Risk-premium shocks and the zero bound on nominal interest rates

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Motivation

Is zero bound on nominal interest rates relevant for optimal monetary policy design?

Eggertsson & Woodford (2003): YES

- If shocks large enough, efficient response may require negative (ex-ante) real interest rate
- In a low inflation environment (typical for optimal monetary policies) zero-bound makes that infeasible

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Are historically-measured shocks large enough to drive real rates to zero?

- Christiano (2004): Not likely, with endogenous investment
- Schmitt-Grohe & Uribe (2005): Highly unlikely

What we do?

In a standard DSGE model, we identify which of commonly considered aggreg. shocks, have large enough historical magnitudes to drive real interest rates to zero.

Aggregate shocks:

1. Neutral technology shocks
2. Investment specific technology shocks
3. Government spending shocks
4. Money demand shocks
5. Risk – premium shocks (RP shocks)

What we find?

Historical magnitude of risk–premium shocks is large enough to drive real rates on government bonds to zero

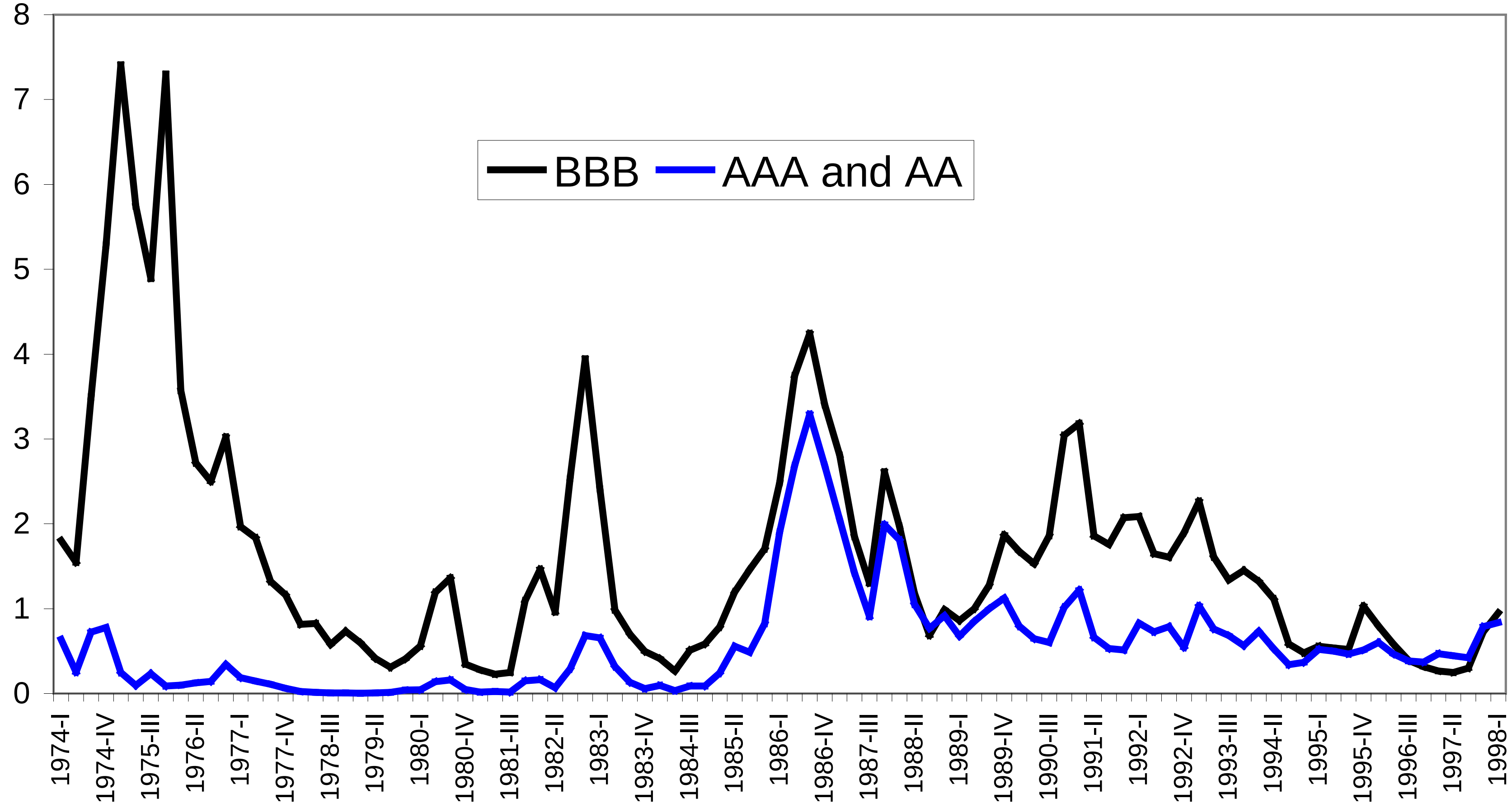
Historical magnitudes of other four aggregate shocks make them unlikely candidates to do the same

Risk-premium shocks

Ex-ante risk premium on equity of US corporations relative to government bonds (net of default-risk compensation)

Campello, Chen, Zhang (2008) estimate ex-ante equity risk premia from micro-level data on grade-specific corporate bond spreads (1974-1998)

Ex-ante equity risk premia



Model

- Rep. household cares about consumption, leisure, and real money balances
- Firms produce with capital and labour
- Sticky nominal prices
- Measured aggregate shocks:
  - o Neutral technology shocks, from TFP
  - o Investment-specific technology shocks, as in Fisher (2005)
  - o Government spending shocks, from NIPA
  - o Money demand shocks, from money demand variation
  - o Risk-premium shocks, Campello et al (2008)

Households

$$\max_{\substack{C_t, H_t, M_t \\ I_t, B_t}} \mathrm{E}_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{\gamma}{\gamma - 1} \log \left(C_t^{\frac{\gamma-1}{\gamma}} + \mu_t^{\frac{1}{\gamma}} \left(\frac{M_t}{P_t} \right)^{\frac{\gamma-1}{\gamma}} \right) + \eta \log \left(1 - H_t \right) \right]$$

subject to

$$P_t \left(C_t + I_t + CAC_t \right) + \frac{B_t}{R_t} + M_t = W_t H_t + P_t^k \left(q_t - \tau_{t-1} \right) K_{t-1} + B_{t-1} + M_{t-1} - T_t$$

$$CAC_t = \frac{\varphi}{2} \left(\frac{K_t}{K_{t-1}} - g_k \right)^2 \frac{K_{t-1}}{X_t}$$

$$K_t = \left(1 - \delta \right) K_{t-1} + X_t I_t$$

Simlified FOCs for bonds and capital

From

$$1 = \beta \mathbf{E}_t \left[\frac{\lambda_{t+1}}{\lambda_t} \frac{R_t}{\pi_{t+1}} \right]$$

$$1 = \beta \mathbf{E}_t \left[\frac{\lambda_{t+1}}{\lambda_t} \frac{X_t}{X_{t+1}} \left(q_{t+1} - \tau_t \right) \right]$$

obtain

$$\mathbf{E}_t \left[\frac{R_t}{\pi_{t+1}} \right] + \tau_t \approx \mathbf{E}_t \left[q_{t+1} \right]$$

Technology

Final good

$$C_t + I_t + G_t + CAC_t = \left(\int_0^1 Y_{j,t}^{\frac{\theta-1}{\theta}} \, \mathrm{d}\, j \right)^{\frac{\theta}{\theta-1}}$$

Monopolistically competitive intermediate producers

$$Y_{j,t} = A_t \left(H_{j,t} \right)^{2/3} \left(K_{j,t} \right)^{1/3}$$

Intermediate goods prices:

Calvo sticky – price adjustment probability, 1/3

Monetary policy

Zero-(net) inflation rate: $\pi_t = \frac{P_t}{P_{t-1}} = 1$

Nearly optimal in sticky-price models

Goodfriend & King (2001), Khan, King & Wolman (2000),

Siu (2003), Schmitt-Grohe & Uribe (2005)

But, calibrate model with forward-looking Taylor rule:

$$\ln\left(\frac{R_t}{\bar{R}}\right) = \left(1-\rho_R\right)\left[\beta_\pi \mathbf{E}_t \ln\left(\frac{\pi_{t+1}}{\bar{\pi}}\right) + \beta_y \ln\left(\frac{y_t}{\bar{y}}\right)\right] + \rho_R \ln\left(\frac{R_{t-1}}{\bar{R}}\right)$$

Aggregate shocks

1. Equity risk-premia, BBB corporations (1974q1-1998q1)

$$\tau_t = 0.16\bar{\tau} + 0.84\tau_{t-1} + \varepsilon_t^\tau, \quad \varepsilon_t^\tau \sim N\left(0,\ 0.8^2\right)$$

2. Neutral technology: $\ln\left(\frac{A_t}{A_{t-1}}\right) = 0.19 + \varepsilon_t^A, \quad \varepsilon_t^A \sim N\left(0,\ 0.6^2\right)$

3. Invest-specif tech: $\ln\left(\frac{X_t}{X_{t-1}}\right) = 0.29 + \varepsilon_t^X, \quad \varepsilon_t^X \sim N\left(0,\ 0.6^2\right)$

4. Gov. spend.: $\frac{G_t}{Y_t} = 0.02\frac{\bar{G}}{Y} + 0.98\frac{G_{t-1}}{Y_{t-1}} + \varepsilon_t^G, \quad \varepsilon_t^G \sim N\left(0,\ 0.2^2\right)$

5. Money dem: $\ln\mu_t = 0.02\ln\bar{\mu} + 0.98\ln\mu_{t-1} + \varepsilon_t^\mu, \quad \varepsilon_t^\mu \sim N\left(0,\ 1^2\right)$

Calibrating structural parameters

1. Most parameters calibrated from first moments

2. Capital adjustment cost parameter φ in

$$CAC_t = \frac{\varphi}{2}\left(\frac{K_t}{K_{t-1}} - g_k\right)^2 \frac{K_{t-1}}{X_t}$$

and three Taylor rule coefficients in

$$\ln\left(\frac{R_t}{\overline{R}}\right) = \left(1-\rho_R\right)\left[\beta_\pi \mathbf{E}_t \ln\left(\frac{\pi_{t+1}}{\overline{\pi}}\right) + \beta_y \ln\left(\frac{y_t}{\overline{y}}\right)\right] + \rho_R \ln\left(\frac{R_{t-1}}{\overline{R}}\right)$$

jointly calibrated to match four second moments

Calibration

Parameter	Matched moment	Moment value
β	Real risk-free rate (90-days T-bill)	2.5
$\bar{\pi}$	PCE inflation rate	3.6
η	Fraction of time worked	0.25
δ	Consumption share of GDP	0.65
θ	Labour income share	0.58
φ	St.dev. of Investm./Consump. Ratio, %	3.26
β_{π}	St.dev. of risk-free rate, %	0.63
β_{y}	St.dev. of labour income share, %	0.92
ρ_{R}	AR(1) coef. of risk-free rate	0.95

Calibration results

Variable	Data (74q1-98q1)		Model	
	St.dev,%	AR(1)	St.dev,%	AR(1)
Risk-free rate	0.63	0.95	0.63	0.95
Labour income share	0.92	0.87	0.92	0.65
Investment/consumpion ratio	3.26	0.93	3.26	0.82
Investment/GDP ratio	1.60	0.93	1.64	0.82
Inflation	0.68	0.86	0.68	0.79
Aggregate hours	0.80	0.99	0.80	0.78

Zero inflation policy

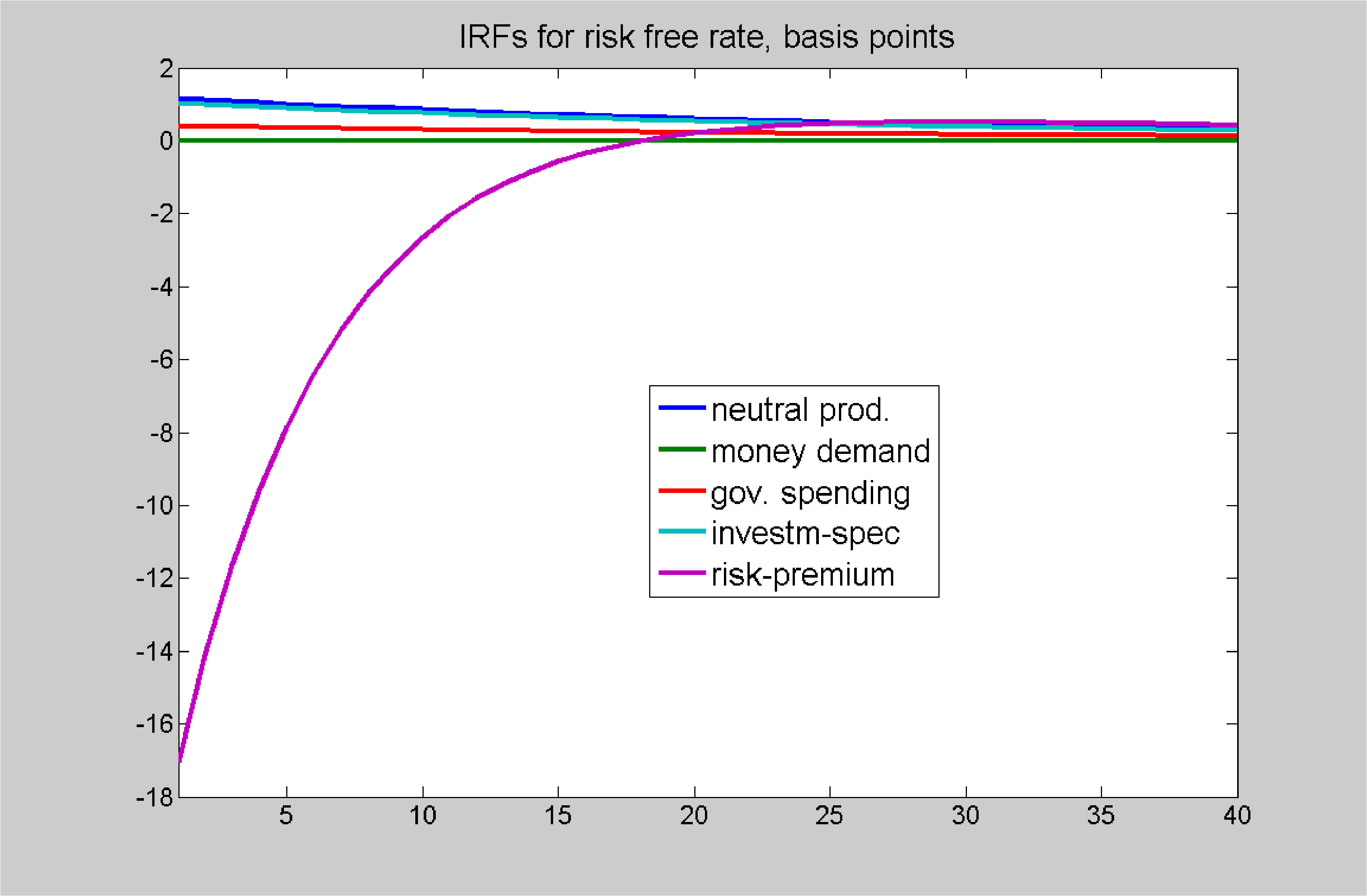
Stabilizes the economy and the risk-free rate (RFR)

St. deviation of	Taylor rule	Zero-inflation
Hours	0.80	0.55
Investm./Output ratio	1.64	1.58
Consum./Output ratio	1.89	1.85
Detrended Output	1.86	1.56
Risk-free rate	0.63	0.31

Probability of RFR in [0, 5 bp] range is 1.7 percent, or once in 15 years

Which shock has largest effect on RFR?

Risk – premium shocks



Zero inflation policy

St. deviation of	With risk-premium shocks	No risk-premium shocks
Hours	0.55	0.26
Investm./Output ratio	1.58	0.29
Consum./Output ratio	1.85	0.89
Detrended Output	1.56	0.97
Risk-free rate	0.31	0.06

Without risk-premium shocks, lowest (simulated) RFR is 6 standard deviations away from zero

Why RP shocks move RFR so much?

From (simplified) FOCs for risk- free bonds and capital

$$1 = \beta \mathbf{E}_t \left[\frac{\lambda_{t+1}}{\lambda_t} \frac{R_t}{\pi_{t+1}} \right]$$

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obtain

$$\mathbf{E}_t \left[\frac{R_t}{\pi_{t+1}} \right] + \tau_t \approx \mathbf{E}_t \left[q_{t+1} \right]$$

RP shock has a first order effect on real risk-free rate

Sensitivity Analysis: Smaller RP shocks

Use equity risk-premia of AAA & AA corporations

(1974q1-1998q1)

$$\tau_t = 0.12\overline{\tau} + 0.88\tau_{t-1} + \varepsilon_t^{\tau}, \quad \varepsilon_t^{\tau} \sim N\left(0,\ 0.3^2\right)$$

instead of those for BBB corporations

$$\tau_t = 0.16\overline{\tau} + 0.84\tau_{t-1} + \varepsilon_t^{\tau}, \quad \varepsilon_t^{\tau} \sim N\left(0,\ 0.8^2\right)$$

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Zero inflation policy results

St. deviation of	Taylor rule	Zero-inflation policy	
		Wth RP shocks	No RP shocks
Hours	0.80	0.48	0.29
Investm./Output ratio	1.64	1.42	0.51
Consum./Output ratio	1.90	1.68	0.99
Detrended Output	1.65	1.30	0.77
Risk-free rate	0.63	0.25	0.08

With RP shocks: probability of RFR in [0, 5 bp] range = 0.6 percent

No RP shocks: lowest RFR 4 standard deviations away from zero

Conclusions

To the extent risk-premium shocks are important, zero bound on nominal interest rates is relevant for monetary policy design

Thank you