Discussion of:
Nonlinearity and Flight-to-Safety in the Risk-Return Tradeoff for Stocks and Bonds
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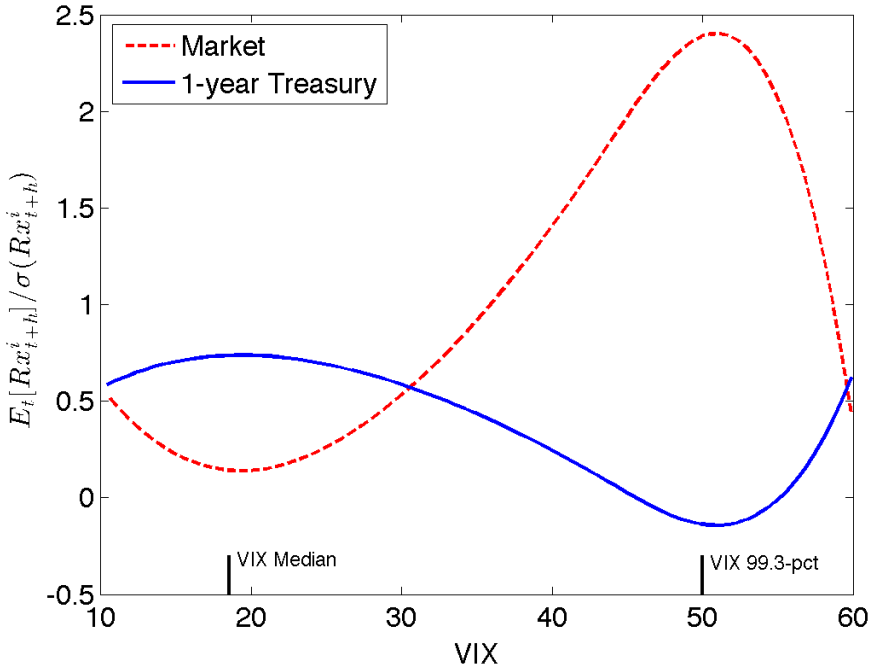
Overview



1. Literature is mixed on whether volatility predicts returns
   - although there is a strong, negative contemporaneous correlation
2. This paper finds a non-linear and non-monotonic relationship for equities and treasuries
3. Equity and treasury expected excess returns are mirror images

Estimation by sieve regression: how it works

Estimate expected h-period excess return function ϕ_h of VIX_t:

$$Rx_{t+h} = \phi_h(VIX_t) + \varepsilon_{t+h}$$

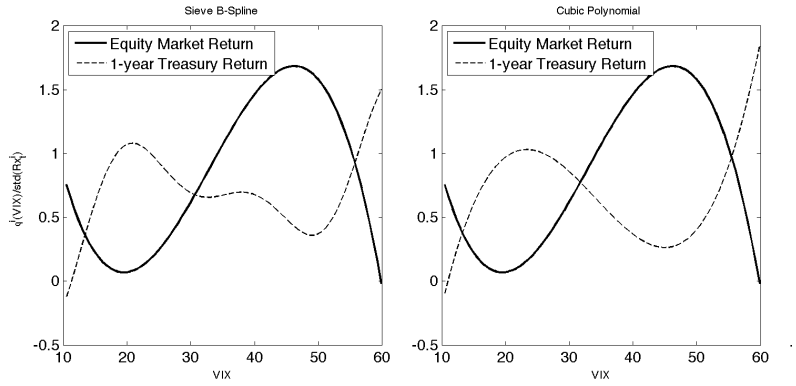
- using linear combinations of m B-splines:

$$\phi_{m,h}(VIX) = \Sigma_{j=1}^{m} \gamma_j \cdot B_j(VIX)$$

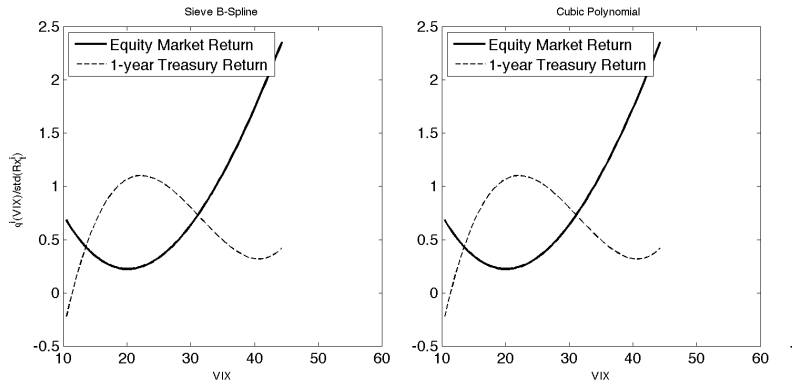
- let $m \to \infty$ slowly as sample size $T \to \infty$
- Nice and simple: estimate γ_j's by OLS on the $(m \times T)$ matrix with columns $[B_j(VIX_1), \ldots B_j(VIX_T)]'$, $j = 1 \ldots m$

Results very similar using cubic polynomials

$\phi_h^i(VIX)$ 1990:1 to 2014:9



$\phi_h^i(VIX)$ 1990:1 to 2007:7



- Using VIX, VIX^2, VIX^3 produces very similar estimates
- note: $VIX > 45$ only occurs in 2008/9

Estimates

1990 - 2007

Horizon h = 6

	(1) Linear VIX		(2) Nonlinear VIX		(3) Nonlinear VIX and Controls					
	a^i	b^i	a^i	b^i	a^i	b^i	f^i_{DEF}	f^i_{VRP}	f^i_{TERM}	f^i_{DY}
MKT	0.03	1.00	0.72	1.00	0.25	1.00	−0.03	−0.84*	0.00	0.12
cmt1	0.00	0.23**	−0.09	−0.16***	−0.15	−0.59***	0.01	0.03	0.00*	0.03***
cmt2	0.00	0.29	−0.16	−0.28**	−0.22	−0.92***	0.01	0.10*	0.00	0.03***
cmt5	0.01	0.30	−0.31	−0.53*	−0.34	−1.57***	0.00	0.25*	0.01	0.03*
cmt7	0.03	0.18	−0.36	−0.62*	−0.35	−1.75**	−0.01	0.31*	0.02	0.02
cmt10	0.04	−0.23	−0.37	−0.62	−0.32	−1.74*	−0.03	0.36*	0.02*	0.02

1990 - 2014

Horizon h = 6

	(1) Linear VIX		(2) Nonlinear VIX		(3) Nonlinear VIX and Controls					
	a^i	b^i	a^i	b^i	a^i	b^i	f^i_{DEF}	f^i_{VRP}	f^i_{TERM}	f^i_{DY}
MKT	−0.01	1.00	1.00*	1.00***	0.31	1.00***	0.05**	−1.42***	−0.01	0.17
cmt1	0.00	0.07*	−0.05*	−0.07***	−0.09**	−0.20***	0.00	0.03*	0.00*	0.02***
cmt2	0.01	0.09	−0.11*	−0.14***	−0.15*	−0.32***	0.00	0.08**	0.00	0.02**
cmt5	0.03	0.04	−0.26	−0.31***	−0.25	−0.60***	−0.02*	0.23**	0.01**	0.01
cmt7	0.04	0.04	−0.31	−0.38**	−0.27	−0.70***	−0.03**	0.32**	0.02**	0.00
cmt10	0.05	−0.08	−0.30	−0.37**	−0.25	−0.66**	−0.03**	0.39**	0.03***	0.01

- Linear only: insignificant for equities and treasuries
- Equity nonlinear: insignificant pre-crisis, significant in full sample
- Treasuries nonlinear: negative and significant
- Note that linear VRP (variance risk premium) is consistently significant
  - sign is correct given how it is defined (realized vol minus VIX)

Comments #1

1. convex relationship for *VIX* above its median is consistent with $E[R_{t+1}] = \gamma\sigma^2$
   - since increased σ_t raises both risk σ_t and risk price $\gamma\sigma_t$

2. Seemingly robust and surprising finding is low-VIX non-monotonicity

3. High-VIX non-monotonicity driven by single episode (fall 2008)
   - but important for finding predictability (Table 3, Figure 8)
   - difficult to rationalize investors knowingly accepting low return

4. Estimated relationship is consistent across treasuries and equities
   - but then not much added by using cross-section

5. Paper "controls" for VRP, but only in early
   - what about non-linearly?

   $\Rightarrow$ interesting to estimate predictability by VRP (or add realized variance as separate predictor)

Comments #2

1. How come VIX predicts six month returns but not 1 or 3 month returns?
   - plausible economic explanation?
   - VIX monthly persistence (AC1) is only 0.80
2. Negative treasury coefficient is consistent with precautionary savings
   - higher uncertainty $\rightarrow$ increased precautionary savings $\rightarrow$ lower r_f
   - impact on long maturities offset by increased term premium
3. Interesting to see how price of variance risk depends on VIX?
   - estimate $RVar_{t,t+1}/VIX_t^2 - 1 = \phi(VIX_t) + \varepsilon_{t+1}$

Final Remarks

- Findings are interesting and give much food for thought
  - non-monotonicity can explain 0 linear predictability
  - but what's a good story for non-monotonicity?
- Low-VIX non-monotonicity is a bigger puzzle than convexity
- Interesting to reconcile non-monotonicity with $corr(R_{t+1}, \Delta VIX) << 0$ ("leverage effect")