (real) search model of Postel-Vinay and Robin (2002) to include nominal wage rigidities
- Use it to study how unexpected shocks to π affect worker behavior and outcomes: real wages, search effort, job transitions:
  - Unanticipated inflationary shocks + rigid nominal wages $\Longrightarrow$ negative shocks to real wages.
  - Intensify search for other jobs to obtain a wage adjustment (J2J or on-the-job)
  - This search and (the possible) associated job mobility is costly. Either pay the cost, or suffer the real earnings loss. *Both are bad for workers.*
    - ... real wage loss net benefit to firms

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Related Work

- Pilossoph and Ryngaert (2025): empirical evidence on the relationship between expected inflation and search behavior
- Moscarini and Postel-Vinay (2023) : EE rate $\implies \pi$. Here: $\pi \implies$ EE rate
  - Misallocation in labor market $\implies$ workers easy to poach, moderating marginal costs and inflation. Workers well-allocated, lower slack in employment pool, inflation effect takes over.
- Shiller (1997), Stantcheva (2024), GHLP (2024) ADMPS (2024) : survey evidence on why workers dislike inflation (it's largely purchasing power effect)
- ABDH, GHLP: measure costs associated with inflation; latter makes point about measured wage growth being a poor indicator
  - measure net costs in addition to losses on worker side
  - allow for productivity gains through job ladder

Agents and Technologies (I)

- Exogenous aggregate productivity z, grows deterministically at rate g_z
- Exogenous price level $P = p \cdot \varepsilon$
  - Exogenous trend price level p, grows deterministically at rate g_p (in balanced growth path)
  - Exogenous stochastic price level ε, grows at rate g'_ε
  - Shocks g_ε follow:

    $$g'_\varepsilon = \rho g_\varepsilon + \nu'$$

    with $\nu' \sim N\left(0, \sigma_\nu^2\right)$.
- Exogenous distribution of vacancies belonging to firms of type $y \in (\underline{y}, \bar{y})$, $F(y)$
- Output is $Y(z, y)$

Agents and Technologies (II)

- Unit mass of workers, $i \in \{e, u\}$ employed and unemployed
- Make private search effort decisions $s \in (0, 1 - \lambda_i)$, determines contact rate with openings, $s + \lambda_i$.
  - real cost is $C(z, s) > 0$, with $\frac{\partial C(z,s)}{\partial s} > 0$, $\frac{\partial^2 C(z,s)}{\partial s \partial s} \geq 0$
  - search decision must be private (not bilateral) to make search depend on wage
- Exogenous separation at rate δ
- Real flow value of unemployment $B(z)$

Wage Setting/Contracts (I)

- Firms offer initial nominal hiring wage w, contracted to grow at rate $(1 + g_z)(1 + g_p)$ (by assumption)
  - mimics COLA in link to trend inflation
  - will return to wage determinants momentarily
- Renegotiated only by mutual consent
- Firms can make counteroffers, Bertrand competition ensues (Postel-Vinay Robin (2002))

Wage Setting/Contracts (II)

- TIOLI offers to unemployed $\Longrightarrow$ nominal wage ϕ_u out of unemployment satisfies $U(z) = W(\phi_u, y, p, \varepsilon, g_\varepsilon, z)$

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- TIOLI offers to unemployed $\Longrightarrow$ nominal wage ϕ_u out of unemployment satisfies $U(z) = W(\phi_u, y, p, \varepsilon, g_\varepsilon, z)$
- Value of unemployment has simple form:

$$\begin{aligned} U(z) &= \max_{s \in [0, 1-\lambda_u]} B(z) - C(z, s) + \beta (1 - (s + \lambda_u)) U(z') \\ &\quad + \beta \mathbf{E}_{g'_\varepsilon} (\lambda_u + s) \int_y \max \left\{ U(z'), W(\phi_u, y, p', \varepsilon', g'_\varepsilon, z') \right\} dF(y) \\ &= B(z) + \beta U(z') \end{aligned}$$

where $p' = p(1 + g_p)$, $\varepsilon' = \varepsilon(1 + g'_\varepsilon)$, $z' = z(1 + g_z)$

- $s^*_u = 0$ since return is zero (a simplification)

Poaching and Contract Adjustments

- Consider worker with y_1 at nominal wage w when state is $(p, \varepsilon, g_\varepsilon, z)$.
  - w': wage that prevails **without any outside offers** in state $(p', \varepsilon', g'_\varepsilon, z')$

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  1. $y_2 \leq y_1$ and $W\left(z'p'\varepsilon' y_2, y_2, p', \varepsilon', g'_\varepsilon, z'\right) \leq W\left(w', y_1, p', \varepsilon', g'_\varepsilon, z'\right)$: no outbidding, same contract

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  2. $y_2 \leq y_1$, but $W\left(z'p'\varepsilon'y_2, y_2, p', \varepsilon', g'_\varepsilon, z'\right) > W\left(w', y_1, p', \varepsilon', g'_\varepsilon, z'\right)$: no outbidding, wage renegotiated. New wage ϕ^{reneg} satisies

$$W\left(z'p'\varepsilon'y_2, y_2, p', \varepsilon', g'_\varepsilon, z'\right) = W\left(\phi^{\text{reneg}}, y_1, p', \varepsilon', g'_\varepsilon, z'\right)$$

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  $$W\left(z'p'\varepsilon'y_2, y_2, p', \varepsilon', g'_\varepsilon, z'\right) = W\left(\phi^{\text{reneg}}, y_1, p', \varepsilon', g'_\varepsilon, z'\right)$$
  3. $y_2 > y_1$ and $W\left(z'p'\varepsilon'y_2, y_2, p', \varepsilon', g'_\varepsilon, z'\right) \ge W\left(z'p'\varepsilon'y_1, y_1, p', \varepsilon', g'_\varepsilon, z'\right)$ cutoff: worker poached, new contract. New wage ϕ^{poach} satisfies
  $$W\left(\phi^{\text{poach}}, y_2, p', \varepsilon', g'_\varepsilon, z'\right) = W\left(z'p'\varepsilon'y_1, y_1, p', \varepsilon', g'_\varepsilon, z'\right)$$

Wage Determinants with No Outside Offers

$$w' = \begin{cases} \hat{w} : J\left(\hat{w}, y, p', \varepsilon', g_\varepsilon', z'\right) = 0, \text{ if } \; J\left(w\left(1+g_z\right)\left(1+g_p\right), y, p', \varepsilon', g_\varepsilon', z'\right) < 0 \\ \hat{w} : W\left(\hat{w}, y, p', \varepsilon', g_\varepsilon', z'\right) - U\left(z'\right) = 0, \text{ if } \; W\left(w\left(1+g_z\right)\left(1+g_p\right), y, p', \varepsilon', g_\varepsilon', z'\right) - U\left(z'\right) < 0, \\ w\left(1+g\right)\left(1+g_p\right), \text{ else} \end{cases}$$

- Cases correspond to: firm boundaries (real wages too high), worker boundaries (real wages too low), status quo.
- This is where downward rigidity could be added

Search Effort, Wages, and Inflation

- Cutoff firm q, above induces wage change, below no wage change (relative to w')

$$W\left(w', y_1, p', \varepsilon', g'_\varepsilon, z'\right) = W\left(z'p'\varepsilon' q, q, p', \varepsilon', g'_\varepsilon, z'\right)$$

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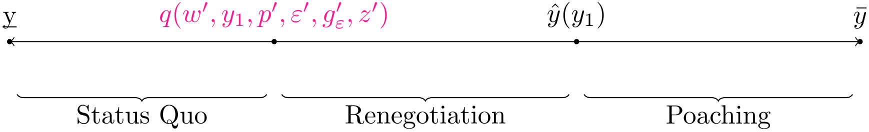


- $q(\cdot)$ depends on current nominal wage and price level:
  - given g'_{ε}: lower $w' \implies$ lower $q(\cdot)$
  - given w': higher g'_{ε} lower $q(\cdot)$
- $q(\cdot)$ directly affects incentives to search

Value of Employment $W\left(w, y, p, g_{\varepsilon}, z\right)$

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

where

$$
\begin{aligned}
p' &= p\left(1+g_p\right) \\
\varepsilon' &= p\left(1+g'_{\varepsilon}\right) \\
z' &= \left(1+g_z\right)
\end{aligned}
$$

Optimal Search Effort

- Optimal search effort (interior):

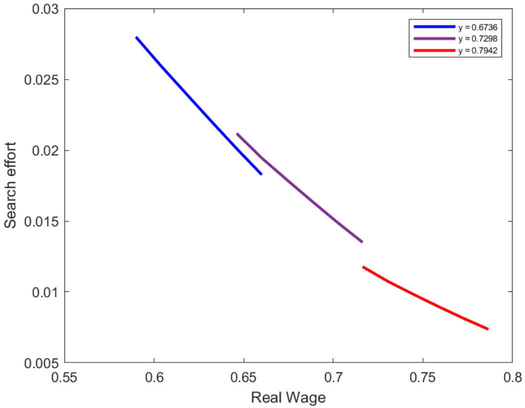
$$\frac{\partial C\left(s_e^*\left(w,y,p,\varepsilon,g_\varepsilon,z\right),z\right)}{\partial s} = \beta \mathbf{E}_{g'_\varepsilon}\left(1-\delta\right)\int^{q\left(w',y,p',\varepsilon',g'_\varepsilon,z'\right)}[0]dF\left(x\right)$$

$$+\beta \mathbf{E}_{g'_\varepsilon}\left(1-\delta\right)\int_{q\left(w',y,p',\varepsilon',g'_\varepsilon,z'\right)}^{y}[\text{Reneg}-\text{Status Quo}]dF\left(x\right)$$

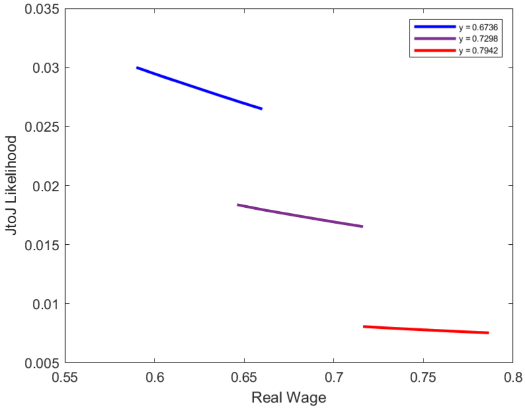
$$+\beta \mathbf{E}_{g'_\varepsilon}\left(1-\delta\right)\int_{y}^{\bar{y}}[\text{Poach}-\text{Status Quo}]dF\left(x\right)$$

J value

Search and J2J Transitions



(a)



(b)

- Search effort and J2J declining in real wage at any given firm (would not happen with bilaterally efficient search)

Balanced Growth and Model Solution

Proposition If $Y(z,y)$, $B(z)$, $C(z,s)$ are homogeneous of degree 1 in z and wage contracts are indexed to trend inflation and TFP, then

$$U((1+g_z)\cdot z) = (1+g_z)\cdot U(z),$$

$$W((1+g_z)(1+g_p)\cdot w, y, (1+g_p)\cdot p, \varepsilon, g_\varepsilon, (1+g_z)\cdot z) = (1+g_z)\cdot W(w,y,p,\varepsilon,g_\varepsilon,z), \quad \text{and}$$
$$J((1+g_z)(1+g_p)\cdot w, y, (1+g_p)\cdot p, \varepsilon, g_\varepsilon, (1+g_z)\cdot z) = (1+g_z)\cdot J(w,y,p,\varepsilon,g_\varepsilon,z)$$

- Model scales with growth g_z and g_p
- **Trend rate of inflation does not matter for allocations as long as it is deterministic and wages are indexed appropriately**

Efficiency

- Natural question: is search socially efficient?
- Answer: **no.**
  - search is chosen privately by worker: they do not internalize loss to current firm when they change jobs or bid up wage
  - worker does not get full surplus in future matches: search does not internalize social gains from moving to more productive firms

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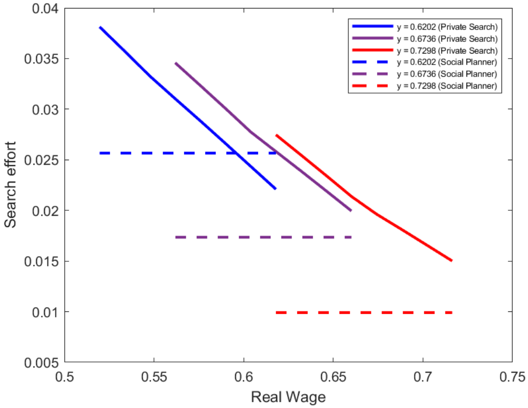
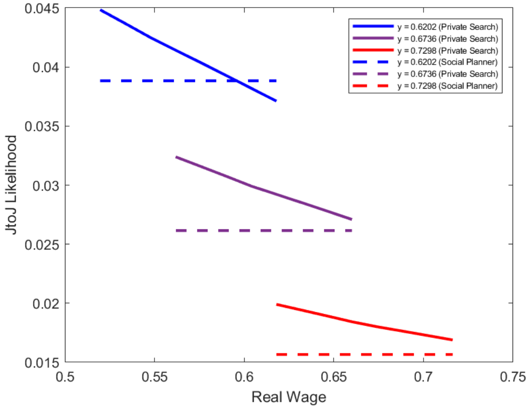
- $\longrightarrow$ gap between efficient search + DE depends on location in job ladder
  - at very top: no productivity gains. Search is too high relative to planner
  - at the bottom: productivity gains present, so depends

Efficiency



(c)



(d)

The Search Costs of Inflation

- Calibrate the model to match U.S. economy with annual trend inflation of 2%, targeting wage growth and search elasticity moments (calibration)
  - + heterogeneity in δ across firms: $\delta(y) = \delta_0 + \delta_1 y$
  - + moving costs: η_e, η_u

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- Two quantitative exercises:
  - consider unanticipated g_ε shock calibrated to Covid
  - consider overall costs associated unexpected shocks to inflation comparing $\sigma_\nu^2 > 0$ to $\sigma_\nu^2 = 0$

Model Calibration

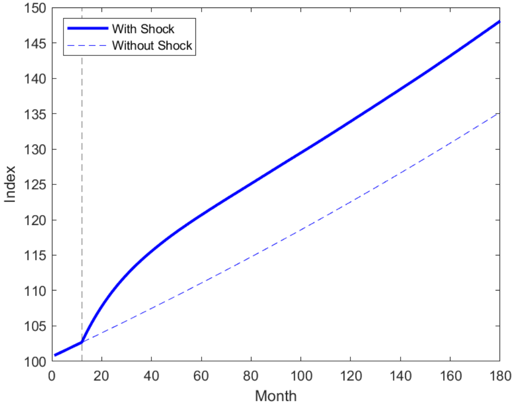
Symbol	Parameter Description	Value	Source/Target
A. Externally calibrated parameters and normalizations			
β	Discount rate	0.996	Annual interest rate of 5%
g	Det. TFP growth rate	0.0004	Average TFP growth: 0.5%
λ_u	Job arrival rate, unemployed	0.342	SCE, 2001-2019
g_p	Trend inflation	0.0017	CPI/PCE inflation (2000-2019)
ρ	Persistence of inflation shock	0.936	Cyclical component of CPI (1947-2024)
σ_ν	SD of inflation shock	0.00036	Cyclical component of CPI (1947-2024)
B. Internally calibrated parameters			
κ	Elasticity of search cost	1.92	Search-wage elasticity
c_0	Search cost parameter	15.76	Relative offer yield ratio
λ_e	Offer arrival rate of emp.	0.055	EE transition rate
b	Flow value of unemployment	0.829	Replacement rate
δ_0	Intercept of job destruction	0.0175	EU rate
δ_1	Slope coefficient of job destruction	-0.024	Separation-wage elasticity
λ_g	Exogenous job mobility shock	0.009	Acceptance ratio
η_u	Moving cost, non-employed	0.83	Average wage growth of EUE movers
η_e	Moving cost share of employed	0.15	Average wage growth of movers
$\tilde{\alpha}, \tilde{\beta}$	Parameters governing vacancy dist.	3.31,2.39	Variance of firm FEs, Average wage growth of stayers

Model Fit

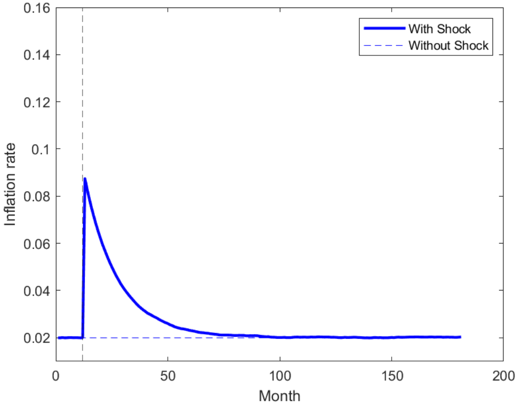
Table 1: Targeted Moments in the Data and the Model

Moment	Source	Data	Model
search-wage elasticity	FMST	−0.07	−0.066
offer yield	FMST	0.237	0.234
acceptance ratio	FMST	0.328	0.314
EE transition rate	FMST	0.025	0.028
replacement rate	CRK	0.55	0.54
EU separation rate	FMST	0.025	0.023
separation-wage elasticity	JK	−0.0392	−0.0393
real wage growth (job stayers)	GHY	0.019	0.019
real wage growth (job movers)	GHY	0.06	0.06
real wage growth (EUE movers)	FM	−0.022	−0.0198
dispersion in Firm FEs	LMSW	0.032	0.037

Exercise I: g'_ε Shock



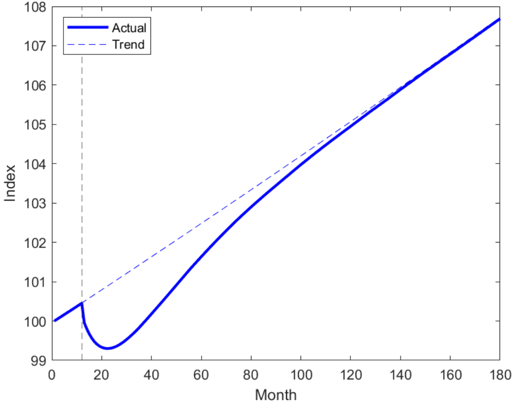
(e) Price level



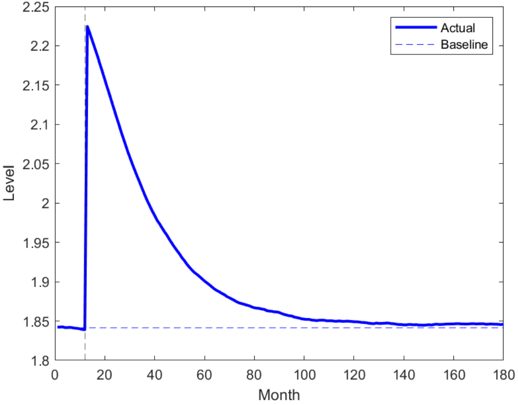
(f) Inflation rate (annualized)

- Only difference from trend shock: expectations

Exercise I: Real Wages and Search Effort for Employed

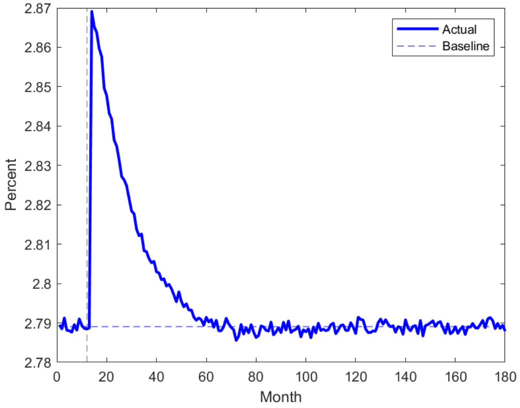


(g) $\frac{w}{p \cdot \varepsilon}$

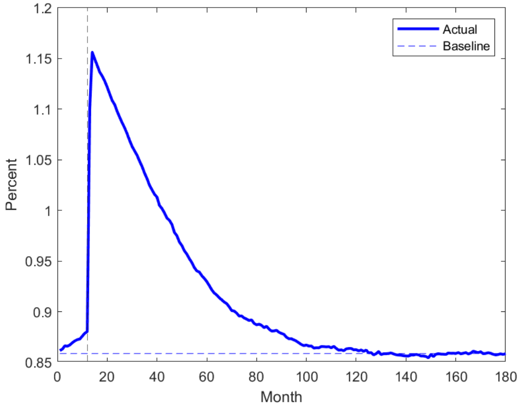


(h) $s^* (\cdot)$

Exercise I: J2J Transitions and Renegotiation Rates

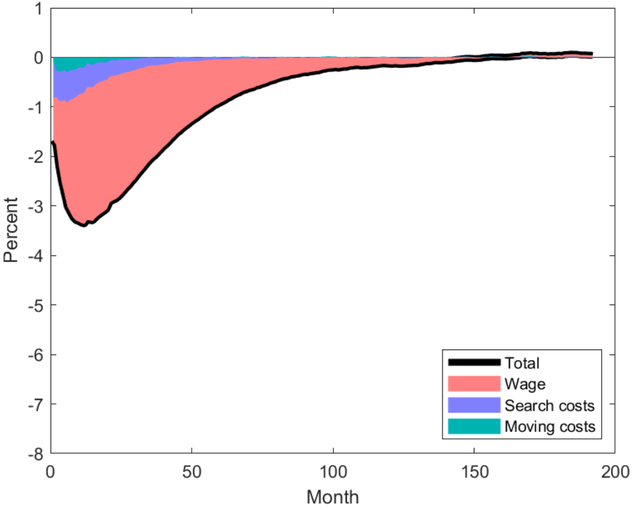


(i) J2J Rate



(j) Renegotiation Rate

Exercise I: Decomposition of Flow Losses



Exercise I: Lifetime Welfare Costs

	Mean Δ W (% baseline)
Total loss	-0.58 %
lost income	-0.4938 %
incurred search costs	-0.069 %
incurred moving costs	-0.017 %

Table 2: Lifetime welfare consequences of 1-time g_ε shock

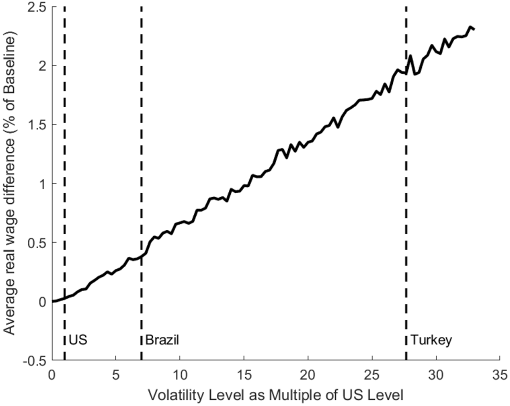
- overall: .6% in CE
- majority is real wage loss
- non-trivial from search and mobility

Exercise I: Heterogeneity

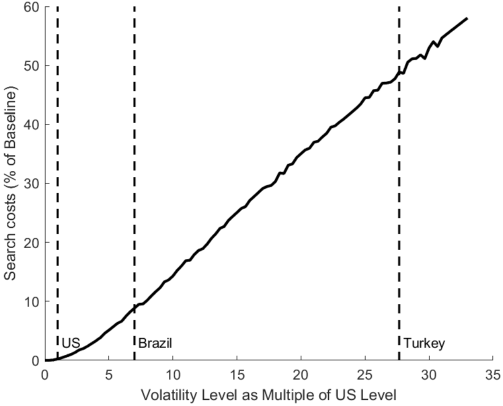
Table 3: Lifetime Welfare Consequences by Wage Quartile

Quartile	Total Loss	Income Loss	Search Costs	Moving Costs
First (Lowest Wages)	-0.1254%	-0.0179%	-0.0857%	-0.0217%
Second	-0.3776%	-0.2542%	-0.0975%	-0.0259%
Third	-0.6993%	-0.6274%	-0.0635%	-0.0085%
Fourth (Highest Wages)	-1.0771%	-1.0446%	-0.0196%	-0.0128%

Exercise II: Set $\sigma_\nu = 0$



(k) Real Wage Losses



(l) Search Effort

Conclusion

- Develop a theory which embodies a new cost of inflation: search costs
  - 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
- Search is costly to workers, and a net cost of inflation
- Large unanticipated shocks are costly to workers; cyclical shocks in the U.S. fairly small, but its important to keep it that way!

Value of Employment to Firm $J\left(w,y,p,\varepsilon,g_{\varepsilon},z\right)$

$$
\begin{aligned}
J\left(w,y,p,g_{\varepsilon},z\right) \ &= \ Y\left(z,y\right)-\frac{w}{p\varepsilon} \\
&+\beta\left(1-\delta\right)\lambda_{e}s_{e}^{*}\left(w,y,p,\varepsilon,g_{\varepsilon},z\right)\mathbf{E}_{g_{\varepsilon}^{\prime}}\int_{q\left(w^{\prime},y,p^{\prime},\varepsilon^{\prime},g_{\varepsilon}^{\prime},z^{\prime}\right)}^{y}J\left(\phi_{w}^{\text{reneg}}\left(y,x,p^{\prime},\varepsilon^{\prime},g_{\varepsilon}^{\prime},z^{\prime}\right),y,p^{\prime},\varepsilon^{\prime},g_{\varepsilon}^{\prime},z^{\prime}\right)dF\left(x\right) \\
&+\beta(1-\delta(y))(1-\lambda_{g})\lambda_{e}s_{e}^{*}\left(w,y,p,\varepsilon,g_{\varepsilon},z\right)\mathbf{E}_{g_{\varepsilon}^{\prime}}\left[\int^{q\left(w^{\prime},y,p^{\prime},\varepsilon^{\prime},g_{\varepsilon}^{\prime},z^{\prime}\right)}dF\left(x\right)\right]J\left(w^{\prime},y,p^{\prime},\varepsilon^{\prime},g_{\varepsilon}^{\prime},z^{\prime}\right) \\
&+\beta\left(1-\delta\right)\left(1-\lambda_{g}\right)\left[\left(1-\lambda_{e}s_{e}^{*}\left(w,p,\varepsilon,g_{\varepsilon},z\right)\right)\right]\mathbf{E}_{g_{\varepsilon}^{\prime}}J\left(w^{\prime},y,p^{\prime},\varepsilon^{\prime},g_{\varepsilon}^{\prime},z^{\prime}\right)
\end{aligned}
$$

where

$$
\begin{aligned}
p^{\prime} &= p\left(1+g_{p}\right) \\
\varepsilon^{\prime} &= p\left(1+g_{\varepsilon}^{\prime}\right) \\
z^{\prime} &= \left(1+g\right)z
\end{aligned}
$$

$$
w^{\prime}=\begin{cases}\hat{w}:J\left(\hat{w},y,p^{\prime},\varepsilon^{\prime},g_{\varepsilon}^{\prime},z^{\prime}\right)=0,\text{if } J\left(w\left(1+g\right)\left(1+g_{p}\right),y,p^{\prime},\varepsilon^{\prime},g_{\varepsilon}^{\prime},z^{\prime}\right)<0\\ \hat{w}:W\left(\hat{w},y,p^{\prime},\varepsilon^{\prime},g_{\varepsilon}^{\prime},z^{\prime}\right)-U\left(z^{\prime}\right)=0,\text{if } W\left(w\left(1+g\right)\left(1+g_{p}\right),y,p^{\prime},\varepsilon^{\prime},g_{\varepsilon}^{\prime},z^{\prime}\right)-U\left(z^{\prime}\right)<0,\\ w\left(1+g\right)\left(1+g_{p}\right),\text{else}\end{cases}
$$

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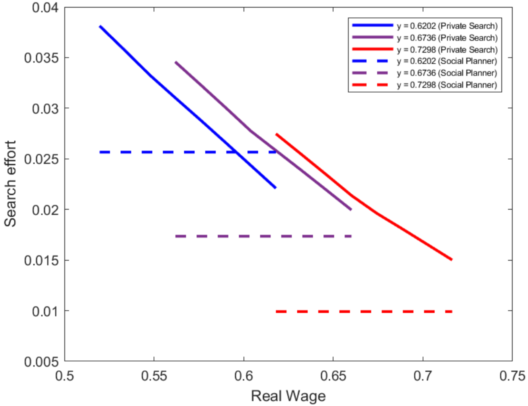
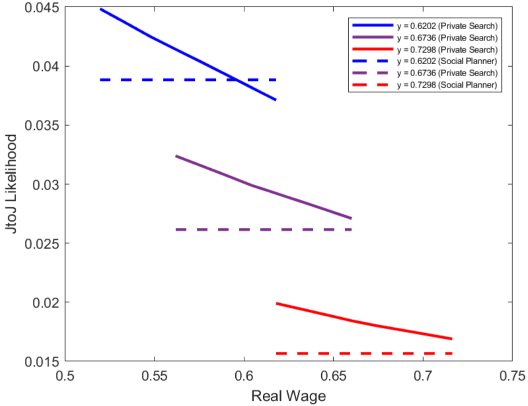
Search and J2J Transitions



(m)



(n)

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Social planner search choice

$$
\begin{aligned}
M(y,z) = \max_{s\in[0,\bar{s}_e]} \Big\{ & y - c(s,z) + \beta\delta(y)U(z') \\
& + \mathbf{E}_{g'_\varepsilon}\beta(1-\delta(y))(1-\lambda_g)(s+\lambda_e)\int_{\underline{y}}^{\hat{y}(y)} M(x,z)\,dF(x) \\
& + \mathbf{E}_{g'_\varepsilon}\beta(1-\delta(y))(1-\lambda_g)(1-s-\lambda_e)M(y,z) \\
& + \mathbf{E}_{g'_\varepsilon}\beta(1-\delta(y))(1-\lambda_g)(s+\lambda_e)\int_{\hat{y}(y)}^{\bar{y}} \big(M(x,z)-\eta_e(x,z)\big)\,dF(x) \Big\} \\
& + (1-\delta(y))\lambda_g \int_{\underline{y}}^{\bar{y}} \max\{(M(x,z)-\eta_u(x,z)\big), U(z')\}, dF(x) \Big\}
\end{aligned}
\tag{1}
$$

$$
\begin{aligned}
c'\big(s^*(y),z\big) = {} & \mathbf{E}_{g'_\varepsilon}\beta(1-\delta(y))(1-\lambda_g)\int_{\underline{y}}^{\hat{y}(y)} M(y,z)\,dF(x) \\
& + \mathbf{E}_{g'_\varepsilon}\beta(1-\delta(y))(1-\lambda_g)\int_{\hat{y}(y)}^{\bar{y}} (M(x,z)-\eta(x,z))\,dF(x) \\
& - \mathbf{E}_{g'_\varepsilon}\beta(1-\delta(y))(1-\lambda_g)M(y,z)
\end{aligned}
\tag{2}
$$

Social value of a match

$$
\begin{aligned}
\tilde{M}(w,y,\varepsilon,\varepsilon,z) &= Y(z,y) - C(s_e^*(w,y,\varepsilon,\varepsilon,z),z) + \beta\delta\tilde{U}(\varepsilon,\varepsilon,z') \\
&+ \beta(1-\delta)(1-\lambda_g)(s_e^*(w,y,\varepsilon,\varepsilon,z)+\lambda_e)\int_{\underline{y}}^{q(w',y,\varepsilon,\varepsilon,z')} \tilde{M}(w',y,\varepsilon,\varepsilon,z')\,dF(x) \\
&+ \beta(1-\delta)(1-\lambda_g)(s_e^*(w,y,\varepsilon,\varepsilon,z)+\lambda_e)\int_{q(w',y,\varepsilon,\varepsilon,z')}^{y} \tilde{M}(\phi^{\text{reneg}},y,\varepsilon,\varepsilon,z')\,dF(x) \\
&+ \beta(1-\delta)(1-\lambda_g)(s_e^*(w,y,\varepsilon,\varepsilon,z)+\lambda_e)\int_{y}^{\bar{y}} (\tilde{M}(\phi^{\text{poach}},x,\varepsilon,\varepsilon,z') - \eta_e(x,z'))\,dF(x) \\
&+ \beta(1-\delta)(1-\lambda_g)(1-s_e^*(w,y,\varepsilon,\varepsilon,z)-\lambda_e)\tilde{M}(w',y,\varepsilon,\varepsilon,z') \\
&+ \beta(1-\delta)\lambda_g\int_{\underline{y}}^{y} [\tilde{M}(\phi_u(x,\varepsilon,\varepsilon,z'),x,\varepsilon,\varepsilon,z') - \eta_u(x,z')]\,dF(x) \qquad (3)
\end{aligned}
$$

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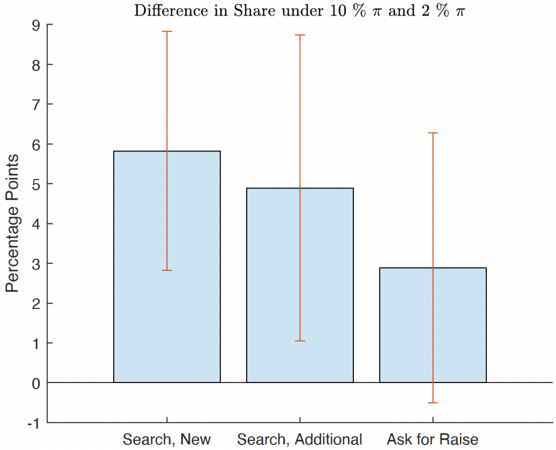
Search Effort Under Higher Hypothetical Inflation



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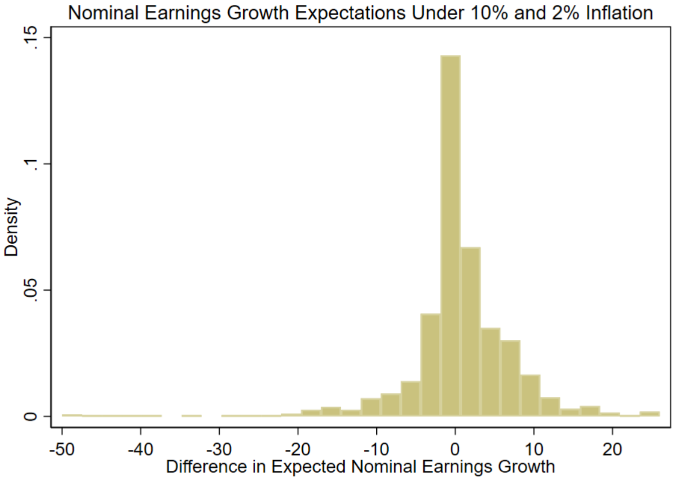
Nominal Wage Growth Under Higher Hypothetical Inflation



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