Discussion of:

“Forecasting the price of crude oil via convenience yield predictions”

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Question?

• Can a focus on marginal convenience yields, $\gamma(t)$, improve the forecasts of future crude oil prices?
  – Comparison with FMH and random walk models
  – Multiple performance criteria
  – Numerous forecast horizons
  – Test are employed to determine if forecasting accuracy differences are statistically significant

• So what are convenience yields?
Expected Net Return on Investment

Equities:
\[
\frac{Ep(t + 1) - p(t) + Ed(t)}{p(t)} = (\rho_s + r)
\]

Commodities:
\[
\frac{Ep(t + 1) - p(t) + E\psi(t,1)}{p(t)} = (\rho + r)
\]

\[
p(t) = \delta \sum_{i=0}^{\infty} \delta^i \psi(t + i,1) \quad \text{with} \quad \delta = 1/(1 + r + \rho)
\]
Bias in Futures Prices

\[ FMH : Ep(t + 1) = f(t,1) \]

\[ E\psi(t,1) = (1 + \rho + r)p(t) - Ep(t + 1) \]

\[ E\psi(t,1) = (1 + r)p(t) - f(t,1) \]

*Alternative Benchmark:* \[ Ep(t + 1) = f(t,1) + \rho \cdot p(t) \]
Calculating Convenience Yields

\[ E\psi(t, T) = (1 + r_T) p(t) - f(t, T) \quad \forall T \]

\[ E\psi(t + T, 1) = E\psi(t, T + 1) - (1 + \mu)E\psi(t, T) \quad \forall T \]

\[ \Rightarrow \{E\psi(t + T, 1)\}^N_{T=0} \]
Forecasting model based solely on market expectations of convenience yields

\[ p(t + h) = \delta \sum_{i=0}^{\infty} \delta^i E\psi(t + h + i) \quad \text{with} \quad \delta = 1/(1 + r + \rho) \]
Main Models

• Models: together with PV equation,
  – \( E_m ? (t,T)'s \) from cost of carry relationship
  – Estimate AR(p) model of \( ? (t,T)'s \)
  – Univariate model of \( ? (t,T+h) \) with \( ? (t-k,1) \)
  – Combined model

• Benchmarks:
  – RWA: \( E_p(t+T) = \) current spot price
  – Futures market hypothesis: \( E_p(t+T) = f(t,T) \)
Forecasting Exercise

• Complete, Robust
  – Many alternatives compared to accepted benchmarks
  – A number of forecast accuracy criteria
  – Different estimation and evaluation periods
  – Lag length criteria

• Findings
  – Proposed models out-forecast FMH
  – RW not statistically significantly outperformed
  – Proposed models out-performs a coin-flip in predicting the future direction of crude oil prices
Estimating the Risk Premium

\[ f(t,1) - (1 - \rho) p(t) \]

- Campbell and Shiller (1987)
- Is this difference stable in the long-run?
  - Only if \( \kappa(t) \) is I(1)
  - Pindyck (1993) finds that \( \kappa(t) \) is stationary
  - AR(p) model, \( \kappa(t) \) is stationary

\[ E\psi(t) = (1 + r) p(t) - f(t,1) \]
Additional Variable to Consider: Inventories

• Brennan (1958)
  – Risk premia vary with inventories

• Reliable data over same sample period
  – e.g., American Petroleum Institute’s weekly bulletin

• Khan, Khokher and Simin (2006)
  – Convenience yields and inventories are related