Discussion of:
Nonlinearity and Flight-to-Safety in the Risk-Return Tradeoff for Stocks and Bonds
by Tobias Adrian, Richard Crump, and Erik Vogt

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Literature is mixed on whether volatility predicts returns
- although there is a strong, negative contemporaneous correlation

This paper finds a non-linear and non-monotonic relationship for equities and treasuries

Equity and treasury expected excess returns are mirror images
Estimation by sieve regression: how it works

Estimate expected $h$-period excess return function $\phi_h$ of $VIX_t$:

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

• using linear combinations of $m$ B-splines:

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

• let $m \rightarrow \infty$ slowly as sample size $T \rightarrow \infty$

• Nice and simple: estimate $\gamma_j$'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

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

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<th>Horizon h = 6</th>
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<td><strong>1990 - 2007</strong></td>
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<td>(1) Linear VIX</td>
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- 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)
convex relationship for VIX above its median is consistent with \( E[R_{t+1}] = \gamma \sigma^2 \)

- since increased \( \sigma_t \) raises both risk \( \sigma_t \) and risk price \( \gamma \sigma_t \)

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

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

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

Paper “controls” for VRP, but only in early
- what about non-linearly?
  \[ \Rightarrow \text{interesting to estimate predictability by VRP (or add realized variance as separate predictor)} \]
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

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

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 \( \text{corr}(R_{t+1}, \Delta VIX) << 0 \) (“leverage effect”)