The Regional Keynesian Cross

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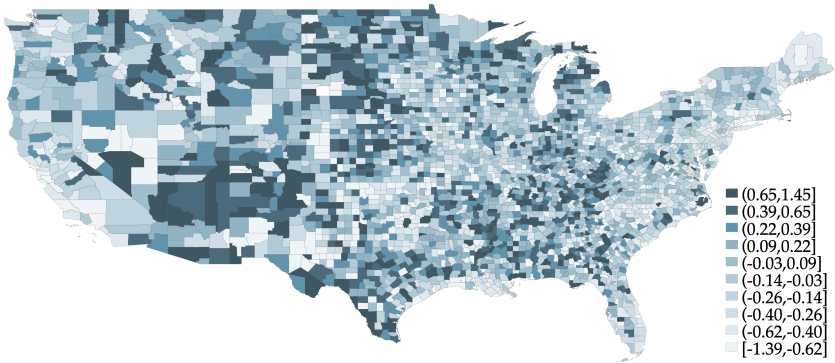
MONETARY POLICY HAS HETEROGENEOUS EFFECTS ACROSS US REGIONS



- County-level emp. response (pct) to 1sd expansionary shock, 3 years ahead
- In deviation from national average of .25%
- Not just noise

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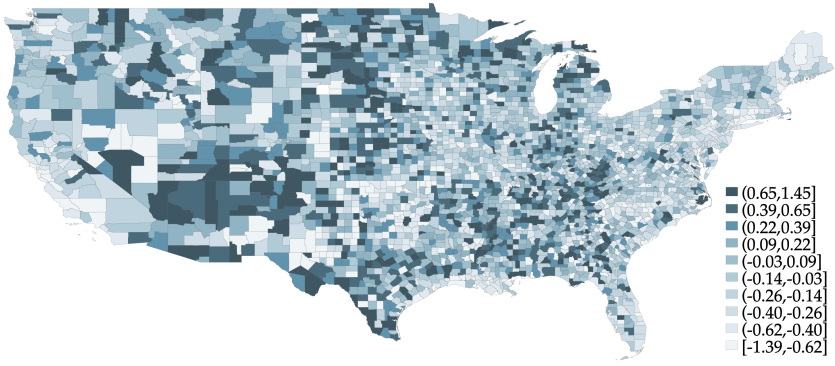

I Why is there spatial heterogeneity in the employment response to MP?

II Does it matter for the aggregate transmission of monetary policy?

WHAT WE DO

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IV Counterfactual: replicate empirical joint distribution and compute IRFs

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$$\frac{1}{1-\rho \times MPC}$$

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- Drivers of regional heterogeneity $\rightarrow$ local share of non-tradable empl. & MPC

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- Distribution dampens monetary policy $\longrightarrow$ waning effects of monetary policy?

CONTRIBUTION: OCA MEETS HANK

I Heterogeneous Agents New Keynesian models (Campbell and Mankiw, 1989; Bilbiie, 2008; Werning, 2015; Debortoli and Galí, 2018; Kaplan et al., 2018; Auclert, 2019; Hagedorn et al., 2019; de Ferra et al., 2020; Auclert et al., 2020, 2021a,b, 2023; Dupor et al., 2023; Patterson, 2023)

- ◇ Heterogeneity & MPCs shape the transmission of MP
- ◇ Our contribution: regional setting, heterogeneity both within & across regions matters

II Optimal Currency Areas (Mundell, 1961; McKinnon, 1963; Kenen, 1969; Alesina et al., 2002; Kenen and Meade, 2008; Farhi and Werning, 2016, 2017)

- ◇ Openness to trade determines potency of monetary and fiscal stabilization tools
- ◇ Our contribution: heterogeneity between union members

Integrate I & II $\rightarrow$ framework for MP transmission across regions + empirically testable insights

- ► MP across space (Carlino and Defina, 1998; De Ridder and Pfajfar, 2017; Hauptmeier et al., 2023; Corsetti et al., 2021; Herreño and Pedemonte, 2022; Almgren et al., 2022)
- ► Sequence space methods (Mankiw and Reis, 2006; Boppart et al., 2018; Auclert et al., 2023)
- ► Open-economy macroeconomics (Obstfeld and Rogoff, 1995; Galí and Monacelli, 2005, 2008; Rey, 2013; Miranda-Agrippino and Rey, 2020)
- ► Cross-sectional identification (Nakamura and Steinsson, 2014, 2018; Beraja et al., 2018; Chodorow-Reich et al., 2021; Hazell et al., 2022; Wolf, 2021a,b)

PLAN FOR TODAY

I Model setup

II Regional and National Keynesian Cross

III Empirics

IV Taking the model to the data & counterfactuals

Model Setup

MODEL

- Multi-region currency union with atomistic counties $j \in [0, 1]$

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- Aggregate consumption basket composed of two goods:
  - I Tradables: $c^T_{jit} = \int_0^1 c^T_{jit}(j')dj' \Rightarrow$ law of one price
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- Two sectors: $\ell_{jit} = \left[\alpha_j{}^{-\frac{1}{\eta}} \left(\ell_{jit}^{NT} \right)^{\frac{\eta+1}{\eta}} + (1 - \alpha_j)^{-\frac{1}{\eta}} \left(\ell_{jit}^{T} \right)^{\frac{\eta+1}{\eta}} \right]^{\frac{\eta}{\eta+1}}, \quad y_{jt}^s = \ell_{jt}^s,$ unions + rigid wages

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  - Regional aggregate consumption function captures all the heterogeneity:

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  - Define Jacobian matrices + stack in vector notation:

$$(\boldsymbol{M}_j)_{ts} = \frac{\partial \log \mathcal{C}_{jt}(\cdot)}{\partial \log Z_{js}}, \qquad (\boldsymbol{M}_j^r)_{ts} = \frac{\partial \log \mathcal{C}_{jt}(\cdot)}{\partial \log(1+r_s)}, \qquad d\boldsymbol{L}_j \equiv \left(d\log L_{j1}, d\log L_{j2}, \cdots\right)'$$

Theory Results

PROPOSITION

The 1st-order response $d\boldsymbol{L}_j$ to a monetary shock $d\boldsymbol{r}$ & tradable demand shock $d\boldsymbol{C}^T$ solves:

$$d\boldsymbol{L}_j = \underbrace{\rho_j \left(\boldsymbol{M}_j^r d\boldsymbol{r} + \boldsymbol{M}_j d\boldsymbol{L}_j \right)}_{\text{Regional exposure}} + \underbrace{(1-\rho_j) d\boldsymbol{C}^T}_{\text{National exposure}}$$

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COROLLARY

When $\rho_j \to 0$: as-if representative county. Regional MPC heterogeneity doesn't matter:

$$d\boldsymbol{L} \quad = \quad \boldsymbol{M}^r \, d\boldsymbol{r} \quad + \quad \boldsymbol{M} \, d\boldsymbol{L}$$

Empirics

THE GEOGRAPHY OF MPCS

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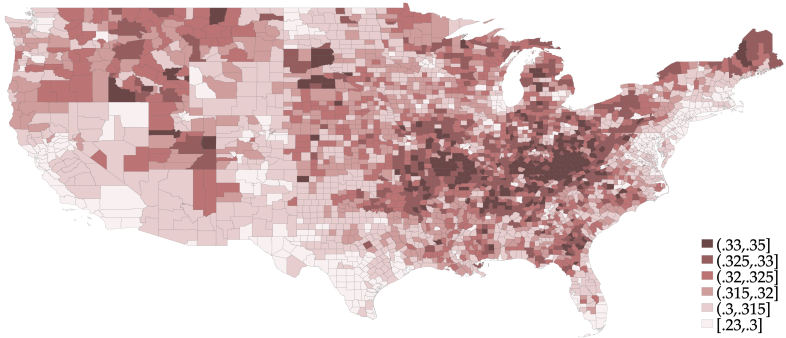

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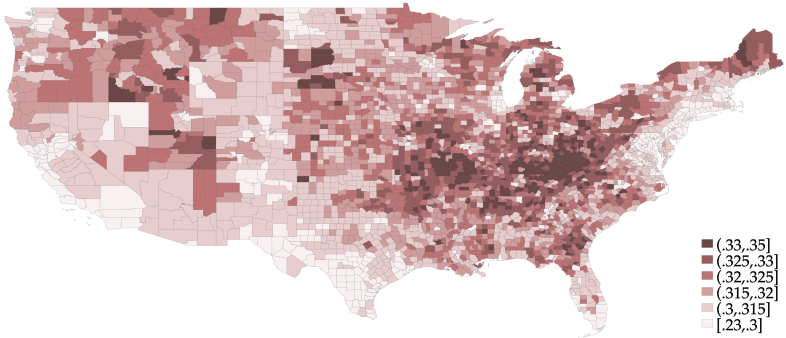

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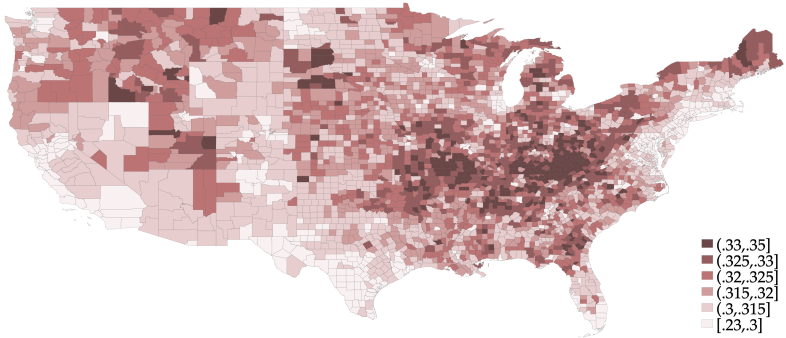

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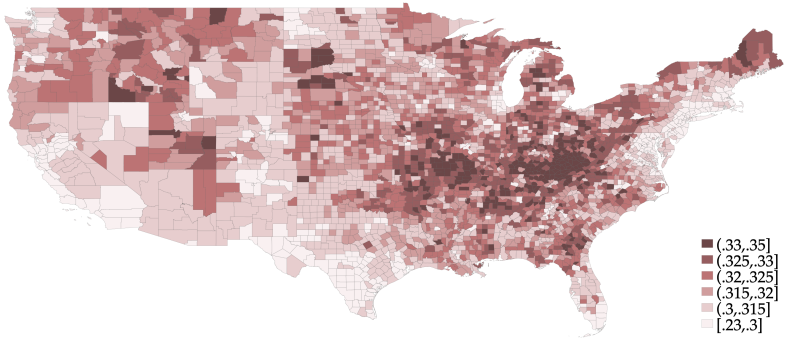

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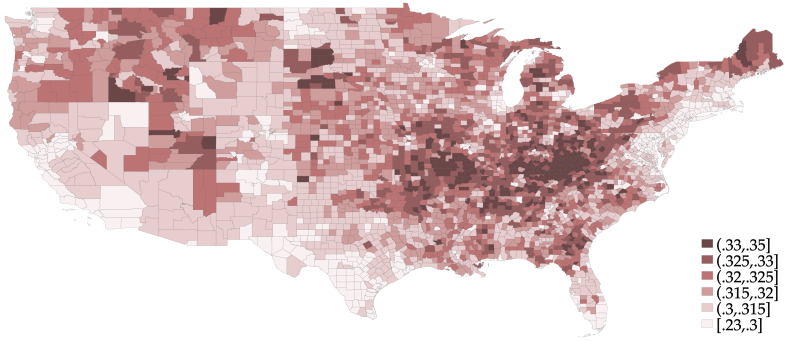

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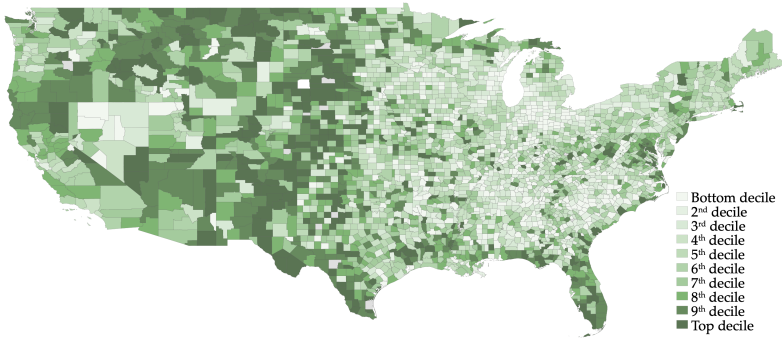
- Account for full distribution of agents along economic & socio-demographic characteristics

THE GEOGRAPHY OF NON-TRADABLE EMPLOYMENT



- Non-tradable sector classification based on Mian & Sufi (2014)
  - Non-tradable = retail + restaurants (4-digit NAICS)
- Annual employment data from US Census County Business Pattern
- Non-tradable employment & MPCs negatively correlated across counties $\approx$ -0.25

- Data:
  - BLS's Local Area Unemployment Statistics – 1990m1-2019m6
  - High frequency monetary shocks (Gertler and Karadi, 2015)

- Panel local-projection:

$$\Delta \log(L_{jt+h}) = \alpha_{jh} + \delta_{th} + \sum_{j=1}^{J} \beta_{jh} \times D_{jh} \times \varepsilon_t + \sum_{\ell=1}^{12} \gamma_{h\ell} \Delta \log(L_{jt-\ell}) + u_{jht}$$

  - D_{jh}: dummy for county j
  - α_{jh}: county fixed effect
  - δ_{th}: time fixed effect $\Rightarrow$ absorbs national shocks
  - β_{jh}: county-specific slope $\Rightarrow$ unexplained heterogeneity

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$$\widehat{\boldsymbol{\alpha}} = \underset{\boldsymbol{\alpha}}{\text{argmin}} \quad ||\boldsymbol{\beta} - \boldsymbol{X}\boldsymbol{\alpha}|| + \lambda \sum_i |\alpha_i|$$

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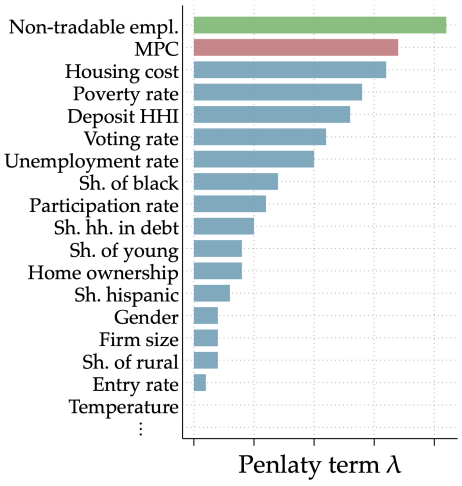
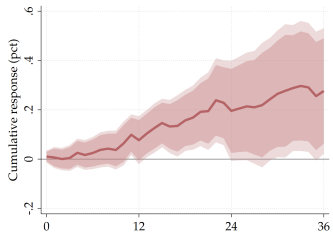
- Increase λ and plot "survival function"
- Local MPCs & non-tradable empl. important



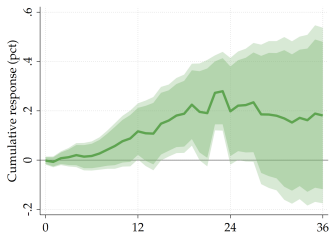
MPCs and ρ_j matter for the local response, but how?

$$\Delta \log(L_{jt+h}) = \alpha_{jh} + \delta_{th} + \underbrace{\beta_h^M \times D_{jt}^M \times \varepsilon_t}_{\text{MPC interaction}} + \underbrace{\beta_h^\rho \times D_{jt}^\rho \times \varepsilon_t}_{\text{Trade interaction}} + \underbrace{\beta_h^{M,\rho} \times D_{jt}^\rho \times D_{jt}^M \times \varepsilon_t}_{\text{Triple interaction}} + \cdots$$

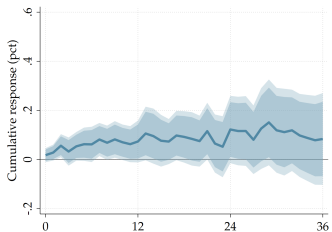
- Baseline group: low MPC, low non-tradables counties
  - I β_h^M: differential response of high MPC, low non-tradables counties
  - II β_h^ρ: differential response of low MPC, high non-tradables counties
  - III $\beta_h^{M,\rho}$: MPC-ρ interaction



β_h^M



β_h^ρ



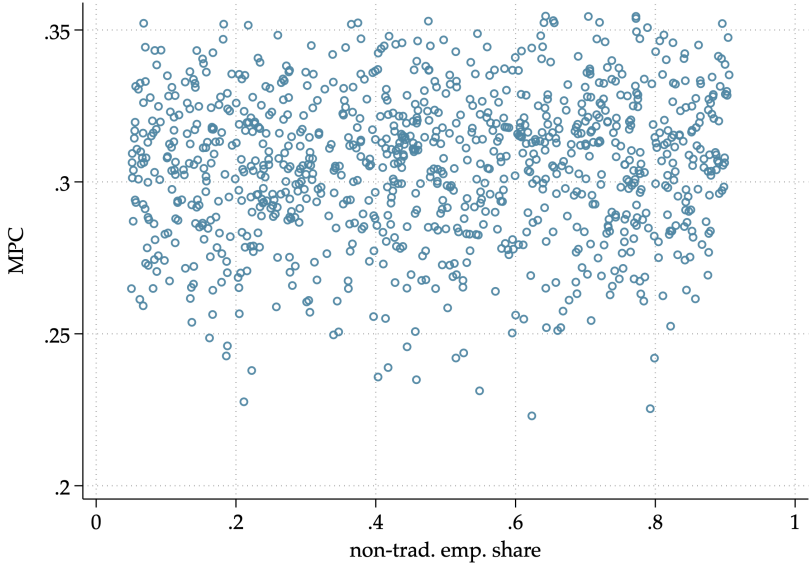
$\beta_h^{M,\rho}$

Model Meets Data

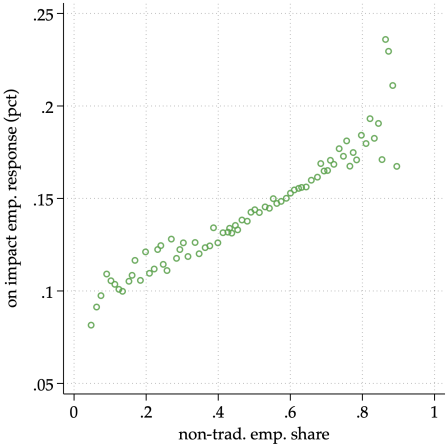
MATCHING THE SPATIAL STRUCTURE

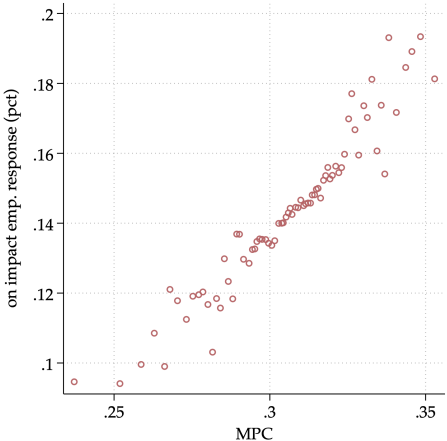
- Calibration computationally intensive with 3000+ counties
- Draw samples of $N = 30$ representative counties from empirical distribution
- Pick the sample closest to moments of interest
- Calibrate β_j and α_j to match the $\{\widehat{MPC}_j, \widehat{\rho}_j\}_{j=1}^{N}$ in the model's steady state
  - Match the empirical MPC to the first entry in $\boldsymbol{M}_j$

HETEROGENEOUS RESPONSE TO MP SHOCKS ACROSS SPACE



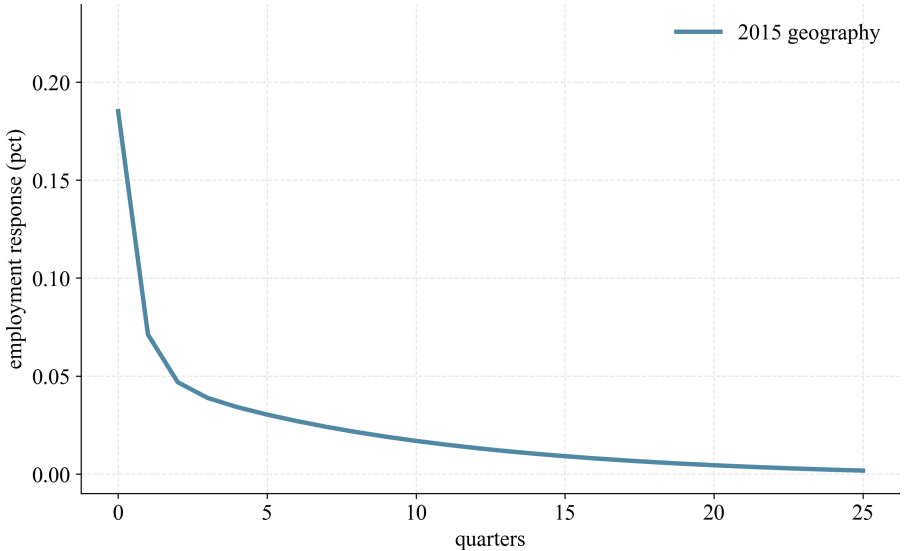
HETEROGENEOUS RESPONSE TO MP SHOCKS ACROSS SPACE





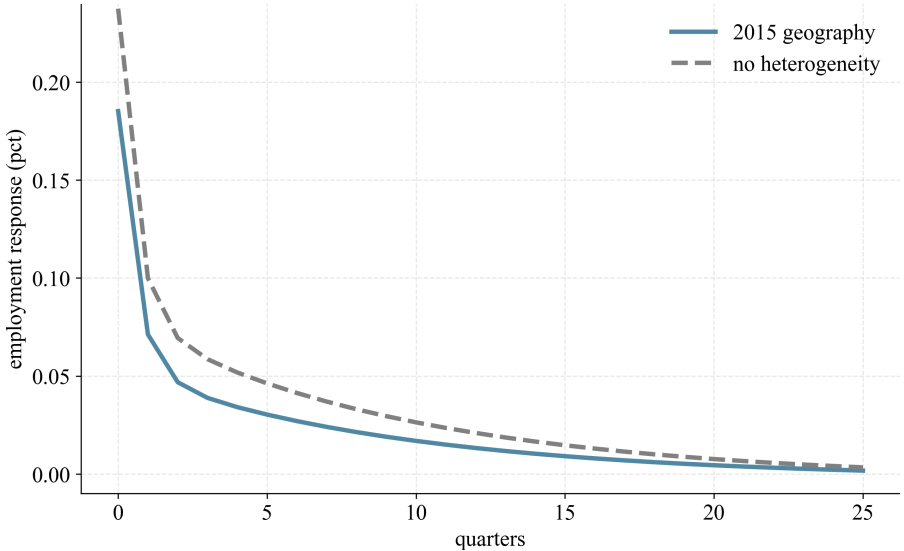
Note: bin-scatter of the on-impact employment response, controlling for MPC/share of non-tradable employment

NO SPATIAL HETEROGENEITY COUNTERFACTUAL



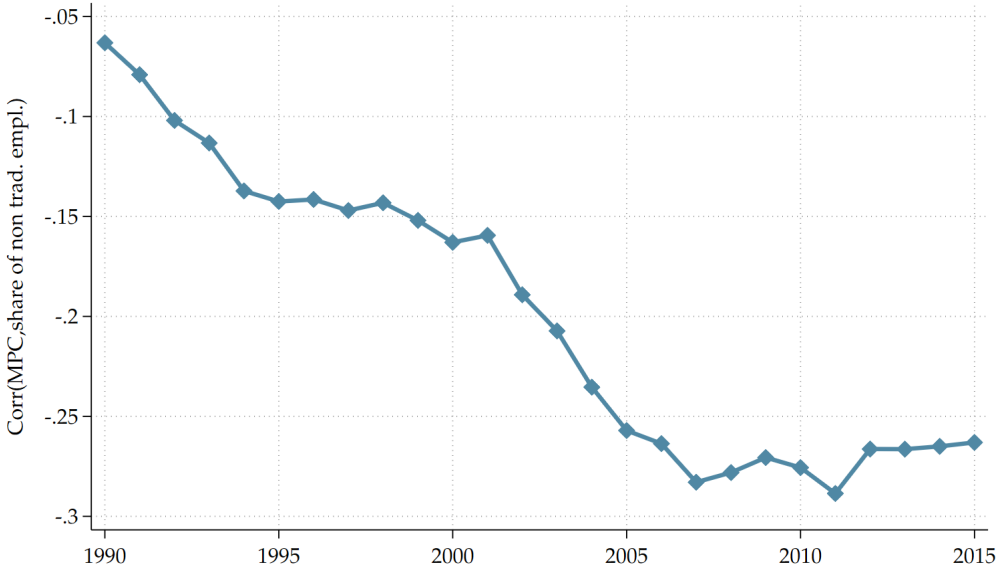
Note: employment response to a negative 1% (p.a.) AR(1) real interest rate shock with quarterly persistence 0.2

NO SPATIAL HETEROGENEITY COUNTERFACTUAL



Note: employment response to a negative 1% (p.a.) AR(1) real interest rate shock with quarterly persistence 0.2

INTERESTING IMPLICATION: WANING EFFECTS OF MP?



CONCLUSION AND WAY FORWARD

- Spatial heterogeneity in response to MP explained theoretically and empirically by
  - Local MPC
  - Local share of the non-tradable sector

- Multiplier non-linear in MPC & $\rho_j \longrightarrow$ joint distribution matters for aggregate
  - 2015 economic geography dampens monetary policy
  - Economic geography time varying: potentially explains waning effects of MP

- Portable framework: follow-up project on €-zone $\rightarrow$ heterogeneous fiscal policy

Appendix

Regression Specification

▸ Histogram ▸ Back

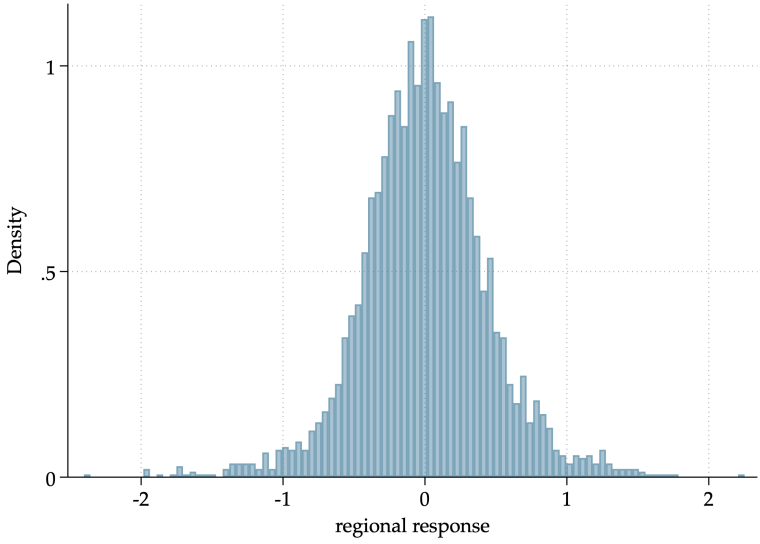
- Panel local-projection (weighted by 2000 population):

$$\Delta \log(L_{jt+h}) = \alpha_{jh} + \delta_{th} + \sum_{j=1}^{J} \beta_{jh} \times D_{jh} \times \varepsilon_t + \sum_{\ell=1}^{12} \gamma_{h\ell} \Delta \log(L_{jt-\ell}) + u_{jht}$$

  - D_{jh}: Dummy for county j
  - α_{jh}: county fixed effect
  - δ_{th}: time fixed effect $\Rightarrow$ absorbs the shock
  - β_{jh}: county-specific slope $\Rightarrow$ unexplained heterogeneity

The Distribution of County-Specific Responses

Back



- Linearize around steady-state without balanced trade
  - New object → non-tradable consumption share: $\xi_j \equiv \frac{c_j^{NT} W_j^{NT}}{C_j P_j} \underbrace{=}_{\text{Under balanced trade}} \rho_j$
- Regional Keynesian Cross:

$$d\boldsymbol{L}_j = \underbrace{\rho_j \left(\boldsymbol{M}_j^r d\boldsymbol{r}_j + \boldsymbol{M}_j d\boldsymbol{L}_j \right)}_{\text{Regional exposure}} + \underbrace{(1-\rho_j) d\boldsymbol{C}^T}_{\text{National exposure}} - \underbrace{\frac{\nu}{\eta}(1-\xi_j)\left(d\boldsymbol{L}_j - d\boldsymbol{C}^T \right)}_{\text{Expenditure switching}}$$
$$+ \underbrace{\frac{\rho_j - \xi_j}{\eta} \boldsymbol{M}_j \left(d\boldsymbol{L}_j - d\boldsymbol{C}^T \right)}_{\text{Real income}}$$

Model Parametrization

Back

Parameter	Description	Value	Comment
β	Discount rate	0.939	Calibrated
σ	Inverse EIS	1	Standard
φ	Frisch Elasticity	1	Chetty et al. (2011)
ψ	Labor disutility	1	Normalization
ω	Preference for non-tradables	0.66	Hazell et al. (2022)
ν	Elasticity of substitution between the two goods	1.5	Hazell et al. (2022)
η	Elasticity of substitution between the two sectors	0.45	Berger et al. (2022)
ρ_e	Persistence of the log-productivity process	0.9	Target MPC = 0.25
σ_e	Cross-sectional std of log-productivity process	0.1	Target MPC = 0.25
$\underline{b}$	Borrowing limit (as pct. of natural borrowing limit)	1.7%	Target MPC = 0.25
P^T	Tradable price index	1	Numeraire
C^T	Rest of nation demand for tradable goods	1	Exogenous

Details on Regional MPCs

Back

- Use self-reported MPC out of capital losses from Fuster et al. (2020)

$$MPC_{it} = \alpha + \delta_t + \underbrace{\sum_{s=1}^{5} \beta_s^R D_{sit}^R}_{\text{Race bins}} + \underbrace{\sum_{s=1}^{4} \beta_s^A D_{sit}^A}_{\text{Age bins}} + \underbrace{\sum_{s=1}^{9} \beta_s^Y D_{sit}^Y}_{\text{Income bins}} + u_{it}$$

- Use ACS to bin households in income×age×race groups g. Group-specific MPC:

$$\widehat{MPC}_g = \hat{\alpha} + \sum_{s=1}^{5} \hat{\beta}_s^R D_{gs}^R + \sum_{s=1}^{4} \hat{\beta}_s^A D_{gs}^A + \sum_{s=1}^{9} \hat{\beta}_s^Y D_{gs}^Y$$

- County-level MPC: avg. of group-specific MPCs, weighted by share of hhs in each group:

$$MPC_{jt} = \sum_g s_{jtg} \widehat{MPC}_g$$

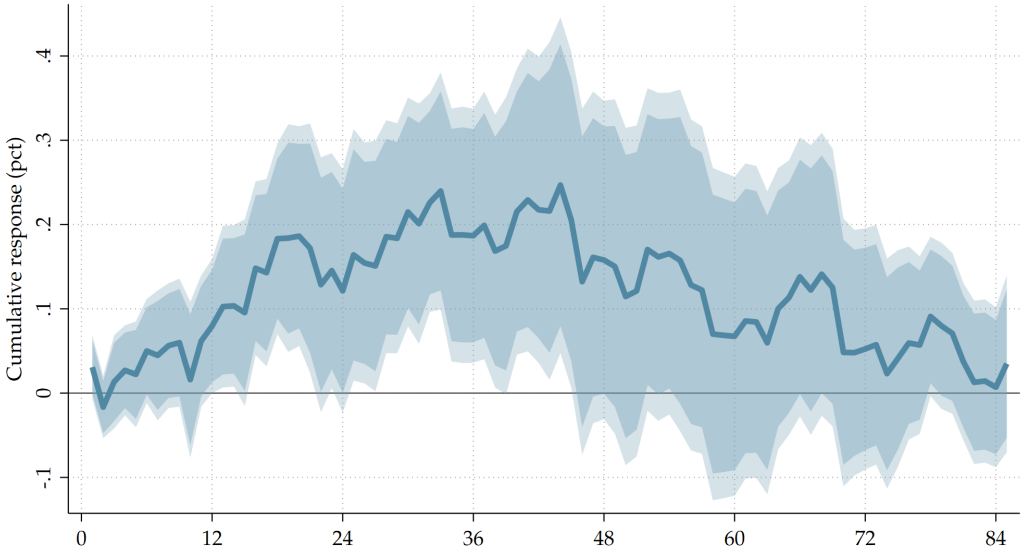
Data

Back

- Deposits: FDIC Summary of Dep, 1994-2015 avg
- Temperature:
  - North America Land Data Assimilation System, 2011 avg
- Firm size: County Business Patterns
  - Mean number of empl. per estab. 1990-2015 avg
- Age, race & gender: Population Estimates Program , 1990-2015 avg
  - Share $\leq$ 35 y.o. & share 40-65 y.o. (Leahy and Thapar, 2022)
  - Share of blacks & share of hispanics
  - Share of women
- Pop. density: 2010 US Census
- Land avail.: (Lutz and Sand, 2022) 2002-2015 avg
- Particip. rate: BLS Local Area Unem. Stats
  - 1990-2015 avg
- Realloc. & firm entry rates: Business Dyn. Stats
  - 1990-2015 avg
- Housing costs & homeown.: ACS, 2011-2015 avg
  - Share of househ. spending > 35% of income in housing
  - Share of owner occupied houses
- Voting rate: MIT Election Lab
  - 6 presidential elections 2000-2020

National IRF

Back LPs



LP FULL SPECIFICATION

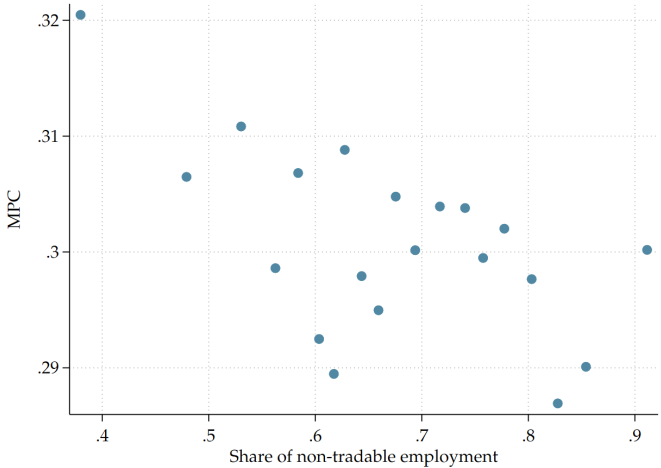
BACK

$$\Delta \log(L_{jt+h}) = \underbrace{\alpha_{jh} + \delta_{th}}_{\text{Fixed effects}} + \underbrace{\beta_h^{NT} \times D_{jt}^{NT} \times \varepsilon_t}_{\text{Openness interaction}} + \underbrace{\beta_h^{M} \times D_{j}^{M} \times \varepsilon_t}_{\text{MPC interaction}} + \underbrace{\beta_h^{NT,M} \times D_{jt}^{NT} \times D_{j}^{M} \times \varepsilon_t}_{\text{Triple interaction}}$$

$$+ \underbrace{\alpha_h^{NT} D_{jt}^{NT} + \alpha_h^{M} D_{j}^{M} + \alpha_h^{NT,M} D_{jt}^{NT} \times D_{j}^{M}}_{\text{Interaction controls}} + \underbrace{\sum_{\ell=1}^{12} \gamma_{h\ell} \Delta \log(L_{jt-\ell})}_{\text{Lagged controls}} + u_{jht}$$

Correlation between MPCs and ρ

Back



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