Expected inflation, real rates, and stock-bond comovement

Greg Duffee
Johns Hopkins University

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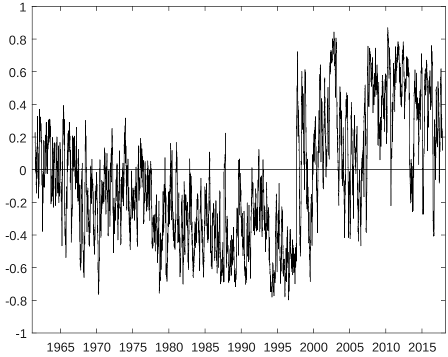
A plot

Sample corrs between aggregate stock returns and { (changes in nominal yields); (nominal bond returns) } vary substantially over time



- Here: 44-day overlapping periods, daily CRSP value-weighted return, daily change in 10-year nominal Treasury coupon bond yield
- Well-known pattern
- General pattern also holds for UK, Euro countries, Japan, Canada

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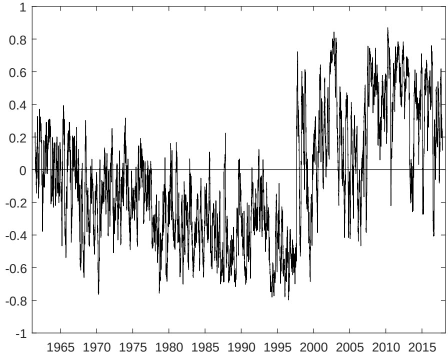

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Why?

My contributions

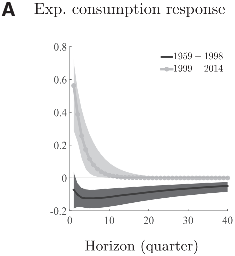
- Document similar time-varying comovement with stock returns and changes in short-term real rates
- Document that variation over time in stock return – real rate comovement appears unrelated to changes in relation between macroeconomy (output, inflation) and asset prices

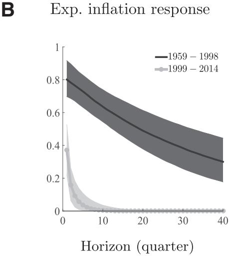
The usual suspect: regime changes in inflation dynamics

- A Campbell-Shiller accounting decomposition

$$\begin{aligned}&\text{Cov}_t\,(\text{stock return, long nominal yield}) = \\ &\text{Cov}_t\,(\text{stock return, news about expected avg inflation}) \\ &+ \text{Cov}_t\,(\text{stock return, news about expected avg real rates}) \\ &+ \text{Cov}_t\,(\text{stock return, news about expected excess bond rets})\end{aligned}$$

- News of higher expected future inflation is either bad or good for stocks





- Song (RFS 2017): impulse response to 1% inflation shock

But central role of inflation seems wrong

Standard deviation of quarterly revisions in expected average inflation over the next five years

Source	Period	Basis Points
SPF + model, Duffee (2018)	1968Q4–2013Q4	23
	1968Q4–1979Q2	27
	1979Q3–1982Q4	33
	1983Q1–2008Q2	16
	2008Q3–2013Q4	8
Burkhardt and Hasseltoft (2012)	Countercyclical infl regime	82
	Procyclical infl regime	40
Song (2017)	Countercyclical/Active Fed	79
	Countercyclical/Passive Fed	104
	Procyclical/Active Fed	44

Central role of inflation seems wrong (2)

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	Regime 2	30
	Regime 3	17
	Regime 4	48
	Regime 5	9
	Regime 6	21

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- Money illusion!

Short-term real rates

- We do not observe inflation-indexed short rates
- I construct mid-quarter ex ante three-month, one-year real rates by subtracting consensus survey forecasts of inflation over next quarter, next year
  - Survey of Professional Forecasters, 1968Q4 through 2017Q4
  - Conclusion in the forecasting literature: consensus forecasts are "right at the frontier of our forecasting ability." (Faust and Wright 2013 handbook chapter)
- Other data: quarterly excess aggregate stock return, 10-year nominal yield

Correlations with quarterly stock returns

Sample [Num Obs]	Three Month Real Rate	One Year Real Rate	Ten Year Nominal Yield
1969Q1 – 1996Q4 [112]	0.00	−0.13	−0.22
1997Q1 – 2007Q4 [44]	0.43	0.45	0.20
2008Q1 – 2017Q4 [40]	0.23	0.28	0.28
1997Q1 – 2017Q4 [84]	0.32	0.36	0.24

My methodology

- Measure “macro news” by quarterly revisions in consensus survey forecasts of expected real GDP growth, expected inflation

$$\epsilon^{x}_{t,t+\tau} = E_t(x_{t+\tau}) - E_{t-1}(x_{t+\tau}), \qquad x \in \{y, \pi\}$$

  - Revisions available for quarters 0 through 3
- Project quarterly excess stock returns, changes in real rates on contemporaneous macro news

  “macro spanned” piece, “residual” piece
- Split covariance between stock returns, changes in real rates into a “macro” covariance and a “residual” covariance

How many types of macro news are there?

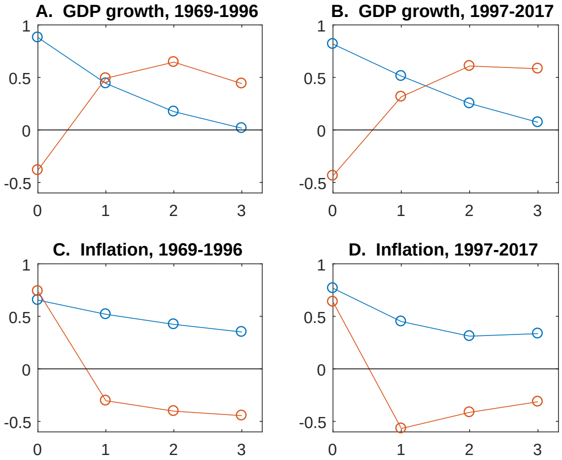
Real GDP growth

Sample	1st PC	2nd PC	3rd PC	4th PC
	Contribution (percent)			
1969Q1 – 1996Q4 (107 obs)	57.8	29.3	10.4	2.5
1997Q1 – 2017Q4 (84 obs)	90.0	6.4	2.5	1.1

Inflation

Sample	1st PC	2nd PC	3rd PC	4th PC
	Contribution (percent)			
1969Q1 – 1996Q4 (107 obs)	85.3	8.7	3.6	2.4
1997Q1 – 2017Q4 (84 obs)	84.4	10.0	3.8	1.8

Principal components of macro news from surveys



- Quarterly data and quarterly forecast horizons
- First PC is blue, second PC is red

The system of equations

- Two forecast innovations for each of GDP growth and inflation

$$\epsilon_t \equiv \begin{pmatrix} \epsilon^y_{t,t} & \epsilon^y_{t,t+2} & \epsilon^\pi_{t,t} & \epsilon^\pi_{t,t+2} \end{pmatrix}'$$

- Projections

$$\begin{pmatrix} \Delta r_t^{(1)} \\ \Delta r_t^{(4)} \\ exRet_t \end{pmatrix} = \mu + F\epsilon_t + \eta_t$$

- Covariances

$$\text{Cov}\begin{pmatrix} \Delta r_t^{(1)} \\ \Delta r_t^{(4)} \\ exRet_t \end{pmatrix} = \underbrace{F\,\text{Cov}(\epsilon_t)F'}_{\text{macro covariance}} + \underbrace{\text{Cov}(\eta_t)}_{\text{residual covariance}}$$

- OLS, exactly identified moments for covariances, stack for GMM

Why does this decomposition make sense?

- Aren't changes in short-term real rates always macro shocks?
  - Taylor rule logic – short nominal rate driven by output, inflation, and monetary policy shocks
- Superficial logic here – monetary policy shock is a macro shock to the extent it affects expectations of future output, inflation
- Better logic – world with four or fewer major macro shocks will have those shocks spanned by “macro shocks”

Explaining stock returns and changes in real rates

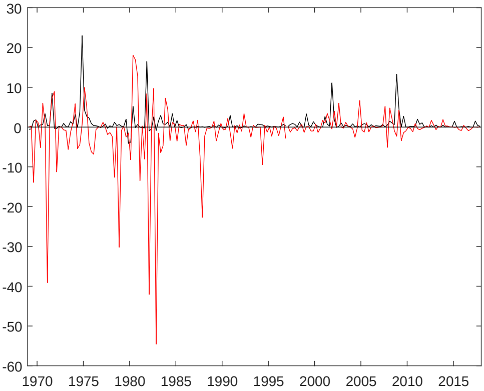
Regressions on the four types of “macro news” from consensus forecast revisions

Sample [Num Obs]	Variable	Std Dev	R^2
1969Q1 – 1996Q4	3-month rate	1.03	0.30
[112]	1-year rate	0.92	0.29
	stock return	8.09	0.09
1997Q1 – 2016Q4	3-month rate	0.46	0.31
[84]	1-year rate	0.37	0.30
	stock return	7.63	0.34

Macro and residual covariances

Sample [Num Obs]	Variable	Macro Covar	Residual Covar
1969Q1 – 1996Q4	3-month rate	1.27*	−1.30
[112]		(0.77)	(0.85)
	1-year rate	0.89	−2.07**
		(0.67)	(0.85)
1997Q1 – 2017Q4	3-month rate	1.00**	0.11
[84]		(0.50)	(0.23)
	1-year rate	0.81***	0.19
		(0.30)	(0.17)
Test of Equality	3-month rate	0.28	−1.42
Across Samples		(0.92)	(0.88)
	1-year rate	0.08	−2.26***
		(0.73)	(0.87)

The observations



- Black is product of fitted innovations of aggregate excess stock return, one-year ex ante real rate
- Red is product of residual innovations

1982Q4 and 1982Q1

Revisions in mean survey forecasts (percent)

	Revision for Quarter t		Revision for Quarter $t+2$	
	GDP Growth	Inflation	GDP Growth	Inflation
Q4	−0.35	−1.29	0.04	−0.54
Q1	−0.44	−0.91	0.09	−0.37

Real interest rates and stock returns (percent)

	Predicted			Actual		
	Stock Return	Δ in 1 Q Rate	Δ in 1 Yr Rate	Stock Return	Δ in 1 Q Rate	Δ in 1 Yr Rate
Q4	3.9	−0.12	−0.33	33.9	0.08	−2.15
Q1	3.0	−0.39	−0.54	−8.7	4.27	3.04

Adding a long-term nominal bond yield

- Cholesky decomposition of covariance matrix of (in order)

  4 macro news variables (consensus forecasts), 1-q, 1-yr real rates, 10-yr nominal yield, excess aggregate stock return

- Responses to 1st 4 innovations determine macro covariances; all else, residual covariances

Cholesky decomposition, early sample

	—Forecast Revisions—				Ex Ante —R. Rates—		10 Yr	
	GDP	$t+2$ GDP	π	$t+2$ π	3 Mon	1 Yr	Nom Yield	Ret
GDP, t	0.34							
GDP, $+2$	0.03	0.19						
π, t	-0.15	-0.34	0.61					
π,$+2$	-0.03	-0.23	0.28	0.28				
1 Quarter	0.65	0.04	-0.17	0.05	1.03			
1 Year	0.56	0.01	-0.07	-0.11	0.80	0.46		
10 Year	0.26	-0.15	0.17	0.01	0.37	0.29	0.35	
Stock Ret	1.49	1.42	-1.30	0.55	-1.27	-2.35	-0.18	7.64

Macro and residual covariance components, early sample

	Total Covar	——Forecast Revisions—— GDP	$t+2$ GDP	π	$t+2$ π	All Else
3 Mon R. Rate	-0.03	0.97	0.06	0.22	0.03	-1.30
1 Yr R. Rate	-1.19	0.84	0.02	0.10	-0.06	-2.07
10 Yr Nom Yield	-1.26	0.39	-0.21	-0.22	0.01	-1.22

Cholesky decomposition, late sample

	——Forecast Revisions——				Ex Ante		10 Yr	
		$t+2$		$t+2$	—R. Rates—		Nom	
	GDP	GDP	π	π	3 Mon	1 Yr	Yield	Ret
GDP, t	0.23							
GDP, $+2$	0.06	0.06						
π, t	0.09	-0.04	0.31					
π,$+2$	0.03	-0.02	0.10	0.10				
1 Quarter	0.18	0.06	-0.17	0.03	0.38			
1 Year	0.19	-0.01	-0.08	0.01	0.23	0.21		
10 Year	0.14	-0.03	0.07	-0.07	0.00	0.18	0.29	
Stock Ret	3.99	1.60	-1.16	-0.11	0.30	0.59	0.55	6.14

Macro and residual covariance components, late sample

	Total Covar	——Forecast Revisions—— GDP	$t+2$ GDP	π	$t+2$ π	All Else
3 Mon R. Rate	1.11	0.71	0.09	0.20	0.00	0.11
1 Yr R. Rate	1.00	0.74	−0.02	0.09	0.00	0.19
10 Yr Nom Yield	0.69	0.55	−0.05	−0.08	0.01	0.26

Are the macro covariances consistent with standard macro-finance models?

- Perhaps not
  - RA models, real rates move with news about expected growth, not news about current growth
- Example: Kung (JFE 2015), New Keynesian endogenous growth
  - NK endogenous growth generates negative relation between expected growth, inflation; problem for macro covariances with nominal yields

Kung (2015) model: simulated data, Cholesky decomposition

	——Forecast Revisions——				Ex Ante —R. Rates—		10 Yr Nom	
	GDP	$t+2$ GDP	π	$t+2$ π	3 Mon	1 Yr	Yield	Ret
GDP, t	1.16							
GDP, $+2$	0.01	0.19						
π, t	-0.10	-1.38	0.15					
π,$+2$	-0.41	-0.54	0.02	0.03				
1 Quarter	-0.30	1.08	-0.17	0.02	0.72			
1 Year	-0.07	0.45	-0.09	0.01	0.28	0.02		
10 Year	-0.26	-0.16	0.02	0.00	0.02	-0.04	0.02	
Stock Ret	2.91	1.17	-0.16	-0.10	-0.28	-0.01	0.26	0.42

Kung (2015) mode; macro and residual covariance components

	Total Covar	——— GDP	Forecast Revisions $t+2$ GDP	π	——— $t+2$ π	All Else
3 Mon R. Rate	0.40	-0.88	1.25	0.03	0.00	-0.20
1 Yr R. Rate	0.33	-0.21	0.53	0.01	0.00	-0.08
10 Yr Nom Yield	-0.94	-0.75	-0.19	0.00	0.00	0.00

Concluding comments

I continue to attempt to understand why the conditional covariance between aggregate stock returns and real, nominal bond yields varies over time