Discussion of "Monetary Policy Drivers of Bond and Equity Returns" by Campbell, Pflueger and Viceira

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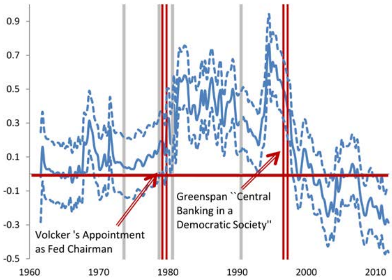
"Monetary Policy and Financial Markets"
Federal Reserve Bank of San Francisco, March 28, 2014

Summary

- Goal: Explain changes in Treasury betas

Panel A: CAPM Beta of 10 YR Nominal Bond



- New Keynesian model with regime shifts
- Add some bells and whistles

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Outline of the discussion

1. Discuss the bells and whistles
2. Look at parameter changes in the three regimes
3. Focus on one parameter: The persistence of monetary policy
4. Role of zero lower bound

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A reduced-form NK model

IS curve + optimal price setting + CB reaction function + CB inflation target

$$x_t = \rho^{x-} x_{t-1} + \rho^{x+} \mathrm{E}_{t-} x_{t+1} - \psi(\mathrm{E}_{t-} i_t - \mathrm{E}_{t-} \pi_{t+1}) + u_t^{IS}, \quad (12)$$

$$\pi_t = \rho^{\pi} \pi_{t-1} + (1 - \rho^{\pi}) \mathrm{E}_{t-} \pi_{t+1} + \lambda x_t + u_t^{PC}, \quad (13)$$

$$i_t = \rho^{i} (i_{t-1} - \pi^*_{t-1}) + (1 - \rho^{i}) \left[\gamma^{x} x_t + \gamma^{\pi} (\pi_t - \pi^*_t) \right] + \pi^*_t + u_t^{MP}, \quad (14)$$

$$\pi^*_t = \pi^*_{t-1} + u^*_t. \quad (15)$$

plus heteroskedastic errors:

$$\mathrm{E}_{t-1}[u_t u_t'] = \Sigma_u \times (1 - b x_{t-1})$$

Assets are priced by the Euler equation

$$-\alpha(s_t + c_t) = (i_t - \mathrm{E}_t \pi_{t+1}) - \alpha \mathrm{E}_t (s_{t+1} + c_{t+1}) + \frac{\alpha^2}{2} \sigma_t^2$$

$$s_t + c_t = x_t + \theta x_{t-1} - v_t$$

New bells and whistles:

- habit term x_{t-1} in the IS equation
- conditional variance changes over time as a function of output gap x_{t-1}

Role of heteroskedasticity

Crucial for asset prices: Need time-varying risk aversion and/or time-varying risk to generate time-varying risk premia

Campbell-Cochrane: time-varying risk via habit formation

Here: different mechanisms $\Rightarrow$ time varying risk

Assumption: $\mathrm{E}_{t-1}[u_t u_t'] = \Sigma_u \times (1 - bx_{t-1})$

Implications:

- Risk premia vary over time
- Risk premia depend *only* on output gap x_t
- All asset returns (equities, bonds, ...) are forecastable by the output gap x_t
- Moreover, the output gap x_t is the *best* forecasting variable, it should drive out all other variables ($p - d$, Cochrane-Piazzesi forward factor,...)
- Data: $\rho(x, p - d) = 0.18$, model: $\rho(x, p - d) = 0.47$

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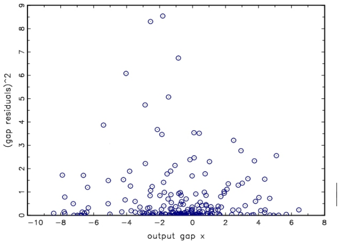
Does volatility depend on the output gap?

Simple check

$$x_t = c + \phi x_{t-1} + \epsilon_t$$

Plot ϵ_t^2 against x_{t-1}:



Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	2.521668	2.676976	0.941984	0.3462
AR(1)	0.965480	0.021097	45.76397	0.0000
Variance Equation				
C	0.039508	0.017848	2.213529	0.0269
RESID(-1)^2	0.216028	0.052857	4.087047	0.0000
GARCH(-1)	0.748540	0.047067	15.90371	0.0000
X(-1)	0.014992	0.005234	2.864445	0.0042

Given the importance of the assumption $E_{t-1}[u_t u_t'] = \Sigma_u \times (1 - b x_{t-1})$,
I would like see more direct evidence that variances vary with the output gap

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Regimes

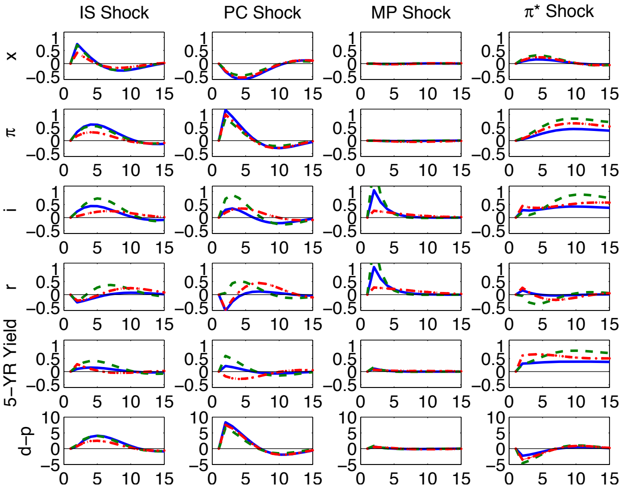
The paper identifies three regimes

Time-Invariant Parameters				
Log-Linearization Constant	ρ		0.99	
Leverage	δ		2.43	
Preference Parameter	α		30	
Backward-Looking Comp. PC	ρ^{π}		0.80	
Slope PC	λ		0.30	
Forward-Looking Comp. IS	ρ^{x+}		0.62	
Backward-Looking Comp. IS	ρ^{x-}		0.45	
Monetary Policy Rule		60.Q1-79.Q2	79.Q3-96.Q4	97.Q1-11.Q4
MP Coefficient Output	γ^{x}	0.42	-0.07	0.44
MP Coefficient Infl.	γ^{π}	0.69	1.44	1.92
Backward-Looking Comp. MP	ρ^{i}	0.56	0.43	0.89
Std. Shocks				
Std. IS	$\bar{\sigma}^{IS}$	0.45	0.43	0.26
Std. PC shock	$\bar{\sigma}^{PC}$	1.08	0.80	0.93
Std. MP shock	$\bar{\sigma}^{MP}$	1.04	2.03	0.26
Std. infl. target shock	$\bar{\sigma}^{*}$	0.37	0.70	0.53

Seven parameters are allowed to change!
$\Rightarrow$ difficult to follow all the moving parts (at least for me)

Regimes

Objectives: explain changes in Treasury betas ⇒ need to understand why stock and bond markets move in opposite directions post 1997



Asset prices across regimes

Asset returns depends on many factors:

- Bonds: expected inflation
- Equities: dividends (here equal to output gap x_t)
- Short term interest rate and expected interest rates
- Risk premium (here function of output gap x_t)

Moreover, the model is a reduced-from NK model with parameters that depend on other "deep" parameters

Alternative approach: Take a structural NK model and change one parameter at a time

Closer look at the persistence of monetary policy

All parameters contribute to changing asset prices, but CPV identify changes in the persistence of monetary policy as the most important one:

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MP Coefficient Infl.	γ^π	0.69	1.44	1.92
Backward-Looking Comp. MP	ρ^i	0.56	0.43	0.89

Nominal Bond Beta		60.Q1-79.Q2	79.Q3-96.Q4	97.Q1-11.Q4
MP Coefficient Output	γ^x	-3.92	-1.50	-1.37
MP Coefficient Inflation	γ^π	5.01	1.80	1.86
MP Persistence	ρ^i	-1.85	-1.91	-20.90
IS Shock Std.	$\bar{\sigma}^{IS}$	-0.56	-0.11	-0.09
PC Shock Std.	$\bar{\sigma}^{PC}$	3.43	3.87	5.25
MP Shock Std.	$\bar{\sigma}^{MP}$	-0.28	-0.33	-0.06
Infl. Target Shock Std.	$\bar{\sigma}^{*}$	-2.59	-3.42	-5.09

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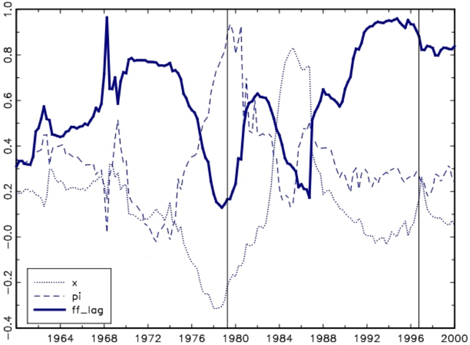
Closer look at the persistence of monetary policy

Anecdotal evidence: uncertainty about state of the economy is rationale for slow policy adjustment and this realization led Greenspan to adopt a more persistent monetary policy after the mid 1990s

Given the importance of the persistence of MP for asset prices in the model, let's look at this parameter in more detail:

$$i_t = c^0 + c^x x_t + c^\pi \pi_t + c^i i_{t-1} + \epsilon_t$$

Rolling regression with 12 years of data



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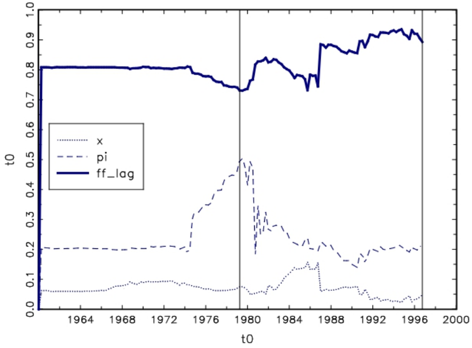
Closer look at the persistence of monetary policy

Backward regression using data from t_0 to 2011Q4:



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Closer look at the persistence of monetary policy

Bai-Perron break test (c^i only)

$$i_t = c^0 + c^x x_t + c^\pi \pi_t + c^i i_{t-1} + \epsilon_t$$

Sequential F-statistic determined breaks:	2
Significant F-statistic largest breaks:	2

Break Test	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	13.51772	13.51772	7.04
1 vs. 2 *	8.876417	8.876417	8.51
2 vs. 3	7.285502	7.285502	9.41
3 vs. 4	3.109413	3.109413	10.04
4 vs. 5	0.000000	0.000000	10.58

* Significant at the 0.10 level
** Bai-Perron (Econometric Journal, 2003) critical values.

Estimated break dates:
1: 1978Q1
2: 1978Q1, 1987Q1
3: 1978Q3, 1987Q1, 2001Q2
4: 1972Q2, 1979Q3, 1987Q1, 2000Q4
5: 1972Q2, 1979Q3, 1987Q1, 1994Q2, 2001Q3

MP reaction function appears to be unstable but breaks to do not coincide with regimes identified in the paper

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Zero lower bound

Open question: How does the zero lower bound affect the model?

- The model does not capture the ZLB (probably for good reason)
- Example: CB reaction function

$$i_t = c^0 + c^x x_t + c^\pi \pi_t + c^i i_{t-1} + \epsilon_t$$

- Interesting question: How does ZLB affect asset prices, risk premia, and asset betas?

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Summary

- The paper tackles an important question
- In finance, regime changes/parameter instability is often ignored
- Moreover, most of the literature models bonds and equity separately
- Important assumption: volatilities depend on out put gap
- The number of changing parameters makes it difficult to follow all the moving parts
- Do parameter changes coincide with the regimes assumed in the model?