No-Arbitrage Macroeconomic Determinants of the Yield Curve

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Affine Term Structure Models

- Affine term structure models (Duffie & Kan (1996), Dai & Singleton (2000, 2002), Duffee (2002)) have been quite successful in explaining bond pricing features.
  - State prices are functions of the state vector s_t.
  - The structure of the pricing kernel m_t is such that bond yields can nicely be written as affine functions of the state vector:

$$r_t^{(n)} = \frac{A(n)}{n} + \frac{B(n)^\top}{n} s_t.$$

  - Rotations are especially convenient. Can recast the state variables into level, slope, curvature, etc.
  - Essentially affine models have been especially useful in fitting the data.
- What are the latent state variables s_t?

Presumably macroeconomic variables....

Monetary Policy Models

- Equilibrium models w/ nominal rigidities can teach us quite a bit about monetary policy.
- Example - A New-Keynesian Model (Clarida, Galí & Gertler (1999))
  - Households (Aggregate Demand) - consume and supply labor.
  - Production Section (Aggregate Supply) - nominal rigidity introduced (monopolistic competition plus staggered price setting).
  - Fiscal Policy - induces supply shocks.
  - Monetary Authority (Policy Rule) - could be optimally derived to maximize household welfare or could be reduced form (Taylor (1993)-like rules) pinning down the short-rate:

$$r_t = \tau_0 + \tau_1 \times \text{Output Gap} + \tau_2 \times \text{(Inflation - Target)} + \tau_3 \eta_t .$$

- Typically, the only financial data used is the short-rate.

Why throw away the information in the rest of the yield curve?

Merging The Two...

1. Reduced-Form - Append a Taylor-like policy rule to an affine term-structure model.
   - Ang & Piazzesi (2003), Ang, Dong, & Piazzesi (2005), Dai & Philippon (2004), Chun (2005), Bikbov & Chernov (2006)
   - Central bank policy rule variables become observable state variables in the term-structure model.
     - From Taylor (1993), the output gap & inflation are natural candidates.
   - “Rotations” are again useful to map the short-rate into a policy rule (perhaps forward looking).
2. Fully Structural - Append a term-structure model to a “risky” macro model with nominal rigidities.
   - Rudebusch & Wu (2003), Bekaert, Cho, & Moreno (2004), Ravenna & Seppala (2004), Gallmeyer, Hollifield, & Zin (2005), Palamino (2006), etc.

What Does This Paper Deliver?

- How to get the most out of the observable state variables in an affine term-structure model with both observable and latent state variables.
- Projection Method
  1. Estimate the term structure model with both observable & latent variables.
  2. By identifying the econometrician's data set as the history of the observables, dynamically project the latent factors onto the macro factors.
  3. The projection residuals represent shocks that are orthogonal to the information in the macro factors.
  4. Can then analyze the role of macro factors when their explanatory power is maximized.
- Related to Duffee (2005) who does a partial term-structure estimation.

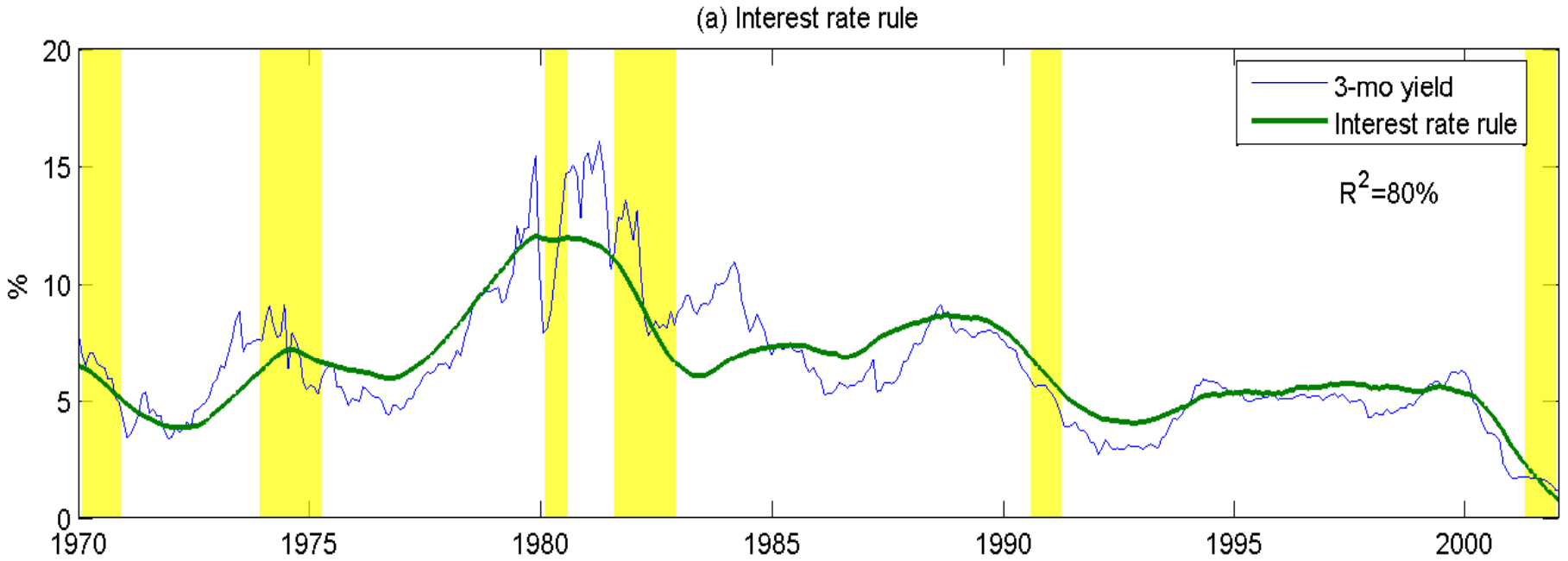
Results Using a Real Activity & Inflation Factor

- Estimate a 4 factor essentially affine model (2 macro & 2 latent).
  - Real activity & inflation explain 80% of the short rate's variation.
  - The two latent factors are correlated with the budget deficit & market liquidity.
  - The latent factors are important in explaining both ends of the yield curve.
  - Decompose the term premiums.
    - Inflation & liquidity shocks provide the most explanatory power at any maturity.
  - Decompose violations of the expectations hypothesis.
    - Inflation & fiscal shocks contribute the most to violations.

Comments/Suggestions

- Very thorough.
- Minor Stuff
  - Data - 1970-2002. Switch to quarterly to use earlier data?
  - How do candidate macro factors perform in an estimation?
    - Public gov't. debt growth should be a state variable in a structural model with fiscal shocks....
  - Forecasts?
- Deeper Questions
  - Regimes?
  - Taylor Rule Interpretations?
- Lucas Critique?

Regimes?



- Quite a bit of evidence on regimes both in policies & bond data.
- Possible paths:
  - Inflation-targeting regimes.
  - Liquidity regimes.

Taylor Rule Interpretations?

$$r_t = \tau_0 + \tau_1 \times \text{Output Gap} + \tau_2 \times (\text{Inflation - Target}) + \tau_3 \eta_t.$$

- Fed Funds relative to the short end of the yield curve?
- Appropriate measures of the output gap?
- Modeling the Inflation Target? Is a constant appropriate?
- Exogenous policy shocks via changing regimes (liquidity).