Macroeconomics II: Course Summary

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What have we covered?

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

Today

- Apart from the RBC extensions, we have focused on the "vanilla" versions of these frameworks in isolation
- Today: attempt to summarize the course material, by means of showing how these frameworks can be put together and are used for quantitative research
- In particular, we will outline a business cycle model with sticky prices, incomplete asset markets and a frictional labor market: a **HANK-SAM Model**

HANK models

- **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?

HANK models

- Extended representation of the vanilla RANK model:

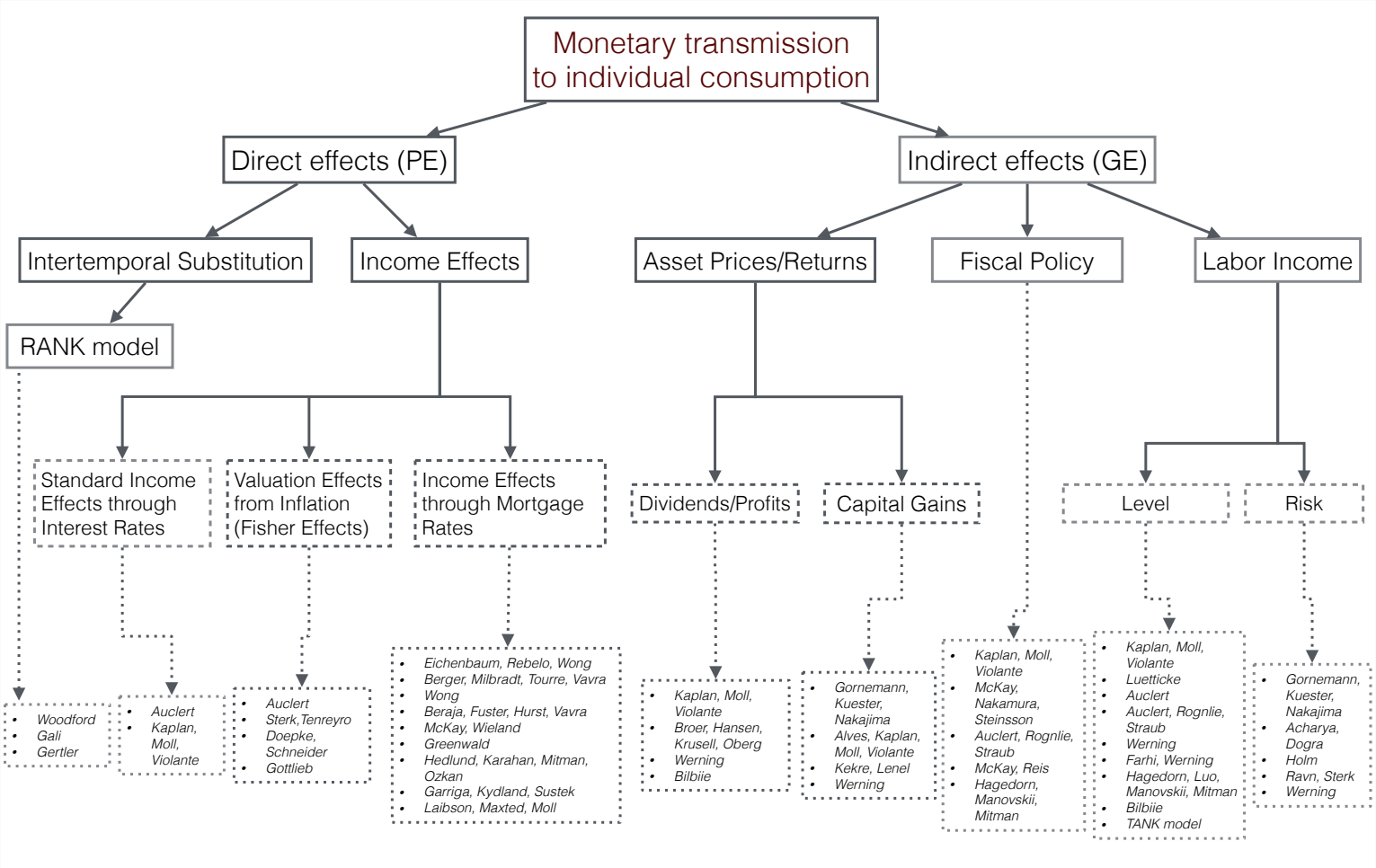
$$\begin{aligned}
\hat{i}_t &= \phi\pi_t + \nu_t \\
\pi_t &= \beta E_t\pi_{t+1} + \kappa\hat{y}_t \\
\hat{c}_t &= -(\hat{i}_t - E_t\pi_{t+1}) + E_t\hat{c}_{t+1} \\
\hat{c}_t &= \hat{y}_t
\end{aligned}$$

- 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 really 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, e.g., Best-Cloyne-Ilzetski-Kleven, REStud 2020)
- Even though income, financial wealth and income risk might respond to monetary policy as well, this has close to no impact on the consumption decisions of well-insured households
  - Recall lecture 10: well-insured households behaves according to PIH
- This is counterintuitive and at odds with what we know from the micro data
- HANK models offer an alternative theory of aggregate demand

HANK models: new transsmission mechanisms



Taken from Ben Moll's website

The Unemployment Risk Channel

- One channel that has attracted much attention: **Unemployment-risk channel (URC)**
  1. **Households:** Unemployment ↑
     ⇒ precautionary saving ↑
     ⇒ goods demand ↓
  2. **Firms:** Goods demand ↓
     ⇒ labor demand ↓
     ⇒ unemployment ↑
- Generates a 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: **HANK-SAM models**

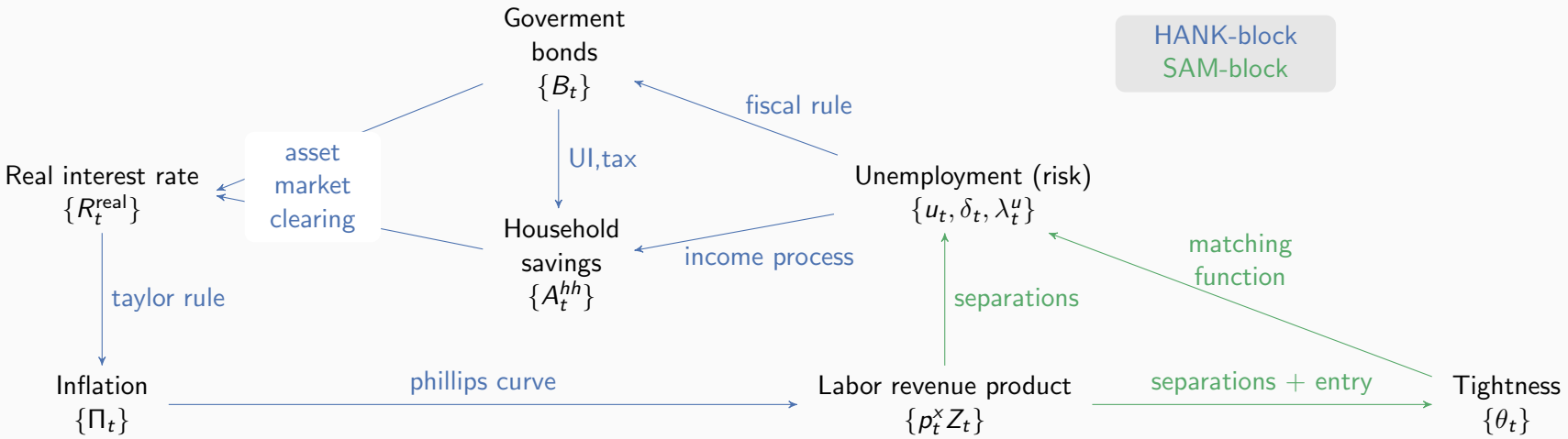
HANK-SAM models

- **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 forthc):** 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 (no paper yet):** A unified framework to evaluate the cost-effectiveness of different fiscal stabilization policies
- To illustrate some of these points, I will employ a (slightly simplified) version of the framework in BDHÖ

A HANK-SAM 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:** Sets the nominal interest rate, collects taxes, issues debt

Graphical model overview

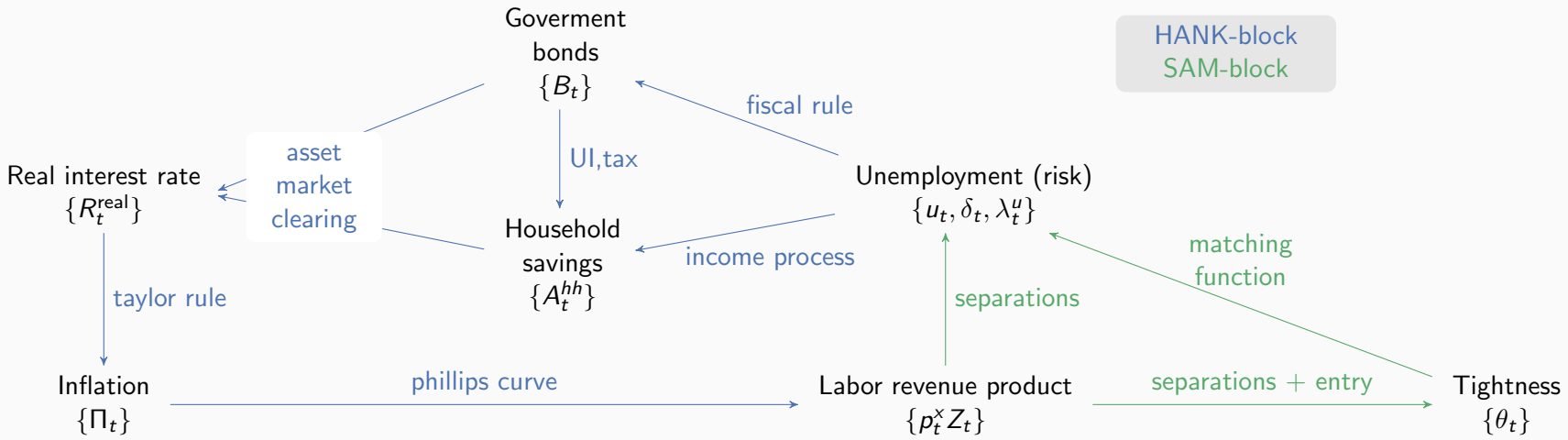


- Consider an exogenous path of TFP $\boldsymbol{z} = [z_0, z_1, ...]$
- To a first-order approximation, the equilibrium is summarized by

  1. **A SAM-block response**: $\boldsymbol{u} = M_{SAM}(\boldsymbol{p^x} + \boldsymbol{z})$

     u is the path of unemployment *and* the labor-market flows

Graphical model overview



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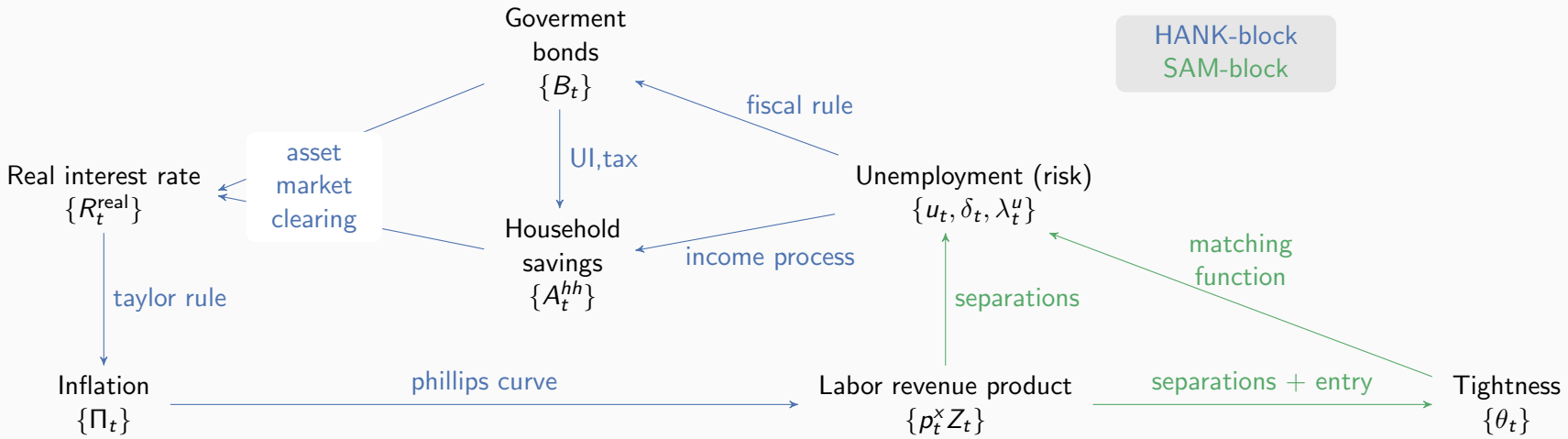
  2. **An HA-block response**: $\boldsymbol{R^{real}} = M_{HA}\boldsymbol{u}$

Graphical model overview



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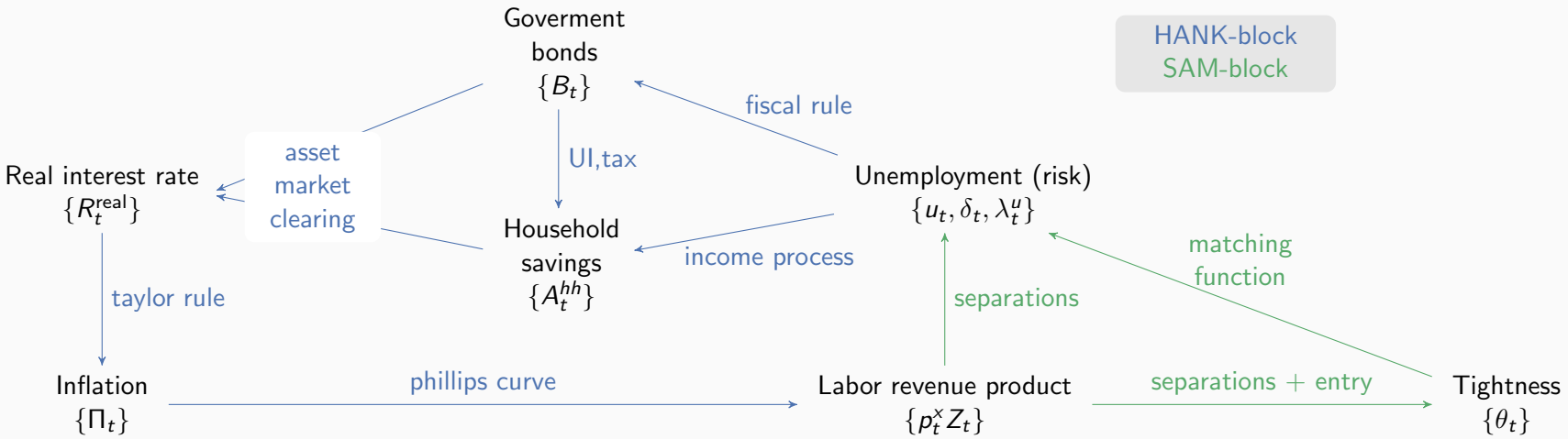
  2. **An HA-block response**: $\boldsymbol{R^{real}} = M_{HA}\boldsymbol{u}$
  3. **An NK-block response**: $\boldsymbol{p^x} = M_{NK}\boldsymbol{R^{real}}$

The multiplier process



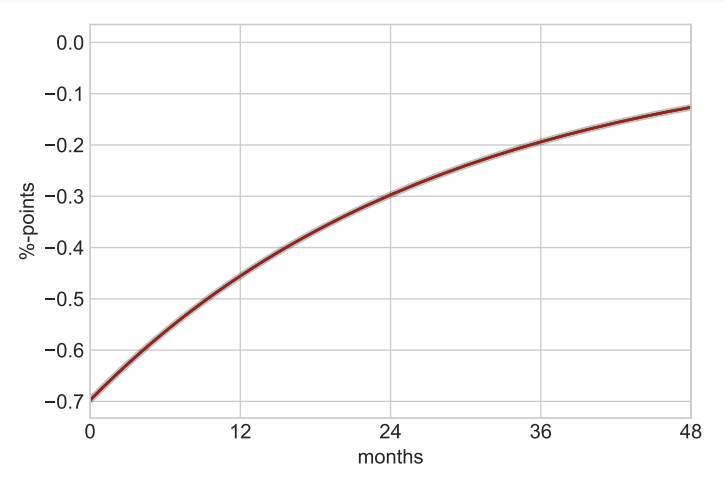
- **Proposition:** Model solution is given by

$$\boldsymbol{u} = (I - M_{\text{SAM}} M_{\text{NK}} M_{\text{HA}})^{-1} M_{SAM} \mathbf{z}$$

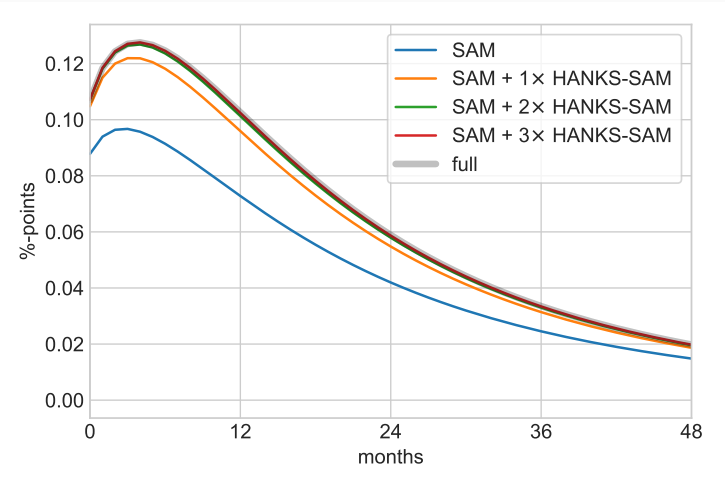
1. $(I - M_{\text{SAM}} M_{\text{NK}} M_{\text{HA}})^{-1}$ captures a repeated **demand-driven** multiplier process generating the equilibrium response to the shock
2. The direct (first-round) response $\boldsymbol{u} = M_{SAM}\mathbf{z}$ is also the response with *flexible prices* (no demand-loop)

The multiplier process: illustration

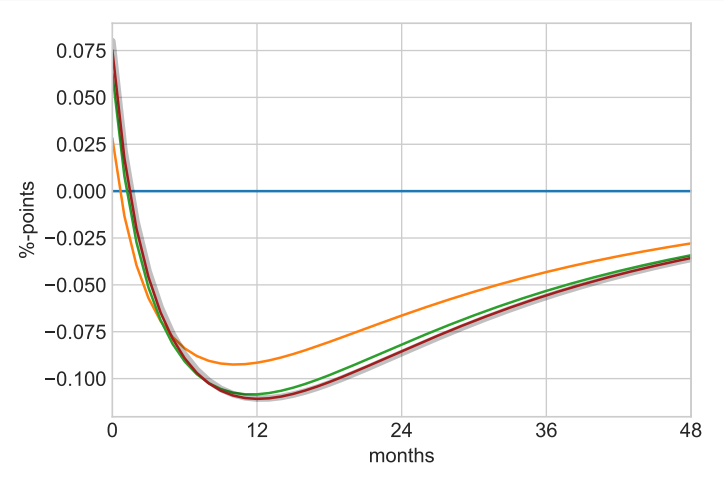
TFP, Z_t



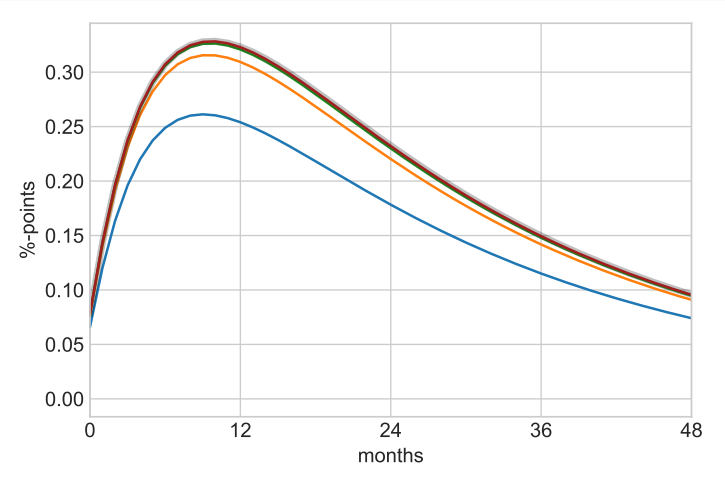
Unemployment Risk, $URISK_t$



Intermediate goods price, P_t^x



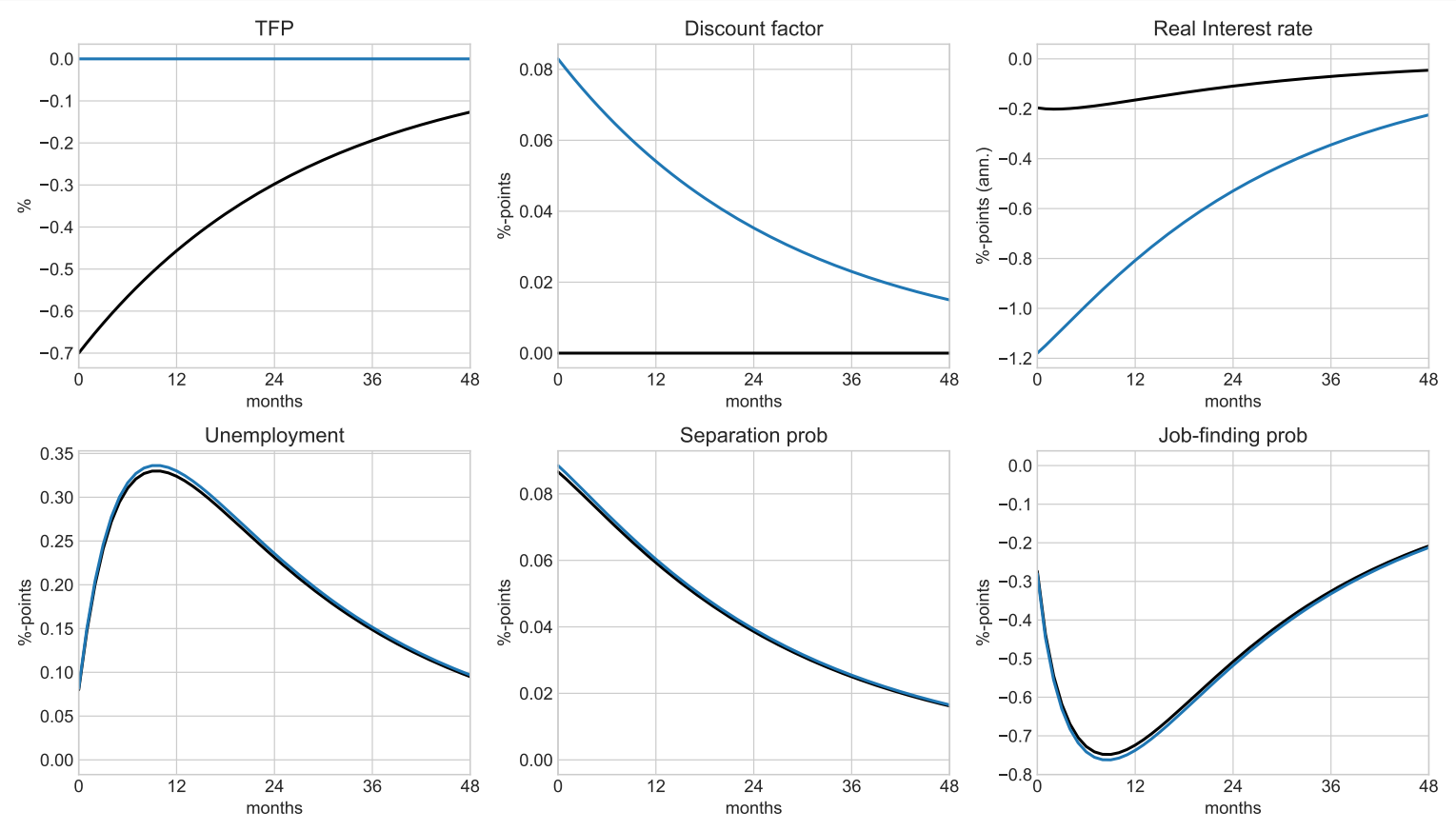
Unemployment, U_t



Equivalence of demand and supply shocks

- **Proposition:** The impulse responses for labor-market variables to a shock to TFP (supply) and to the discount factor of workers (demand) are equivalent up to a scaling factor.
- Interesting, because IRFs of labor market variables to TFP and MP shocks look very similar in the data (at odds with vanilla NK model!)

Equivalence of shocks in the model: illustration

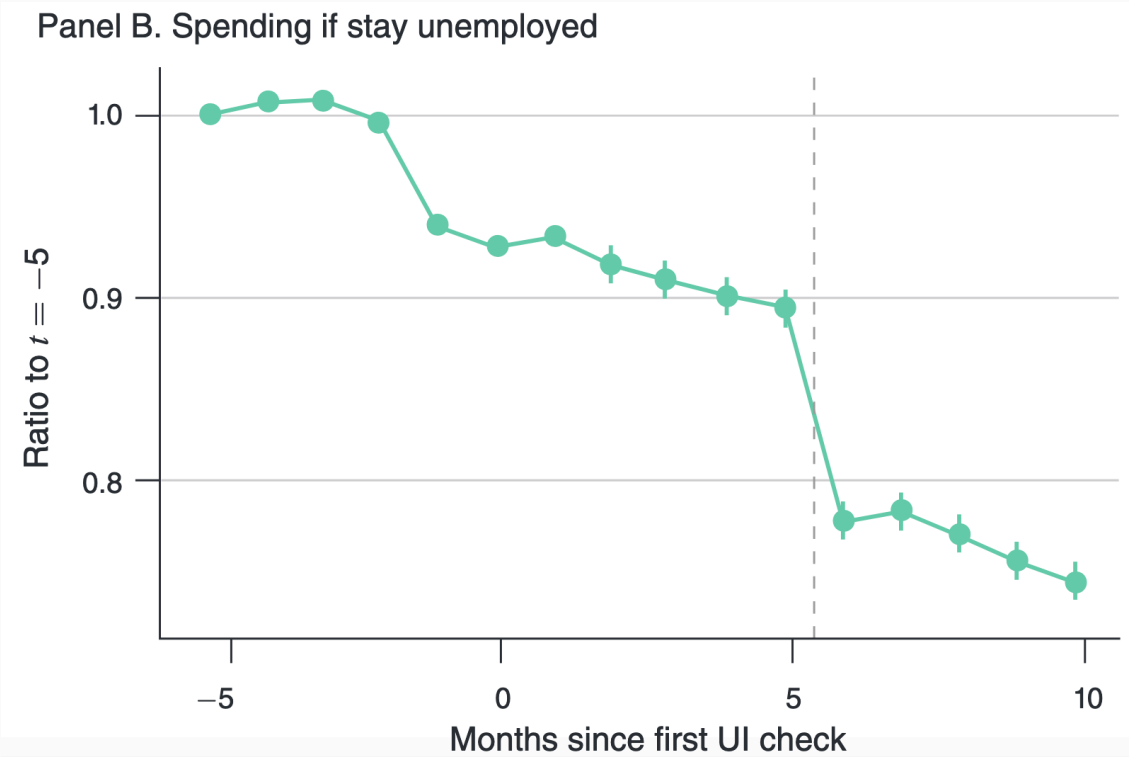


Our calibration approach

- **Calibrate HA block** so consumption-saving of households match evidence on
  1. Fall in consumption in response to unemployment
  2. Fall in consumption in response to unemployment-benefit expiration
  3. Marginal propensity to consume (not targeted but in line with data)
- **Calibrate SAM block** so firing-hiring of firms match evidence on
  1. Relative timing of the peak for the separation rate and the trough for the job-finding rate
  2. Contribution of separation and the job-finding rate to unemployment dynamics

Consumption effects of unemployment

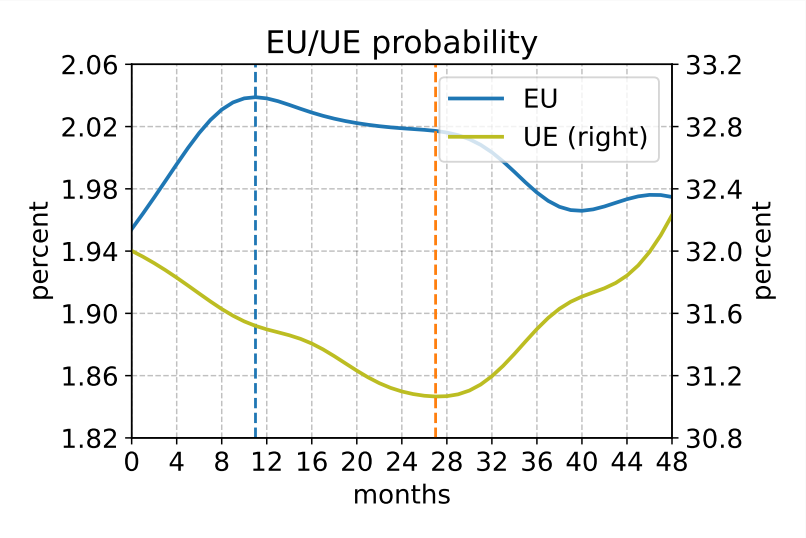
- **Stylized fact #1:** Consumption ~20% lower for unemployed (Chodorow-Reich-Karabarbounis, 2016)
- **Stylized fact #2:** Drop at UI exhaustion of ~45% of income drop (Ganong-Noel, 2019)



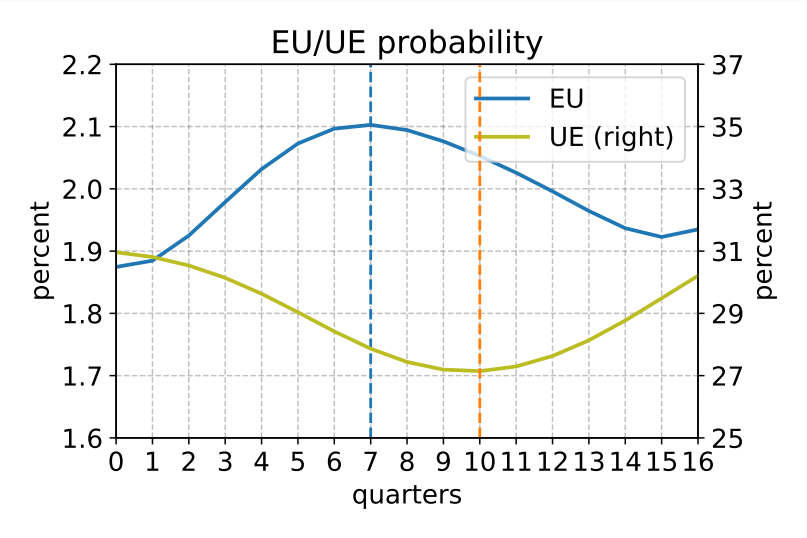
Source: Ganong-Noel (2019)

Separation rate leads job-finding rate

Monetary policy shock



Technology shock



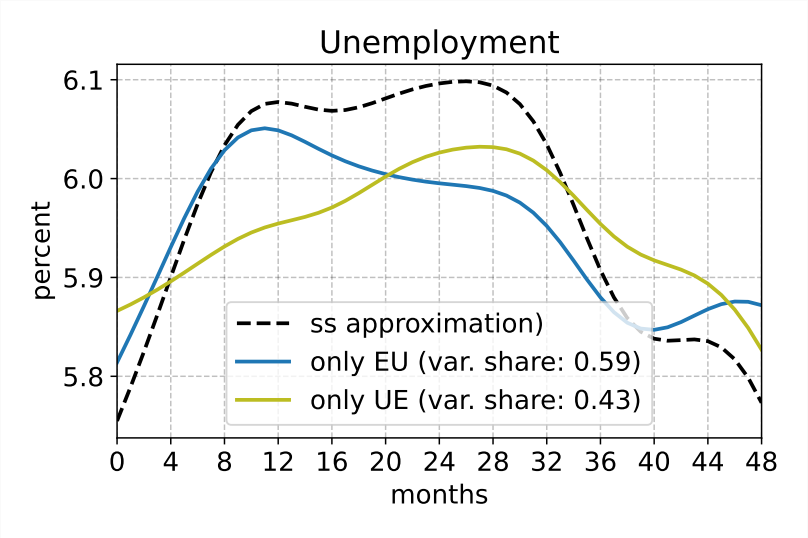
Source: CPS 1967-2020; Romer-Romer MP shock; Fernald TFP shock.

- **Stylized Fact #3:**
  Separation rate leads job-finding rate by 9-16 months

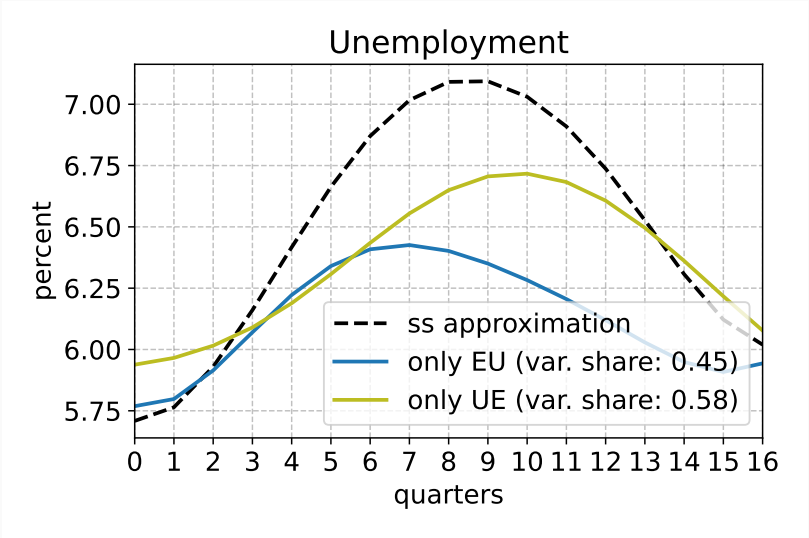
- Also true for *uncertainty shocks* (Oh-Picco, 2020)

Separation rate explains substantial share of unemployment

Monetary policy shock



TFP shock



Source: CPS 1967-2020; Romer-Romer MP shock; Fernald TFP shock.

- **Stylized Fact #4:**
  Separations account for 40-60 percent of unemployment response

- Also true for *uncertainty shocks* (Oh-Picco, 2020)

To explain separation rate response, our model has elastic job destruction

- **Job value:**

$$V_t^j = P_t^x Z_t - W + \beta \mathbb{E}_t \left[(1 - \delta_{t+1})(V_{t+1}^j - \mu_{t+1}) \right]$$

  - TFP: Z_t
  - Real output price: P_t^x
  - Wage: W
  - Separation rate: δ_t
  - Continuation cost: μ_t
- **Firms draw continuation cost** $\chi_t \sim G$: mixture of point-mass and Pareto
- **Implied separation rate:**

$$\delta_t = \delta_{ss} \left(\frac{V_t^j}{V_{ss}^j} \right)^{-\psi}$$

- **Exogenous separation limit:** $\psi \to 0$

To explain job-finding rate response, our model has inelastic job creation

- **Vacancy value:**

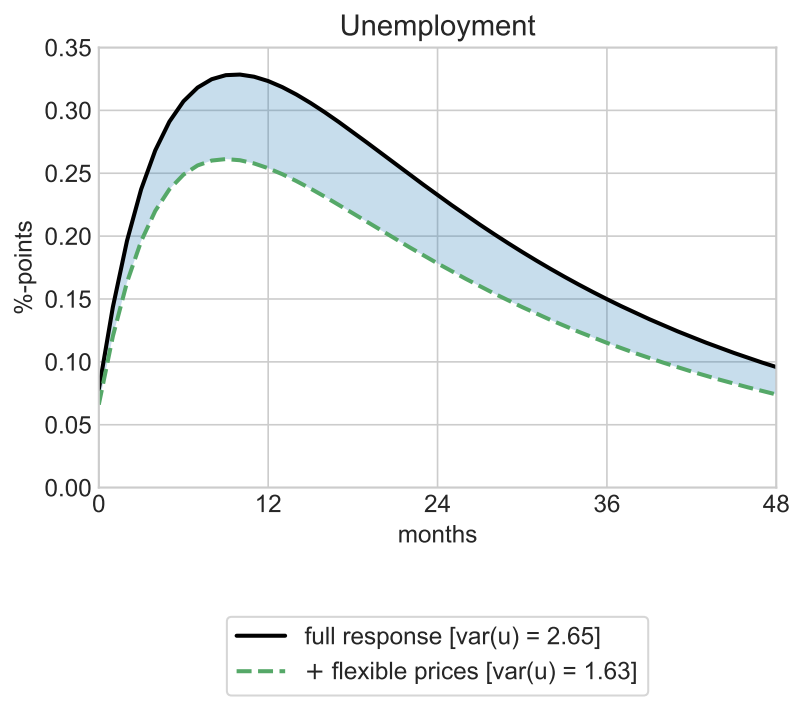
$$V_t^v = -\kappa + \lambda_t^v V_t^j + (1 - \lambda_t^v)\beta \mathbb{E}_t \left[V_{t+1}^v \right]$$

  - Vacancy posting cost: κ
  - Job-filling rate: λ_t^v
- **Firms draw entry cost $c \sim H$:** exponential distribution
- **Implied entry**

$$\iota_t = \iota_{ss} \left(\frac{V_t^v}{V_{ss}^v} \right)^{\frac{1}{\xi}}$$

- **Free entry model:** $\xi \to \infty$, $V_{ss}^v \to 0$
  (Only $\xi \to \infty$: Fixed homogenous entry cost)

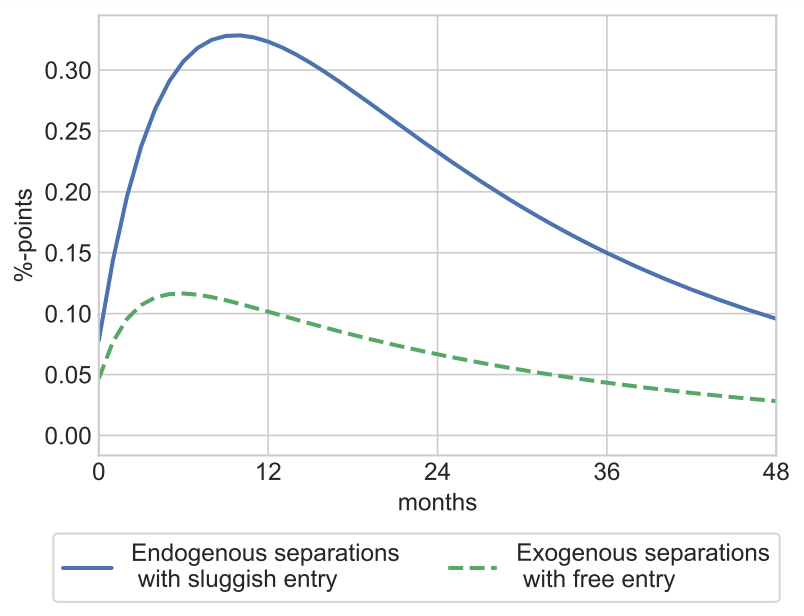
Demand externality matters only with active URC



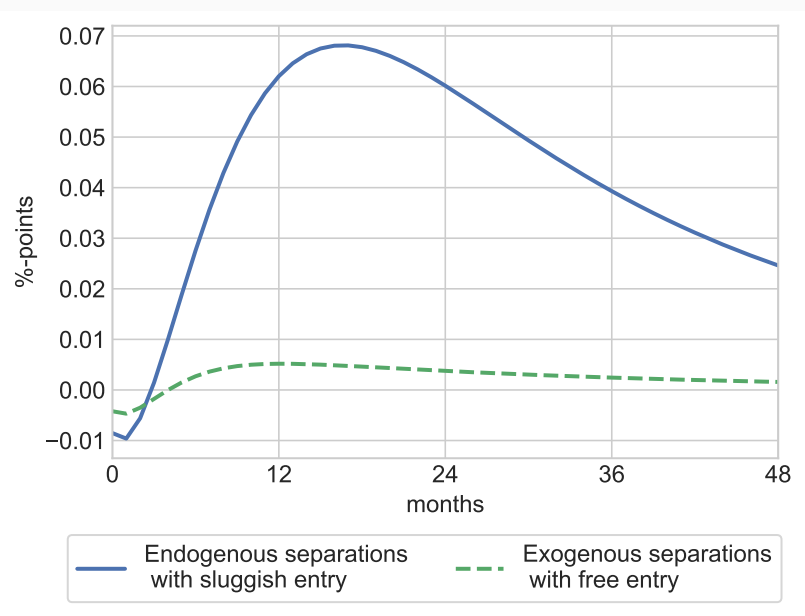
- **Baseline with incomplete markets:** substantial amplification with sticky prices
- **With complete markets**: only aggregate income path matters; sticky prices make little difference

Substantial amplification due to elastic firing and inelastic hiring

Unemployment



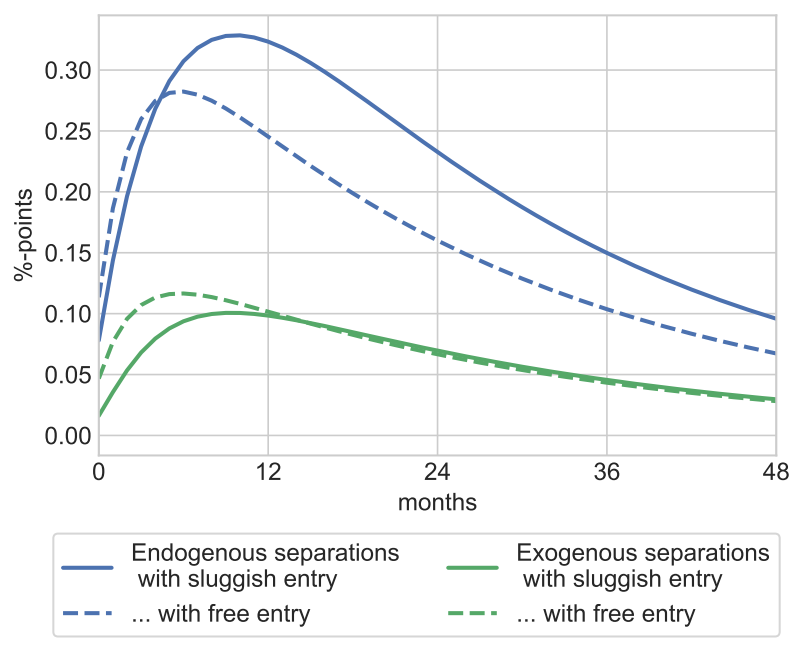
Unemployment gap (com. mkts)



- **Standard HANK-SAM** (exo. sep., free entry):
  1. Much smaller unemployment response

Interaction of elastic firing and inelastic hiring

Unemployment



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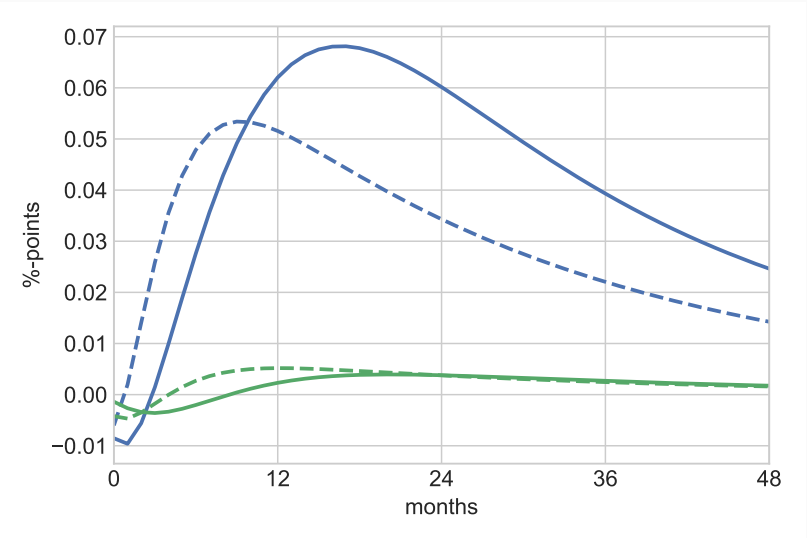

1. **Endogenous separations** always amplifies
2. **Sluggish entry** *only amplifies with endogenous separations*
   - With limited entry response, newly separated *deplete the current vacancy stock*
   - ⇒Higher separation rate causes lower job-finding rate

Back to the litterature

- **Ravn-Sterk (JME 2017; JEEA 2021), Rendahl-Riegler-Den Haan (JEEA 2019):** HANK-SAM interaction is a source of amplification
  - These models typically features a large demand-driven multiplier
- **McKay-Reis (Ecmtra 2016; REStud 2021), Kekre (REStud forthc):** HANK-SAM interaction raises the value of automatic stabilizers (esp unempl. insurance)
  - The demand-driven multiplier stems from limited insurance to unemployment risk
- **Challe (AEJmacro 2020):** HANK-SAM interaction changes optimal monetary policy
  - The demand-driven multiplier changes the trade-off between stabilizing inflation and output

Back to the litterature

- **Broer-Druedahl-Harmenberg-Öberg (no paper yet):** A unified framework to evaluate the cost-effectiveness of different fiscal stabilization policies
  - Commonly used labor-market policies (e.g. retention policies, hiring subsidies) may be very effective macroeconomic stabilization tools
  - Whether labor-market policies are preferable over UI (and other fiscal polciies) depend very much on the elasticity of job creation and job destruction
  - We need more micro-level evidence on these elasticities