# Surprises, sentiments and the expectations hypothesis of the term structure of interest rates

by

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# Motivation

- Test the Unbiased Expectations Hypothesis (UEH)
  - $R_{t+1} = \alpha + \beta F_{t+1,t} + u_{t+1}$
  - $H_0: \alpha = 0 \cap \beta = 1$

- Re-specify the model to stationary variables
  - Under the null: $R_{t+1} = F_{t+1,t} + u_{t+1}$
  - Add and subtract $R_t$: $(R_{t+1} - R_t) = \left(F_{t+1,t} - R_t\right) + u_{t+1}$
  - $\Delta R_{t+1} = FP_{t+1,t} + u_{t+1}$ where $FP_{t+1,t}$ is the Forward Premium

- Estimated Model
  - $\Delta R_{t+1} = \alpha + \beta FP_{t+1,t} + u_{t+1}$

- Existing Literature: Typically rejects $H_0$
- This Paper (Table 1): Reject using 3 month forward US (Libor and Treasury) Rates over the 1998-2010 time period

# Objectives of the Paper

- Explain why $FP_{t+1,t}$ is not an unbiased predictor of $R_{t+1}$ by accounting for:
- **Omitted variables**
  1. Term Premium $= F_{t+1,t} - E(R_{t+1}|I_t)$: Compensation required by investors to hold long-term bonds relative to the return generated by rolling a series of short-term bonds (since Forward rates are a function of long- and short-term spot rates term premium shows up here)
  2. Expectation Error $= E(R_{t+1}|I_t) - R_{t+1}$

     - Term Premium and Expectation Error are unobservable
     - Try to related TP and EE to macroeconomics shocks and sentiment

- **Parameter instability**
  1. Preliminary test for structural breaks – Bai and Perron (2003) test dates the timing of possible breaks
  2. Time-varying parameters estimated using Kalman Filter
     - Try to relate time-varying $\alpha$ and $\beta$ to macroeconomics shocks and sentiment

# Some Findings

- Constant Coefficient Model (Table 6)
  - $\Delta R_{t+1} = a + b\left(F_{t+1,t} - R_t\right) + c\left(E(R_{t+1}|I_t) - F_{t+1,t}\right)$
    $+d(E(R_{t+1}|I_t) - R_{t+1}) + \varepsilon_{t+1}$
  - $\Delta R_{t+1} = a + b\left(F_{t+1,t} - R_t\right) + c\theta_t^* + d\delta_{t+1}^* + \varepsilon_{t+1}$
  - $\delta_{t+1}^*$ - ex-post expectation error computed as $(f_{t+1,t} - R_{t+1})$, where $f_{t+1,t}$ is the Libor 3 month contract
  - $\theta_t^*$ - Term Premium computed using Kalman filter from
    $(F_{t+1,t} - R_{t+1}) = \theta_t^* + \delta_{t+1}^* + \xi_{t+1};\ \theta_t = \varphi\theta_{t-1} + \zeta_t$ (notes to Tbl 6. p.32)
- Findings
  - $H_0: \alpha = 0 \cap b = 1 \cap c = 0 \cap d = 0$ rejected based on individual $t$ −tests (p.23)
  - $H_0: \alpha = 0 \cap b = 1$ rejected based on individual $t$ −tests
- Questions:
  - Why not report $F$ −statistics?
  - Besides being marked to market how is $f_{t+1,t}$ different from $F_{t+1,t}$??

# Some Findings

- Extend the model to estimate time-varying parameters (Table 3)
  - Several specifications estimated…. one of which is

$$\Delta R_{t+1} = a_t + b_t\left(F_{t+1,t} - R_t\right) + c_t\theta_t^* + d_t\delta_{t+1}^* + \xi_{t+1}$$

  - $\theta_t^*$ - Term Premium computed using Kalman filter from
    $(F_{t+1,t} - R_{t+1}) = \theta_t^* + \delta_{t+1}^* + \eta_{t+1}$
    where $\theta_t = \varphi\theta_{t-1} + \zeta_t$ (pg.13. line 7.)

- Findings:
  - Significant departures of $a_t$ and $b_t$ from 0 and 1 during the periods of the doc.com bubble collapse (March 2000-June 2002) and subprime crisis (Nov 2007-June 2009)
  - Individual $t$ –tests using $\bar{a}_t$ and $\bar{b}_t$ don't reject $H_0: E(a_t) = 0$ and $H_0: E(b_t) = 1$
  - Question: Can you do a joint test?

# Some Findings

- Table A1: Try to explain $\theta_t^*$ and $\delta_{t+1}^*$ with using
  - *Sent* - a measure of *market sentiment*
  - *U_PC* - a variable measuring *macroeconomic shocks*

- Findings
  - $\delta_{t+1}^*$ (EE) positively related to *Sent,* and negatively related to *U_PC*
  - $\theta_t^*$ (TP) no significant relation with *Sent* or *U_PC*

# Some Findings

- Table 4 relates time variation in $\alpha_t$ and $\beta_t$ to
  - *Sent* - a measure of *market sentiment*
  - *U_PC* - a variable measuring *macroeconomic shocks*

1. $\Delta R_{t+1} = a_t + b_t FP_{t+1,t} + \xi_{t+1}$
   - $a_t$ negatively related to *Sent* and positively to *U_PC* , $b_t$ positively related to *Sent* no relation with *U_PC*
2. $\Delta R_{t+1} = a_t + b_t FP_{t+1,t} + c_t \theta_t \ + \xi_{t+1}$
   - Both $a_t$ and $b_t$ positively related to *Sent,* no relation with *U_PC*
3. $\Delta R_{t+1} = a_t + b_t FP_{t+1,t} + c_t \theta_t^* + d_t \delta_{t+1}^* + \xi_{t+1}$
   - No relation between $i)$ $a_t$ and $b_t$ and $ii)$ *Sent* and *U_PC*

- Questions:
  - Could this be interpreted as a specification test?
  - Can it imply that the model is misspecified? E.g. Make $a_t, b_t = f$ (*Sent* and *U_PC)* and see if $c = d = 0$
  - Why not do more conventional specification tests on the constant coefficient model?