

Some Like It Hot:

Monetary Policy Under Okun's Hypothesis

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New Developments in Business Cycle Research - Danmarks Nationalbank

The views expressed in this paper solely reflect those of the authors and do not necessarily represent those of the Bank of Canada or its Governing Council

New Monetary Policy Framework of the Fed

- New features of the dual mandate:
 1. **Price stability:** strict inflation target → average inflation target
 2. **Maximum employment:** (i) deviations → shortfalls from maximum level
(ii) reinterpreted as a broad based and inclusive goal

- Fed Listens events were a key input into the monetary policy strategy review

One clear takeaway from the Fed Listens 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 economy. (Powell, 2020)

- Lower for Longer strategy during recoveries with the aim of running the economy hot for longer

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
- Okun recognized the existence of an 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 Lower for Longer strategy run an economy hot for longer and, if so, generate a meaningful inflation-inclusion trade-off?
3. Can this trade-off be sustained in the long-run?

How The Paper Addresses These Questions

1. Build a **quantitative HA+NK model** which features
 - **Three-state frictional labor market** (E,U,N)
 - Aggregate demand and supply shocks
2. **Okun's hypothesis** at work through three channels (**exposure + attachment + persistence**)
3. Calibrate the model to match micro evidence of labor market trajectories across distribution
4. Quantify the key **inflation vs inclusion trade-off** generated by the new framework

The Model

Transitions Across Labor Market States

- Time is continuous

▶: participation ▷: job-acceptance (λ, η) : exogenous rates

- Island economy (Lucas-Prescott, 1978)

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

	e	u_1	u_0	n_1	n_0
e	\ddots	λ_{zt}^{eu}	\times	▶	η^{en_0}
u_1	$\lambda_{zt}^{ue} \cdot \triangleright$	\ddots	$\eta^{u_1 u_0}$	▶	$\eta^{u n_0}$
u_0	$\lambda_{zt}^{ue} \cdot \triangleright$	\times	\ddots	▶	$\eta^{u n_0}$
n_1	$\lambda_{zt}^{ne} \cdot \triangleright$	\times	▶	\ddots	$\eta^{n_1 n_0}$
n_0	\times	\times	\times	$\eta^{n_0 n_1}$	\ddots

- Skills indexed by z

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

Individual Problem

- **Period utility:**

$$u^{s_t}(c_t, h_t) = \log c_t - \psi \frac{h_t^{1+\frac{1}{\sigma}}}{1+\frac{1}{\sigma}} - \kappa^{s_t}, \quad s_t \in \{e, u_0, u_1, n_0, n_1\}$$

- **Budget constraint:**

$$\begin{aligned} c_t + \dot{a}_t &= r_t a_t + \phi_t + (1 - \tau_t) w_t z_t h_t, & \text{if } s_t = e \\ c_t + \dot{a}_t &= r_t a_t + \phi_t + (1 - \tau_t) b(z_t), & \text{if } s_t = u_1 \\ c_t + \dot{a}_t &= r_t a_t + \phi_t, & \text{if } s_t \in \{u_0, n_0, n_1\} \end{aligned}$$

subject to: $a_t \geq 0$

- a_t : shares of a mutual fund that holds firms' equity and government bonds

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subject to: $a_t \geq 0$

- a_t : shares of a mutual fund that holds firms' equity and government bonds
- **Workers make three decisions:** consumption / saving (optimal control), participation (optimal stopping), job acceptance (Poisson switching)

Production

- Continuum of monopolistic intermediate-good producers
 - Flexible prices
 - Linear technology in labor
- Representative final good producer with CES aggregator over intermediate goods

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

Nominal Wage Setting → Phillips Curve

- We follow Erceg et al. (2000) & Auclert et al. (2019)
- Unions set nominal wage ω_t to maximize utility of all **employed** workers
 - Quadratic adjustment costs à la Rotemberg $\Theta_t = \frac{\theta}{2} \left(\frac{\dot{\omega}_t}{\omega_t} - \pi^* \right)^2$
 - Uniform hour allocation rule: $h_{it} = h_t$

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 - Uniform hour allocation rule: $h_{it} = h_t$

$$\rho(\pi_t - \pi^*) - \dot{\pi}_t = \frac{\varepsilon_w}{\theta} H_t \left[\overbrace{\psi h_t^\sigma}^{\text{mg. disutility of extra } h} - \left(\frac{\varepsilon_w - 1}{\varepsilon_w} \right) \times \underbrace{\left(\frac{1}{E_t} \int_{s_{it}=e} \frac{Z_{it}}{Z_t} (C_{it})^{-1} di \right)}_{\text{average mg. disutility of } c} \times \overbrace{Z_t^e}^{\text{efficiency of extra } h} \times W_t \right]$$

Government

- Fiscal authority issues debt, taxes, and spends

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

- Passive fiscal policy rule

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

- Monetary authority follows an [Inflation Targeting \(IT\)](#) rule for the nominal rate l_t

$$\frac{dl_t}{dt} = \begin{cases} -\beta_l (l_t - i^* - \beta_\pi(\pi_t - \pi^*) - \beta_u(u_t - u^*)) & \text{if } l_t > 0 \\ \max \{0, -\beta_l (l_t - i^* - \beta_\pi(\pi_t - \pi^*) - \beta_u(u_t - u^*))\} & \text{if } l_t = 0 \end{cases}$$

Aggregate Shocks

Aggregate Fluctuations

- Sources of Aggregate Shocks

- Wedge in the Euler equation (demand shocks)
- Wedge in the wage Phillips curve (supply shocks)

- Fluctuations in Labor Market Frictions

- Assume $\lambda_{z_t}^{ue}, \lambda_{z_t}^{ne}, \lambda_{z_t}^{eu}$ shift up and down as a function of average hours worked h_t

- Demand shock: \uparrow AD for goods, labor input \Rightarrow $\left\{ \begin{array}{l} \uparrow \text{ hours } h_t \text{ [intensive]} \\ \uparrow \lambda_z^{ue}, \lambda_z^{ne} \text{ \& } \downarrow \lambda_z^{eu} \Rightarrow \uparrow E_t \text{ [extensive]} \end{array} \right.$

Why Does a High-Pressure Economy Favor Low-Wage Workers?

The Mechanics of Okun's Hypothesis

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

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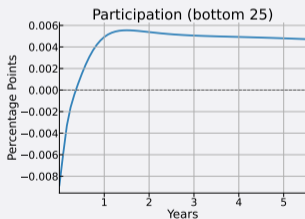
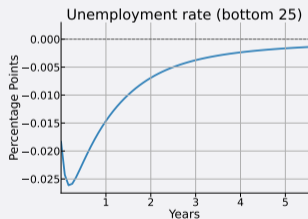
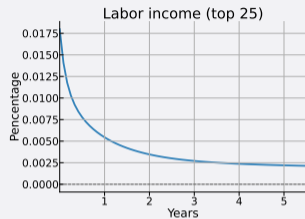
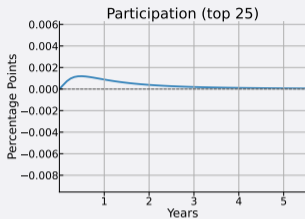
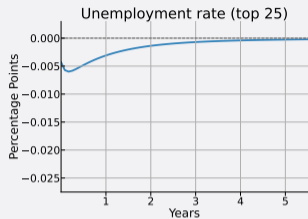
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3. **Persistence**: Long-term earnings losses upon displacement (Davis-von Wachter, 2011)

- Losses from job displacement are large, persistent & counter-cyclical

\Rightarrow High-pressure economy allows low-wage workers to find/retain employment, sustains their attachment to the labor force, and limits persistent earning losses upon displacement

Combining All Three Mechanisms



- Fluctuations at the bottom of the skill distribution are both larger and more persistent

Policy Experiments

Alternative Monetary Policy Rules

$$\frac{di_t}{dt} = -\beta_i (i_t - i^* - \dots)$$

Baseline Inflation Target

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

Alternative Monetary Policy Rules

$$\frac{dI_t}{dt} = -\beta_I (I_t - i^* - \dots)$$

Baseline Inflation Target

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

Average Inflation Target

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

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Shortfall Rule

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

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Shortfall Rule

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

Lower for Longer Rule

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

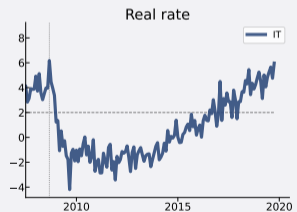
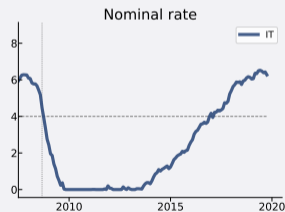
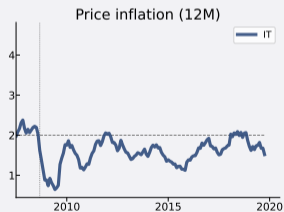
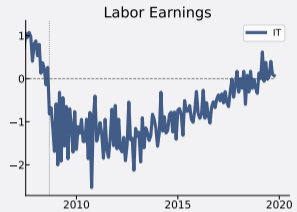
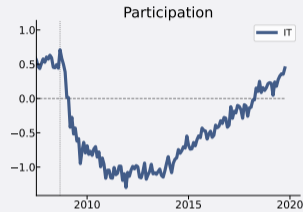
Policy Counterfactuals

How would labor market and inflation dynamics look like under the new framework?

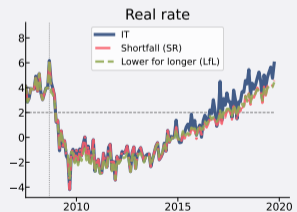
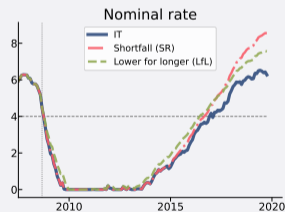
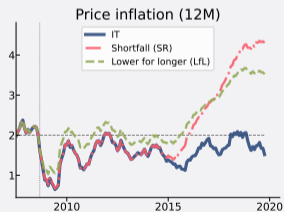
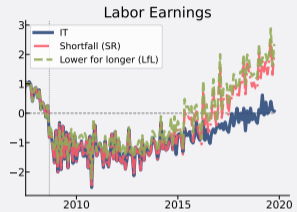
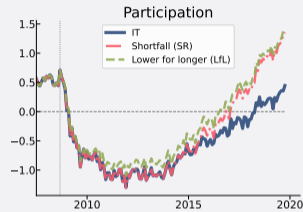
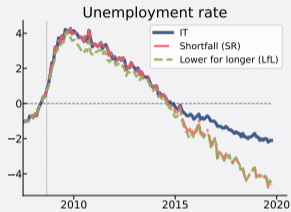
- **Short-run:** One business cycle [Great Recession and its recovery, 2008-2020]
- **Medium-run:** Simulation of the ergodic distribution
- **Long-run:** Wage setters respond to the shift in policy environment

Short-Run

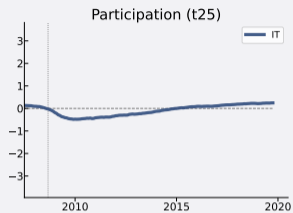
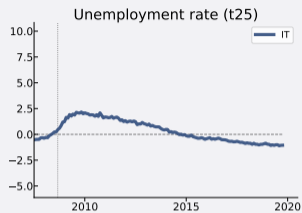
Great Recession and its Recovery



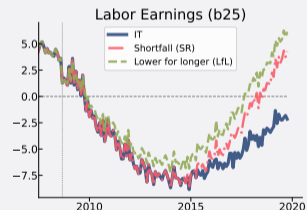
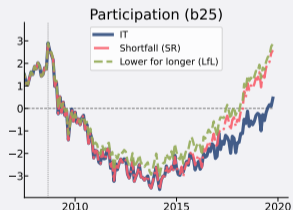
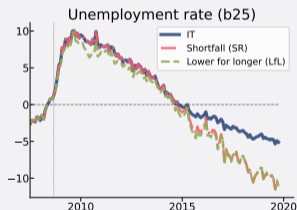
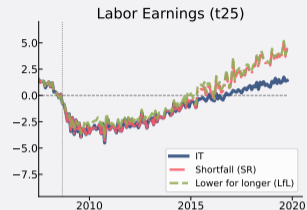
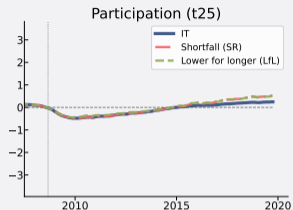
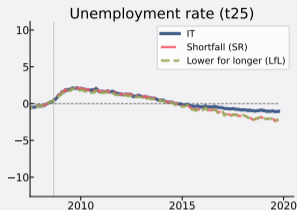
Great Recession and its Recovery



Great Recession and its Distributional Implications

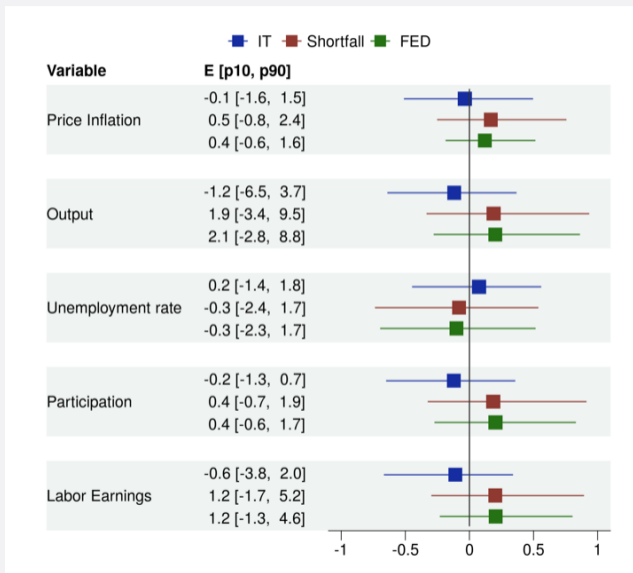


Great Recession and its Distributional Implications

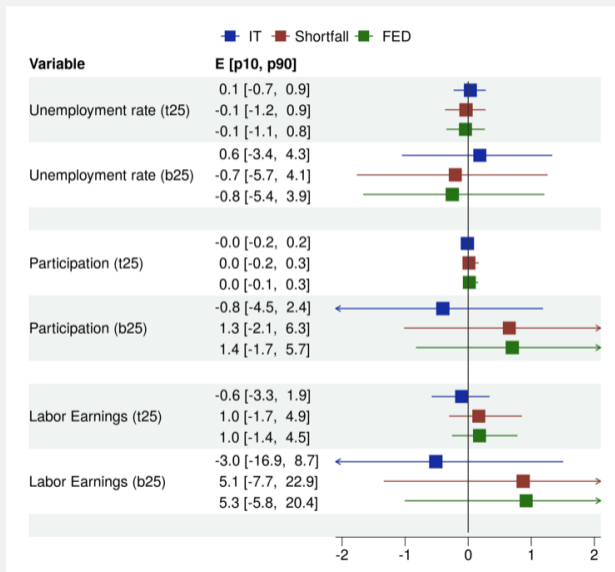


Medium-Run

Ergodic Distribution



Ergodic Distribution



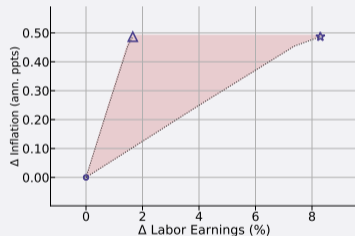
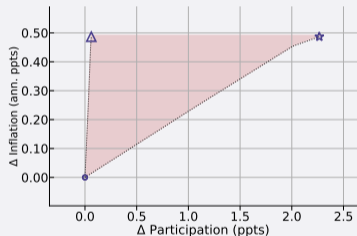
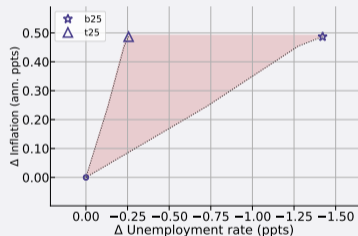
Role of Three Okun's Channels

	Total		Top 25		Bottom 25	
	$\mathbb{E}[X_t] - X^{SS}$	% Total Y	$\mathbb{E}[X_t] - X^{SS}$	% Total Y	$\mathbb{E}[X_t] - X^{SS}$	% Total Y
Total Labor Income	3.26	1.00	1.98	1.00	17.61	1.00
Unemployment rate	-0.57	0.18	-0.26	0.13	-1.42	0.09
Participation	0.67	0.26	0.06	0.03	2.27	0.44
Earnings	1.83	0.56	1.65	0.84	8.29	0.47

$$\text{Total Labor Income}_t = (1 - u_t) \times P_t \times (w Z_t^e h_t)$$

Assessing the Inflation-Inclusion Trade-Off: “Okun cones”

- Okun cones as menus for the policymaker
- Vary coefficients in the LfL rule



Long-Run

Long-run Trade-off? The Role of Indexation

- New framework generates a **persistent gap between average inflation and the target π^***
- Over time wage setters' expectations should incorporate this bias
- Allow the **indexation term** in Rotemberg adjustment cost to depend on past inflation

$$\Theta_t = \frac{\theta}{2} \left(\frac{\dot{\omega}_t}{\omega_t} - \tilde{\pi}_t \right)^2, \quad \tilde{\pi}_t = (1 - \gamma)\pi^* + \gamma \left(\int_{t-1}^t \pi_j dj \right)$$

Indexation and the Limits of Inclusive Monetary Policy

- Differences between LfL + γ -indexation and IT

	$\gamma = 0.50$	$\gamma = 0.75$	$\gamma = 1.00$
Δ Inflation	0.413	0.430	0.447
Δ Output	1.343	0.719	0.165
Δ Unemployment	-0.225	-0.125	-0.036
Δ Participation	0.277	0.152	0.043
Δ Unemployment (b25)	-0.560	-0.310	-0.089

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- As Fed “run the economy hot”, indexation leaves inflation high for longer
 - Higher inflation calls for higher real rates, which partially dampens MP dovish stance
- ⇒ Increasing indexation steepens the tradeoff, which eventually vanishes as $\gamma \rightarrow 1.00$

Conclusions

1. *How can one formalize Okun's hypothesis within a macro model?*
 - We build extensively on recent **micro evidence** in labor economics
 - Three channels: **exposure + attachment + persistence**

Conclusions

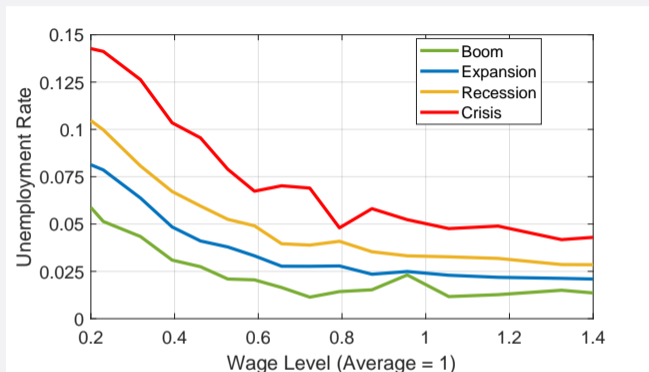
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 - Yes. For example, at a cost of 30bp of higher *average inflation*, the new framework permanently boost **real earnings by 6%** for the **bottom quartile of the skill distribution**
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 - Both AIT and Shortfall components play important and distinct roles
3. *Can this trade-off be sustained in the long-run?*
 - If inflation bias becomes ingrained in wage setting, the **trade-off steepens sharply**

Thanks!

Mechanism I: Uneven Incidence of Business Cycles



- Low-wage workers (i) suffer higher unemployment and (ii) are more sensitive to the cycle

→ Estimate λ_z^{eu} , λ_z^{ue} from CPS using information on weekly earnings

Mechanism II: Participation Cycle

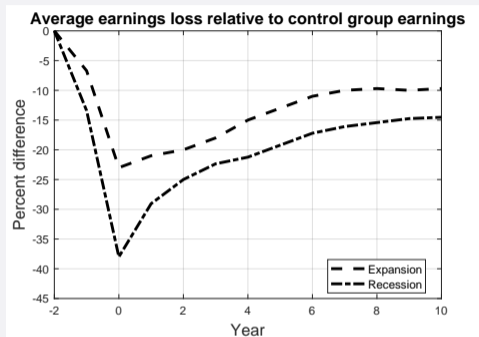
Data			
	E	U	N
E	-	0.017	0.011
U	0.242	-	0.189
N	0.065	0.064	-

Model			
	E	U	N
E	-	0.017	0.011
U	0.298	-	0.196
N	0.044	0.076	-

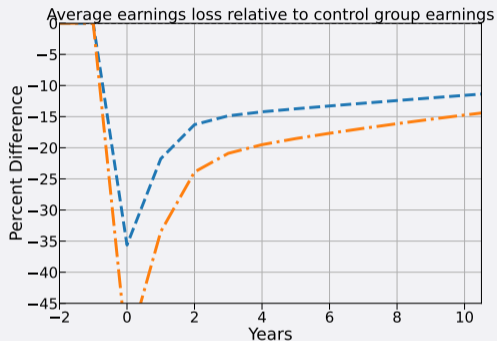
- Fluctuations in U induce **procyclical fluctuations on labor force participation**

→ **Target the attachment wedge $UN \gg EN$ in our calibration**

Mechanism III: Earnings Losses from Displacement



Davis-von Wachter



Model

- Earnings losses upon displacement are large, persistent & cyclical
- Set skill depreciation δ^- to replicate earnings losses after 10 years