Some Like it Hot: Monetary Policy Under Okun‘s Hypothesis

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CIRANO - CIREQ - CREEi - FRQSC

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New Monetary Policy Framework of the Fed

New features of the dual mandate:

1. **Price stability**: average inflation target
2. **Maximum employment**: broad based and inclusive goal

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> *One clear takeaway from the **Fed Listens** events was the importance of sustaining a strong job market, particularly for people from low- and moderate-income communities. Everyone deserves the opportunity to participate fully in our society and in our economy.* (Powell, 2020).

Okun's (1973) Hypothesis

ARTHUR M. OKUN*

Brookings Institution

Upward Mobility in a High-pressure Economy

- Sustaining a high-pressure economy improves the economic outcomes of low-wage workers, by allowing them to find steady employment, build their skills, and climb the job ladder

- To Okun policymakers face a potentially stark inflation-inclusion tradeoff: *"The sacrifice of upward mobility must be reckoned as one high cost of accepting slack as an insurance policy against inflation."*

Three Questions

1. How can one formalize Okun's hypothesis within a macro model?

2. Can the LfL strategy run an economy hot for longer?

3. If so, does it generate a meaningful inflation-inclusion trade-off?

How The Paper Addresses These Questions

- Build a quantitative HA+NK model which features
  - Three-state frictional labor market (E,U,N)
  - Aggregate demand and supply shocks
- Calibrate the model to match micro evidence of labor market trajectories across the worker distribution
- Simulate series of (short $\rightarrow$long-run) counterfactuals under alternative ‘inclusive’ monetary policy rules

Preview of our Answers

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    - Three channels: u *exposure + persistence + attachment*

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1. *How can one formalize Okun's hypothesis within a macro model?*

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2. *Can the LfL strategy run an economy hot for longer, and if so, does it generate a meaningful inflation-inclusion trade-off*?

   - Yes, it can. At a cost of 40-50bp of higher *average inflation*, the new framework reduces average unemployment by 1.75ppt, raises participation by 2.25ppts, and boost real earnings per worker by 5.5% for the bottom quartile of the skill distribution.

   - Both AIT and Shortfall components play important & distinct roles

Literature

1. Okun's hypothesis
   - Aaronson-Daly-Wascher-Wilcox (2019), Cajner-Radner-Ratner-Vidangos (2017), Davis-von Wachter (2011), Rothstein (2019), Hobijn-Sahin (2021)
2. New monetary policy framework and racial inequality
   - Lee-Macaluso-Schwartzman (2021), Bartscher-Kuhn-Schularik-Wachtel (2021), Nakajima (2022), Bergman-Matsa-Weber (2022)
   - Bianchi-Melosi-Rottner (2021), Bundick-Petrosky Nadeau (2021)
3. Participation margin and gross worker flows
   - Krusell-Mukoyama-Rogerson-Sahin (2017), Cairo-Fujita-Morales Jimenez (2022), Gregory-Menzio-Wiczer (2021), Graves-Huckfeldt-Swanson (2023)
4. Numerical methods for filtering and counterfactuals
   - Holden (2016), Hebden-Winkler (2021), McKay-Wieland (2021)

The Mechanics of Okun's Hypothesis

1. Unemployment exposure: Uneven incidence of business cycles (Aaronson et al., 2019)
   - Unemployment of low-wage workers is larger and more sensitive to the cycle
2. Persistence: Long-term earnings losses upon displacement (Davis-von Wachter, 2011)
   - Losses from job displacement are large, persistent & counter-cyclical
3. Labor force attachment: *"attachment wedge"* (Hobijn-Sahin, 2021)
   - $\overline{UN} >> \overline{EN} \rightarrow \downarrow U$ during expansions drives up participation

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$\rightarrow$*Build a model where a 'high-pressure economy' allows low-wage workers to find/retain employment more easily, limits persistent earning losses upon displacement, and sustains their attachment to the labor force.*

Model

Labor Market States and Earnings Process

- Time is continuous
- Island economy (Lucas-Prescott, 1978)

$$s = \begin{cases} e, & \text{employed} \\ u_1, & \text{unemployed, eligible for UI} \\ u_0, & \text{unemployed, ineligible for UI} \\ n_1, & \text{active non-participant} \\ n_0, & \text{passive non-participant} \end{cases}$$

- Skill indexed by z

$$d\log z_t = \left\{ -\rho_z \log z_t + \mathbb{I}_{\{s_t=e\}}\,\delta_z^+ - \mathbb{I}_{\{s_t\neq e\}}\,\delta_z^- \right\} dt + \sigma_z dW_t$$

$\blacktriangleright$ participation $\quad\triangleright$ job-acceptance $\quad\lambda, \eta$ exogenous rates

	e	u_1	u_0	n_1	n_0
e	$\ddots$	λ_{zt}^{eu}	$\times$	$\blacktriangleright$	η^{en_0}
u_1	$\lambda_{zt}^{ue}\cdot\triangleright$	$\ddots$	$\eta^{u_1u_0}$	$\blacktriangleright$	η^{un_0}
u_0	$\lambda_{zt}^{ue}\cdot\triangleright$	$\times$	$\ddots$	$\blacktriangleright$	η^{un_0}
n_1	$\lambda_{zt}^{ne}\cdot\triangleright$	$\times$	$\blacktriangleright$	$\ddots$	$\eta^{n_1n_0}$
n_0	$\times$	$\times$	$\times$	$\eta^{n_0n_1}$	$\ddots$

Individual Problem

- Demographics
  - individuals die at rate ζ
  - newborns with skill $\log z_0 \sim \mathcal{N}(\mu_{0,z}, \sigma_{0,z})$ and zero wealth

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- Budget constraint:

$$
\begin{aligned}
c_t + \dot{a}_t &= r_t a_t + \phi_t + (1 - \mathfrak{t}_t) z_t w_t h_t, && \text{if } s = e \\
c_t + \dot{a}_t &= r_t a_t + \phi_t + (1 - \mathfrak{t}_t) b(z_t), && \text{if } s = u_1 \\
c_t + \dot{a}_t &= r_t a_t + \phi_t, && \text{if } s \in \{u_0, n_0, n_1\}
\end{aligned}
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$a_t \geq 0$: shares of mutual fund that holds firms's equity and government bonds

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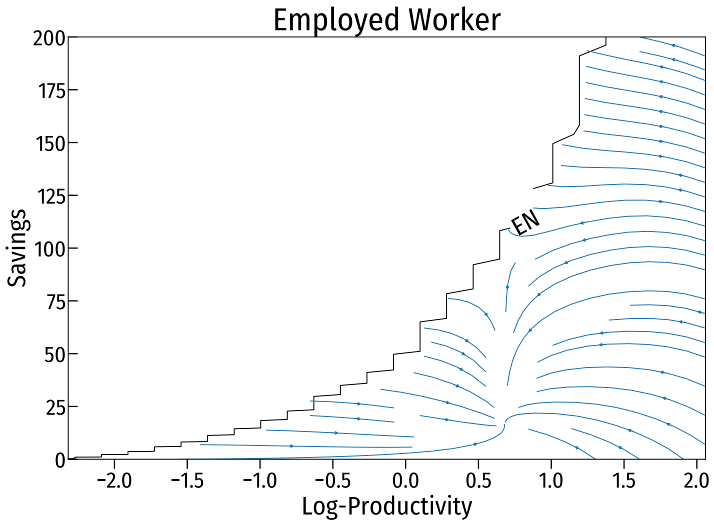
- Period utility:

$$
\mathrm{u}^s(c, h, z) = \log\left(c - \psi \frac{z h^{1+\frac{1}{\nu}}}{1 + \frac{1}{\nu}}\right) - \kappa^s, \qquad s \in \{e, u_0, u_1, n_0, n_1\}
$$

  - $\mathrm{u}^n = \log(c)$
  - $\mathrm{u}^u = \log(c) - \kappa^u$
  - $\mathrm{u}^e = \log\left(c - \frac{1}{1+\frac{1}{\nu}}(1 - \mathfrak{t}_t) z_t w_t h_t\right) - \kappa^e$

Participation Decision over the State Space

- Optimal participation choice splits the state space into two regions



→ Worker participate if currently productive (substitution effect) or poor (wealth effect)

Government and Mutual Fund

- Fiscal authority issues debt, taxes, and spends

$$\dot{B}_t + \mathfrak{t}_t w_t N_t = r_t B_t + (1 - \mathfrak{t}_t) \int_{s_{it}=u_1} b(z_{it}) di + \phi_t + G_t$$

$$G_t - G^* = -\beta_b (B_t - B^*)$$

- Monetary authority follows an Inflation Targeting (IT) rule for the nominal rate $\imath_t$

$$\frac{d\imath_t}{dt} = \begin{cases} -\beta_\imath \Big(\imath_t - \imath^* - \beta_\pi (\pi_t - \pi^*) - \beta_u (u_t - u^*) \Big) & \text{if } \imath_t > 0 \\ \max \Big\{ 0, -\beta_\imath \Big(\imath_t - \imath^* - \beta_\pi (\pi_t - \pi^*) - \beta_u (u_t - u^*) \Big) \Big\} & \text{if } \imath_t = 0 \end{cases}$$

Wage-Setting and Production

Unions (Erceg et al, 2000; Auclert et al., 2019)

- Unions set nominal wage *per unit of efficient hour* ω_t to max util of workers in employment island
  - Sticky wages: quadratic adjustment costs $\Theta_t = \frac{\theta}{2}\left(\frac{\dot{\omega}_t}{\omega_t} - \pi^*\right)^2$ à la Rotemberg
  - **Uniform hour rationing:** union members work the same hours, $h_{it} = h_t$

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$$\rho(\pi_t^w - \pi^*) - \dot{\pi}_t^w = \kappa^w \left[\quad \psi h_t^\nu \qquad - \left(\frac{\epsilon_w - 1}{\epsilon_w}\right) \times w_t \quad \right]$$

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Firms

- Intermediate-good producers with flexible prices + linear technology on labor
- Representative firm produces final good with an CES aggregator over intermediate goods

$$Y_t = Z_t \times \underbrace{E_t}_{\text{extensive}} \times \underbrace{h_t}_{\text{intensive}}$$

Aggregate Fluctuations

- Sources of Aggregate Shocks
  - "Risk-premium" (wedge between the rate of return of the fund and real rate paid on B^g)
  - "Cost-push" (wedge in the wage Phillips curve)

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  - "Risk-premium" (wedge between the rate of return of the fund and real rate paid on B^g)
  - "Cost-push" (wedge in the wage Phillips curve)
- Fluctuations in Labor Market Frictions
  - Assume $\lambda_{zt}^{eu}, \lambda_{zt}^{ue}, \lambda_{zt}^{ne}$ shift up and down as a function of average hours worked h_t
  - Demand shock causes $\uparrow$ AD for Y_t, $\uparrow$ (Total hours)$_t$ $\Rightarrow \begin{cases} \uparrow \text{ union hours } h_t \text{ [intensive]} \\ \downarrow \lambda_{zt}^{eu} \;\&\uparrow \lambda_{zt}^{ue}, \lambda_{zt}^{ne} \Rightarrow \uparrow E_t \text{ [extensive]} \end{cases}$

Parameterization

Steady State		
Parameter		Value
Preferences and Credit limit		
Discount rate	ρ	0.0047
Credit limit	$\bar{a}$	0.00
Risk aversion	γ	1.00
Labor supply elasticity	σ	1.00
Utility weight on hours	ψ	1.00
Disutility of working	κ^e	1.2341
Disutility of searching	κ^u	0.0376
Disutility of nonparticipation	κ^n	0
Demographics		
Death rate	θ	$1/312$
Mean of initial skill distribution	$\bar{z}_0$	0.6899
Variance of initial skill distribution	σ^2_{0z}	0.25
Productivity process		
Skill mean reversion	ρ_z	0.0017
Skill drift while employed	δ^+	0.0024
Skill drift while non-employed	δ^-	0.0214
Skill diffusion	σ_z	0.0467
Labor market frictions		
Job-separation rate out of E	$\lambda_0^{eu} + \lambda_1^{eu} \exp(+\lambda_2^{eu} z)$	–
Job-finding rate out of U	$\lambda_0^{ue} + \lambda_1^{ue} \exp(+\lambda_2^{ue} z)$	–
Job-finding rate out of N	$\lambda_0^{ne} + \lambda_1^{ne} \exp(+\lambda_2^{ne} z)$	–
Passive nonparticipation exit rate	$\eta^{n_0 n_1}$	0.229
Passive nonparticipation rate during E	$\eta^{e n_0}$	0.007
Passive nonparticipation rate during U/N	$\eta^{u n_0}, \eta^{n_1 n_0}$	0.070
Taxes, transfers and expenditures		
UI replacement rate	$\bar{b}$	0.50
UI expiration rate	$\eta^{u_1 u_0}$	0.167
Labor tax rate	$\mathfrak{t}$	0.2
Lump-sum transfer	ϕ	0.068
Government debt	B^g	1.733
Government expenditures	G	0.177
Technology		
Firm productivity	α	1.3889
Firm fixed cost	χ	0.1428
Price/Wage markups	ν, ε	10

Out of Steady State		
Parameter		Value
Fiscal and Monetary Policy		
Trend inflation	π^*	2%
Taylor rule persistence	β_i	0.07
Taylor rule reaction to inflation	β_π	2.25
Taylor rule reaction to unemployment rate	β_u	-0.15
Government expenditures response to debt	β_B	0.10
Phillips Curve and Labor market Frictions		
Slope of the wage Phillips curve (quarterly)	—	0.007
Elasticity of (λ^{eu}) to hours	ω^{eu}	10.00
Elasticity of $(\lambda^{ue}, \lambda^{ne})$ to hours	ω^{ue}, ω^{ne}	21.00
Shocks		
Demand shock drift (annual)	ρ_d	0.24
Demand shock diffusion (annual)	σ_d	–
Supply shock drift (annual)	ρ_s	0.24
Supply shock diffusion (annual)	σ_s	–

Labor market stocks and flows

	Data			Model		
	$E(x)$	$std(x)$	$cor(x,Y)$	$E(x)$	$std(x)$	$cor(x,Y)$
Total hours	–	1.260	0.835	–	1.170	0.938
Employment	0.764	1.040	0.746	0.717	0.881	0.971
Unemployment rate	0.055	12.663	-0.866	0.057	10.618	-0.797
Labor Force Participation	0.808	0.379	0.146	0.761	0.401	0.852
EU	0.013	8.526	-0.771	0.013	6.727	-0.816
UE	0.248	8.567	0.770	0.301	6.345	0.796
NE	0.069	3.821	0.435	0.014	5.700	0.814
EN	0.017	3.922	0.312	0.008	1.149	0.538
UN	0.133	8.644	0.666	0.085	2.637	0.755
NU	0.027	8.344	-0.651	0.025	4.769	-0.699

Okun's Hypothesis Through the Lenses of our Model

- Does Okun's hypothesis hold in our model? Which of the three channels matter the most?
- Consider a set of workers G (e.g., bottom/top tercile of the skill distribution)

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$$\text{Total Labor Income}_t^G = \int_{\{s_{it}=e\} \,\cap\, G} w h_t z_{it} di$$

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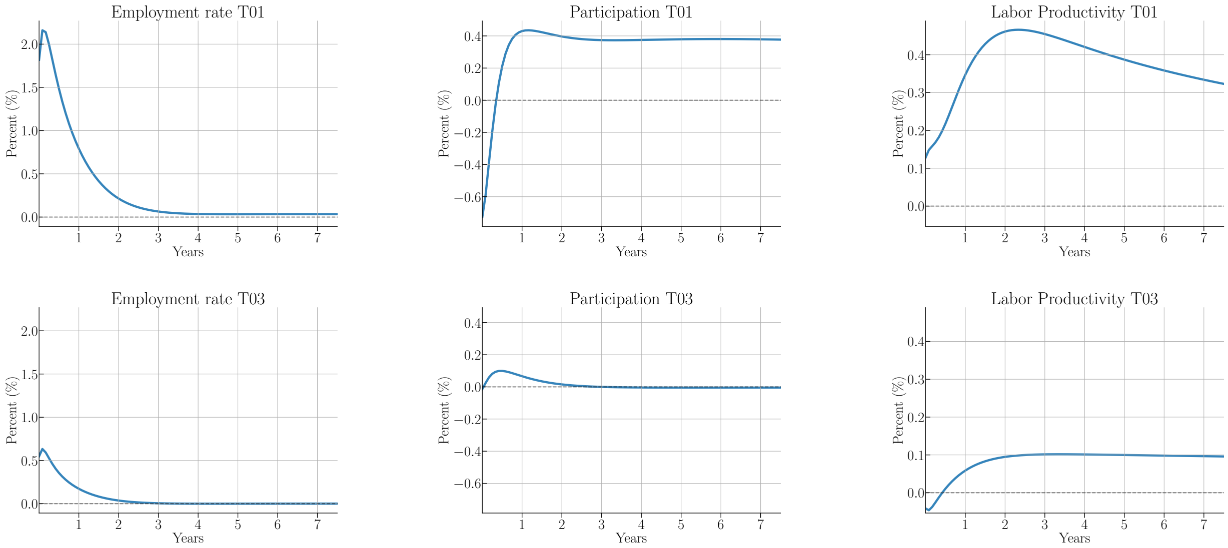
$$\text{Total Labor Income}_t^G = \int_{\{s_{it}=e\} \,\cap\, G} wh_t z_{it} di$$

$$= wh_t \quad \times \quad \underbrace{(1-u_t^G)}_{\text{Exposure}} \quad \times \quad \underbrace{P_t^G}_{\text{Attachment}} \quad \times \quad \underbrace{Z_t^{e,G}}_{\text{Persistence}}$$

MP shock Effect Through the Skill Distribution



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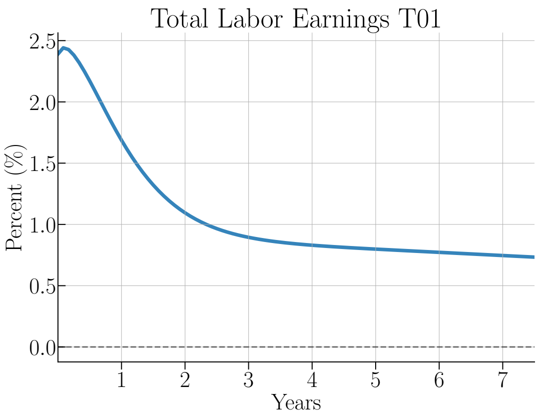

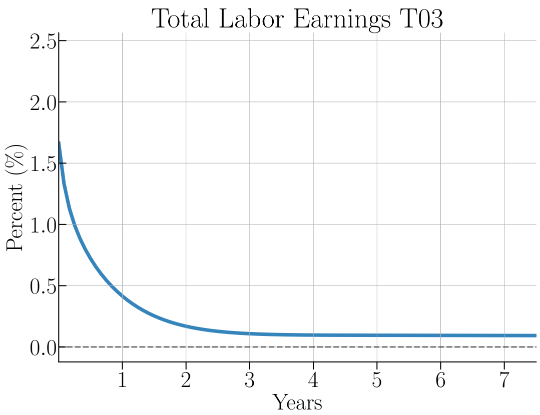

Evaluating the New Framework

Alternative Monetary Policy Rules

$$\frac{d\imath_t}{dt} = -\beta_\imath\Big(\imath_t - \dots\Big)$$

Baseline Inflation Target $\dots = \imath^* + \beta_\pi(\pi_t - \pi^*) + \beta_u(u_t - u^*)$

Asymmetric AIT $\dots = \imath^* + \beta_\pi(\pi_t - \pi^*) + \beta_{AIT}(\pi_t^{MA} - \pi^*)^- + \beta_u(u_t - u^*)$

Lower for Longer Rule $\dots = \imath^* + \beta_\pi(\pi_t - \pi^*) + \beta_{AIT}(\pi_t^{MA} - \pi^*)^- + \beta_u^+(u_t - u^*)^+$

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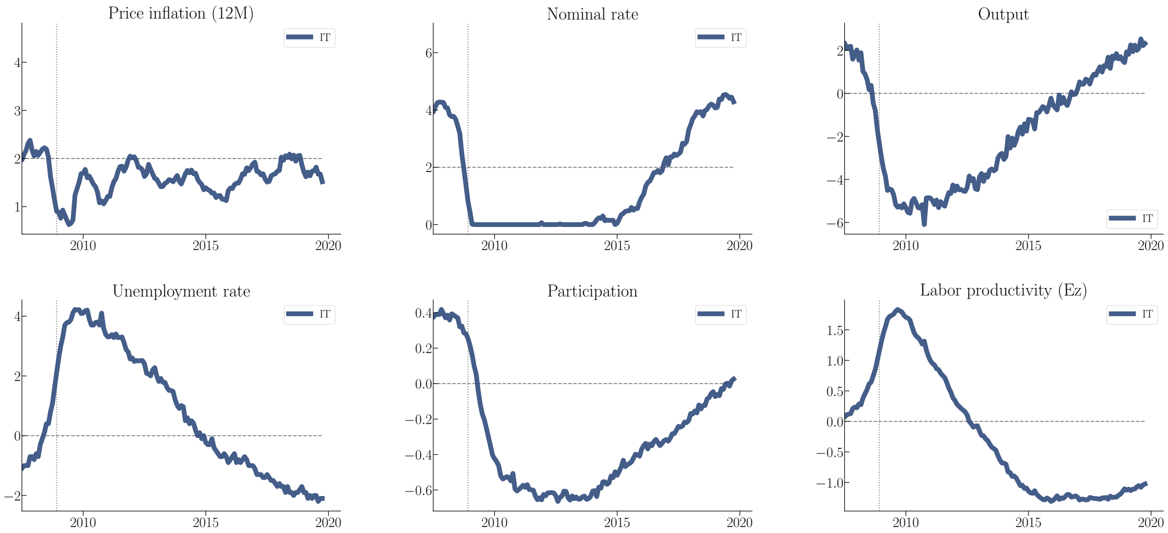
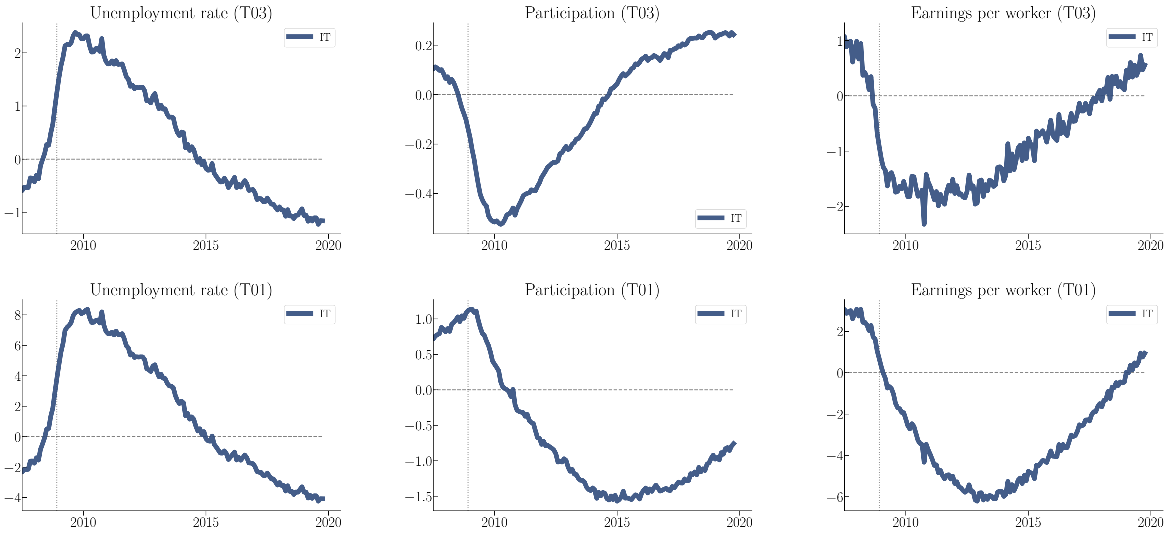
$\rightarrow$ *How would the labor market and inflation dynamics look like under the new framework?*

Short-Run

Great Recession and its Recovery



Great Recession and its Distributional Implications



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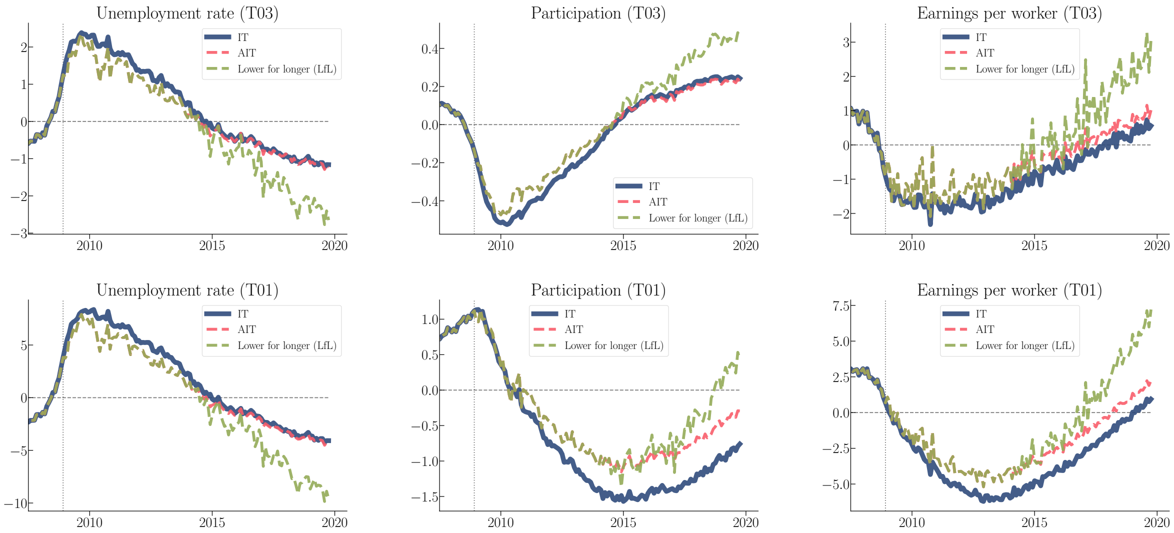
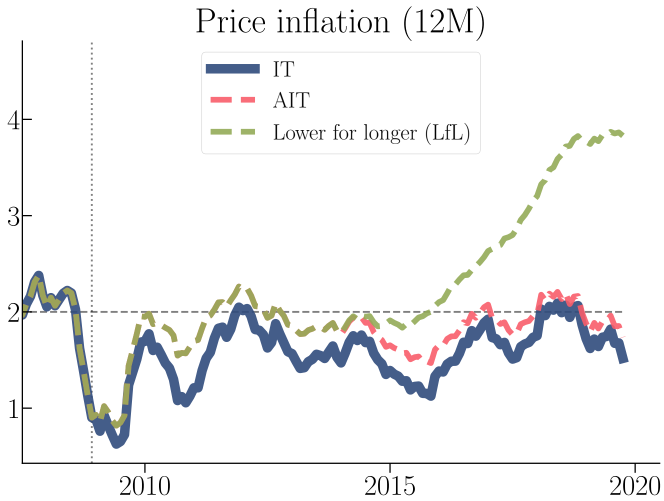


Cost of Running a High-Pressure Economy?

More inflation along the recovery



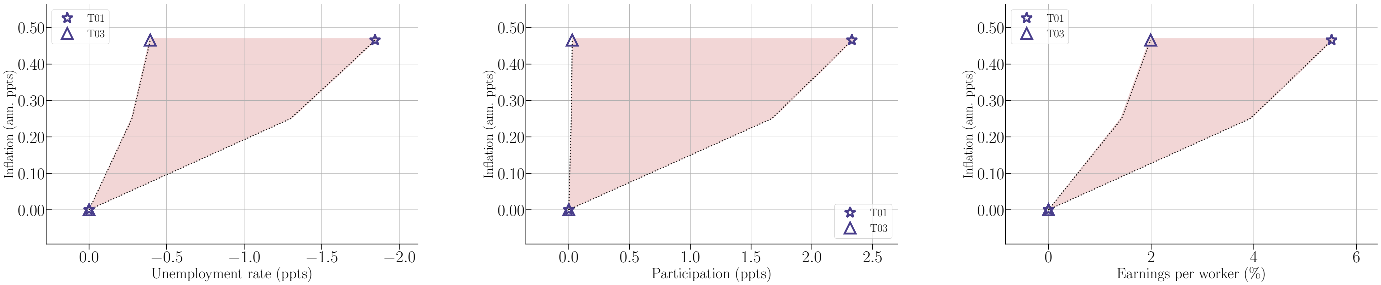
Long-Run

Ergodic Simulation

	Inflation Targeting		ASYM AIT		Lower for Longer	
	mean	std	mean	std	mean	std
Price inflation	1.83	1.37	2.11	0.47	2.30	0.52
Output	-2.33	5.19	0.09	1.29	0.96	1.79
Unemployment rate	0.52	2.36	−0.03	0.64	−0.23	0.90
Participation	−0.60	1.19	0.02	0.28	0.24	0.38
Total Labor Earnings (T01)	-9.95	20.33	0.40	4.83	4.08	6.58
Unemployment rate (T01)	1.29	4.88	−0.06	1.29	−0.56	1.82
Participation (T01)	-1.66	3.35	0.06	0.78	0.66	1.06
Earnings per worker (T01)	-3.90	8.23	0.16	1.96	1.61	2.66
Recessions (% simulation)	0.237		0.193		0.197	
Expansions (% simulation)	0.201		0.238		0.346	
ZLB frequency	0.056		0.022		0.022	

Assessing the Trade-Off: “Okun cones”

- Previous slides are under a *given parameterization* of the LfL strategy
- Here we look at outcomes for *multiple parameterizations* $\longrightarrow$ “Okun cones” as menus for the policymaker



Conclusion

This paper:

- Three-state frictional labor market HANK model
- Running a 'high-pressure' economy favors low-wage workers (Okun's hypothesis)

Question: Does the new lower for longer strategy generate a persistent inflation-inclusion trade-off?

- Policy generates quantitatively meaninful and persistent gains at the bottom
- Additional inflation can become ingrained into wage setting if policy is pushed too far...

Thank you!

Parameterization

Key Aspects of Parameterization

▸ Table of parameters

- Labor market frictions and participation choice ▸ Labor Market Frictions ▸ u,LFPR over skill ▸ u,LFPR business cycle
  - $\{\kappa^e, \kappa^u, \eta^{en_0}, \eta^{un_0}, \eta^{n_1 n_0}, \eta^{n_0 n_1}, \lambda_z^{eu}, \lambda_z^{ue}, \lambda_z^{ne}\}$, $\{\partial\lambda_{zt}^{eu}/\partial h_t, \partial\lambda_{zt}^{ue}/\partial h_t, \partial\lambda_{zt}^{ne}/\partial h_t\}$
  - **Job finding and separation across the skill distribution**
  - **u, LFPR and labor market flows over the business cycle**
- Skill calibration ▸ Earnings moments
  - $\{\bar{z}_0, \sigma_{0z}, \rho_z, \delta^+, \delta^-, \sigma_z\}$
  - Initial skill distribution, wage dispersion, average earnings growth over life-cycle, **earnings losses upon displacement**
  - Moments of earnings (level and growth) distribution
- HANK ▸ PC
  - $\{\ldots\}$, $\{\kappa^w, \beta_B, \ldots\}$
  - Liquidity, taxes and transfers, ...
  - **Slope of Phillips curve**, monetary and fiscal policy, nominal rate level, shocks volatilities...

BACK

Steady State

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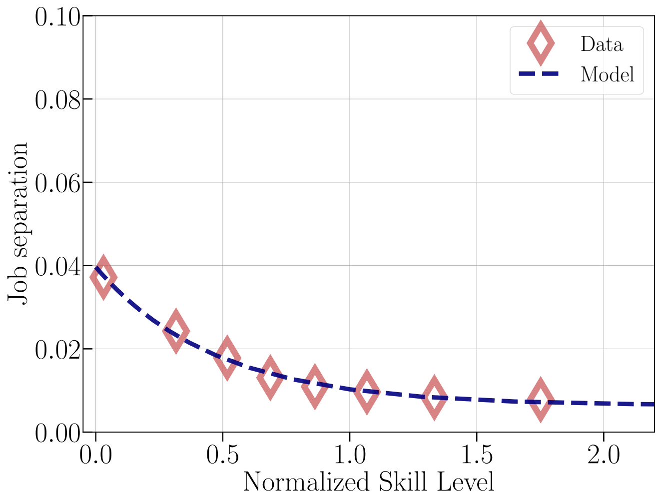
Job-finding rate out of U	$\lambda_0^{ue} + \lambda_1^{ue} \exp\left(+\lambda_2^{ue} z\right)$	–
Job-finding rate out of N	$\lambda_0^{ne} + \lambda_1^{ne} \exp\left(+\lambda_2^{ne} z\right)$	–
Passive nonparticipation exit rate	$\eta^{n_0 n_1}$	0.229
Passive nonparticipation rate during E	$\eta^{e n_0}$	0.007
Passive nonparticipation rate during U/N	$\eta^{u n_0}, \eta^{n_1 n_0}$	0.070
Taxes, transfers and expenditures		
UI replacement rate	$\bar{b}$	0.50
UI expiration rate	$\eta^{u_1 u_0}$	0.167
Labor tax rate	$\mathfrak{t}$	0.2
Lump-sum transfer	ϕ	0.068
Government debt	B^g	1.733
Government expenditures	G	0.177
Technology		
Firm productivity	α	1.3889
Firm fixed cost	χ	0.1428
Price/Wage markups	ν, ε	10

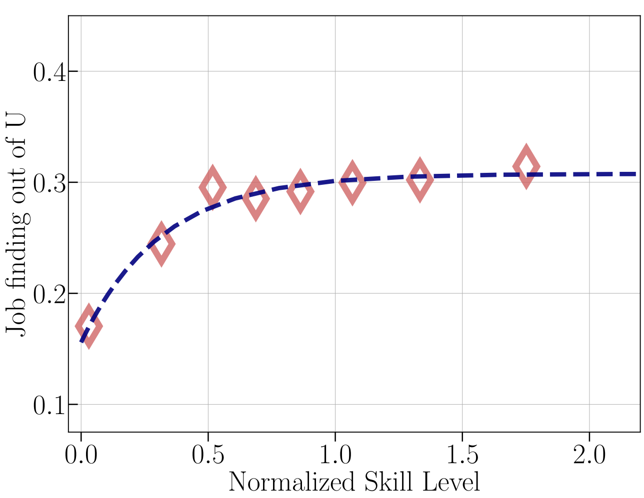
Out of Steady State

Parameter		Value
Fiscal and Monetary Policy		
Trend inflation	π^*	2%
Taylor rule persistence	β_i	0.07
Taylor rule reaction to inflation	β_π	2.25
Taylor rule reaction to unemployment rate	β_u	-0.15
Government expenditures response to debt	β_B	0.10
Phillips Curve and Labor market Frictions		
Slope of the wage Phillips curve (quarterly)	–	0.007
Elasticity of (λ^{eu}) to hours	ω^{eu}	10.00
Elasticity of $(\lambda^{ue}, \lambda^{ne})$ to hours	ω^{ue}, ω^{ne}	21.00
Shocks		
Demand shock drift (annual)	ρ_d	0.24
Demand shock diffusion (annual)	σ_d	–
Supply shock drift (annual)	ρ_s	0.24
Supply shock diffusion (annual)	σ_s	–

EU/UE as a function of Skill Levels

BACK





Stocks over the skill distribution

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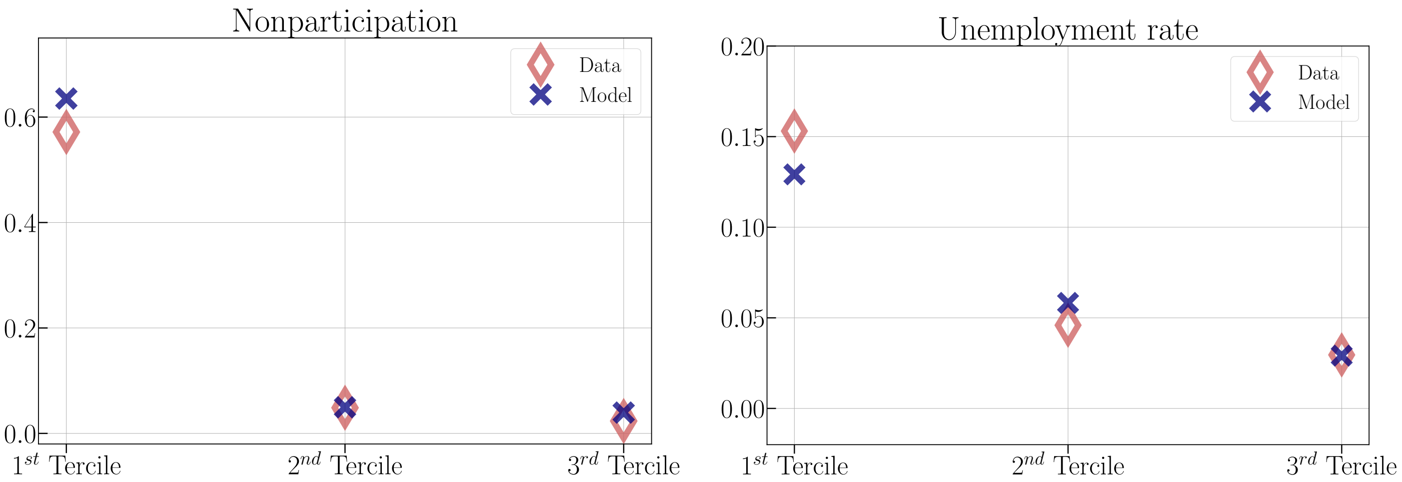

Labor market stocks and flows

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	Data			Model		
	$E(x)$	$std(x)$	$cor(x,Y)$	$E(x)$	$std(x)$	$cor(x,Y)$
Total hours	–	1.260	0.835	–	1.170	0.938
Hours						
Employment	0.764	1.040	0.746	0.717	0.881	0.971
Unemployment rate	0.055	12.663	−0.866	0.057	10.618	−0.797
Labor Force Participation	0.808	0.379	0.146	0.761	0.401	0.852
EU	0.013	8.526	−0.771	0.013	6.727	−0.816
UE	0.248	8.567	0.770	0.301	6.345	0.796
NE	0.069	3.821	0.435	0.014	5.700	0.814
EN	0.017	3.922	0.312	0.008	1.149	0.538
UN	0.133	8.644	0.666	0.085	2.637	0.755
NU	0.027	8.344	−0.651	0.025	4.769	−0.699

Earnings losses from displacement

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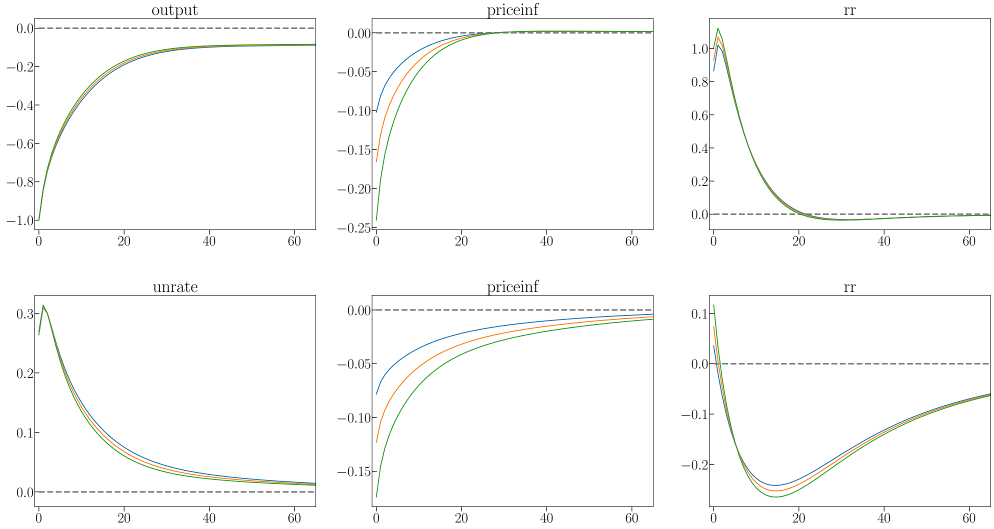
Targeted Moments	Data	Model	Non-Targeted Moment	Data	Model
90-50 wage ratio (entrants)[2]	2.00	1.95	10-Year earnings losses from a full-year non-emp. (p25)[6]	−0.50	−0.37
90-50 wage ratio (all workers)[2]	3.00	3.04	10-Year earnings losses from a full-year non-emp. (p50)[6]	−0.37	−0.26
55/25 log earnings growth[3]	0.70	0.62	10-Year earnings losses from a full-year non-emp. (p75)[6]	−0.30	−0.16
10-Year earnings losses upon displacement[4]	−0.15	−0.13	Cross-sectional (log) earnings variance (age 25)[7]	0.60	0.45
			Cross-sectional (log) earnings variance (age 55)[7]	0.91	0.90
			Standard dev. of one-year earnings change [7]	0.51	0.43
			Skewness of one-year earnings change [7]	−1.07	−0.38
			Kurtosis of one-year earnings change [7]	14.93	8.07

Slope of PC

BACK



Two options to pin down the slope of the PC (be careful with the persistence). Figure B.2 in mckaywolf: 1.00% output, 0.30-0.40% annual inflation. Figure 2, 3.1 of delnegro20: 0.4, 0.3% in unenployment rate, 0.1, 0.2% annual inflation.