The Young, the Old, and the Government: Demographics and Fiscal Multipliers

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Outline

1. Introduction
2. Empirical Evidence
3. Model
4. Quantitative Analysis
5. Conclusions

Motivation - Demographics

- Age structure of the population matters for macroeconomic dynamics
- Different age groups
  - have different savings behavior & marginal propensity to consume
  - have different labor supply elasticities
  - have different productivity levels (age-profile of wages)
- Demographics is slow moving $\Rightarrow$ **long-run** effects
- Demographics also affect responses in the **short-run**

This Paper

Question

- Do fiscal multipliers depend on the **age structure** of the population?

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- Panel of military govt spending, output & demographics across U.S. states
- Causal effect of demographics on **local fiscal multipliers**
- 1% increase in share of young people $\rightarrow$ local fiscal multiplier rises by 3.1%

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- We rationalize this fact with parsimonious life-cycle open-economy NK model
- Model has credit market imperfections & age-specific Frisch elasticities

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Exercise - Population Aging

- Nowadays national fiscal multipliers are 36% lower than in 1980

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Empirical Evidence

- Panel of military spending, output & demographics across U.S. states
- Annual data over 1967 - 2015 ▸ Data
- Estimate local fiscal multipliers: federally-financed open-economy relative multipliers

$$\frac{Y_{i,t} - Y_{i,t-2}}{Y_{i,t-2}} = \alpha_i + \delta_t + \beta \frac{G_{i,t} - G_{i,t-2}}{Y_{i,t-2}} + \gamma \frac{G_{i,t} - G_{i,t-2}}{Y_{i,t-2}} \left(D_{i,t} - \bar{D}\right) + \zeta D_{i,t} + \epsilon_{i,t}$$

  - $D_{i,t} \equiv$ log-share of white males **aged 20-30** in total white male population
  - $\beta \equiv$ fiscal multiplier for a state with average share of young people
  - $\gamma \equiv$ how fiscal multiplier changes with demographics
  - When share of young people rises by 1% $\rightarrow$ multiplier goes from β to $\beta + \gamma$

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  - $\gamma \equiv$ how fiscal multiplier changes with demographics
  - When share of young people rises by 1% $\rightarrow$ multiplier goes from β to $\beta + \gamma$
- We also estimate local employment rate fiscal multipliers

Identification of Government Spending Shocks

- National military spending is **heterogeneously** distributed across states
  - After Vietnam War, military spending (as fraction of GDP) dropped by 1.5%
  - In California it dropped by 2.5% & in Illinois it dropped by 1%

- We estimate a first-stage regression:

$$\frac{G_{i,t} - G_{i,t-2}}{Y_{i,t-2}} = \eta_i \frac{G_t - G_{t-2}}{Y_{t-2}} + \epsilon_{i,t}$$

  - η_i captures **state-specific sensitivity** to national military spending
  - Assumption: US don't go to war when a state output is low (relative to other states)
  - Weaker than usual assumption US don't go to war when national output is low

Identification of the Role of Demograhics

- We exploit the time-series & cross-sectional variation of demographic shares
- In 2015 the share of young people ranges between 11.9% (Maine) & 22.6% (D.C.)
- Time-variation is due to the onset & aging of Baby-boomers
- Also large changes in the cross-sectional variation
  - In 1980 NY had the 4th lowest share of young people in the U.S.
  - In 2015 the share of young people of NY has become the 10th highest

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  - In 1980 NY had the 4th lowest share of young people in the U.S.
  - In 2015 the share of young people of NY has become the 10th highest
- **Migration** flows react to shocks $\rightarrow$ age structure is not exogenous
  - We instrument share of young people with 20-30 year **lagged birth rates**

▸ Validity Birth Rates

Results

	(1)	(2)
	Output per Capita	Employment Rate
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	1.511^{***}	1.095^{***}
	(0.406)	(0.215)
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}} \times \left(D_{i,t} - \bar{D}\right)$	0.047^{***}	0.034^{***}
	(0.016)	(0.011)
$D_{i,t}$	0.002^{***}	0.001
	(0.001)	(0.001)
R^2	0.374	0.621
N. Observations	2374	2374

Robustness Checks

- We consider:
  - OLS regression & IV regression where demographics is not instrumented
  - Different measure of young (15-29 years old) & different birth rate (20 year lagged)
  - Entire male population & entire population ▸ First Checks
- Additional national-level variables:
  - Oil price, households' debt, federal debt, interest rate, Ramey news ▸ National Controls
- Additional state-level variables:
  - House price, personal tax, unempl. rate & benefits ▸ State Controls
- Changes in labor market (skill composition & female participation) ▸ Labor Market
- Two-year cumulative fiscal multipliers ▸ Cumulative Multipliers
- The effect of spending shocks on states' population ▸ Population Dynamics
- The effect of spending shocks on hours worked ▸ Response of Hours
- Link between demographics & national multipliers
  - Panel SVAR à la Blanchard-Perotti across countries ▸ National Multipliers

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Environment

- 2 states in a **monetary union**
- Each state has a standard Calvo pricing New Keynesian setup
- Labor and capital are immobile, bonds move freely across states
- Household sector has a **life-cycle** structure
- Individuals face three stages of life: young, mature, and old
- Idiosyncratic probability to age (moving across age groups) and die
- We follow Gertler (1999) to **aggregate linearly** individuals within age group
- All the individuals supply labor, accumulate assets, and consume
- Government spending is partially financed through debt

▸ Production Structure ▸ Government ▸ Household

Differences Across Age Groups

- Young & old agents have higher **Frisch elasticity** than prime-age workers
- Young households face a hump-shaped labor income over the life-cycle
- Would like to borrow & smooth consumption
- **Credit market imperfections**
  - Incomplete markets: Idiosyncratic aging risk & non-contingent one-period bond
  - Borrowing constraint: Households cannot borrow
- Credit mkt imperfections boost the marginal propensity to consume of the young

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Calibration

- Symmetric countries. Share of home country is 10%
- We match the average 1967-2015 age structure
  - Young are 20-29 years old, Mature are 30-64 years old, Old are 65+ years old
- The model is calibrated to match the hump-shaped dynamics of labor income:
  - Young workers earn 68% of hourly wage of mature workers
  - Old workers earn 72% of hourly wage of mature workers
  - Mature individuals work 0.35 hours in steady-state
  - Hours worked by young & old are normalized by relative employment rates
- Frisch elasticity disciplined by estimates on micro intensive margin elasticity:
  - Elasticity of prime-age workers is $\nu_m = 0.2$ (Chetty et al., 2013)
  - Elasticity of old workers is $\nu_o = 0.75$ (Rogerson and Wallenius, 2013)
  - Elasticity of young workers is $\nu_y = 0.71 \rightarrow$ weighted avg elasticity of 0.4

▶ More on Calibration

Local Fiscal Multiplier

- We estimate the following regression using simulated data from the model

$$\frac{Y_{i,t} - Y_{i,t-2}}{Y_{i,t-2}} = \alpha_i + \delta_t + \beta \frac{G_{i,t} - G_{i,t-2}}{Y_{i,t-2}} + \epsilon_{i,t}, \qquad i \equiv \{H, F\}$$

- We change the age structure of the economy & replicate the estimation

- Difference between $\hat{\beta} \rightarrow$ sensitivity to demographics

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- Difference between $\hat{\beta} \rightarrow$ sensitivity to demographics

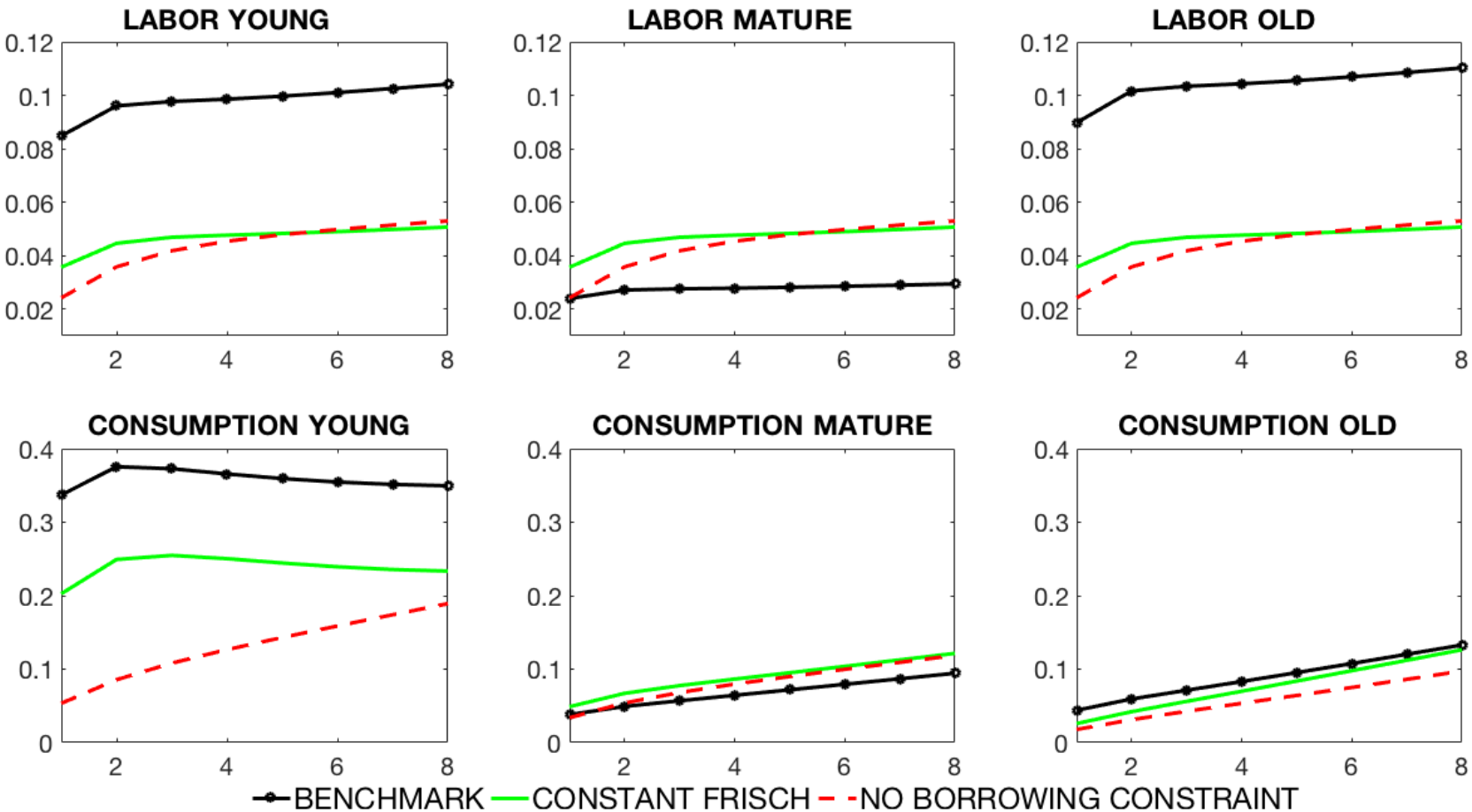
		Data	Model
Local Output Fiscal Multiplier	β	1.511	1.392
Sensitivity of Output Fiscal Multiplier with States' Age Structure	γ	0.047	0.027
Δ Local Fiscal Multiplier if Share Young People Rises by 1%	γ/β	3.1%	2.0%

Local Fiscal Multiplier - Channels

- We compare the baseline model with three counterfactual economies
  - "Constant Frisch Elasticity": $\nu_y = \nu_m = \nu_o = 0.4$
  - "No Borrowing Constraint": constant Frisch & without borrowing constraint

	Data	Baseline Model	Constant Frisch Elasticity	No Borrowing Constraint
Δ Local Output Fiscal Multiplier of 1% Increase in Share Young People	3.1%	2%	1.8%	0.9%

Individual Responses by Age Groups



Results on National Fiscal Multipliers

- We consider an increase in **national** government spending
- National govt spending is $G_t^u = G_{H,t} + G_{F,t}$
- National output is $Y_t^u = Y_{H,t} + Y_{F,t}$
- We estimate the regression

$$\frac{Y_t^u - Y_{t-2}^u}{Y_{t-2}^u} = \beta_N \frac{G_t^u - G_{t-2}^u}{Y_{t-2}^u} + \epsilon_t.$$

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	Output	Consumption	Investment	Employment
National Fiscal Multiplier	0.94	0.84	−0.90	1.38
Δ National Fiscal Multiplier if Share Young People Rises by 1%	1.1%	1.3%	−0.1%	1%

Implications of Population Aging

- U.S. population has progressively shifted towards older ages
- The share of young people dropped by 30%
- Feed the model with these shares & compare the response to govt spending shock

▸ Population Aging ▸ Fiscal Multipliers 1967 - 2015 ▸ Fiscal Multipliers 2040 - 2100 ▸ Female Labor Participation

Implications of Population Aging

- U.S. population has progressively shifted towards older ages
- The share of young people dropped by 30%
- Feed the model with these shares & compare the response to govt spending shock
- In 1980 the model yields a fiscal multiplier of 1.12
- In 2015 the fiscal multiplier dropped by 36%, down to 0.72
- In 2100 the fiscal multiplier will be 0.44
- **Population aging reduces substantially the size of fiscal multipliers**

▸ Population Aging ▸ Fiscal Multipliers 1967 - 2015 ▸ Fiscal Multipliers 2040 - 2100 ▸ Female Labor Participation

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Conclusion

- We document that fiscal multipliers depend on demographics
- Local fiscal multipliers increase with the share of young people in total population
- We rationalize this fact with a life-cycle open-economy New Keynesian model with:
  - credit market imperfections
  - age-specific differences in labor supply
- Model explains 61% of the link between demographics & local fiscal multipliers
- Also national fiscal multipliers depend on the age structure of an economy
- US population aging has reduced fiscal multipliers by 36% over the last 30 years

APPENDIX

Data

- Annual data from 1967 until 2015 across 50 U.S. states & District of Columbia
- GDP from BEA
- Employment from CES-BLS
- Military spending from the U.S. Statistical Abstract & usaspending.gov
  - Data on allocation across states of national military spending
  - Based on electronic database of procurements of U.S. Department of Defense
  - Cover procurements above 25,000$
- Population from Surveillance, Epidemiology & End Results Program
  - Young white males: 20-30 years old
- Birth rates from Census Bureau

Go Back

Response of Output - Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Baseline	Baseline	No IV Birth Rates	Share Age 15-29	Birth Rates 25 Year Lag	All Men	Men & Women
	IV	OLS	Partial IV	IV	IV	IV	IV
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	1.511***	0.109	1.515***	1.251***	1.451***	1.664***	1.613***
	(0.409)	(0.112)	(0.468)	(0.394)	(0.396)	(0.432)	(0.435)
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}} \times (D_{i,t} - \bar{D})$	0.047***	0.011*	0.067**	0.051**	0.051***	0.066**	0.060**
	(0.017)	(0.006)	(0.028)	(0.024)	(0.017)	(0.028)	(0.025)
$D_{i,t}$	0.002***	0.002***	0.002***	0.003***	0.001	0.002**	0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.374	0.390	0.330	0.382	0.411	0.362	0.364
N. Observations	2374	2397	2397	2374	2366	2374	2374

Go Back

Response of Employment Rate - Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Baseline	Baseline	No IV Birth Rates	Share Age 15-29	Birth Rates 25 Year Lag	All Men	Men & Women
	IV	OLS	Partial IV	IV	IV	IV	IV
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	1.095***	0.180**	1.046***	0.959***	1.097***	1.091***	1.075***
	(0.215)	(0.076)	(0.236)	(0.210)	(0.210)	(0.226)	(0.220)
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}} \times (D_{i,t} - \bar{D})$	0.034***	0.001	0.025**	0.038**	0.035***	0.038**	0.039**
	(0.011)	(0.005)	(0.010)	(0.016)	(0.010)	(0.017)	(0.016)
$D_{i,t}$	0.001	0.001	0.001	0.001**	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.621	0.635	0.590	0.627	0.627	0.625	0.624
N. Observations	2374	2397	2397	2374	2366	2374	2374

Go Back

Response of Output - National Controls

	(1)	(2)	(3)	(4)	(5)
	Oil Price	Households' Debt	Federal Debt	Real Interest Rate	Ramey News
	IV	IV	IV	IV	IV
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	1.311***	1.661***	1.511***	1.500***	1.508***
	(0.333)	(0.451)	(0.443)	(0.395)	(0.416)
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}} \times \left(D_{i,t} - \bar{D}\right)$	0.039**	0.065***	0.041**	0.048***	0.039**
	(0.015)	(0.022)	(0.017)	(0.017)	(0.018)
$D_{i,t}$	0.001**	0.002**	0.002***	0.001**	0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.446	0.371	0.397	0.405	0.389
N. Obs.	2374	2374	2374	2374	2374

Go Back

Response of Employment Rate - National Controls

	(1)	(2)	(3)	(4)	(5)
	Oil Price	Households' Debt	Federal Debt	Real Interest Rate	Ramey News
	IV	IV	IV	IV	IV
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	1.104***	1.070***	1.025***	1.069***	1.073***
	(0.207)	(0.013)	(0.216)	(0.211)	(0.222)
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}} \times \left(D_{i,t} - \bar{D}\right)$	0.033***	0.040***	0.034***	0.032***	0.035***
	(0.011)	(0.013)	(0.011)	(0.011)	(0.011)
$D_{i,t}$	0.001	0.001	0.001	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.630	0.635	0.641	0.639	0.625
N. Obs.	2374	2374	2374	2374	2374

Go Back

Response of Output - State Controls

	(1)	(2)	(3)	(4)
	House Price	Personal Taxes	Unempl. Rate	Unempl. Benefits
	IV	IV	IV	IV
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	0.795^{***}	1.468^{***}	0.627	1.500^{***}
	(0.398)	(0.401)	(0.412)	(0.406)
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}} \times (D_{i,t} - \bar{D})$	0.066^{***}	0.048^{***}	0.049^{***}	0.047^{***}
	(0.016)	(0.016)	(0.016)	(0.016)
$D_{i,t}$	0.001^{***}	0.001^{**}	0.001^{**}	0.002^{***}
	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.441	0.378	0.451	0.375
N. Obs.	2031	2374	2374	2031

Go Back

Response of Employment Rate - State Controls

	(1)	(2)	(3)	(4)
	House Price	Personal Taxes	Unempl. Rate	Unempl. Benefits
	IV	IV	IV	IV
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	0.416**	1.071***	0.325	1.084***
	(0.220)	(0.218)	(0.220)	(0.217)
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}} \times (D_{i,t} - \bar{D})$	0.043***	0.035***	0.035***	0.035***
	(0.008)	(0.011)	(0.009)	(0.011)
$D_{i,t}$	-0.001	0.001	-0.001**	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.723	0.624	0.726	0.622
N. Obs.	2031	2374	2031	2374

Go Back

Response of Output - Labor Market

	(1)	(2)	(3)	(4)
	Skilled Workers	Young Skilled Workers	Female Workers	Young Female Workers
	IV	IV	IV	IV
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	1.125**	1.177**	1.147**	1.138**
	(0.480)	(0.478)	(0.477)	(0.470)
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}} \times (D_{i,t} - \bar{D})$	0.070***	0.070***	0.071***	0.067***
	(0.018)	(0.018)	(0.017)	(0.017)
$D_{i,t}$	0.001*	0.001**	0.001*	0.001**
	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.348	0.351	0.349	0.352
N. Observations	1982	1982	1982	1982

Go Back

Response of Employment Rate - Labor Market

	(1)	(2)	(3)	(4)
	Skilled Workers	Young Skilled Workers	Female Workers	Young Female Workers
	IV	IV	IV	IV
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	0.537*	0.611**	0.581*	0.591**
	(0.298)	(0.300)	(0.301)	(0.298)
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}} \times (D_{i,t} - \bar{D})$	0.045***	0.046***	0.046***	0.045***
	(0.010)	(0.011)	(0.011)	(0.011)
$D_{i,t}$	-0.001*	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)
R^2	0.664	0.660	0.660	0.663
N. Observations	1982	1982	1982	1982

Go Back

2 Year Cumulative Local Fiscal Multiplier

	(1)	(2)
	Output per Capita	Employment Rate
$\frac{\left(\sum_{j=1}^{2} G_{i,t+1-j} - 2G_{i,t-2}\right)}{Y_{i,t-2}}$	1.453^{***}	1.019^{***}
	(0.405)	(0.212)
$\frac{\left(\sum_{j=1}^{2} G_{i,t+1-j} - 2G_{i,t-2}\right)}{Y_{i,t-2}} \times \left(D_{i,t} - \bar{D}\right)$	0.046^{***}	0.033^{***}
	(0.016)	(0.011)
$D_{i,t}$	0.003^{***}	0.001
	(0.001)	(0.001)
R^2	0.369	0.618
N. Observations	2374	2374

Go Back

Response of Population

	(1)	(2)	(3)	(4)
	Overall Population	Young Population	Mature Population	Old Population
	IV	IV	IV	IV
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	-0.179	1.145^{***}	-0.398	-0.070
	(0.303)	(0.399)	(0.403)	(0.212)
R^2	0.611	0.654	0.584	0.790
N. Observations	2295	2295	2295	2295

Go Back

Response of Hours

- We use CPS data from 1977 on to build state measures of hours worked for:
  - all workers
  - young workers (between 20 and 30 years old)
  - older workers (above 30 years old)

	(1)	(2)	(3)
	All Workers	Young Workers	Older Workers
	IV	IV	IV
$\frac{G_{i,t}-G_{i,t-2}}{Y_{i,t-2}}$	0.656**	1.036	0.449
	(0.294)	(0.711)	(0.407)
R^2	0.176	0.100	0.121
N. Observations	1887	1887	1887

Go Back Go Back to Robustness

Structure & Production

- 2 states (Home & Foreign) under same monetary policy rule
- The home economy has a population N_t and foreign N_t^*, such that $N_t + N_t^\star = N_{U,t}$
- In each economy there is a final goods firm & a continuum of intermediate firms
- In the home economy:

$$Y_{H,t} = \left(\int_0^1 {Y_{H,t}^i}^{\frac{\varepsilon-1}{\varepsilon}} \mathrm{d}i \right)^{\frac{\varepsilon}{\varepsilon-1}} \qquad P_{H,t} = \left(\int_0^1 {P_{H,t}^i}^{1-\varepsilon} \mathrm{d}i \right)^{\frac{1}{1-\varepsilon}}$$

- In each economy consumption & investment bundle goods produced in both states

Go back

Government

- **Monetary authority** follows a union-level Taylor rule
- **Fiscal authority** purchases home goods $G_{H,t}$ and foreign goods $G_{F,t}$
- Purchases $G_{H,t}$ and $G_{F,t}$ follow exogenous AR(1) processes
- Government finances its expenditures with:
  - revenues of one-period non-contingent bond $B_{g,t}$
  - lump-sum taxes in home state T_t & foreign state $T_t^\star$
  - proceeds from dividend taxation
- Fiscal rule determines the response of debt & tax to govt spending shocks

$$\frac{\widehat{B}_{g,t+1}}{Y^u_{SS}} = \rho_{bg}\frac{\widehat{B}_{g,t}}{Y^u_{SS}} + \phi_G\frac{\widehat{P_{H,t}G_{H,t}}}{Y^u_{SS}} + \phi_G\frac{\widehat{P_{F,t}G_{F,t}}}{Y^u_{SS}} + \phi_T\frac{\widehat{P_tT_t}}{Y^u_{SS}} + \phi_T\frac{\widehat{P_t^\star T_t^\star}}{Y^u_{SS}}$$

Go back

Intermediate Goods Firms

- Production function: $Y^i_{H,t} = {L^i_t}^{\alpha} {K^i_t}^{1-\alpha}$
- Firms' nominal profits: $D^i_t = P^i_{H,t} Y^i_{H,t} - W_t L^i_t - R_{k,t} K^i_t$
- Calvo pricing frictions: firms can adjust prices with probability $1 - \zeta$
- Optimal price setting problem: $\max_{P^i_{H,t}} \mathbb{E}_t \left\{ \sum_{s=0}^{\infty} \zeta^s Q_{m,t,t+s} \frac{D^i_{t+s}\left(P^i_{H,t}\right)}{P_{t+s}} \right\}$
- Optimal reset price: $P^{\#}_{H,t} = \frac{\varepsilon}{\varepsilon - 1} \frac{\mathbb{E}_t \sum_{s=0}^{\infty} \zeta^s Q_{m,t,t+s} \Phi^i_{t+s} P^{\varepsilon}_{H,t+s} P^{-1}_{t+s} Y_{t+s}}{\mathbb{E}_t \sum_{s=0}^{\infty} \zeta^s Q_{m,t,t+s} P^{\varepsilon}_{H,t+s} P^{-1}_{t+s} Y_{t+s}}$
- Law of motion of prices: $P^{1-\varepsilon}_{H,t} = (1-\zeta) {P^{\#}_{H,t}}^{1-\varepsilon} + \zeta P^{1-\varepsilon}_{H,t-1}$

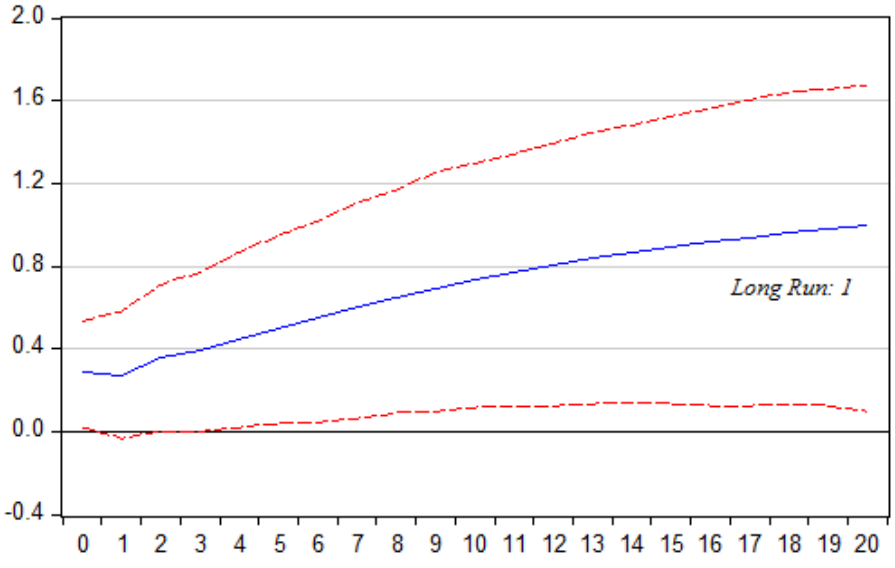
Go back

National Fiscal Multipliers

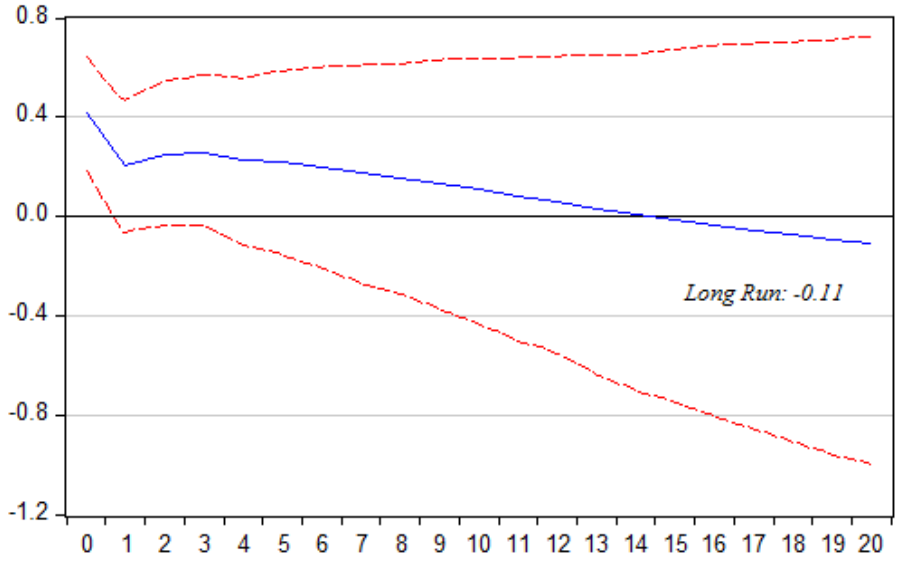
- We study how national fiscal multipliers depend on demographics
- We estimate fiscal multipliers with a panel SVAR
- Quarterly data on output & govt spending across countries
  Ilzetzki, Mendoza, and Vegh (2013)
- Identify govt spending shocks with restriction a la Blanchard and Perotti (2002)
- Govt spending shocks react with a delay of a quarter to other variables
- We consider a panel of developed countries & a panel of developing countries
  19 developed countries & 25 developing countries
- We split countries in two groups, depending on the shares of young people

Go back

National Fiscal Multipliers - Developed Countries



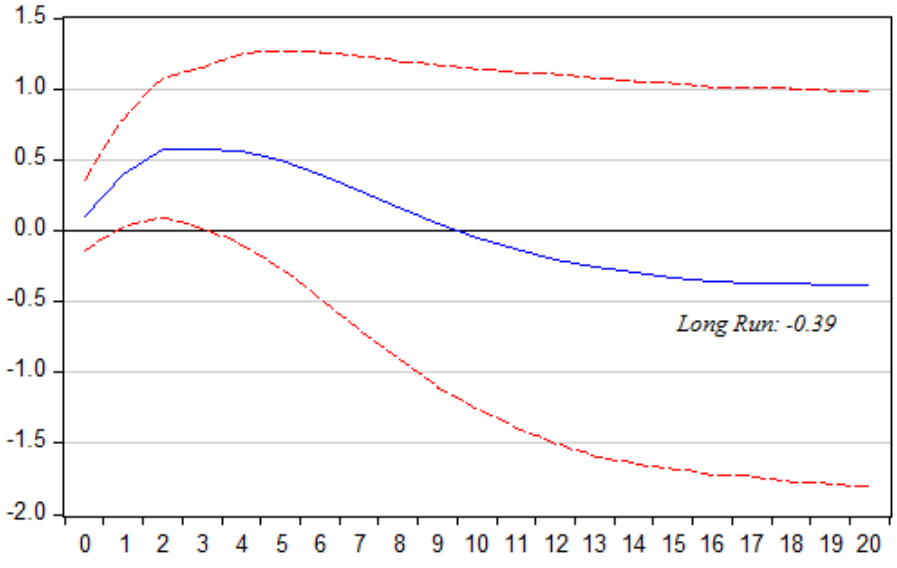
(a) High Share of Young People



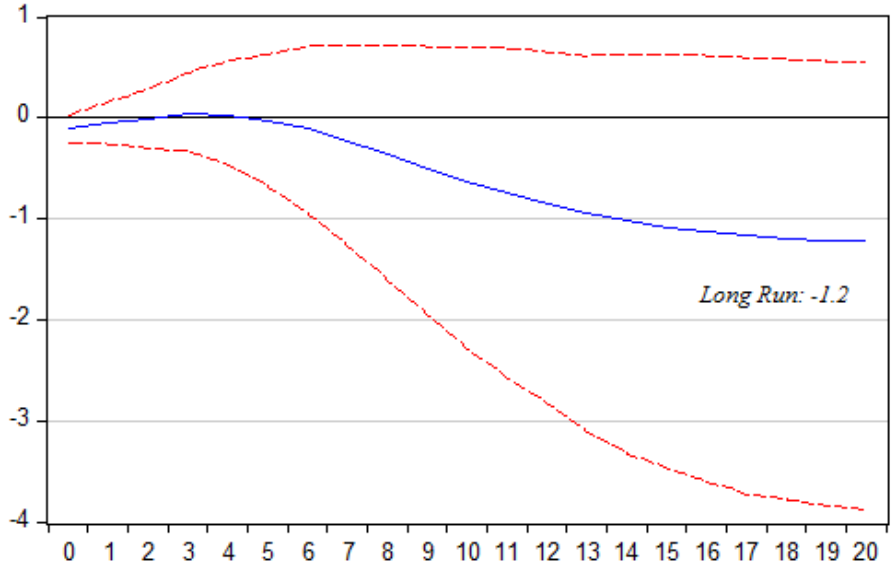
(b) Low Share of Young People

Go back

National Fiscal Multipliers - Developing Countries



(c) High Share of Young



(d) Low Share of Young

Go back

Age-Specific Labor Supply

- In the data the volatility of hours worked (& hourly wages) depends on age
- The standard deviation of hours worked is highest for old workers (65+ years old) and young workers (20-30 years old)
- We use CPS data and find that the local hours worked fiscal multiplier of young workers is much higher than for older workers ▸ Response of Hours
- To capture these patterns, we assume that the Frisch elasticity depends on age
- In the calibration, we set $\nu_o > \nu_y >> \nu_m$
- Young workers are more reactive to govt spending shocks than prime-age individuals

▸ Go Back

Calibration - Standard Parameters

Parameter	Value	Target/Source
Time Discount Factor	$\beta = 0.995$	Standard Value
Elasticity Intertemporal Substitution	$\eta = -9$	EIS $= 0.1$
Capital Depreciation Rate	$\delta = 0.025$	Standard Value
Capital Adjustment Cost	$\kappa = 135$	Two-Year National Investment Fiscal Multiplier = -0.9
Home Bias in Consumption & Investment	$\lambda = 0.69$	Nakamura and Steinsson (2014)
Elasticity Substitution Home & Foreign Consumption	$\psi_c = 2$	Nakamura and Steinsson (2014)
Elasticity Substitution Home & Foreign Investment	$\psi_i = 2$	$\psi_i = \psi_c$
Elasticity Substitution Across Varieties	$\epsilon = 7$	Standard Value
Capital Share in Production	$\alpha = 0.33$	Standard Value
Calvo Parameter	$\zeta = 0.75$	Standard Value

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Calibration - Standard Parameters

Parameter	Value	Target/Source
Dividend Taxation Rate	$\tau_d = 0.9394$	Mature Agents Receive 60% Total Dividends
Steady-State Government Spending to Output Ratio	$\frac{G_{H,SS}+G_{F,SS}}{Y^U_{SS}} = 0.2$	Data
Persistence Government Spending Shock	$\rho_G = 0.933$	Data
Inertia of Government Debt	$\rho_{bg} = 0.95$	Dynamic Response to Spending of Government Debt
Response to Spending of Government Debt	$\phi_G = 4.5$	Dynamic Response to Spending of Government Debt
Response to Spending of Taxation	$\phi_T = 0.01$	Dynamic Response to Spending of Taxation
Inertia of Taylor Rule	$\psi_R = 0.8$	Clarida et *al.* (2000)
Taylor Rule Response to Inflation	$\psi_\pi = 1.5$	Clarida et *al.* (2000)
Taylor Rule Response to Output Gap	$\psi_Y = 0.2$	Clarida et *al.* (2000)

Go back

Calibration - Demographics

Parameter	Value	Target/Source
Birth Rate of New Young Agents	$\omega_n = 0.0241$	Share of Young in Population
Probability Transition from Young to Mature	$1 - \omega_y = 0.0250$	Avg. Number of Years as Young: 10y
Probability Transition from Mature to Old	$1 - \omega_m = 0.0083$	Avg. Number of Years as Mature: 30y
Death Probability of Old Agents	$1 - \omega_o = 0.0320$	Share of Old in Population
Relative Size Population Home Economy	$N/N^u = 0.1$	Relative Size of California

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Calibration - Life Cycle

Parameter	Value	Target/Source
Disutility Labor for Young Agents	$\chi_y = 4.9963$	Fraction of Hours Worked $= 0.3238$
Disutility Labor for Mature Agents	$\chi_m = 490.1585$	Fraction of Hours Worked $= 0.35$
Disutility Labor for Old Agents	$\chi_o = 1.6923$	Fraction of Hours Worked $= 0.08$
Efficiency Units of Hours for Young Agents	$\xi_y = 0.68$	Wage Young $= 68\%$ Wage Mature
Efficiency Units of Hours for Mature Agents	$\xi_m = 1$	Normalization
Efficiency Units of Hours for Old Agents	$\xi_o = 0.72$	Wage Old $= 72\%$ Wage Mature
Frisch Elasticity for Young Agents	$\nu_y = 0.71$	Weighted Avg. Frisch Elasticity $= 0.4$
Frisch Elasticity for Mature Agents	$\nu_m = 0.2$	Chetty et *al.* (2011)
Frisch Elasticity for Old Agents	$\nu_o = 0.75$	Rogerson and Wallenius (2013)

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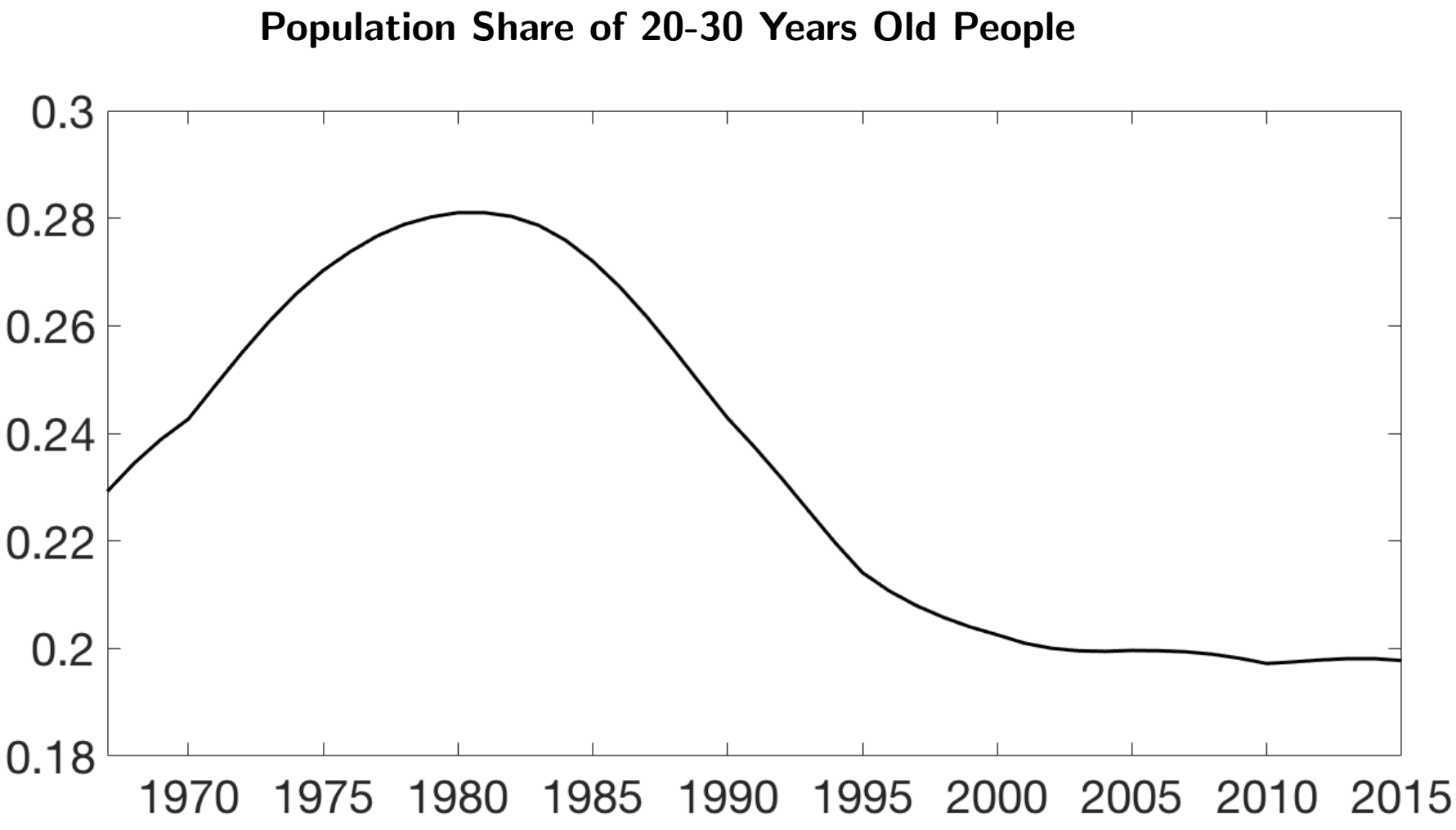
Population Aging



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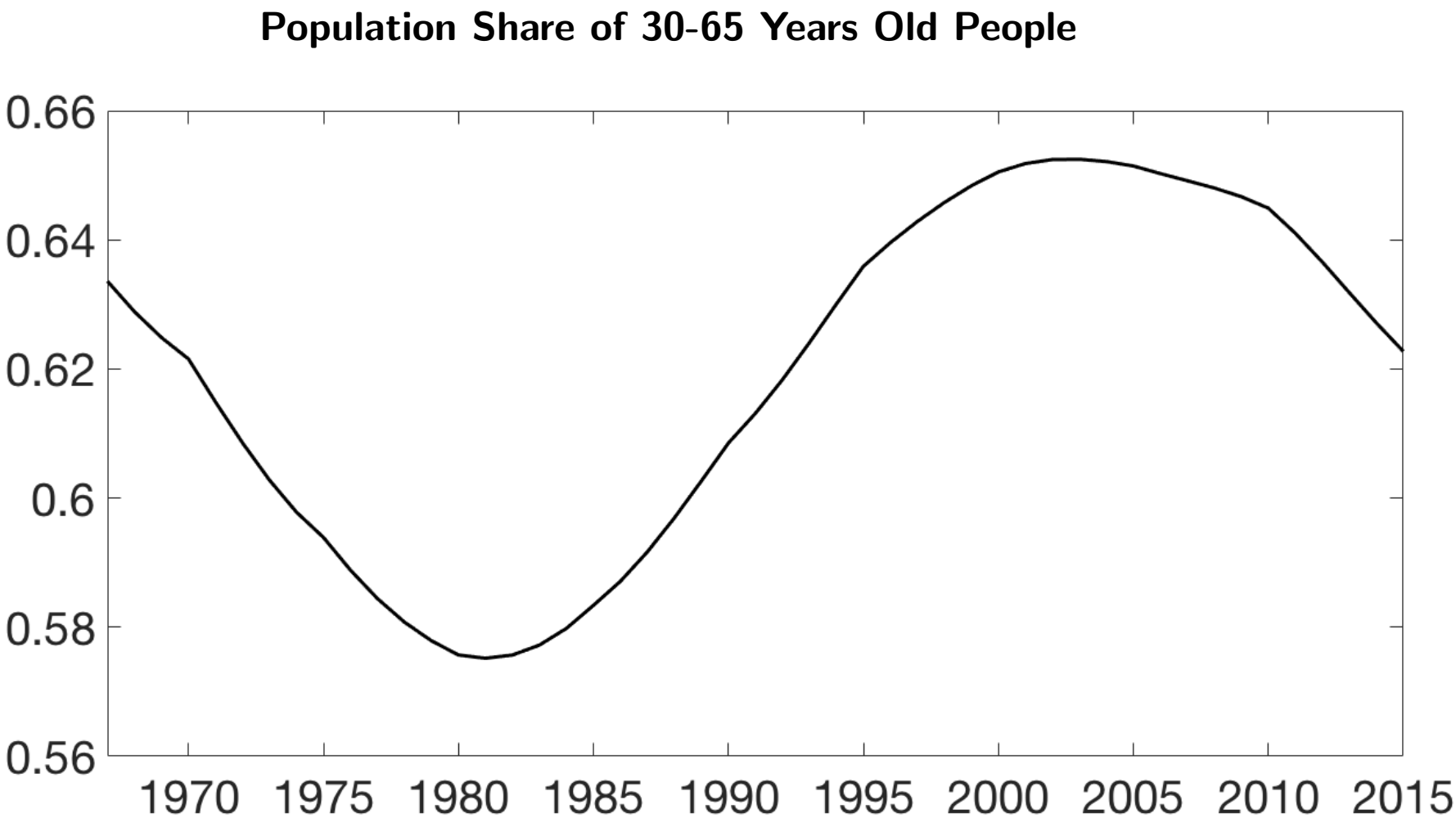
Population Aging



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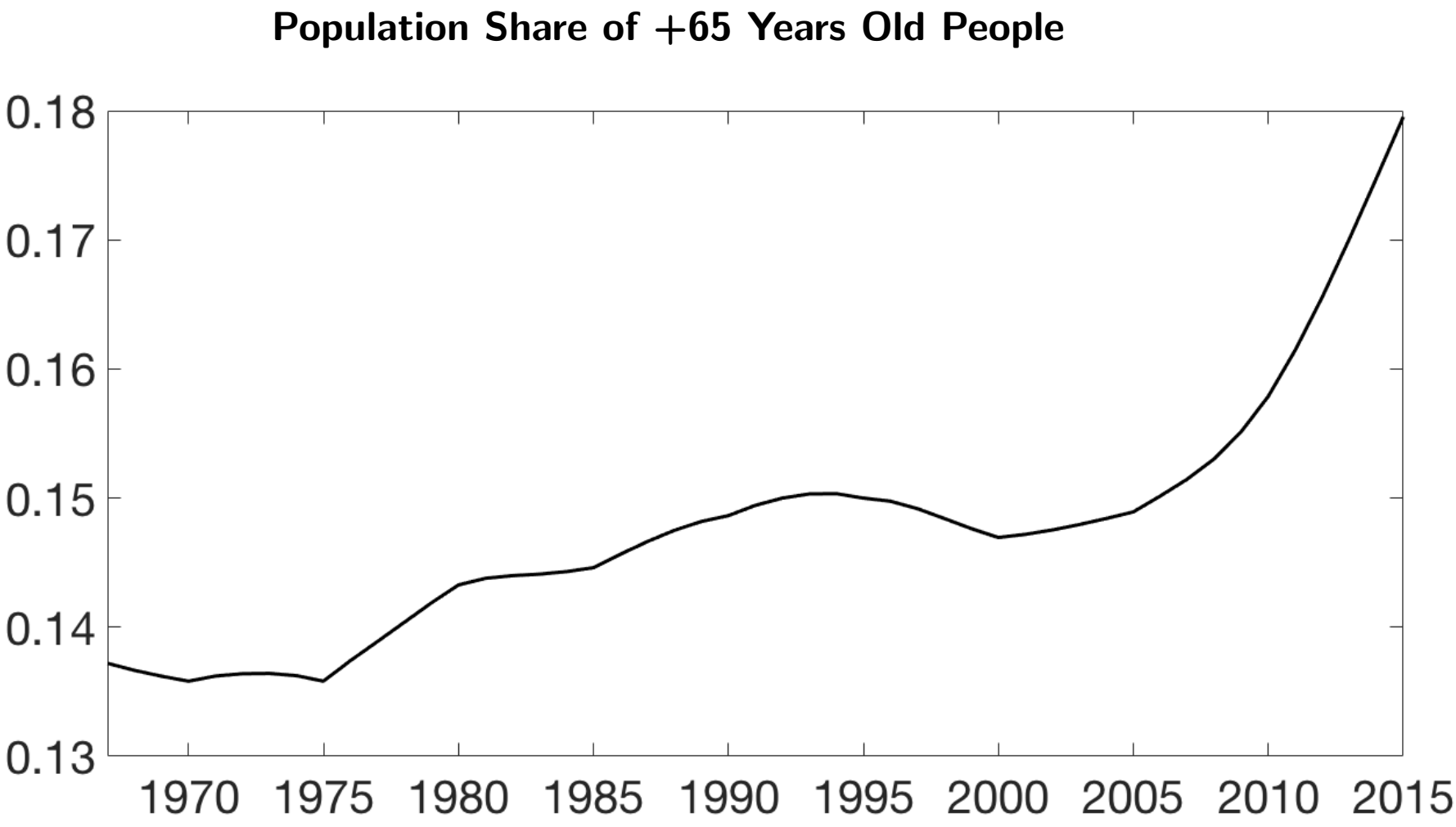
Population Aging



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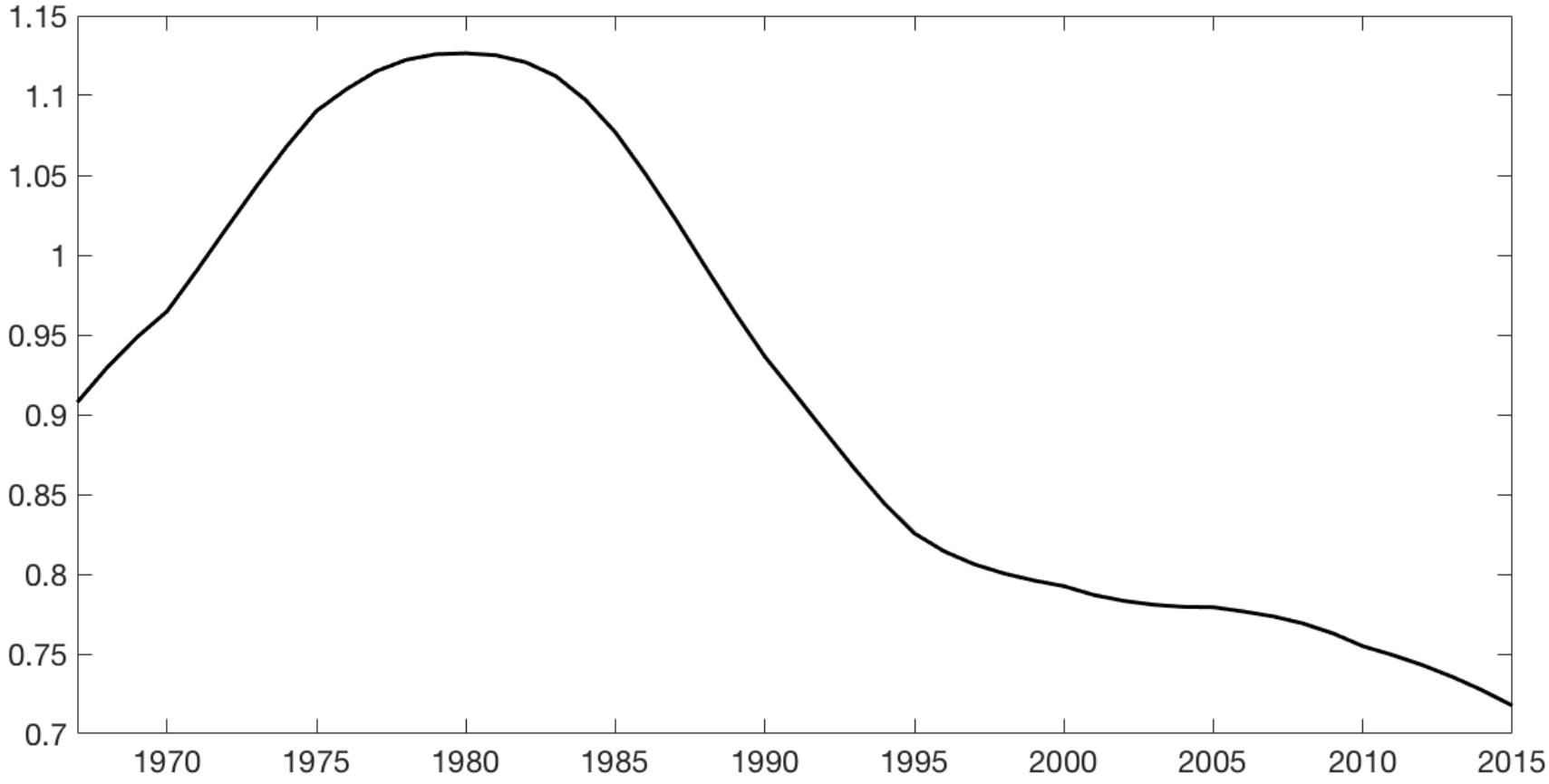
Output Fiscal Multiplier 1967 - 2015



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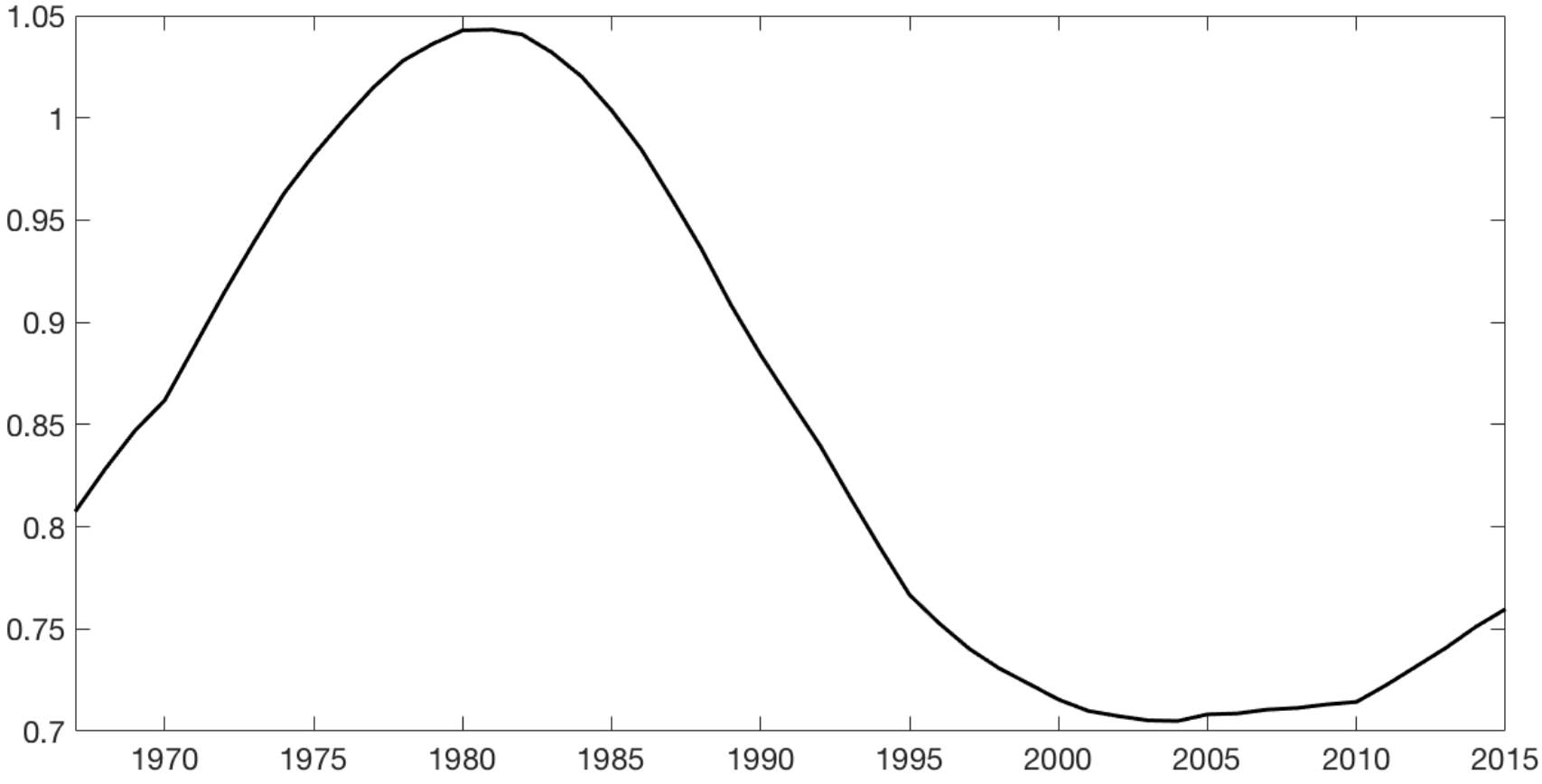
Consumption Fiscal Multiplier 1967 - 2015



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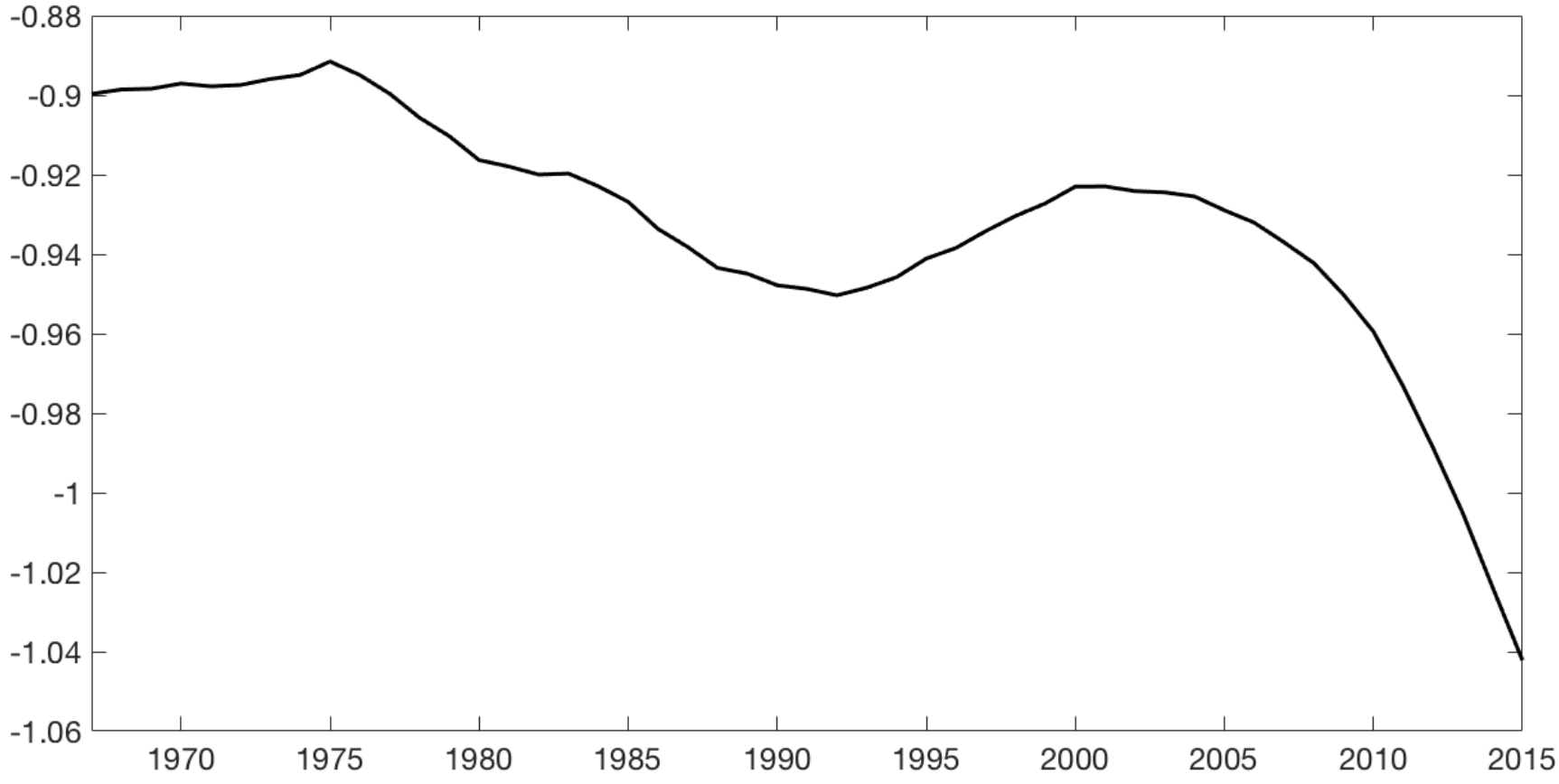
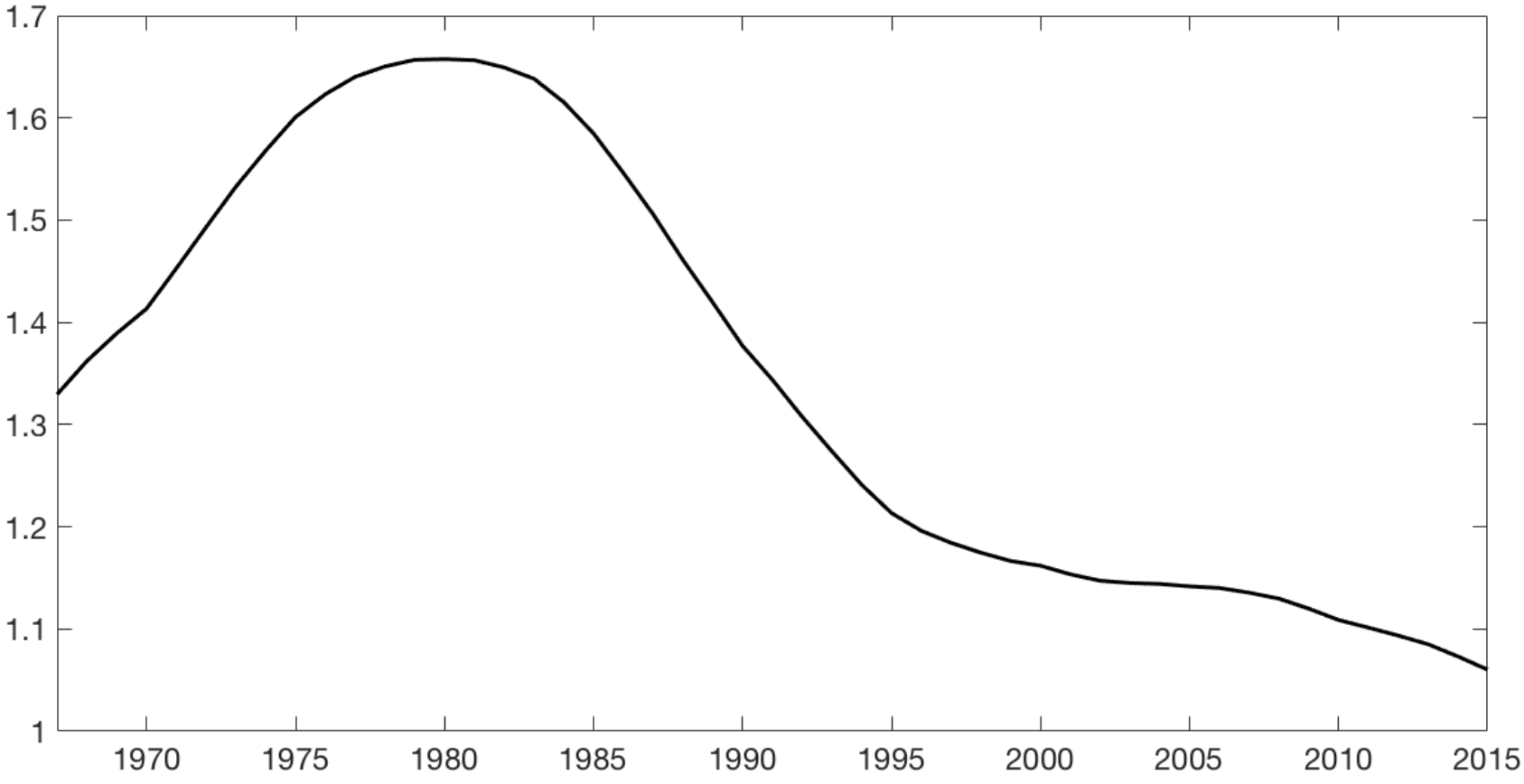
Investment Fiscal Multiplier 1967 - 2015



Go back

Employment Fiscal Multiplier 1967 - 2015



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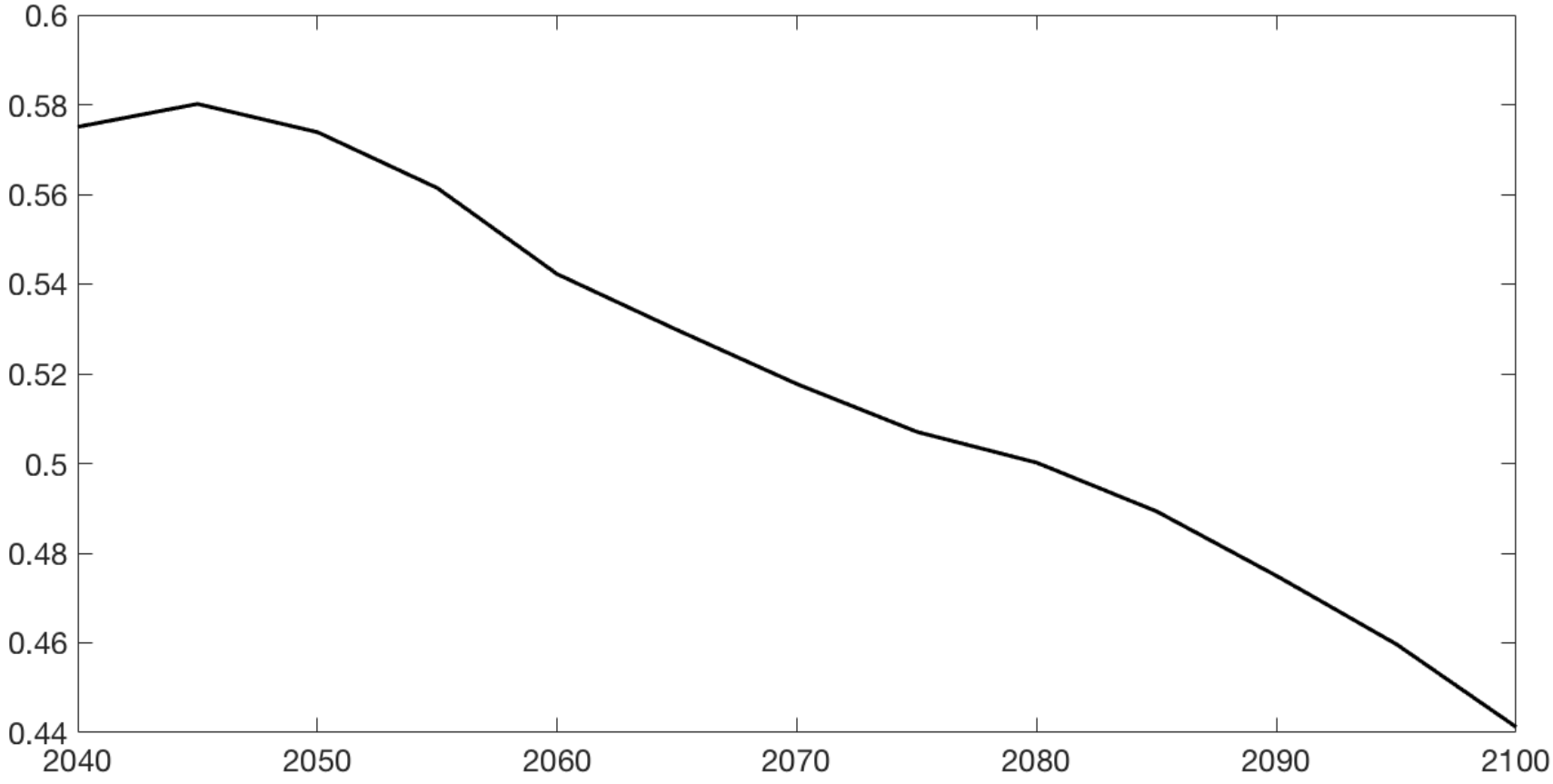
Output Fiscal Multiplier 2040 - 2100



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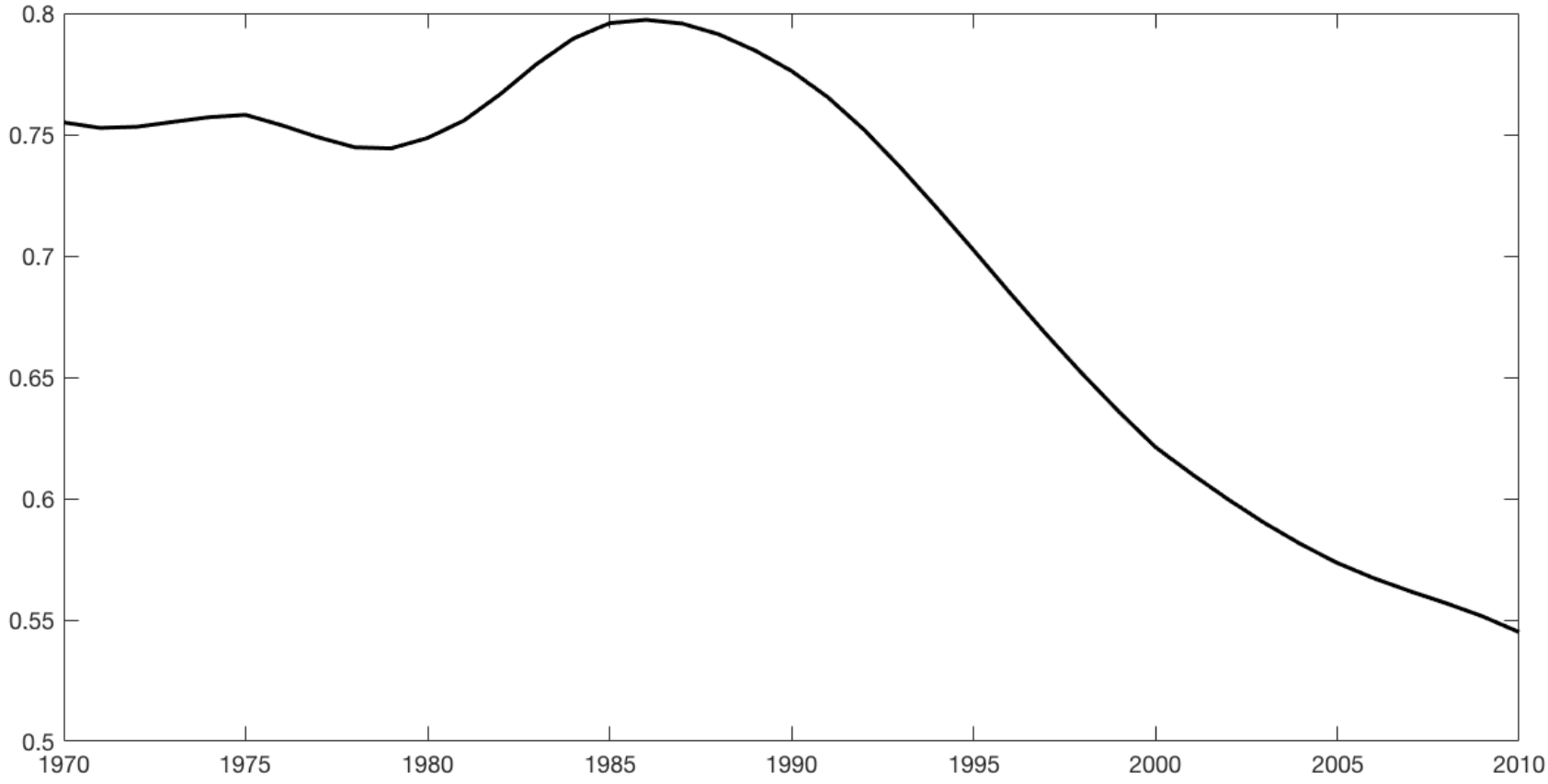
Output Fiscal Multiplier 1970 - 2010



Go back

Validity of Lagged Birth Rates as IV

- We report the first-stage regressions of the share of young people on lagged birth rates
- We consider the share of young white males, young males, and all young people
- For each series, we consider four different first-stage regressions
  - We regress the raw share on raw birth rates and state & year fixed effects
  - We regress the residual share of young people on residual birth rates w/o fixed effects
  - The residuals are derived by regressing each raw series on state & year fixed effects
  - We replicate these two cases for the log share of young people and log birth rates

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Share of Young White Males

	(1) Raw	(2) Residuals	(3) Log	(4) Log, Residuals
Lagged Birth Rates	0.317^{***}			
	(0.062)			
Lagged Birth Rates (Residuals)		0.317^{***}		
		(0.014)		
Lagged Birth Rates (Log)			0.509^{***}	
			(0.064)	
Lagged Birth Rates (Log, Residuals)				0.509^{***}
				(0.018)
State FE	YES	NO	YES	NO
Year FE	YES	NO	YES	NO
R^2	0.938	0.176	0.934	0.259
N. Observations	2374	2374	2374	2374

Go back

Share of Young Males

	(1) Raw	(2) Residuals	(3) Log	(4) Log, Residuals
Lagged Birth Rates	0.280^{***} (0.062)			
Lagged Birth Rates (Residuals)		0.280^{***} (0.013)		
Lagged Birth Rates (Log)			0.446^{***} (0.059)	
Lagged Birth Rates (Log, Residuals)				0.446^{***} (0.017)
State FE	YES	NO	YES	NO
Year FE	YES	NO	YES	NO
R^2	0.913	0.159	0.915	0.228
N. Observations	2374	2374	2374	2374

Go back

Share of Young People

	(1) Raw	(2) Residuals	(3) Log	(4) Log, Residuals
Lagged Birth Rates	0.262^{***} (0.057)			
Lagged Birth Rates (Residuals)		0.262^{***} (0.012)		
Lagged Birth Rates (Log)			0.427^{***} (0.057)	
Lagged Birth Rates (Log, Residuals)				0.427^{***} (0.016)
State FE	YES	NO	YES	NO
Year FE	YES	NO	YES	NO
R^2	0.921	0.159	0.922	0.226
N. Observations	2374	2374	2374	2374

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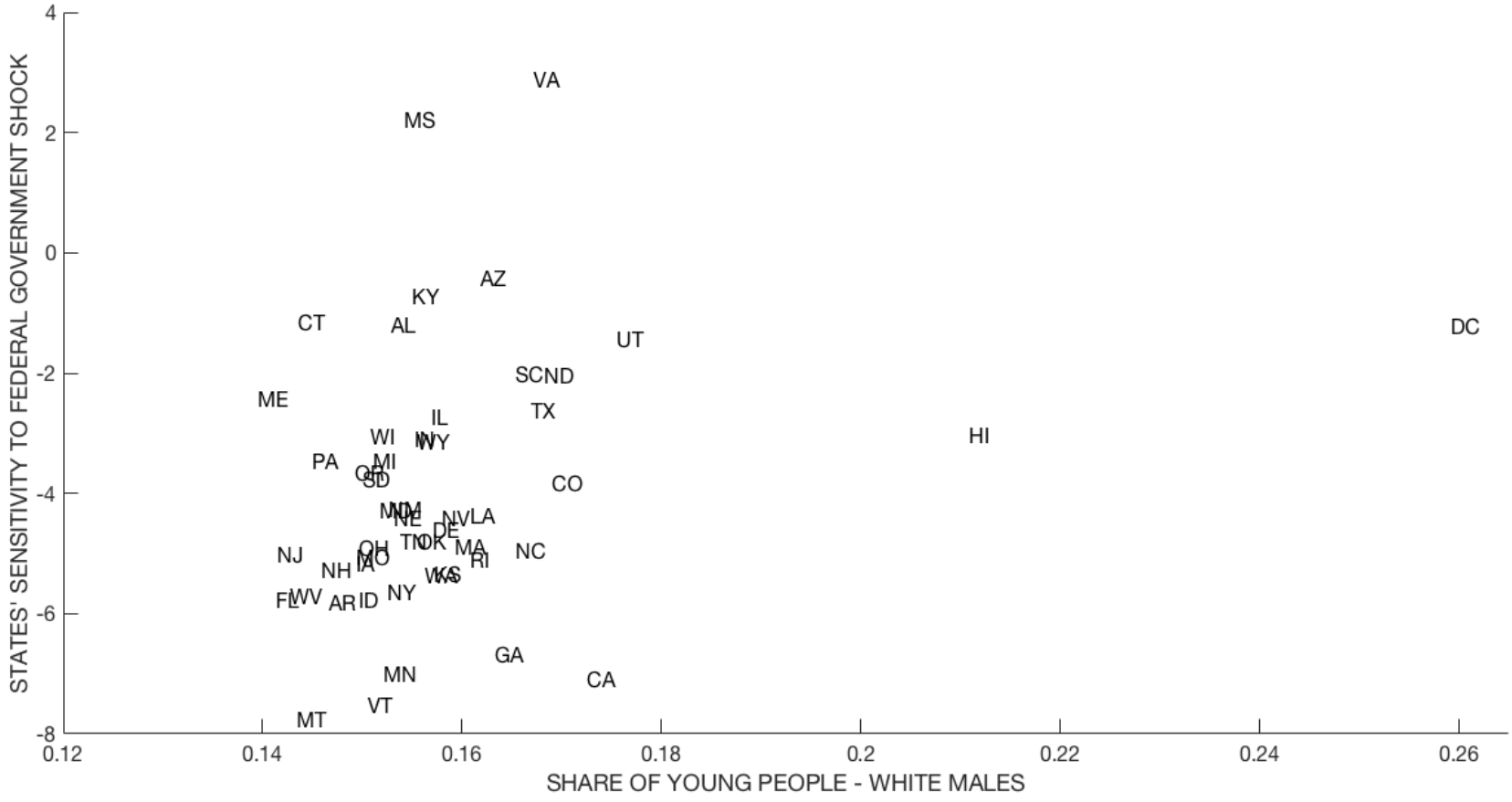
Validity of Lagged Birth Rates as Instrument for Demographics



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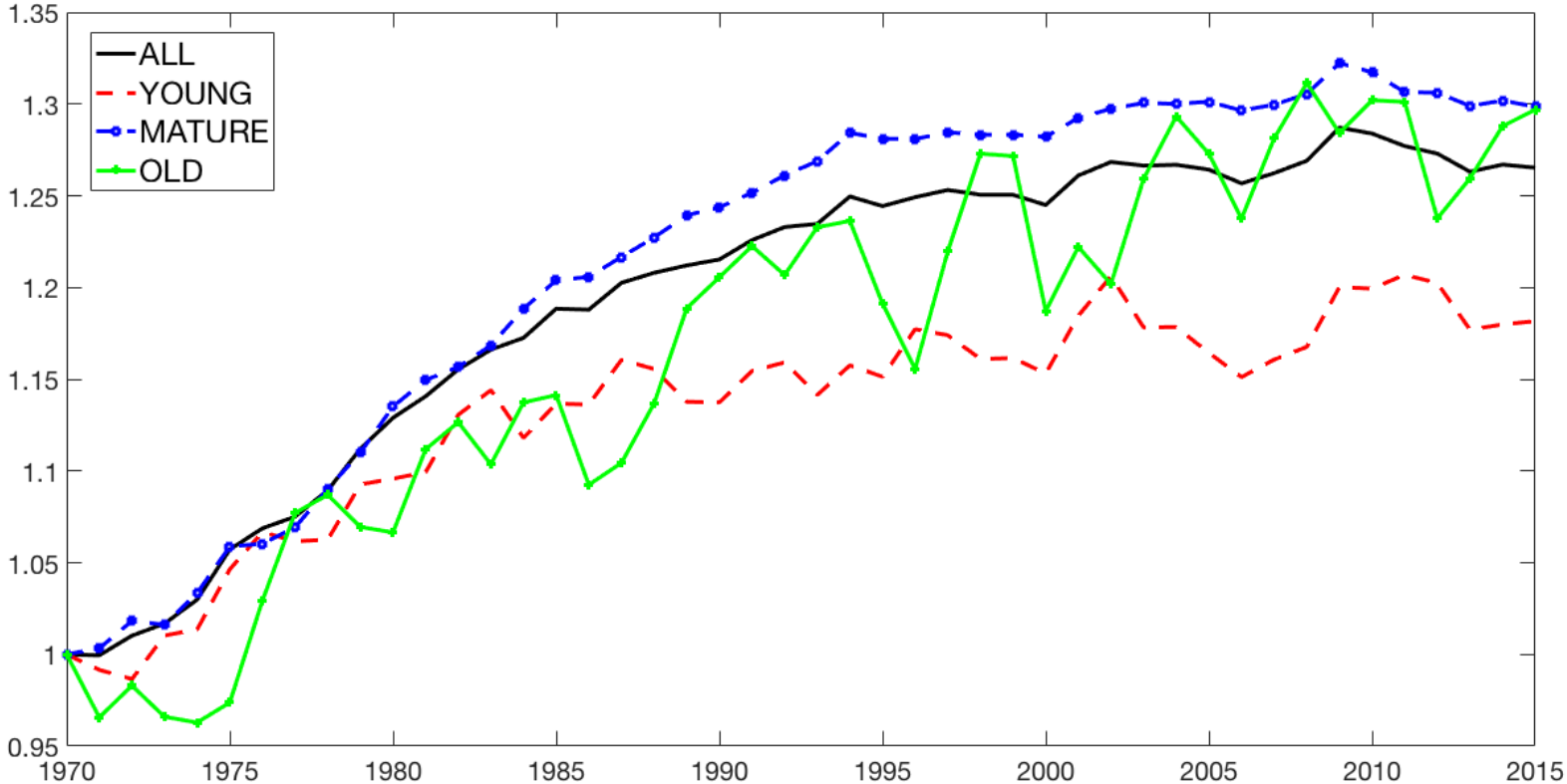
The Rise of the Female Labor Force Participation

- Unless MPC depends on sex, only difference stems from the Frisch elasticities
- The Frisch elasticity channel in the model is quantitatively not so relevant
- Bulk of rise in female labor force participation is concentrated in workers aged 30+



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The Rise of the Female Labor Force Participation

- We account for the rise of the female labor force participation in a reduced-form
  - We compute a weighted-average Frisch elasticity by age-group
  - Frisch elasticities of females are 1.5 times larger the Frisch elasticity of males
  - Consider the changes in the relative employment rate of female and male workers
  - Compare the change in national output fiscal multipliers between 1980 and 2015

	Baseline Model	Female Labor Force Participation Model
Δ National Fiscal Multiplier 1980-2015	-36%	-31%

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Households

- Continuum of households that face **life-cycle**
- Households belong to three different groups: young (y), mature (m) and old (o)
- Measures of young, mature, and old are such that $N_{y,t} + N_{m,t} + N_{o,t} = N_t$
- In every period:
  - $\omega_n N_{y,t}$ new young agents are born and enter the economy
  - young agents become mature in the next period with a probability $1 - \omega_y$
  - mature agents become old in the next period with a probability $1 - \omega_m$
  - old agents die with a probability $1 - \omega_o$

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Households - Idiosyncratic Risk

- Households face idiosyncratic risk of transition to mature, to old, and death
- We introduce perfect **annuity market** to insure old agents against risk of death
  - Old agents transfer their investment in capital & bonds to financial intermediaries
  - Intermediaries pay back nominal return $a^i_{z,t}$ to surviving old agent

$$a^i_{z,t} = \frac{1}{\omega_o}\left(R_{k,t}k^i_{z,t} + R_{n,t}b^i_{z,t}\right)$$

- We assume that each individual is **risk neutral**
  - Uncertainty on transition to mature & old does not affect individual choices
  - We assume that Epstein and Zin individual preferences
  - **Elasticity intertemporal substitution is positive** $\rightarrow$ consumption smoothing
- We can linearly aggregate choices of each individual within each age group $\rightarrow$ **three representative agents**

Go Back

Households' Problem

- Agent j of age $z = \{y, m, o\}$ chooses consumption, labor, capital & bonds

$$\max_{c^i_{z,t},\, l^i_{z,t},\, k^i_{z,t+1},\, b^i_{z,t+1}} v^i_{z,t} = \left\{ \left(c^i_{z,t} - \chi_z \frac{{l^i_{z,t}}^{1+\frac{1}{\nu_z}}}{1+\frac{1}{\nu_z}} \right)^{\eta} + \beta \mathbb{E}_t [v^i_{z',t+1} \mid z]^{\eta} \right\}^{1/\eta}$$

$$P_t c^i_{z,t} + P_{I,t} x^i_{z,t} + b^i_{z,t+1} + P_t \tau^i_{z,t} = a^i_{z,t} + W_t \xi_z l^i_{z,t} + (1-\tau_d) d^i_{z,t}$$

$$a^i_{z,t} = \left(R_{k,t} k^i_{z,t} + R_{n,t} b^i_{z,t} \right) \left[1 - \mathbb{I}_{\{z=r\}} \times \left(1 - \frac{1}{\omega_r} \right) \right]$$

$$k^i_{z,t+1} = (1-\delta) k^i_{z,t} + x^i_{z,t} - AC^j_{z,t+1}$$

$$k^i_{z,t+1} \geqslant 0, \quad b^i_{z,t} \geqslant 0$$

$$c^i_{z,t} = \left[(1-\lambda)^{1/\psi_c} {c^i_{H,z,t}}^{\frac{\psi_c - 1}{\psi_c}} + \lambda^{1/\psi_c} {c^i_{F,z,t}}^{\frac{\psi_c - 1}{\psi_c}} \right]^{\frac{\psi_c}{\psi_c - 1}}$$

$$x^i_{z,t} = \left[(1-\lambda)^{1/\psi_I} {x^i_{H,z,t}}^{\frac{\psi_I - 1}{\psi_I}} + \lambda^{1/\psi_I} {x^i_{F,z,t}}^{\frac{\psi_I - 1}{\psi_I}} \right]^{\frac{\psi_I}{\psi_I - 1}}$$

- Age-specific Frisch elasticity ν_z & borrowing constraint $b^i_{z,t} \geqslant 0$

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