Optimal Fiscal Policy with Labor Selection

February 20, 2019

Labor Markets – Structure and Policy

- Labor market structure and analysis changing over the years
  - Secular changes
  - Cyclical changes
- Labor market conditions a prime concern for policy
- Search and matching in labor markets
- Technological primitives
  - Costs of posting job openings
  - Matching function
- But many other components of hiring costs

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- Screening/selection in labor markets
- Technological primitives
  - Costs of integrating new workers into production process
  - Distribution of idiosyncratic "match-quality" shocks for new workers

- (Davis, Faberman, & Haltiwanger (2013 *QJE*): ≈ 60% of hiring costs are vacancy costs)

Labor Markets – Structure and Policy

- **Benevolent policy desires efficient labor markets**
- **Characterization of efficient allocations ("first-best")**
  - **Model-consistent efficiency**
  - **Model-consistent distortions**
- **Builds on analysis of**
  - **GE selection efficiency in Chugh and Merkl (2016 *IER*)**
  - **GE matching efficiency in Arseneau and Chugh (2012 *JPE*)**

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  - **GE selection efficiency in Chugh and Merkl (2016 *IER*)**
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- **Characterization of optimal policy**
  - **Ramsey (1927) ("second-best")**
  - **Lucas and Stokey (1984 *JME*), CCK (1991 *JMCB*, 1999 *Handbook of Macro*), Werning (2007 *QJE*), many others**
  - **Recent summary by Stiglitz (2014 *NBER WP*)**
- **Pigovian corrective taxation**
  - **Ramsey (1927) was response to question posed by Pigou w/o lump-sum *T***
  - **Pigou (1928, *A Study in Public Finance*) incorporated Ramsey results w/ *T***

LABOR MARKETS – STRUCTURE AND POLICY

- **Calibrate exogenous policy economy to hit empirical volatility of**
  - ***ue*, *lfp*, and $\eta(\varepsilon)$**
- **Requires distortionary structural parameters**

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- Labor tax rate smoothing ***not*** optimal in either selection model…

	Labor Selection		Walrasian
Relative SD (wrt GDP)	1.0		≈ 0 (CCK 1999, Werning 2007 *QJE*, many others)

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- **…or in matching model**

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- Hiring subsidies large in long-run – $\tau^h = 81\%$
- Hiring subsidies volatile in business cycles
- Economic difference vs. Walrasian labor markets?

LABOR MARKETS – MODEL-CONSISTENT WEDGES

- **Technological primitives**

- **Develop selection-model consistent transformation function and MRTs**
  - **Aggregate goods production technology**
  - **Aggregate matching technology**

$\Rightarrow$ **model-consistent decentralized wedges**

- **Tax volatility $\Rightarrow$ EFFICIENT fluctuations**
  - **Selection model wedge fluctuations EXACTLY = 0**

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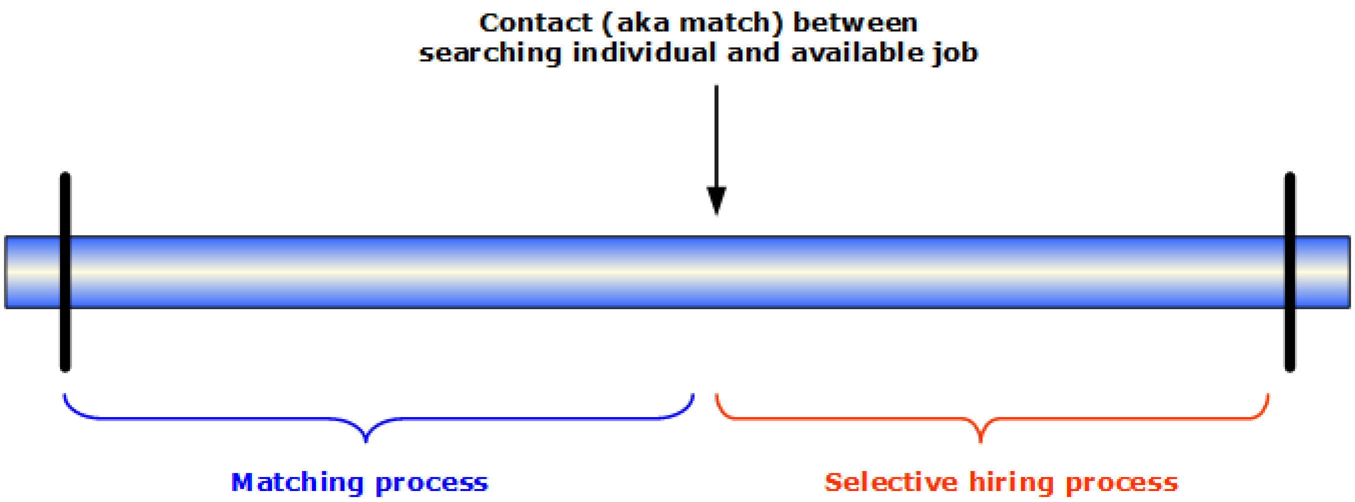
$\Rightarrow$ model-consistent decentralized wedges

- Tax volatility $\Rightarrow$ EFFICIENT fluctuations
  - Selection model wedge fluctuations EXACTLY = 0
- Analytically characterize source of externalities
  - Cost gap = marginal hiring cost – avg. hiring cost
- "Selection Market Tightness"
  - Play highly similar role as market tightness externalities in matching model
- Compare and contrast with search and matching model

LABOR MARKETS – MATCHING VS. SELECTION

- **Matching and selection two distinct components of recruiting process**

"match quality"

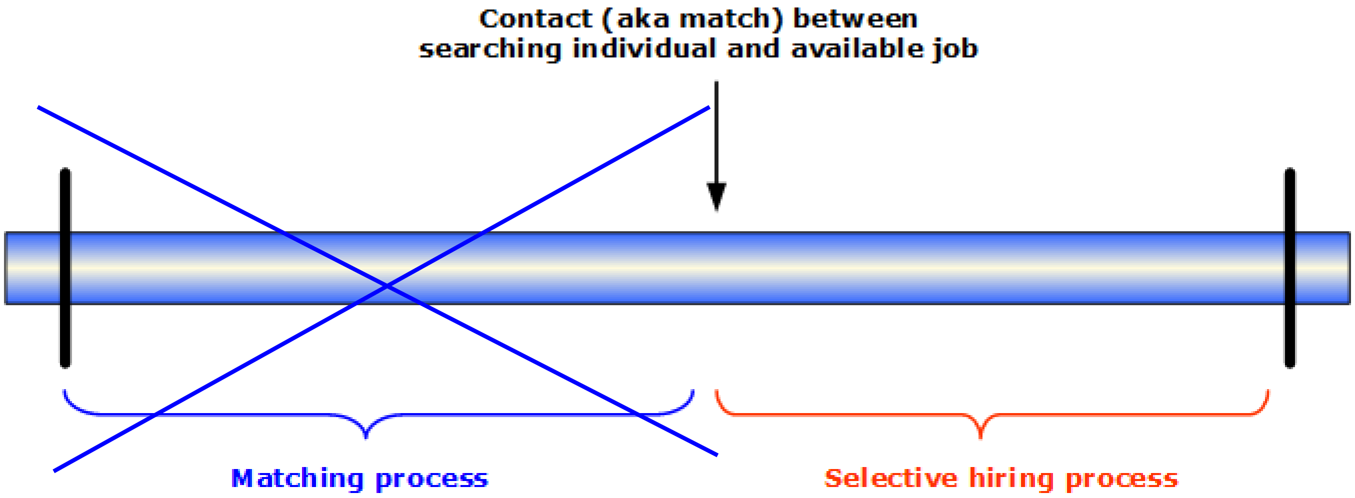


LABOR MARKETS – MATCHING VS. SELECTION

- ~~Matching and~~ selection two distinct components of recruiting process

  "match quality"

- Components of recruiting costs
  - Vacancy posting costs
  - Screening costs
  - Training costs



Contribution to Labor & Policy Literatures

- **Need to know appropriate "wedges" for designing optimal policy**
  - **Fiscal policy**
  - **Monetary policy**
  - **Regulatory policy**

- **Recent literature on labor selection**
  - **Lechthaler, Merkl, and Snower (2010 *JECD*)**
  - **Merkl and van Rens (2012)**
  - **Brown, Merkl, and Snower (2015 *MD*)**
  - **Chugh and Merkl (2016 *IER*)**
  - **Faia, Lechthaler, and Merkl (2014 *JMCB*) (optimal monetary policy)**
  - **Baydur (2017 *AEJ: Macro*) – partial match quality revelation**

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- **Previous work**
  - **Arseneau, Chahrour, Chugh, Finkelstein Shapiro (2015 *JMCB*) (customer matching)**
  - **Chugh and Ghironi (2015) (endogenous product varieties)**
  - **Arseneau and Chugh (2012 *JPE*)**
  - **Aruoba and Chugh (2010 *JET*) (new monetarist)**
  - **Arseneau and Chugh (2008 *JME*) (nominal wage rigidities in labor matching model)**

OUTLINE

- Model – Structure of Labor Markets
- GE efficiency – definitions of model-consistent wedges
  - Extended model (labor search and matching + labor selection)
  - Focus on labor selection model (this paper)
- Positive analysis (non-Ramsey policy)
- Ramsey equilibrium
- Calibration
- Normative analysis (Ramsey policy) – wedge/distortion smoothing
- Compare and contrast with search and matching model
  - Implications for Beveridge Curve
  - Wage determination
  - Model-consistent wedges and "market tightness"
- Conclusion

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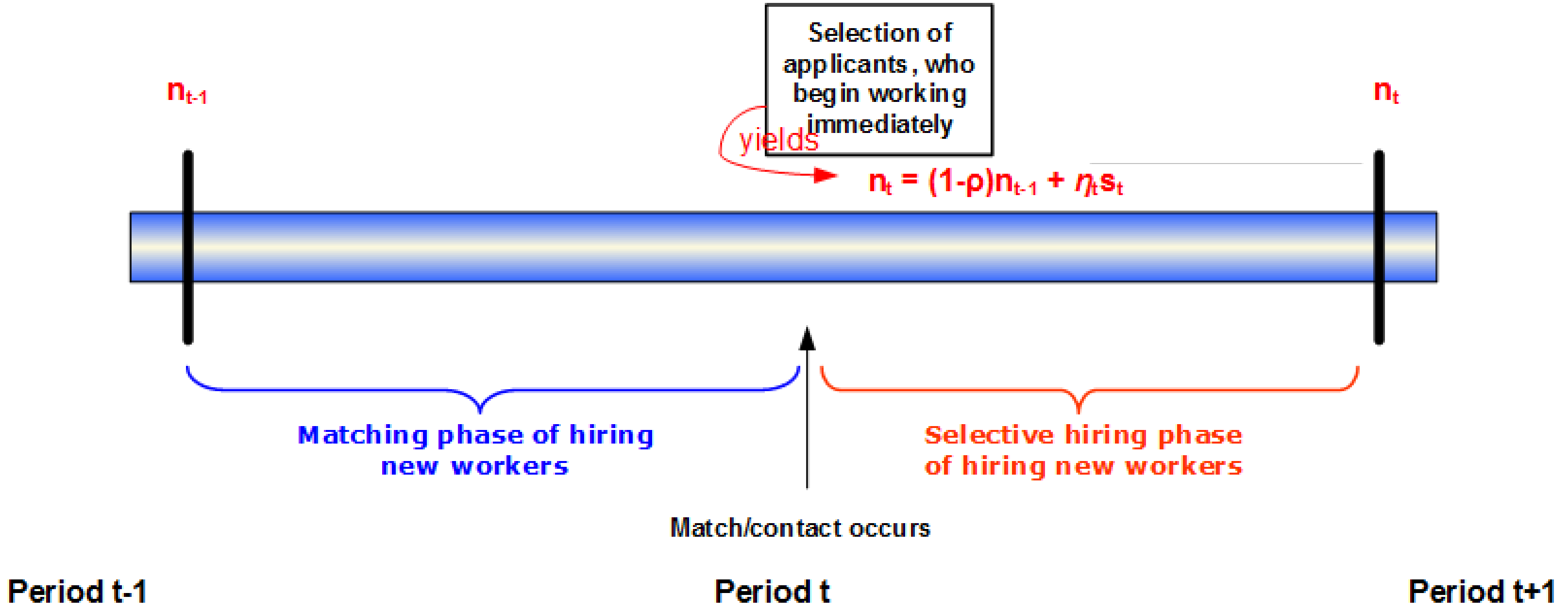
Labor Market Structure

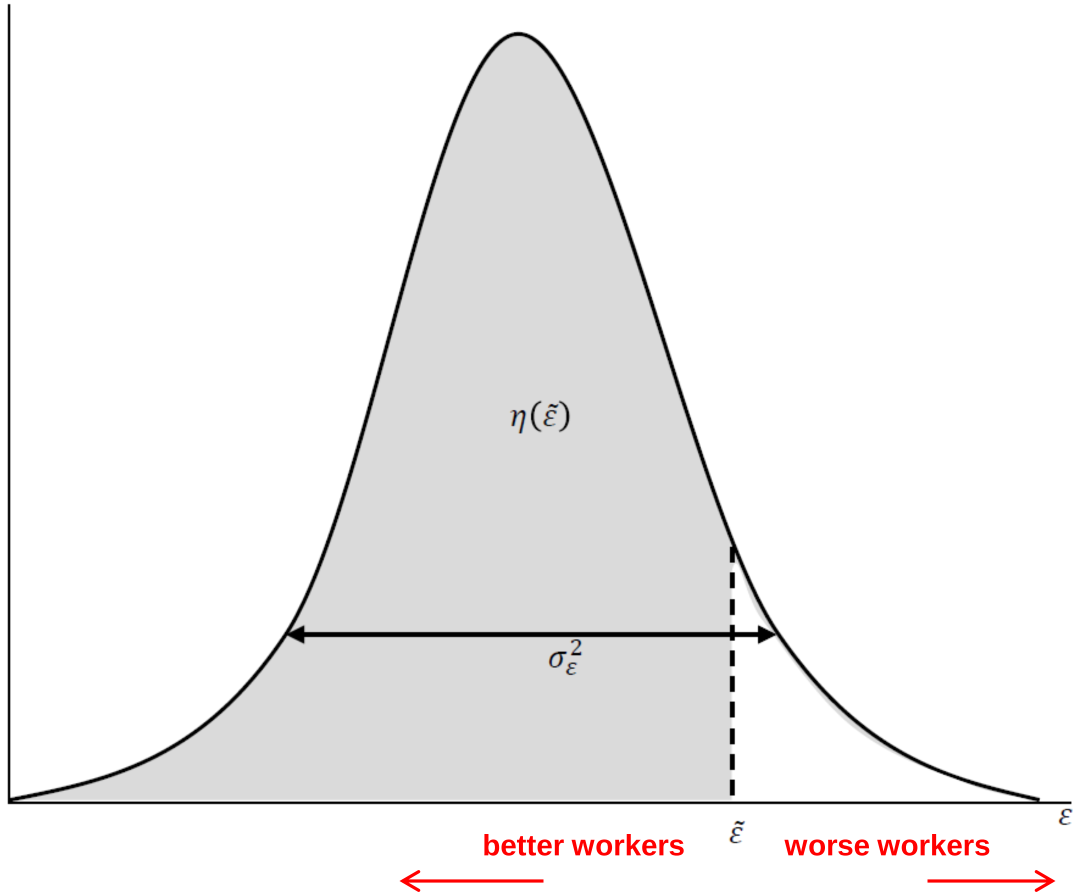
- Matching and selection two distinct concepts of frictional labor markets

"match quality"



LABOR MARKET STRUCTURE

- **Distribution of idiosyncratic hiring costs ε_i**



LABOR MARKET STRUCTURE

- $\tilde{\varepsilon}_t$ **endogenous selection threshold**
- $\eta(\tilde{\varepsilon}_t)$ **endogenous selection probability**
- $\frac{H(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)}$ **average training cost for all newly-selected employees**
- σ_ε **cross-sectional SD of training cost distribution**
- v_t **vacancies**
- k_t^h **matching probability for actively searching individual**
- γ **vacancy posting cost**
- $m(s_t, v_t)$ **aggregate matching function**

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Matching + Selection Efficiency

- **Social Planner**

$$lfp_t \equiv (1-\eta(\tilde{\varepsilon}_t)k_t^h)s_t + n_t$$

$$\max_{\{c,n_t,s_t,\tilde{\varepsilon}_t,v_t\}} E_0 \sum_{t=0}^{\infty} \beta^t \left[u(c_t) - h\left(lfp_t\right) \right]$$

s.t.

$$c_t + g_t + \frac{H(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)} \cdot \eta(\tilde{\varepsilon}_t) \cdot m\left(s_t, v_t\right) + \gamma v_t = z_t n_t$$

Goods resource constraint

$$n_t = (1-\rho)n_{t-1} + \eta(\tilde{\varepsilon}_t) \cdot m(s_t, v_t)$$

Aggregate LOM for total employment

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Goods resource constraint

$$n_t = (1-\rho)n_{t-1} + \eta(\tilde{\varepsilon}_t) \cdot m(s_t, v_t)$$

Aggregate LOM for total employment

Efficient LFP

$$\frac{h'(lfp_t)}{u'(c_t)} = m_s(s_t, v_t) \cdot \left[\tilde{\varepsilon}_t \cdot \eta(\tilde{\varepsilon}_t) - H(\tilde{\varepsilon}_t)\right]$$

Efficient vacancy creation

$$\frac{\gamma}{m_v(s_t, v_t)} = \tilde{\varepsilon}_t \cdot \eta(\tilde{\varepsilon}_t) - H(\tilde{\varepsilon}_t)$$

… rewrite in terms of model-consistent wedges …

Intertemporal Efficiency

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \frac{(1-\rho)\left[\tilde{\varepsilon}_{t+1} - m_s(s_{t+1}, v_{t+1})\left(\tilde{\varepsilon}_{t+1}\eta(\tilde{\varepsilon}_{t+1}) - H(\tilde{\varepsilon}_{t+1})\right)\right]}{\tilde{\varepsilon}_t - z_t}$$

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Goods resource constraint

$$n_t = (1-\rho)n_{t-1} + \eta(\tilde{\varepsilon}_t) \cdot m(s_t, v_t)$$

Aggregate LOM for total employment

Efficient LFP – identical to Arseneau and Chugh 2012 *JPE* (p. 949, eqn. 21)

$$\frac{h'(lfp_t)}{u'(c_t)} = \frac{g \times m_s(s_t, v_t)}{m_v(s_t, v_t)}$$

MRT between non-participation and output

Intertemporal Efficiency

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \frac{(1-\rho)\left[\tilde{\varepsilon}_{t+1} - m_s(s_{t+1}, v_{t+1})\left(\tilde{\varepsilon}_{t+1}\eta(\tilde{\varepsilon}_{t+1}) - H(\tilde{\varepsilon}_{t+1})\right)\right]}{\tilde{\varepsilon}_t - z_t}$$

IMRT: quantity of c_{t+1} that can be produced by reducing c_t by one unit, all else equal, by accumulating "wealth" in form of employment

Selection Efficiency

- **Social Planner**

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Aggregate LOM for total employment

SELECTION EFFICIENCY

- **Social Planner**

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$$\max_{\{c,n_t,s_t,\tilde{\varepsilon}_t\}} E_0 \sum_{t=0}^{\infty} \beta^t \left[u(c_t) - h\left(lfp_t\right) \right]$$

s.t.

$$c_t + g_t + \frac{H(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)} \cdot \eta(\tilde{\varepsilon}_t) \cdot s_t = z_t n_t$$ **Goods resource constraint**

$$n_t = (1-\rho)n_{t-1} + \eta(\tilde{\varepsilon}_t) \cdot s_t$$ **Aggregate LOM for total employment**

- $\gamma = 0$ **zero vacancy posting cost**

- $m(s_t, v_t) = s_t^{\xi} v_t^{1-\xi}$ **trivial matching function**

  ↓ if $\xi = 1$

  $m(s_t, v_t) = s_t$

Crucial obs. #1 for decentralized efficiency

Selection Efficiency

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Aggregate LOM for total employment

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Intertemporal Efficiency

Derivation in Appendix D based on transformation frontier

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \underbrace{\frac{(1-\rho)\left(\tilde{\varepsilon}_{t+1} - \left(\tilde{\varepsilon}_{t+1} \cdot \eta(\tilde{\varepsilon}_{t+1}) - H(\tilde{\varepsilon}_{t+1})\right)\right)}{\tilde{\varepsilon}_t - z_t}}$$

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Overview

- Infinitely-lived representative household, measure one of members
- Full consumption insurance amongst – i.e., risk-sharing
  - Employed members
  - Unemployed members
  - Members outside the labor force ("leisure")
- Labor income taxation
- Government-provided hiring subsidies

} Guarantees completeness of tax instruments (Ramsey issue)

- Government-provided unemployment benefits
- Individual-specific Nash bargaining for newly-hired worker with ε_i
- Only an extensive labor margin, no intensive labor margin
- Long-lasting labor-market relationships – exogenous separation rate ρ

FIRMS

- **Production**
  - **New job *i* produces $y_{it} = z_t - \varepsilon_{it}$ (output – hiring cost)**
  - **Hiring costs subsidized at rate τ^h**
  - **(Each incumbent job produces $y_t = z_t$)**

	New hires	Avg. hiring costs	Avg. wage for new workers	Marg. wage for threshold new worker	Wage for incumbent worker	"Tightness"
	$n_t^{NEW} = \eta(\tilde{\varepsilon}_t)s_t$	$\frac{H(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)}$	$\frac{\omega_e(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)}$	$w(\tilde{\varepsilon}_t)$	w_t^I	$\tilde{\varepsilon}_t \cdot \eta(\tilde{\varepsilon}_t) - H(\tilde{\varepsilon}_t)$

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- **Selection condition (aka labor demand) condition**

$$(1-\tau_t^h)\cdot\tilde{\varepsilon}_t = z_t - w(\tilde{\varepsilon}_t) + (1-\rho)E_t\left\{\Xi_{t+1}\left[(1-\tau_{t+1}^h)\cdot\tilde{\varepsilon}_{t+1} + w(\tilde{\varepsilon}_{t+1}) - w_{t+1}^I\right]\right\}$$

Cost of hiring = expected payoff of hiring

- **Given individualistic wage setting, holds for every new worker**

$$(1-\tau_t^h)\cdot\varepsilon_{it} = z_t - w(\varepsilon_{it}) + (1-\rho)E_t\left\{\Xi_{t+1}\left[(1-\tau_{t+1}^h)\cdot\tilde{\varepsilon}_{t+1} + w(\tilde{\varepsilon}_{t+1}) - w_{t+1}^I\right]\right\}$$

HOUSEHOLD OPTIMIZATION

- **Maximize expected lifetime utility**

$$\max_{\{c, n_t, s_t, b_{it}\}} \quad E_0 \sum_{t=0}^{\infty} \beta^t \left[u(c_t) - \underbrace{h\left((1-\eta_t)s_t + n_t\right)}_{\text{disutility of participation}} \right]$$

s.t.

$$c_t + \sum_j \frac{1}{R_t^j} b_{t+1}^j = \underbrace{(1-\rho)n_{t-1} \cdot (1-\tau_t^n) w_t^I}_{\text{wages for measure of incumbent employees}} + \underbrace{(1-\tau_t^n) \cdot \left(\frac{\omega_{et}}{\eta_t} \right) \cdot \eta_t \cdot s_t}_{\text{wages for measure of newly-hired employees}} + \underbrace{(1-\eta_t) s_t \chi}_{\text{ue benefits for unemployed}} + b_t + \overbrace{(1-\tau^{pr}) \Pi_t}^{\text{aggregate flow dividends received lump sum}}$$

View χ as fixed institutional parameter, not a cyclical policy choice

HOUSEHOLD OPTIMIZATION

- **Maximize expected lifetime utility**

$$\max_{\{c,n_t,s_t,b_{it}\}} \; E_0 \sum_{t=0}^{\infty} \beta^t \left[u(c_t) - h\left((1-\eta_t)s_t + n_t\right) \right]$$

disutility of participation: $h\left((1-\eta_t)s_t + n_t\right)$

s.t.

$$c_t + \sum_j \frac{1}{R_t^j} b_{t+1}^j = (1-\rho)n_{t-1} \cdot (1-\tau_t^n) w_t^I + (1-\tau_t^n) \cdot \left(\frac{\omega_{et}}{\eta_t} \right) \cdot \eta_t \cdot s_t + (1-\eta_t)s_t \chi + b_t + (1-\tau^{pr})\Pi_t$$

- wages for measure of incumbent employees: $(1-\rho)n_{t-1} \cdot (1-\tau_t^n) w_t^I$
- wages for measure of newly-hired employees: $(1-\tau_t^n) \cdot \left(\frac{\omega_{et}}{\eta_t} \right) \cdot \eta_t \cdot s_t$
- ue benefits for unemployed: $(1-\eta_t)s_t \chi$
- aggregate flow dividends received lump sum: $(1-\tau^{pr})\Pi_t$

View χ as fixed institutional parameter, not a cyclical policy choice

$$n_t = (1-\rho)n_{t-1} + \eta_t s_t$$

Perceived LOM for employment (“instantaneous production”)

- $(1-\rho)n_{t-1}$: (exogenous) measure of pre-existing employment relationships terminate
- $\eta_t s_t$: flow of new employment relationships = measure of searchers s_t x probability a searcher successfully lands a job

↓ **FOCs**

HOUSEHOLD OPTIMIZATION

- **Optimal labor force participation (aka labor supply) condition**

Envelope condition of period *t*+1 hh-level problem

$$\frac{h'(lfp_t)}{u'(c_t)} = \eta_t \left[(1-\tau_t^n)\left(\frac{\omega_{et}}{\eta_t}\right) + (1-\rho)E_t\left\{ \Xi_{t+1|t}\left[(1-\tau_{t+1}^n)w_{t+1}^I + \frac{\mu_{ht+1}}{u'(c_{t+1})} \right] \right\} \right] + (1-\eta_t)\chi$$

- **Equates MRS cost with expected payoff of participation**

↓ $\rho = 1$

↓ $\chi = 1$

↓ $\eta = 1$

$$\frac{h'(lfp_t)}{u'(c_t)} = (1-\tau_t^n)\omega_{et}$$

Nests RBC labor supply function

WAGES

- **Surplus sharing via individualistic Nash bargaining power**
  - **Newly-hired employee bargaining power = α^E**
  - **Incumbent employee bargaining power = α^I**

WAGES

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  - **Newly-hired employee bargaining power = α^E**
  - **Incumbent employee bargaining power = α^I**

$$w(\tilde{\varepsilon}_t) = \frac{\chi}{1-\tau_t^n} + \mathrm{PDV}_t$$

Wage for marginal new worker

$$w(\varepsilon_{it}) = \frac{\chi}{1-\tau_t^n} + \alpha^E(1-\tau_t^h)(\tilde{\varepsilon}_t - \varepsilon_{it}) + \mathrm{PDV}_t$$

Wage for infra-marginal new worker ε_{it}

WAGES

- **Surplus sharing via individualistic Nash bargaining power**
  - **Newly-hired employee bargaining power = α^E**
  - **Incumbent employee bargaining power = α^I**

$$w(\tilde{\varepsilon}_t) = \frac{\chi}{1-\tau_t^n} + \mathrm{PDV}_t$$

Wage for marginal new worker

$$w(\varepsilon_{it}) = \frac{\chi}{1-\tau_t^n} + \alpha^E(1-\tau_t^h)(\tilde{\varepsilon}_t - \varepsilon_{it}) + \mathrm{PDV}_t$$

Wage for infra-marginal new worker ε_{it}

$$\frac{\omega_e(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)} = \frac{\chi}{1-\tau_t^n} + \alpha^E(1-\tau_t^h)\underbrace{\left(\tilde{\varepsilon}_t - \frac{H(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)}\right)}_{\text{"Tightness"}} + \mathrm{PDV}_t$$

Conditional average wage for all new workers

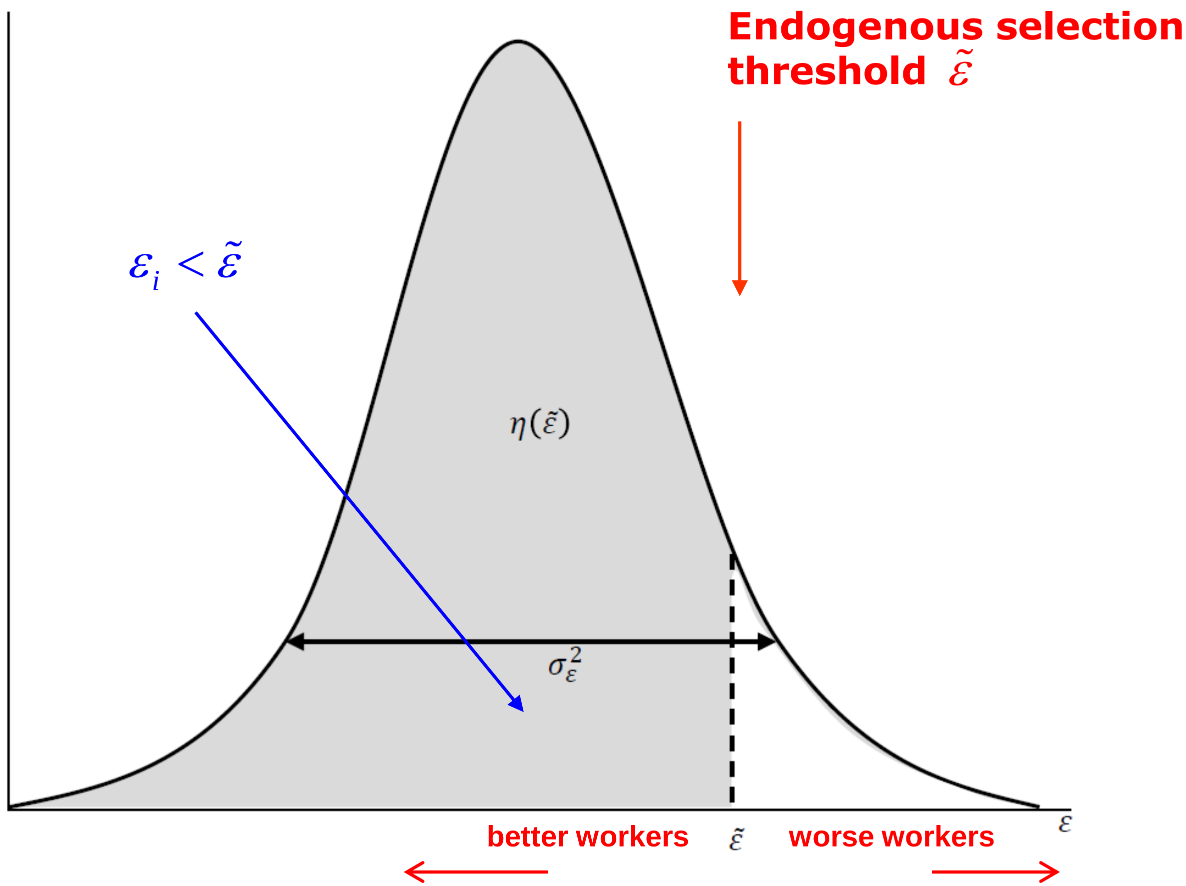
$$w_t^I = \frac{\chi}{1-\tau_t^n} + \alpha^I(1-\tau_t^h)\tilde{\varepsilon}_t + \mathrm{PDV}_t$$

Wage for incumbent worker

- **Endogenous wage dispersion**
  - **Within newly-hired employees**
  - **Across newly-hired employees and incumbent employees**

WAGES

- Distribution of idiosyncratic hiring costs ε_i



GOVERNMENT AND RESOURCE FRONTIER

- **Government**
  - **Government spending**
  - **Labor income tax**
  - **Hiring subsidies**
  - **Provision of ue benefits**
  - **One-period state contingent real debt**

- **Aggregate goods resource constraint**

$$c_t + g_t + \left(\frac{H(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)} \right) \eta(\tilde{\varepsilon}_t) s_t = z_t n_t$$

- **Aggregate LOM for labor**

$$n_t = (1-\rho) n_{t-1} + \eta(\tilde{\varepsilon}_t) s_t$$

PRIVATE-SECTOR EQUILIBRIUM

- State-contingent stochastic processes $\left\{c_t, n_t, s_t, \tilde{\varepsilon}_t, w_t^I, w(\tilde{\varepsilon}_t), \omega_e(\tilde{\varepsilon}), R_t^j\right\}_{t=0}^{\infty}$ that satisfy
  - Household's bond Euler equations
  - LFP condition
  - Selective hiring condition
  - Nash wage outcomes
  - Law of motion for employment $n_t = (1-\rho)n_{t-1} + \eta(\tilde{\varepsilon}_t)s_t$
  - Government budget constraint (key condition in Ramsey models)
  - Goods resource constraint $c_t + g_t + \left(\frac{H(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)}\right)\eta(\tilde{\varepsilon}_t)s_t = z_t n_t$
  - Given processes $\left\{g_t, z_t, \tau_t^n, \tau_t^h\right\}_{t=0}^{\infty}$

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$\mathbf{X}_t$ is private-sector decision functions

Ramsey Problem

- **Ramsey problem – "Hybrid" Formulation**

$$\max_{\{c_t, n_t, s_t, \tilde{\varepsilon}_t\}} E_0 \sum_{t=0}^{\infty} \beta^t \left[u(c_t) - h(lfp_t) \right]$$

$lfp_t \equiv (1-\eta_t)s_t + n_t$

s.t.

$$c_t + g_t + (H(\tilde{\varepsilon}_t) / \eta(\tilde{\varepsilon}_t)) \cdot \eta(\tilde{\varepsilon}_t) s_t = z_t n_t$$

Lagrange multiplier for each *t*

PVIC

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[u'(c_t) \cdot c_t - h'(lfp_t) \cdot lfp_t - u'(c_t) \cdot (1 - \tau^d) \cdot d_t \right] = A_0$$

Single Lagrange multiplier *μ*

Ramsey Problem

- **Ramsey problem – "Hybrid" Formulation**

$$\max_{\{c_t, n_t, s_t, \tilde{\varepsilon}_t, w(\tilde{\varepsilon}_t), w_t^I, \tau_t^n, \tau_t^h\}} E_0 \sum_{t=0}^{\infty} \beta^t \left[u(c_t) - h(lfp_t) \right]$$

$lfp_t \equiv (1-\eta_t)s_t + n_t$

s.t.

$$c_t + g_t + (H(\tilde{\varepsilon}_t)/\eta(\tilde{\varepsilon}_t)) \cdot \eta(\tilde{\varepsilon}_t) s_t = z_t n_t$$

Lagrange multiplier for each *t*

PVIC

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[u'(c_t) \cdot c_t - h'(lfp_t) \cdot lfp_t - u'(c_t) \cdot (1-\tau^d) \cdot d_t \right] = A_0$$

Single Lagrange multiplier μ

$$n_t = (1-\rho) n_{t-1} + \eta(\tilde{\varepsilon}_t) s_t$$

$$\frac{h'(lfp_t)}{u'(c_t)} = \eta_t \left[(1-\tau_t^n) \left(\frac{\omega_{et}}{\eta_t} \right) + (1-\rho) E_t \left\{ \Xi_{t+1|t} \left[(1-\tau_{t+1}^n) w_{t+1}^I + \frac{\mu_{ht+1}}{u'(c_{t+1})} \right] \right\} \right] + (1-\eta_t)\chi$$

$$(1-\tau_t^h) \cdot \tilde{\varepsilon}_t = z_t - w(\tilde{\varepsilon}_t) + (1-\rho) E_t \left\{ \Xi_{t+1} \left[(1-\tau_{t+1}^h) \cdot \tilde{\varepsilon}_{t+1} + w(\tilde{\varepsilon}_{t+1}) - w_{t+1}^I \right] \right\}$$

Ramsey Problem

- Ramsey problem – "Hybrid" Formulation

$$\max_{\{c_t, n_t, s_t, \tilde{\varepsilon}_t, w(\tilde{\varepsilon}_t), w_t^I, \tau_t^n, \tau_t^h\}} E_0 \sum_{t=0}^{\infty} \beta^t \left[u(c_t) - h(lfp_t) \right]$$

$lfp_t \equiv (1-\eta_t)s_t + n_t$

s.t.

$$c_t + g_t + (H(\tilde{\varepsilon}_t)/\eta(\tilde{\varepsilon}_t)) \cdot \eta(\tilde{\varepsilon}_t) s_t = z_t n_t$$

Lagrange multiplier for each *t*

PVIC

$$E_0 \sum_{t=0}^{\infty} \beta^t \left[u'(c_t) \cdot c_t - h'(lfp_t) \cdot lfp_t - u'(c_t) \cdot (1-\tau^d) \cdot d_t \right] = A_0$$

Single Lagrange multiplier μ

$$n_t = (1-\rho) n_{t-1} + \eta(\tilde{\varepsilon}_t) s_t$$

$$\frac{h'(lfp_t)}{u'(c_t)} = \eta_t \left[(1-\tau_t^n) \left(\frac{\omega_{et}}{\eta_t} \right) + (1-\rho) E_t \left\{ \Xi_{t+1|t} \left[(1-\tau_{t+1}^n) w_{t+1}^I + \frac{\mu_{ht+1}}{u'(c_{t+1})} \right] \right\} \right] + (1-\eta_t)\chi$$

$$(1-\tau_t^h) \cdot \tilde{\varepsilon}_t = z_t - w(\tilde{\varepsilon}_t) + (1-\rho) E_t \left\{ \Xi_{t+1} \left[(1-\tau_{t+1}^h) \cdot \tilde{\varepsilon}_{t+1} + w(\tilde{\varepsilon}_{t+1}) - w_{t+1}^I \right] \right\}$$

$$w(\tilde{\varepsilon}_t) = \frac{\chi}{1-\tau_t^n} + \mathrm{PDV}_t \qquad \frac{\omega_e(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)} = \frac{\chi}{1-\tau_t^n} + \alpha^E (1-\tau_t^h) \left(\tilde{\varepsilon}_t - \frac{H(\tilde{\varepsilon}_t)}{\eta(\tilde{\varepsilon}_t)} \right) + \mathrm{PDV}_t \qquad w_t^I = \frac{\chi}{1-\tau_t^n} + \alpha^I (1-\tau_t^h) \tilde{\varepsilon}_t + \mathrm{PDV}_t$$

NOT captured in PVIC

Lagrange multiplier for each *t*

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CALIBRATION

- **Parameterize so non-Ramsey economy generates empirically reasonable labor market fluctuations in *ue*, *lfp*, and hiring rate $\eta(\varepsilon)$**

- **Conditional on exogenous fluctuations in**
  - **Labor tax rate**
  - **Productivity**
  - **Government purchases**

- **Crucial parameters – Part I**
  - **Distributional form – logistic (also have used normal distribution)**
  - **Mean μ_ε = 0.30**
  - **Cross-sectional standard deviation σ_ε = 0.19**

- **Value of σ_ε disciplined by micro-level evidence**
  - **SD σ_ε across new hires of training costs = 207 hours (= 40% of MPN)**
  - **Barron, Black, and Loewenstein (1989 *JLE*)**
  - **Firm-level costs of interviewing/hiring/training new workers**
  - **Based on 1982 EOPP (Employment Opportunities Pilot Project)**

CALIBRATION

- Parameterize so non-Ramsey economy generates empirically reasonable labor market fluctuations in *ue*, *lfp*, and hiring rate $\eta(\varepsilon)$

- Conditional on exogenous fluctuations in
  - Labor tax rate
  - Productivity
  - Government purchases

- Crucial parameters – Part I
  - Distributional form – logistic (also have used normal distribution)
  - Mean $\mu_\varepsilon = 0.30$
  - Cross-sectional standard deviation $\sigma_\varepsilon = 0.19$

- Crucial parameters – Part II
  - Unemployment benefits = 0.70
  - Worker Nash bargaining power $\alpha^E = \alpha^I = 0.50$
    - For both new hires and incumbents

Crucial obs. #2 for decentralized efficiency

- Other parameters "standard" (Table 3)

DYNAMIC RESULTS

			Non-Ramsey Policy (positive)	Data
Labor Tax Rate	Mean		20%	20%
	Rel. SD		0.98	1.8
"Tightness" ($\varepsilon\eta(\varepsilon) - H(\varepsilon)$)	Rel. SD		5.58	
Hiring rate $\eta(\varepsilon)$	Rel. SD		3.5	3.7
Unemployment	Rel. SD		8.6	5.2
LFP	Rel. SD		0.22	0.20

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DYNAMIC RESULTS

		Ramsey	Non-Ramsey Policy (positive)	Data
Labor Tax Rate	Mean	22%	20%	20%
	Rel. SD	0.98	0.98	1.8
"Tightness" ($\varepsilon\eta(\varepsilon) - H(\varepsilon)$)	Rel. SD	1.09	5.58	
Hiring rate $\eta(\varepsilon)$	Rel. SD	0.03	3.5	3.7
Unemployment	Rel. SD	5.3	8.6	5.2
LFP	Rel. SD	0.23	0.22	0.20

- Ramsey simulations: shocks to z, g conditional on structural parameters
- Observations
  1. Labor income tax rate smoothing NOT optimal
  2. Volatility of $\eta(\varepsilon)$ much smaller than in data

DYNAMIC RESULTS

		Ramsey Policy		
		Baseline parameters		Social Planner
Labor Tax Rate	Mean	22%		0%
	Rel. SD	0.99		0
"Tightness" ($\varepsilon\eta(\varepsilon) - H(\varepsilon)$)	Rel. SD	1.09		1.09
Hiring rate $\eta(\varepsilon)$	Rel. SD	0.03		0.03
Unemployment	Rel. SD	5.39		5.39
LFP	Rel. SD	0.04		0.04

- **Social Planner simulations: shocks to *z***
- **Ramsey simulations: Inefficient structural parameters DO appear in problem**
- **Efficient surplus sharing**

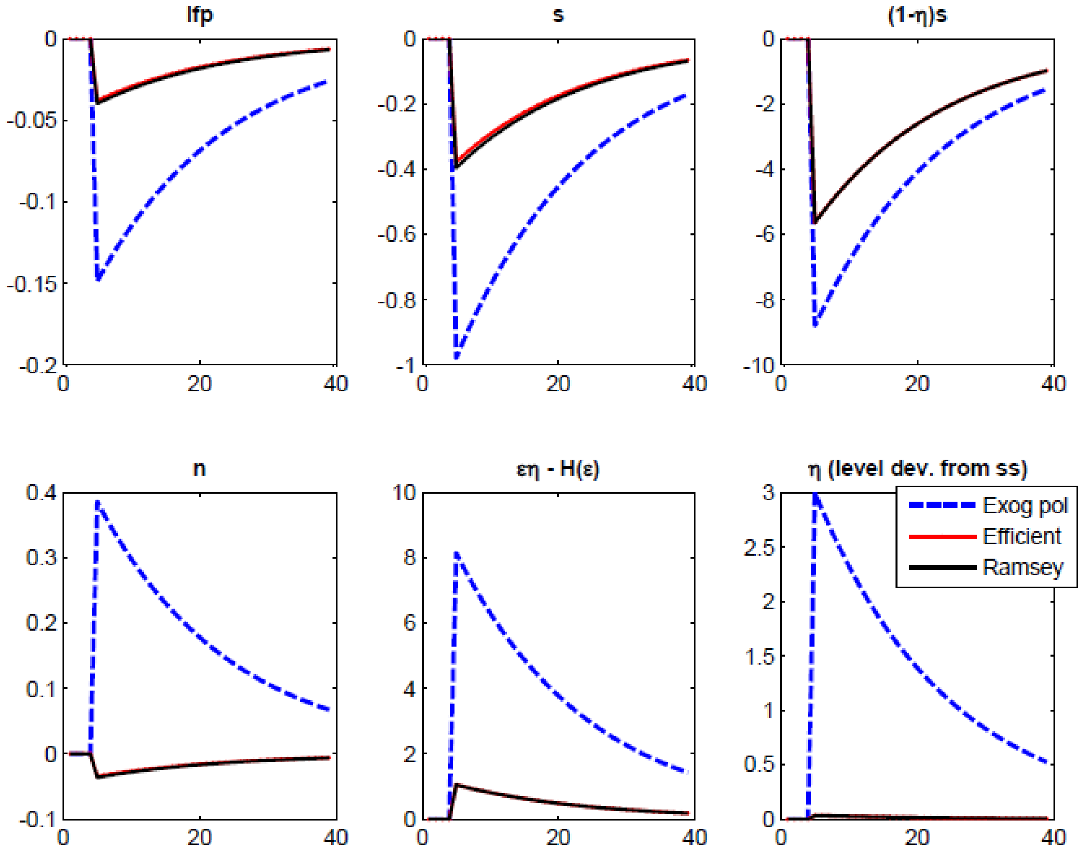
DYNAMIC RESULTS

		Ramsey Policy		
		Baseline parameters	For ANY (a,χ) pair	Social Planner
Labor Tax Rate	Mean	22%	---	0%
	Rel. SD	0.99	---	0
"Tightness" ($\varepsilon\eta(\varepsilon) - H(\varepsilon)$)	Rel. SD	1.09	1.09	1.09
Hiring rate $\eta(\varepsilon)$	Rel. SD	0.03	0.04	0.03
Unemployment	Rel. SD	5.39	5.39	5.39
LFP	Rel. SD	0.04	0.04	0.04

- Social Planner simulations: shocks to z
- Ramsey simulations: Inefficient structural parameters DO appear in problem
- Efficient surplus sharing for ANY (a, χ) pair

Dynamic Results

- Impulse response to productivity



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BEVERIDGE CURVE

- **Outwards shift of Beveridge Curve during Great Recession**
  - **Elsby, Michaels, and Ratner (2015 *JEL*)**
  - **Diamond and Sahin (2014 *NY Fed Staff Report*)**

- **Reduced-form interpretation: "matching efficiency" Ω has declined**

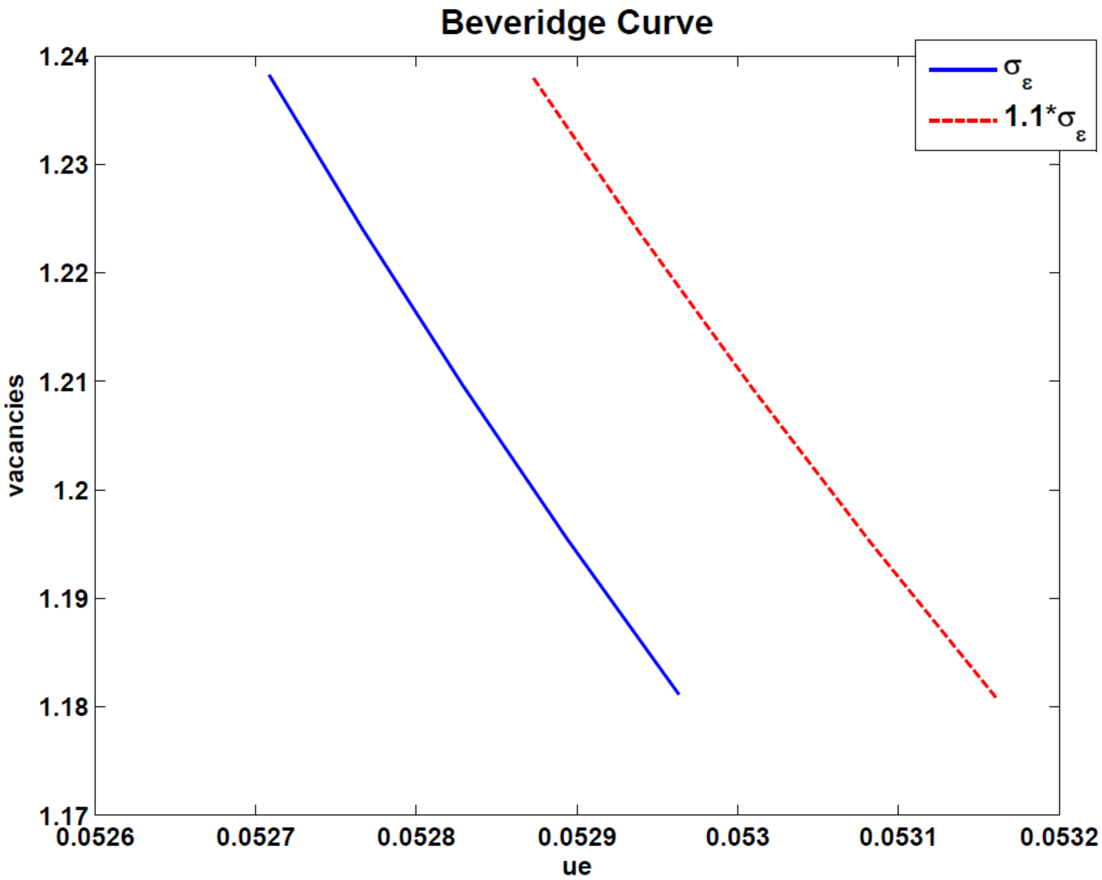
$$\Omega \cdot m(s_t, v_t)$$

  - **Cheremukhin and Restrepo-Echavarria (2014 *EER*)**
  - **Pescatori and Tasci (2011)**
  - **Chahrour, Chugh, and Potter (2018)**

- **Proposal: increase in primitive cross-sectional SD σ_ε**
  - **Gets inside black-box Ω**
  - **(Distributional explanation at heart of Lester (2010 *JET*))**

Beveridge Curve

- Outwards shift of Beveridge Curve during Great Recession



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NASH BARGAINING & EFFICIENCY

- **Suppose zero taxes in decentralized economy**
- **Selection model (no search and matching)**
  - **(Trivial matching function)**

$$m(s_t, v_t) = s_t^{\xi} v_t^{1-\xi} \quad \text{(with } \xi = 1\text{)}$$
$$= s_t$$

- **Nash bargaining parameter** $\alpha^E = \xi = 1$ **achieves efficient allocations**
  - **Efficient surplus sharing**

NASH BARGAINING & EFFICIENCY

- Suppose zero taxes in decentralized economy
- Selection model (no search and matching)
  - (Trivial matching function)

$$m(s_t, v_t) = s_t^{\xi} v_t^{1-\xi} \quad \text{(with } \xi = 1)$$
$$= s_t$$

- Nash bargaining parameter $\alpha^E = \xi = 1$ achieves efficient allocations
  - Efficient surplus sharing

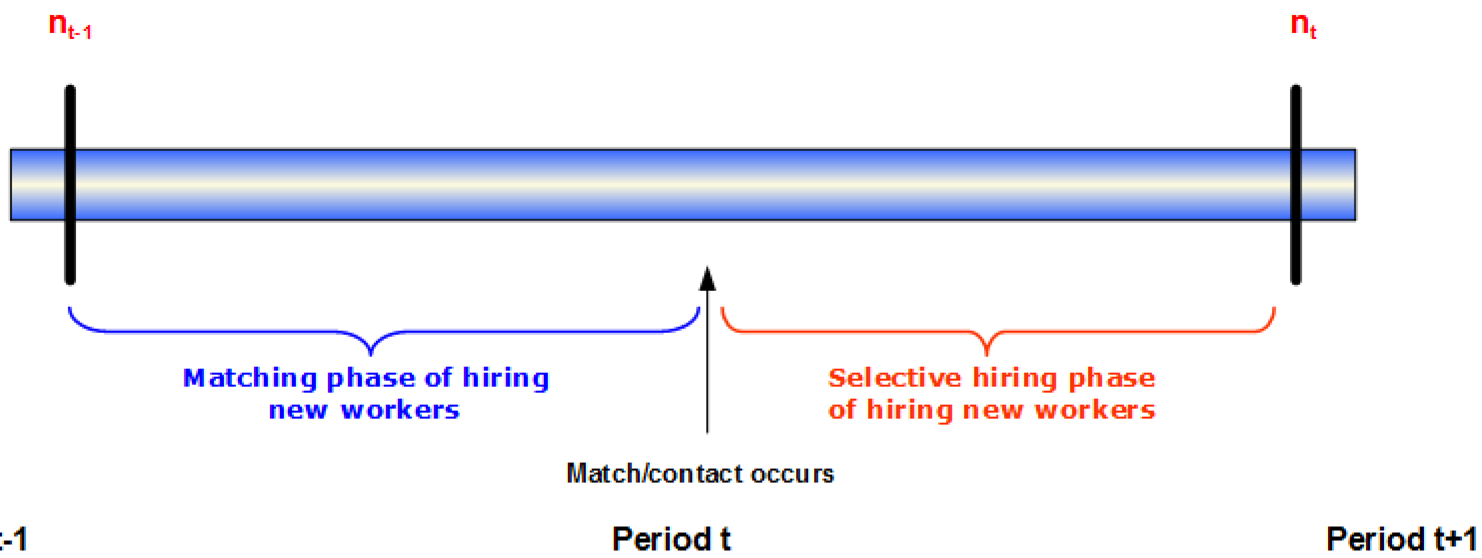
- Search and matching model (no selection)
  - Matching function (fundamental)

$$m(s_t, v_t) = s_t^{\xi} v_t^{1-\xi} \qquad \xi \in (0.3, 0.7)$$

- Nash bargaining parameter $\alpha^E = \xi < 1$ achieves efficient allocations
  - Hosios (1990) condition
  - Efficient surplus sharing

NASH BARGAINING & EFFICIENCY

- Suppose zero taxes in decentralized economy
- Matching + Selection
- No value of α^E can decentralize efficient surplus sharing
  - Two competing efficiency goals…
  - …but only ONE wage determination mechanism



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LABOR MARKETS – MODEL-CONSISTENT WEDGES

- Develop selection-model consistent transformation function and MRTs
  - Aggregate goods resource constraint
  - Aggregate law of motion of employment

$\Rightarrow$ model-consistent decentralized wedges

- Tax volatility $\Rightarrow$ EFFICIENT fluctuations
  - Selection model wedge fluctuations EXACTLY = 0
- Analytically characterize source of externalities
  - Cost gap = marginal hiring cost – avg. hiring cost
- "Selection Market Tightness"
  - Play highly similar role as market tightness externalities in matching model

Efficient labor supply in matching model (Arseneau and Chugh 2012 *JPE*)

$$MRS_{c_t,n_t} = \gamma \cdot \left(\frac{\alpha}{1-\alpha}\right) \cdot \theta_t$$

$$MRS_{c_t,n_t} = \tilde{\varepsilon}_t \cdot \eta(\tilde{\varepsilon}_t) - H(\tilde{\varepsilon}_t)$$

Efficient labor supply from Chugh and Merkl 2016 *IER*

Labor Markets

Efficient labor supply in matching model (Arseneau and Chugh 2012 *JPE*)

$$\frac{h'(lfp_t)}{u'(c_t)} = \underbrace{\gamma \cdot \left(\frac{\alpha}{1-\alpha}\right) \cdot \theta_t}_{\text{Within-period MRT}}$$

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \underbrace{\frac{(1-\rho)\left(\frac{\gamma}{(1-\alpha)\theta_{t+1}^{-\alpha}} - \gamma \cdot \frac{\alpha}{1-\alpha} \cdot \theta_{t+1}\right)}{\frac{\gamma}{(1-\alpha)\theta_t^{-\alpha}} - z_t}}_{\text{Intertemporal MRT}}$$

Labor Markets

Efficient labor supply in matching model (Arseneau and Chugh 2012 *JPE*)

$$\frac{h'(lfp_t)}{u'(c_t)} = \gamma \cdot \left(\frac{\alpha}{1-\alpha}\right) \cdot \theta_t$$

Within-period MRT

Efficient labor supply in selection model (Chugh and Merkl 2016 *IER*)

$$\frac{h'(lfp_t)}{u'(c_t)} = \tilde{\varepsilon}_t \cdot \eta(\tilde{\varepsilon}_t) - H(\tilde{\varepsilon}_t)$$

Within-period MRT

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \frac{(1-\rho)\left(\frac{\gamma}{(1-\alpha)\theta_{t+1}^{-\alpha}} - \gamma \cdot \frac{\alpha}{1-\alpha} \cdot \theta_{t+1}\right)}{\frac{\gamma}{(1-\alpha)\theta_t^{-\alpha}} - z_t}$$

Intertemporal MRT

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \frac{(1-\rho)\left(\tilde{\varepsilon}_{t+1} - (\tilde{\varepsilon}_{t+1}\eta(\tilde{\varepsilon}_{t+1}) - H(\tilde{\varepsilon}_{t+1}))\right)}{\tilde{\varepsilon}_t - z_t}$$

Intertemporal MRT

Substitute intratemporal conditions into intertemporal conditions

Labor Markets

Marginal cost of hiring a new employee

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \frac{(1-\rho)\left(\frac{\gamma}{(1-\alpha)\theta_{t+1}^{-\alpha}} - \frac{h'(lfp_{t+1})}{u'(c_{t+1})}\right)}{\frac{\gamma}{(1-\alpha)\theta_t^{-\alpha}} - z_t}$$

Marginal cost of hiring a new employee

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \frac{(1-\rho)\left(\tilde{\varepsilon}_{t+1} - \frac{h'(lfp_{t+1})}{u'(c_{t+1})}\right)}{\tilde{\varepsilon}_t - z_t}$$

CONCLUSIONS

- **Selective hiring framework realistic**
- **Selective hiring costs are distinct from vacancy posting costs**
  - **Davis, Faberman, and Haltiwanger (2013 *QJE*): ≈ 40% of hiring costs are NOT vacancy posting costs**
- **Smoothing (model-consistent) wedges the goal for optimal policy**
  - **Not smoothing policy instruments**
- **Model-consistent wedges apply to**
  - **Fiscal policy**
  - **Monetary policy**
  - **Regulatory policy**