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.

- 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.

⇒ 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
⇒ 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 hedging 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-announcements will propagate through the term structure?
- Practitioner issues with this literature:
  - contemporaneous as opposed to predictive
  - low-frequency (monthly or quarterly) 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
• Importance of Institutional Features for pricing
  – Basis swaps (Collateral?)
  – Marking to Market