

# The Labor Demand and Labor Supply Channels of Monetary Policy

Sebastian Graves<sup>1</sup>, Christopher Huckfeldt<sup>2</sup>, and Eric Swanson<sup>3</sup>

<sup>1</sup>University of Cambridge

<sup>2</sup>Federal Reserve Board

<sup>3</sup>UC Irvine & NBER

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Conference on Global Monetary Policy and Inflation

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## Labor supply response to monetary policy

- ▶ Conventional wisdom: monetary policy affects employment through **labor demand**
  - ▶ Little role (if any!) for **labor supply**
- ▶ Typical NK model abstracts from **labor supply** response to monetary policy
  - ▶ Sticky wages + neoclassical labor market clearing ⇒ labor is **demand-determined**
  - ▶ NK + search-and-matching ⇒ labor supplied **inelastically**
- ▶ This paper: new evidence from labor market flows consistent with **substantial increase in labor supply** to a **contractionary monetary policy shock**
  - ▶ Increase in **search** activity + decline in **quits** to non-employment
  - ▶ Decline in employment **twice as large** holding **supply**-driven flows fixed
- ▶ Study **HA** model with **frictional labor markets** + **active labor supply** margin:
  - ▶ Model accounts for large labor supply response to monetary policy shock...
  - ▶ But also matches **micro** estimates of MPC's and (modest) MPE's
- ▶ **Interpretation:** Labor supply important for monetary transmission mechanism

# Data & Methodology

# Labor Market Flows

- ▶ Time series data on labor market flows from CPS microdata
- ▶ Three states: employment (**E**), unemployment (**U**), nonparticipation (**N**)
- ▶ Interpret dynamics of **labor market stocks** through response of **flows**:

$$\begin{bmatrix} E \\ U \\ N \end{bmatrix}_{t+1} = \begin{bmatrix} 1 - p_{EU} - p_{EN} & p_{UE} & p_{NE} \\ p_{EU} & 1 - p_{UE} - p_{UN} & p_{NU} \\ p_{EN} & p_{UN} & 1 - p_{NE} - p_{NU} \end{bmatrix}_{t+1} \begin{bmatrix} E \\ U \\ N \end{bmatrix}_t$$

- ▶ Particular focus on response of **supply-driven flows** to monetary policy shock
  - ▶ Decision to search from non-employment, e.g. **U-to-N** and **N-to-U**
  - ▶ Quits to unemployment and nonparticipation (**new!**)

## Estimating the Effects of Monetary Policy

- ▶ Begin with reduced-form VAR:

$$Y_t = \alpha + B(L)Y_{t-1} + u_t \quad (1)$$

- ▶ Six monthly variables for baseline specification: two-year Treasury yield, unemployment rate, participation rate, log CPI, log IP, excess bond premium
- ▶ Assume structural shocks:

$$u_t = S\varepsilon_t \quad (2)$$

where the first structural shock is a “monetary policy shock”,  $\varepsilon_t^{mp}$

- ▶ First column of  $S$ , denoted  $s_1$ , describes the impact effect of the structural monetary policy shock  $\varepsilon_t^{mp}$  on  $u_t$  and  $Y_t$ .
- ▶ Use an external instrument  $z_t$  to identify  $s_1$

## External Instrument

- ▶ External instrument  $z_t$  needs to satisfy:

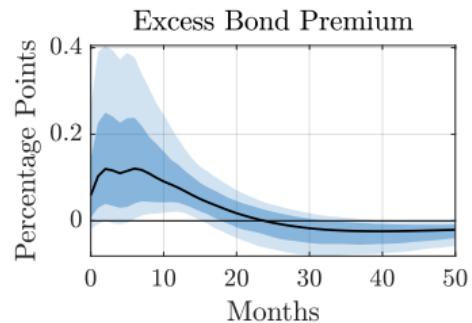
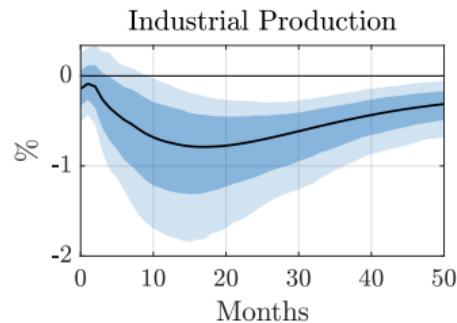
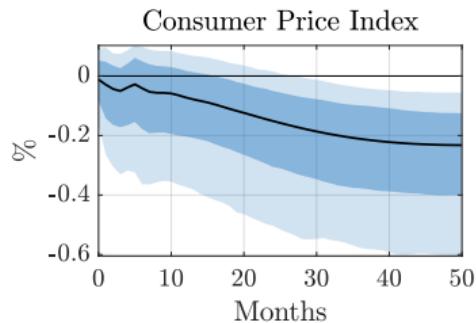
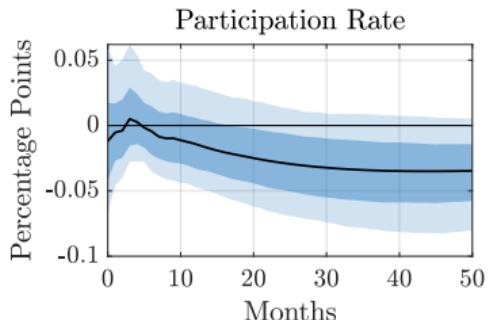
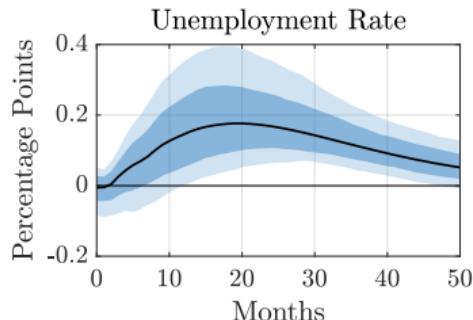
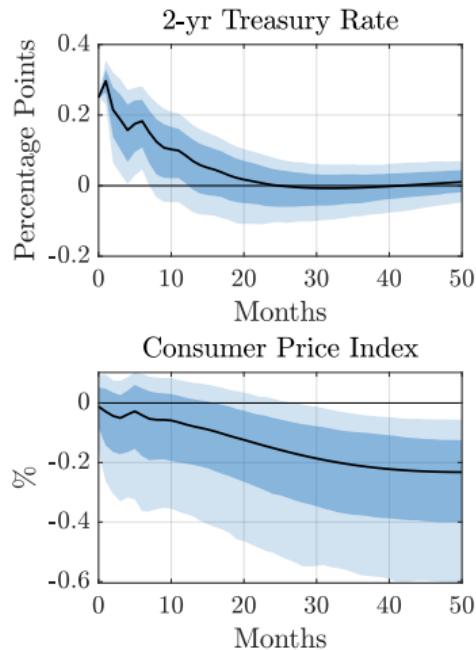
$$\mathbb{E} \left\{ z_t \varepsilon_t^{mp} \right\} \neq 0 \quad (\text{relevance})$$

$$\mathbb{E} \left\{ z_t \varepsilon_t^{-mp} \right\} = 0 \quad (\text{exogeneity})$$

- ▶ Use HFI changes in interest rate futures as external instrument in VAR
  - ▶ e.g., Stock and Watson (2012), Gertler & Karadi (2015)
- ▶ Implement methodology from Bauer & Swanson (2023)
  - ▶ Use interest rate changes around FOMC announcements and Fed Chair speeches
  - ▶ Orthogonalized with respect to recent macro/financial news
- ▶ Both speeches and orthogonalizing necessary for accurate estimates of flow IRFs
  - ▶ Avoids known issues of HFI estimation (e.g., Ramey 2016)
  - ▶ Additional noise from labor market flows requires more valid instrument
- ▶ Labor market flows added one-by-one to the main VAR

# Estimates

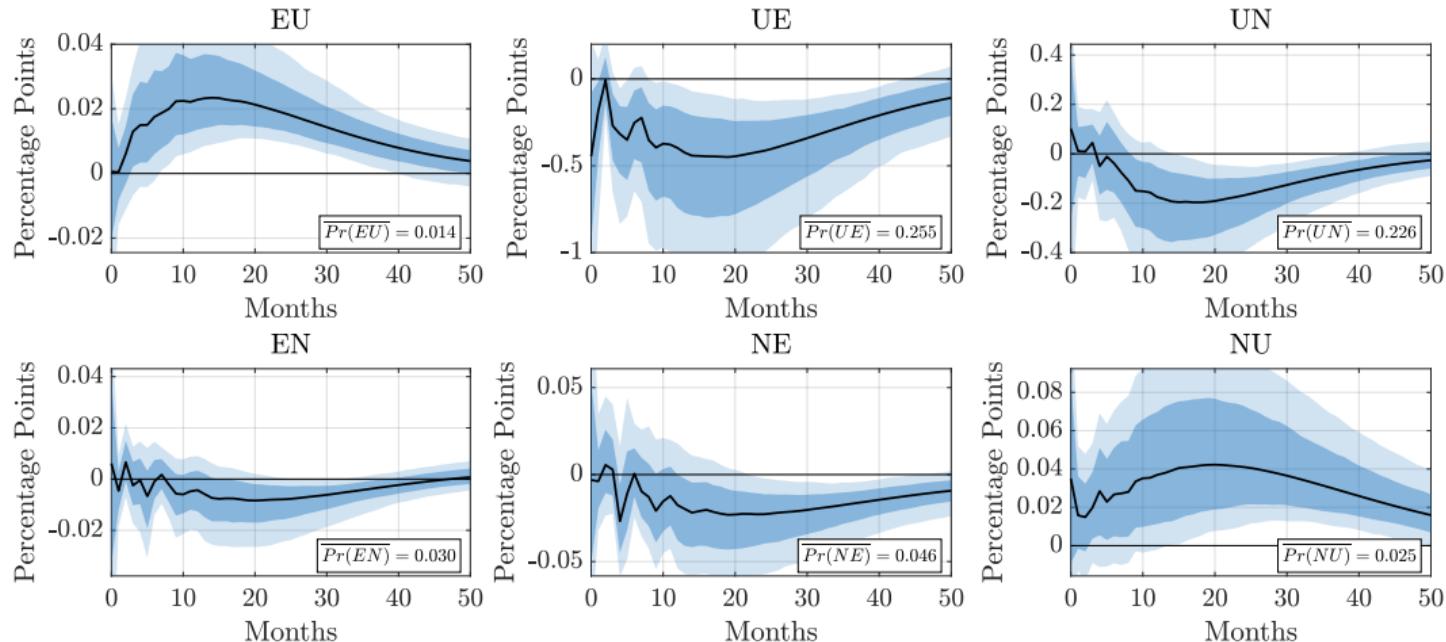
# Baseline VAR



Robust  $F$ -statistic: 13.05

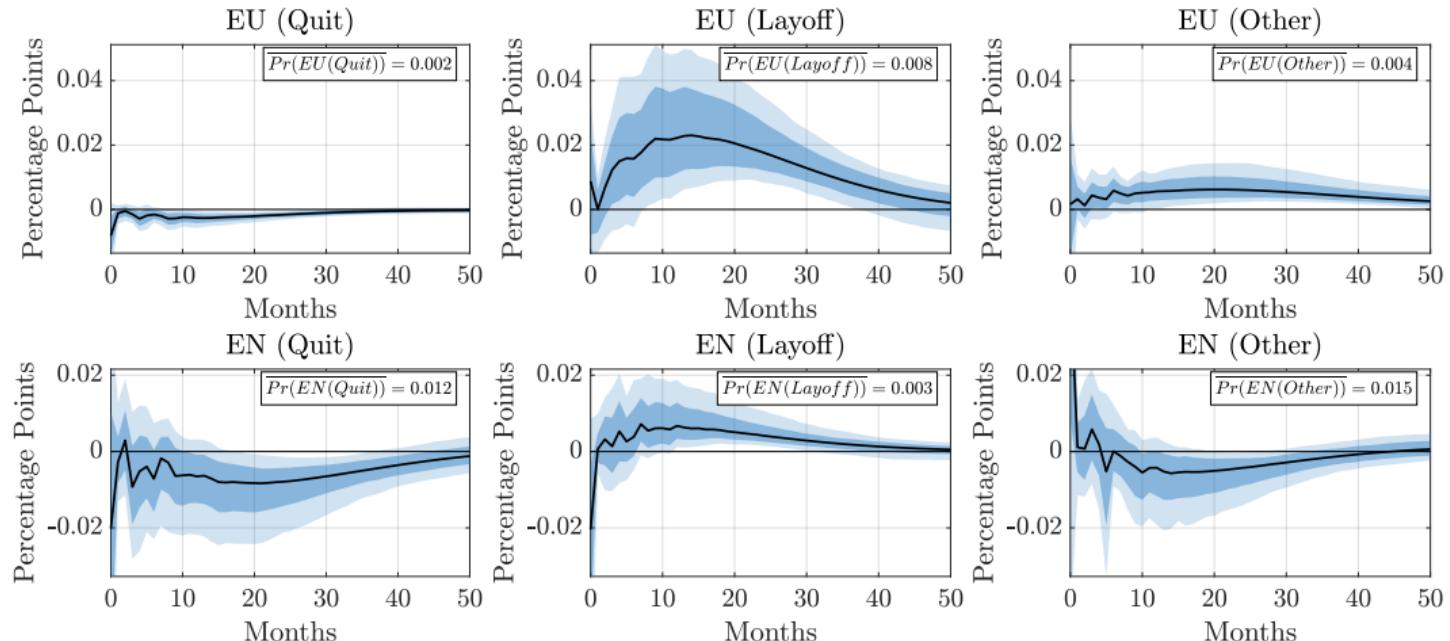
- ▶ Monthly data, 1978:M1–2019:M12
- ▶ Dark and light shaded regions report **68%** and **90%** confidence intervals

# Response of Labor Market Flows



- $pEU \uparrow$  &  $pUE \downarrow \Rightarrow$  Consistent with narrative of **decline** in **labor demand**
- $pNU \uparrow$ ,  $pUN \downarrow$ , &  $pEN \downarrow \Rightarrow$  Consistent with **increase** in **labor supply**

# Response of EU & EN Flows: Quits vs Layoffs



- ▶ Increase in layoffs explains rise in EU rate
- ▶ Decline in quits explains fall in EN rate

## Additional Results

After contractionary monetary policy shock we also find:

1. Increase in “intensive margins” of search from non-employment 
2. Cyclical composition plays limited role in shaping response of aggregate flows 
3. Larger response of supply-driven flows among less-educated 
4. Decline in participation driven by labor force exit (through increase in unemployment); attenuated by increase in labor force entry 
5. Significant decline in vacancies 
6. Nominal wages decline slowly 
7. No response of job-to-job transitions 
8. Use of Chair speeches and orthogonalized shocks necessary for our estimates 

# Using Flows to Account for Dynamics of Labor Market Stocks

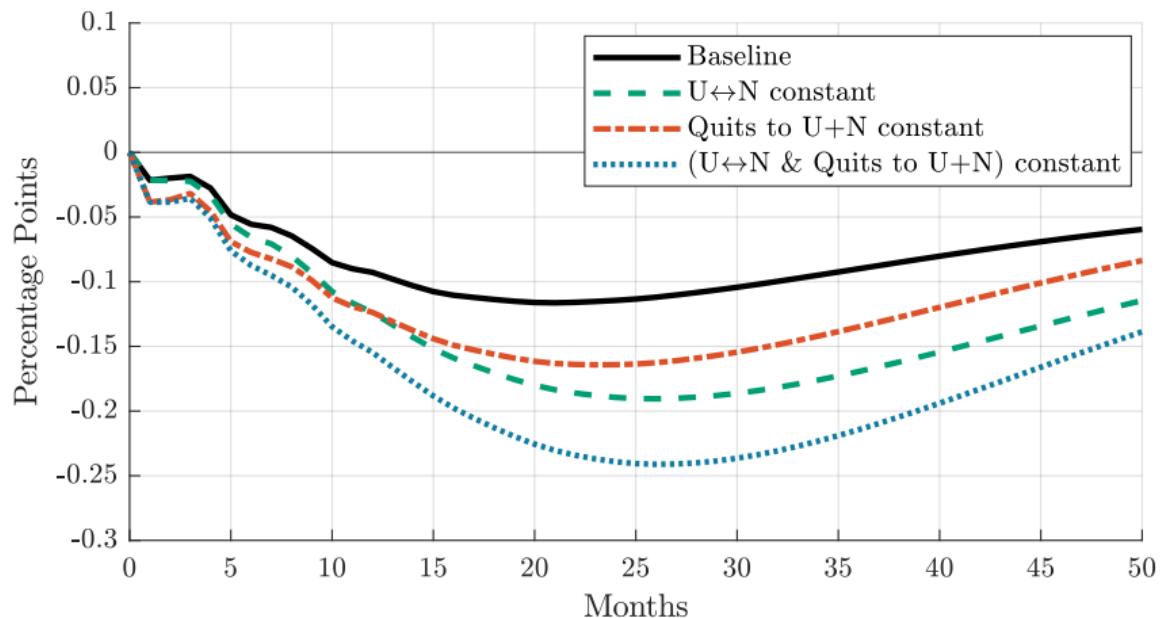
# Flow-Based Accounting for Dynamics of Stocks

- ▶ Take IRF's as given, use **transition probabilities** to construct **hypothetical stocks**
- ▶ **Law of motion** for **stocks** in terms of **transition probabilities** (i.e., flows)

$$\begin{bmatrix} E_{t+k} \\ U_{t+k} \\ N_{t+k} \end{bmatrix} = \left( \prod_{j=1}^k P_{t+j} \right) \begin{bmatrix} E_t \\ U_t \\ N_t \end{bmatrix}$$

- ▶ Assess contribution of flow  $p_{XY}$  to stock  $Z$  by replacing  $\{p_{XY}\}_t$  with steady-state value,  $\tilde{p}_{XY}$
- ▶ Study behavior of resulting hypothetical stock  $\check{Z}$  to isolate role of flow  $p_{XY}$
- ▶ Assess role of **supply-driven flows** in shaping impulse response of **employment**

# Decomposing Employment Response to a Monetary Policy Shock



- ▶ Holding **supply-driven** flows fixed  $\Rightarrow$  Employment falls **twice as much**

▶ Controls for composition

▶ Participation

▶ Unemployment

# Model

## Model

- ▶ What do IRFs of **supply-driven labor flows** say about household **labor supply response** to a monetary policy shock?
- ▶ To answer, we study **heterogeneous agent model** with **labor market frictions** and **endogenous participation** à la Krusell et al (2017)
  - ▶ Households face **employment risk** (job-finding/layoff) + shocks to **labor productivity**
  - ▶ Choose **consumption/savings** and **labor supply** (quit, search, accept)
- ▶ Estimate **key model parameters** to match response of **labor market flows** to contractionary monetary policy shock
  - ▶ Study by feeding responses for layoff rate, job-finding rate, interest rate and wages
- ▶ Findings:
  1. Model achieves **close fit** for all **labor market flows**
  2. **Consistent** with recent evidence on **MPCs** and **MPEs**
  3. Implies quantitatively important **increase in labor supply**

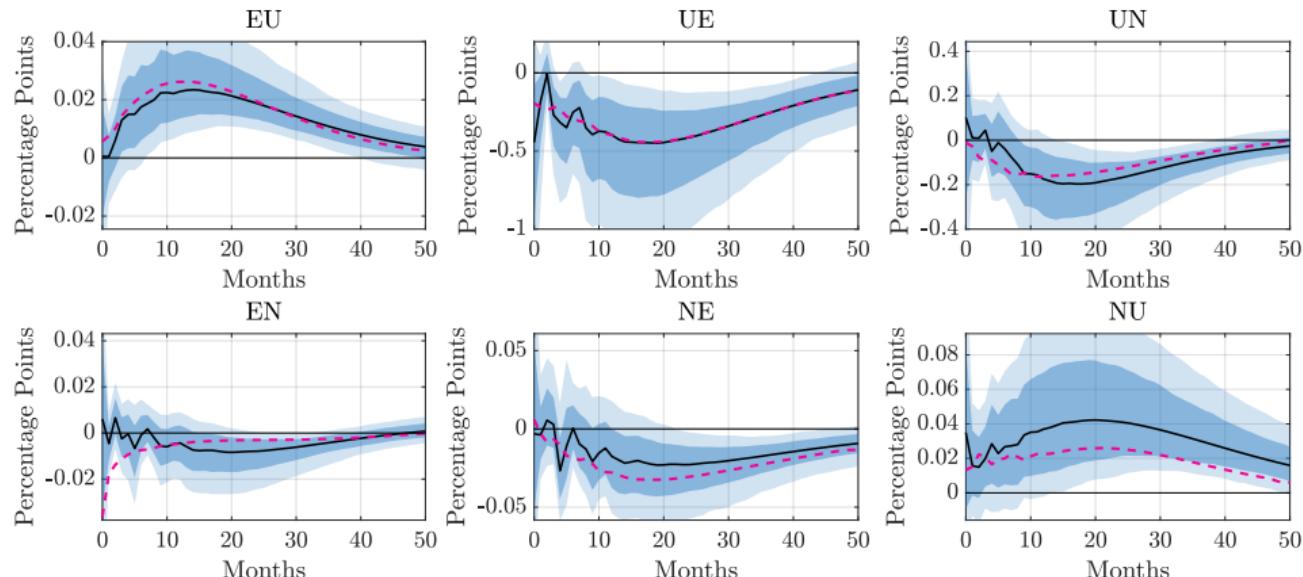
## Model Implications for Monetary Policy Shock

- ▶ Feed in response of job-finding rate, layoff rate, real interest rates and wages from the data
- ▶ Overall response of labor market flows also determined by endogenous changes in policy functions + distribution of households across labor market states
- ▶ Choose model parameters to match IRFs of labor market flows
  - ▶ Targets:  $\{EU_t, EN_t, UE_t, UN_t, NE_t, NU_t\}_{t=0}^{50}$
  - ▶ À la Christiano, Eichenbaum, Evans (2005) or Auclert, Rognlie, Straub (2020)
- ▶ Steady-State Results:
  1. Model has near-perfect fit for steady-state flow rates between E, U and N
  2. Model produces quarterly MPC of 7-8%, annual MPE of 2-3%  
In line with (recent) literature

▶ Model parameters

▶ Policy functions

# Response of Labor Market Flows: Model vs Data



- ▶ Labor market flows from model (magenta lines) largely fall within 68% CI's

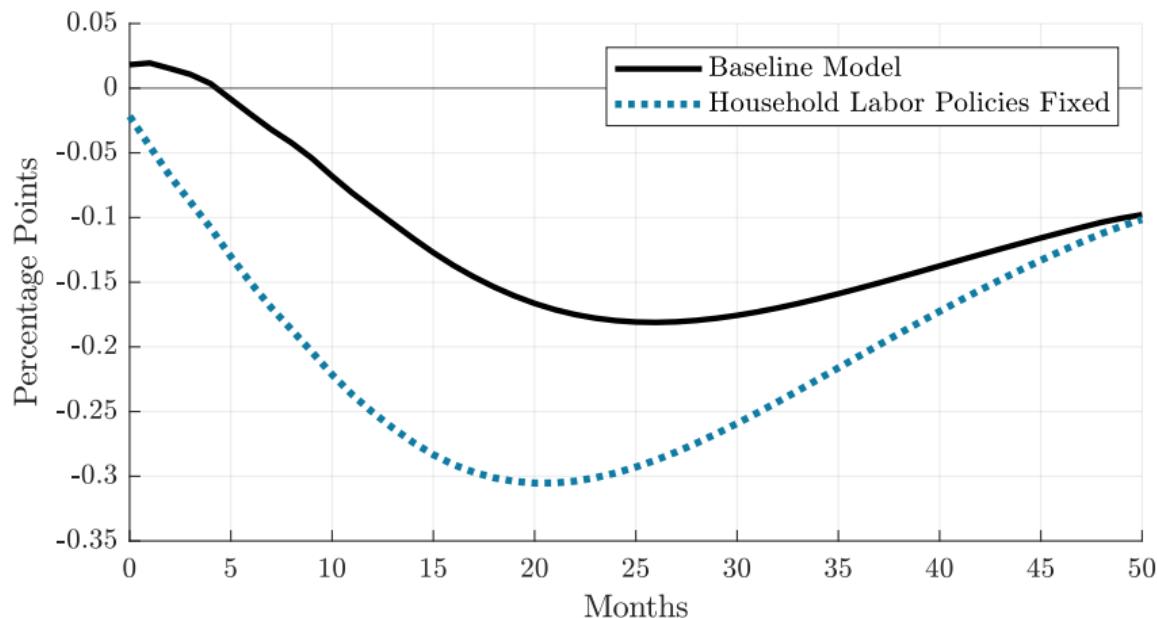
▶ Response of Quits and Layoffs

▶ Response of Labor Market Stocks

## The Role of Labor Supply

- ▶ Ability of model to match response of labor market flows could reflect endogenous changes in **composition** or household **labor supply**
- ▶ For example, **decrease in UN** flows could reflect
  - ▶ Greater mass of “likely searchers” in non-employment, or
  - ▶ **Higher propensity to search** for employment of all workers
- ▶ To assess relative importance of two channels, simulate model holding labor supply policy functions at steady state
  - ▶ If changes in **labor supply** do not matter, **employment** should be **unaffected**

## The Role of Labor Supply: Employment Response



- ▶ **Finding:** Employment drops by additional  $\approx 70\%$ 
  - ▶ Indicates broad-based increase in labor supply to contractionary monetary shock

# Conclusion

## Conclusion

- ▶ Estimate substantial response of **supply-driven** labor market flows to contractionary monetary policy shock
- ▶ Holding **supply-driven flows** at **steady state**, fall in employment **doubles**
- ▶ Use **heterogenous agent** model with **frictional labor markets** and **participation margin** to understand role of **household labor supply**
- ▶ Model fit to labor flows achieved through **broad-based increase in labor supply**
- ▶ Empirical evidence + model findings consistent with important role of **labor supply** in **monetary transmission mechanism**
- ▶ Future/ongoing work: study labor supply response to Covid-era transfers (e.g., “**Great Resignation**”) and evaluate role in for subsequent inflation

# Extra Slides

# Cyclical Properties of Labor Market Stocks and Flows

## Cyclicality of Labor Market Stocks

	Employment- Population Ratio	Unemployment Rate	Participation Rate
mean( $x$ )	61.14	6.19	65.16
std( $x$ )/std( $Y$ )	0.72	8.25	0.23
corr( $x, Y$ )	0.83	-0.85	0.35

Note:  $x$  denotes the variable in each column,  $Y$  denotes HP-filtered log real GDP. Standard deviations and correlations are computed for HP-filtered quarterly averages. The sample is 1978-2019.

## Cyclicality of Labor Market Flows

	EU	EN	UE	UN	NE	NU
mean( $x$ )	0.014	0.030	0.255	0.226	0.046	0.025
std( $x$ )/std( $Y$ )	5.20	2.46	5.69	4.14	3.00	5.22
corr( $x, Y$ )	-0.83	0.49	0.78	0.71	0.65	-0.68

Note:  $x$  denotes the variable in each column,  $Y$  denotes HP-filtered log real GDP. Standard deviations and correlations are computed for HP-filtered quarterly averages. The sample is 1978-2019.

# New Decomposition of Flows From Employment to Non-Employment

- ▶ Previous work: EU flows dominated by layoffs (Elsby et al. 2009, Ahn, 2023)

	Total	Quits	Layoffs	Other
mean( $x$ )	0.014	0.002	0.008	0.004
std( $x$ )/std( $Y$ )	5.20	8.11	8.03	5.43
corr( $x, Y$ )	-0.83	0.60	-0.83	-0.54

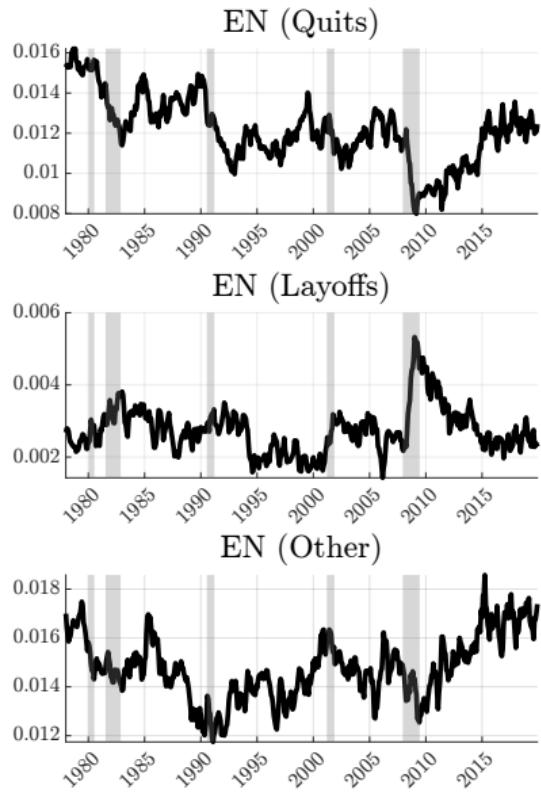
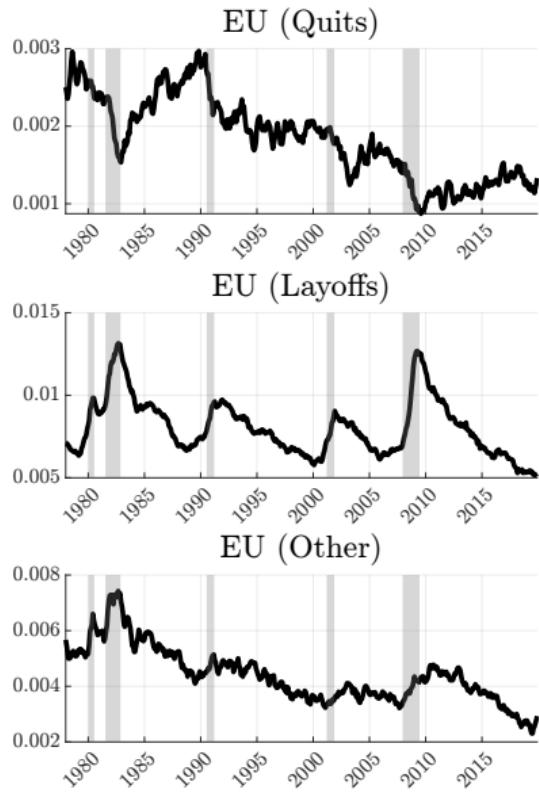
Note:  $x$  denotes the variable in each column,  $Y$  denotes HP-filtered log real GDP. Standard deviations and correlations are computed for HP-filtered quarterly averages.

- ▶ This paper: EN flows show larger role for quits

	Total	Quits	Layoffs	Other
mean( $x$ )	0.030	0.012	0.003	0.015
std( $x$ )/std( $Y$ )	2.46	5.88	14.42	4.80
corr( $x, Y$ )	0.49	0.53	-0.44	0.25

Note:  $x$  denotes the variable in each column,  $Y$  denotes HP-filtered log real GDP. Standard deviations and correlations are computed for HP-filtered quarterly averages.

# Decomposition of EU Flows



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## Relevance of Distinction Between Quits and Layoffs

Post-EU Transition Rates: Quits vs Layoffs

From	To		
	E	U	N
E – U(Quit)	0.448	0.399	0.153
E – U(Layoff)	0.426	0.468	0.106

Note: Transition rates are shown for individuals that are in their first month of unemployment following an employment spell, split by reason for unemployment.

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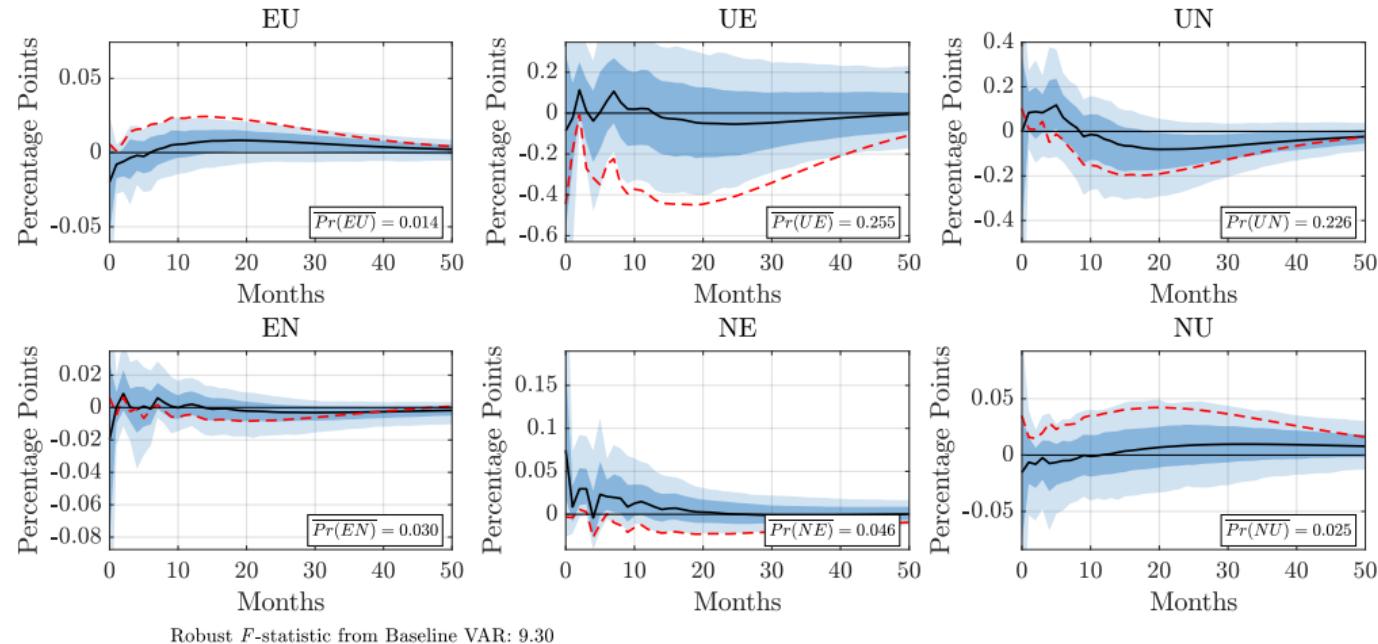
## Relevance of Distinction Between Quits and Layoffs

	Average Probability
Want Job   E-N(Quit)	0.224
Want Job   E-N(layoff)	0.528
NE   Want Job	0.152
NE   Do Not Want Job	0.039
NU   Want Job	0.177
NU   Do Not Want Job	0.013

*Note:* The top section shows the probability that individuals want a job, split by the reason for leaving to nonparticipation. The bottom section shows the probabilities of moving to employment, split by whether or not nonparticipants report wanting a job.

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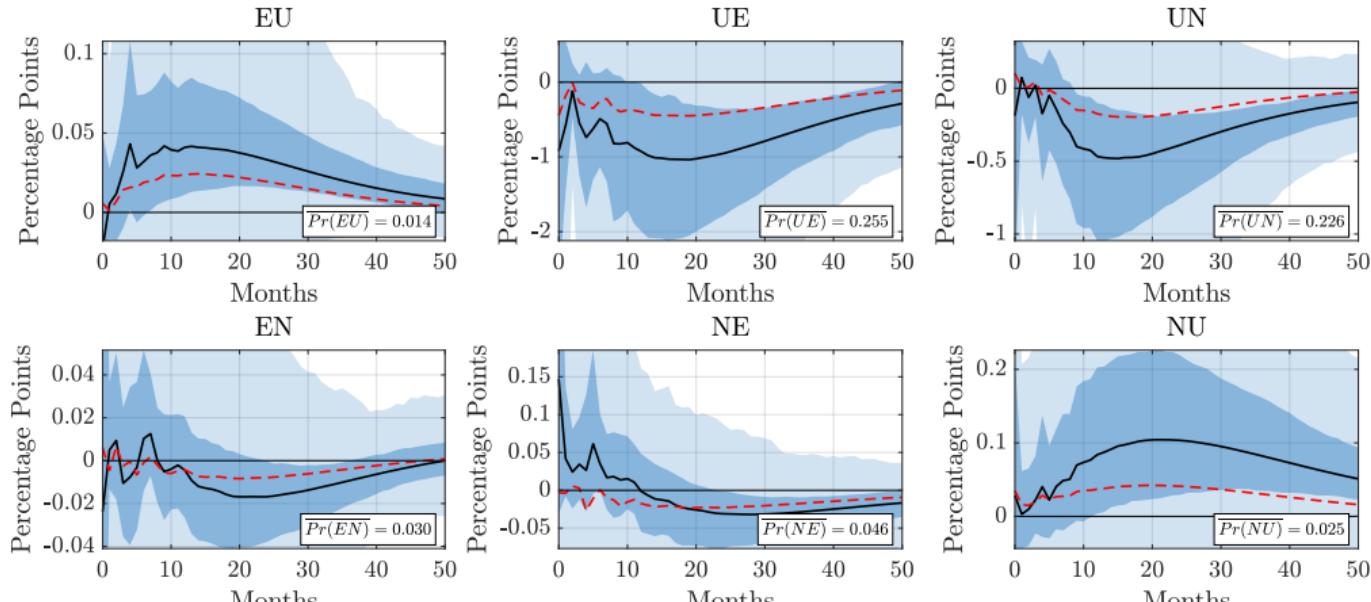
# Labor Market Flows: No Speeches (Not Orthogonalized)



- ▶ High-frequency shocks from announcements only (e.g. Gertler & Karadi (2015))
- ▶ Dashed red lines report our baseline estimates

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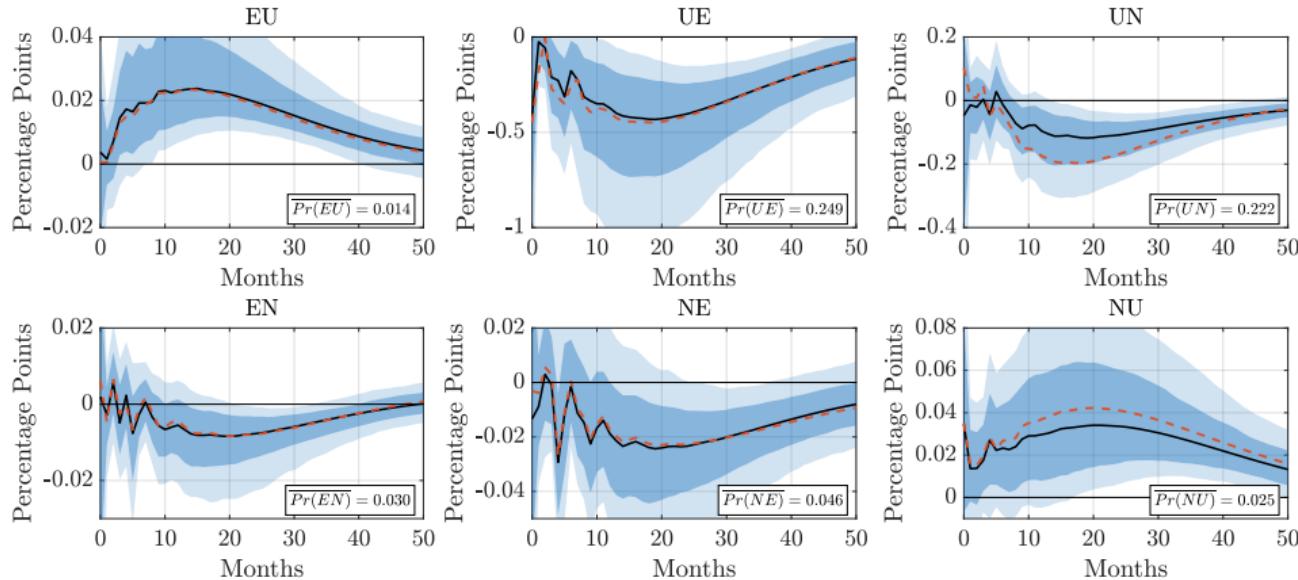
# Labor Market Flows: No Speeches (Orthogonalized)



- ▶ From announcements only, orthogonalized as in Bauer & Swanson (2023)
- ▶ Dashed red lines report our baseline estimates

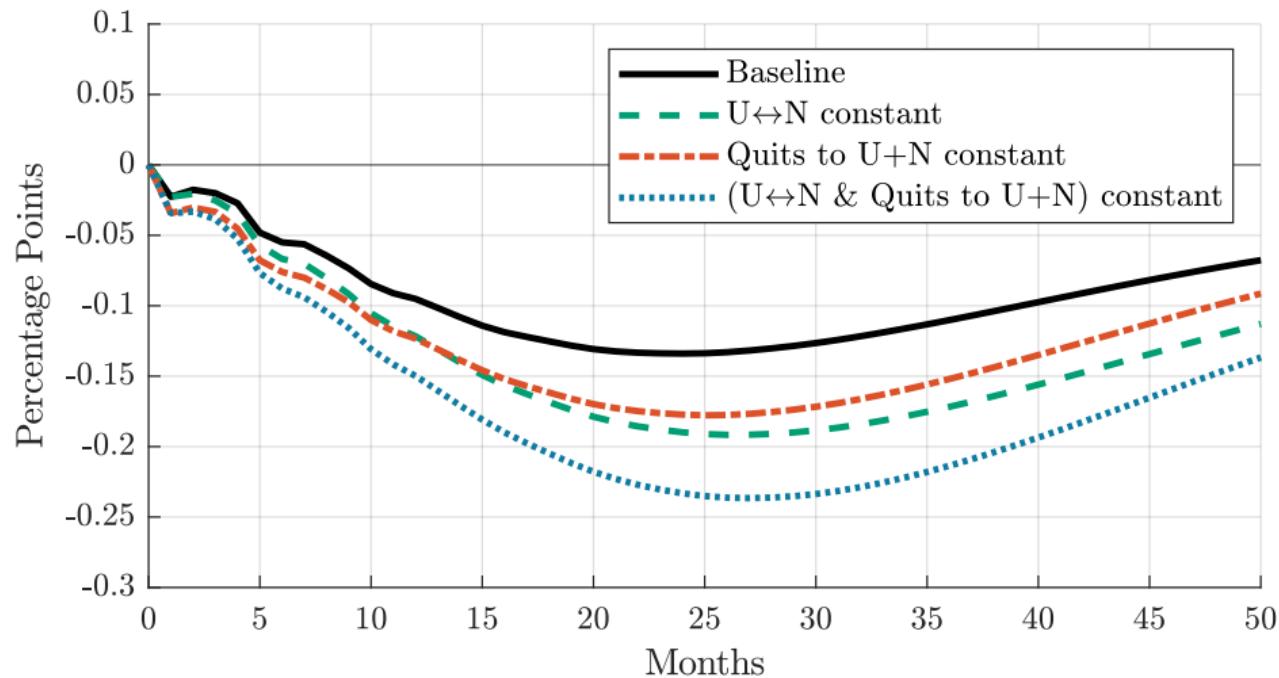
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# Labor Market Flows: Holding Composition Fixed

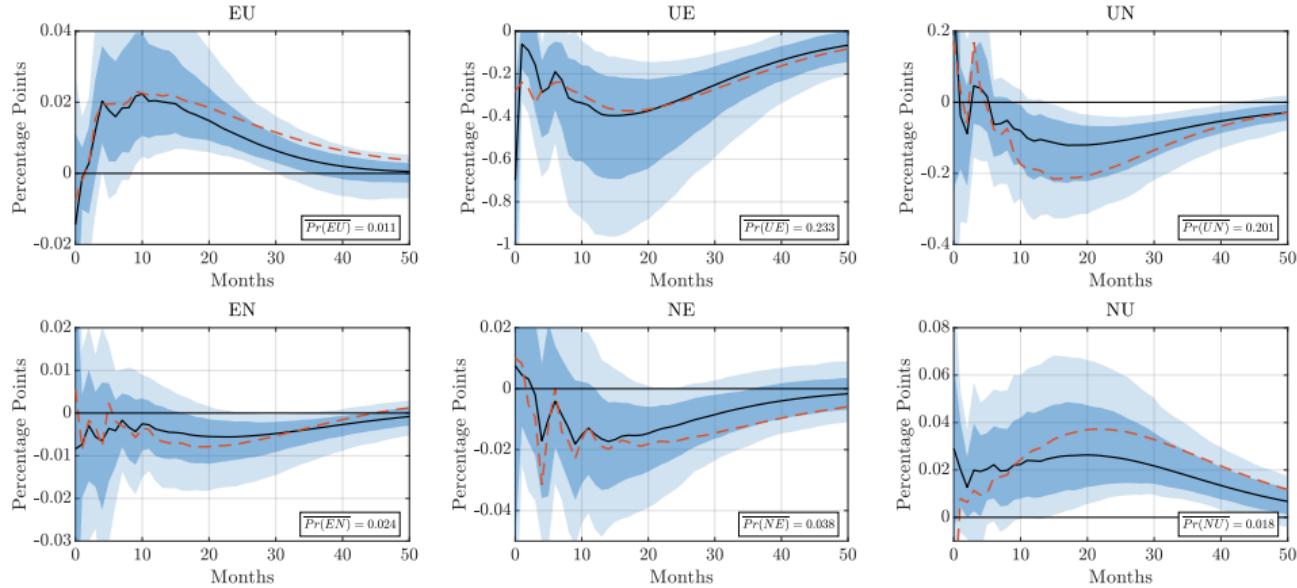


- ▶ Composition-adjusted flows by ex-ante characteristics, à la Elsby et al. (2015)
- ▶ Fix shares using bins for age  $\times$  gender  $\times$  education  $\times$  reason for unemployment
- ▶ Dashed red lines report our baseline estimates

## Decomposing Employment Response: Holding Composition Fixed

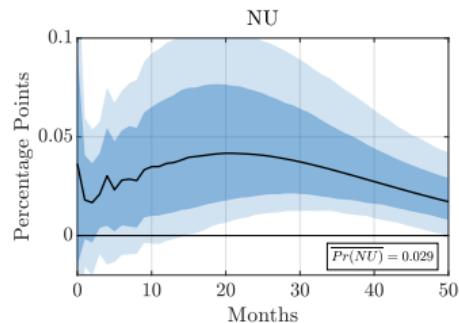
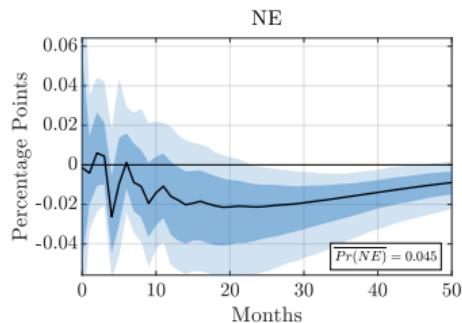
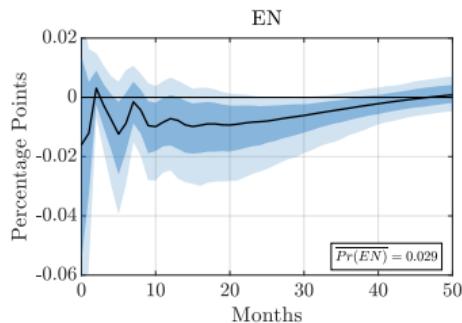
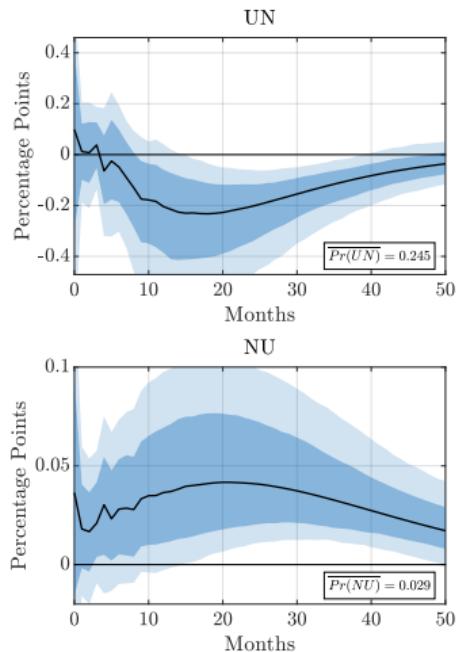
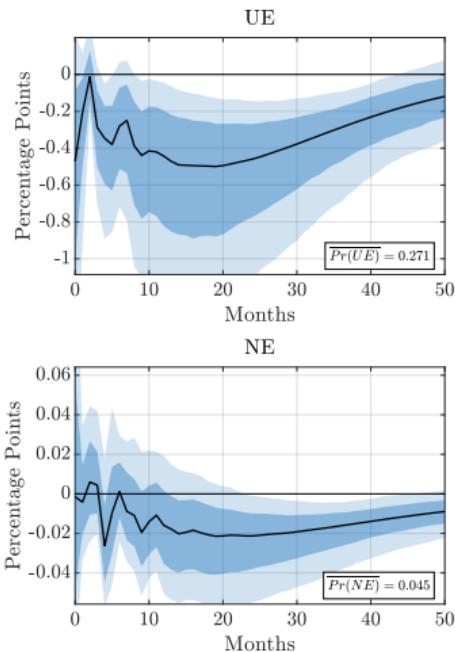
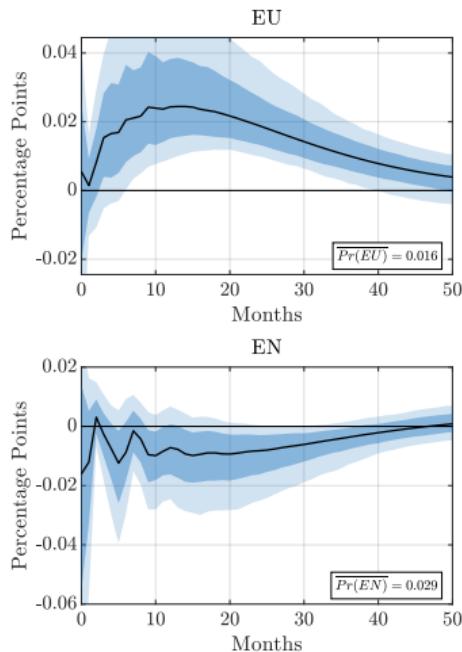


# Labor Market Flows: Holding Composition Fixed (Full Controls)



- ▶ Fix shares using bins for age  $\times$  gender  $\times$  education  $\times$  reason for unemployment  $\times$  labor market status one year ago
- ▶ Dashed red lines are responses for unadjusted flows with the same sample

# Labor Market Flows: Corrected for Time-Aggregation

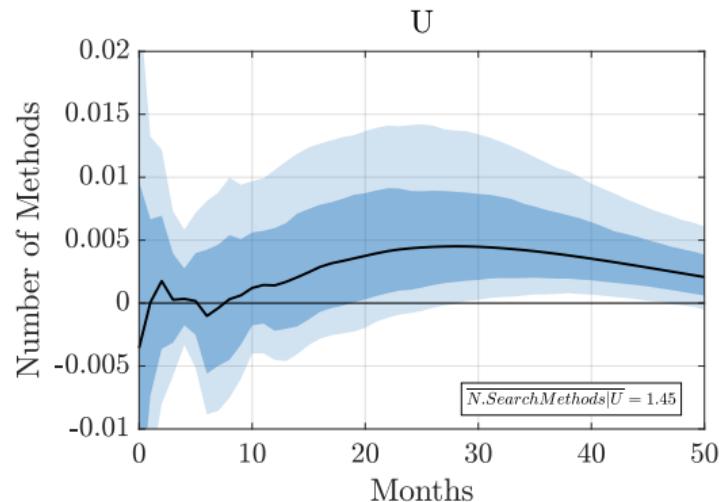
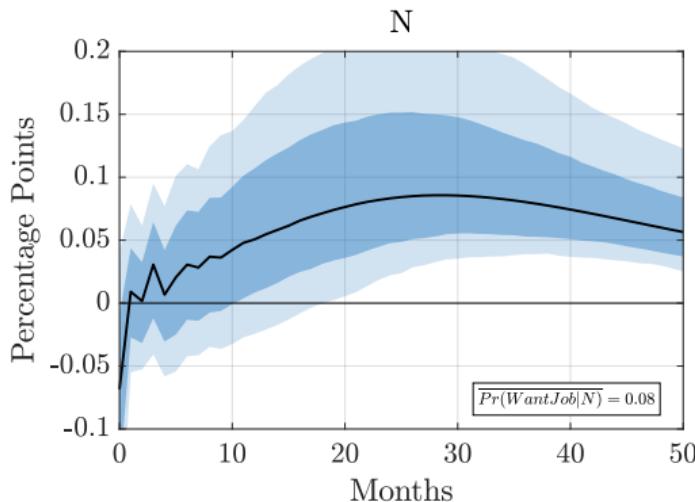


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# Intensive Margins of Labor Supply

Intensive margins of job search consistent with behavior of NU/UN flows:

- ▶ For **N**: share that **want a job**
- ▶ For **U**: **number of search methods**

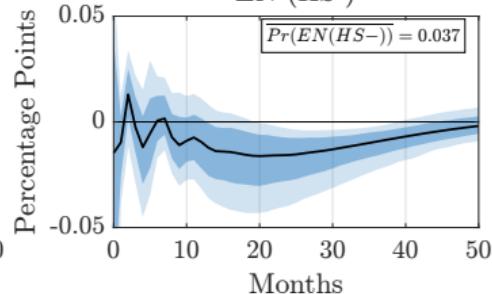
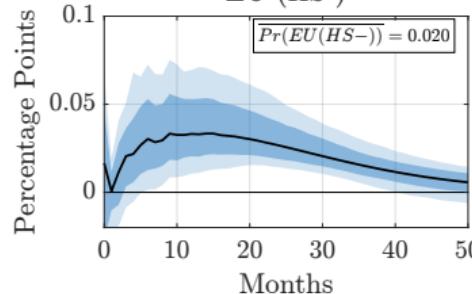
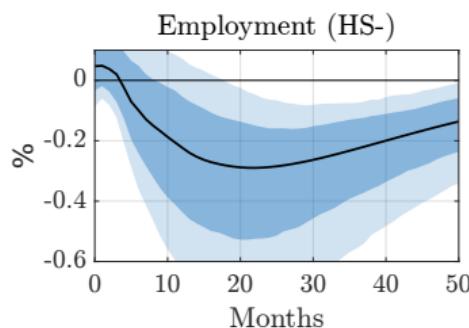
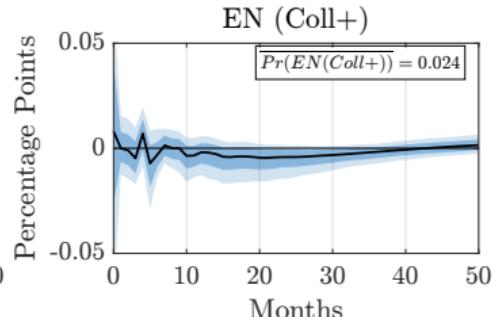
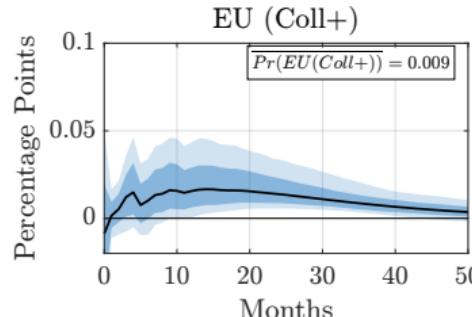
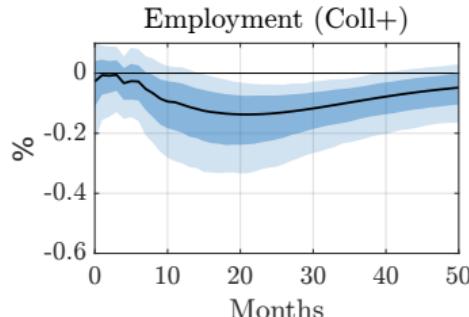


## Intensive Margins: Time-Series



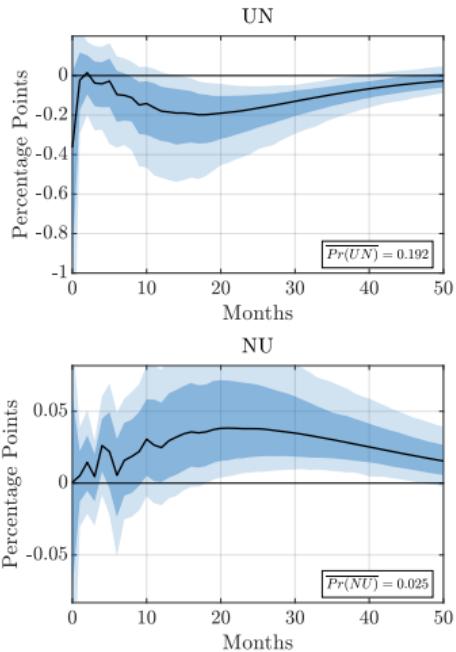
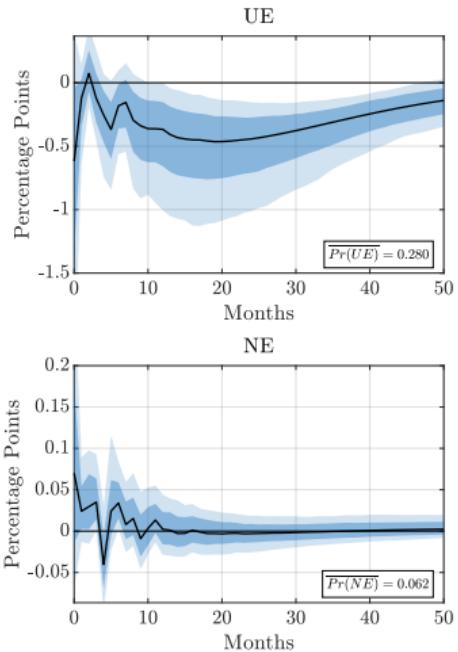
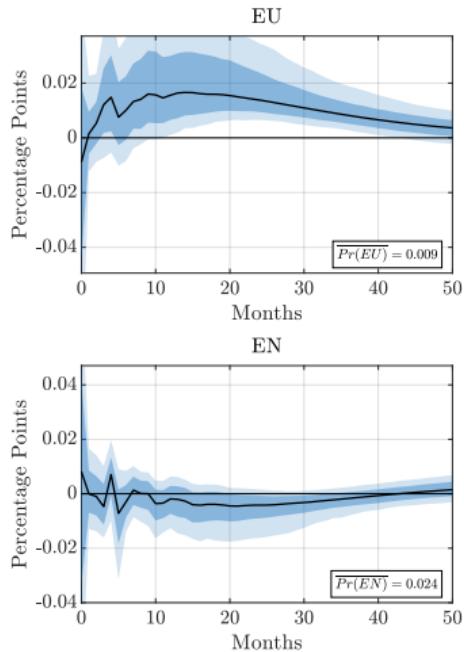
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# Heterogeneity in Labor Market Responses: Education



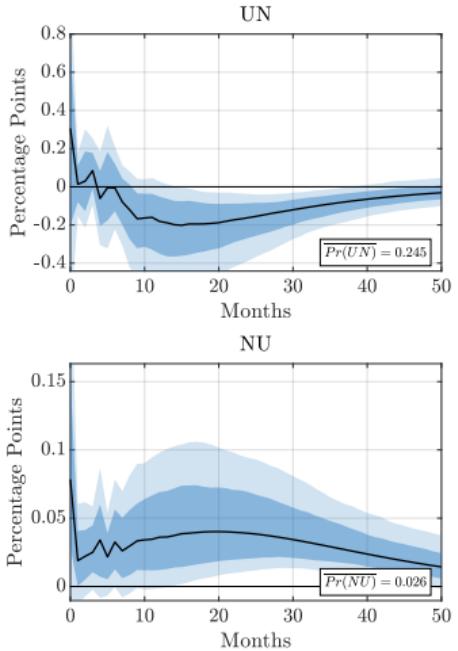
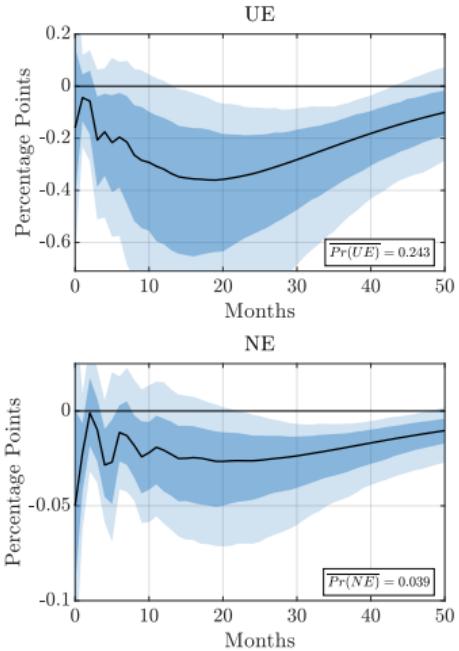
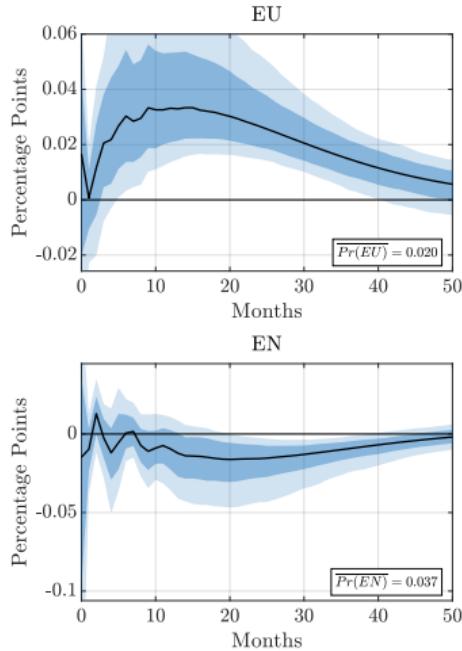
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# Labor Market Flows: Higher-Educated



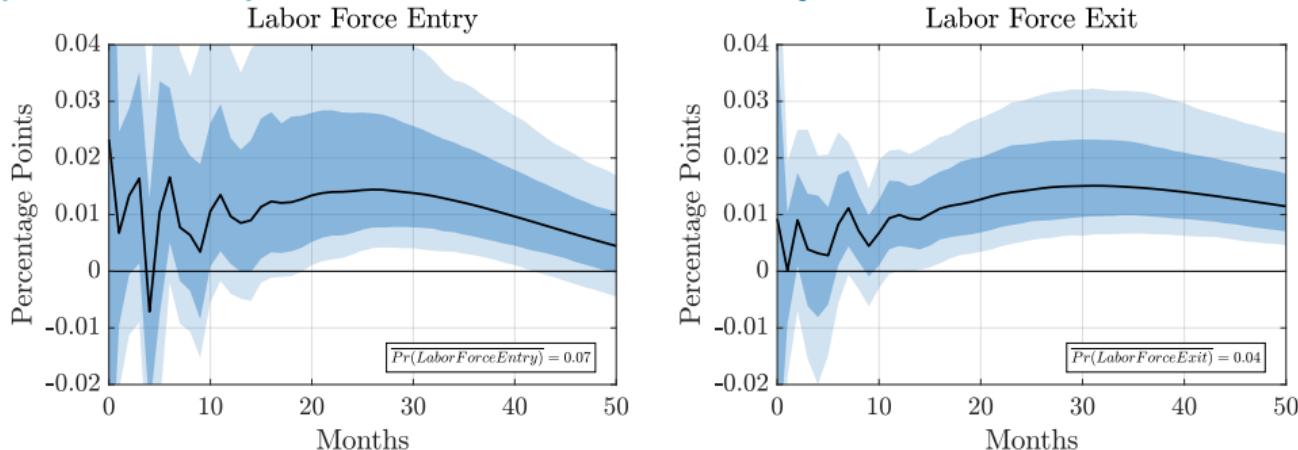
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# Labor Market Flows: Lower-Educated



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## Participation: Response of Labor Force Entry and Exit



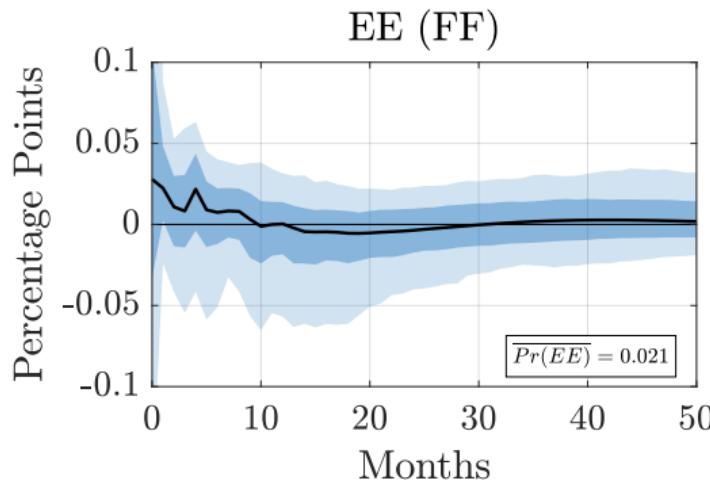
- ▶ Participation falls due to higher exit rate, offset by rise in entry
- ▶ Increase in exits driven by  $u_t$ , attenuated by  $EN_t$  and  $UN_t$

$$(\text{Labor Force Entry Rate})_t = NU_t + NE_t,$$

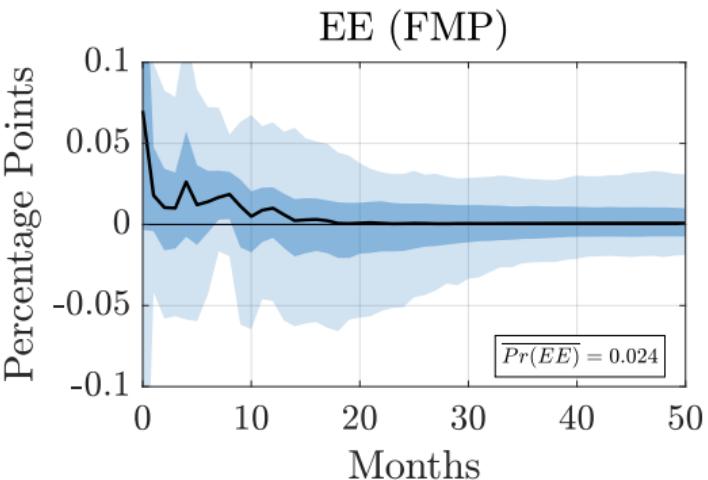
$$(\text{Labor Force Exit Rate})_t = u_{t-1} \cdot UN_t + (1 - u_{t-1}) \cdot EN_t,$$

where  $u_{t-1}$  denotes the unemployment rate (and  $\overline{UN} >> \overline{EN}$ )

## Response of Job-to-Job Flows (1995-2019)

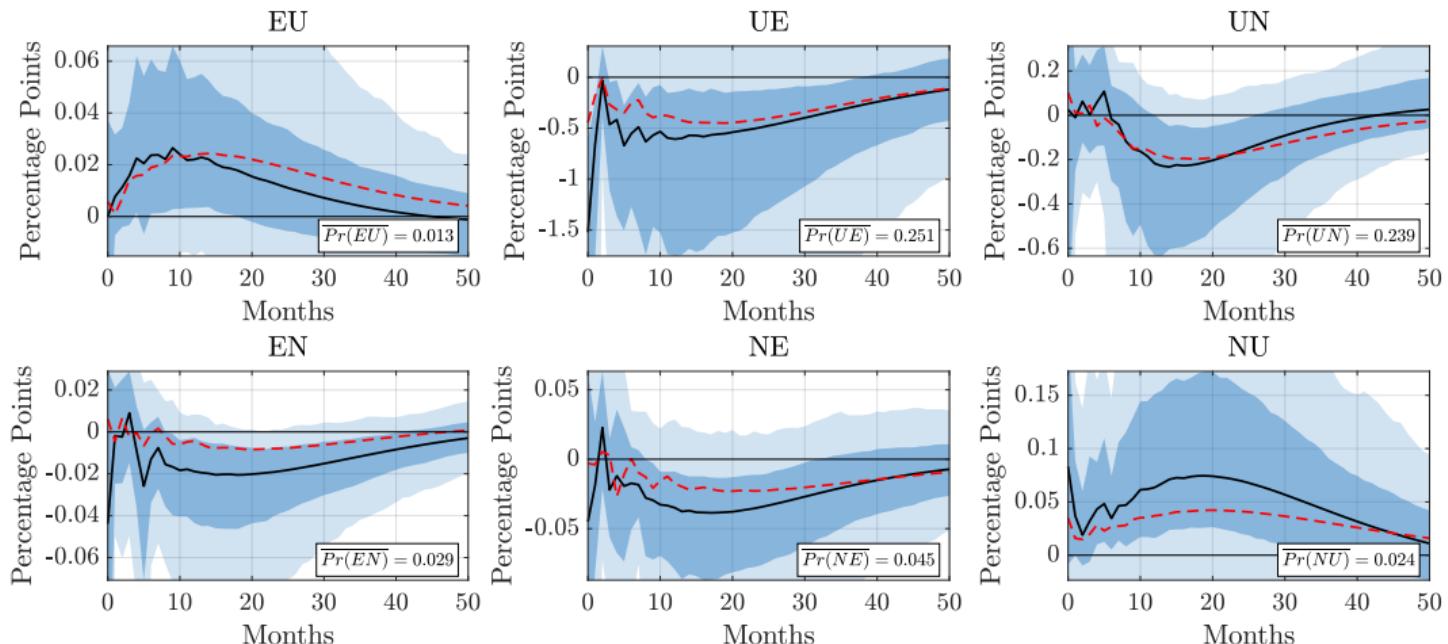


Robust  $F$ -statistic from Baseline VAR: 5.44



- ▶ Use measures from Fujita, Moscarini, Postel-Vinay (2024)
- ▶ No response of EE rate to contractionary MPS
- ▶ Cyclicalities of EE series from CPS likely muted by workers who “jump ship”

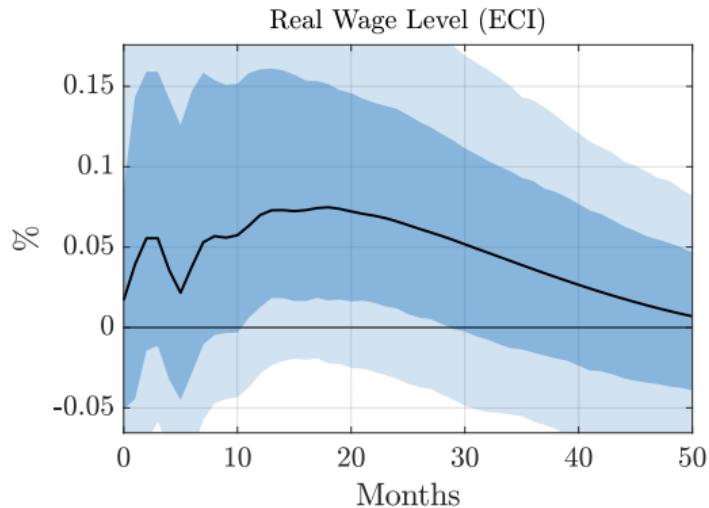
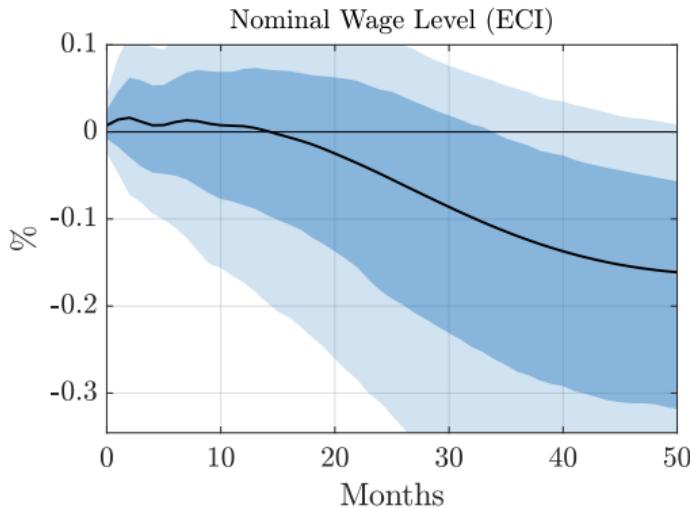
# Response of Labor Market Flows (1995-2019)



- Dashed red lines report impulse responses using full sample

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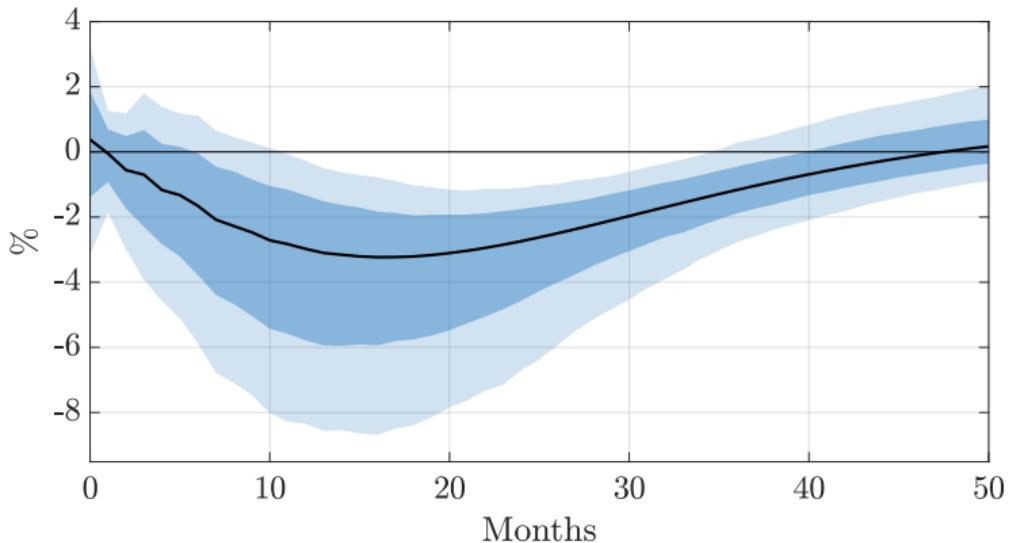
## Response of Wages



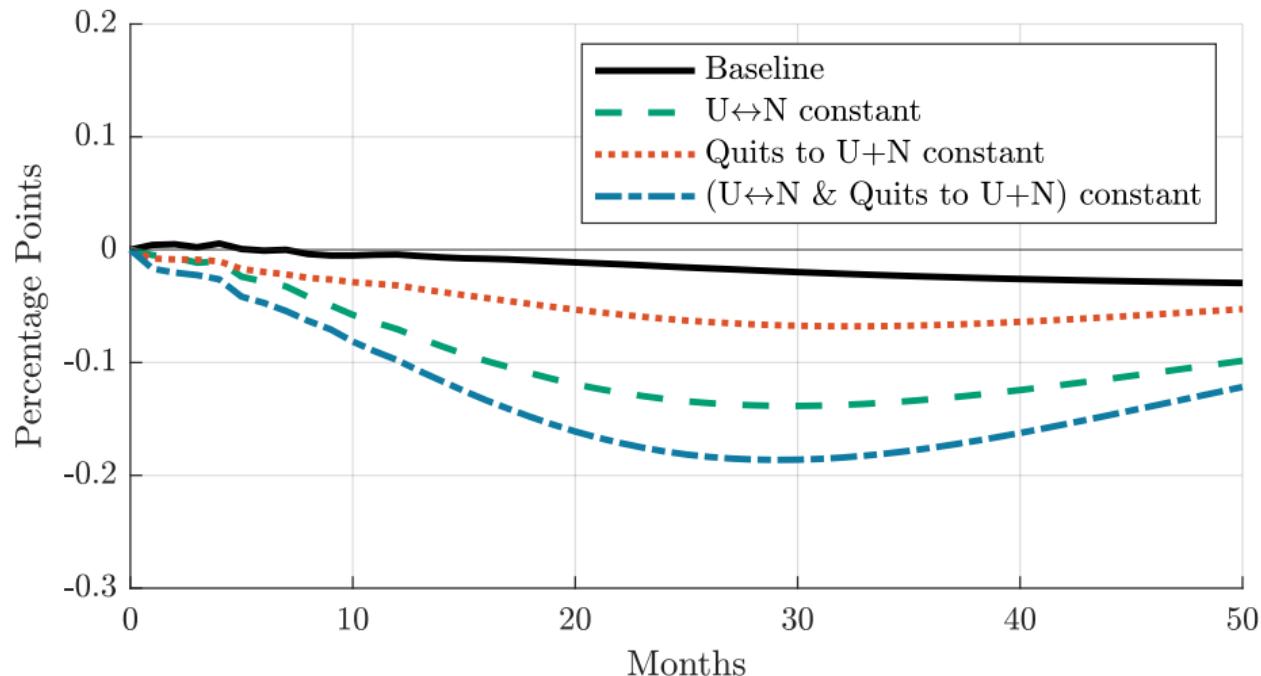
- ▶ Nominal wages decline more slowly than CPI
- ▶ So real wages rise slightly in the short-run

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## Response of Vacancies



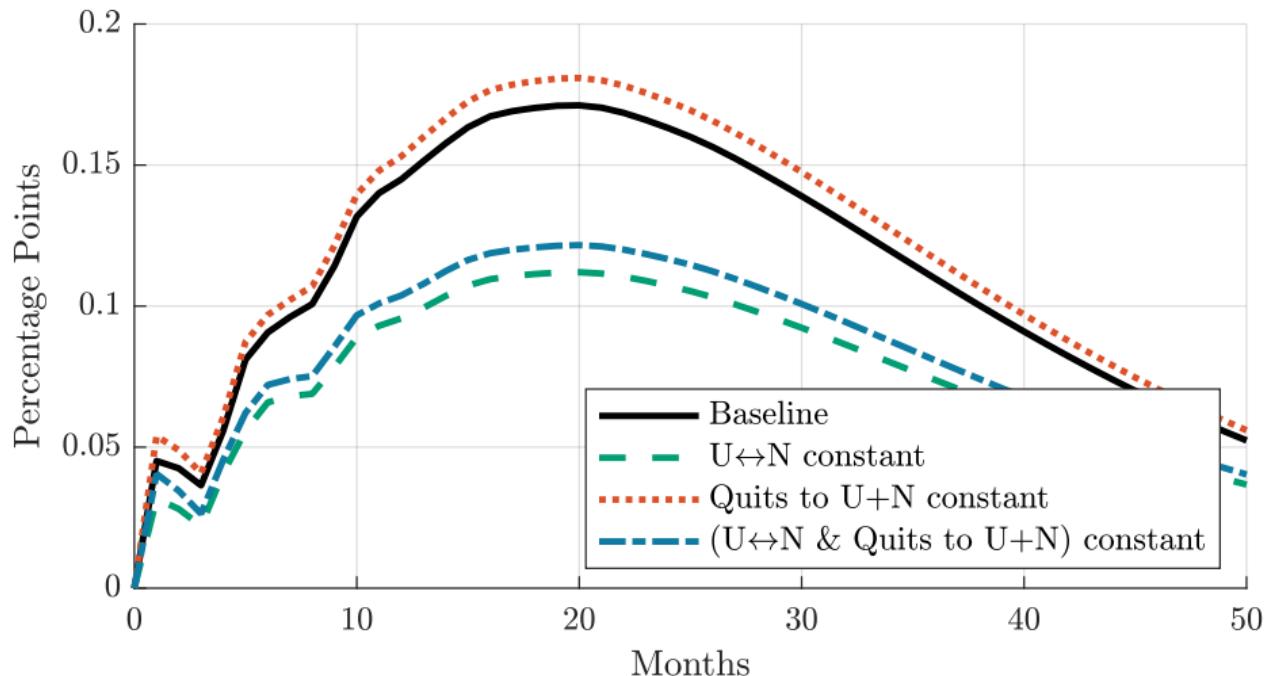
## Participation Response to a Monetary Policy Shock



- With response of supply-driven flows fixed  $\Rightarrow$  Participation far more procyclical

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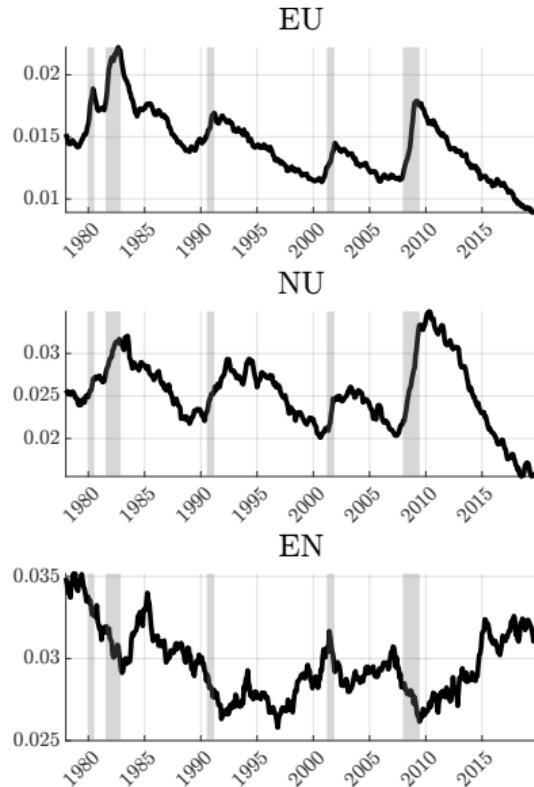
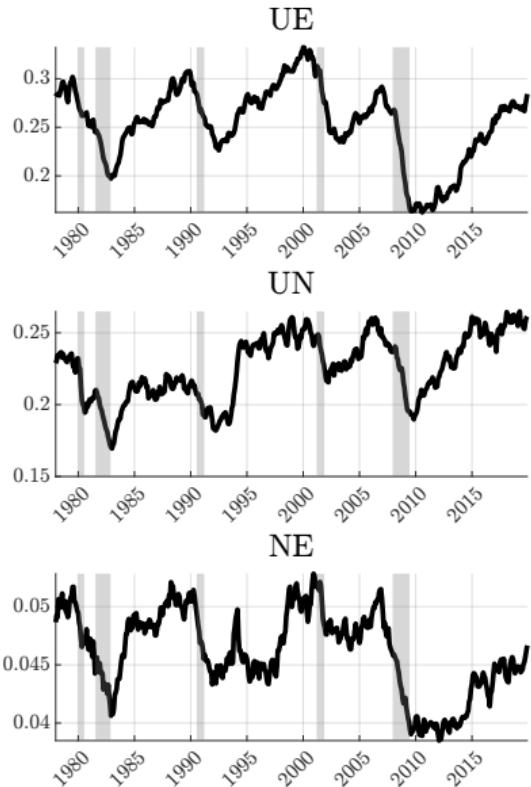
## Unemployment Response to a Monetary Policy Shock



- ▶ Response of quits not important for unemployment dynamics

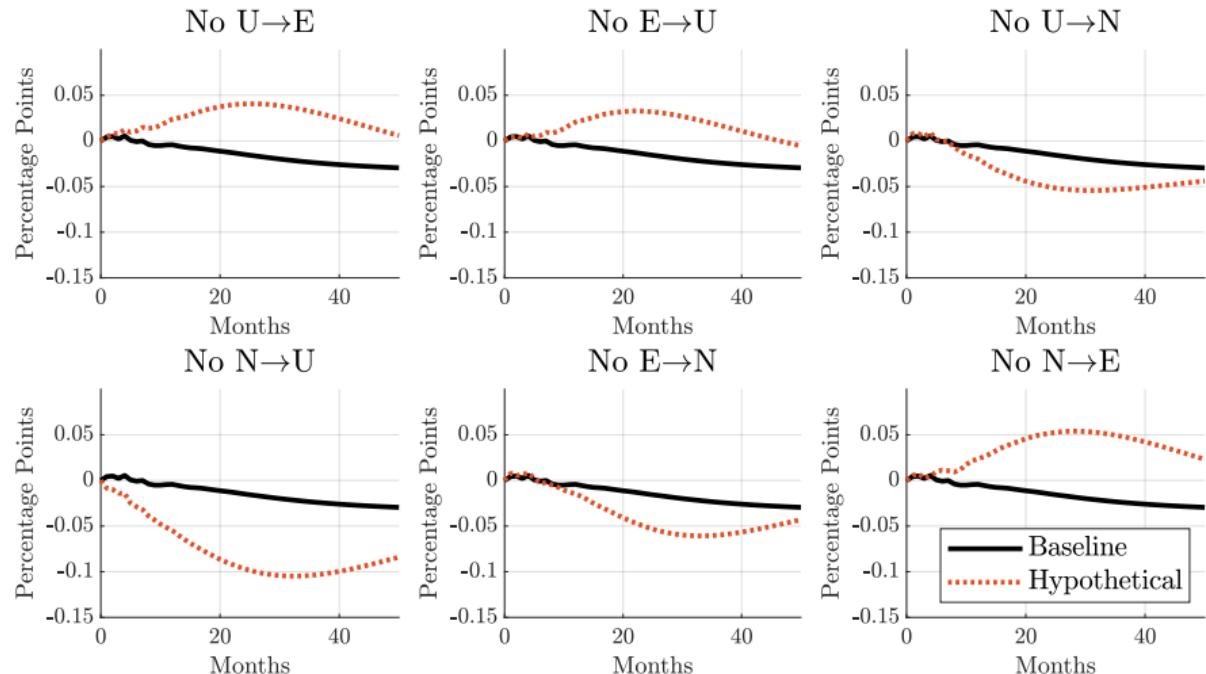
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# Time Series of Labor Market Flows



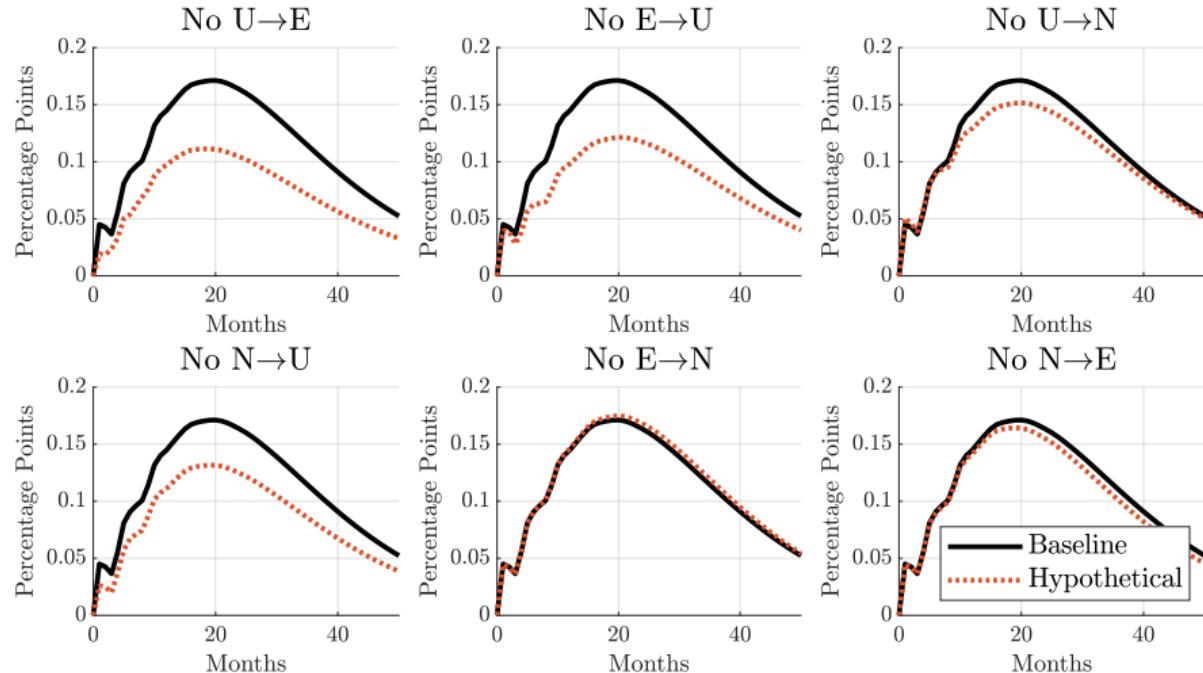
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# The Ins and Outs of Participation



- ▶  $E \rightarrow U$  and  $U \rightarrow E$  are important for participation cycle

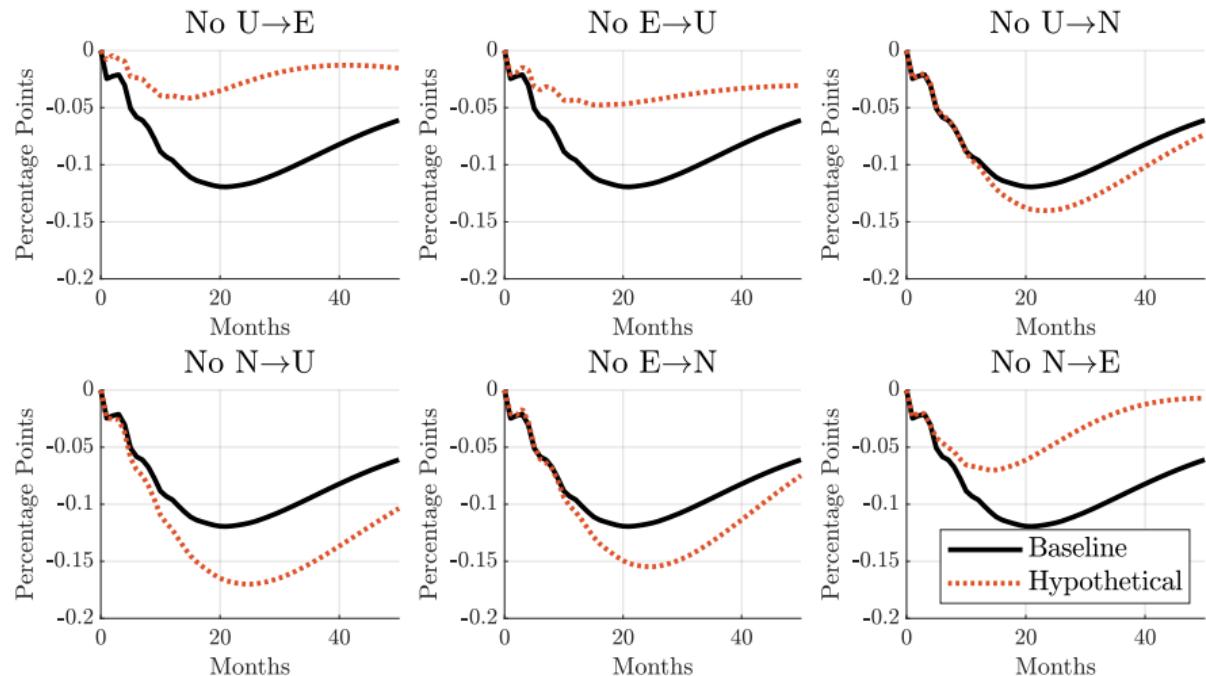
# The Ins and Outs of Unemployment



- ▶  $E \rightarrow U$  and  $U \rightarrow E$  roughly equally responsible for rise in unemployment

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# The Ins and Outs of Employment



- $N \rightarrow U$  more important than  $U \rightarrow N$  for supporting employment

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## Timing within a Model Period

1. All individuals draw a new value of **productivity**,  $z$ . Non-employed individuals draw an **i.i.d. search cost**,  $\kappa$ .
2. Employed individuals make **consumption/saving** decisions and choose whether or not to **quit their job**. Non-employed individuals make **consumption/saving** decisions and choose whether or not to **search for a job**.
3. Employed individuals who do not quit are exogenously **laid off** with probability  $\delta$ . Non-employed individuals receive **job offers** with probabilities  $f_s$  of  $f_{ns}$ , depending on whether or not they actively search.
4. Non-employed individuals who receive job offers **decide whether or not to accept** such offers.
5. UI-eligible non-employed individuals who search and either do not receive a job offer or do not accept an offer are subject to **UI expiry** with probability  $\delta_{UI}$ .

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## Value Functions

Let  $V_E(a, z)$ ,  $V_U(a, z, \kappa)$ , and  $V_N(a, z, \kappa)$  represent the values of being employed, UI-eligible non-employed, and UI-ineligible non-employed

- ▶  $a$  is assets
- ▶  $z$  is idiosyncratic productivity, AR(1) process in logs
- ▶  $\kappa$  is the cost of job search, iid from logistic distribution

$$V_E(a, z) = \max_{c, a'} \left\{ u(c) + \beta \max \left\{ \mathbb{E} V_N(a', z', \kappa'), \mathbb{E} [\delta_L V_U(a', z', \kappa') + (1 - \delta_L) V_E(a', z')] \right\} \right\}$$

subject to

$$c + a' = \bar{R}a + (1 - \tau)wz + T, \quad a' \geq 0$$

## Value Functions

Let  $V_E(a, z)$ ,  $V_U(a, z, \kappa)$ , and  $V_N(a, z, \kappa)$  represent the values of being employed, UI-eligible non-employed, and UI-ineligible non-employed

$$V_U(a, z, \kappa) = \max_{c, a'} \left\{ u(c) + \max \left\{ (1 - \kappa)\psi + \beta V_U^s(a', z), \psi + \beta V_U^{ns}(a', z) \right\} \right\}$$

subject to

$$c + a' = \bar{R}a + (1 - \tau) \min\{\phi wz, \bar{\phi}\} + T, \quad a' \geq 0$$

where

$$V_U^s(a', z) = f_s \cdot \max\{\mathbb{E} V_E(a', z'), \mathbb{E} \tilde{V}_U(a', z', \kappa')\} + (1 - f_s) \mathbb{E} \tilde{V}_U(a', z', \kappa')$$

$$V_U^{ns}(a', z) = f_{ns} \cdot \max\{\mathbb{E} V_E(a', z'), \mathbb{E} V_N(a', z', \kappa')\} + (1 - f_{ns}) \mathbb{E} V_N(a', z', \kappa')$$

$$\tilde{V}_U(a, z, \kappa) = \delta_{UI} V_N(a, z, \kappa) + (1 - \delta_{UI}) V_U(a, z, \kappa).$$

## Value Functions

Let  $V_E(a, z)$ ,  $V_U(a, z, \kappa)$ , and  $V_N(a, z, \kappa)$  represent the values of being employed, UI-eligible non-employed, and UI-ineligible non-employed

$$V_N(a, z, \kappa) = \max_{c, a'} \left\{ u(c) + \max \left\{ (1 - \kappa)\psi + \beta V_N^s(a', z), \psi + \beta V_N^{ns}(a', z) \right\} \right\} \quad (3)$$

subject to

$$c + a' = \bar{R}a + T, \quad a' \geq 0 \quad (4)$$

where

$$V_N^s(a', z) = f_s \cdot \max\{\mathbb{E} V_E(a', z'), \mathbb{E} V_N(a', z', \kappa')\} + (1 - f_s) \mathbb{E} V_N(a', z', \kappa')$$

$$V_N^{ns}(a', z) = f_{ns} \cdot \max\{\mathbb{E} V_E(a', z'), \mathbb{E} V_N(a', z', \kappa')\} + (1 - f_{ns}) \mathbb{E} V_N(a', z', \kappa')$$

# Model Parameters

Calibrated			
Parameter	Description	Value	Source/Target
$\beta$	Discount Factor	0.988	Quarterly MPC of 7-8%
$R$	Steady-State Real Interest Rate	1.001	1% Annual
$\gamma$	Risk Aversion Coefficient	2	Standard value
$\delta^{UI}$	Benefit Exhaustion Probability	0.167	Expected duration of UI
$w$	Steady-State Wage	1	Normalization
$\alpha$	Efficiency of Passive Search	0.6	Job-finding rate from N
$\phi$	UI Replacement Rate	0.50	Graves (2023)
$\bar{\phi}$	Maximum UI Payments	1.85	Graves (2023)
$\tau$	Labor Income Tax Rate	0.33	Auclert et al. (2021)
$T$	Lump-sum Transfer	0.24	Auclert et al. (2021)

Estimated			
Parameter	Description	Value	Standard Error
$\rho_z$	Persistence of Labor Productivity	0.960	(0.004)
$\sigma_z$	Standard Deviation of Labor Productivity	0.362	(0.023)
$\mu_\kappa$	Mean Value of Search Cost	0.783	(0.105)
$\sigma_\kappa$	Dispersion of Search Cost	0.167	(0.022)
$\psi$	Value of Leisure	0.421	(0.107)
$\delta$	Steady-State Layoff Rate	0.019	(0.002)
$f_s$	Steady-State Job-Finding Rate	0.273	(0.028)

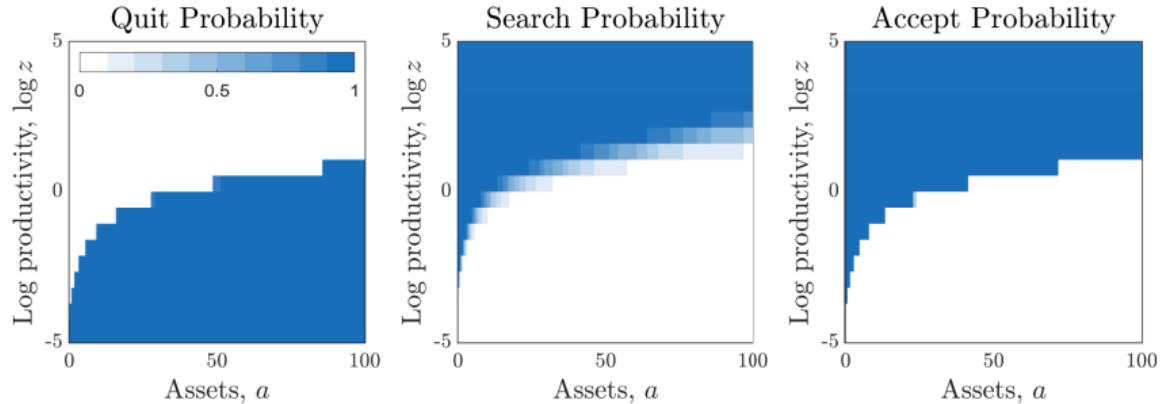
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## Steady-State Labor Market Flows

Transition Rate	Model	Data
EU	0.0143	0.0143
EN	0.0297	0.0296
UE	0.2547	0.2547
UN	0.2260	0.2262
NE	0.0462	0.0461
NU	0.0253	0.0252

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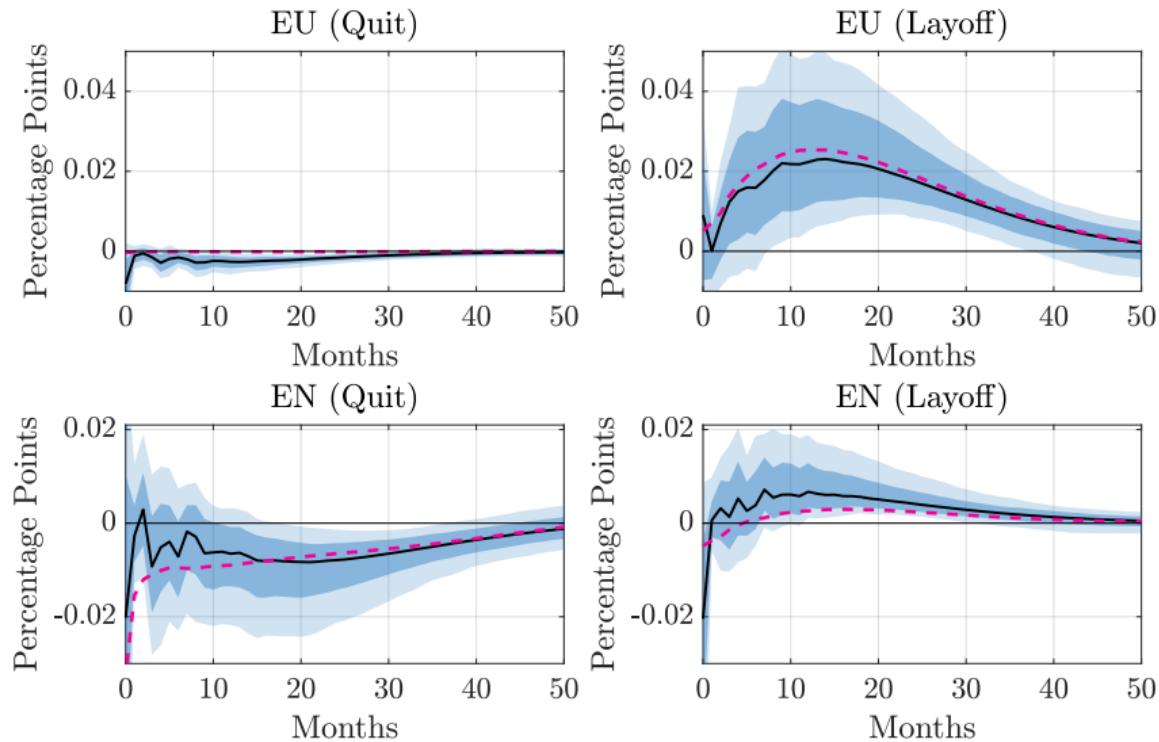
# Steady State Policy Functions



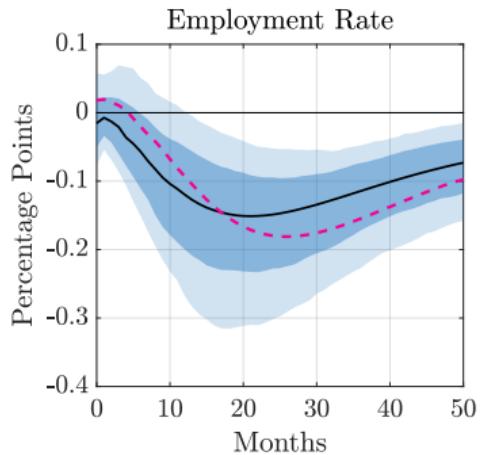
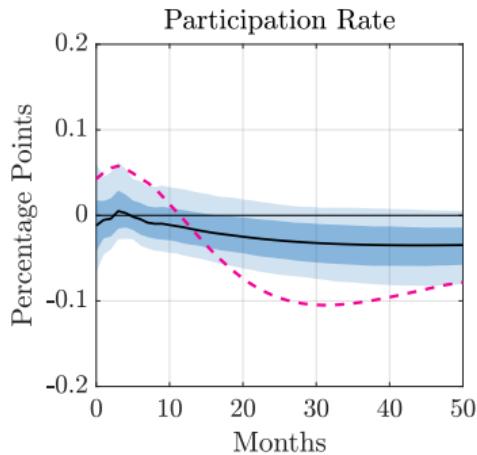
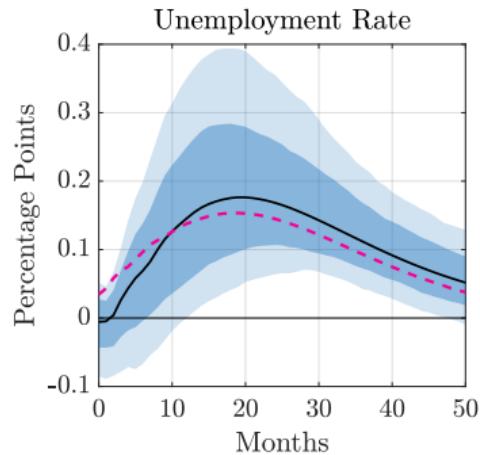
- Substantial variation in attachment to employment across state space

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## Response of Quits and Layoffs: Model vs Data



# Response of Labor Market Stocks: Model vs Data



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