

## Macroeconomics II, Lecture XIV: Course Summary and Q&A

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## This course

- **Business-cycle frameworks:** RBC, NK
- **Fricitional labor markets:** McCall, Burdett-Mortensen, DMP
- **Incomplete asset markets:** Consumption-savings dynamics, Aiyagari

- Summarize the course material, by putting these frameworks together in one model: a Heterogenous-Agent New-Keynesian model with Search And Matching frictions — a **HANK & SAM** model
- Use this “meta model” to understand some questions at the research frontier
- First: some history of >recent< ideas

- **Heterogeneous Agents New Keynesian** models: NK business cycle models with incomplete asset markets (and therefore household heterogeneity)
- Why interesting?
- Consider the vanilla RANK model:

$$\begin{aligned}\hat{i}_t &= \phi\pi_t + \nu_t \\ \pi_t &= \beta E_t \pi_{t+1} + \kappa \hat{y}_t \\ \hat{y}_t &= -(\hat{i}_t - E_t \pi_{t+1}) + E_t \hat{y}_{t+1}\end{aligned}$$

- What is the transmission mechanism of an MP shock?

- Extended representation of the vanilla RANK model:

$$\begin{aligned}\hat{i}_t &= \phi\pi_t + \nu_t \\ \pi_t &= \beta E_t \pi_{t+1} + \kappa \hat{y}_t \\ \hat{c}_t &= -(\hat{i}_t - E_t \pi_{t+1}) + E_t \hat{c}_{t+1} \\ \hat{c}_t &= \hat{y}_t\end{aligned}$$

- What is the transmission mechanism of an MP shock to output? Roughly:
  - ① Shock: nominal rate  $i_t$  up
  - ② Sticky prices: real rate  $\hat{i}_t - E_t \pi_{t+1}$  up
  - ③ Intertemporal substitution: consumption  $c_t$  down
  - ④ Market clearing: output  $y_t$  down

## HANK models: motivation

- Is intertemporal substitution a reasonable theory of fluctuations in aggregate demand?
  - ▶ Macro evidence: No (see, e.g., Yogo, REStat 2004; Canzoneri-Cumby-Dilba, JME 2007)
  - ▶ Micro evidence: Limited, but also no (see Best-Cloyne-Ilzetski-Kleven, REStud 2020)
- Even though evidence shows that wages, unemployment, financial wealth and income risk respond to monetary policy, these responses are close-to-irrelevant to the representative (PIH) households
- This is counterintuitive and at odds with what we know from the micro data
  - ▶ Recall lecture 12: surmounting evidence of high MPCs
- HANK models offer an alternative theory of aggregate demand

## HANK models

- HANK models replaces the representative (PIH) household with a distribution of households that faces limited insurance (as in Ayiagari)
  - ▶ Emphasizes building models of household consumption-saving decisions that are consistent with the rich heterogeneity seen in micro data
  - ▶ By so doing, they present a theory of aggregate demand that put fluctuations in household income, wealth, credit and risk at center stage
- Early contributions: Mckay-Reis (Ecmtra 2016); Guerrieri-Lorenzoni (AER 2017); Kaplan-Moll-Violante (AER 2018)
- Exploding literature, small excerpt of recent publications (most of it is still in the making):
  - ▶ **Transmission mechanisms:** Auclert (AER 2019); McKay-Wieland (Ecmtra 2021); Maxted-Holm-Laibson (QJE 2024 )
  - ▶ **Analytical frameworks:** Broer-Hansen-Krusell-Öberg (REStud 2020); Acharya-Challe-Dogra (AER 2023); Bilbiie (REStud 2025)
  - ▶ **Estimation/Identification:** Auclert-Rognlie-Straub (JPE 2024), Wolf (JPE 2025) Bayer-Born-Luetticke (AER 2024),
  - ▶ **Optimal policy:** Bhandari-Evans-Golosov-Sargent (Ecmtra 2021); Le Grand-{Martin-Baillon}-Ragot (REStud 2025)
  - ▶ **Evidence:** Cloyne-Ferriera-Surico (REStud 2020); Holm-Paul-Tischbirek (JPE 2021); Patterson (AER 2023)

# The Unemployment Risk Channel

- One channel that has attracted much attention: **Unemployment-risk channel (URC)**
- In response to some contractionary shock:
  - ① **Households:** Unemployment ↑  
⇒ precautionary saving ↑  
⇒ goods demand ↓
  - ② **Firms:** Goods demand ↓  
⇒ labor demand ↓  
⇒ unemployment ↑
- Generates a demand-driven multiplier
  - ① *Inefficient* amplification & propagation
  - ② May be mitigated with targeted fiscal policy
- To evaluate the implications of this channel, we need a HANK model with endogenous unemployment dynamics: a **HANK-SAM** model

## HANK-SAM models, some examples

- **Ravn-Sterk (JME 2017; JEEA 2021), Rendahl-Riegler-Den Haan (JEEA 2019):** HANK-SAM interaction is a source of amplification
- **McKay-Reis (Ecmtra 2016; REStud 2021), Kekre (REStud 2024):** HANK-SAM interaction raises the value of automatic stabilizers (esp unempl. insurance)
- **Challe (AEJmacro 2020):** HANK-SAM interaction changes optimal monetary policy
- **Broer-Druedahl-Harmenberg-Öberg (2025):** A unified framework to evaluate the cost-effectiveness of different fiscal stabilization policies

## Research question

Which fiscal policies are most cost effective in stabilizing unemployment?

## Motivation

Resurgence of countercyclical fiscal policies as stabilization tool

- Government: expenditures
- Households: cash transfers + UI increases and extensions
- Firms: retention and hiring subsidies

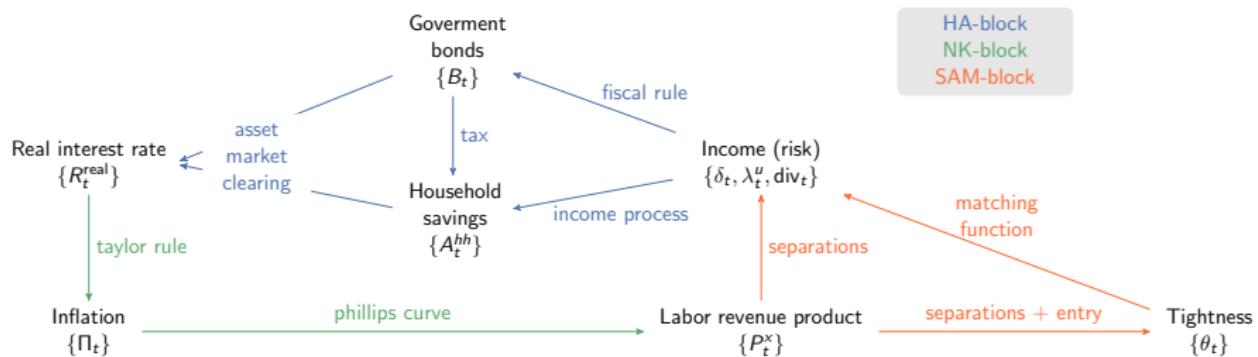
## Approach

Compute fiscal multipliers for different fiscal policies in an **HANK-SAM** model with empirically grounded interaction between firm hiring-and-firing decisions and consumption-saving decisions of households.

# Our Model

- **Households:**
  - ① **Workers:** can be *employed* or *unemployed*
    - ★ Employed: Earn fixed real wage  $W$ , pay labor income taxes
    - ★ Unemployed: enjoy UI benefits
  - ② **Capitalists:** collect all firm profits, do not work, risk neutral
- **Producers:**
  - ① **Intermediate good producers**
    - ★ Labor  $\Rightarrow$  intermediate goods
    - ★ Frictional labor market, CRS matching function
    - ★ Sluggish vacancy posting due to idiosyncratic stochastic entry cost
    - ★ Separations due to idiosyncratic stochastic continuation cost
  - ② **Wholesale producers**
    - ★ Intermediate goods  $\Rightarrow$  differentiated goods
    - ★ Monopolistic competition + Rotemberg price adjustment costs
  - ③ **Final producers**
    - ★ Differentiated goods  $\Rightarrow$  final good
    - ★ Perfect competition
- **Government:**
  - ① Sets interest rate according to Taylor rule
  - ② collects taxes, pays UI, issues debt
  - ③ Today: focus on household transfer spending shocks (cash transfers + UI increases and extensions)

# Equilibrium as a Directed Cycle Graph

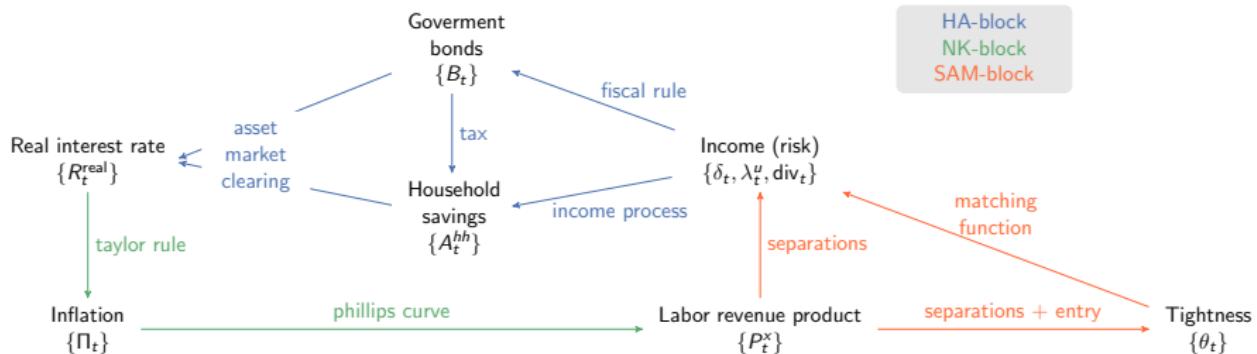


To a first order, the equilibrium can be written as

$$\begin{aligned}
 r^{real} &= M_{HA} inc + M_{d,r} d, \\
 p^x &= M_{NK} r^{real}, \\
 inc &= M_{SAM} p^x,
 \end{aligned}$$

and can thus be represented by a *directed cycle graph*.

# Equilibrium as a Directed Cycle Graph: solution



To a first order, the solution is given by

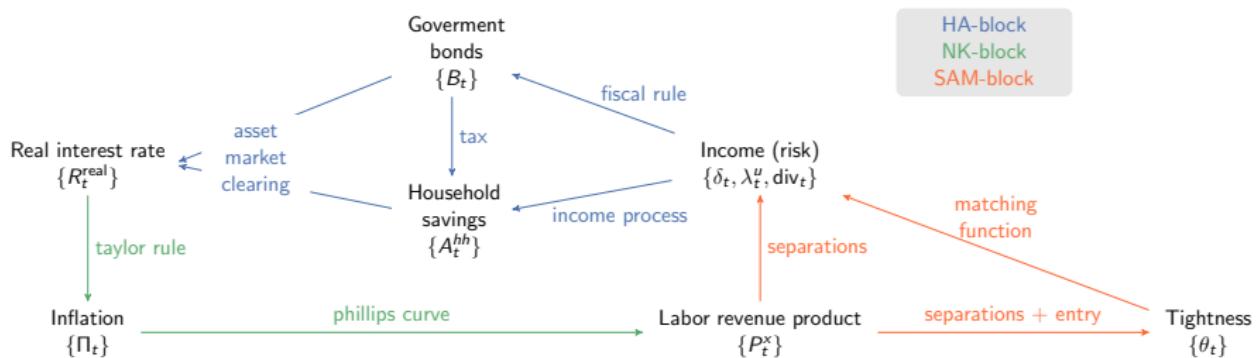
$$inc = \underbrace{\mathcal{G}}_{\text{GE effect}} \times M_{SAM} M_{NK} \underbrace{M_{d,r} d}_{\text{direct}},$$

first round PE effect

where

$$\mathcal{G} = (I - M_{SAM} M_{NK} M_{HA})^{-1}.$$

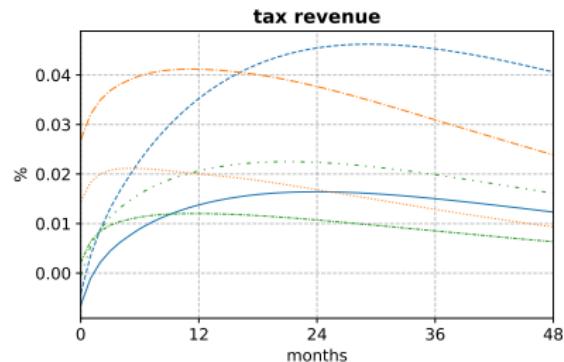
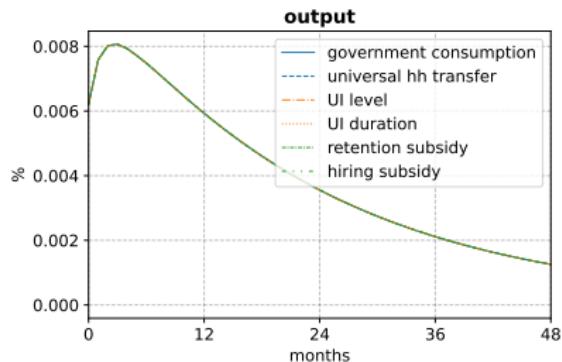
# Equilibrium as a Directed Cycle Graph: implications



Implies:

- ① GE amplification decomposed into three (HA-NK-SAM) blocks, admits partial identification
- ② Direct effects sufficient for policy comparison
- ③ Relative multiplier of different policies invariant to parameter outside HA block

## Policy paths and fiscal costs



- Baseline policy: Persistent  $\mathbf{G}$  shock ( $\rho_G = 0.965$ ).
- Other policies chosen to yield identical output paths
- Yet, starkly different paths of tax revenues  $\Rightarrow$  different multipliers

## Fiscal multipliers relative to **G**

| G [level]  | HH transfers |       |          | Firm subsidies |      |
|------------|--------------|-------|----------|----------------|------|
|            | Transfer     | Level | Duration | Retain         | Hire |
| 1.0 [0.99] | 0.28         | 0.44  | 1.03     | 1.64           | 0.72 |

- Fiscal Multiplier =  $\frac{\sum output_t}{\sum spending_t}$
- Strong dispersion in multipliers.
- Retention subsidies most, universal transfers least stimulative

## Determinants of fiscal multipliers

- Identify determinants by reducing frictions one-by-one

## Determinants of fiscal multipliers

| G [level]                         | Household transfers |        | Firm transfers |        |      |
|-----------------------------------|---------------------|--------|----------------|--------|------|
|                                   | Transfer            | Level  | Duration       | Retain | Hire |
| 1. Baseline                       | 1.0                 | [0.99] | 0.28           | 0.44   | 1.03 |
| 2. Less sticky $P$ ( $\phi=178$ ) |                     |        |                |        |      |
| 3. Reactive mp ( $\delta_\pi=2$ ) |                     |        |                |        |      |
| 4. Representative agent           |                     |        |                |        |      |
| 5. Fewer HtM (17.4%)              |                     |        |                |        |      |
| 6. Reactive tax ( $\omega=0.10$ ) |                     |        |                |        |      |
| 7. Ex. separations ( $\psi=0$ )   |                     |        |                |        |      |
| 8. Free entry ( $\xi=\infty$ )    |                     |        |                |        |      |
| 9. Wage rule ( $\eta_e=0.50$ )    |                     |        |                |        |      |
| 10. 95% of div. to PIH            |                     |        |                |        |      |

## Benchmark **G** multiplier

| G [level]                         | Household transfers |        | Firm transfers |        |      |
|-----------------------------------|---------------------|--------|----------------|--------|------|
|                                   | Transfer            | Level  | Duration       | Retain | Hire |
| 1. Baseline                       | 1.0                 | [0.99] | 0.28           | 0.44   | 1.03 |
| 2. Less sticky $P$ ( $\phi=178$ ) | 1.0                 | [0.61] |                |        |      |
| 3. Reactive mp ( $\delta_\pi=2$ ) | 1.0                 | [0.64] |                |        |      |
| 4. Representative agent           | 1.0                 | [0.54] |                |        |      |
| 5. Fewer HtM (17.4%)              | 1.0                 | [0.80] |                |        |      |
| 6. Reactive tax ( $\omega=0.10$ ) | 1.0                 | [0.84] |                |        |      |
| 7. Ex. separations ( $\psi=0$ )   | 1.0                 |        |                |        |      |
| 8. Free entry ( $\xi=\infty$ )    | 1.0                 |        |                |        |      |
| 9. Wage rule ( $\eta_e=0.50$ )    | 1.0                 |        |                |        |      |
| 10. 95% of div. to PIH            | 1.0                 |        |                |        |      |

- Government-consumption multipliers increase with ...
  - ▶ Nominal rigidity, passive MP, debt-financing, less-Ricardian HHs (Auclert et al 2024, Hagedorn et al 2023)

## Benchmark **G** multiplier

| G [level]                         | Household transfers |       | Firm transfers |        |      |
|-----------------------------------|---------------------|-------|----------------|--------|------|
|                                   | Transfer            | Level | Duration       | Retain | Hire |
| 1. Baseline                       | 1.0 [0.99]          | 0.28  | 0.44           | 1.03   | 1.64 |
| 2. Less sticky $P$ ( $\phi=178$ ) | 1.0 [0.61]          |       |                |        |      |
| 3. Reactive mp ( $\delta_\pi=2$ ) | 1.0 [0.64]          |       |                |        |      |
| 4. Representative agent           | 1.0 [0.54]          |       |                |        |      |
| 5. Fewer HtM (17.4%)              | 1.0 [0.80]          |       |                |        |      |
| 6. Reactive tax ( $\omega=0.10$ ) | 1.0 [0.84]          |       |                |        |      |
| 7. Ex. separations ( $\psi=0$ )   | 1.0 [0.13]          |       |                |        |      |
| 8. Free entry ( $\xi=\infty$ )    | 1.0 [0.54]          |       |                |        |      |
| 9. Wage rule ( $\eta_e=0.50$ )    | 1.0 [0.73]          |       |                |        |      |
| 10. 95% of div. to PIH            | 1.0 [0.82]          |       |                |        |      |

- Government-consumption multiplier increases with ...
  - ▶ Nominal rigidity, passive MP, debt-financing, less-Ricardian HHs
  - ▶ SAM frictions, wage rigidity, MPC o/o profits

## Relative HH-transfer multipliers: non-HA frictions

| G [level]                         |            | Household transfers |       | Firm transfers |        |
|-----------------------------------|------------|---------------------|-------|----------------|--------|
|                                   |            | Transfer            | Level | Duration       | Retain |
| 1. Baseline                       | 1.0 [0.99] | 0.28                | 0.44  | 1.03           |        |
| 2. Less sticky $P$ ( $\phi=178$ ) | 1.0 [0.61] | 0.30                | 0.47  | 1.03           |        |
| 3. Reactive mp ( $\delta_\pi=2$ ) | 1.0 [0.64] | 0.30                | 0.47  | 1.03           |        |
| 4. Representative agent           | 1.0 [0.54] | 0.00                | 0.00  | 0.00           |        |
| 5. Fewer HtM (17.4%)              | 1.0 [0.80] | 0.19                | 0.41  | 1.11           |        |
| 6. Reactive tax ( $\omega=0.10$ ) | 1.0 [0.84] | 0.19                | 0.40  | 1.10           |        |
| 7. Ex. separations ( $\psi=0$ )   | 1.0 [0.13] | 0.35                | 0.52  | 1.02           |        |
| 8. Free entry ( $\xi=\infty$ )    | 1.0 [0.54] | 0.31                | 0.47  | 1.03           |        |
| 9. Wage rule ( $\eta_e=0.50$ )    | 1.0 [0.73] | 0.29                | 0.46  | 1.03           |        |
| 10. 95% of div. to PIH            | 1.0 [0.82] | 0.28                | 0.43  | 0.99           |        |

- Relative HH transfer multipliers  $\approx$  unaffected by non-HA frictions

## Relative HH-transfer multipliers: HA frictions

|                                   | G [level]  | Household transfers |       |          | Firm transfers |      |
|-----------------------------------|------------|---------------------|-------|----------|----------------|------|
|                                   |            | Transfer            | Level | Duration | Retain         | Hire |
| 1. Baseline                       | 1.0 [0.99] | 0.28                | 0.44  | 1.03     | 1.64           | 0.72 |
| 2. Less sticky $P$ ( $\phi=178$ ) | 1.0 [0.61] | 0.30                | 0.47  | 1.03     |                |      |
| 3. Reactive mp ( $\delta_\pi=2$ ) | 1.0 [0.64] | 0.30                | 0.47  | 1.03     |                |      |
| 4. Representative agent           | 1.0 [0.54] | 0.00                | 0.00  | 0.00     |                |      |
| 5. Fewer HtM (17.4%)              | 1.0 [0.80] | 0.19                | 0.41  | 1.11     | 1              |      |
| 6. Reactive tax ( $\omega=0.10$ ) | 1.0 [0.84] | 0.19                | 0.40  | 1.10     |                |      |
| 7. Ex. separations ( $\psi=0$ )   | 1.0 [0.13] | 0.35                | 0.52  | 1.02     |                |      |
| 8. Free entry ( $\xi=\infty$ )    | 1.0 [0.54] | 0.31                | 0.47  | 1.03     |                |      |
| 9. Wage rule ( $\eta_e=0.50$ )    | 1.0 [0.73] | 0.29                | 0.46  | 1.03     |                |      |
| 10. 95% of div. to PIH            | 1.0 [0.82] | 0.28                | 0.43  | 0.99     |                |      |

- Ricardian households: zero transfer multipliers
- Lower MPC lowers transfer multipliers & raises duration multiplier
- Same holds for more tax financing

## Relative firm-subsidy multipliers: non-SAM frictions

|                                   | G [level]  | Household transfers |       |          | Firm transfers |             |
|-----------------------------------|------------|---------------------|-------|----------|----------------|-------------|
|                                   |            | Transfer            | Level | Duration | Retain         | Hire        |
| 1. Baseline                       | 1.0 [0.99] | 0.28                | 0.44  | 1.03     | <b>1.64</b>    | <b>0.72</b> |
| 2. Less sticky $P$ ( $\phi=178$ ) | 1.0 [0.61] | 0.30                | 0.47  | 1.03     | <b>3.43</b>    | <b>1.15</b> |
| 3. Reactive mp ( $\delta_\pi=2$ ) | 1.0 [0.64] | 0.30                | 0.47  | 1.03     | <b>3.33</b>    | <b>1.13</b> |
| 4. Representative agent           | 1.0 [0.54] | 0.00                | 0.00  | 0.00     | <b>1.92</b>    | <b>0.57</b> |
| 5. Fewer HtM (17.4%)              | 1.0 [0.80] | 0.19                | 0.41  | 1.11     | <b>1.80</b>    | <b>0.69</b> |
| 6. Reactive tax ( $\omega=0.10$ ) | 1.0 [0.84] | 0.19                | 0.40  | 1.10     | <b>1.70</b>    | <b>0.67</b> |
| 7. Ex. separations ( $\psi=0$ )   | 1.0 [0.13] | 0.35                | 0.52  | 1.02     | 1.39           | 3.38        |
| 8. Free entry ( $\xi=\infty$ )    | 1.0 [0.54] | 0.31                | 0.47  | 1.03     | 1.50           | 1.21        |
| 9. Wage rule ( $\eta_e=0.50$ )    | 1.0 [0.73] | 0.29                | 0.46  | 1.03     | 1.55           | 0.74        |
| 10. 95% of div. to PIH            | 1.0 [0.82] | 0.28                | 0.43  | 0.99     | 0.72           | 0.16        |

- Relative multipliers of subsidies  $\approx$  unaffected by non-SAM frictions
- Less nominal rigidity: subsidies more effective wrt HH transfers/G

## Relative firm-subsidy multipliers: SAM frictions

|                                   | G [level]  | Household transfers |       | Firm transfers |        |      |
|-----------------------------------|------------|---------------------|-------|----------------|--------|------|
|                                   |            | Transfer            | Level | Duration       | Retain | Hire |
| 1. Baseline                       | 1.0 [0.99] | 0.28                | 0.44  | 1.03           | 1.64   | 0.72 |
| 2. Less sticky $P$ ( $\phi=178$ ) | 1.0 [0.61] | 0.30                | 0.47  | 1.03           | 3.43   | 1.15 |
| 3. Reactive mp ( $\delta_\pi=2$ ) | 1.0 [0.64] | 0.30                | 0.47  | 1.03           | 3.33   | 1.13 |
| 4. Representative agent           | 1.0 [0.54] | 0.00                | 0.00  | 0.00           | 1.92   | 0.57 |
| 5. Fewer HtM (17.4%)              | 1.0 [0.80] | 0.19                | 0.41  | 1.11           | 1.80   | 0.69 |
| 6. Reactive tax ( $\omega=0.10$ ) | 1.0 [0.84] | 0.19                | 0.40  | 1.10           | 1.70   | 0.67 |
| 7. Ex. separations ( $\psi=0$ )   | 1.0 [0.13] | 0.35                | 0.52  | 1.02           | 1.39   | 3.38 |
| 8. Free entry ( $\xi=\infty$ )    | 1.0 [0.54] | 0.31                | 0.47  | 1.03           | 1.50   | 1.21 |
| 9. Wage rule ( $\eta_e=0.50$ )    | 1.0 [0.73] | 0.29                | 0.46  | 1.03           | 1.55   | 0.74 |
| 10. 95% of div. to PIH            | 1.0 [0.82] | 0.28                | 0.43  | 0.99           | 0.72   | 0.16 |

- Hiring subsidy more effective with higher entry/lower separation elasticity
- Lower MPC o/o profits weakens both subsidies