The Actuarial Profession
making financial sense of the future

Liquidity and Investment Strategy

Andrew D Smith and Grigory Spivak

21 November 2011

Liquidity and Investment Strategy

- Why illiquidity matters in investment
- Estimating illiquidity premiums
- Quantifying illiquidity costs
- The reward for illiquidity
- Hedging and replication arguments without liquidity
- Implications for Economic Scenario Generators
- Conclusions

The relevance of illiquid assets

- Insurers and pension funds have historically held significant portfolios of illiquid assets such as corporate bonds and property
- Developments in banking regulation (Basel III) render assets such as private equity, asset-backed securities and infrastructure investments less attractive to banks than they once were.
- Banks now target insurers and pension funds as possible buyers, but is this a good buy?

2

Arguments for and Against Illiquidity Premiums

- Sellers argue that illiquid assets carry an inherent return premium for illiquidity, which represents a free lunch for long term hold-to-maturity investors.
- Sceptics argue that as institutional funds also hold cash and gilts, then at the margin they are indifferent between liquid and illiquid assets.
- The free lunch vanishes because the illiquid asset prices are bid up to a level that puts a minimal price on their illiquidity.
- Difficult to determine if this has happened or not, because any ex ante estimate of illiquidity premiums depends on estimates of uncertain cash flows ....

3

Liquidity and Investment Strategy

- Why illiquidity matters in investment
- Estimating illiquidity premiums
- Quantifying illiquidity costs
- The reward for illiquidity
- Hedging and replication arguments without liquidity
- Implications for Economic Scenario Generators
- Conclusions

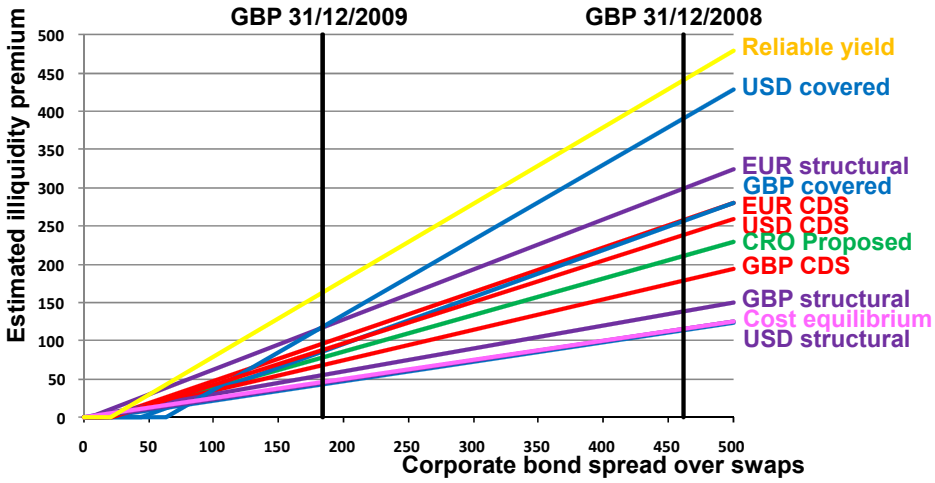
4

No Perfect Tool to Estimate Illiquidity Premiums

Method	Description	Chief Limitations
Cross sectional regression	Regress bond spreads against measures of credit risk and illiquidity	Relies on credit ratings and accounting ratios to be measures of credit risk (and not illiquidity risk). Requires vast data.
Illiquidity cost equilibrium	Equilibrium investment choices relates spreads to historic default and illiquidity costs, allowing for illiquidity cost nonlinearity.	Need description of representative investor illiquidity cost function. Assumes investor rationality.
Asset swap spreads	Bank sells an illiquid asset to a long term investor and swaps back total return for LIBOR + illiquidity premium	Infrequent trades. Also reflects credit risk of joint bank / collateral failure.
Covered bond	Yield on government guaranteed corporate bonds compared to government issued bonds.	Few bonds exist in most currencies, and these bonds are often quite liquid so attract a low illiquidity premium.
Reliable yield	Bond spread minus “prudent” (ie 2x) historic defaults	Premium for uncertainty in defaults counted as illiquidity premium.
Structural model	Bond spread less theoretical value of put option to default	Illiquidity premium counts missing elements in option pricing model (transaction costs, jumps, stochastic, volatility)
CDS basis	Bond spread minus CDS spread	Illiquidity premium estimate includes counterparty credit risk on CDS and ignores illiquidity priced into CDS itself.

5

Different Illiquidity Premium Estimation Methods Linear Regression against Yield Spreads



Source: CRO forum risk free calibration / Deloitte calculations.

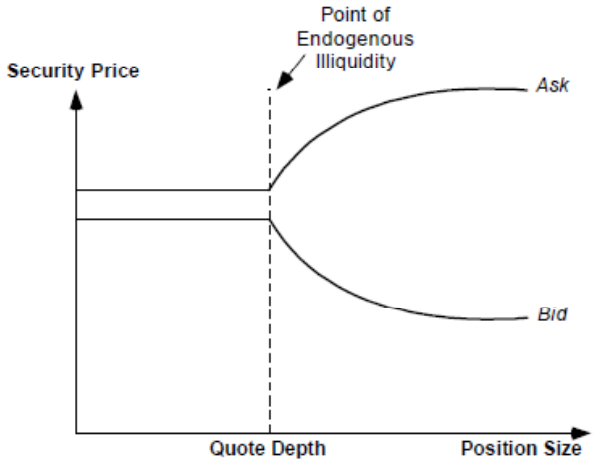
6

Liquidity and Investment Strategy

- Why illiquidity matters in investment
- Estimating illiquidity premiums
- Quantifying illiquidity costs
- The reward for illiquidity
- Hedging and replication arguments without liquidity
- Implications for Economic Scenario Generators
- Conclusions

7

Exogenous and endogenous illiquidity



This graph is taken from: "Modelling Liquidity Risk, With Implications for Traditional Market Risk Measurement and Management", by Anil Bangia, Francis X. Diebold, Til Schuermann and John D. Stroughair

8

Understanding causes for illiquidity

Low liquidity is typically associated with high bid-ask spreads. In most markets, there is a dealer or market maker who sets the bid-ask spread, and there are three types of costs to that the dealer faces that the spread is designed to cover:

1. The Inventory Rationale
2. The Processing Cost Argument
3. The Adverse Selection Problem

9

Incorporating liquidity costs into the VaR model

A simple approach is proposed in the following paper: "Modelling Liquidity Risk, With Implications for Traditional Market Risk Measurement and Management", by Anil Bangia, Francis X. Diebold, Til Schuermann and John D. Stroughair

A standard parametric 99% VaR for mid-value asset values assuming Normal distribution of asset return and 0 expected returns:

$VaR = P_t \times [1 - e^{-2.33\sigma 1}]$

The exogenous cost of liquidity based on a certain average spread S plus a multiple of the spread volatility, $a \times \sigma_2$, to cover 99% of the spread situations will be approximately:

$\frac{1}{2} P_t (S + a \times \sigma_2)$

So the total adjusted VaR is simply:

$adjVaR = P_t \times [1 - e^{-2.33\sigma 1}] - \frac{1}{2} P_t (S + a \times \sigma_2)$

10

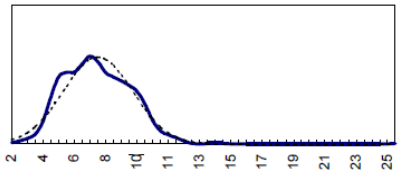
Assumptions

- 99^{th} percentile of the assets mid-price movement corresponds to the 99^{th} percentile of the spread movement
- We need to calibrate a distribution for spread movements from the market data

11

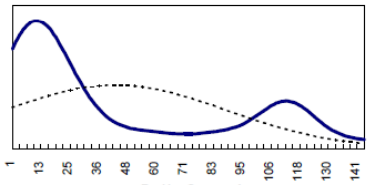
Distributions of spreads

Daily Spread Distribution for Japanese Yen
5/95 - 5/97



Daily Spread

Daily Spread Distribution for Indian Rupee
5/95 - 5/97



Daily Spread

These graphs are taken from: "Modelling Liquidity Risk, With Implications for Traditional Market Risk Measurement and Management", by Anil Bangia, Francis X. Diebold, Til Schuermann and John D. Stroughair

12

Bid-Offer Spread Magnitude

Bid-offer spreads tend to be lower on securities that

- Have higher daily trading volumes
- Safer (higher rated)
- Have higher market capitalisation

13

Determinants of Bid-Offer Spread

Academic studies find that spreads are correlated negatively with:

- the price level,
- volume
- number of market makers,

and positively with volatility and level of institutional activity on a stock.

Markets with high volatility are typically associated with a greater "information differential" and greater uncertainty about future information.

There may be a perception on the part of market makers that institutional investors tend to be informed investors with more or better information.

14

Determinants of Bid-Offer Spread

Bid-Offer spreads also seem to depend on how the specific stock exchanges are organised.

Comparison of NYSE and NASDAQ bid-offer spreads.

Difference: There is a designated specialist for each stock on the NYSE who is directly responsible for maintaining a reasonable level of liquidity whereas there is no such designated dealer on NASDAQ.

Result: NYSE specialist system provides better liquidity than the NASDAQ dealer system in volatile periods and in thin markets.

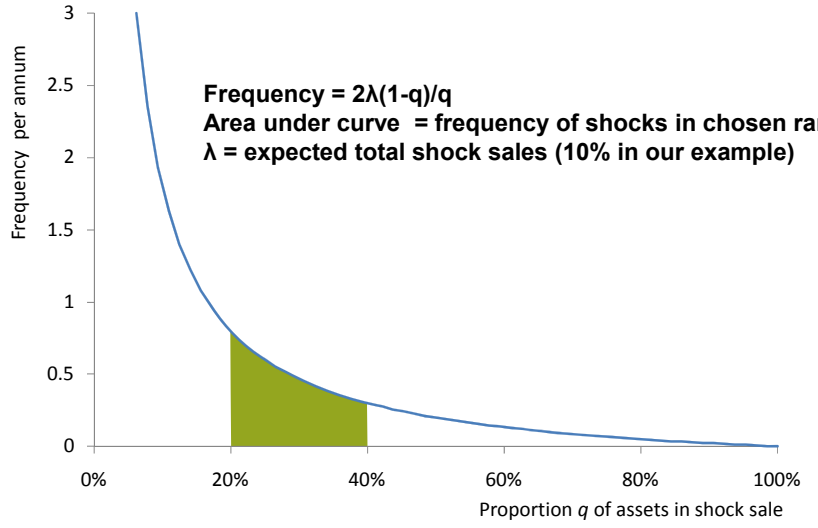
15

Triggers for Liquidity Shocks

Policy Drivers	Market Drivers
Catastrophe insurance payout Loss of confidence /adverse publicity No MVA dates Embedded options moneyness New product launches / churn Optional additional premium	Delta hedging Other guarantee hedging Hedge rollover Group fungibility limits Derivative physical delivery Collateral posting on derivatives
Credit Drivers	**Financing Drivers**
Downgrades effect on - Investment risk appetite - Collateral quality - Tracking an index Accelerated settlement / collateral liquidation through counterparty failures	Debt coupons / principal Merger / acquisition finance Collateral payments on securitisation

16

Example of Illiquidity Cost Curve



17

Matching Premiums: Likely Developments

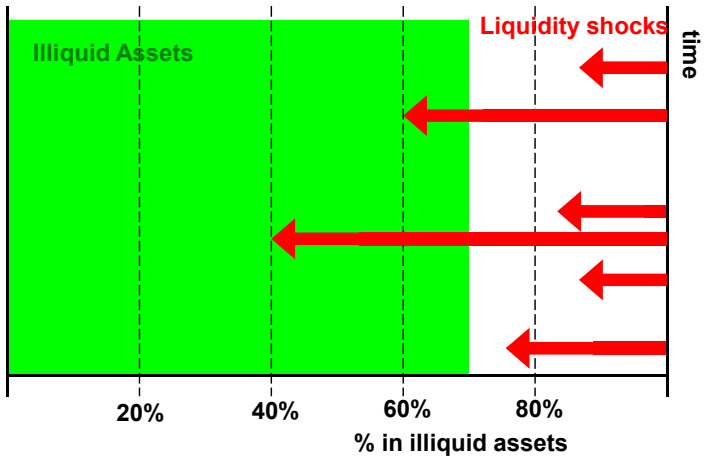
Currently under discussion for Solvency II

- It is likely that insurers may be able to take credit for a "matching premium" in some circumstances for Solvency II
- Likely tests correspond to low levels of illiquidity costs
  - Ring-fenced liabilities and assigned portfolio of assets
  - Cash flow and currency match
  - Hold-to-maturity intentions
  - No future premiums
  - Liabilities can include longevity, expense and revision risk
  - Restrictions on asset credit quality.
- Where a matching premium is not permitted, this can be interpreted as saying the illiquidity costs negate the illiquidity premium.

Liquidity and Investment Strategy

- Why illiquidity matters in investment
- Estimating illiquidity premiums
- Quantifying illiquidity costs
- The reward for illiquidity
- Hedging and replication arguments without liquidity
- Implications for Economic Scenario Generators
- Conclusions

Equilibrium Construction: Why marginal > average illiquidity cost



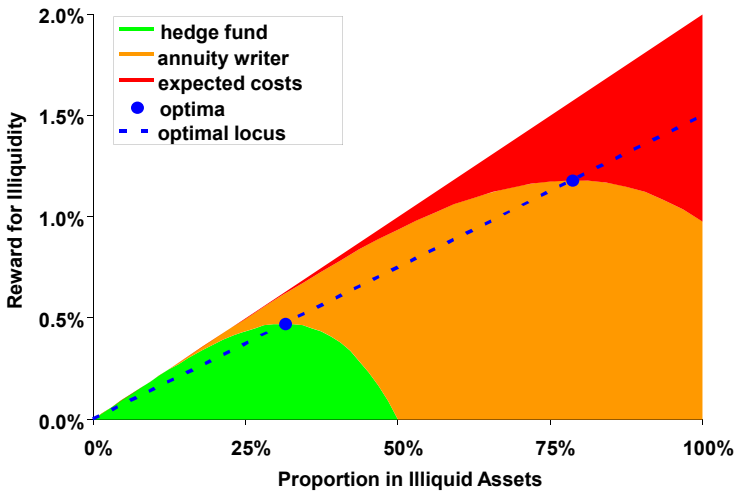
20

Marginal and Average Illiquidity Costs

- Consider the argument:
  - "as institutional funds hold cash and gilts alongside illiquid assets, then at the margin they are indifferent between liquid and illiquid assets"
- This confuses marginal and average illiquidity cost
  - These are the same for many investment problems, so we may be tempted to believe they are "always" the same
  - If you have 50 bonds from the same issue then the price and default experience on the last bond you bought is the same as all the others
  - Some elements do not work in this way, such as market impact of trades which drives illiquidity costs

21

Illiquidity Optimisation Model



22

Multi-asset Equilibrium Example

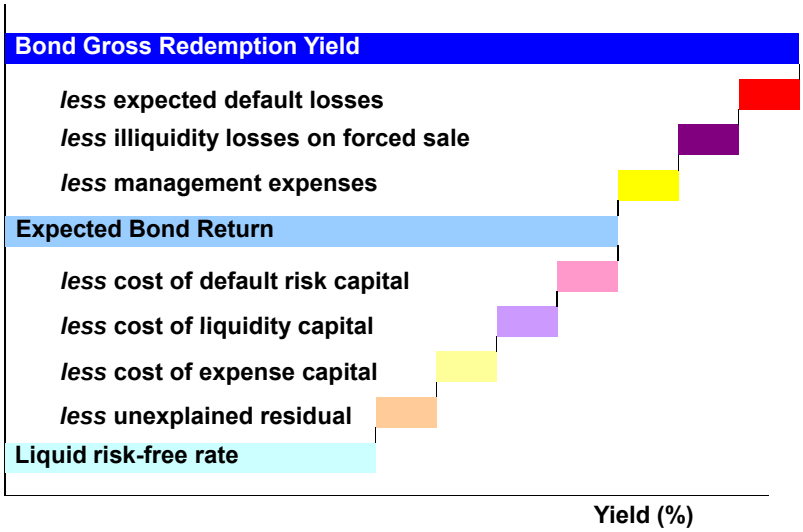
Asset	Vol	Bid / Ask spread	Risk-free	Beta term	Marginal illiq cost	Gross return	Av illiq cost	Net return
1	0%	0%	5.00%	0.00%	0.00%	5.00%	0.00%	5.00%
2	10%	0%	5.00%	2.20%	0.00%	7.20%	0.00%	7.20%
3	20%	0%	5.00%	4.58%	0.00%	9.58%	0.00%	9.58%
4	10%	10%	5.00%	2.20%	0.39%	7.59%	0.25%	7.34%
5	20%	10%	5.00%	4.58%	0.39%	9.97%	0.08%	9.89%
6	20%	20%	5.00%	4.58%	0.42%	10.00%	0.02%	9.98%

Other assumptions: asset correlations 75%, illiquidity cost curve $2\lambda(1-q)/q$, market portfolio is 1/6 in each asset.

Note the average illiquidity cost depends on arbitrary order of liquidation for assets 4 and 5, while the marginal cost does not.

23

Many other factors influence bond spreads



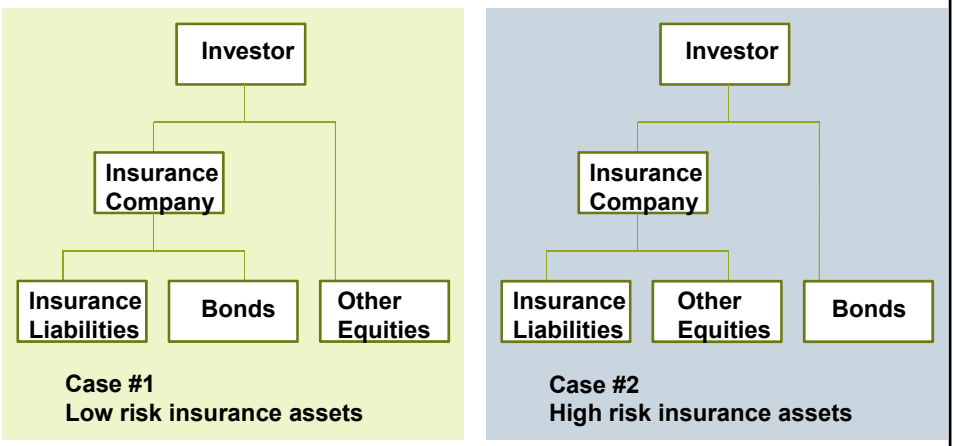
24

Liquidity and Investment Strategy

- Why illiquidity matters in investment
- Estimating illiquidity premiums
- Quantifying illiquidity costs
- The reward for illiquidity
- Hedging and replication arguments without liquidity
- Implications for Economic Scenario Generators
- Conclusions

25

Application of Modigliani and Miller to Insurance Investment



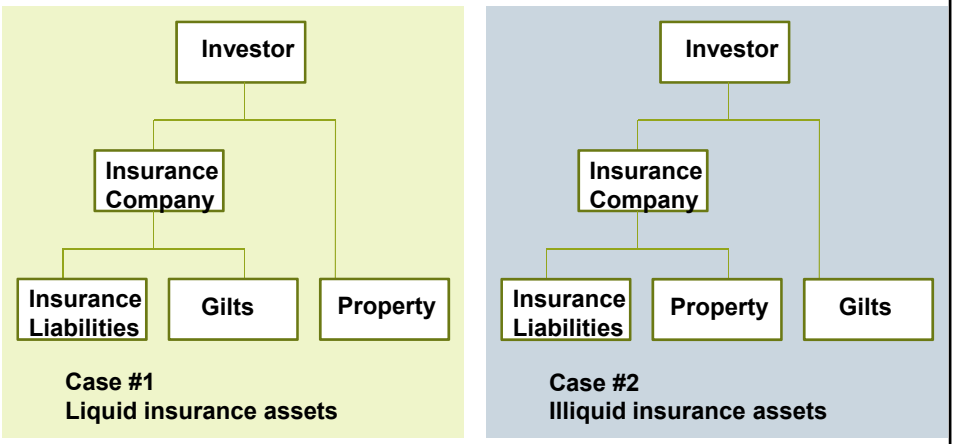
26

Does M&M Apply to All Kinds of Risk?

- M&M argument is that end-user investors get the same exposure to risky assets whether they are held directly or within an insurance vehicle.
- Having dismissed the risk-return arguments, strategic optimisation comes down to more subtle effects such as taxation, capital raising and distribution costs and agency costs.
- Does M&M still apply if the assets are subject to uncertain liquidity rather than uncertain price?

27

Breaking out of the zero sum game: illiquid assets does not mean illiquid shares.



28

Liquidity and Investment Strategy

- Why illiquidity matters in investment
- Estimating illiquidity premiums
- Quantifying illiquidity costs
- The reward for illiquidity
- Hedging and replication arguments without liquidity
- Implications for Economic Scenario Generators
- Conclusions

29

Economic Scenario Generators and Market Consistent Value

- Methodology: simulate stochastic interest rates, equity returns, foreign exchange, corporate bond spreads and defaults, implied volatilities etc
- Under this methodology cash flow valuation depends on the characteristics of the cash flow
  - Not on how the fund invests to meet that cash flow
  - Nor on the characteristic of who owns the cash flow
- Theoretical basis relies on “perfect market” assumptions: continuous trading, no dealing spreads, no market impact, infinitely divisible assets and so on. These do not hold exactly; the question is whether they are close enough for the purpose.
- There is disconnect between the real world effect of liquidity and the perfect market of option pricing theory.

30

Liquidity and Investment Strategy

- Why illiquidity matters in investment
- Estimating illiquidity premiums
- Quantifying illiquidity costs
- The reward for illiquidity
- Hedging and replication arguments without liquidity
- Implications for Economic Scenario Generators
- Conclusions

31

Conclusions

- In contrast to the banking world, insurance and pensions ALM studies have focused on measures of risk and return, with liquidity added as an after-thought.
- Long term funds may end up as repositories for illiquid assets that banks no longer want, but better methodologies are now needed to ensure value for money
- Estimates of illiquidity premium vary widely according to methodology and purpose
- This gives scope to break out of some the classic “zero sum games”, for example getting paid for stable financing and saving the real economic costs of prematurely aborted projects
- Financial theory based on perfect markets has greatly influenced thinking over the past 15 years, but it is important to understand the limitations and assumptions

32