Much ado about nothing: A study of differential pricing and liquidity of short and long term bonds

Netspar IPW, 2017

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Motivation

• European pension funds and insurers managed more than EUR 3.5 trillion worth of assets in 2015

• One of the key inputs for their risk, and asset and liability management is the long term discount rate

• Very few academic studies examine or model the long end of the term structure
  • Specifically, long maturity government bonds (>10 yrs)
Research question

• Are yields of long-maturity bonds distorted by
  • demand pressure of clientele investors?
  • regulatory effects?
  • or default, flight-to-safety or liquidity premiums?

• We study the differential pricing and liquidity of short and long maturity bonds

• We focus on showing whether the bond market is segmented and if so, how large these segmentation effects are
Methodology

• Data on German nominal bonds between 2005 and 2015

• Construct a measure of differential liquidity
  • Noise similar to Hu, Pan and Wang (2013) separately for short and long maturities (20 years to maturity)
  • Other, marketwide and bond issue level liquidity measures

• Time series regressions to test the differential pricing of liquidity and segmentation along the yield curve
Findings

• We find statistically significant, but economically negligible segmentation effects in yields and some degree of liquidity segmentation
  • Effects are typically in the ballpark of 1-3 basis points

• Policy implication
  • Solvency II and ultimate forward rate discussion
  • Long maturity bond yields might be appropriate for the valuation of long-term liabilities after all
    • Much ado about nothing...
Market and liquidity segmentation

- Why would prices and/or liquidity differ across maturities?
  - Market segmentation: some investors do not have access to the overall yield curve
    - Due to regulatory constraints or endogenous choice of investment horizon
  - If local demand shocks are accompanied by limited arbitrage capital, pricing inefficiencies cannot be eliminated and become persistent
  - If short and long maturity bonds are exposed to risk factors to a different extent, different levels of risk premiums will emerge
Market and liquidity segmentation

• Factors that can lead to segmentation
  • Clientele or preferred habitat
    • Vayanos and Vila (2009), Greenwood and Vayanos (2010), etc.
  • Demand pressure
    • regulatory changes
    • flight-to-safety flows
    • unconventional monetary policies, e.g. LSAP and QE
  • Risk premiums
    • Liquidity: level or risk
    • (Sovereign) default

• Liquidity segmentation
  • Cross-sectional differences in liquidity premium
  • Due to different holding periods (Amihud and Mendelson, 1986)
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All present in the nominal bond segment of Germany between 2005 and 2015
Data

• German nominal capital market securities
  • Prices, yields and characteristics (size of an issue, age, ttm)

• Controls:
  • Risk free curve: EONIA and euro swap curves
  • KfW agency bonds and German generic yield
  • SCDS: Germany, periphery countries
  • Asset side of ECB balance sheet
  • Ted spread, VIX, DAX
  • Primary dealer transaction volumes from Finanzagentur
Measuring segmentation

  - Measure of bond liquidity
  - Deviation from a theoretical smooth curve
  - Related to available arbitrage capital

- Separate measures for short and long yields
  - Below and above 20 ytm

- Curve fitting
  - Nelson-Siegel with fixed tau
  - Fitted on short and extrapolated for long maturities
Noise measure – curve fitting

Short end (below 20 ytm)

Long end (above 20 ytm)
Noise measure – time series

• Difference along the curve
  • Average short noise: 7.91 bps
  • Average long noise: 19.39 bps

• Do German noise measures proxy for liquidity?
  • Short measure relates to age market and funding liquidity
  • Long is correlated with bond issue level illiquidity and the US noise measure
  • However, they go beyond traditional measures of liquidity
Segmentation effects: the bias

- Bias is the ‘structural distortion’ of long term bond yields
  - Absolute deviations from the extrapolated curve
  - On average -9.25 bps, but rages between -47 and +25 bps
    - Persistently negative!
  - Why are long yields too low?
    - Bias correlates with the Roll measure, time to maturity of bonds, liquidity risk, Ted spread, flight-to-safety flows and the credit risk of Germany
Segmentation effects: yield decomposition

• Ideal empirical setting:
  • Cross-sectional pricing tests
  • But too small cross-section!

• Instead we decompose yields similar to Krishnamurthy et al (2015)
  • Yields contain the following distinguishable components:
    • Risk free component and term premium – maturity-matched Euro or EONIA swap rate
    • Liquidity premium – corresponding noise measure
    • Demand pressure – time trend for regulation, flight-to-safety from CDS, ECB asset growth
    • Default premium – breakup risk (KfW spread)
    • Potential other convenience yields – other segment’s noise measure, other liquidity proxies, volatility, etc.

• Separate decomposition of short and long yields
Segmentation effects: yield decomposition

• Results:
  • Short yields:
    • ECB demand pressure: 1% growth increases yields by 0.28 bps
  • Long yields:
    • Noise measure is important with economic effect of 1 bps: large pricing error leads to decreased prices
  • Both:
    • FTS: affects the whole curve, 3 bps is periphery credit quality decreases
    • Default premium but more for long end: 0.96 vs 1.84 bps, but safe haven CDS premium!
    • Intercept insignificant: variables capture general negative trend in yields
Liquidity implications

• Yields and liquidity
  • Could liquidity have a differential effect on short vs. long-term bond yield?
    • Time series variation
      • Spillovers along the curve
    • Effect of liquidity dry-up: financial crisis
  • Results
    • Short end: short noise measure (0.92 bps) and funding liquidity (1.71 bps)
    • Long end: long noise (0.89 bps), spillover from short end (0.75 bps)

• Liquidity segmentation
  • Could the pricing of liquidity be different in the short and long ends?
    • No formal cross-sectional tests
  • Results:
    • Short noise is driven by ECB LSAPs, changes in stock market volatility and flight-to-safety flows.
    • Long noise is driven by safe haven flows, declining credit quality of the issuer, and breakup risk
Comparison of NS and UFR curves

• NS is our proposed curve
  • Based on bond market data
  • Fitted up to 20 ytm
  • Simply extrapolated beyond the last liquid point (20 ytm)

• UFR curve
  • Provided by DNB
  • Derived from German interest swaps
  • Converges to 4.2% (reaches it around 100 ytm)
  • Used for ALM (regulator)
Comparison of NS and UFR curves

- **Swap premium**
  - 25-30 bps capturing counterparty risk and illiquidity of certain swap maturities

- **Increasing difference for long maturities**
  - Large effect for liability valuation, especially for funds with long-maturity liabilities!

Yield curve on February 23, 2015

- UFR shifted
- NS extrapolated
Liability valuation

• Thought experiment
  • 2 pension funds that pay out EUR 100 over 60 years period
  • Participants start contribution at 25, start receiving pension at 65 and die at 85.

• Steady state fund
  • Older fund
  • Balanced participant in and outflows
  • Pays out the same amount every period

• Young fund (e.g. IT sector)
  • Initial participants are between 25 and 50
  • Payouts start after 15 years
  • Reaches steady state after 35 years
Liability valuation

- Examine the effect of different yield curves for valuation of liabilities
  - UFR: higher values, especially for long-term liabilities
  - NS: lower discount rates based on market data

- Present value calculation
  - Steady fund: 14.5% difference
  - Young fund: 28.3% difference!!!

- Impact on the funding ratio can be substantial
  - Similar in magnitude to those stemming from fluctuations of funding ratios due to market returns and interest rate changes
Policy discussion

• Three crucial issues of the UFR method:

1. How to fit and extrapolate the yield curve (beyond the last liquid point)?

2. Where to set the last liquid point?

3. Which information should we use to determine long-term discount rates?
Policy discussion

• Three crucial issues of the UFR method:
  1. How to fit and extrapolate the yield curve (beyond the last liquid point)?
    Our approach: We offer a simple method to fit a smooth curve and extrapolate beyond a pre-specified point.
  
  2. Where to set the last liquid point?
    Our approach: We follow the Solvency II discussion and set it at 20 years to maturity. However, this is subject to debate and further research should be done to determine where to set the ’segmentation’ point.
  
  3. Which information should we use to determine long-term discount rates?
    Our approach: Our results suggest that long maturity bond yields might be appropriate for the valuation of long-term liabilities - especially if the distortion in long yields due to segmentation is smaller than risk premiums in observable swap quotes.
Summary

• We study the differential pricing and liquidity of short and long maturity bonds looking for signs of market segmentation

• Data on German nominal bonds between 2005 and 2015

• Construct a measure of differential liquidity
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Summary

• We find statistically significant, but economically negligible segmentation effects in yields and liquidity
  • Effects are typically in the ballpark of 1-3 basis points

• Policy implication
  • Long maturity bond yields might be appropriate for the valuation of long-term liabilities after all
    • Much ado about nothing...
    • Wealth effects of the current valuation method?
Thank you for your attention!