Discussion of:

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

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Question?

- Can a focus on marginal convenience yields, ? (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: $$\frac{Ep(t+1) - p(t) + Ed(t)}{p(t)} = (r_s + r)$$

Commodities: $$\frac{Ep(t+1) - p(t) + Ey\ (t,1)}{p(t)} = (r + r)$$

$$p(t) = d\sum_{i=0}^{\infty} d^i Ey\ (t+i,1) \quad with \quad d = 1/(1+r+r)$$

Bias in Futures Prices

$$FMH : Ep(t+1) = f(t,1)$$

$$Ey(t,1) = (1 + r + r)\,p(t) - Ep(t+1)$$

$$Ey(t,1) = (1 + r)\,p(t) - f(t,1)$$

$$\begin{matrix} Alternative \\ Benchmark \end{matrix} : Ep(t+1) = f(t,1) + r \cdot p(t)$$

Calculating Convenience Yields

$$Ey\,(t,T) = (1+r_T)\,p(t) - f\,(t,T) \quad \forall T$$

$$Ey\,(t+T,1) = Ey\,(t,T+1) - (1+m)Ey\,(t,T) \quad \forall T$$

$$\Rightarrow \left\{Ey\,(t+T,1)\right\}_{T=0}^{N}$$

Forecasting model based solely on market expectations of convenience yields

$$p(t+h) = d \sum_{i=0}^{\infty} d^{\,i} E y\,(t+h+i) \quad \textit{with} \quad d = 1/\left(1+r+r\right)$$

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
  - Univatiate model of ? (t,T+h) with ? (t-k,1)
  - Combined model
- Benchmarks:
  - RWA: Ep(t+T) = current spot price
  - Futures market hypothesis: Ep(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

$$f(t,1) - (1 - r)\,p(t)$$

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

$$Ey\,(t) = (1+r)\,p(t) - f(t,1)$$

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