Actuarial Research Centre

Institute and Faculty of Actuaries

Actuarial Research Centre (ARC)

PhD studentship output

The Actuarial Research Centre (ARC) is the Institute and Faculty of Actuaries' network of actuarial researchers around the world. The ARC seeks to deliver research programmes that bridge academic rigour with practitioner needs by working collaboratively with academics, industry and other actuarial bodies.
The ARC supports actuarial researchers around the world in the delivery of cutting-edge research programmes that aim to address some of the significant challenges in actuarial science.

Modelling the Liquidity Premium on Corporate Bonds

Paul van Loon (*), Andrew J.G. Cairns, Alex McNeil

Heriot-Watt University

& The Actuarial Research Centre (ARC) (**)

Alex Veys

Partnership

Acknowledgements: (*) PhD funding from Partnership and the ARC. (**) The ARC is funded by the Institute & Faculty of Actuaries and by industry co-sponsors including Partnership.

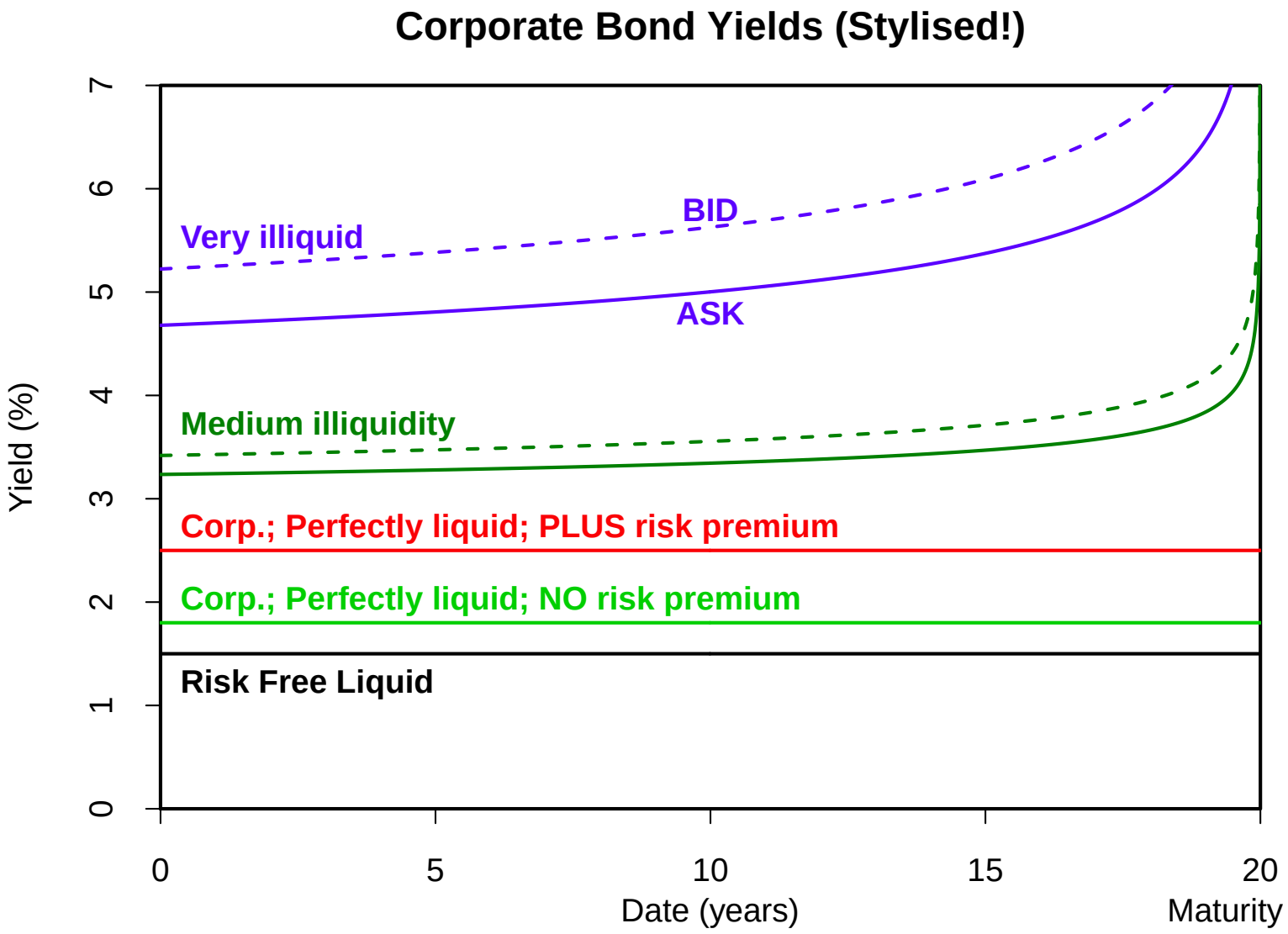
Plan

- The problem
- Stylised decomposition of bond prices and spreads
- Modelling the Bid-Ask Spread
- Modelling the Credit Spread
- Discussion

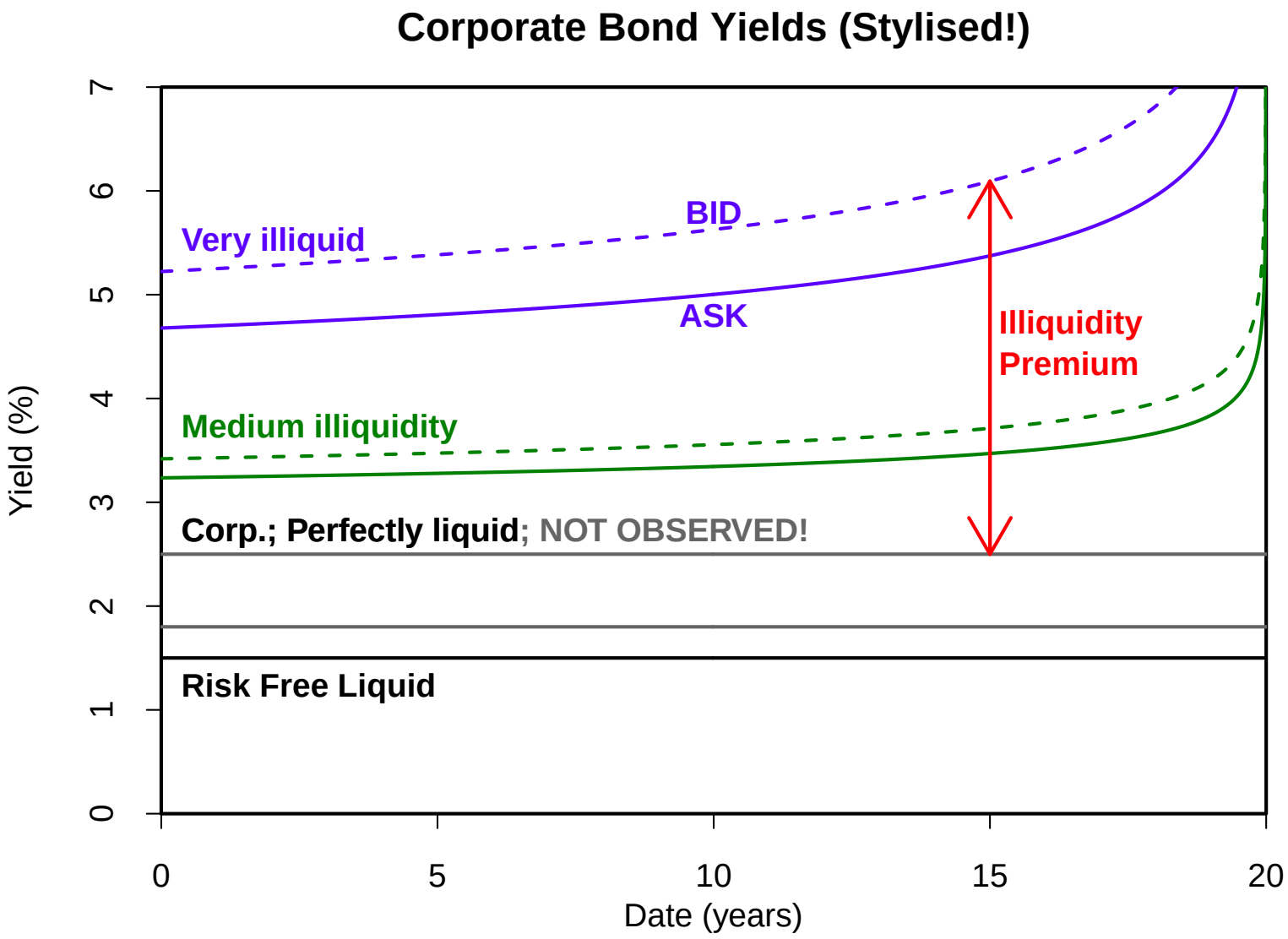
The problem

- How to decompose the credit spread on a corporate bond?
  - Expected default and rerating losses
  - Risk premium for default/rerating risk
  - Illiquidity premium
  - Other factors
- Hold to maturity *versus* sell before maturity
- Impact on liability valuation

Equivalent Bond Yields



Illiquidity Premium (LQP)



Data

Markit: GBP investment grade corporate bonds

- Daily from 2003 to 2013 ($\approx 2500 \times 1000 \times 50 = 125$million items)
- Contractual data:

  e.g. coupon rate, maturity, issuer, seniority etc.
- Unpredictable, time dependent data
  - Bid and Ask prices (quotes not transactions!)
  - Credit rating
  - Credit spread
  - etc.

Modelling Summary

Stage 1:

- Model the Bid-Ask spread as a function of various inputs
- Output: Relative Bid-Ask Spread for each bond (RBAS)

Stage 2:

- Model the Credit-Spread as a function of various inputs

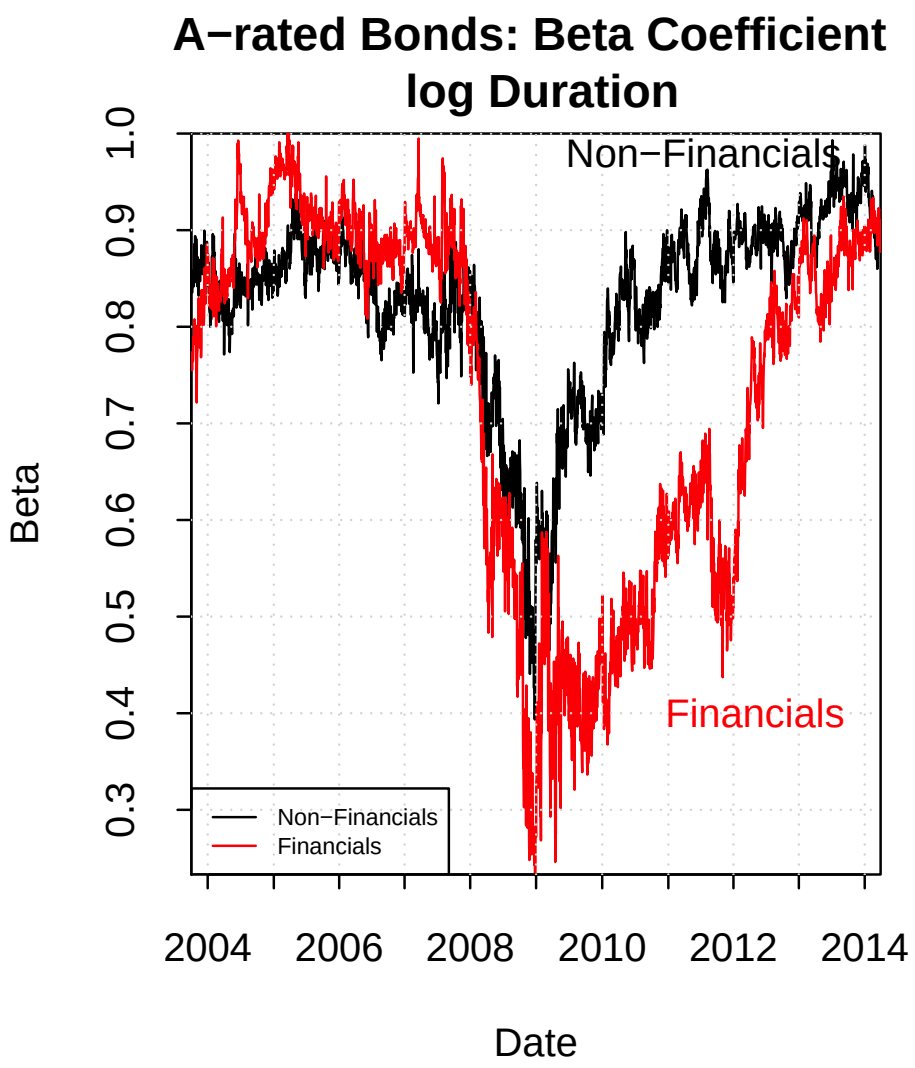
Stage 3:

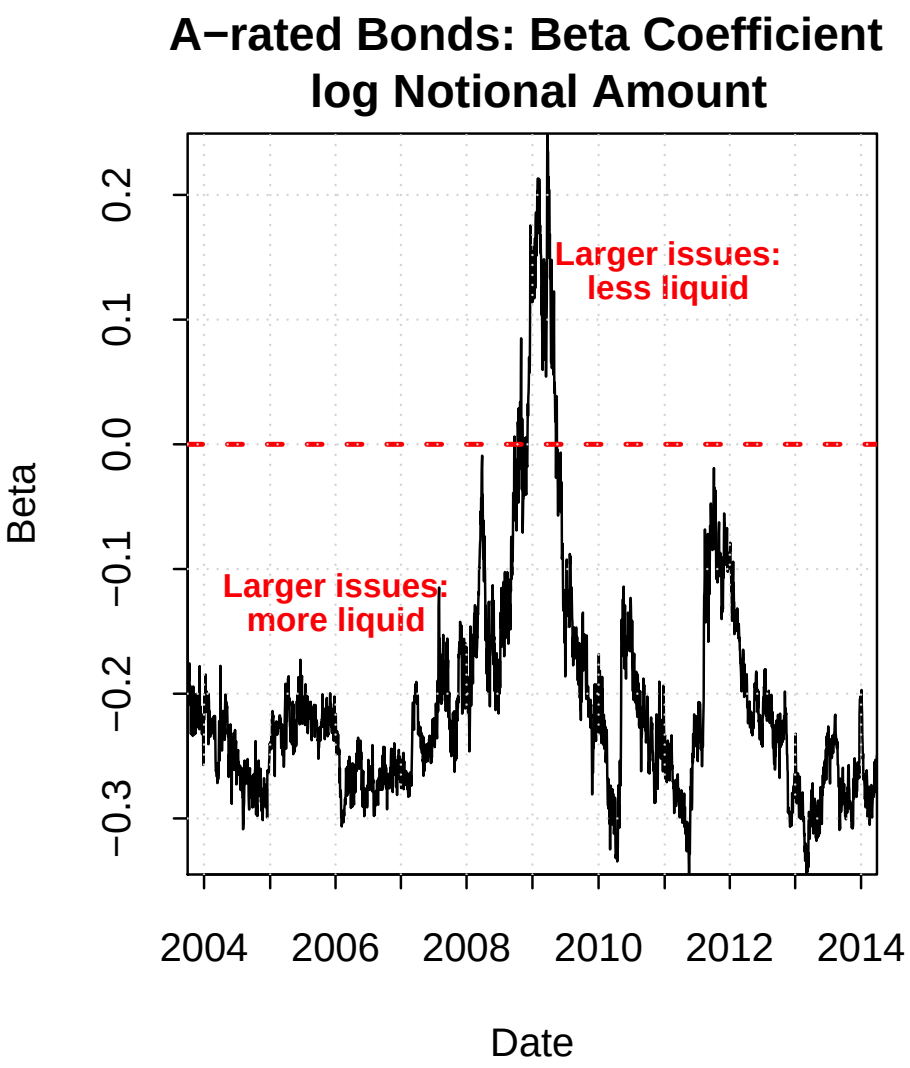
- Estimate the price of each bond as if it was perfectly liquid
- Difference in yield $=$ illiquidity premium

Bid-Ask Spreads (BAS): Time t, Bond i, Rating $r \equiv r(i,t)$

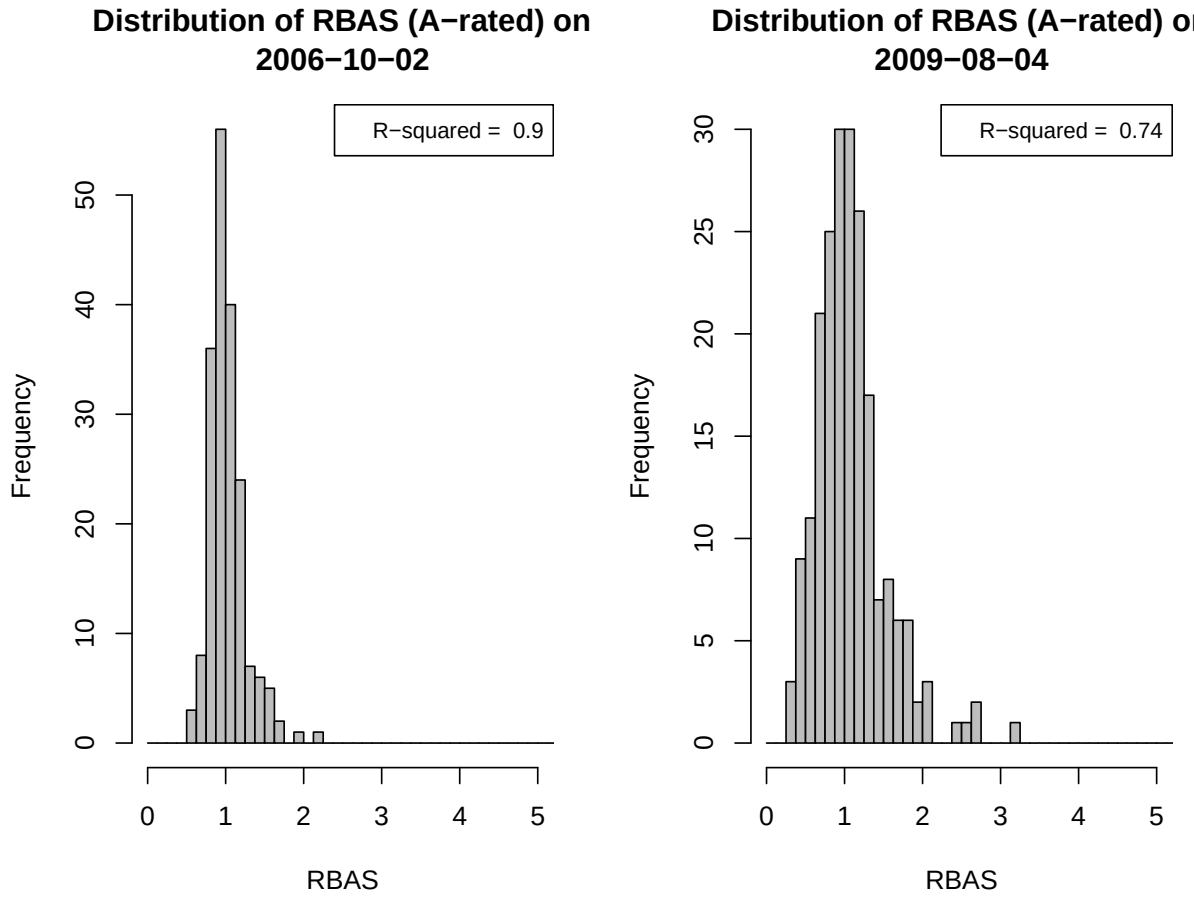
$$
\begin{aligned}
BAS(i,r,t) &= (\text{Ask Price} - \text{Bid Price})/\text{Bid Price} \\
I_X(i,t) &= \text{characteristic X indicator: } 0 \text{ or } 1 \\
\log BAS(i,r,t) &= c(r,t) \\
&\quad + \beta_{1,F}(r,t) \times \log \text{duration}(i,t) \times I_{Fin}(i) \\
&\quad + \beta_{1,NF}(r,t) \times \log \text{duration}(i,t) \times I_{NF}(i) \\
&\quad + \beta_2(r,t) \times \log \text{notional}(i,t) \\
&\quad + \sum_k \beta_k(r,t) \times I_k(i,t) \\
&\quad + \log RBAS(i,t) \qquad \text{(residual).}
\end{aligned}
$$

Indicators: Financials; Sovereign; Senior; Collateralised; Bond age ...





x-axis: e.g. "2008"' means 1 January 2008



e.g. $RBAS = 2 \Rightarrow BAS$ is $2\times$ the predicted BAS

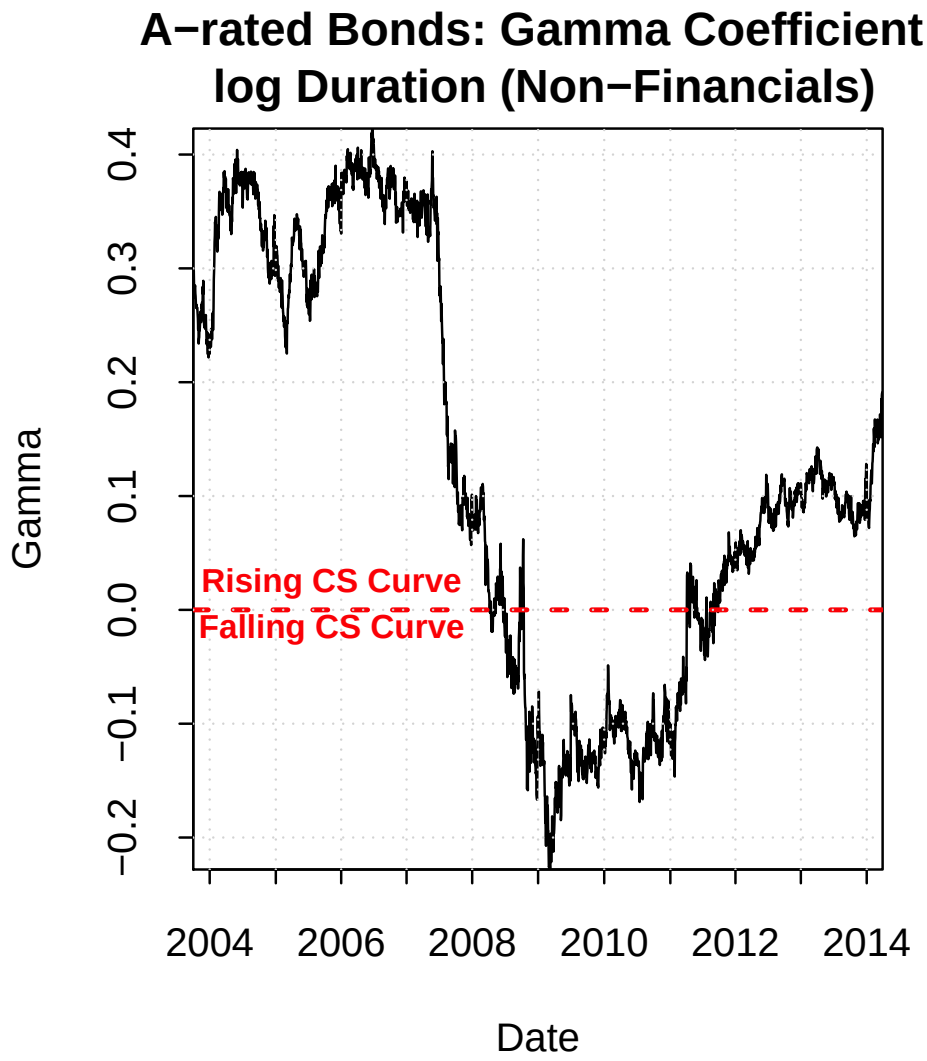
$RBAS = 0 \Rightarrow BAS = 0$; perfectly liquid

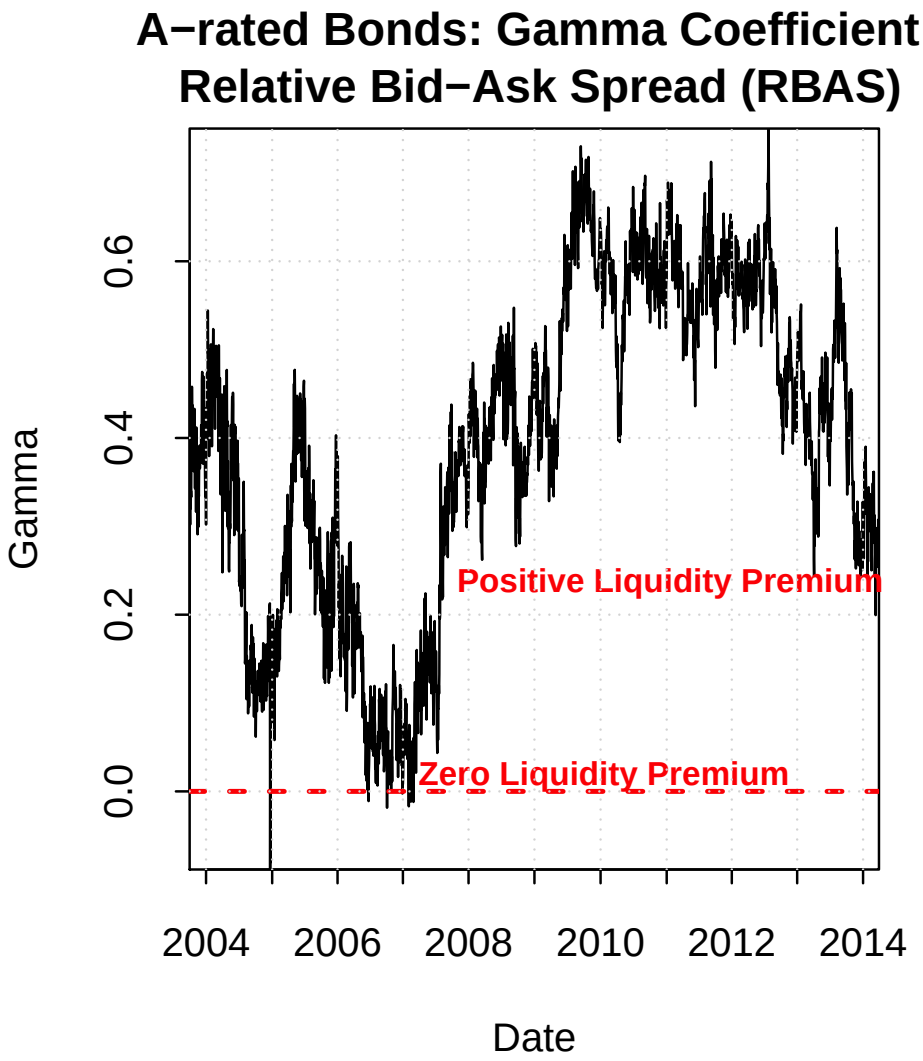
$RBAS$ uncorrelated with inputs

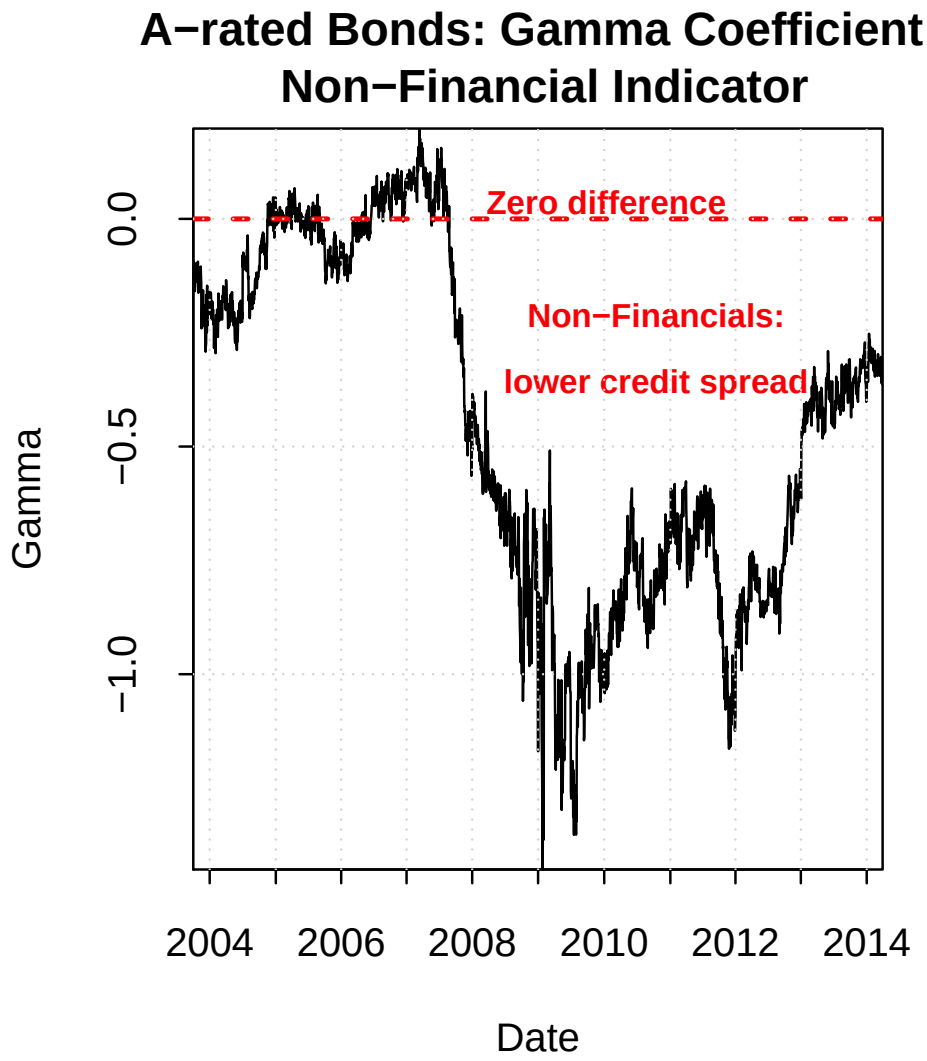
Credit Spreads

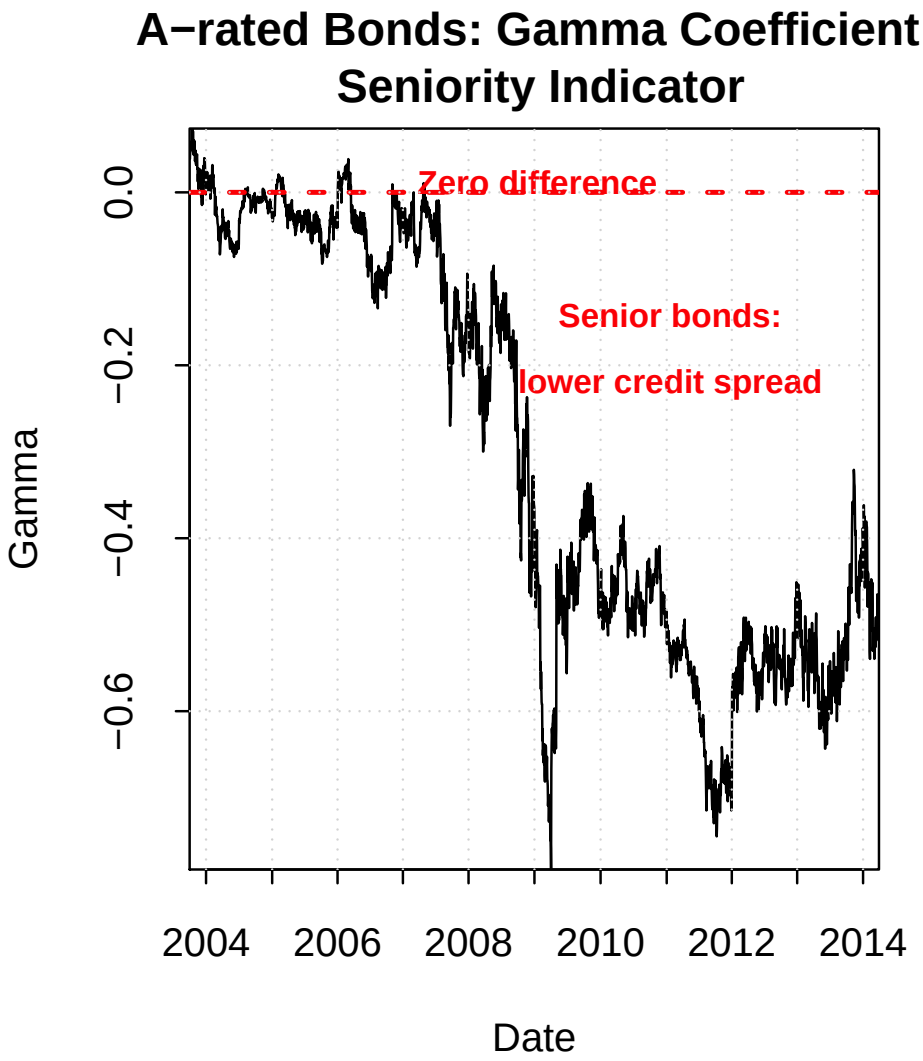
$$
\begin{aligned}
\log CS(i,r,t) \;=\; & d(r,t) \\
& + \gamma_1(r,t) \times \log \text{duration}(i,t) \\
& + \gamma_2(r,t) \times \text{RBAS}(i,t) \\
& + \gamma_3(r,t) \times I\left(\text{bond age}(i,t) < 1\right) \\
& + \gamma_4(r,t) \times \text{coupon}(i,t) \\
& + \sum_k \gamma_k(r,t) \times I_k(i,t) \\
& + \epsilon(i,t) \qquad \text{(residual).}
\end{aligned}
$$

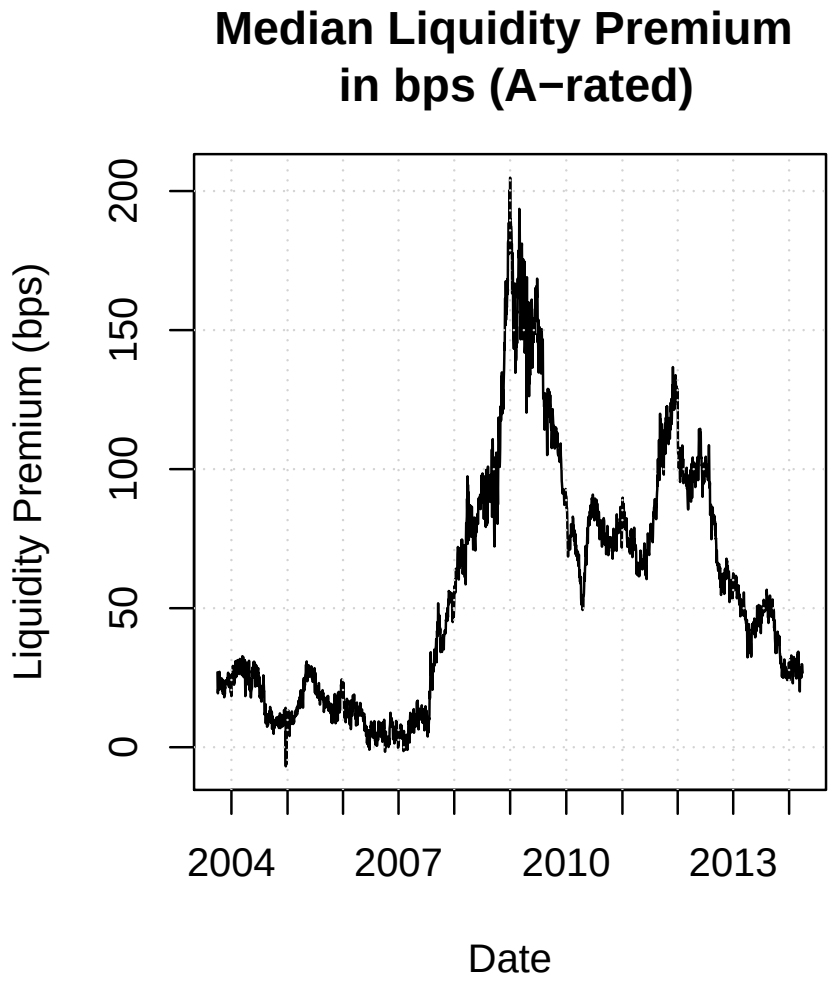
Indicators: Financials; Senior; Collateralised;...

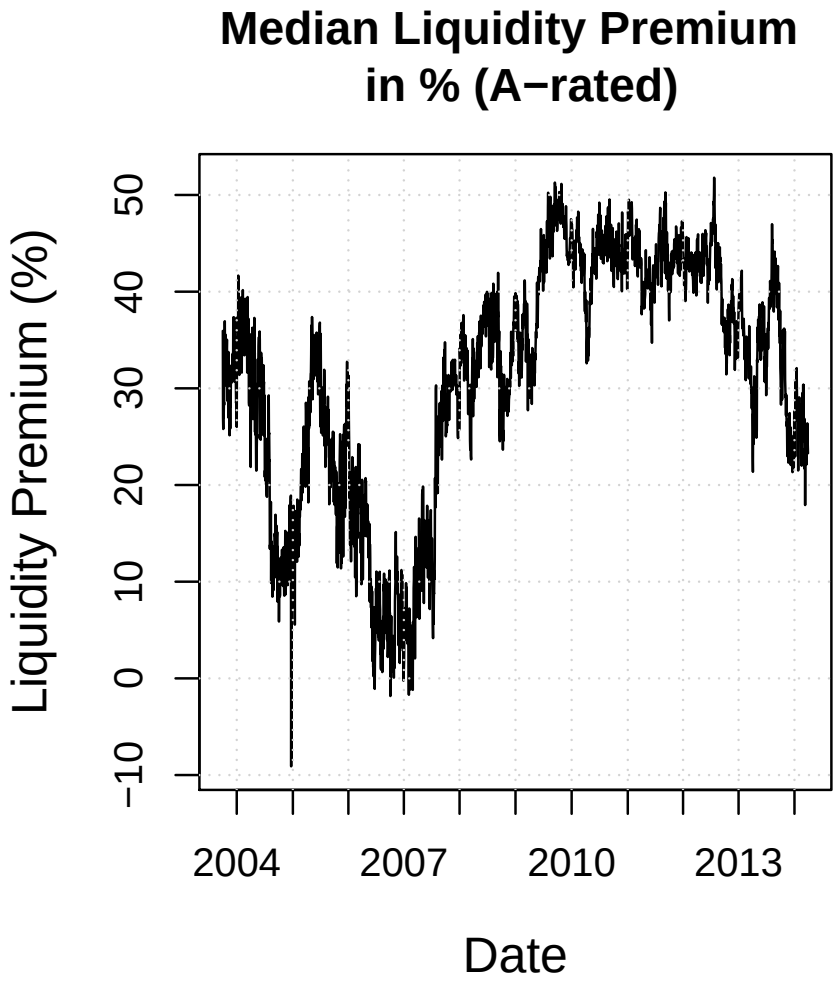

A−rated Bonds: Gamma Coefficient
log Duration (Non−Financials)
Gamma
0.4
0.3
0.2
0.1
0.0
−0.1
−0.2
Rising CS Curve
Falling CS Curve
2004
2006
2008
2010
2012
2014
Date


A−rated Bonds: Gamma Coefficient
Relative Bid−Ask Spread (RBAS)
Gamma
0.6
0.4
0.2
0.0
Positive Liquidity Premium
Zero Liquidity Premium
2004
2006
2008
2010
2012
2014
Date


A−rated Bonds: Gamma Coefficient
Non−Financial Indicator
Zero difference
Non−Financials:
lower credit spread
Gamma
0.0
−0.5
−1.0
2004
2006
2008
2010
2012
2014
Date


A−rated Bonds: Gamma Coefficient
Seniority Indicator
Zero difference
Senior bonds:
lower credit spread
Gamma
0.0
−0.2
−0.4
−0.6
2004
2006
2008
2010
2012
2014
Date


Median Liquidity Premium
in bps (A−rated)
Liquidity Premium (bps)
0
50
100
150
200
2004
2007
2010
2013
Date


Median Liquidity Premium
in % (A−rated)
Liquidity Premium (%)
−10
0
10
20
30
40
50
2004
2007
2010
2013
Date

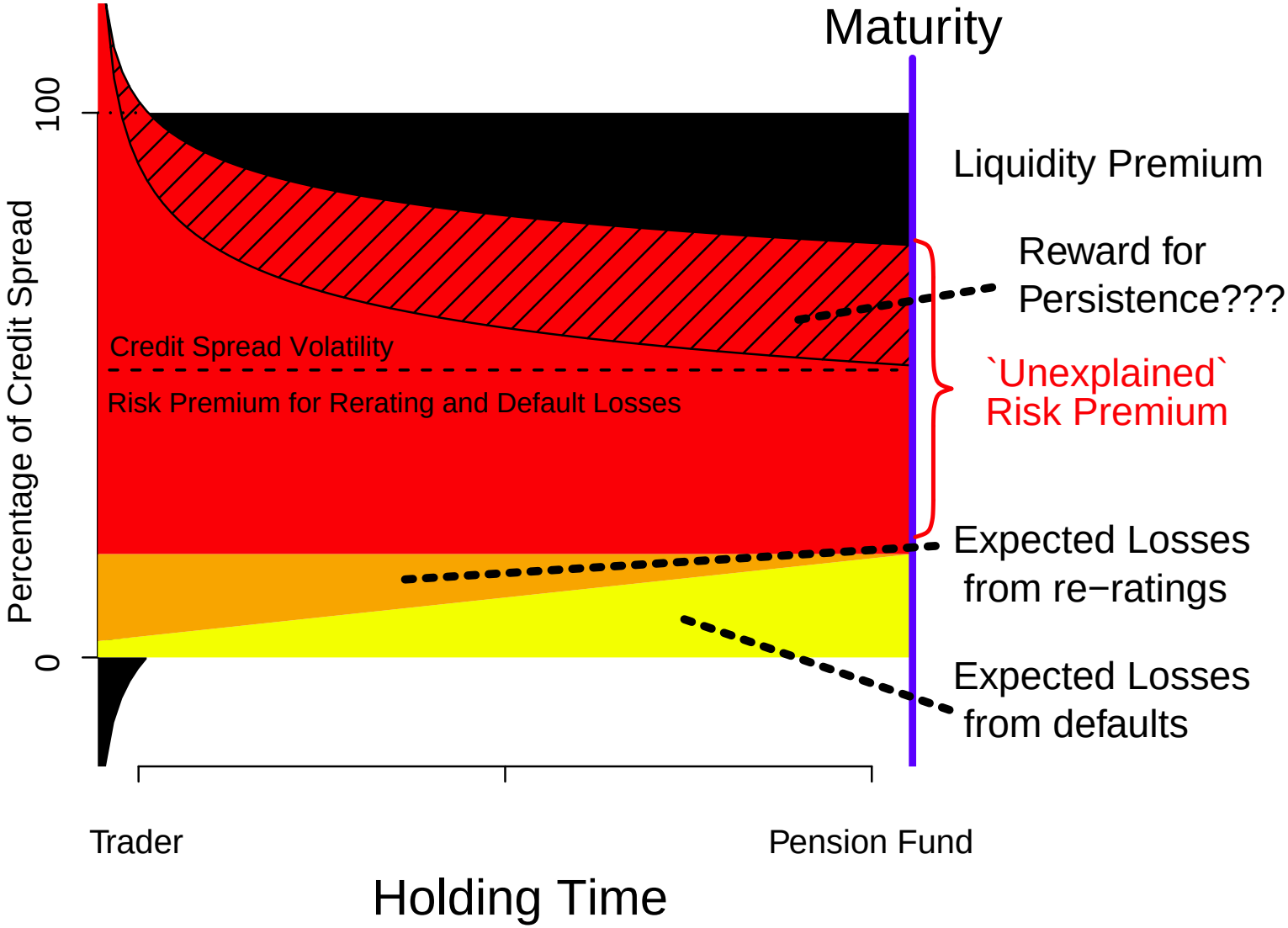
Observations

- Method applies to all quoted bonds on individual basis
- Objectivity: Method requires no subjective inputs
- Parameter estimates are robust
- Parameter dynamics consistent with market events
- Illiquidity premium (LQP) *as a percentage of credit spread*
  - Varies considerably: between bonds; over time; rating
  - e.g. A-rated bonds during 2011:

    Median $LQP \approx 40\%$; 10% quantile $\approx 32\%$; 90% $\approx 55\%$
  - More generally: LQP ranges from 20% to $> 70\%$
  - Exception: much lower just before Northern Rock collapse

Discussion: Holding Time

Decomposing the Credit Spread (Stylised)



Discussion and Future Work

- Markit data: quotes, not actual transactions
- Ongoing work:

  Compare *hold-to-maturity* with *sell-on-BB-downgrade*:

  How much of the Illiquidity premium do we sacrifice?