The Macroeconomic Effects of Unemployment Insurance Extensions: A Policy Rule-Based Identification Approach

Rubén Domínguez-Díaz[1] Donghai Zhang[2]

[1]Banco de España

[2]National University of Singapore & University of Bonn

2nd Banco de España and Banco de Portugal Conference on Labour Markets

Introduction

Unemployment insurance (UI) duration systematically extended during bad times in the US

A four-fold increase during Great Recession and a three-fold increase during pandemic
Stands out as one of the main countercyclical stabilization measures

Opposing effects of UI extensions on unemployment:

Supply: increase wages and depress hiring, moral hazard
Demand: increase transfers to high-MPC unemployed and reduce precautionary savings

Mixed results in the literature leave debate unsettled

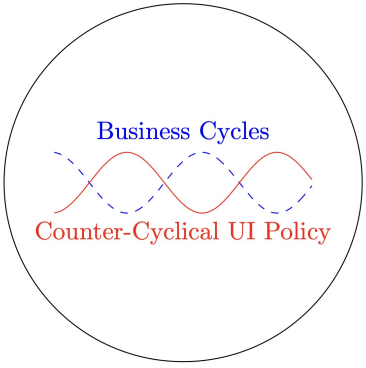
Contractionary effects: Hagedorn *et al.* (2019), Johnston and Mas (2018), Acosta et al. (2023)
Expansionary or non-negative effects: Di Maggio and Kermani (2016),Chodorow-Reich *et al.* (2018),Boone *et al.* (2021), Dieterle *et al.* (2020)

What we do

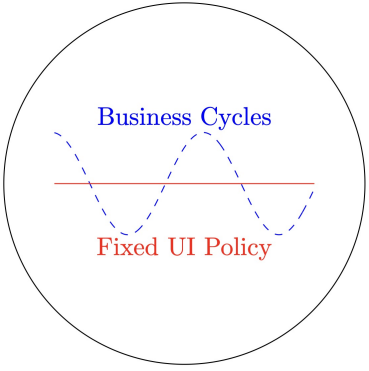
Question: What are the macroeconomic effects of *systematic* UI extensions?

- **Empirics**:
  - Exploit **non-linear design of UI policy and government spending shocks** to assess macroeconomic effects of UI extensions
- **Model**:
  - Het. households **model** of SOE in a currency union that accounts for demand and supply-side effects

Identification Strategy: the Ideal Scenario

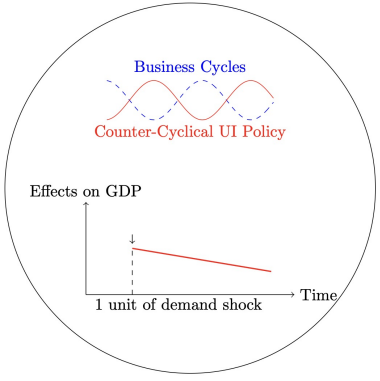


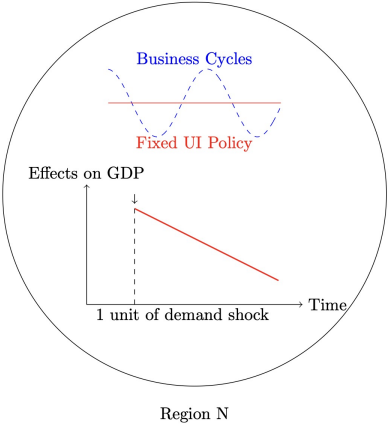
Region A



Region N

Identification Strategy: the Ideal Scenario





Differences in UI policy ⇒ differences in the effects of a demand shock

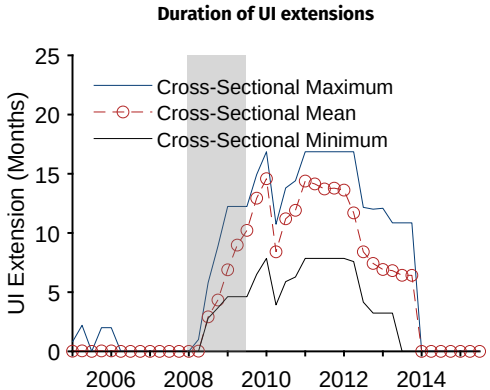
Unemployment Insurance in the US: Background

Variation in UI duration across time and states:

- Regular UI duration (26 weeks): irrespective of local unemployment
- EB program: +1 quarter if unemployment above threshold
- EUC program (GFC): up to +4 quarters depending on unemployment

Same fall in unemployment may lead to different UI changes depending on *pre-existing* UI duration, e.g.

- States with regular vs. extended UI
- States with different levels of extended UI



What we find literature full

- Exploit the **non-linear design of UI policy and G shocks to approximate ideal scenario**:
  1. UI extension response to economic activity depends on pre-existing level of UI duration

     Extended UI → larger cut in UI duration
  2. Fiscal multipliers depend on pre-existing level of UI duration

     Extended UI → *smaller* fiscal multiplier

- Approximation of infeasible experiment, **address limitations**:
  3. Account for heterogeneity slackness: fiscal multiplier *larger* when U high
  4. Unobserved covariates: UI measurement error from Chodorow-Reich *et al.* (2018)

- Het. households **model** of SOE that accounts for demand and supply-side effects:
  5. Replicates well empirical results
  6. UI multiplier ≈ 0.11: MPCs and insurance amplify, while wage flexibility reduces it

Empirical Evidence

Data

Quarterly regional US dataset from Regional Economic Accounts of BEA (2005Q1 - 2015Q4)

- Quarterly GDP and government value added at state-level
- Gov. value added: spent within the region, excludes UI benefits

Quarterly employment data

- Employed persons obtained from Bureau of Labor Statistics (BLS)
- State-level population obtained from Boone *et al.* (2021)

Government spending shocks as in Blanchard and Perotti (2002):

- Government spending predetermined within the quarter

UI benefits extensions:

- Actual additional UI duration for each US state (Chodorow-Reich *et al.*, 2018)

Empirical Evidence

1. **Non-linear response of UI duration**
2. Fiscal multipliers & UI duration
3. Accouting for heterogeneity in slackness
4. Accouting for unobserved covariates

Non-linear responses of UI Duration

Non-linear response of UI duration $T^*_{i,t}$ to a given change in economic activity:

$$\sum_{j=0}^{h} T^*_{i,t+j} - T^*_{i,t-1} = \alpha_{i,h} + \delta_{t,h} + \boldsymbol{\beta_h} \sum_{j=0}^{h} \log(Y_{i,t+j} \backslash Y_{i,t-1}) + \gamma_h(L) Z_{i,t-1}$$
$$+ \boldsymbol{T^*_{i,t-1}} \left(\boldsymbol{\beta_h^{UI}} \sum_{j=0}^{h} \log(Y_{i,t+j} \backslash Y_{i,t-1}) + \gamma_h^{UI}(L) Z_{i,t-1} \right) + \eta_h T^*_{i,t-1} + \varepsilon_{i,t+h}, \quad h \geq 0,$$

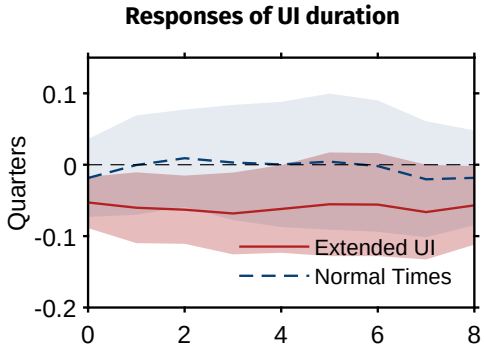
$\boldsymbol{Y_{i,t+j}}$: state i's GDP, instrumented with $\log(G_{i,t} \backslash G_{i,t-1})$ (Ramey and Zubairy, 2018)

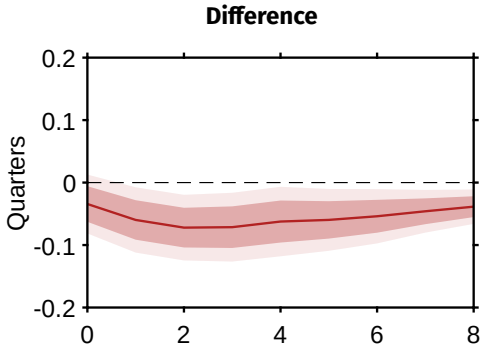
$\boldsymbol{\beta_h}$: effect of a fiscal-induced change in $Y_{i,t}$ on $T^*_{i,t}$ during "normal times"

$\boldsymbol{T^*_{i,t}}$: additional UI duration in state i

$\boldsymbol{\beta_h^{UI}}$: additional effect of extended UI benefits

Non-linear responses of UI Duration





Empirical Evidence

1. Non-linear response of UI duration
2. **Fiscal multipliers & UI duration**
3. Accouting for heterogeneity in slackness
4. Accouting for unobserved covariates

Empirical Specification – Fiscal Multipliers

Estimate **local fiscal multipliers** using state-dependent LPs (Jordà, 2005; Ramey and Zubairy, 2018)

$$\sum_{j=0}^{h} X_{i,t+j} = \boldsymbol{\beta_h} \sum_{j=0}^{h} \frac{G_{i,t+j} - G_{i,t-1}}{Y^*_{i,t-1}} + \gamma_h(L) Z_{i,t-1} + \boldsymbol{T^*_{i,t-1}} \left(\boldsymbol{\beta_h^{UI}} \sum_{j=0}^{h} \frac{G_{i,t+j} - G_{i,t-1}}{Y^*_{i,t-1}} + \gamma_h^{UI}(L) Z_{i,t-1} \right) + \alpha_{i,h} + \delta_{t,h} + \eta_h T^*_{i,t-1} + \varepsilon_{i,t+h}, \quad h \geq 0,$$

$G_{i,t+j}$: state $i's$ gov. spending over potential output $Y^*_{i,t-1}$

$X_{i,t+j}$: either state $i's$ GDP $Y_{i,t+j} - Y_{i,t-1} / Y^*_{i,t-1}$ or employment rate $N_{i,t+j} - N_{i,t-1} / N_{i,t-1}$

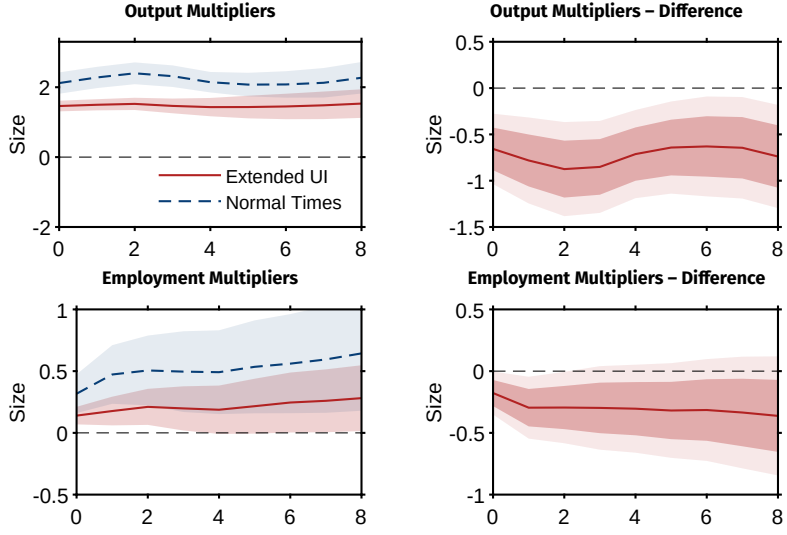
$\boldsymbol{\beta_H}$: multiplier during "normal times"

$\boldsymbol{T^*_{i,t}}$: additional UI duration in state i

$\boldsymbol{\beta_h^{UI}}$: additional effect on fiscal multiplier of extended UI benefits

Fiscal Multipliers & UI Extensions

Bartik Instrument | sub-sample



Empirical Evidence

1. Non-linear response of UI duration
2. Fiscal multipliers & UI duration
3. **Accouting for heterogeneity in slackness**
4. Accouting for unobserved covariates

Horse-race: Accounting for heterogeneity in slackness

Recessions or UI extensions?

If anything, fiscal multipliers *larger* in recessions (Auerbach and Gorodnichenko, 2012)

Yet, extend baseline to run **horse-race**:

$$\sum_{j=0}^{h} X_{i,t+j} = \beta_h \sum_{j=0}^{h} \frac{G_{i,t+j} - G_{i,t-1}}{Y^*_{i,t-1}} + \gamma_h(L) Z_{i,t-1} + \alpha_{i,h} + \delta_{t,h} + \eta_h T^*_{i,t-1} + \varepsilon_{i,t+h}$$
$$+ T^*_{i,t-1} \left(\beta_h^{UI} \sum_{j=0}^{h} \frac{G_{i,t+j} - G_{i,t-1}}{Y^*_{i,t-1}} + \gamma_h^{UI}(L) Z_{i,t-1} \right) + \mathbb{I}^{Slack}_{i,t-1} \left(\beta_h^{Slack} \sum_{j=0}^{h} \frac{G_{i,t+j} - G_{i,t-1}}{Y^*_{i,t-1}} + \gamma_h^{Slack}(L) Z_{i,t-1} \right)$$

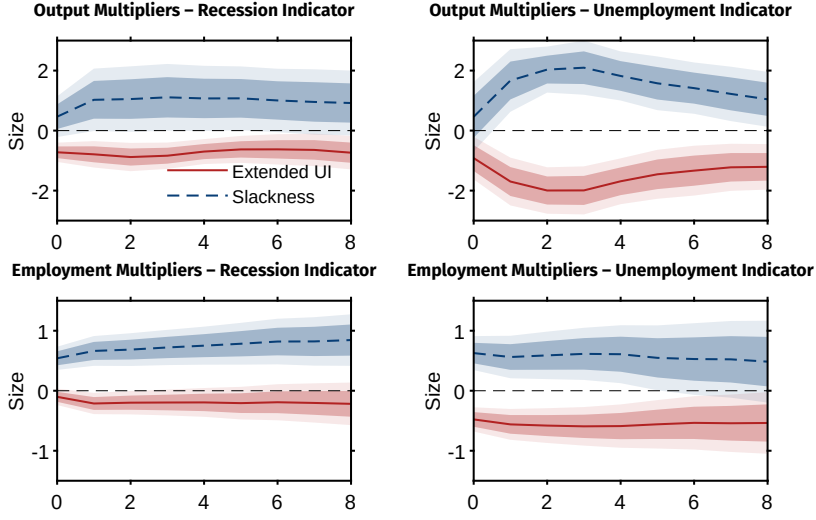
β_h^{UI}: additional effect of UI extended

$\mathbb{I}^{Slack}_{i,t-1}$: state i with 2 qrts. of negative growth or unemployment rate above 6.5%

β_h^{Slack}: additional effect of recession

Horse-race: Accounting for heterogeneity in slackness

sub-sample



Empirical Evidence

1. Non-linear response of UI duration
2. Fiscal multipliers & UI duration
3. Accouting for heterogeneity in slackness
4. **Accouting for unobserved covariates**

Accounting for unobserved covariates

Unobserved covariates driving results?

E.g., local wage rigidity can affect T^* and multiplier

If anything, source of *amplification*

Use **UI extensions due to unemployment measurement error** (Chodorow-Reich *et al.*, 2018) , ie. *orthogonal* to fundamentals

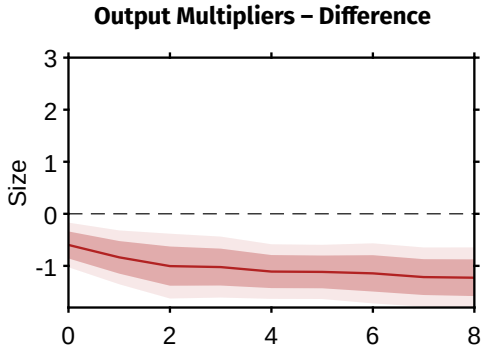
$$\sum_{j=0}^{h} X_{i,t+j} = \beta_h \sum_{j=0}^{h} \frac{G_{i,t+j} - G_{i,t-1}}{Y^*_{i,t-1}} + \gamma_h(L) Z_{i,t-1} + \alpha_{i,h} + \delta_{t,h} + \eta_h \widehat{T}_{i,t-1} + \varepsilon_{i,t+h}$$

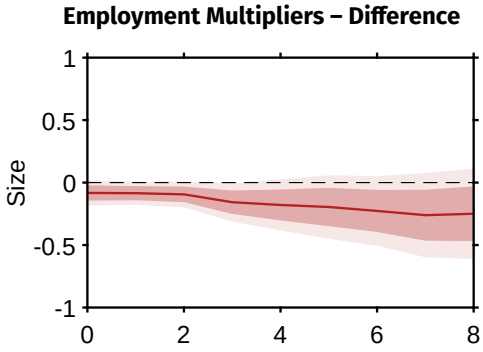
$$+ \widehat{T}_{i,t-1} \left(\beta_h^{\widehat{T}} \sum_{j=0}^{h} \frac{G_{i,t+j} - G_{i,t-1}}{Y^*_{i,t-1}} + \gamma_h^{\widehat{T}}(L) Z_{i,t-1} \right) + \mathbb{I}^{T^*}_{i,t-1} \left(\beta_h^{T^*} \sum_{j=0}^{h} \frac{G_{i,t+j} - G_{i,t-1}}{Y^*_{i,t-1}} + \gamma_h^{T^*}(L) Z_{i,t-1} \right)$$

$\widehat{T}_{i,t-1}$: UI extended due to *measurement error*

$\beta_h^{\widehat{T}}$: additional effect of UI extended *due to measurement error*

Accounting for unobserved covariates sub-sample





Model

Model Overview

Small-open-economy in a monetary union (Galí and Monacelli, 2005)

Search-and-matching frictions in the labor market (Mortensen and Pissarides, 1994)

Heterogeneous households (İmrohoroğlu-Bewley-Hugget-Aiyagary) see:

- **Receive unemployment benefits while unemployed if eligible** see
- **Risk of exhausting UI benefits** while unemployed

Firms see:

- Standard New Keynesian block
- Partly rigid **wages affected by UI policy**

Local fiscal authority see:

- **Government consumption** on home goods
- Sets **UI duration according to UI policy rule** that depends on unemployment

Calibration

Calibration table

- **UI duration rule** T_t^*:

$$\mathsf{T}_t^* = \begin{cases} T^* & \text{if} \quad U_t \leq \tilde{U}, \\ \mathsf{T}^* \left(\frac{U_t}{\tilde{U}} \right)^{\phi_U} & \text{else.} \end{cases}$$

  T^*: avg. UI duration at s.s. ("normal times") of 2 qrts.
  ϕ_U: elast. of T^* to unemp. increases in Great Recession of 3.88

- **Household-level moments**:

  Aggregate MPC 0.20 → discount factors
  Inc. drop unemployment & UI exhaustion (Ganong and Noel, 2019) → replacement rates
  Avg. time to lose & regain eligibility 2 qrts. (Mitman and Rabinovich, 2019) → transition probabilities

- **Wage rigidity**: elasticity of wage to output of 0.45 on impact (Hagedorn and Manovskii, 2008)

- **Remaining parameters** are set to conventional values in the literature

Steady State Results

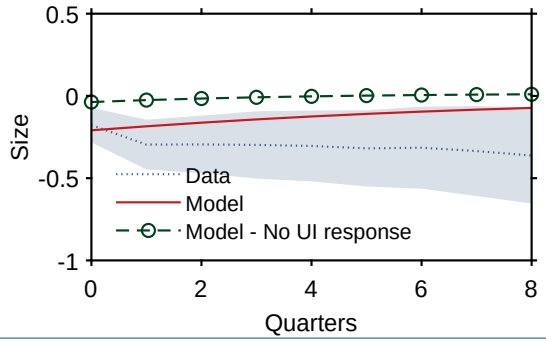
Untargeted Moments: Data vs. Model

Moment	Model	Data	Data Source
1. Marginal Propensities to Consume (MPC)			
Quarterly Agg. MPC (targeted)	0.20	0.20	Parker and Broda (2013)
Annual MPC Employed	0.49	0.47	Kekre (2022)
Annual MPC Unemployed	0.64	0.72	Kekre (2022)
2. Consumption and Unemployment			
Cons. drop during unemp. w/ UI benefits	6pp	8pp	Ganong and Noel (2019)
Cons. drop during unemp. w/o UI benefits	19pp	24pp	Ganong and Noel (2019)
Employed's cons. response to job loss risk	-0.62%	-0.70%	Graves (2023)

UI Extensions & Fiscal Multipliers in the model

UI Extensions & Fiscal Multipliers in the model IRFs

- Mimic empirical set up: consider the effects of G shock without extended UI (steady state) vs. extended UI (in a recession), and then compute difference in fiscal multipliers
- **Model matches perfectly the difference in fiscal multipliers on impact**
- Model **without UI response predicts no difference in fiscal multipliers**



UI Multiplier & Channels

UI Multiplier

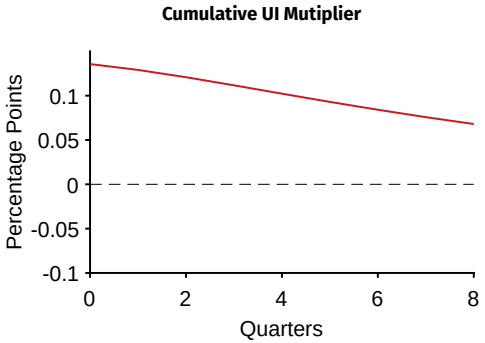
- **UI multiplier** as a useful summary statistic:

$$\text{UI}_h^{\text{M}} = \frac{\sum_{t=0}^{h} N_{t|T^*>0} - N_{t|T^*=0}}{\sum_{t=0}^{h} T^*_{t|T^*>0} - T^*_{t|T^*=0}}.$$

- **One-year multiplier** 0.11: one-quarter extensions raises employment 0.11 p.p.
- Within the ballpark of empirical estimates including positive effects:

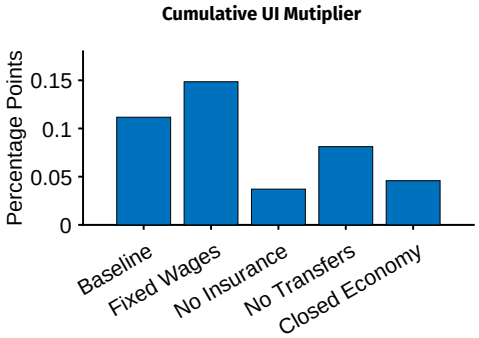
  Chodorow-Reich *et al.* (2018) $\approx 0.09 p.p.$

  Boone *et al.* (2021) ≈ 0.24 p.p.



Transmission Channels of UI Extensions dynamic

- **Main channels** drive effects of UI extensions:
  1. **Wages**: improves outside option and raises wages
  2. **Insurance**: reduces the need to accumulate precautionary savings
  3. **Transfers**: increases transfers to unemployed workers, households with high MPCs
  4. **Closed Economy**: at the union-wide level, monetary policy response stabilizes demand and reduces multiplier



Conclusion

Conclusion

Stabilization consequences of **countercyclical UI extensions**?

Exploit institutional **non-linear design of UI policy** in the US

- Government spending crowds out UI duration
- UI extensions reduce local fiscal multipliers
- Effects are unlikely to be explained by recessions or unobserved covariates

Model: SOE in monetary union with equilibrium unemployment

- Heterogeneous agents economy rationalizes empirical findings
- One-year UI multiplier of 0.11
- Transfers to **high-MPC unemployed** and **insurance** both key in driving results

References (1/5)

Auclert, A., Rognlie, M., Souchier, M. and Straub, L. (2021). *Exchange rates and monetary policy with heterogeneous agents: Sizing up the real income channel*. Tech. rep., National Bureau of Economic Research.

Auerbach, A. J. and Gorodnichenko, Y. (2012). Measuring the output responses to fiscal policy. *American Economic Journal: Economic Policy*, **4** (2), 1–27.

Bayer, C., Lütticke, R., Pham-Dao, L. and Tjaden, V. (2019). Precautionary savings, illiquid assets, and the aggregate consequences of shocks to household income risk. *Econometrica*, **87** (1), 255–290.

Bernardini, M., De Schryder, S. and Peersman, G. (2020). Heterogeneous Government Spending Multipliers in the Era Surrounding the Great Recession. *The Review of Economics and Statistics*, **102** (2), 304–322.

Blanchard, O. and Perotti, R. (2002). An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output*. *The Quarterly Journal of Economics*, **117** (4), 1329–1368.

References (2/5)

Boone, C., Dube, A., Goodman, L. and Kaplan, E. (2021). Unemployment insurance generosity and aggregate employment. *American Economic Journal: Economic Policy*, **13** (2), 58–99.

Chari, V. V., Kehoe, P. J. and McGrattan, E. R. (2002). Can Sticky Price Models Generate Volatile and Persistent Real Exchange Rates? *The Review of Economic Studies*, **69** (3), 533–563.

Chodorow-Reich, G., Coglianese, J. and Karabarbounis, L. (2018). The Macro Effects of Unemployment Benefit Extensions: a Measurement Error Approach*. *The Quarterly Journal of Economics*, **134** (1), 227–279.

Cugat, G. (2019). Emerging markets, household heterogeneity, and exchange rate policy. *Unpublished paper*.

de Ferra, S., Mitman, K. and Romei, F. (2020). Household heterogeneity and the transmission of foreign shocks. *Journal of International Economics*, **124**, 103303, nBER International Seminar on Macroeconomics 2019.

Di Maggio, M. and Kermani, A. (2016). *The importance of unemployment insurance as an automatic stabilizer*. Tech. rep., National Bureau of Economic Research.

References (3/5)

Dieterle, S., Bartalotti, O. and Brummet, Q. (2020). Revisiting the effects of unemployment insurance extensions on unemployment: A measurement-error-corrected regression discontinuity approach. *American Economic Journal: Economic Policy*, **12** (2), 84–114.

Galí, J. and Monacelli, T. (2005). Monetary Policy and Exchange Rate Volatility in a Small Open Economy. *The Review of Economic Studies*, **72** (3), 707–734.

Ganong, P. and Noel, P. (2019). Consumer spending during unemployment: Positive and normative implications. *American Economic Review*, **109** (7), 2383–2424.

Gorn, A. and Trigari, A. (2021). *Assessing the (De) Stabilizing Effects of Unemployment Benefit Extensions*. Tech. rep., CEPR Discussion Paper No. DP16125.

Guo, X., Ottonello, P. and Perez, D. J. (2020). *Monetary Policy and Redistribution in Open Economies*. Working Paper 28213, National Bureau of Economic Research.

Hagedorn, M., Karahan, F., Manovskii, I. and Mitman, K. (2019). *Unemployment Benefits and Unemployment in the Great Recession: The Role of Equilibrium Effects*. Tech. rep., Federal Reserve Bank of New York Staff Reports, no. 646.

References (4/5)

— and Manovskii, I. (2008). The cyclical behavior of equilibrium unemployment and vacancies revisited. *American Economic Review*, **98** (4), 1692–1706.

Johnston, A. C. and Mas, A. (2018). Potential unemployment insurance duration and labor supply: The individual and market-level response to a benefit cut. *Journal of Political Economy*, **126** (6), 2480–2522.

Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review*, **95** (1), 161–182.

Jung, P. and Kuester, K. (2015). Optimal labor-market policy in recessions. *American Economic Journal: Macroeconomics*, **7** (2), 124–56.

Kekre, R. (2021). *Unemployment Insurance in Macroeconomic Stabilization*. Working Paper 29505, National Bureau of Economic Research.

Krusell, P., Mukoyama, T. and Şahin, A. (2010). Labour-Market Matching with Precautionary Savings and Aggregate Fluctuations. *The Review of Economic Studies*, **77** (4), 1477–1507.

References (5/5)

Landais, C., Michaillat, P. and Saez, E. (2018). A macroeconomic approach to optimal unemployment insurance: Theory. *American Economic Journal: Economic Policy*, **10** (2), 152–81.

McKay, A. and Reis, R. (2021). Optimal Automatic Stabilizers. *The Review of Economic Studies*, **88** (5), 2375–2406.

Mitman, K. and Rabinovich, S. (2019). *Do Unemployment Benefit Extensions Explain the Emergence of Jobless Recoveries?* Tech. rep., CEPR Discussion Paper No. DP13760.

Mortensen, D. T. and Pissarides, C. A. (1994). Job creation and job destruction in the theory of unemployment. *The Review of Economic Studies*, **61** (3), 397–415.

Nakamura, E. and Steinsson, J. (2014). Fiscal stimulus in a monetary union: Evidence from us regions. *American Economic Review*, **104** (3), 753–92.

Petrongolo, B. and Pissarides, C. A. (2001). Looking into the black box: A survey of the matching function. *Journal of Economic Literature*, **39** (2), 390–431.

Ramey, V. A. and Zubairy, S. (2018). Government spending multipliers in good times and in bad: evidence from us historical data. *Journal of Political Economy*, **126** (2), 850–901.

Appendix

Related Literature back

Macro effects of UI benefits:

Empirics: Chodorow-Reich *et al.* (2018); Hagedorn *et al.* (2019); Di Maggio and Kermani (2016); Boone *et al.* (2021); Johnston and Mas (2018); Dieterle *et al.* (2020); Acosta et al. (2023)

We exploit the non-linear design of UI policy to study the effects UI duration extensions

Theory I: Mitman and Rabinovich (2019); Krusell *et al.* (2010); Jung and Kuester (2015); Landais *et al.* (2018)

We incorporate supply side and demand side channels to study the effects of UI extensions

Theory II: Kekre (2021); McKay and Reis (2021); Gorn and Trigari (2021)

We consider a small-open-economy model suitable to speak to our empirical findings

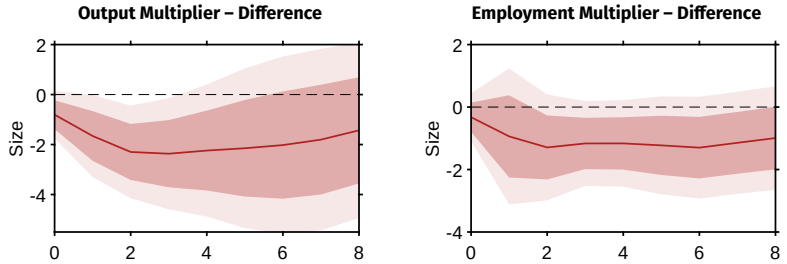
Open economy with heterogeneous households:

de Ferra *et al.* (2020); Auclert *et al.* (2021); Cugat (2019); Guo *et al.* (2020)

Our open economy model features unemployment risk and UI policies.

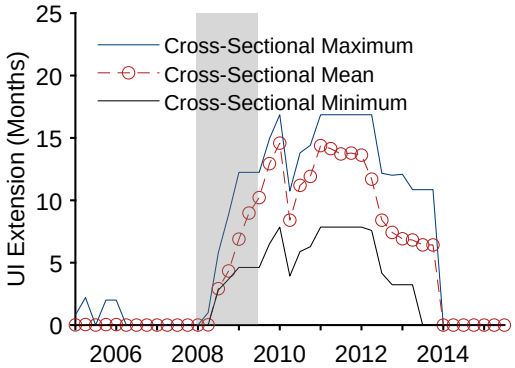
Bartik Identification back

- Bartik-type identification as in Nakamura and Steinsson (2014) and Bernardini *et al.* (2020)



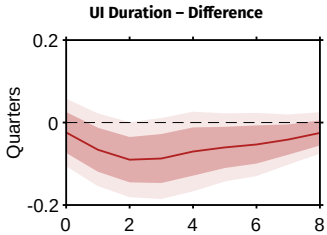
Source of Variations: Overtime v.s. Cross-section

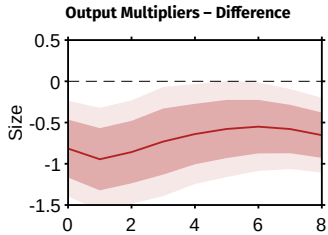
back mult back u back error

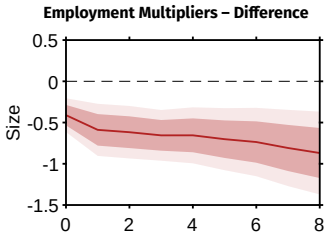


Source of Variations: Cross-section

back mult back u back error







UI Eligibility & Households

UI eligibility

labor market back

UI benefits expire stochastically ≈ limited duration of UI benefits

Lose eligibility during unemployment

Regain eligibility during employment

1. Eligible employed

- Keep job: remains eligible
- Lose job: lose eligibility with prob. pe_t

2. Non-eligible employed

- Keep job: eligible with prob. pr
- Lose job: remains non-eligible

3. Eligible unemployed

- Find job: remains eligible
- Unemployed: non-eligible with prob. pe_t

4. Non-eligible unempl.

- Find job: eligible with prob. pr
- Unemployed: remains non-eligible

Domestic Households MF foreign back

Household with idiosyncratic state vector $(s) = \{$discount factor (β), labor income productivity (h), employment status (n), UI eligibility (e), savings $(a)\}$

Chooses consumption of home (c_{Ht}) and foreign (c_{Ft}) goods, savings a_t in mutual fund:

$$V_t(s) = \max_{c_{Ht}, c_{Ft}, a_t} u\left(c_{Ht}, c_{Ft}\right) + \beta \mathbb{E}_t V_{t+1}\left(s'\right)$$

$$\text{s.t.} \quad \frac{P_{Ht}}{P_t} c_{Ht} + \frac{P_{Ft}}{P_t} c_{Ft} + a_t = \left(1 - \tau_t\right) h_t \left(d_t + \mathbb{I}_{n=1} w_t + \mathbb{I}_{(n=0,e=1)} b_t + \mathbb{I}_{(n=0,e=0)} \tilde{b}_t\right) + (1 + r_t^a) a_{t-1}, \quad a_t \geq 0.$$

Income depends on employment & eligibility status:

Employed: wage w_t

Unemployed and eligible: UI benefits b_t

Unemployed non-eligible: "safety-net" transfers $\tilde{b}_t$

Firms & Wages

Differentiated goods producers: set prices s.t. Rottemberg adjust. costs.

$$\log(1+\pi_{H,t}) = \kappa_p \left(\frac{MC_t}{P_{Ht}} - \frac{\varepsilon - 1}{\varepsilon} \right) + \mathbb{E}_t \frac{1}{1+r^a} \log(1+\pi_{H,t+1}) \frac{Y^D_{t+1}}{Y^D_t}$$

Labor goods producers: post vacancies v_t to hire workers

$$J^L_t = Z_t \frac{MC_t}{P_t} - \frac{W_t}{P_t} + \mathbb{E}_t \frac{1}{1+r^a} (1-\delta) J^L_{t+1},$$

Free-entry: value of job J^L_t, vacancy filling rate q_t

$$\kappa_v = q_t J^L_t$$

Wage rule: weighted between Nash wage and st.-st. wage :

$$\log\left(w_t/w\right) = \phi^w \log\left(w_t^{\text{Nash}}/w^{\text{Nash}}\right),$$

Nash Wage back

Union bargains w_t^{nash} on behalf of workers to maximize average surplus from employment

$$w_t^{nash} = \arg\max_{w_t} (J_t^L)^{\epsilon^w} (\Delta_t^{n,u})^{1-\epsilon^w}$$

Average surplus from employment $\Delta_t^{n,u}$:

$$\Delta_t^{n,u} = (n_t^e + u_t^e)\Delta_{t,e=1}^{n,u} + (n_t^{ne} + u_t^{ne})\Delta_{t,e=0}^{n,u}$$

Average surplus from employment for eligible workers $\Delta_{t,e=1}^{n,u}$:

$$\Delta_{t,e=1}^{n,u} = U(C_{t,e=1}^n) - U(C_{t,e=1}^u) + \beta(1-\delta)(1-f_{t+1})(\Delta_{t+1,e=1}^{n,u} + pe_t \Delta_{t+1,n=0}^{e,ne})$$

Average surplus from employment for non-eligible workers $\Delta_{t,e=0}^{n,u}$:

$$\Delta_{t,e=0}^{n,u} = U(C_{t,e=0}^n) - U(C_{t,e=0}^u) + \beta(1-\delta)(1-f_{t+1})(\Delta_{t+1,e=0}^{n,u} + pr\Delta_{t+1,n=1}^{e,ne})$$

Average surplus from employment for eligible workers $\Delta^{n,u}_{t,e=1}$:

$$\Delta^{n,u}_{t,e=1} = U(C^{n}_{t,e=1}) - U(C^{u}_{t,e=1}) + \beta(1-\delta)(1-f_{t+1})(\Delta^{n,u}_{t+1,e=1} + pe_t \Delta^{e,ne}_{t+1,n=0})$$

Average surplus from eligibility for unemployed workers $\Delta^{e,ne}_{t+1,n=0}$:

$$\Delta^{e,ne}_{t,n=0} = U(C^{u}_{t,e=1}) - U(C^{u}_{t,e=0}) + \beta\left[(1-f_{t+1})(1-\mathrm{pe}_{t+1})\Delta^{e,ne}_{t+1,n=0} + f_{t+1}(1-\mathrm{pr})\Delta^{e,ne}_{t+1,n=1}\right]$$

Average surplus from employment for non-eligible workers $\Delta^{n,u}_{t,e=0}$:

$$\Delta^{n,u}_{t,e=0} = U(C^{n}_{t,e=0}) - U(C^{u}_{t,e=0}) + \beta(1-\delta)(1-f_{t+1})(\Delta^{n,u}_{t+1,e=0} + pr\Delta^{e,ne}_{t+1,n=1})$$

Average surplus from eligibility for employed workers $\Delta^{e,ne}_{t+1,n=1}$:

$$\Delta^{e,ne}_{t,n=1} = U(C^{n}_{t,e=1}) - U(C^{n}_{t,e=0}) + \beta\left[\left(1-\delta(1-f_{t+1})\right)(1-\mathrm{pr})\Delta^{e,ne}_{t+1,n=1} + \delta(1-f_{t+1})(1-\mathrm{pe}_{t+1})\Delta^{e,ne}_{t+1,n=0}\right]$$

Local Government

Government back

Monetary authority sets nominal rate to fix nominal exchange rate

Fiscal authority, budget constraint:

$$\frac{P_{Ht}}{P_t} G_t + (1 + r_t) B_{H,t-1} + b_t U_t^e + \tilde{b}_t U_t^{ne} = B_{H,t} + \tau_t \left(w_t N_t + b_t U_t^e + \tilde{b}_t U_t^{ne} + d_t \right) + \mathrm{TR}_t.$$

Government consumption G_t: $log\left(\frac{G_t}{G}\right) = \rho_G \log\left(\frac{G_{t-1}}{G}\right) + \varepsilon_t^G, \quad , \quad \varepsilon_t^G \sim \mathcal{N}(0,1)$

Federal transfers pay for UI expenses: $\mathrm{TR}_t = (b_t U_t^e + \tilde{b}_t U_t^{ne}) - (bU^e + \tilde{b}U^{ne})$

Local government debt $B_{H,t}$ stays constant and taxes τ_t adjusts to balance budget

UI benefits level: $b_t = bw_t, \quad b \in (0,1)$

Safety-net transfers to non-eligible: $\tilde{b}_t = \tilde{b}w_t, \quad \tilde{b} < b$

Government - UI benefits extensions back

UI benefits duration $T_t^* = 1/pe_t$:

$$\mathsf{T}_t^* = \begin{cases} \mathsf{T}^* & \text{if} \quad U_t \leq \tilde{U}, \\ \mathsf{T}^* \left(\frac{U_t}{\tilde{U}} \right)^{\phi_U} & \text{else.} \end{cases}$$

If unemployment below threshold $\tilde{U}$ keep UI duration at regular UI duration T^*

We let UI duration follow a simple rule **when unemployment above** $\tilde{U}$

Captures parsimoniously multiple thresholds active during our sample period

Calibration

Calibration back

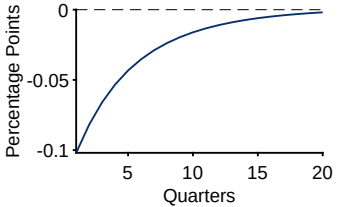
Parameter	Description	Value	Target / Source
Households			
$1/\sigma$	IES	0.5	Standard value
β_1	**Discount factor high**	0.98	$B_H/4Y$ = 0.45
β_2	**Discount factor low**	0.93	MPC = 0.20
ρ_h	Persistence h	0.98	Bayer *et al.* (2019)
σ_h	Std. innovations to h	0.06	Bayer *et al.* (2019)
ε	Elast. subs. intermediate goods	7	Standard value
η	Elast. subs. H and F goods	1.5	Chari *et al.* (2002)
α	Share imported goods	0.3	Nakamura and Steinsson (2014)
Firms			
κ_v	Vacancy posting cost	0.05	4.5% of quarterly wage
ε^w	Bargaining power firm	0.18	$q = 0.71$
ϕ^w	**Wage rigidity**	0.30	Hagedorn and Manovskii (2008)
Z	St-st. productivity	1.24	C = 1
κ_p	Slope NKPC	0.05	Mean price duration of 5 q.

Calibration back

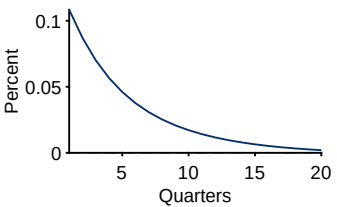
Parameter	Description	Value	Target / Source
Labor market			
δ	Separation rate	0.10	Standard value
χ	Matching efficiency	0.66	$N = 0.94$
γ	Curvature matching function	0.5	Petrongolo and Pissarides (2001)
Government			
τ	Steady-state tax rate	0.20	G/Y = 0.14
$1+i$	Steady-sate nominal rate	1.01	4% p.a.
b	**Replacement rate UI**	0.83	Income drop upon unemployment
$\tilde{b}$	**Replacement rate safety-net**	0.54	Income drop upon UI exhaustion
pe	**Prob. loosing eligibility**	0.5	Avg. duration UI of 2 q.
pr	**Prop. regaining eligibility**	0.5	2 q. to regain eligibility
$\tilde{U}$	**UI extension threshold**	6.0%	Normalization
ϕ^U	**UI duration rule**	3.88	Avg. UI extension

Impulse Responses

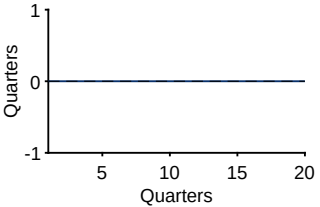
G shock starting from steady state back



(a) Unemployment

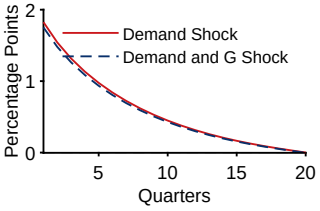


(b) Output

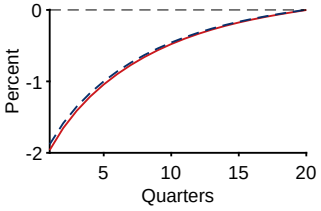


(c) UI duration

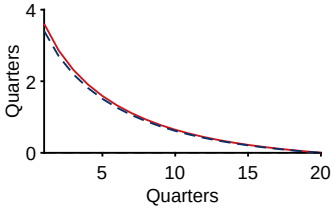
Demand driven recession back



(a) Unemployment

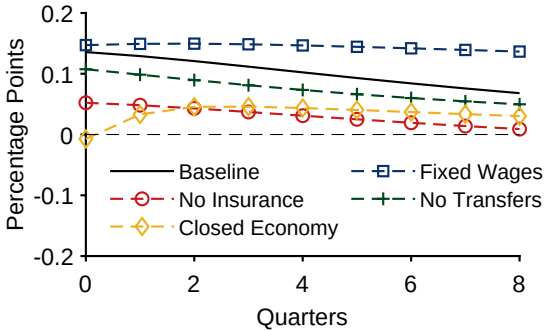


(b) Output



(c) UI duration

Dynamic cumulative UI multipliers back



Law of motion for **employment** N_t:

$$N_t = (1-\delta)N_{t-1} + M_t$$

δ: exogenous separation rate
$(1-\delta)N_{t-1}$: existing employment at the beginning of t
M_t: new matches
define $f_t := \frac{M_t}{1-(1-\delta)N_{t-1}}$ the job finding rate

New matches M_t formed according to:

$$M_t = \chi V_t^{\gamma} \left(1-(1-\delta)N_{t-1}\right)^{1-\gamma}$$

V_t: firms' vacancies, posted at cost κ_v

UI eligibility back

N_t^e: employed eligible

N_t^{ne}: employed non-eligible

U_t^e: unemployed eligible

U_t^{ne}: unemployed non-eligible

pe_t: prob. loosing eligibility

pr: prob. regaining eligibility

$$
\begin{aligned}
N_t^e &= (1-\delta+\delta f_t)N_{t-1}^e + pr(1-\delta+\delta f_t)N_{t-1}^{ne} + f_t\left(U_{t-1}^e + prU_{t-1}^{ne}\right)\\
N_t^{ne} &= (1-pr)(1-\delta+\delta f_t)N_{t-1}^{ne} + (1-pr)f_tU_{t-1}^{ne}\\
U_t^e &= (1-f_t)(1-pe_t)\left(U_{t-1}^e + \delta N_{t-1}^e\right)\\
U_t^{ne} &= (1-f_t)\left(U_{t-1}^{ne} + \delta N_{t-1}^{ne}\right) + (1-f_t)pe_t\left(U_{t-1}^e + \delta N_{t-1}^e\right)
\end{aligned}
$$

Foreign households back

Export demand from Foreign households C^*_{Ht}:

$$C^*_{Ht} = \alpha \left(\frac{P^*_{Ht}}{P^*_t} \right)^{-\eta} C^*_t,$$

Nominal exchange rate: $\mathscr{E}_t$

Law of one price holds: $P_{Ht} = \mathscr{E}_t P^*_{Ht}$ and $P_{Ft} = \mathscr{E}_t P^*_{Ft}$

Real exchange rate: $Q_t := \frac{\mathscr{E}_t P^*_t}{P_t}$

Terms of trade: $S_t := \frac{P_{Ft}}{P_{Ht}}$

Mutual Fund back

Risk-neutral mutual fund issues A_t, purchases domestic B_{Ht} and foreign B_{Ft} bonds

$$A_t = B_{Ht} + Q_t B_{Ft}$$

Beginning-of-period flow constraint:

$$(1 + r_t^a)A_{t-1} = (1 + r_t)B_{H,t-1} + (1 + r_t^*)Q_t B_{F.t-1}.$$

Non-arbitrage conditions:

$$\mathbb{E}_t \frac{1 + i_t}{1 + \pi_{t+1}} = \mathbb{E}_t \frac{1 + i_t^*}{1 + \pi_{t+1}^*} \frac{Q_{t+1}}{Q_t},$$

$$\mathbb{E}_t 1 + r_{t+1}^a = \mathbb{E}_t 1 + r_{t+1}$$