

The Labor Demand and Labor Supply Channels of Monetary Policy

Sebastian Graves¹, Christopher Huckfeldt², and Eric Swanson³

¹University of Cambridge

²Federal Reserve Board

³UC Irvine & NBER

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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 \Rightarrow labor is **demand-determined**
 - ▶ NK + **search-and-matching** \Rightarrow 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”, ε_t^{mp}

- ▶ First column of S , denoted s_1 , describes the impact effect of the structural monetary policy shock ε_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:

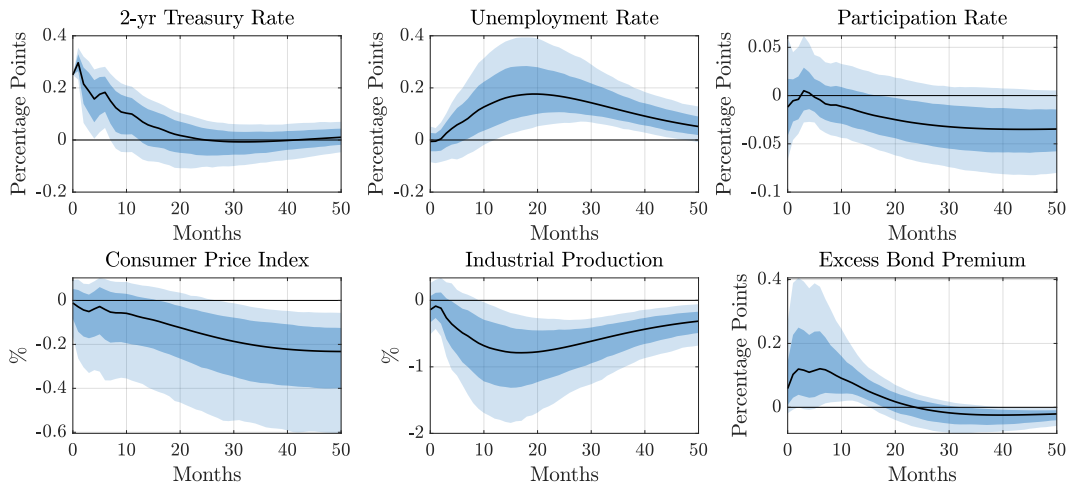
$$\mathbb{E} \{ z_t \varepsilon_t^{mp} \} \neq 0 \quad (\text{relevance})$$

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

- ▶ 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

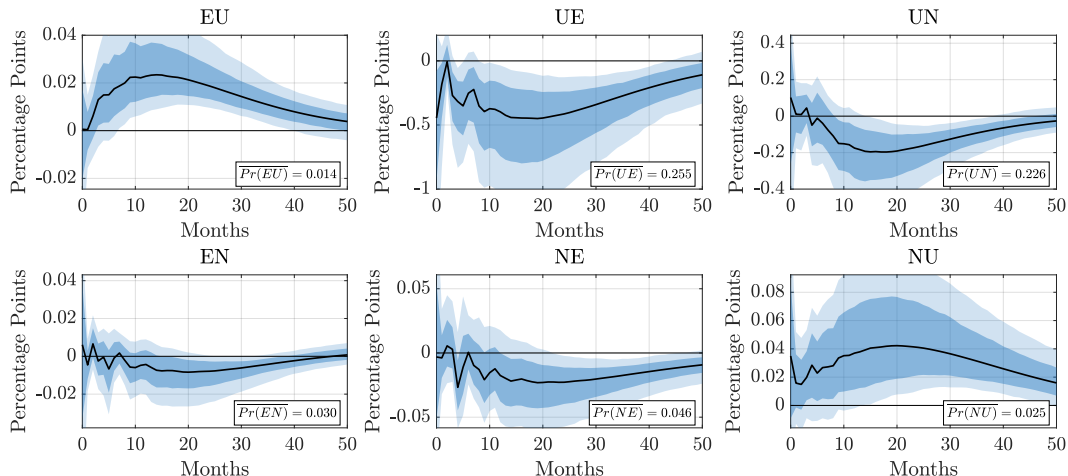
Baseline VAR



Robust F -statistic: 13.05

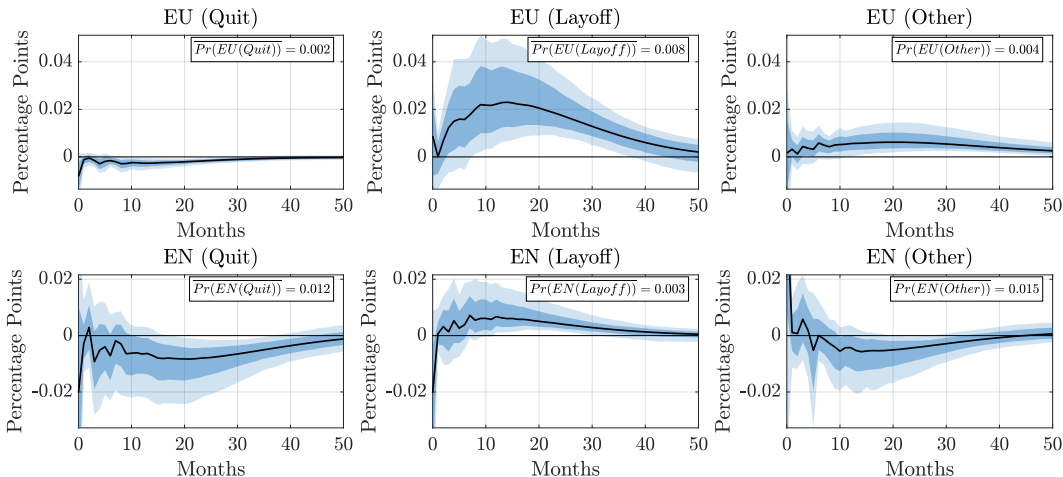
- ▶ Monthly data, 1978:M1–2019:M12
- ▶ Dark and light shaded regions report **68%** and **90%** confidence intervals

Response of Labor Market Flows



- ▶ $p_{EU} \uparrow$ & $p_{UE} \downarrow \Rightarrow$ Consistent with narrative of **decline** in labor demand
- ▶ $p_{NU} \uparrow$, $p_{UN} \downarrow$, & $p_{EN} \downarrow \Rightarrow$ 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)

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

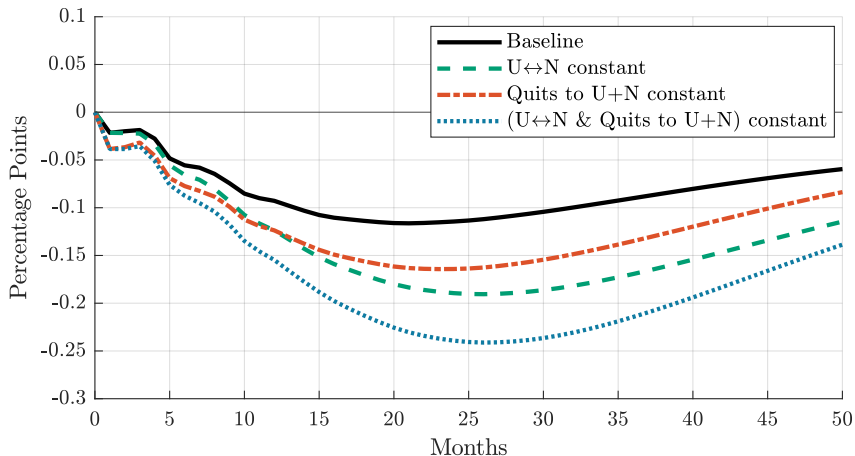
- ▶ Assess contribution of flow p_{XY} to stock Z by replacing $\{p_{XY}\}_t$ with steady-state value, \tilde{p}_{XY}
- ▶ Study behavior of resulting hypothetical stock \check{Z} to isolate role of flow p_{XY}
- ▶ Assess role of **supply-driven flows** in shaping impulse response of **employment**

▶ Ins and Outs of Employment

▶ Ins and Outs of Unemployment

▶ Ins and Outs of Participation

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**

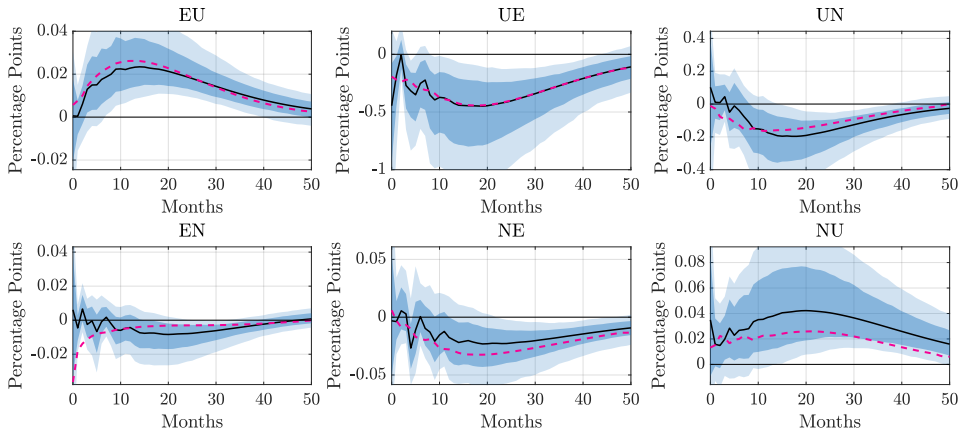
Model Implications for Monetary Policy Shock

- ▶ 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

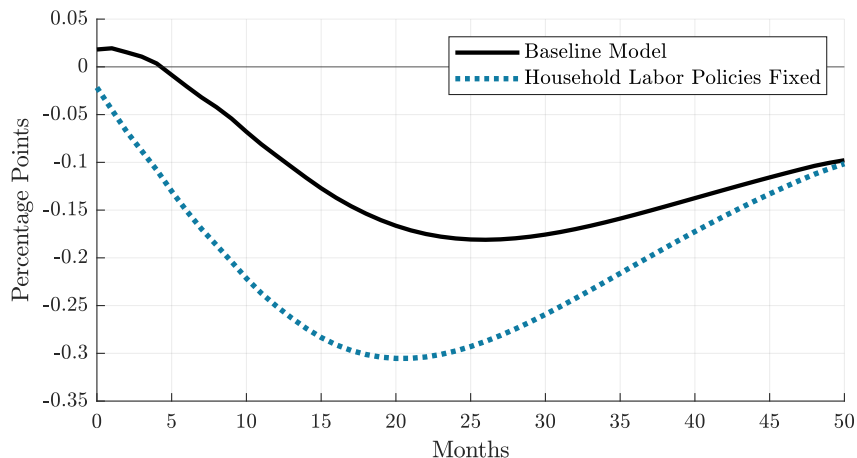
▶ Response of Quits and Layoffs

▶ 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

Cyclical Properties of Labor Market Stocks

	Employment- Population Ratio	Unemployment Rate	Participation Rate
$\text{mean}(x)$	61.14	6.19	65.16
$\text{std}(x)/\text{std}(Y)$	0.72	8.25	0.23
$\text{corr}(x, Y)$	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.

Cyclical Properties of Labor Market Flows

	EU	EN	UE	UN	NE	NU
$\text{mean}(x)$	0.014	0.030	0.255	0.226	0.046	0.025
$\text{std}(x)/\text{std}(Y)$	5.20	2.46	5.69	4.14	3.00	5.22
$\text{corr}(x, Y)$	-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

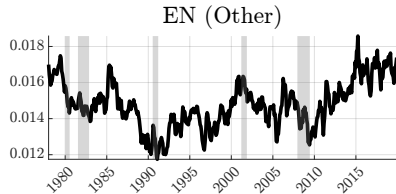
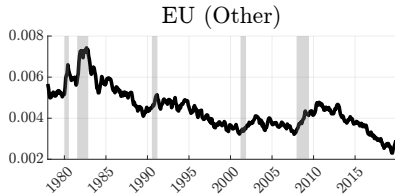
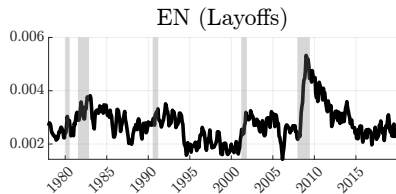
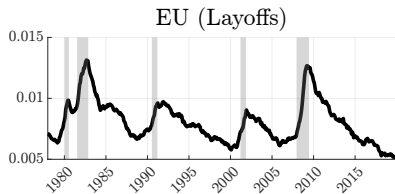
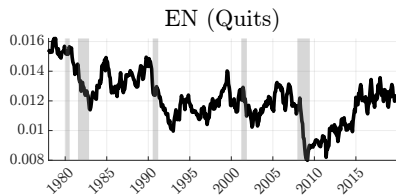
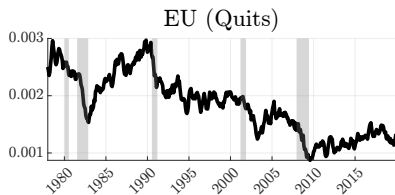
Note: x denotes the variable in each column, Y denotes HP-filtered log real GDP. Standard deviations and correlations are computed for HP-filtered quarterly averages.

- ▶ 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



Relevance of Distinction Between Quits and Layoffs

Post-EU Transition Rates: Quits vs Layoffs

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

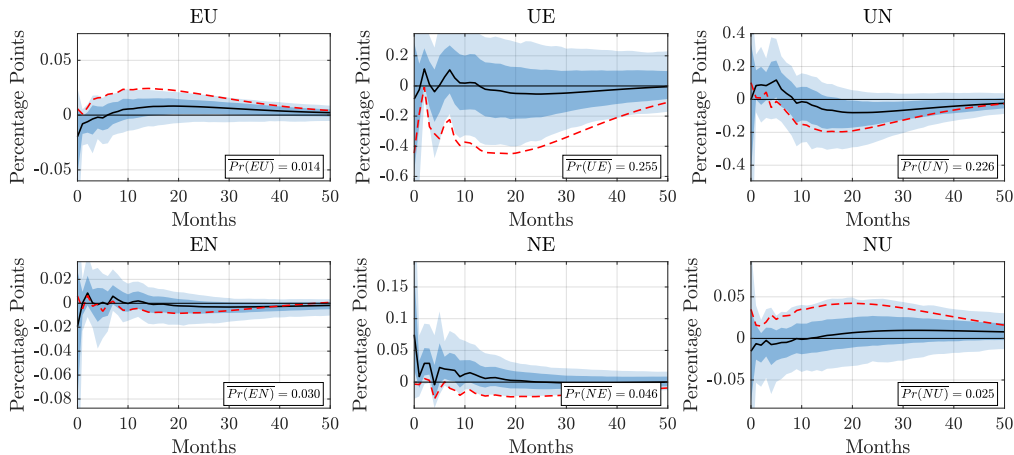
Note: Transition rates are shown for individuals that are in their first month of unemployment following an employment spell, split by reason for unemployment.

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.

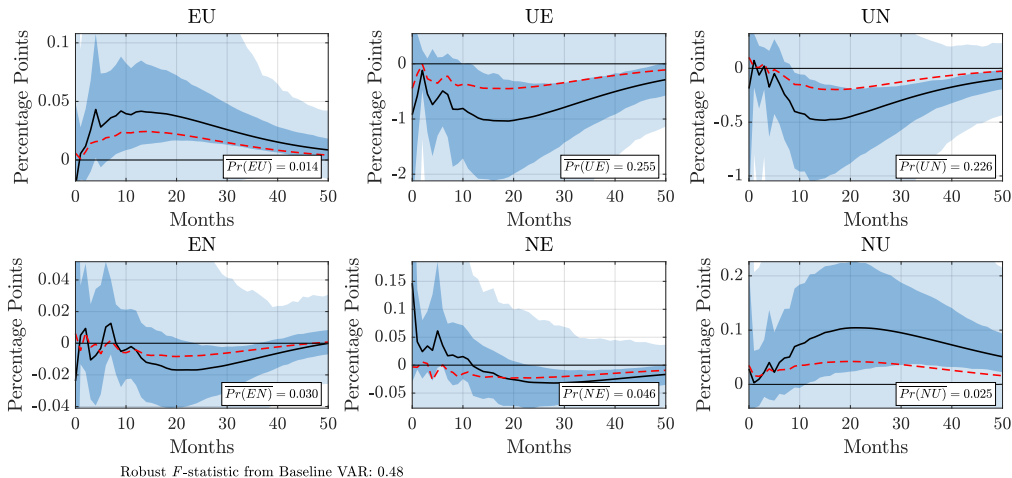
Labor Market Flows: No Speeches (Not Orthogonalized)



Robust F -statistic from Baseline VAR: 9.30

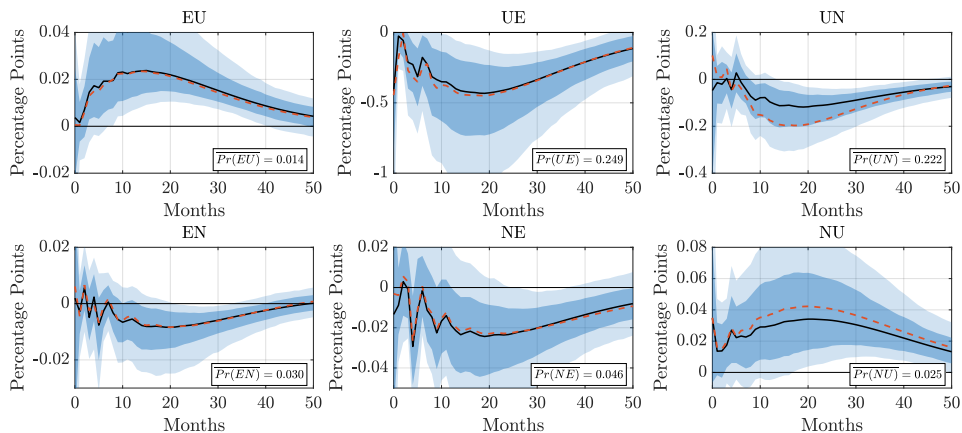
- ▶ High-frequency shocks from announcements only (e.g. Gertler & Karadi (2015))
- ▶ Dashed red lines report our baseline estimates

Labor Market Flows: No Speeches (Orthogonalized)



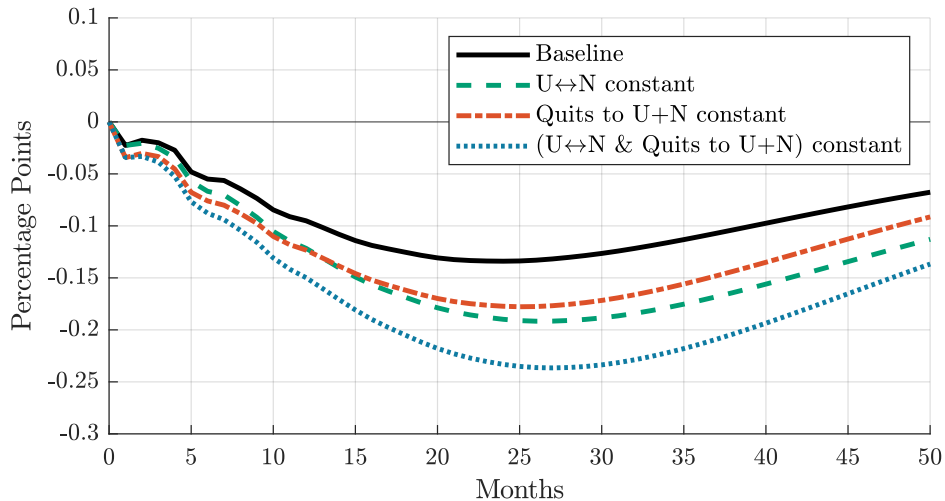
- ▶ From announcements only, orthogonalized as in Bauer & Swanson (2023)
- ▶ Dashed red lines report our baseline estimates

Labor Market Flows: Holding Composition Fixed

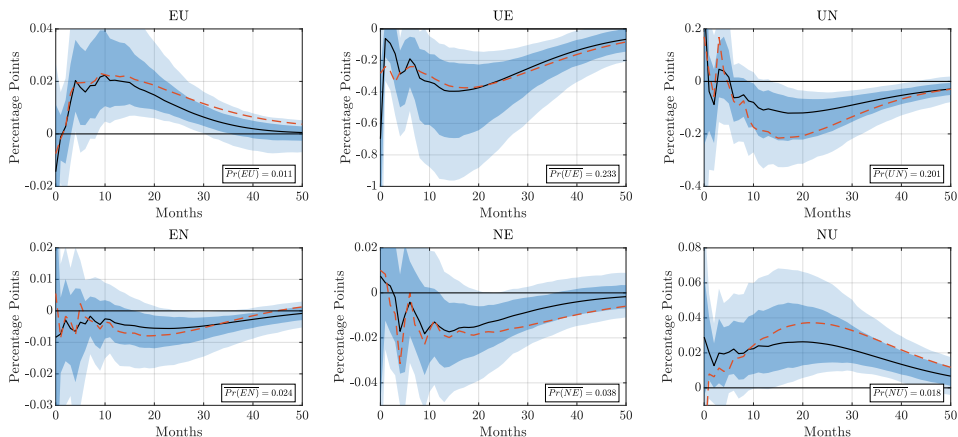


- ▶ Composition-adjusted flows by ex-ante characteristics, à la Elsby et al. (2015)
- ▶ Fix shares using bins for age \times gender \times education \times reason for unemployment
- ▶ Dashed red lines report our baseline estimates

Decomposing Employment Response: Holding Composition Fixed

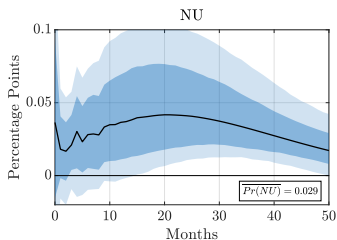
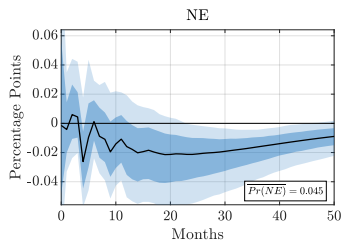
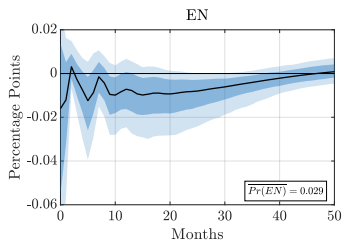
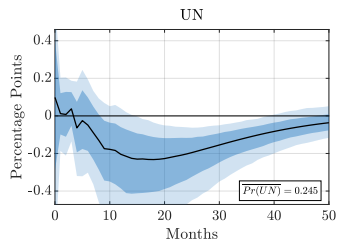
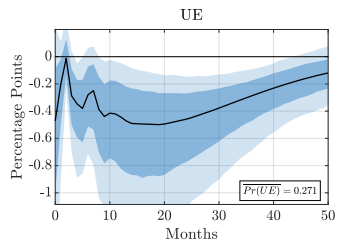
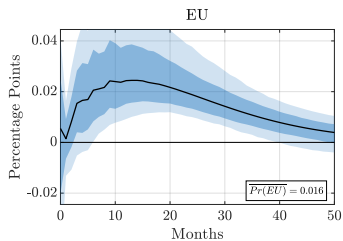


Labor Market Flows: Holding Composition Fixed (Full Controls)



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

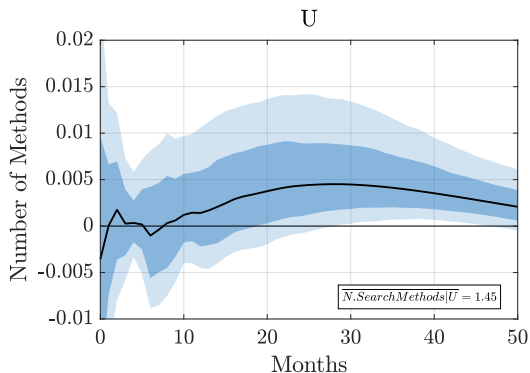
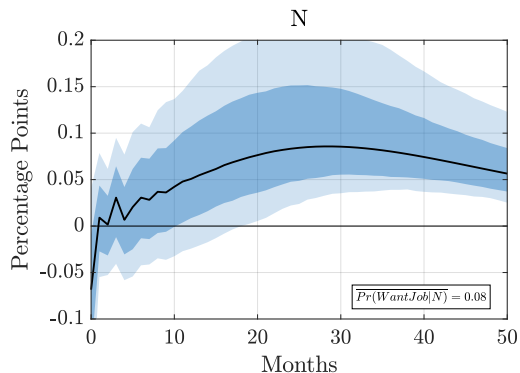
Labor Market Flows: Corrected for Time-Aggregation



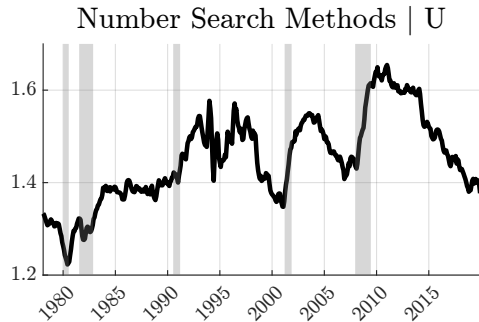
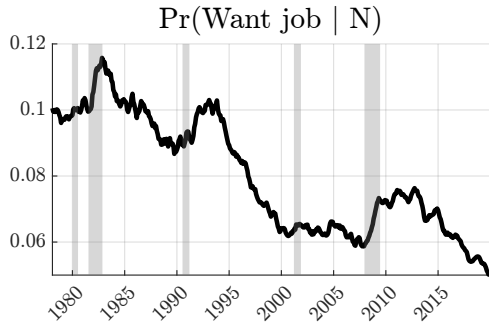
Intensive Margins of Labor Supply

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

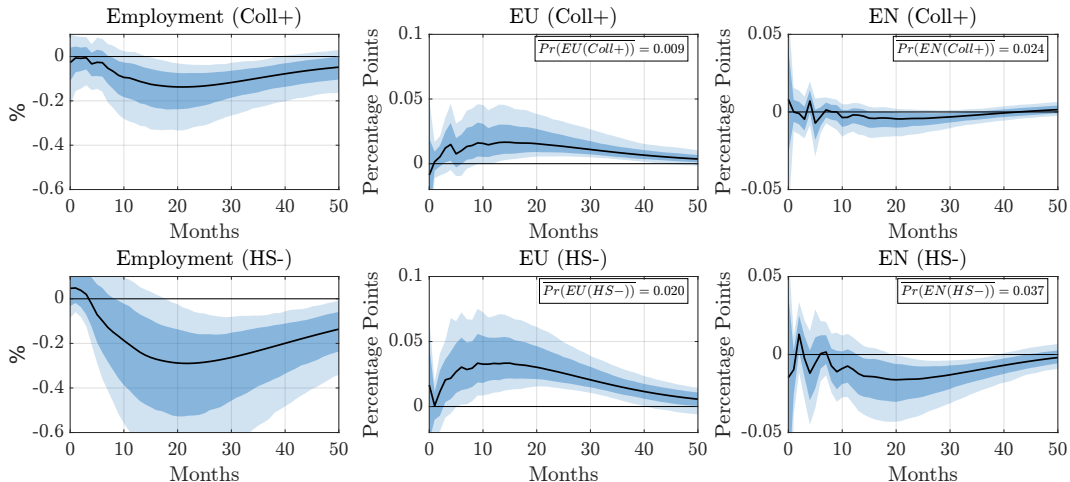


Intensive Margins: Time-Series



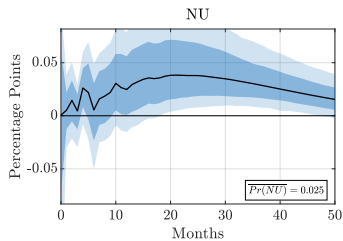
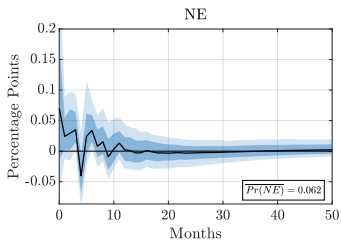
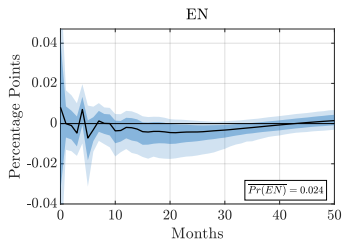
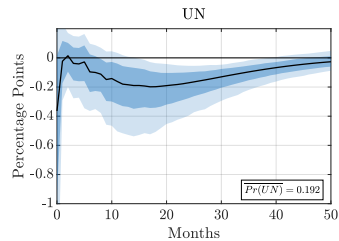
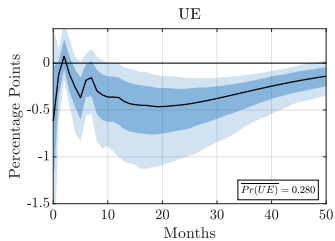
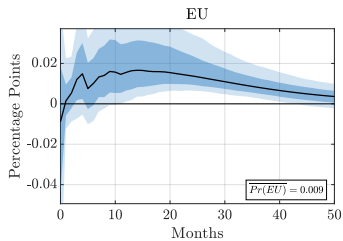
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Heterogeneity in Labor Market Responses: Education



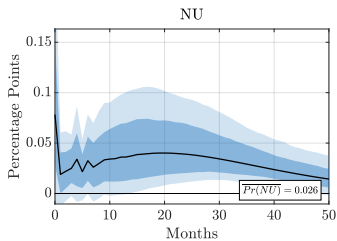
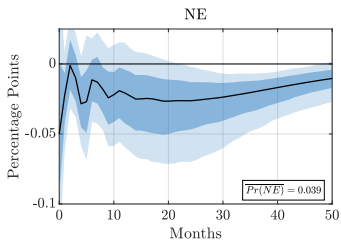
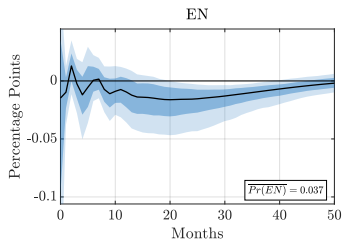
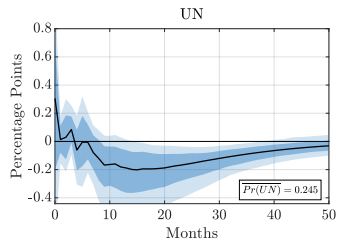
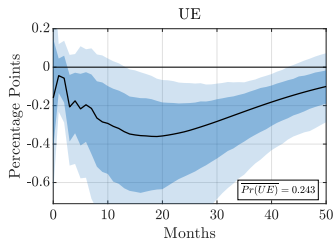
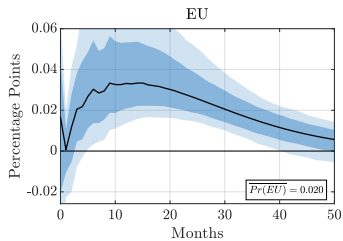
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Labor Market Flows: Higher-Educated



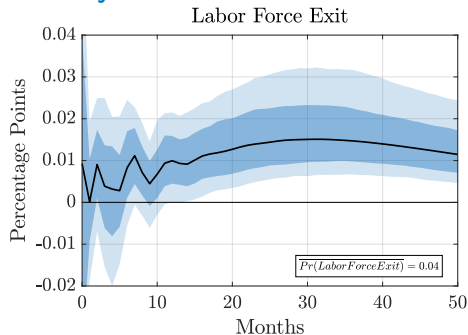
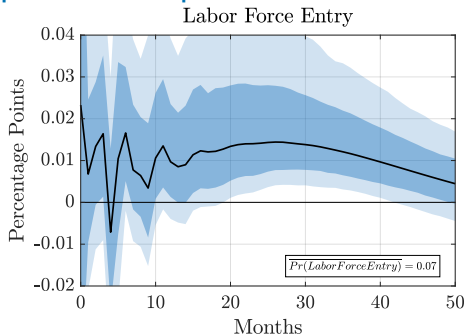
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Labor Market Flows: Lower-Educated



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Participation: Response of Labor Force Entry and Exit



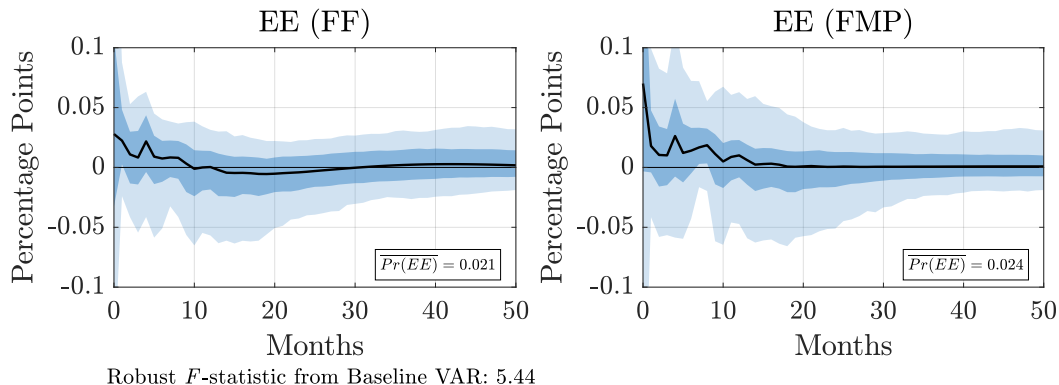
- ▶ Participation falls due to higher exit rate, offset by rise in entry
- ▶ Increase in exits driven by u_t , attenuated by EN_t and UN_t

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

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

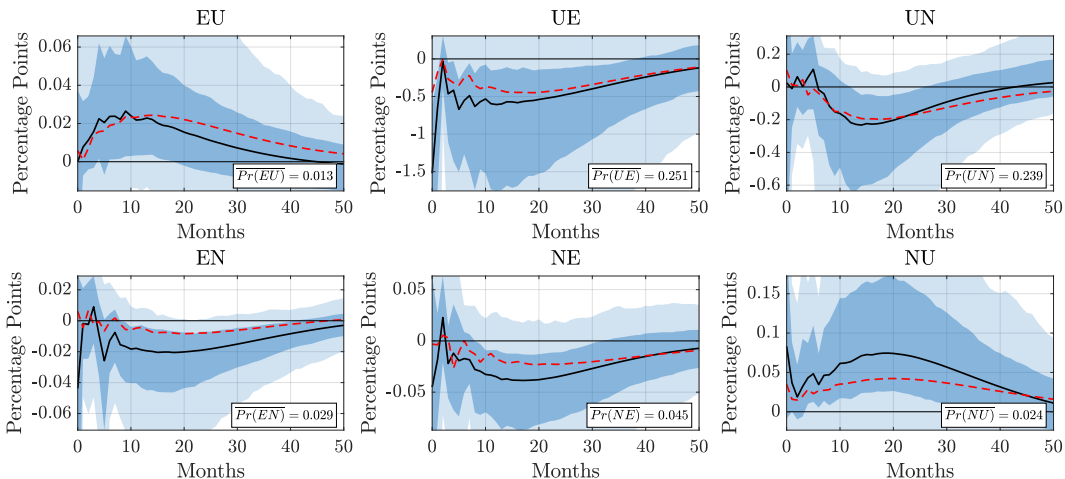
where u_{t-1} denotes the unemployment rate (and $\overline{UN} \gg \overline{EN}$)

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



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

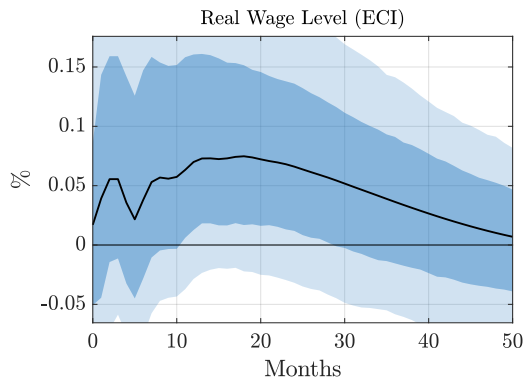
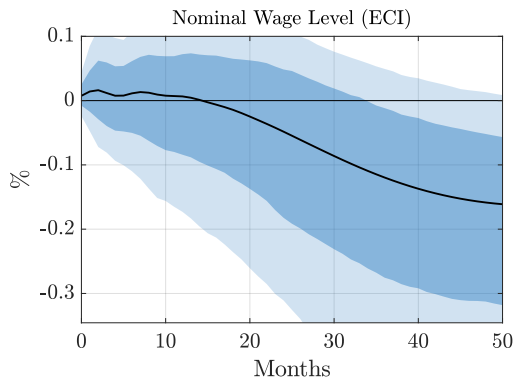
Response of Labor Market Flows (1995-2019)



Robust F -statistic from Baseline VAR: 5.44

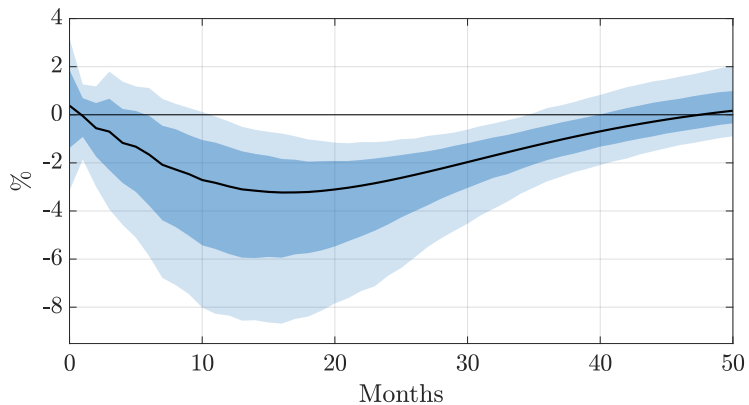
- ▶ Dashed red lines report impulse responses using full sample

Response of Wages

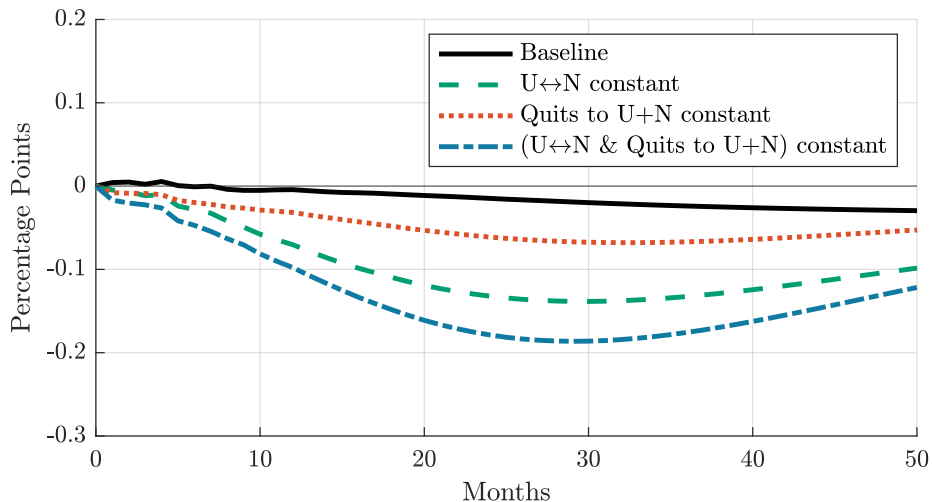


- ▶ Nominal wages **decline more slowly** than CPI
- ▶ So **real wages rise slightly** in the short-run

Response of Vacancies

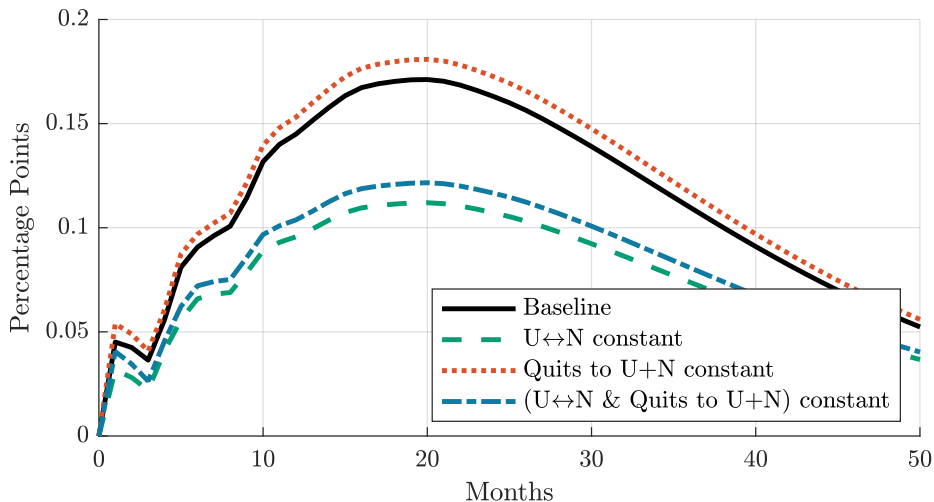


Participation Response to a Monetary Policy Shock



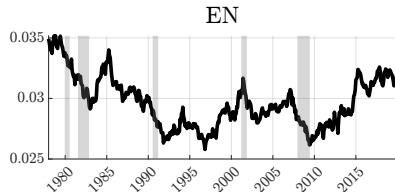
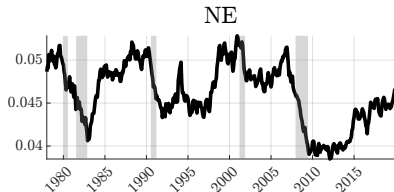
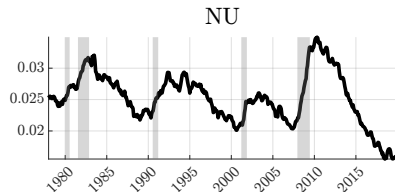
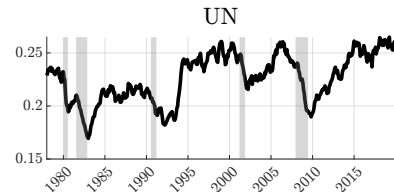
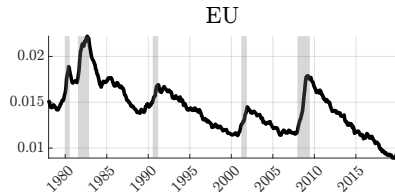
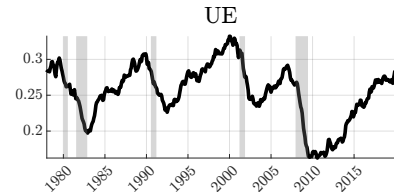
► With response of **supply-driven flows** fixed \Rightarrow Participation far **more procyclical**

Unemployment Response to a Monetary Policy Shock



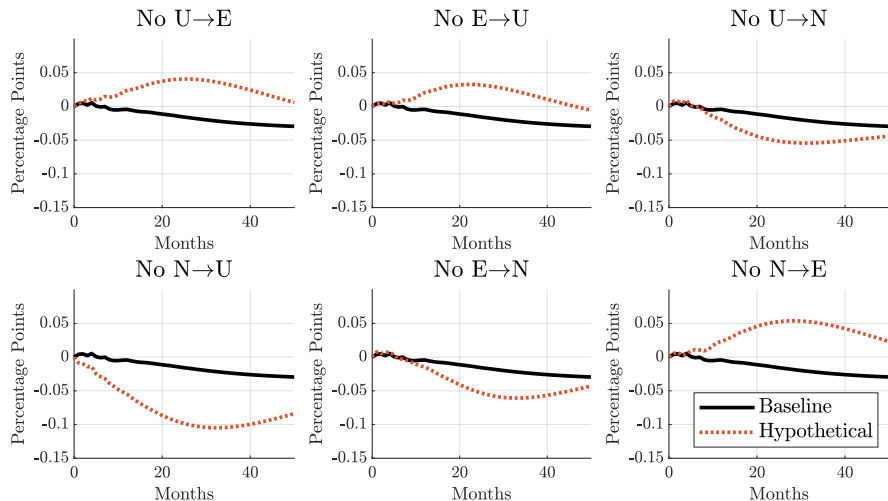
- ▶ Response of **quits** not important for unemployment dynamics

Time Series of Labor Market Flows



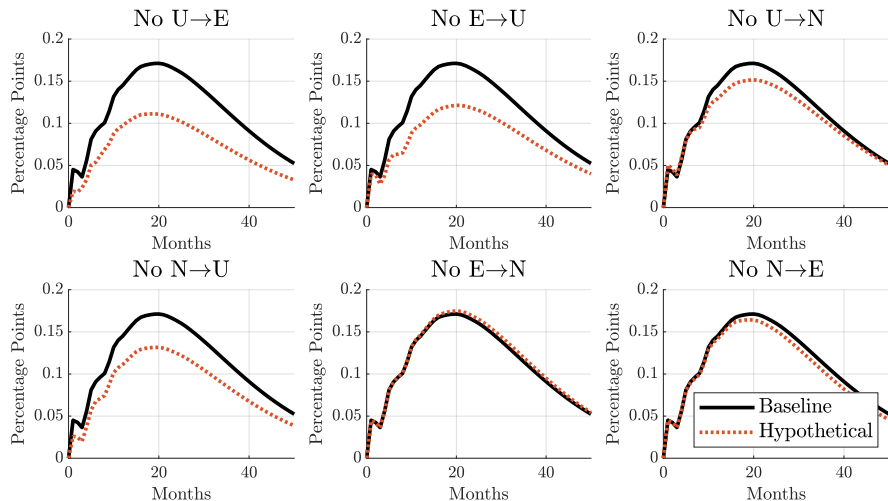
[← Back](#)

The Ins and Outs of Participation



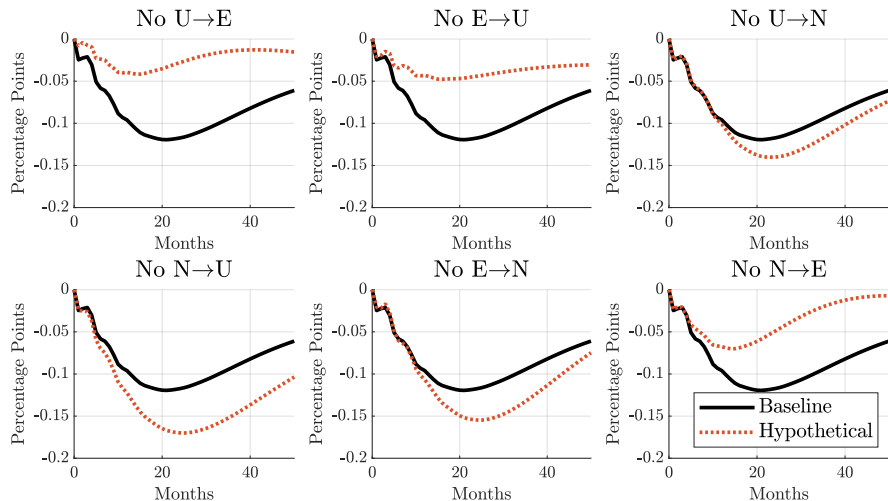
- ▶ $E \rightarrow U$ and $U \rightarrow E$ are important for participation cycle

The Ins and Outs of Unemployment



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

The Ins and Outs of Employment



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

Timin within a Model Period

1. All individuals draw a new value of **productivity**, z . Non-employed individuals draw an **i.i.d. search cost**, κ .
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 δ . 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 δ_{UI} .

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
- ▶ κ 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

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

subject to

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

where

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

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

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

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

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

subject to

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

where

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

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

Model Parameters

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

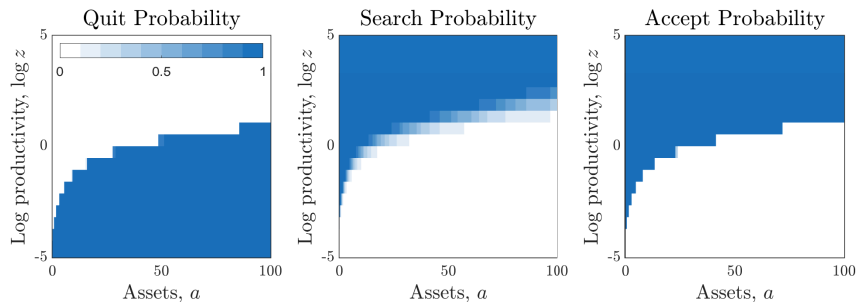
Estimated			
Parameter	Description	Value	Standard Error
ρ_z	Persistence of Labor Productivity	0.960	(0.004)
σ_z	Standard Deviation of Labor Productivity	0.362	(0.023)
μ_κ	Mean Value of Search Cost	0.783	(0.105)
σ_κ	Dispersion of Search Cost	0.167	(0.022)
ψ	Value of Leisure	0.421	(0.107)
δ	Steady-State Layoff Rate	0.019	(0.002)
f_s	Steady-State Job-Finding Rate	0.273	(0.028)

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

◀ Back

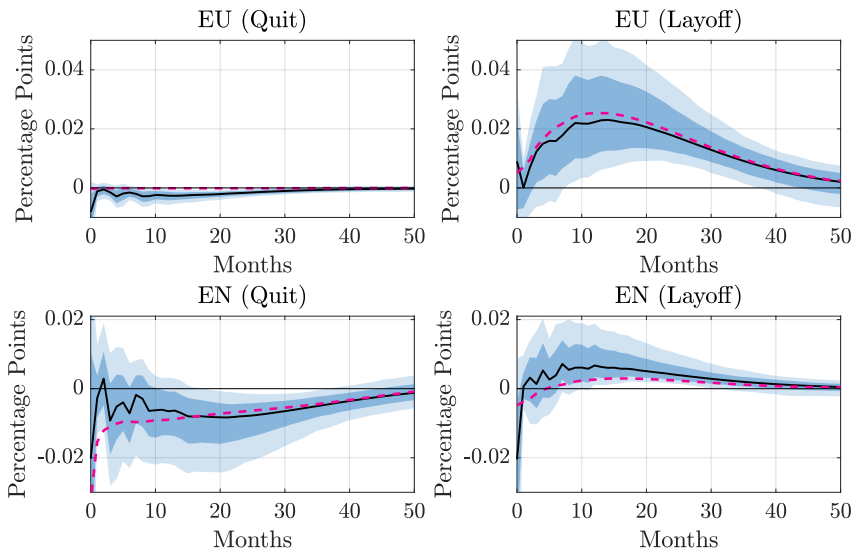
Steady State Policy Functions



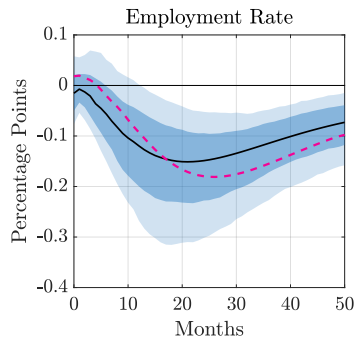
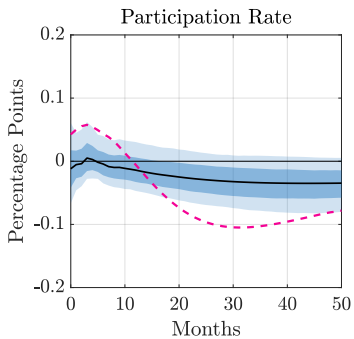
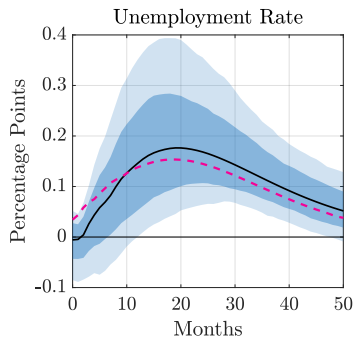
- ▶ Substantial variation in attachment to employment across state space

◀ Back

Response of Quits and Layoffs: Model vs Data



Response of Labor Market Stocks: Model vs Data



◀ Back

