Monetary Policy Regimes and the Term Structure of Interest Rates

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Overview

- Introduction
- Model
- Results
- Conclusion

Literature and Contribution

Existing Literature

- Monetary policies matter for the real economy (Woodford, 2003) and improved over time, such improvement has been modeled by assuming a break point (Clarida et al., 2000) or modeled explicitly regime changes (Sims and Zha, 2006).
- Two strands of macro literature:
  - Understanding the role of time-varying volatility of exogenous shocks in relation to time-varying monetary policy in generating fluctuations in business cycle. (Cogley and Sargent (2005), Primiceri (2005) etc.)
  - Using information in the yield curve to inform about potential misspecification in macro models not necessarily concerned with changing monetary policy. (Rudebusch (2002), Gurkaynak et al (2005))

Contribution

- Pointing out monetary policy regimes may not be estimated precisely if one uses information from the short interest rate only.
- Bridging two strands of the macro literature by using a term structure model to bring evidence from the yield curve.

Model

Forward-Looking Regime-Switching Model

$$
\begin{aligned}
g_t =& m_g + (1-\mu_g)g_{t-1} + \mu_g E_t g_{t+1} - \phi(r_t - E_t\pi_{t+1}) + \sigma_g(s_t^e)\epsilon_t^g \\
\pi_t =& m_\pi + (1-\mu_\pi)\pi_{t-1} + \mu_\pi E_t \pi_{t+1} - \delta g_t + \sigma_\pi(s_t^e)\epsilon_t^\pi \\
r_t =& m_r(s_t^m) + (1-\rho(s_t^m))[\alpha(s_t^m)E_t\pi_{t+1} + \beta(E_t\pi_{t+1})g_t] + \rho(s_t^m)r_{t-1} \\
& + \sigma_r(s_t^d)\epsilon_t^r
\end{aligned}
$$

- Model based on New IS-LM model, and represents an empirical specification of economy dynamics.
- Private sector parameters are not regime independent.
- Regimes are assumed to be independent (8 regimes in total), and shocks are mutually uncorrelated.

Model

Rational Expectation Solution

$$x_t = \mu(S_t) + \Phi(S_t)x_{t-1} + \sum(S_t)\epsilon_t$$

- Private sector and the Fed have the same information when forming expectations about future values of state variables.
- Fed and private sector both know the current realization of regimes.

Model

Market Prices of Risk

- **SDF**: $logM_{r,t+1} = -r_t - \frac{1}{2}\Lambda'_{t,t+1}\Lambda_{t,t+1} - \Lambda'_{t,t+1}\epsilon_{t+1}$
- **Market Price of Risk**: $\Lambda_{t,t+1} = \sum'(S_{t+1})\Pi(x_t)$
- **Preference (Duffie 2002)**: $\Pi(x_t) = \Pi_0 + \Pi_x x_t$

- SDF follows "no-arbitrage restrictions".
- Investor requires greater compensations for holding bonds in a more volatile economic environment.
- Agents are risk averse, but "preference" does not depend on regimes.

Model

Bond Valuation

$$M_{t,t+n} = \prod_{i=1}^{n} M_{t+i-1,t+i}$$

$$B_t^n(x_t, S_t) = E[M_{t,t+n}|x_t, S_t]$$

Results

- Three categories of regimes:
  - **Discretionary** and Commitment;
  - **Active** and Passive;
  - **High Volatility** and Low Volatility.
- 2 types of model:
  - SRM (Short-Rate Model): inflation, detrended output, 3 month-yield.
  - TSM (Term-Structure Model): SRM + yields and macro-variables.

Estimation of State Dynamics

Private sector	$m_g \times 10^3$	m_π	μ_g	μ_π	$\phi \times 10^4$	δ		
TSM	1.79 (−1.08, 4.02)	0.00 (−0.01, 0.01)	0.54 (0.53, 0.58)	0.48 (0.42, 0.51)	8.61 (1.07, 19.00)	0.01 (0.00, 0.03)		
SRM	0.00 (−0.01, 0.01)	0.00 (−0.01, 0.01)	0.53 (0.51, 0.57)	0.50 (0.50, 0.51)	0.00 (0.00, 0.00)	0.01 (0.00, 0.01)		
Monetary policy	$m_r(1) \times 10^2$	$m_r(2) \times 10^2$	$\rho(1)$	$\rho(2)$	$\alpha(1)$	$\alpha(2)$	$\beta(1)$	$\beta(2)$
TSM	−0.19 (−0.34, 0.08)	0.80 (0.13, 4.20)	0.97 (0.95, 0.99)	0.81 (0.09, 0.87)	3.53 (1.44, 6.90)	0.36 (0.01, 1.10)	2.18 (0.60, 4.60)	1.27 (0.04, 1.80)
SRM	−0.10 (−1.15, 0.80)	1.52 (0.95, 1.80)	0.97 (0.90, 0.99)	0.55 (0.47, 0.57)	5.61 (1.50, 38.00)	0.32 (0.14, 0.42)	6.52 (2.86, 32.00)	0.83 (0.44, 1.11)
Volatilities	$\sigma_g(1)$	$\sigma_g(2)$	$\sigma_\pi(1)$	$\sigma_\pi(2)$	$\sigma_r(1)$	$\sigma_r(2)$		
TSM	1.06 (0.87, 1.28)	0.66 (0.55, 0.75)	0.56 (0.46, 0.67)	0.23 (0.19, 0.26)	2.84 (2.40, 3.29)	1.41 (1.17, 1.61)		
SRM	1.17 (1.00, 1.30)	0.49 (0.32, 0.60)	0.52 (0.31, 0.62)	0.23 (0.09, 0.29)	2.19 (1.50, 2.79)	0.40 (0.25, 0.47)		

- Volatility of exogenous monetary policy is higher in state 1, than 2. (discretionary vs. commitment)
- Strong reaction to one-quarter inflation in active regime, while reducing long-term target of inflation of inflation in passive regime.
- Fed also reacts more aggressively to real output in the active regime.

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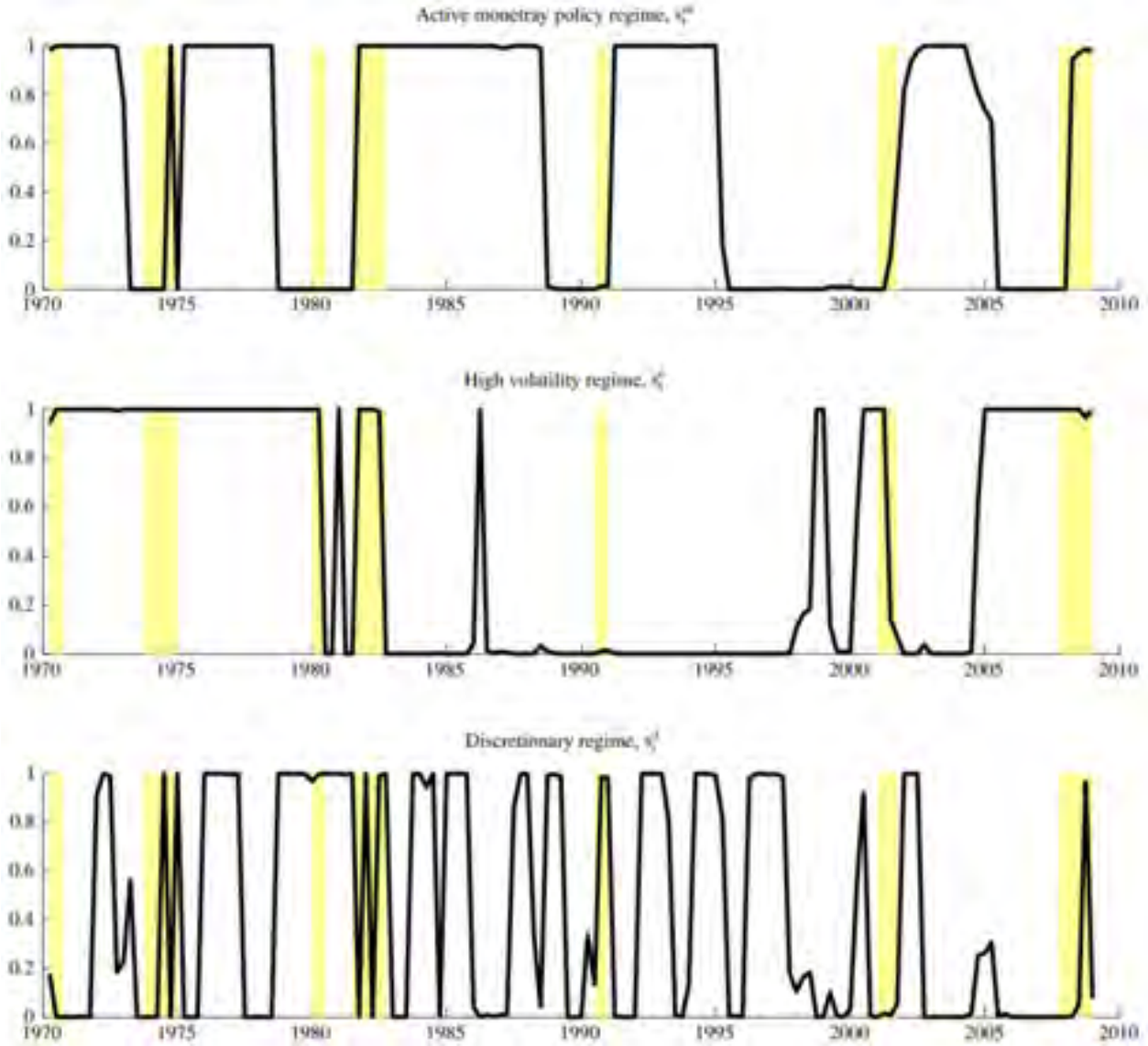
Regime Probabilities

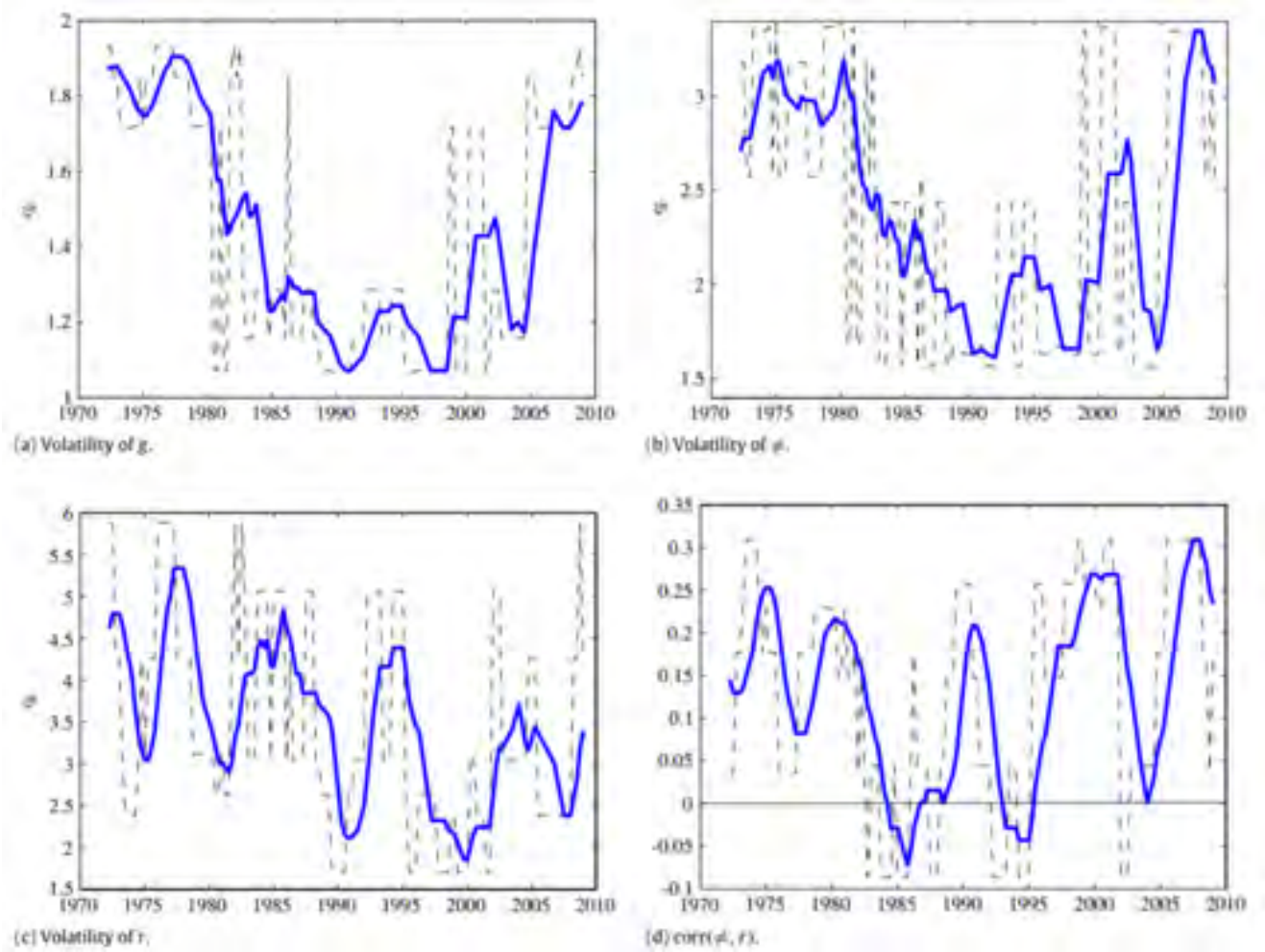
TSM			*SRM*		
Systematic monetary policy regime variable s_t^m					
	Active	Passive		Active	Passive
Active	98.21 (97.19, 99.56)	1.78 (0.43, 2.80)	Active	69.65 (56.61, 81.99)	30.35 (17.75, 43.57)
Passive	9.69 (4.50, 18.40)	90.31 (81.15, 95.52)	Passive	72.57 (58.70, 91.66)	26.43 (6.61, 40.18)
Volatility of exogenous shocks regime variable s_t^e					
	High vol	Low vol		High vol	Low vol
High vol	94.34 (82.15, 99.79)	5.66 (0.80, 17.96)	High vol	98.72 (76.67, 99.68)	1.28 (0.22, 20.90)
Low vol	4.97 (1.50, 8.83)	95.03 (91.03, 98.34)	Low vol	1.66 (1.02, 15.30)	98.34 (83.76, 99.12)
Volatility of monetary policy shock regime variable s_t^d					
	Discretion	Commitment		Discretion	Commitment
Discretion	78.66 (67.76, 83.30)	21.34 (14.50, 29.99)	Discretion	90.55 (67.38, 97.25)	9.45 (2.60, 31.81)
Commitment	17.74 (12.70, 26.10)	82.26 (75.75, 89.30)	Commitment	7.47 (2.70, 21.73)	92.53 (78.27, 97.40

- Monetary regimes are the most persistent (98% continue), monetary shock regime, are the least persistent.

Regime Probabilities

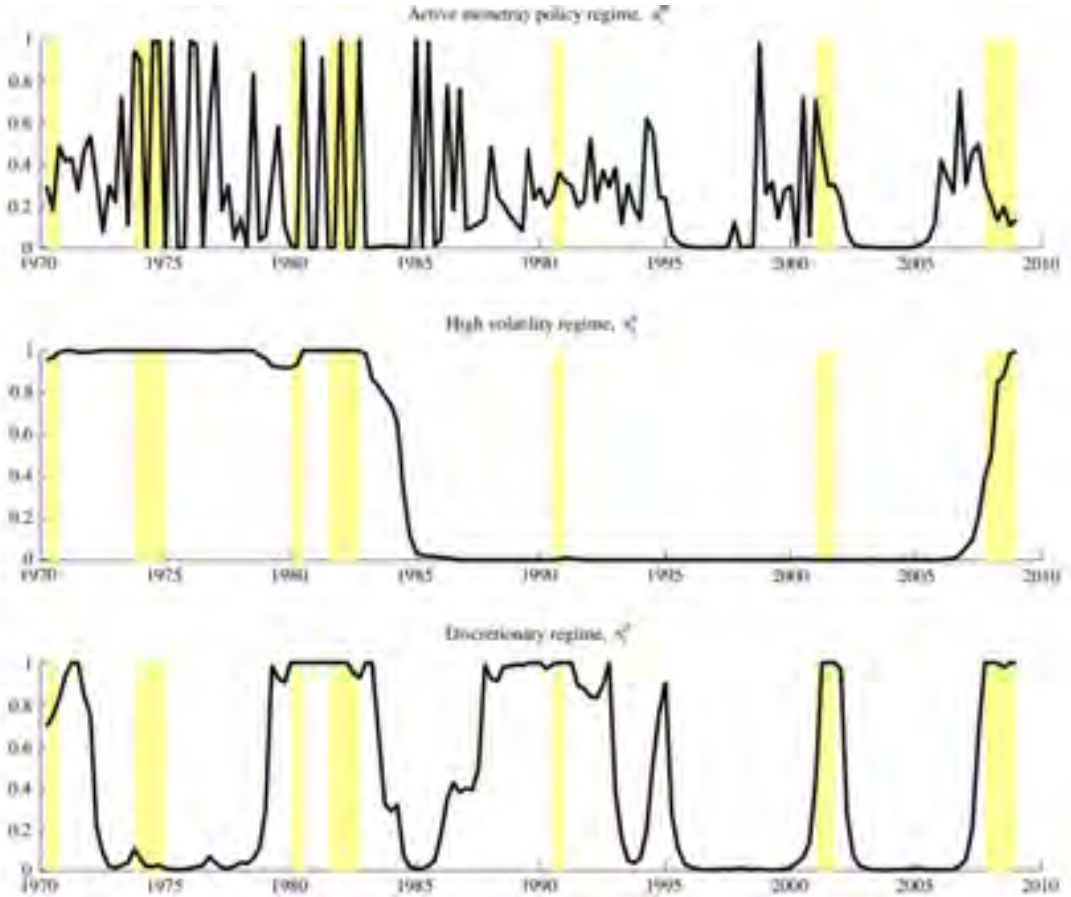


Implication of Reduced Form Model



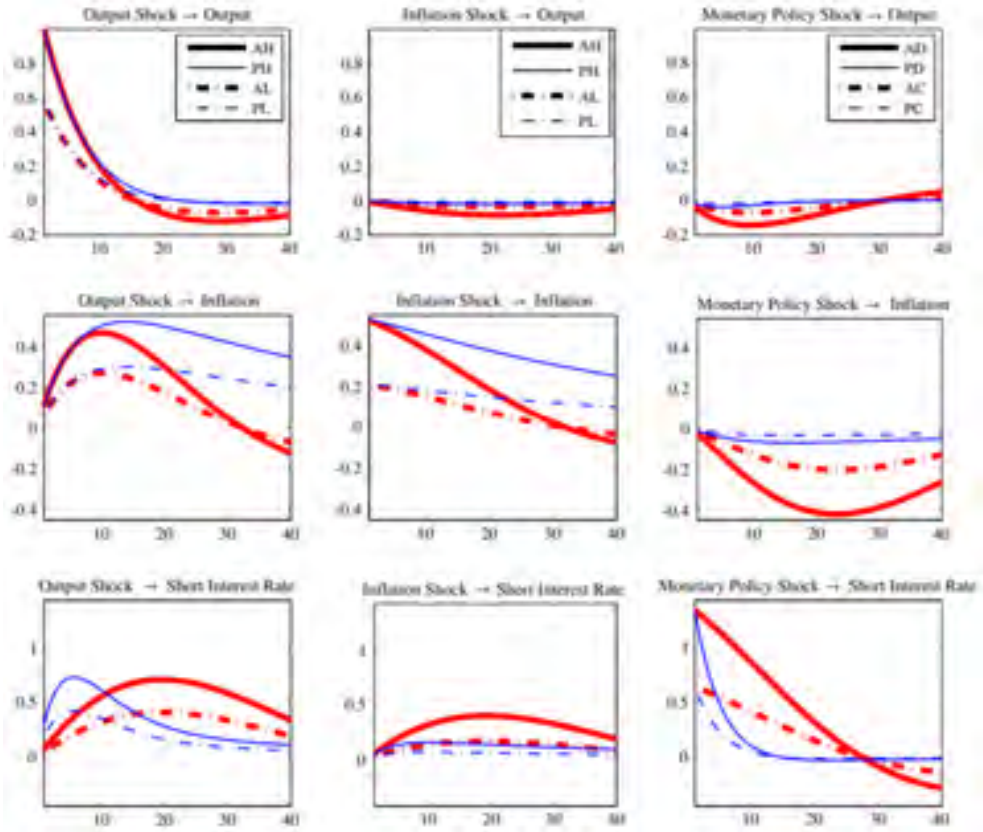
- Volatilities are not tied to any specific structural regime.
- Despite assumption, inflation and short interest rate are correlated.

Implication of Reduced Form Model



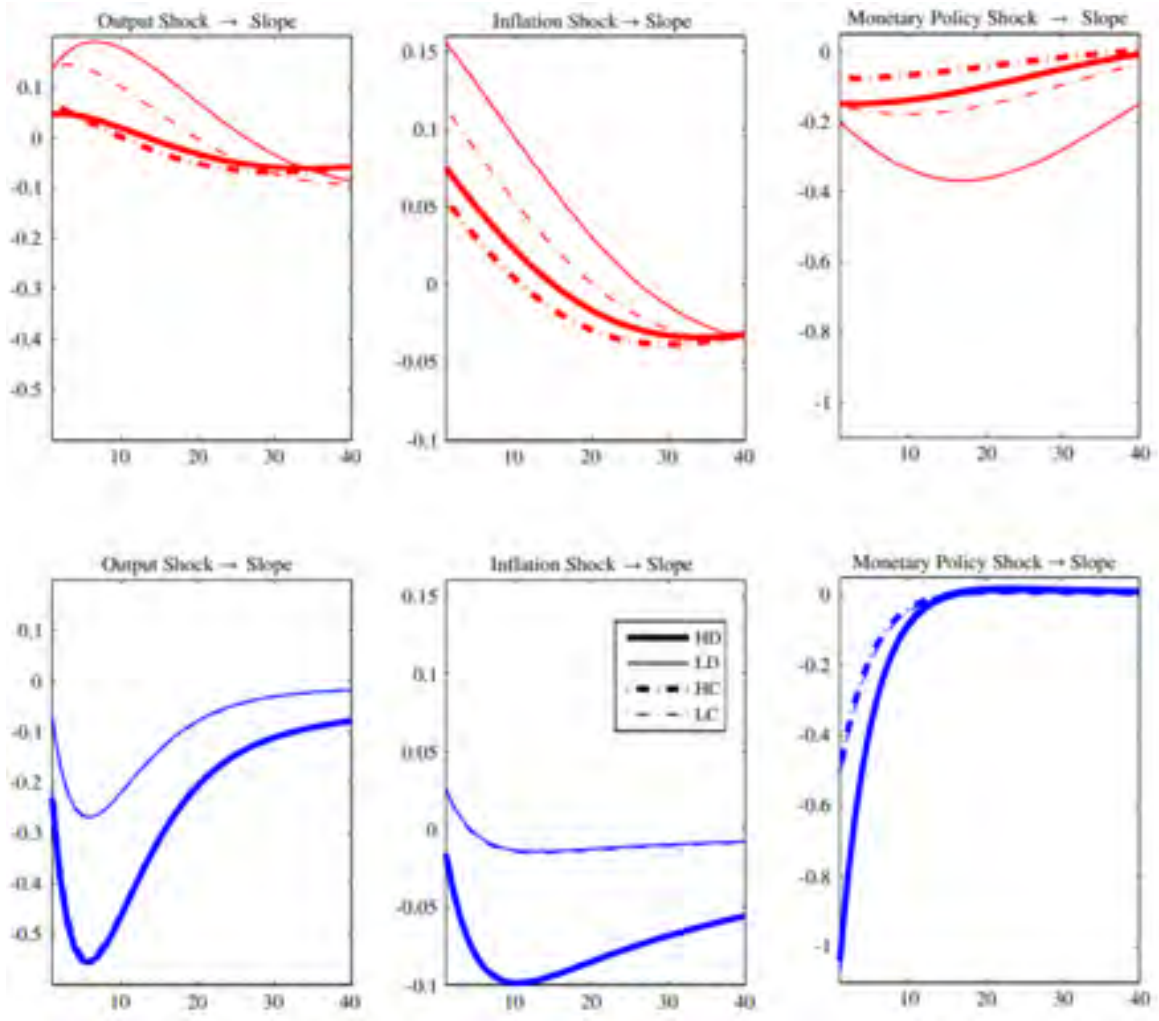
- Monetary regimes in SRM are much less persistent than TSM.
- In active regime, SRM are not as well-defined, probability hovers around 0.5.

Counterfactual Impulse Response



- In passive regime, commitment and discretion regimes almost identical, in active regime qualitatively similar in monetary policy shock.
- In active regime, rise in interest rate is more prolonged, total effect on output and inflation is stronger.
- In high-volatility regime, Fed always reacts more strongly.

Counterfactual Impulse Response (Slope)



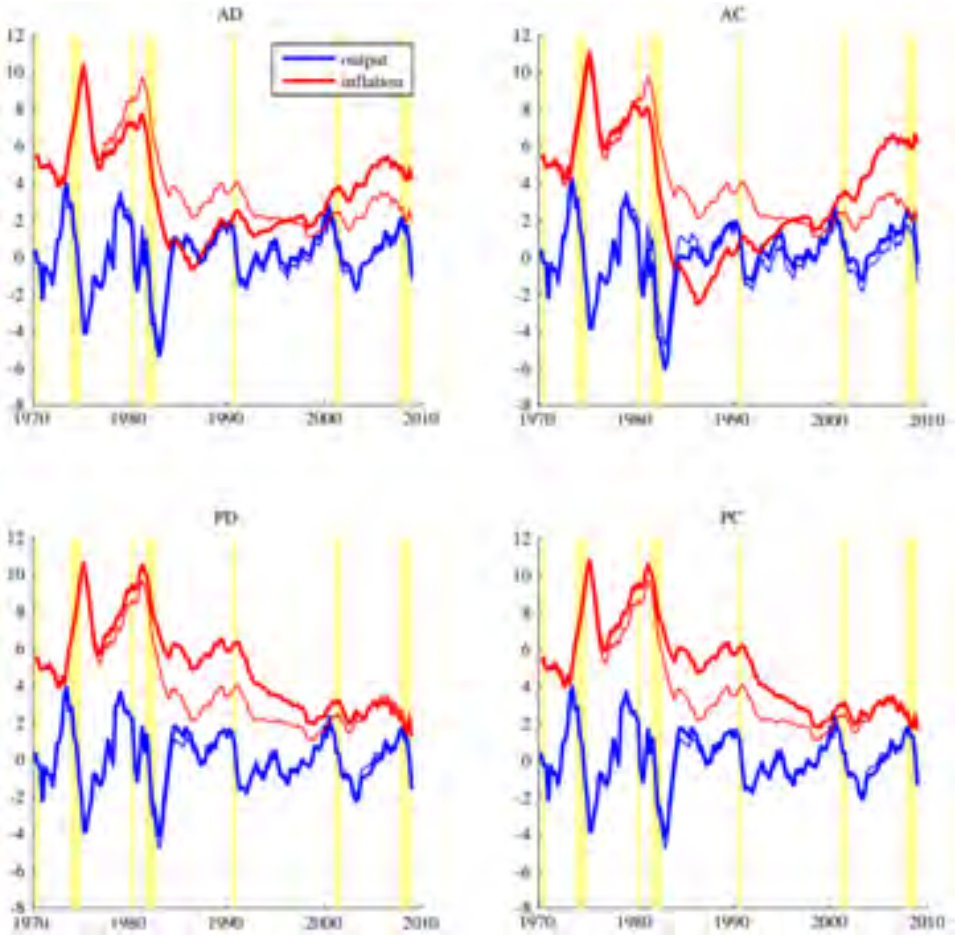
- Active regimes steer economy in a more stable way.

Counterfactual Economies

				Average				Standard deviation			
				g	π	$y(1)$	$y(40)$	g	π	$y(1)$	$y(40)$
Subsample 1 (1970–1982)				−0.04	6.73	7.74	8.47	2.17	1.78	3.26	2.38
Model	s_t^m	s_t^g	s_t^z								
	A	C	H	−0.51	6.50	8.45	10.25	2.67	2.01	6.10	4.71
	A	D	H	−0.52	5.91	8.27	9.09	2.50	1.72	3.43	2.66
	P	C	H	−0.12	7.26	6.83	7.19	2.33	1.93	3.70	1.93
	P	D	H	−0.12	7.17	6.68	6.55	2.32	1.92	2.55	1.41
Subsample 2 (1983–2008)				0.02	2.58	4.95	6.70	1.09	0.80	2.37	2.22
Model	s_t^m	s_t^g	s_t^z								
	A	C	L	0.35	2.36	3.38	6.79	1.04	2.40	4.83	2.98
	A	D	L	0.28	2.73	4.06	6.66	1.00	1.48	2.62	1.64
	P	C	L	0.12	3.79	4.81	7.12	1.01	1.18	2.43	1.33
	P	D	L	0.10	3.88	5.11	6.76	1.02	1.23	1.56	1.06
Full sample (1970–2008)				0.00	3.97	5.88	7.29	1.54	2.31	2.99	2.41
Model	s_t^m	s_t^g									
	A	C		0.14	3.51	4.97	7.48	1.72	3.19	6.17	4.78
	A	D		0.09	3.56	5.37	7.05	1.62	2.34	3.89	3.07
	P	C		0.08	4.97	5.54	7.02	1.52	2.34	3.22	1.99
	P	D		0.08	5.00	5.69	6.57	1.53	2.32	2.23	1.59

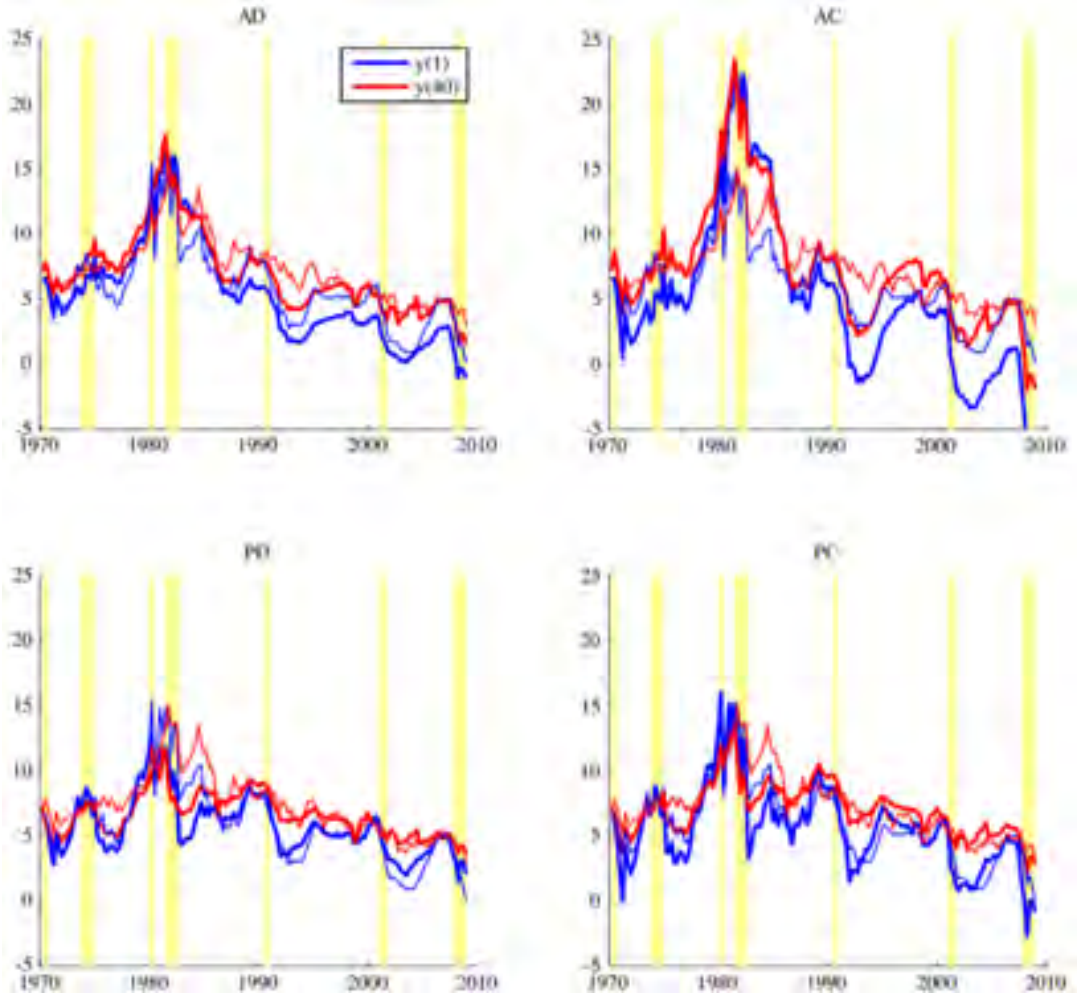
- If one regime is fixed throughout the sample, we should observe the same signs of observation in the actual data. Therefore, a large driver of moderation is the change of the private sector shocks.

Counterfactual Economies



- In PC and PD, Almost no difference between realized and real output, counterfactual inflation is higher overall than realized.
- More complicated in AC and AD.

Counterfactual Economies



- AD are not implemented for long for highly volatile yields.

Conclusion

- Long-term rates helps identify monetary policy regimes.
- At least two types of systematic policies are identified.
- Monetary policy is important for the moderation.

Thanks!