Does Precautionary Savings Drive the Real Interest Rate? Evidence from the Stock Market

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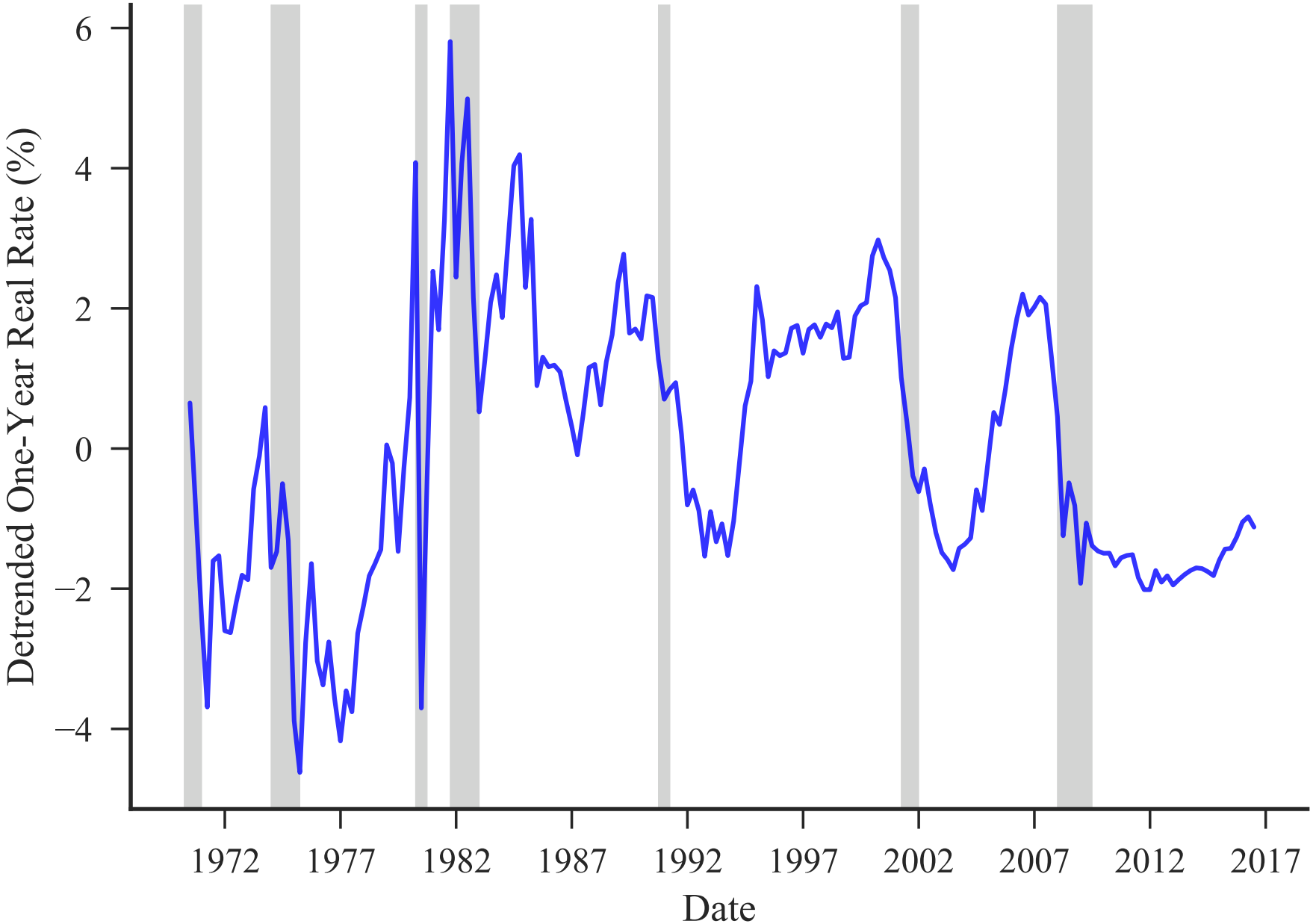
The Real Interest Rate



Organizing Framework

- Asset pricing Euler equation:

$$r_t = \beta_0 + \beta_g \times \mathbb{E}_t\left[\text{Growth}\right] - \beta_p \times \text{Precautionary Savings}_t$$

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This paper: Some answers from the stock market

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Our interpretation = PVS captures a stock-market implied precautionary savings motive

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Precautionary savings demand reflects time-varying aversion to diversifiable shocks

Related Literature

Idiosyncratic Risk in the Stock Market: Ang, Hodrick, Xing, and Zhang (2006), Johnson (2004), Fu (2009), Stambaugh et al. (2015), Herskovic, Kelly, Lustig, and Van Nieuwerburgh (2016)

Estimating Precautionary Savings: Carroll and Samwick (1998), Lusardi (1998), Banks, Blundell, and Brugiavini (2001), Parker and Preston (2005)

Estimating the Natural Real Rate of Interest: Laubach and Williams (2003), Cúrdia, Ferrero, Ng, and Tambalotti (2015), Hartzmark (2016)

Our Contribution: Relate variation in the valuation of high- and low-vol stocks to the precautionary savings component of interest rates

The Data

Data Sources

Main Sample Runs from 1973Q1 - 2015Q4

- **Real rate**: 1 year T-bill minus SPF inflation expectations
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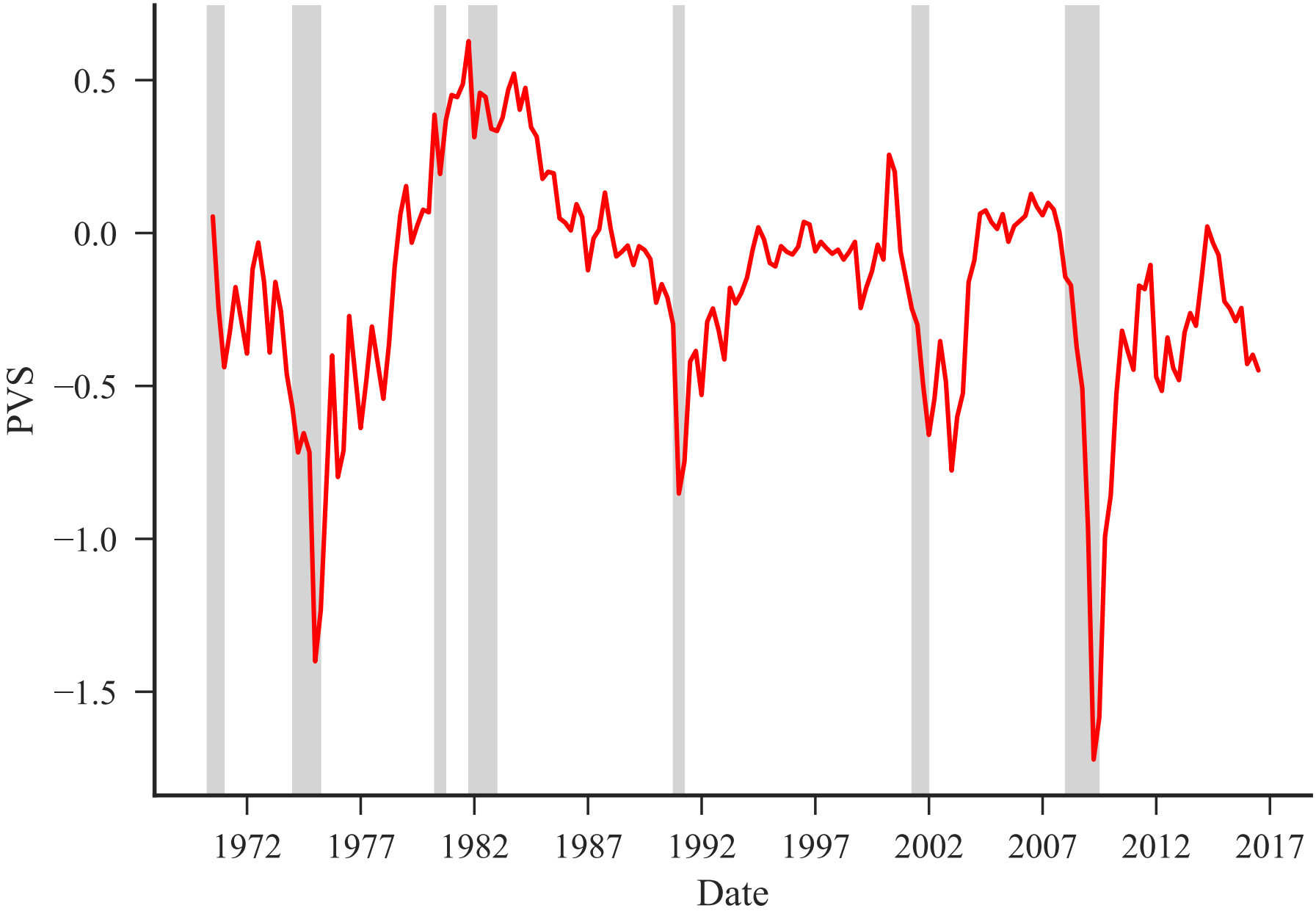
- Quarterly book-to-market ratios from CRSP/Compustat
- Measuring volatility and portfolio formation:
  - At end of each quarter, use past two months of daily data to compute stock return volatility
  - Form five equal-weighted portfolios based on volatility
- $PVS_t \equiv$ Avg. B/M of Low-Vol Stocks - Avg. B/M High-Vol Stocks

PVS = Price of Volatile Stocks



Explaining the Real Rate

Explaining the Real Rate

Fact 1: The real rate is not reliably correlated with the aggregate stock market

Dependent Variable:	One-Year Real Rate			
	(1)	(2)	(3)	(4)
Aggregate BM	**-1.24**			0.32
	(-0.56)			(0.17)
PVS_t		3.49**	3.61**	3.25**
		(4.58)	(5.15)	(3.73)
Output Gap				0.11
				(0.77)
Inflation				-0.11
				(-0.93)
Adj. R^2	**0.02**	0.44	0.32	0.45
Detrended	Y	Y	N	Y
N	172	172	172	172

Explaining the Real Rate

Fact 2: PVS Explains 44% of Real Rate Variation.

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One sigma move in PVS ⇒ 0.7 sigma move in the real rate

Explaining the Real Rate

Robustness: Identical results for raw real rate

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Robustness: Identical results with aggregate BM and Taylor rule controls

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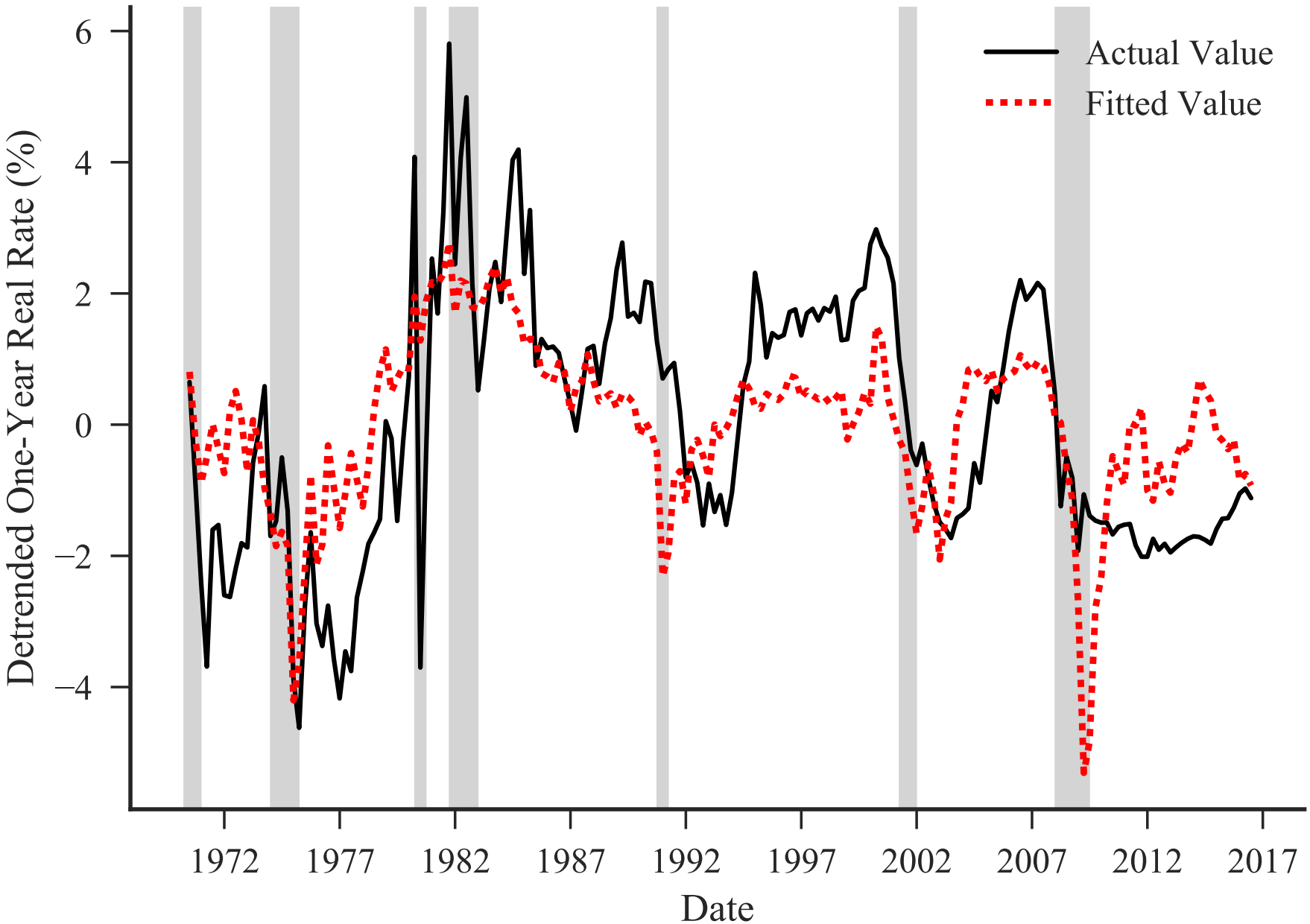
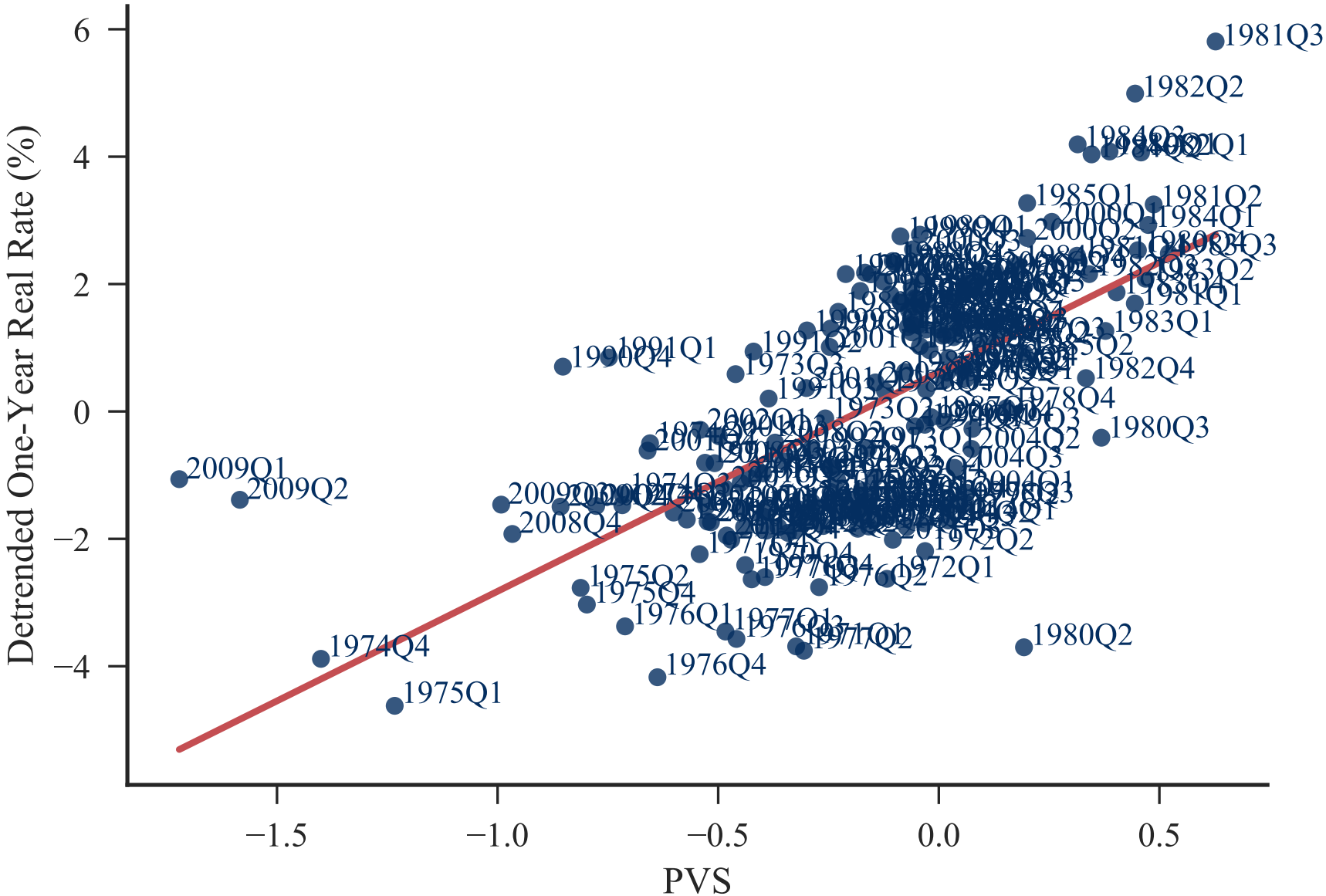
PVS and the Real Rate



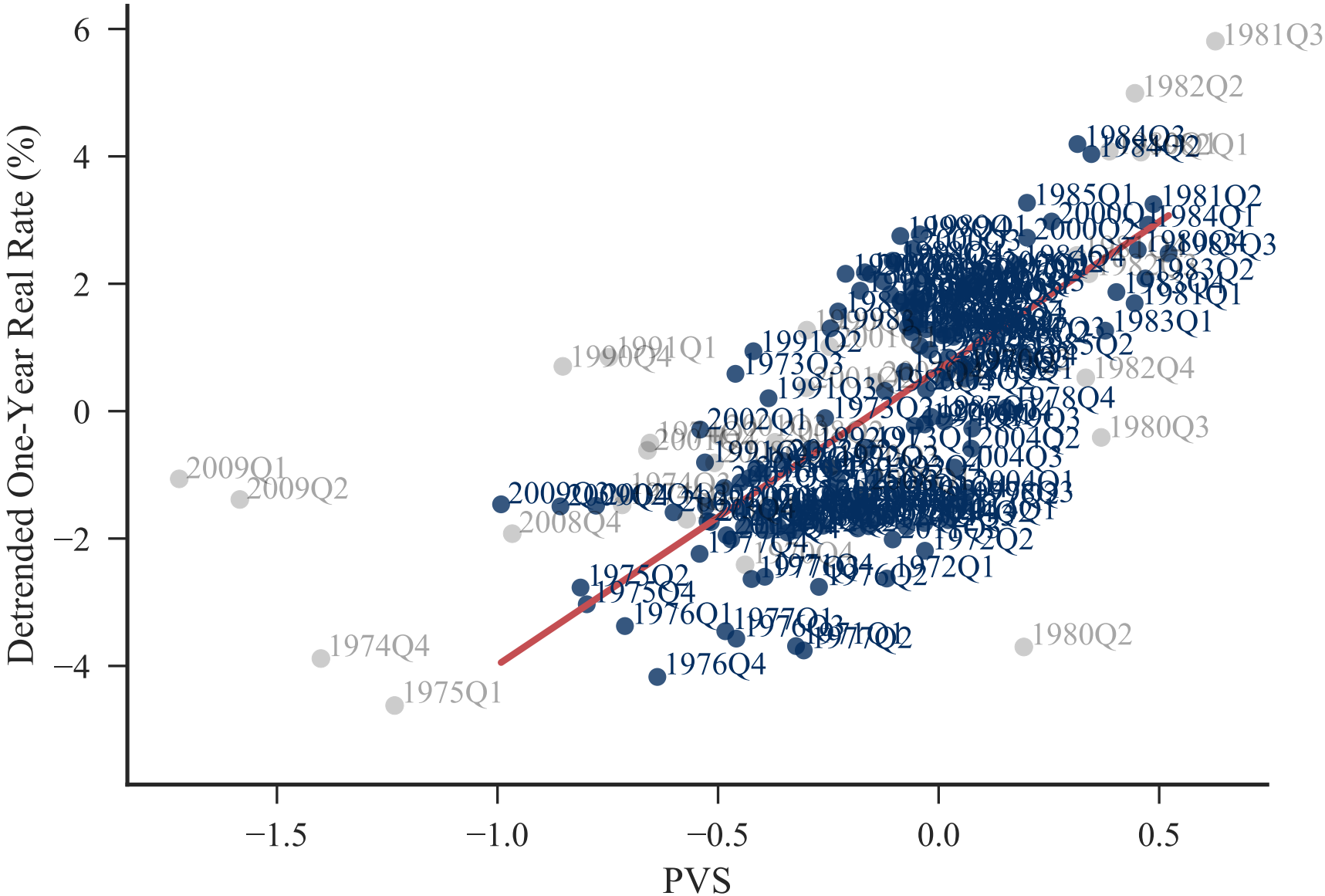
Robustness

Are Results Driven By Recessions?



Are Results Driven By Recessions? No.

The relationship is strong during non-recessions



Time-Series Robustness

The relationship between PVS and r_t appears statistically robust

	Levels			4Q Changes		
	b	$t(b)$	R^2	b	$t(b)$	R^2
Baseline	3.45	4.63	0.45	1.77	2.22	0.12
Pre-Crisis	3.95	6.80	0.51	3.32	4.80	0.24
2YR Vol	4.81	5.39	0.57	2.61	2.64	0.17

- Pre-crisis is 1973Q1 - 2008Q4
- Dealing with persistence:
  - Changes
  - Bootstrap simulation p-values $< 0.5\%$
  - Maximum likelihood with AR-GARCH errors
- Same conclusions using two-year vol and idiosyncratic vol

Is Volatility Special?

Volatility might just proxy for another signal that matters for r_t

- For example:
  - Market beta: what matters to diversified investors
  - Duration: firms w/ high cash flow duration benefit from low rates
  - Leverage: firms w/ high leverage may have interest rate exposure

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- We use two complementary methods to test these alternatives:
  1. Horse races. Form B/M spreads based on a given characteristic Y:

$$r_t = a + \boldsymbol{b} \times \text{PVS}_t + c_s \times (\text{BM-Spread from Sort on Y})_t + c_a \times \text{Agg BM}_t + \epsilon_t$$

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  2. Form double-sorted versions of PVS, run baseline regression

- In the paper, we also do this in differences, pre-crisis, etc.

Is Volatility Special? Yes.

Not proxying for duration or leverage

			b	$t(b)$	R^2
	(1)	Baseline	3.45**	4.63	0.45
Horse Races Against:	(2)	**Duration**	**3.21****	**3.25**	**0.45**
	(3)	**Leverage**	**4.81****	**6.63**	**0.49**
	(4)	Beta	2.53**	3.14	0.47
	(5)	2M-Beta	3.51**	5.31	0.45
	(6)	LR Beta	2.69**	2.73	0.46
	(7)	CF Beta	3.65**	5.25	0.47
	(8)	Size	3.02*	1.88	0.45
	(9)	Value	4.84**	4.76	0.48
Multivariate Sorts:	(10)	**Duration**	**4.29****	**4.26**	**0.24**
	(11)	**Leverage**	**5.03****	**4.98**	**0.45**
	(12)	2M-Beta	4.36**	5.18	0.45
	(13)	Size	5.18**	3.71	0.38
	(14)	Value	9.12**	4.80	0.42
	(15)	Industry-Adj	3.71**	4.89	0.40

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What Drives Precautionary Savings Itself?

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- Standard forecasting regressions to disentangle:

$$Returns_{t \to t+h} = a + b \times PVS_t + \varepsilon_{t \to t+h}$$

  where returns are on the low-minus-high volatility portfolio

Why Does Precautionary Savings Move Around?

PVS Driven by Changes in Expected Returns, Not Cash Flows

Annual Forecasting	Returns$_{t\to t+4}$			
	(1)	(2)	(3)	(4)
PVS$_t$	45.92**	30.03**		
	(4.09)	(2.46)		
Real Rate$_t$			5.77**	2.58
			(2.52)	(0.91)
Fama-French$_{t\to t+4}$	N	Y	N	Y
Adj. R^2	0.31	0.61	0.13	0.52
N	168	168	168	168

Standard errors based on Hodrick (1992)

Whatever drives the expected return for holding high-volatility stocks also drives precautionary savings and the real rate

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- Expected returns main driver of variation in PVS (precautionary savings)
- Two potential drivers:
  - Quantity of risk changes
  - Price of risk changes
- Hard to fully disentangle, but we can test relation between PVS, real rate and measurable quantities of risk

The Real Rate and the Quantity of Risk

Dependent Variable:	Real Rate		
	(1)	(2)	(3)
σ (LMH-Vol Portfolio)	**-0.00**		-0.02
	(-0.08)		(-0.67)
σ (TFP Growth)		-0.09	0.21
		(-0.18)	(0.93)
σ (Mkt-Rf)		**-0.19****	-0.06
		(-3.20)	(-1.63)
σ (SMB)		0.28**	0.05
		(3.41)	(1.37)
σ (HML)		0.10	0.12
		(1.03)	(2.68)
CIV		0.01	0.04*
		(0.49)	(1.83)
PVS_t			**4.00****
			(7.62)
Adj R^2	-0.01	0.14	0.57
N	172	172	172

Real rate doesn't line up with amount of risk ⇒ Precautionary savings motives ≈ time-varying aversion to diversifiable shocks

Summary

- Headline result = PVS explains real rate variation
  - High-vol stocks fall when aversion to volatility is high
  - Aggregate + other characteristic-sorted valuation spreads don't
- In turn, PVS moves around because expected returns on volatility vary
- Expected returns do not appear to change due to varying risk

Implications and Extensions

Implications for a Model

- Hard to rationalize these facts about a key asset price – the real rate – with models based on perfect risk sharing and diversification

- Diversification means investors should care about beta, not vol
  - But the data says precautionary savings are driven by risks that investors could easily diversify away from

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- Alternative view: segmented markets
  - Investors specialized in high-vol assets have strong precautionary savings, so marginal in bond market much of the time
  - Risk-aversion shock to investors in high-vol stocks simultaneously drives down their prices and raises the price of the riskless asset
  - Break link between real rate and aggregate equity premium

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- Which bond market participants have concentrated exposures to high-vol stocks?

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- Suppose intermediary i specializes in high vol stocks:
  - Negative net worth shock increases i's risk aversion
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$$Ret_t^i = a + \beta_i^{vol} \times \text{HML-Vol Returns}_t + \xi_t$$

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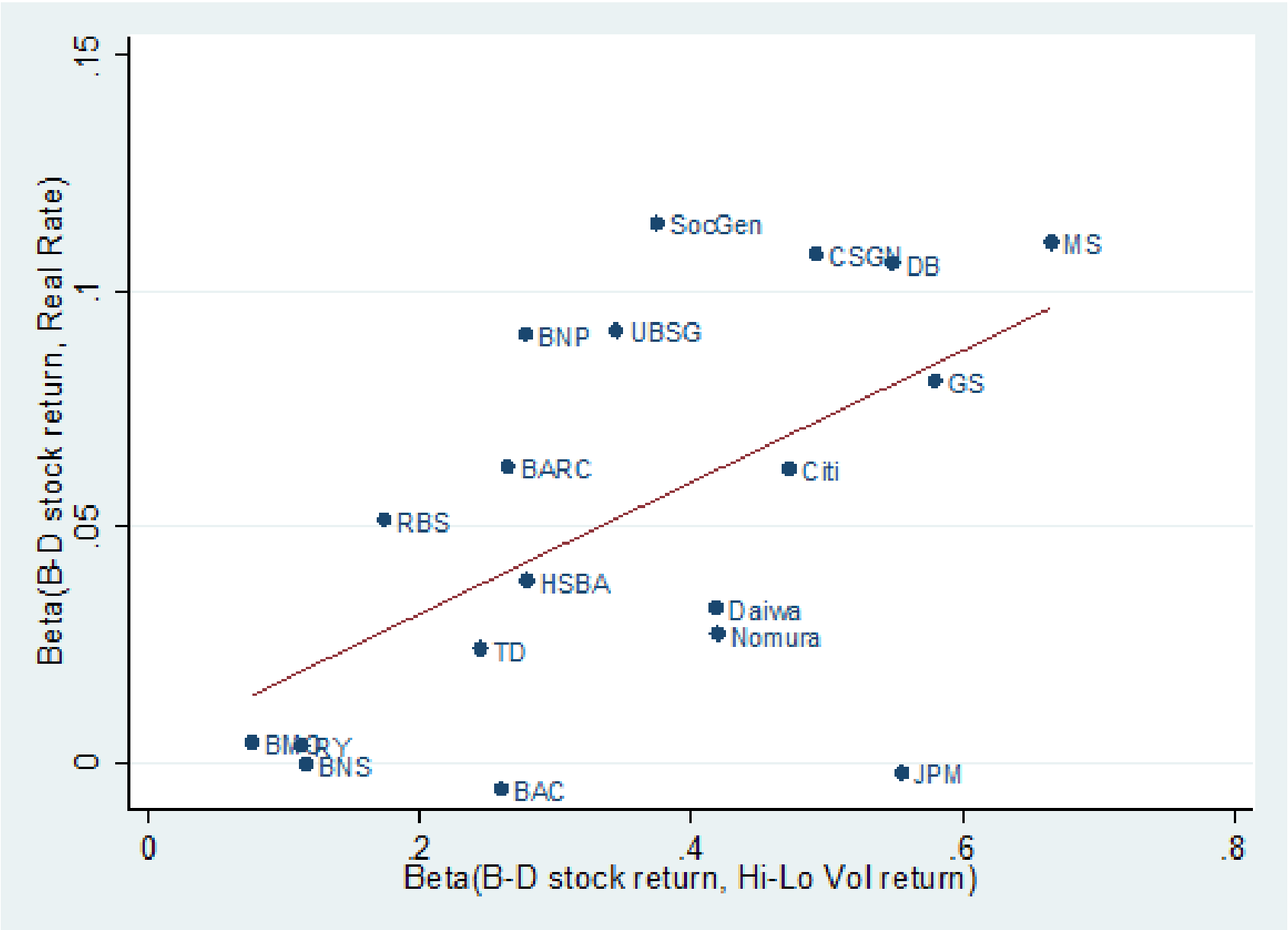
The specialized intermediary story predicts $\rho(\beta_i^{vol}, \beta_i^{rr}) > 0$

Intermediary Asset Pricing View



Mutual Fund Flows

- We also study mutual funds that focus on high volatility stocks
  - Validate baseline regressions in independent data set
- Suppose high-vol investors suffer adverse shock
  - High-vol fund outflows
  - Increase in demand for bonds and drop in real rate
- Fund f is"high-vol" if its returns have a high beta, β_f^{Vol}, with the HML-Vol portfolio
- Then run the following regression:

$$\text{Net Inflow}_{f,t} = c_f + \theta_r \times r_t + \theta_{vol} \times \left(r_t \times \beta_f^{Vol} \right) + \sum_{i=0}^{1} \gamma_i Ret_{f,t-i} + \varepsilon_{f,t}$$

- Our story predicts that $\theta_{vol} > 0$
  - Control for contemporaneous and lagged fund returns

Fund flows tell the same story as valuation ratios

Investors pull their money out of high vol funds when the real rate is falling

Dep. Variable	Net Inflow$_{f,t}$	
	(1)	(2)
r_t	0.90**	
	(4.69)	
$r_t \times \beta_f^{Vol}$	**1.73****	**1.52****
	(4.64)	(4.30)
Adj. R^2	0.12	0.16
Time FE	N	Y
Fund Returns	Y	Y
N	630,592	630,592

- 1 pp drop in real rate leads to 1 pp outflow from all funds
- Effect is nearly doubled for high vol funds

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- All depends on central bank reaction to precautionary savings shocks

An Exploratory VAR

$$Y_t = B_1 Y_{t-1} + C_1 P_{t-1} + A^y \nu_{y,t}$$

$$P_t = \sum_{i=0}^{1} D_i Y_{t-i} + \sum_{i=0}^{1} G_i P_{t-i} + A^p \nu_{p,t}$$

- P are *policy* variables (r_t and PVS_t)
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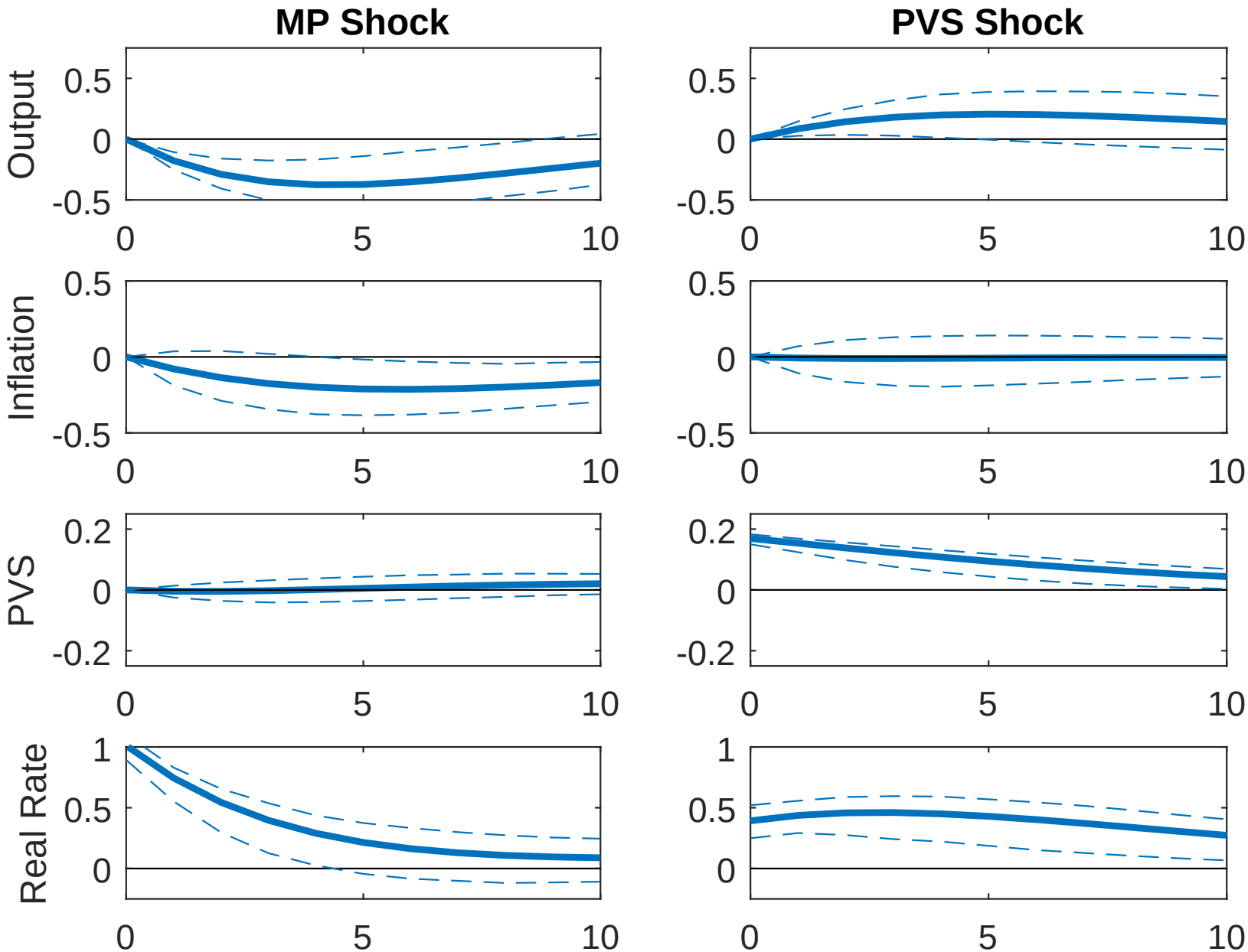
- P are *policy* variables (r_t and PVS_t)
- Y are *non-policy* variables (output gap and inflation)
- Recursive identification (Bernanke and Mihov, 1998, Gilchrist and Zakrajsek, 2012)
  - Central bank (via r_t) acts faster than precautionary savings demand, which acts faster than output gap and inflation

Impulse Responses



Alternative LHS Variables

Univariate regression on PVS

		Reg. on PVS		
		b	$t(b)$	R^2
(1)	Baseline Detrended	3.49	5.08	0.44
(2)	Baseline Raw	3.61	5.15	0.32
(3)	Nominal 1-Year Rate	3.97	2.49	0.14
(4)	Expected Inflation	0.36	0.34	-0.00
(5)	Fixed Taylor Rule Implied Rate (Taylor, 1993)	0.71	0.70	0.02
(6)	Residual	2.90	2.70	0.22
(7)	Fitted Taylor Rule Implied Rate	0.50	0.93	0.03
(8)	Residual	3.11	3.92	0.29
(9)	10Y-1Y Term Spread	-0.97	-1.99	0.08
(10)	BAA-10Y Spread	-0.93	-2.91	0.21

Conclusion

- New link between price of high-vol stocks and real rate
- Puzzling for standard models, but consistent with segmented markets view
- Evidence that stock market implied precautionary savings is a meaningful component of the natural rate of interest
- Monetary policy implications

Thank You!

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