

# Debt Burdens and the Interest Rate Response to Fiscal Stimulus: Theory and Cross-Country Evidence.

Jorge Miranda-Pinto <sup>1</sup>, Daniel Murphy <sup>2</sup>, Kieran Walsh <sup>2</sup>, Eric Young <sup>1</sup>

<sup>1</sup>UVA , <sup>2</sup>UVA Darden School of Business

June 9, 2017

# Government Spending and Interest Rates

- Theoretical near-consensus:  $G$  shocks raise interest rates
  - ▶ channel: gov't uses resources, rates rise to clear markets
  - ▶ crowds out investment, limiting economic stimulus
  - ▶ widely taught; assumed in policy debates

# Government Spending and Interest Rates: A Puzzle

Data: fail to show that government spending increases rates

- Interest rates in U.S. and U.K. may fall in response to government spending
  - ▶ e.g., Barro (1984, 1987), Engen and Hubbard (2004)  
Evans (1987), Fisher and Peters (2010), Ramey (2011)

# Government Spending and Interest Rates: A Puzzle

Data: fail to show that government spending increases rates

- Interest rates in U.S. and U.K. may fall in response to government spending
  - ▶ e.g., Barro (1984, 1987), Engen and Hubbard (2004)  
Evans (1987), Fisher and Peters (2010), Ramey (2011)
- Related empirical puzzle:
  - ▶ Fiscal shocks are *not* associated with exchange rate appreciation  
Ravn, Schmitt-Grohé, Uribe (2012); Corsetti, Meier, Müller (2012)

## This paper: New cross-country evidence

- We document substantial heterogeneity in the response of interest rates to government spending across OECD countries.
  - ▶ government bond yields fall in over half of OECD countries

## This paper: New cross-country evidence

- We document substantial heterogeneity in the response of interest rates to government spending across OECD countries.
  - ▶ government bond yields fall in over half of OECD countries
- General Equilibrium models are generally unable to explain negative interest rate responses to fiscal stimulus (IRRFs)
  - ▶ Few theoretical explanations for heterogeneity in IRRFs

# Outline

- Data and Cross-country variation in IRRFs
- Theory of debt-burdened households:
  - ▶ Government spending increases income for borrowers and relaxes credit markets
  - ▶ Borrowers are households with debt overhang:
    - Savings-constrained households due to minimum consumption levels*
- Empirical test using country-level data
  - ▶ Examine whether the IRRF depends on theory-implied proxies for debt burdens.
- Evidence of debt-burdened households from microdata (PSID)

# Outline

- Data and Cross-country variation in IRRFs
- Theory of debt-burdened households:
  - ▶ Government spending increases income for borrowers and relaxes credit markets
  - ▶ Borrowers are households with debt overhang:
    - Savings*-constrained households due to minimum consumption levels
- Empirical test using country-level data
  - ▶ Examine whether the IRRF depends on theory-implied proxies for debt burdens.
- Evidence of debt-burdened households from microdata (PSID)

# Outline

- Data and Cross-country variation in IRRFs
- Theory of debt-burdened households:
  - ▶ Government spending increases income for borrowers and relaxes credit markets
  - ▶ Borrowers are households with debt overhang:
    - Savings-constrained households due to minimum consumption levels*
- Empirical test using country-level data
  - ▶ Examine whether the IRRF depends on theory-implied proxies for debt burdens.
- Evidence of debt-burdened households from microdata (PSID)

# Outline

- Data and Cross-country variation in IRRFs
- Theory of debt-burdened households:
  - ▶ Government spending increases income for borrowers and relaxes credit markets
  - ▶ Borrowers are households with debt overhang:
    - Savings-constrained households due to minimum consumption levels*
- Empirical test using country-level data
  - ▶ Examine whether the IRRF depends on theory-implied proxies for debt burdens.
- Evidence of debt-burdened households from microdata (PSID)

## Related Literature

### Sources of heterogeneity in Marginal Propensities to Consume

- Low-income households may have lower MPCs than high-income households
  - ▶ Misra and Surico (2014), Shapiro and Slemrod (2003)
- Kaplan and Violante (2014) suggest due to liquidity-constrained rich.

## Related Literature

### Sources of heterogeneity in Marginal Propensities to Consume

- Low-income households may have lower MPCs than high-income households
  - ▶ Misra and Surico (2014), Shapiro and Slemrod (2003)
- Kaplan and Violante (2014) suggest due to liquidity-constrained rich.

### Cross-country differences in effects of fiscal shocks

Ilzetzki, Mendoza, Vegh (2013); Corsetti, Meier, Müller (2012)

- We examine differences in IRRFs rather than output multipliers

## Related Literature

### Sources of heterogeneity in Marginal Propensities to Consume

- Low-income households may have lower MPCs than high-income households
  - ▶ Misra and Surico (2014), Shapiro and Slemrod (2003)
- Kaplan and Violante (2014) suggest due to liquidity-constrained rich.

### Cross-country differences in effects of fiscal shocks

Ilzetzki, Mendoza, Vegh (2013); Corsetti, Meier, Müller (2012)

- We examine differences in IRRFs rather than output multipliers

### Exchange Rate Puzzle

Ravn, Schmitt-Grohé, Uribe (2012); Corsetti, Meier, Müller (2012)

## Related Literature

### State-dependent fiscal effects

Auerbach and Gorodnichenko (2012); Bachmann and Sims (2012); Ramey and Zubairy (2017); Demyanyk, Loutskina and Murphy (2016)

# Interest Rates Responses to Fiscal Stimulus (IRRF)

## Data

- OECD countries
- Quarterly data on government consumption, real GDP, and interest rates
  - ▶ focus on government bond yields when available
- Data from OECD and Haver.

▶ Data Table

# Interest Rates Responses to Fiscal Stimulus (IRRF)

Identifying fiscal shocks

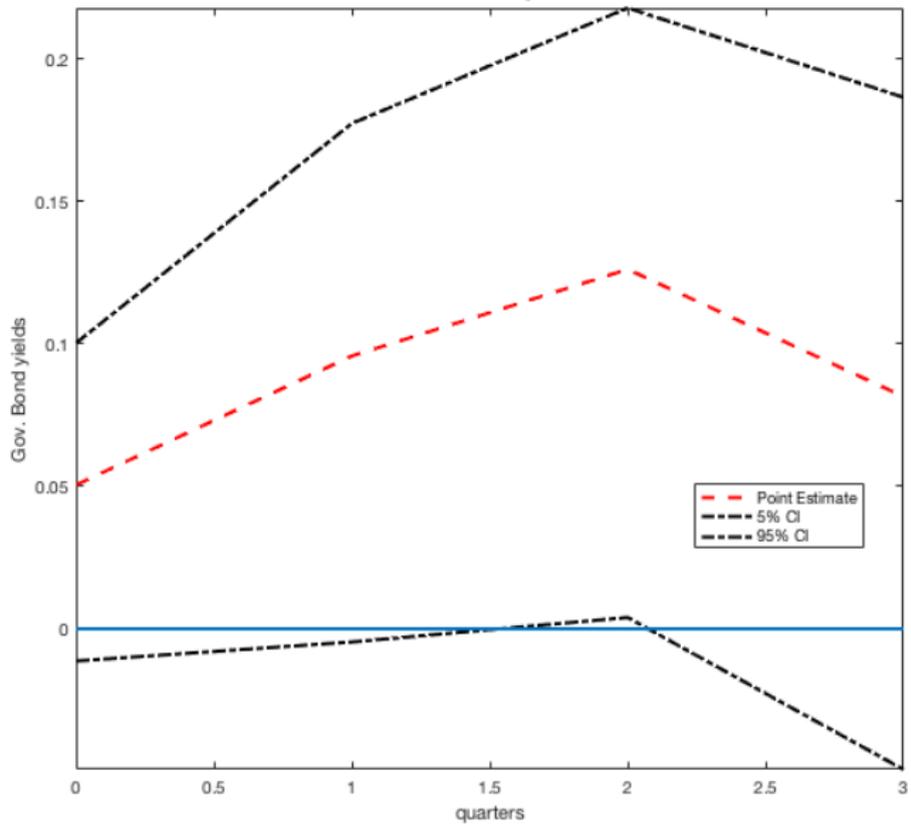
$$A_0 X_t = \sum_{j=1}^4 A_j X_{t-j} + \varepsilon_t,$$

$$X_t = [G_t, Y_t, r_t]'$$

$$\varepsilon_t = [v_t, \varepsilon_t^2, \varepsilon_t^3]'$$

- Identifying assumption: government spending is predetermined (within a quarter) with respect to other macro variables
- Blanchard and Perotti (2002); Auerbach and Gorodnichenko (2012); Ilzetzki, Mendoza, Vegh (2013)

Germany (p90<sub>p</sub> 10=3.5)



# United States (p90<sub>p</sub> 10=6.2)

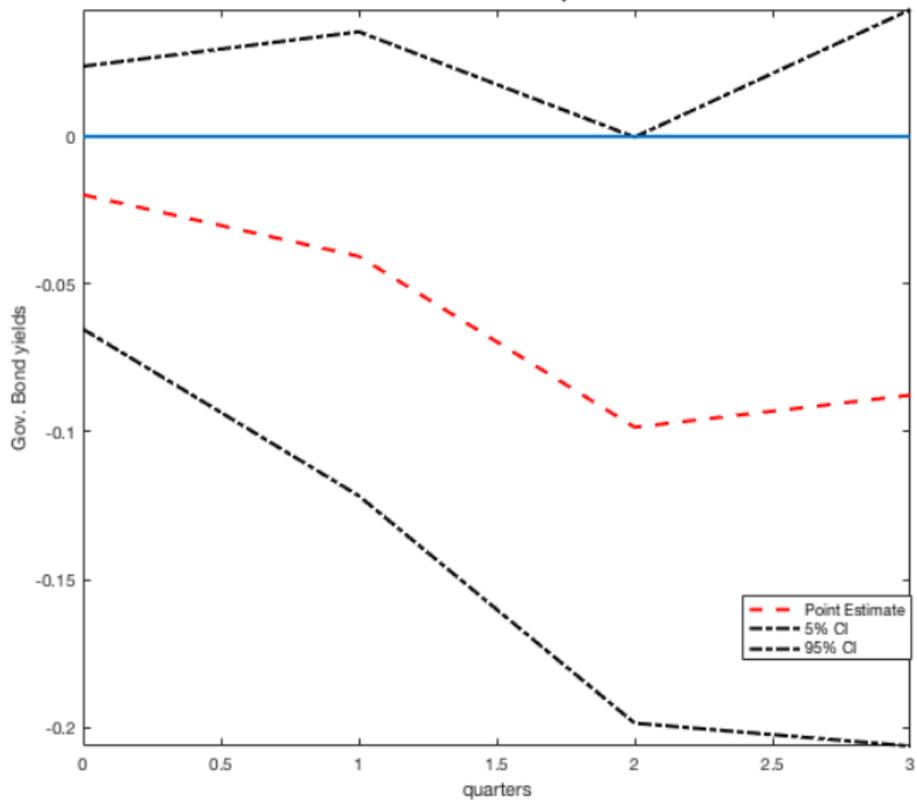
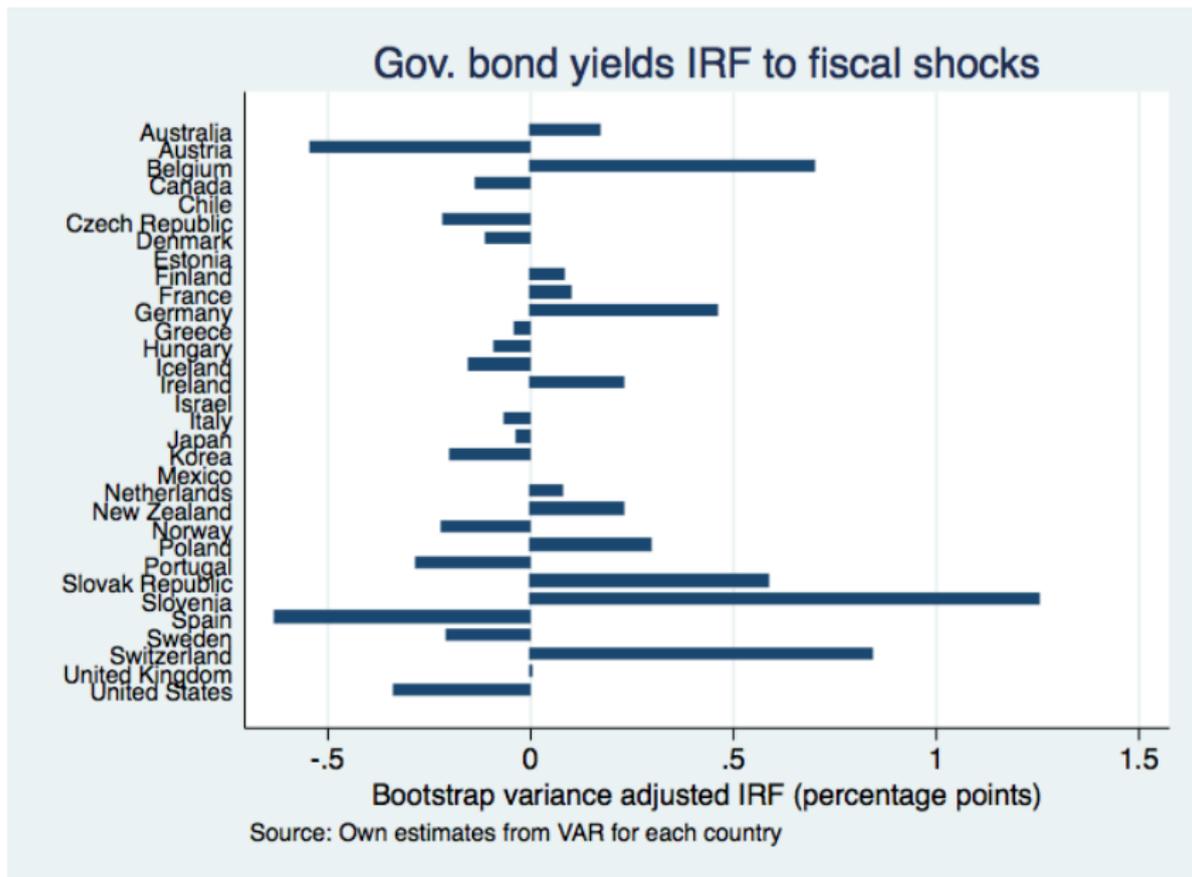


Figure: Cum. 4 qtrs. effect of fiscal shocks on gov. yields OECD Countries



# Model

# Model

Two agent types, two periods, endowment economy.

## Non-rich $p$

- measure  $\pi \in [1/2, 1)$
- per-period income  $y^p = 1 / (2\pi)$

## Rich $r$

- measure  $1 - \pi$
- per-period income  $y^r = 1 / (2(1 - \pi))$

Total income  $1 = \pi y^p + (1 - \pi) y^r$

- $\pi$  governs inequality
- measure of rich agents falls to 0 as  $\pi \rightarrow 1$

Agent  $i \in \{r, p\}$  solves

$$\max_{c_0, c_1, b} \{ \log(c_0) + \log(c_1) \} \text{ subject to}$$

$$(i) : c_0 + qb = y^i + G$$

$$(ii) : c_1 = y^i (1 - \tau) + b$$

$$(iii) : c_0 \geq \underline{c}$$

- $G \in [0, 1)$  is an exogenous wage from the government
- $\tau$  is the marginal tax rate.
- $\underline{c}$  is the minimum consumption level

Government budget constraint:

$$\frac{(1 + \omega) G}{q} = \tau$$

- To pay wages  $G$ ,  $\omega G$  must be redirected to unproductive activities.
  - ▶ reduced-form for private sector output lost when agents work for the government.

## Equilibrium

Equilibrium consists of a bond price, agent consumption, and taxes such that bond and goods markets clear and the government budget constraint is satisfied.

With minimum consumption constraint binding for non-rich

$$q = 3 - 4\pi\underline{c} + (2\pi - 1 - 3\omega) G$$

- Response of interest rate  $R = \frac{1}{q}$  to  $G$  may be positive or negative
- IRRF is strictly decreasing in inequality  $\pi$

$$\frac{\partial^2 R}{\partial G \partial \pi} < 0.$$

## Equilibrium

Equilibrium consists of a bond price, agent consumption, and taxes such that bond and goods markets clear and the government budget constraint is satisfied.

With minimum consumption constraint binding for non-rich

$$q = 3 - 4\pi\underline{c} + (2\pi - 1 - 3\omega) G$$

- Response of interest rate  $R = \frac{1}{q}$  to  $G$  may be positive or negative
- IRRF is strictly decreasing in inequality  $\pi$

$$\frac{\partial^2 R}{\partial G \partial \pi} < 0.$$

Without minimum consumption constraint

$$q = 1 - \omega G$$

## Savings constraints and $G$ in a Huggett (1993) Model

- Large number of agents,  $t = 0, 1, \dots$
- Individual endowment  $y_s$  depends on the realization of an  $S$  state Markov process with transition matrix  $\Pi = \{\pi_{ss'}\}_{s,s' \in S}$
- agents can partially insure with bonds ( $a$ )

$$V(a, s) = \max_{c, a'} \{u(c) - \lambda[\underline{c} - c]_+ + \beta E_s[V(a', s')]\} \text{ subject to}$$

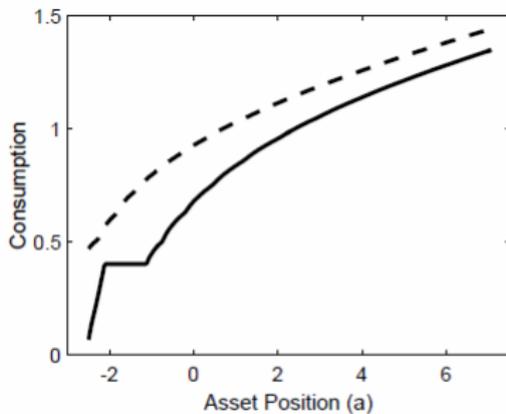
$$c + qa' = y_s(1 - \tau) + a + G$$

$$a' \geq \underline{a}.$$

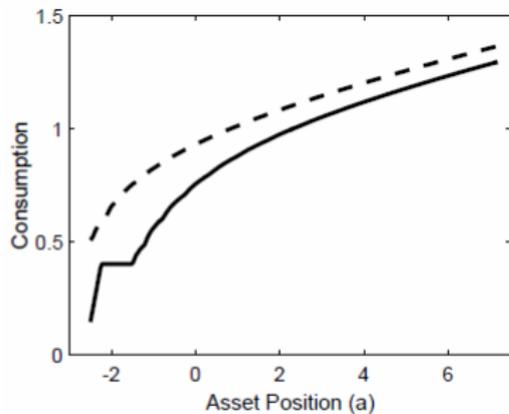
- Steady-state equilibrium:
  - ▶  $r = 1/q - 1$  and wealth dist. constant over time
  - ▶ Markets clear:  $\int a^i di = 0$
  - ▶ Gov't budget constraint holds:  $G_w(1 + \omega) = \tau \int y^i di$ .

Table 1  
Model Parameters

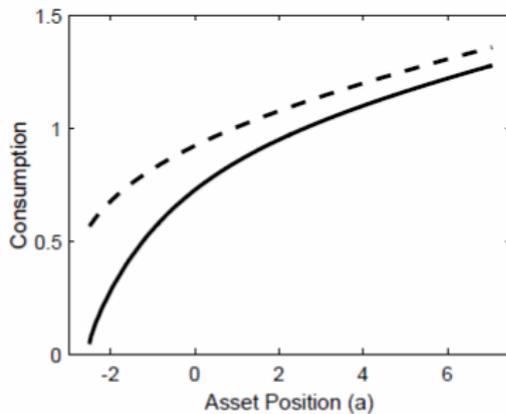
Parameter	Value	Source/Target	Description
$S = \{y_L, y_H\}$	$\{0.10, 1.00\}$ $\{0.20, 0.985\}$	Huggett (1993)	endowment grid
$\Pi = \{\pi_{HH}, \pi_{LH}\}$	$\{0.925, 0.50\}$	Huggett (1993)	transition matrix
$\gamma$	1.5	Huggett (1993)	risk aversion
$\underline{a}$	-2.50		borrowing constraint
$\underline{c}$	$\{0.00, 0.40\}$		minimum consumption level
$\lambda$	20.00		cost of choosing $c < \underline{c}$
$\omega$	0.10		government waste
$G$	$\{0.00, 0.10\}$		government spending
$\beta$	0.96		discount factor



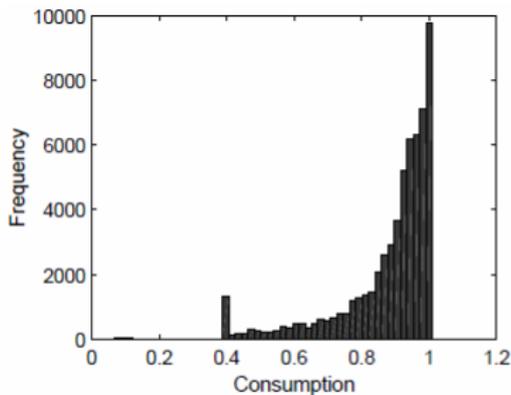
(a)  $\underline{c} = .4, \{y_L, y_H\} = \{0.10, 1.00\}$



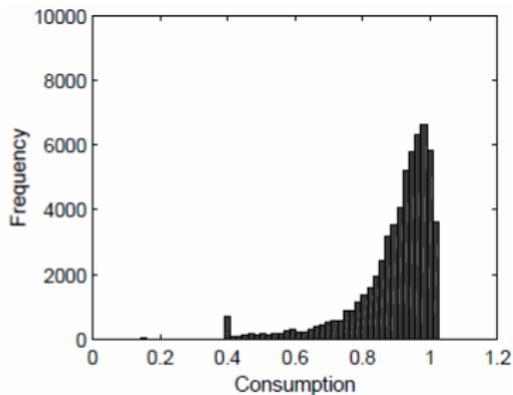
(b)  $\underline{c} = .4, \{y_L, y_H\} = \{0.20, 0.985\}$



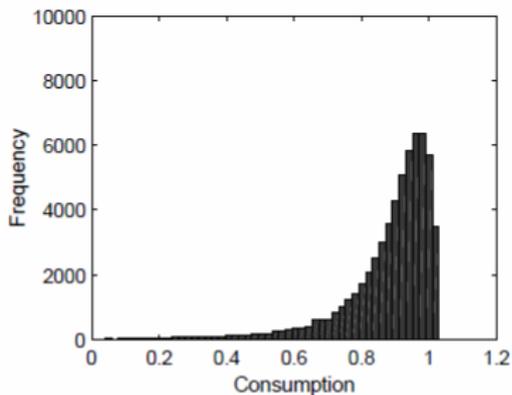
(c)  $\underline{c} = 0, \{y_L, y_H\} = \{0.10, 1.00\}$



(a)  $\underline{c} = .4, \{y_L, y_H\} = \{0.10, 1.00\}$

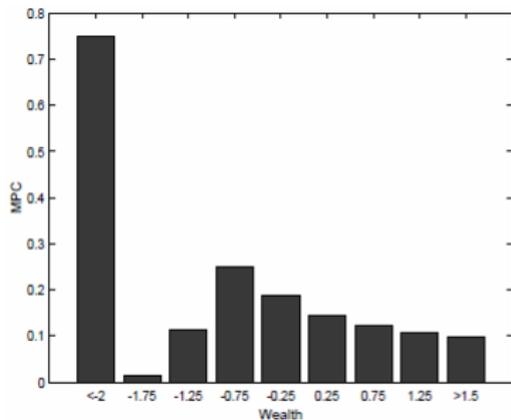


(b)  $\underline{c} = .4, \{y_L, y_H\} = \{0.20, 0.985\}$

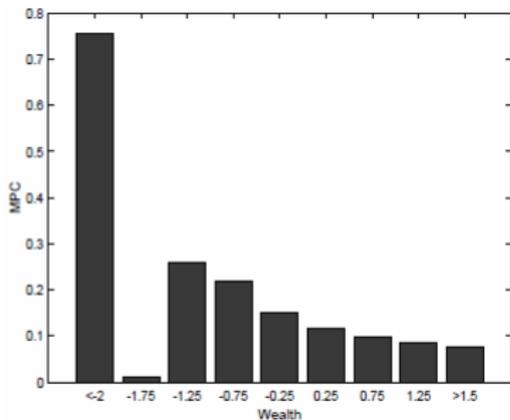


(c)  $\underline{c} = 0, \{y_L, y_H\} = \{0.10, 1.00\}$

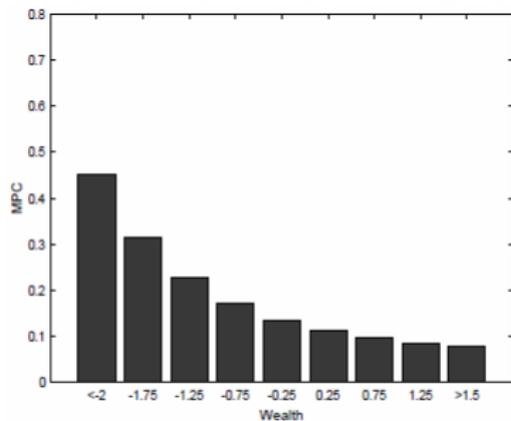
Figure 2



(a)  $c = .4, \{y_L, y_H\} = \{0.10, 1.00\}$



(b)  $c = .4, \{y_L, y_H\} = \{0.20, 0.985\}$



(c)  $c = 0, \{y_L, y_H\} = \{0.10, 1.00\}$

## Cross-Country Evidence: Cross-section

Data on country-level determinants of the IRRF

- Inequality:
  - ▶ ratio of income of richest 10 percent to income of poorest 10 percent (OECD)
- Central Bank Independence
  - ▶ Index from Dincer and Eichengreen (2014) available for only 14 countries
  - ▶ Use inflation volatility as proxy (Alesina and Summers 1993)
- Financial openness
  - ▶ index from Lane and Milesi-Ferretti (2007): (financial assets plus liabilities)/GDP
- Output Multipliers (from VAR estimates)

## Gov. bond yields IRF and Inequality

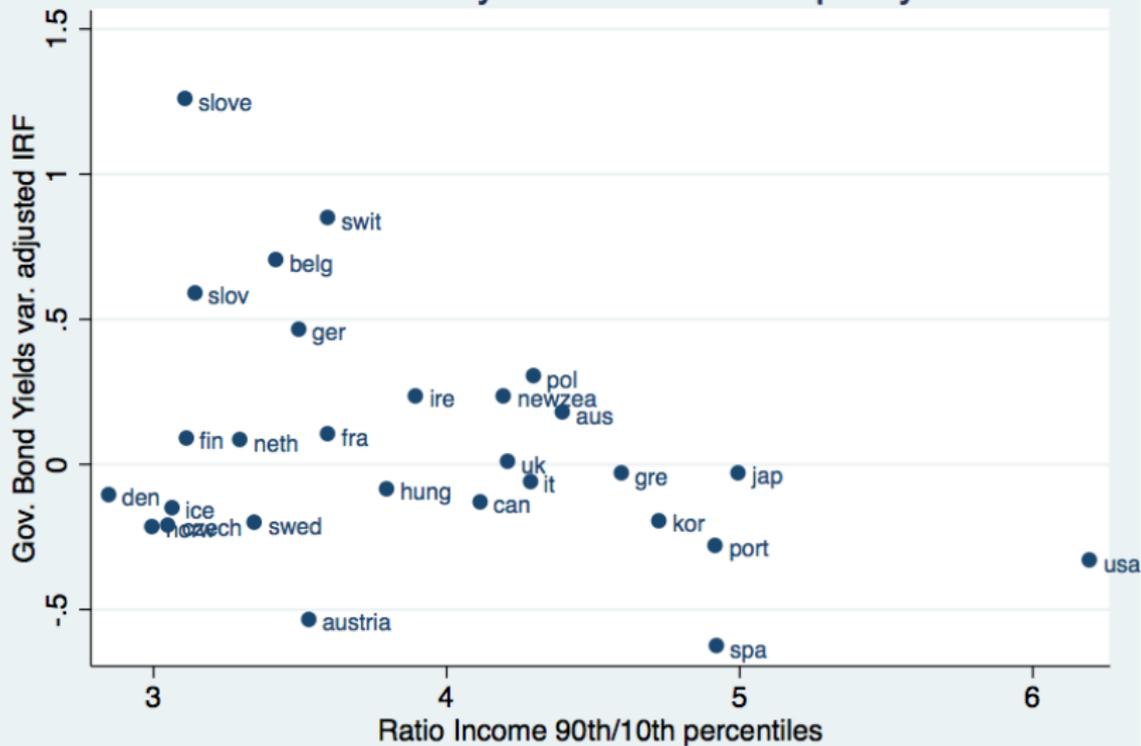
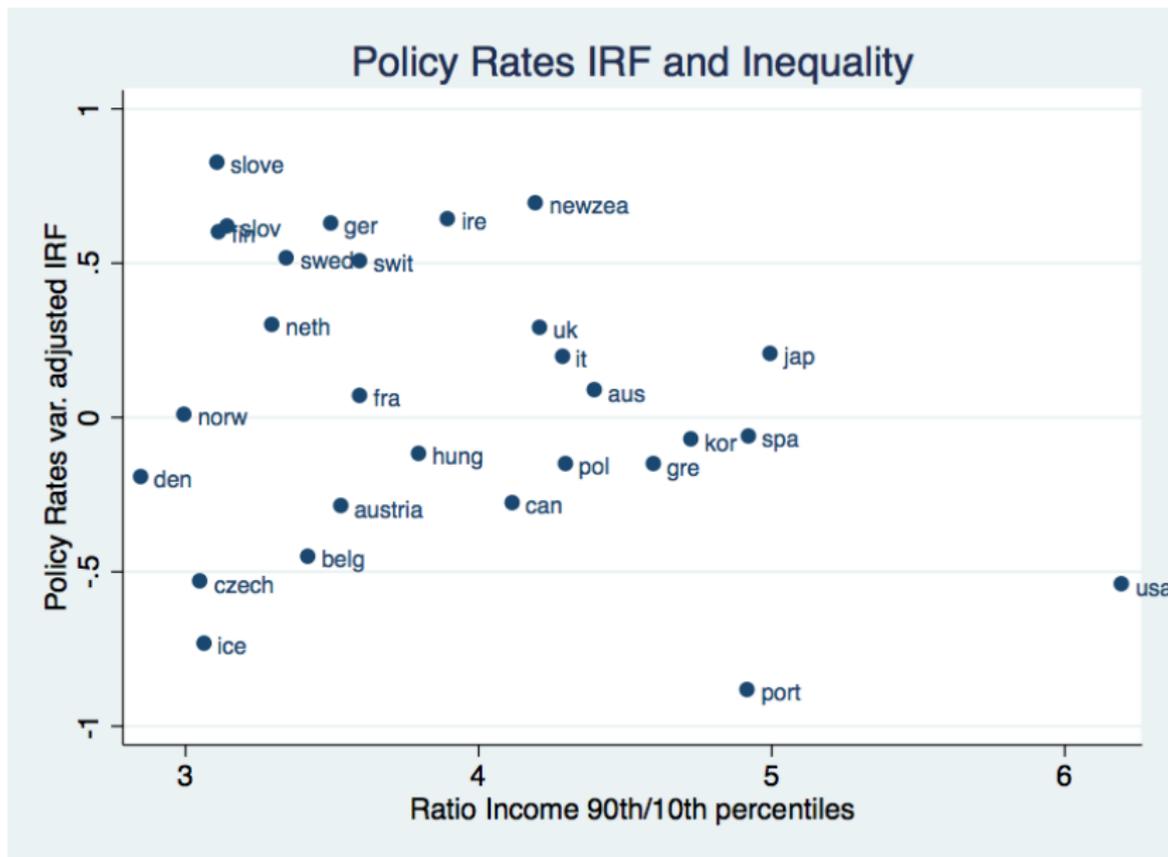


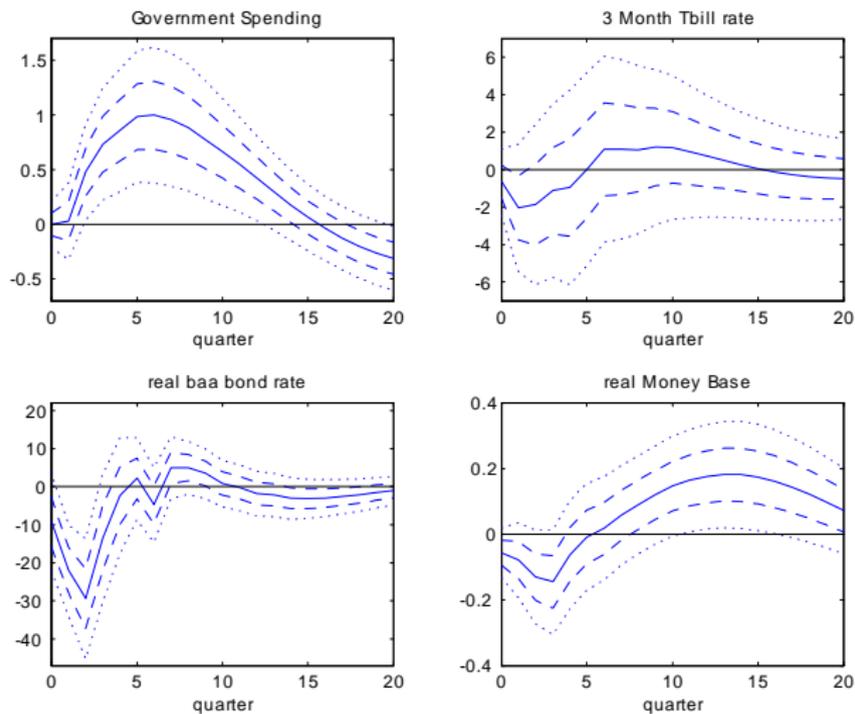
Table: IRRF and Country Characteristics

VARIABLES	(1) Bond IRRF	(2) Bond IRRF	(3) Bond IRRF	(4) Bond IRRF
p9010	-0.18** (0.08)	-0.16** (0.08)	-0.15* (0.08)	-0.16* (0.09)
St. Dev. Inflation		0.11 (0.10)	0.11 (0.11)	0.10 (0.10)
Financial Openness			0.02 (0.03)	0.03 (0.03)
Fiscal Mult. 4 qtrs.				-0.17 (0.22)
Constant	0.78* (0.38)	0.54 (0.37)	0.41 (0.38)	0.51 (0.44)
Observations	28	28	28	28
R-squared	0.12	0.17	0.20	0.22

# Is Monetary Policy Responding to $G$ ?

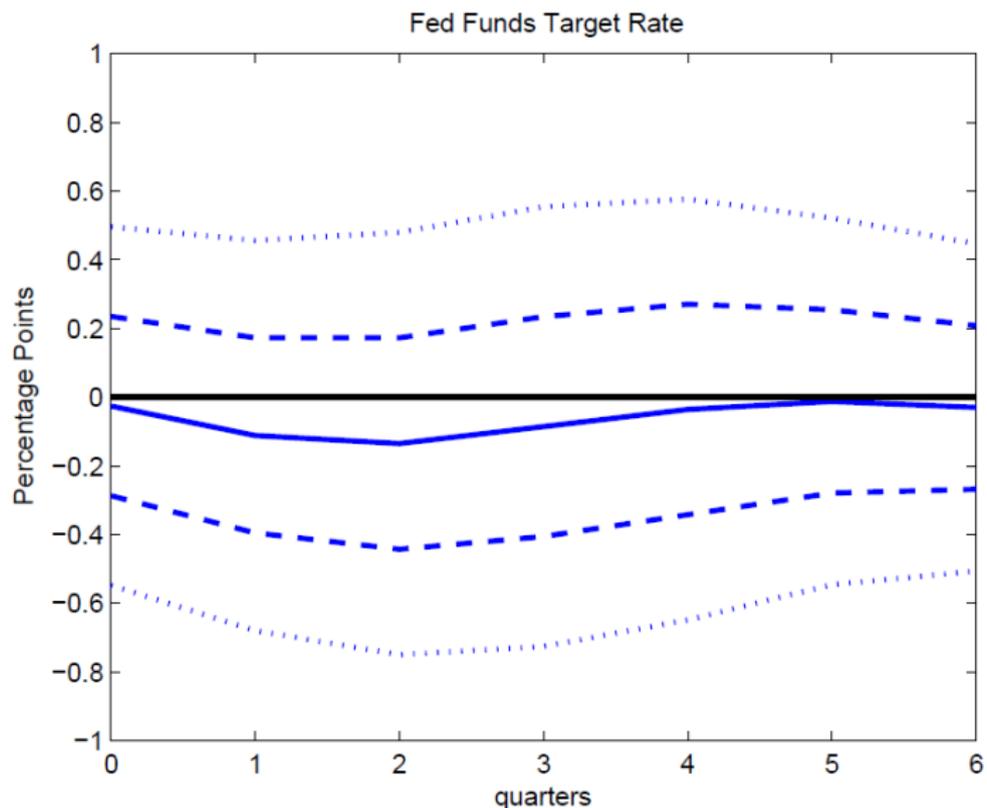


# Is Monetary Policy Responding to $G$ ?



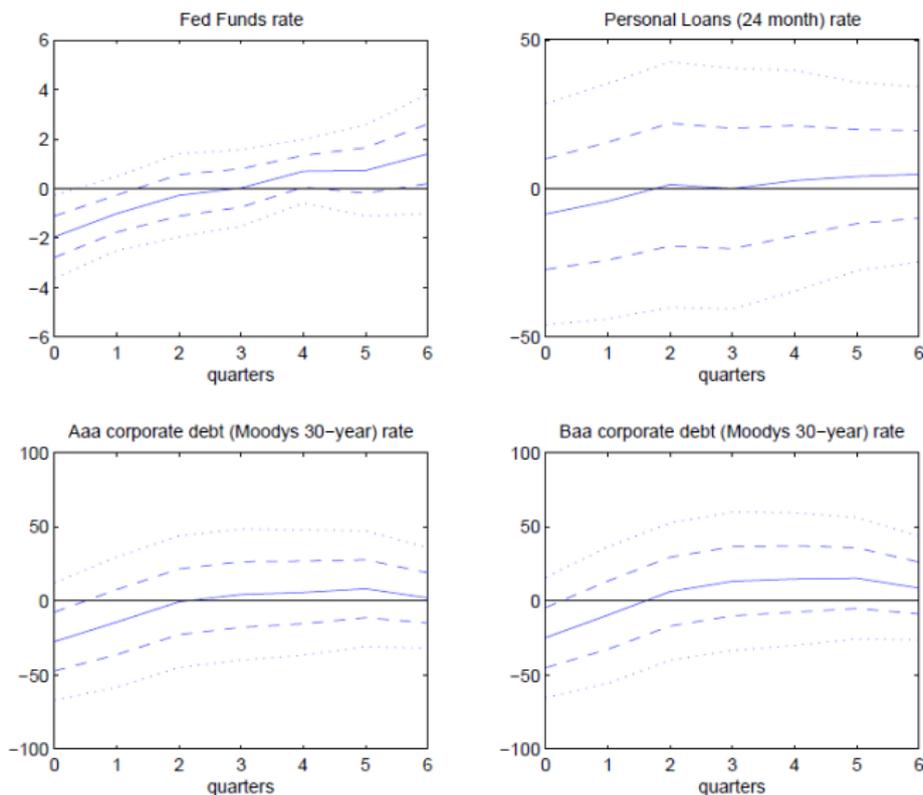
IRRF, Ramey's Defense News Shocks (U.S. 1939Q1-2008Q4), MW (2016)

# Is Monetary Policy Responding to $G$ ?



IRRF, VAR  $G$  Shock (U.S. 1983Q1-2007Q4), MW (2016)

# Is Monetary Policy Responding to $G$ ?



Impulse Responses of Spreads (over the FFR target) to VAR Gov't Spending Shocks (1983Q1-2007Q4), MW (2016)

## Cross-Country Evidence: Panel Data

Model prediction: The IRRF is falling in debt overhang

- Use lagged country-level consumer credit (BIS) as a proxy for debt overhang

$$\text{Spread}_{it} = \alpha_i + \delta_t + \gamma_0 \text{G\_shock}_{it} + \gamma_2 \text{Credit}_{it-1} \\ + \gamma_3 \text{G\_shock}_{it} \cdot \text{Credit}_{it-1} + \gamma X_{it-1} + \epsilon_{it}.$$

Table 6  
 Dependent variable: government bond yield spreads

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
	All	All	All	IRF<-0.05	All	IIRF<-0.05
G_shock	-1.687 (1.783)	-3.225** (1.165)	-3.505*** (1.194)	-4.347 (2.877)	-1.549 (2.967)	-1.409 (2.846)
L. Credit	-0.028** (0.011)	-0.023** (0.010)	-0.023** (0.009)	-0.031** (0.010)		
G_shock·L. Credit	-0.472*** (0.165)	-0.464*** (0.157)	-0.488*** (0.158)	-0.721*** (0.195)		
L. RGDP		0.012*** (0.004)	0.015** (0.005)	-0.007 (0.005)		
L. Inflation		-24.10*** (6.059)	-24.04*** (6.087)	-18.02** (7.122)	-22.16*** (6.743)	-21.37*** (4.912)
G_shock*L. RGDP			0.212*** (0.0701)	1.109*** (0.253)		
L. $\Delta_4$ Credit					-6.381 (5.944)	10.83 (11.09)
G_shock·L. $\Delta_4$ Credit					-486.6*** (140.9)	-907.4*** (118.2)
L. $\Delta_4$ RGDP					-0.204 (3.389)	-6.613 (4.064)
G_shock · L. $\Delta_4$ RGDP					549.0*** (179.9)	936.1*** (205.2)
Observations	1,824	1,824	1,824	824	1,764	800
R-squared	0.463	0.508	0.509	0.487	0.504	0.491

## Evidence from U.S. microdata

### PSID

- Biennial panel data
- Data on consumption starting in 1999
- Data on medical debt 2011, 2013

Table: Summary Statistics

	N	Mean
Households:		
Has Expenditure Shock	7,475	0.9
Has Income Shock and Lagged Expenditure Shock	7,475	0.38
Households-time observations:		
Has Expenditure Shock	59,800	0.17
Has Income Shock and Lagged Expenditure Shock	59,800	0.04

\* Note: A household has high income ( expenditure) in periods in which income ( expenditure) is over a standard deviation above average income (health expenditure) for the household.

VARIABLES	Dependent variable: Log consumption		
	(1) All	(2) < Median Wealth	(3) > Median Wealth
High Income	0.275*** (0.007)	0.313*** (0.011)	0.235*** (0.010)
L1. High Consumption	0.0002 (0.008)	0.017 (0.014)	-0.017* (0.009)
L2. High Consumption	-0.121*** (0.009)	-0.108*** (0.016)	-0.134*** (0.010)
L1. High Cons · High Income	-0.040*** (0.015)	-0.058** (0.023)	-0.022 (0.019)
L2. High Cons · High Income	-0.019 (0.018)	-0.058** (0.026)	0.021 (0.026)
Observations	44,850	22,428	22,422
R-squared	0.664	0.604	0.646
Indiv. and Time FE	Yes	Yes	Yes

\* Note: A household has high income (consumption) in periods in which income (consumption) is over a standard deviation above average income (consumption) for the household. All regressions control for household wealth, income, and the age of the head of the household. Robust standard errors in parentheses, clustered at the household level. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ .

# Conclusion

- New cross-country stylized fact: IRRF is negative in half of OECD countries.
- Theory
  - ▶ IRRF depends on fraction of debt-burdened households.
    - ★ New explanation for heterogeneous MPCs.
- Evidence of theory's mechanisms
  - ▶ Microdata: low-wealth households behave as predicted by model.
  - ▶ Aggregate data: IRRF depends on inequality and consumer credit

## Sample for VAR estimation

Country	G		GDP		Interest Rates		Credit BIS
	OECD	Haver	OECD	Haver	bond ylds.	policy rate	
Australia	1959-Q4		1959-Q3		1957-Q1	1969-Q3	1977-Q4
Austria	1988-Q1		1988-Q1		1971-Q1	1957-Q1*	1995-Q4
Belgium	1995-Q1		1995-1		1957-Q1	1957-Q1*	1980-Q4
Canada		1957-Q1		1957-Q1	1957-Q1	1957-Q1	1969-Q2
Czech Republic	1996-Q2		1996-Q1		2000-Q2	1995-Q4	1995-Q4
Denmark		<i>1977-Q1</i>		<i>1977-Q1</i>	1960-Q1	1957-Q1	1994-Q4
Finland	1990-Q1		1990-Q1		1988-Q1	1957-Q1*	1970-Q4
France	1955-Q1		1955-Q1		1957-Q1	1964-Q1**	1977-Q4
Germany	1970-Q1		1970-Q1		1957-Q1	1957-Q1*	1971-Q1
Greece	1970-Q1		1970-Q1		1992-Q4	1957-Q1*	1994-Q1
Hungary	1995-Q1		1995-Q1		2001-Q1	1981-Q1	1989-Q4
Iceland	1997-Q1		1997-Q1		1992-Q1	1964-Q1	
Ireland	1997-Q1		1997-Q1		1964-Q1	1957-Q1**	2002-Q1
Italy	1981-Q4		1981-Q4		1958-Q1	1964-Q1*	1960-Q4
Japan		1957-Q1		1957-Q1	1966-Q4	1957-Q1	1964-Q4
Korea		<i>1960-Q1</i>		<i>1960-Q1</i>	1973-Q2	1999-Q2	1962-Q4
Netherlands	1988-Q1		1988-Q1		1964-Q4**		1990-Q4
New Zealand	1987-Q2		1987-Q2		1964-Q1	1999-Q1	1990-Q4
Norway		1961-Q1		1961-Q1	1961-Q4	1964-Q1**	1975-Q1
Poland	1995-Q1		1995-Q1		2001-Q1	1998-Q1	1995-Q4
Portugal	1995-Q1		1995-Q1		1957-Q1	1957-Q1*	1979-Q4
Slovak Republic	1997-Q1		1997-Q1		2000-Q1	1993-Q2**	
Slovenia	1995-Q1		1995-Q1		2002-Q2	1992-Q1	
Spain	1995-Q1		1995-Q1		1978-Q1	1964-Q1*	1980-Q4
Sweden	1960-Q1		1960-Q1		1960-Q1	1960-Q1**	1980-Q1
Switzerland	1980-Q1		1980-Q1		1964-Q1	1964-Q1	1999-Q4
United Kingdom	1955-Q1		1955-Q1		1957-Q1	1959-Q1	1966-Q4
United States	1955-Q1		1955-Q1		1957-Q1	1983-Q3	1956-Q3

\* Supplemented by ECB policy rates since 1999-Q1

\*\* Supplemented by by short term rates from Ilzetzki et al. (2013) and ECB rates

Note: *Information in cursive means data were not originally seasonally adjusted*