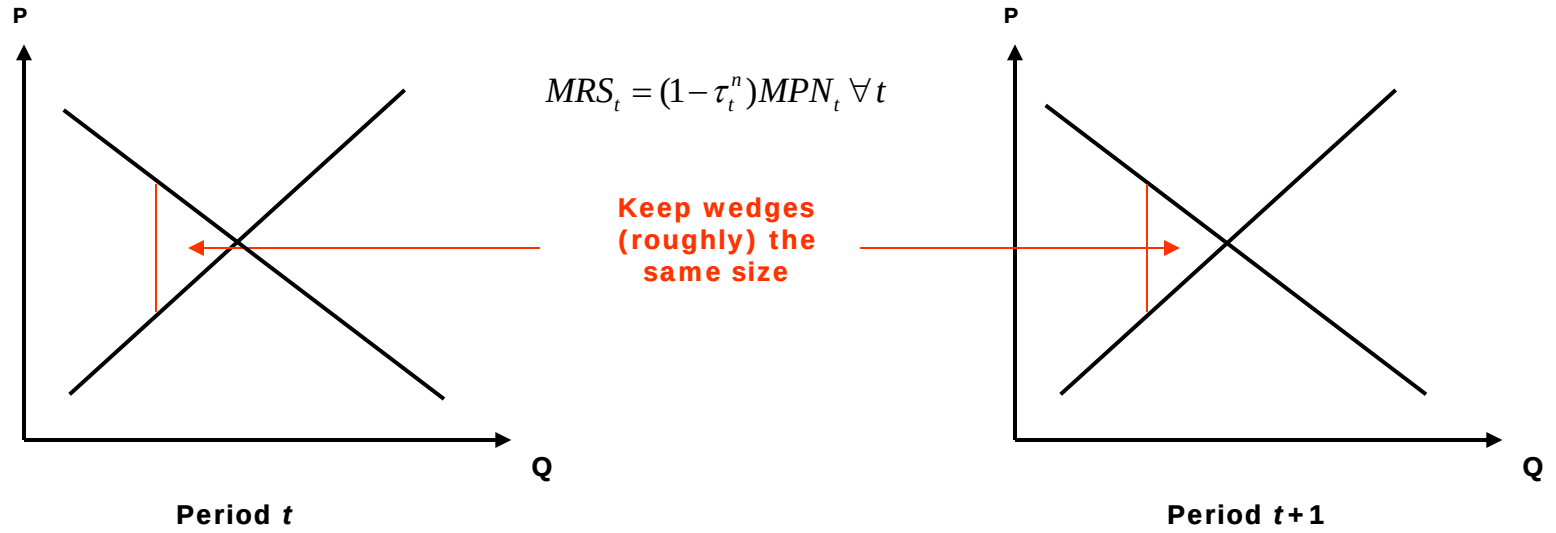
Tax Smoothing in Frictional Labor Markets

December 10, 2013

TAX SMOOTHING



- **Ramsey wants to keep these wedges constant**
- **Result and intuition depend on neoclassical view of labor markets**
  - **Labor tax is the only wedge → tax-smoothing is wedge-smoothing**
- **Question: Is tax smoothing optimal from the point of view of the modern theory of frictional labor markets?**

TAX SMOOTHING

$$MRS_t = (1-\tau_t^n)MPN_t \ \forall t$$

- Ramsey wants to keep these wedges constant
- Result and intuition depend on neoclassical view of labor markets
  - Labor tax is the only wedge → tax-smoothing is wedge-smoothing
- Question: Is tax smoothing optimal from the point of view of the modern theory of frictional labor markets?

TAX SMOOTHING

In neoclassical view, MPN = MRT
(between labor and consumption)

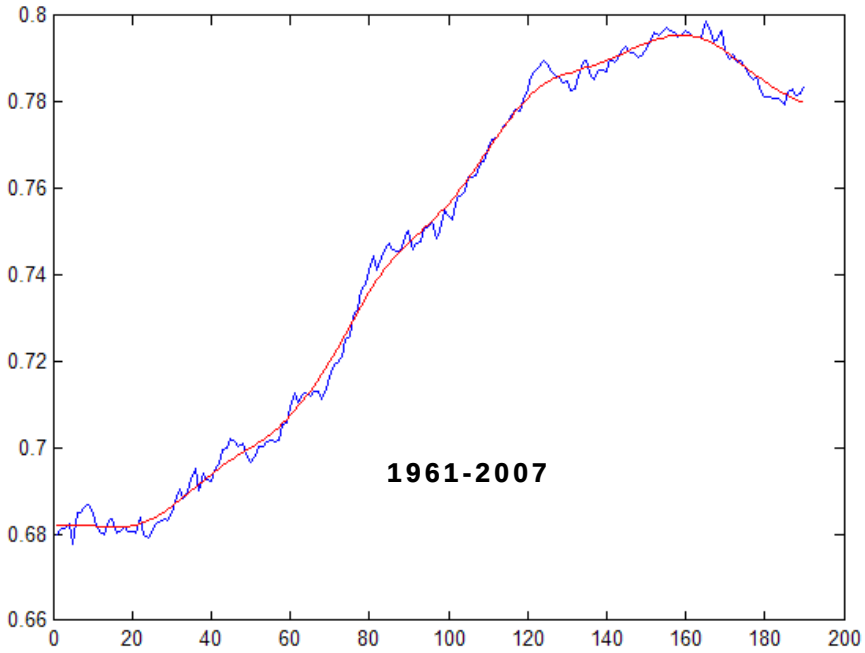
$$MRS_t = (1-\tau_t^n)MRT_t \ \forall t$$

Think in terms of transformation frontier in which every object can be viewed as either an input to or an output of the technology to which it is associated

- Ramsey wants to keep these wedges constant
- Result and intuition depend on neoclassical view of labor markets
  - Labor tax is the only wedge → tax-smoothing is wedge-smoothing
- Question: Is tax smoothing optimal from the point of view of the modern theory of frictional labor markets?

Labor Force Participation

- Introduce endogenous labor supply (participation)
- Conventional empirical wisdom
  - Cyclical LFP fluctuations "small"
  - Basis for typically abstracting from participation in matching models
  - Volatility of LFP relative to that of GDP ≈ 0.20



Overview of Model

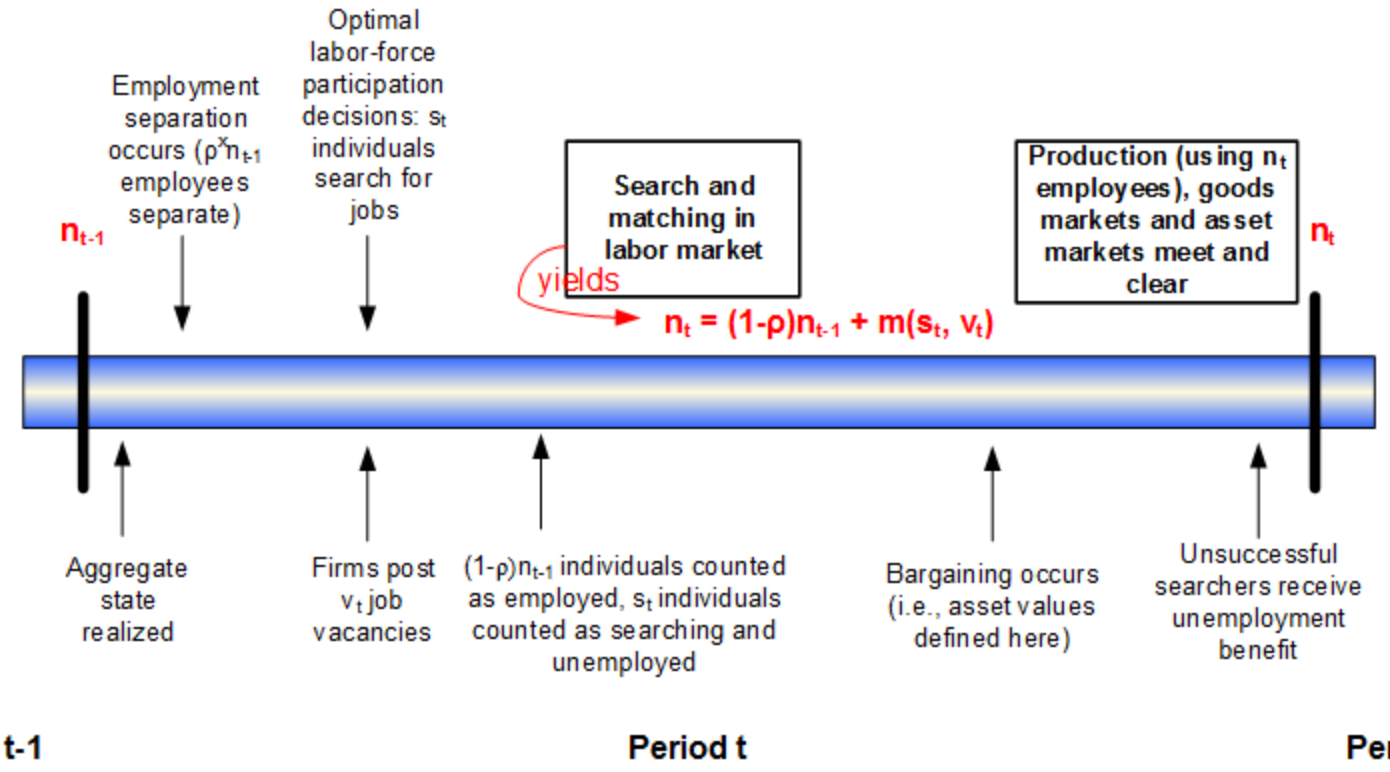
- Infinitely-lived representative household, measure one of members
  - Employed members
  - Unemployed members
  - Members outside the labor force ("leisure")

Full consumption insurance – standard in DSGE labor search models

Incompleteness of government debt markets NOT driving our results (Aiyagari et al (2002 *JPE*))

- Exogenous stochastic government spending
  - Financed via labor income taxation and one-period real state-contingent debt
  - Government provides unemployment benefits
  - Government provides vacancy subsidies
    - For completeness of tax instruments (Ramsey issue)
- Labor market with matching frictions and wage-setting frictions
- Only an extensive labor margin, no intensive labor margin
- Timing: "instantaneous production"

Overview of Model



- **Unemployed are the unsuccessful searchers: $ue_t = (1-p_t)s_t$**
  - **p_t = probability an individual finds a job and begins working immediately**

HOUSEHOLD OPTIMIZATION

- **Maximize expected lifetime utility**

$$\max_{\{c,n_t,s_t,b_t\}} \; \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \left[u(c_t) - h\left((1-p_t)s_t + n_t\right) \right]$$

disutility of employment + unsuccessful search

s.t.

$$c_t + b_t = n_t(1-\tau_t^n)w_t + (1-p_t)s_t\chi + R_t b_{t-1} + (1-\tau^d)d_t$$

Flow budget constraint

measure *n* earn after-tax wage income

measure *ue* = (1-*p*)*s* receive ue benefit χ (government financed)

Baseline analysis: set $\tau^d = 1 \rightarrow$ no *profit*-taxation issues driving results

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

Perceived LOM for employment ("instantaneous production")

(exogenous) measure of pre-existing employment relationships terminate

flow of new employment relationships = measure of searchers s_t x probability a searcher successfully lands a job

↓ FOCs with respect c_t, n_t, s_t, b_t

HOUSEHOLDS

- **Household LFP condition (think of as labor supply condition)**

$$\frac{h'(lfp_t)}{u'(c_t)} = p_t\left[(1-\tau_t^n)w_t + (1-\rho)E_t\left\{\Xi_{t+1|t}\left(\frac{1-p_{t+1}}{p_{t+1}}\right)\left(\frac{h'(lfp_{t+1})}{u'(c_{t+1})} - \chi\right)\right\}\right] + (1-p_t)\chi$$

  - **MRS between lfp_t and c_t = expected payoff of searching**
    - **Unemployment benefit (with probability 1 – p_t)**
    - **After-tax wage + continuation value (with probability p_t)**

To recover standard labor supply function (e.g., RBC)

1. **ρ = 1 (all employment relationships terminate at end of every period)**
2. **p = 1 (probability a searcher finds a job)**
3. **χ = 0 (no ue benefit because no notion of "ue")**

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

FIRMS

- **Production**
  - Requires a matched job-worker pair: posting cost γ per vacancy
  - Individual job i produces $y_{it} = z_t$
  - Aggregate output $y_t = n_t z_t$ (symmetry across jobs)

- **Dynamic profit-maximization problem**

Ensures completeness of tax instruments

$$\max_{\{n_t, v_t\}} \sum_{t=0}^{\infty} \Xi_{t|0} \left[z_t n_t - w_t n_t - (1-\tau_t^s)\gamma v_t \right]$$

$$n_t = (1-\rho) n_{t-1} + v_t q_t$$

Firm's perceived LOM for total employment ("instantaneous hiring")

(exogenous) measure of pre-existing employment relationships terminate

flow of new employment relationships = # job-openings x probability an opening attracts a searching individual

- **Vacancy-creation condition**

$$\frac{\gamma(1-\tau_t^s)}{q_t} = z_t - w_t + (1-\rho) E_t \left[\Xi_{t+1|t} \frac{\gamma(1-\tau_{t+1}^s)}{q_{t+1}} \right]$$

cost of posting vacancy (inclusive of subsidy or tax)

benefit of posting vacancy

Labor Market

- **Labor-market tightness $\theta_t = v_t / u_t$**
  - **Important aggregate variable in matching-based models**
  - **Matching probabilities p and q depend only on θ given CRTS matching**
  - **Key statistic for matching efficiency**

- **Matching function** $m(s_t, v_t) = \psi s_t^{\xi} v_t^{1-\xi}$
- **LOM for aggregate employment** $n_t = (1-\rho) n_{t-1} + m(s_t, v_t)$

- **Nash bargaining over wage payment solves**

$$\max_{w_t} \left(\mathbf{W}_t - \mathbf{U}_t\right)^{\eta} \mathbf{J}_t^{1-\eta} \longrightarrow \frac{\mathbf{W}_t - \mathbf{U}_t}{1-\tau_t^n} = \frac{\eta}{1-\eta} \mathbf{J}_t$$

Gain to household of successfully forming another employment relationship

Value to firm of hiring another worker

$$\longrightarrow w_t = \eta z_t + (1-\eta)\frac{\chi}{1-\tau_t^n} + \eta(1-\rho) E_t \left\{ \Xi_{t+1|t} \left[1 - (1-p_{t+1}) \frac{1-\tau_{t+1}^n}{1-\tau_t^n} \right] \frac{\gamma(1-\tau_{t+1}^s)}{q_{t+1}} \right\}$$

GOVERNMENT AND RESOURCE FRONTIER

- Exogenous government spending financed via
  - Labor income tax
  - One-period state contingent real debt

$$\tau_t^n w_t n_t + b_t + \tau^d d_t = g_t + R_t b_{t-1} + (1 - p_t) s_t \chi + \tau_t^s \gamma v_t$$

  - Government provides unemployment benefits
    - Rather than assuming χ is "home production"

- Resource constraint

$$c_t + g_t + \gamma v_t = z_t n_t$$

  - = govt budget constraint + hh budget constraint
  - Assuming χ is govt-financed allows it to drop out of resource constraint
    - Makes model more comparable to existing Ramsey models

- Precise nature of χ (ue benefit? home production? value of leisure?) not typically specified in DSGE matching models
  - Our model articulates both ue benefit and value of leisure

PRIVATE-SECTOR EQUILIBRIUM

- **Stochastic processes** $\{c_t, n_t, s_t, w_t, \theta_t, R_t, b_t\}_{t=0}^{\infty}$ **that satisfy**
  - **Household's bond Euler equation**
  - **Vacancy-creation condition**
  - **Labor force participation condition**
  - **Nash wage outcome**
  - **Law of motion for employment** $n_t = (1-\rho)n_{t-1} + m(s_t, v_t)$
  - **Government budget constraint (key condition in Ramsey models)**
  - **Resource constraint** $c_t + g_t + \gamma v_t = z_t n_t$
  - **Given processes** $\{g_t, z_t, \tau_t^n, \tau_t^s\}_{t=0}^{\infty}$

Standard conditions in basic Ramsey models

MATCHING EFFICIENCY

- **Social Planner**

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

s.t.

$$c_t + g_t + \gamma v_t = z_t n_t$$

Resource constraint

$$n_t = (1-\rho) n_{t-1} + m(s_t, v_t)$$

Aggregate LOM for total employment

MATCHING EFFICIENCY

- **Social Planner**

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

s.t.

$$c_t + g_t + \gamma v_t = z_t n_t$$

Resource constraint

$$n_t = (1-\rho) n_{t-1} + m(s_t, v_t)$$

Aggregate LOM for total employment

FOCs

(consider deterministic case)

$$\frac{h'(lfp_t)}{u'(c_t)} = \frac{\gamma m_s(s_t, v_t)}{m_v(s_t, v_t)} = \gamma \theta_t \frac{\xi}{1-\xi}$$

Static Efficiency Condition.

"Efficient Participation Condition"

Can instead derive directly off transformation frontier of model.

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \frac{(1-\rho)\left(\dfrac{\gamma}{m_v(s_{t+1}, v_{t+1})}\right)\left(1 - m_s(s_{t+1}, v_{t+1})\right)}{\dfrac{\gamma}{m_v(s_t, v_t)} - z_t}$$

Intertemporal Efficiency Condition.

"Efficient Vacancies Condition"

Can instead derive directly off transformation frontier of model.

MATCHING EFFICIENCY

- **Efficiency characterized by**

$$\frac{h'(lfp_t)}{u'(c_t)} = \frac{\gamma m_s(s_t, v_t)}{m_v(s_t, v_t)} = \underbrace{\gamma\theta_t \frac{\xi}{1-\xi}}_{\text{= Static MRT}_t}$$

Static Efficiency Condition.

Can instead derive directly off transformation frontier of model.

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \underbrace{\frac{(1-\rho)\left(\frac{\gamma}{m_v(s_{t+1}, v_{t+1})}\right)\left(1 - m_s(s_{t+1}, v_{t+1})\right)}{\frac{\gamma}{m_v(s_t, v_t)} - z_t}}_{\text{= Intertemporal MRT}_t}$$

Intertemporal Efficiency Condition.

Can instead derive directly off transformation frontier of model.

- **Hypothesis based on Ramsey theory: stabilizing or closing any wedges in THESE efficiency conditions is optimal**
- **Contribution to understanding efficiency in DGE models with "entry" margins**
  - **IMRT in search-theoretic monetary models: Aruoba and Chugh (2010 *JET*)**
  - **IMRT in endogenous product variety framework: Chugh and Ghironi (2012)**

CALIBRATION

- **Baseline calibration**
  - **So that exogenous policy (non-Ramsey) equilibrium broadly matches U.S. labor market fluctuations**
  - **Preferences and key parameters**

$$u(c_t) - h(lfp_t) = \ln c_t - \frac{\kappa}{1+1/\iota} lfp_t^{1+1/\iota}$$

  - **Participation (labor supply) elasticity (ι = 0.18)**
  - **Low worker bargaining power (η = 0.05)**
  - **High unemployment benefit (98% of real wage)**

The two key parameters of HM calibration

- **Rest of parameters, matching-related and otherwise, standard**
  - **β = 0.99**
  - **ρ = 0.10**
  - **ξ = 0.40**
  - **AR(1) parameters for LOMs for TFP and government spending**
  - **Etc.**

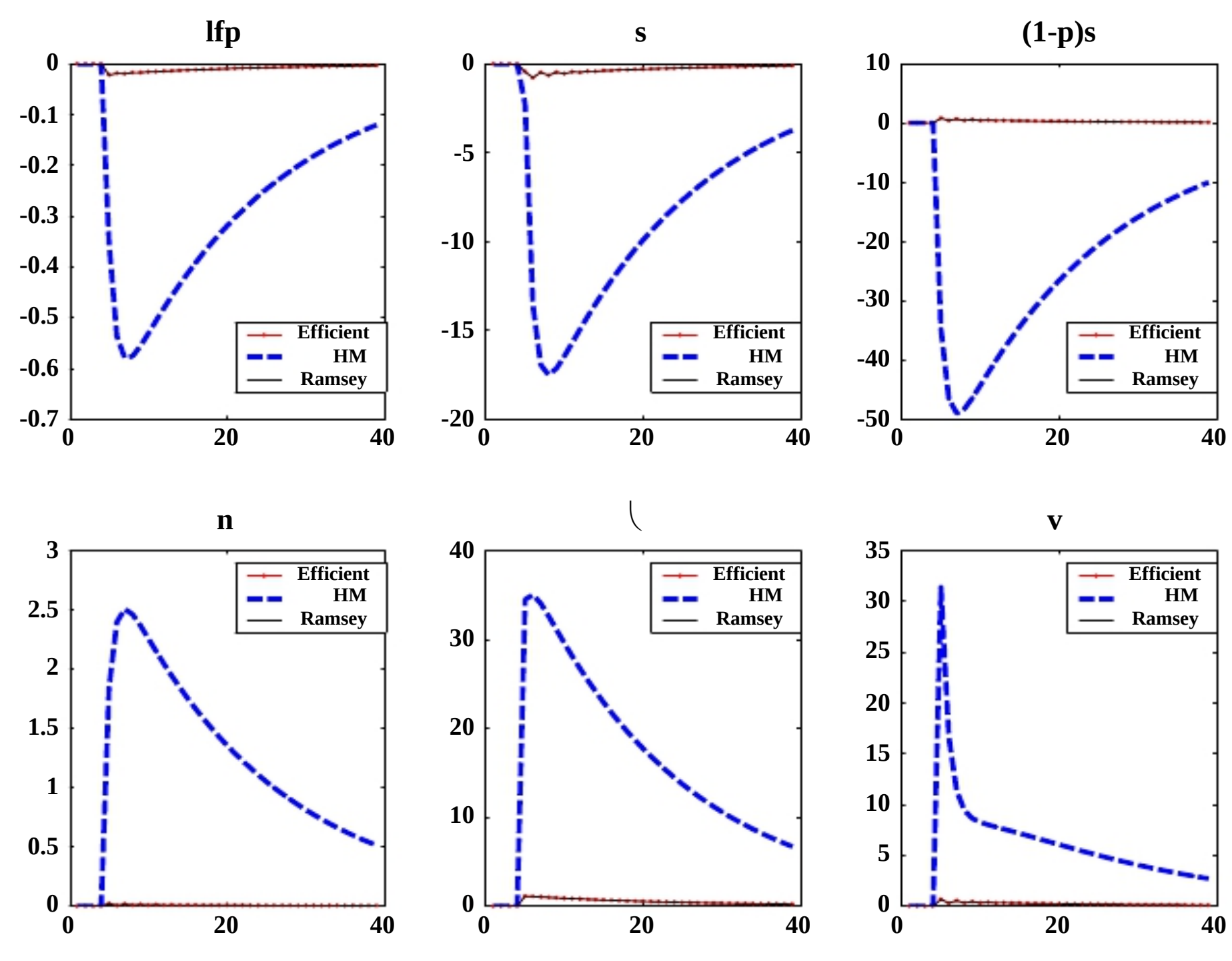
DYNAMICS

		Ramsey		Exogenous Policy Benchmark		Data
		Calibration		Calibration		
		HM	0% and Hosios	HM		
Labor Tax Rate	Mean	11%		22%		22%
	Rel SD	5.6		1.4		1.4
Market tightness (θ)	Rel SD	1.1		10.9		11.3
Vacancies	Rel SD	1.3		6.9		6.3
Unemployment	Rel SD	1.4		5.4		5.2
LFP	Rel SD	0.13		0.20		0.20
Real wage	Rel SD	0.50		0.28		0.52
Static wedge	SD (%)					
Intertemporal wedge	SD (%)					

Gertler and Trigari (2009 *JPE*)

DYNAMICS

- **Ramsey fluctuations IDENTICAL to efficient fluctuations for ANY (η, χ) pair**
  - **In terms of fluctuations around a given steady state**
  - **Steady-state levels of (τ^n, τ^s) depend on (η, χ) pair**


lfp
s
(1-p)s
n
v
Efficient
HM
Ramsey

DYNAMICS

- **Ramsey fluctuations IDENTICAL to efficient fluctuations for ANY (η, χ) pair**
  - **In terms of fluctuations around a given steady state**
  - **Steady-state levels of (τ^n, τ^s) depend on (η, χ) pair**

- **Interpretation: Ramsey government always ensures efficient labor-market fluctuations (v_t, s_t, θ_t)**
  - **By appropriately adjusting (τ^n, τ^s) over the business cycle**

DYNAMICS

		Ramsey		Exogenous Policy Benchmark		Data
		Calibration		Calibration		
		HM	0% and Hosios	HM		
Labor Tax Rate	Mean	11%	15%	22%		22%
	Rel SD	5.6	0	1.4		1.4
Market tightness (θ)	Rel SD	1.1	1.1	10.9		11.3
Vacancies	Rel SD	1.3	1.3	6.9		6.3
Unemployment	Rel SD	1.4	1.4	5.4		5.2
LFP	Rel SD	0.13	0.13	0.20		0.20
Real wage	Rel SD	0.50	1.1	0.28		0.52
Static wedge	SD (%)					
Intertemporal wedge	SD (%)					

Gertler and Trigari (2009 *JPE*)

DYNAMICS

- **Ramsey fluctuations IDENTICAL to efficient fluctuations for ANY (η, χ) pair**
  - **In terms of fluctuations around a given steady state**
  - **Steady-state levels of (τ^n, τ^s) depend on (η, χ) pair**

- **Interpretation: Ramsey government always ensures efficient labor-market fluctuations (v_t, s_t, θ_t)**
  - **By appropriately adjusting (τ^n, τ^s) over the business cycle**

- **Wedge dynamics?**
  - **Ramsey smooths both static wedge….**
  - **…and intertemporal wedge**

DYNAMICS

		Ramsey		Exogenous Policy Benchmark		Data
		Calibration		Calibration		
		HM	0% and Hosios	HM	0% and Hosios	
Labor Tax Rate	Mean	11%	15%	22%		22%
	Rel SD	5.6	0	1.4		1.4
Market tightness (θ)	Rel SD	1.1	1.1	10.9		11.3
Vacancies	Rel SD	1.3	1.3	6.9		6.3
Unemployment	Rel SD	1.4	1.4	5.4		5.2
LFP	Rel SD	0.13	0.13	0.20		0.20
Real wage	Rel SD	0.50	1.1	0.28		0.52
Static wedge	SD (%)	0.08	0	22.9	0.66	
Intertemporal wedge	SD (%)	0	0	12.3	0.63	

Gertler and Trigari (2009 *JPE*)

STATIC AND INTERTEMPORAL CONDITIONS

Static Condition

- **Efficiency characterized by**

$$\frac{h'(lfp_t)}{u'(c_t)} = \frac{\gamma m_s(s_t, v_t)}{m_v(s_t, v_t)} = \gamma\theta_t \frac{\xi}{1-\xi}$$

Intertemporal Condition

$$\frac{u'(c_t)}{\beta u'(c_{t+1})} = \frac{(1-\rho)\left(\frac{\gamma}{m_v(s_{t+1}, v_{t+1})}\right)\left(1 - m_s(s_{t+1}, v_{t+1})\right)}{\frac{\gamma}{m_v(s_t, v_t)} - z_t}$$

- **Decentralized equilibrium conditions characterized by**

$$\frac{h'(lfp_t)}{u'(c_t)} = \left[\frac{\chi(1-\xi)}{\gamma \cdot \xi \cdot \theta_t} + (1-\tau_t^n)(1-\tau_t^s)\frac{\eta(1-\xi)}{\xi(1-\eta)}\right]\gamma\theta_t \frac{\xi}{1-\xi}$$

= wedge between static MRS_t and static MRT_t

(Too complicated to gain any immediate intuition – see Section 6 and Appendix D)

To obtain zero static wedge in every period, need $\tau^n = \tau^s = 0$ in every period, $\eta = \xi$, $\chi = 0$

To obtain zero intertemporal wedge in every period, need $\tau^n = \tau^s = 0$ in every period, $\eta = \xi$, $\chi = 0$

CONCLUSIONS

- Labor tax smoothing not optimal in DSGE search and matching model
  - Calibrated to match key labor market dynamics under exogenous tax policy
  - Rigid real wage (delivered through Nash-Hosios bargaining as benchmark) the important feature of the model
- But wedge smoothing IS optimal
  - Basic Ramsey theory
- Ramsey fluctuations in allocations efficient regardless of calibration
- Welfare-relevant notions of wedges
  - Developing matching-model concepts of efficiency and MRTs for use in virtually any matching application
- Could think of "labor wedge" as featuring both static and intertemporal dimensions
  - Use as framework to empirically measure labor wedges?