Alternative (?) Perspective on Fixed Income Markets

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Academic Dynamic Term Structure Literature

- Traditional academic literature on dynamic term structure models (DTSM) typically:
  - Writes down Multi-factor, multi-state variable, multi-parameter, preferably quadratic-affine jump diffusion model for some latent variables under some Risk-neutral Pricing measure,
  - Derives analytic solution for ”arbitrage-free” bond prices and derivatives.
  - Specifies some complex risk-premium structure (Change from Q to P-measure).
  - Uses complex empirical techniques to estimate the model parameters and state variables from bond prices or swap rates.

    (Vasicek (1978), Langetieg (1981), Duffie and Kan (1996), Chen Scott (1993), Pearson and Sun (1991), Duffie and Singleton (1997), Dai and Singleton (2000), Duffee (2001)...)
- Typically finds that more (at least three) factors is better than less to describe term structure cross-section and dynamics, but difficult to discriminate across various models.

Recent Developments in Academic DTSM literature

- Turn to other data sources to extract information about models:
  - Combine derivatives data with term structure data:
    - more informative for higher moments/volatility
  - Use macro-economic data:
    - to interpret latent variables
  - Use intra-day high-frequency data
    - to pin down higher order moments (volatility, jumps) model independently
    - to study microstructure of announcement effects

Why might DTSM be useful?

- Trading strategies:
  - Curve trades (Picking rich vs. cheap bonds)?
  - Optimal bond portfolios?
- Price and hedge derivatives
- Macro-economics:
  - to inform macro-policy
  - to help predict macro-variables
- Financial economics:
  - analyze the risk-return trade-off (risk-premia).

Using DTSM for trading strategies

- Curve (slope, butterfly, condor…) trades.
  - Over-fitting (many local optima),
  - Parameters are not stable across time,
  - Definition of latent State variables are changing.
- Optimal bond portfolios:
  - Variance covariance matrix is too restrictive (degenerate)
  - In three factor model, three bond portfolio is sufficient.

$\Rightarrow$ DTSM not widely used (successfully?).

Using DTSM for pricing and hedging derivatives

- Traditional DTSM all imply pricing by replication, because model bond markets as complete and therefore derivatives are redundant:
  - Much larger number of bonds are traded than factors (Brownian motions) driving the term structure
  - Relatively simple volatility structure

  $\Rightarrow$ Any shock to derivative prices should be a shock to some bond portfolio.
- Evidence?
  - Collin-Dufresne and Goldstein (2002) find evidence for *Unspanned Stochastic Volatility* using Cap-Floor data:
    - Find low R^2 in the regression of ATM straddle returns on swap changes
    - volatility specific (unspanned) factors.
  - Heidari and Wu (2002) find similar evidence for swaption data
- Q? Are these findings inconsistent with absence of arbitrage?

- A! Not necessarily, if bond markets are incomplete. In other words, if we can replicate derivative payoff using dynamic trading strategy then derivative prices should not exhibit USV.
- Andersen and Benzoni find evidence for volatility specific factors looking only at bond markets (i.e., without looking at derivatives data). Reassuring!
- Q? What might be economic sources of USV?
  - Demand/supply imbalance (market segmentation?) in derivatives/underlying is a candidate:
    - Duarte finds that heding activity of MBS can decouple derivative prices from their underlying.
    - Proposes a model where actual swap rate volatilities are functions of mortgage refinancing activity and prices swaption using risk-neutral pricing.
      (But is this consistent with his empirical results?)
- Seems important to incorporate demand/supply factors (market "technicals") that might introduce dislocation in relation between derivatives and their underlying at times. But can we do it within standard risk-neutral pricing framework?
  - Bond market incompleteness seems necessary (but absent of most standard DTSM).

Macro-economics

- Difficult to link latent variables to macro-fundamentals.
- Typically latent factors which are combination of yields drive out macro factors (‘explaining yields with yields’).
- Bikbov Chernov approach takes different stand and maximizes explanatory power of macro variables:
  - Does it help better forecast future changes in term structure using forecasted changes in macro-variables?
  - Can we use the model to understand how macro-annoucements will propagate through the term structure?
- Practitioner issues with this literature:
  - contemporaneous as opposed to predictive
  - low-frequency (monthly or quaterly) data
  - not real time (i.e, ex-post revisions).

Financial Economics

- DTSM can help us understand risk-return tradeoff:
  - Do long maturity bonds earn higher return than short maturity bonds on average?
  - Are bond expected returns predictable?
  - Is volatility risk priced? (Is there a premium to selling options)
  - Is correlation risk-priced? (Is there a premium to dispersion trades)
- Problem with ubiquitous market price of risk in academic literature:
  - More and more complex specification of MPR to fit the data (over parametrized).
  - Resulting market price of risk is highly time-varying and very large, but quite imprecisely estimated (expected return!).
  - What/whose risk are we talking about? (not the correlation between bond returns and aggregate consumption!).
  - Model mis-specification vs. beta vs. alpha?

Conclusion

- for yield curve trading strategies:
  - simpler models (less parameters),
  - interpretable/physical state variables,
  - more robust out of sample
- for derivatives pricing and hedging:
  - for sophisticated interpolation and hedging use HJM or string models (sell side).
  - understand economic sources of USV/market incompleteness, segmentation in markets? inefficiencies? (buy side)
- macro-economics:
  - macro-annoucement studies,
  - forecasting
- financial economics
  - Get serious about the market price of risk