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The many faces of liquidity

Role of Liquidity in Economics, Risk and Investment

Speakers:

James Walton, L&G

Andrew P Smith, AXA UK

Working Group:

Jon Hatchett, Hymans Robertson

Con Keating, Brighton Rock Group

Tony Zhao, eValue FE



‘Liquidity’ in 3 different contexts:

1. Capital markets and instruments
2. Micro: Balance sheet, risk and investment management
3. Macro: Global liquidity and monetary policy

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Summary

- Increasing focus on liquidity in markets, within institutions and at a macro level. Investment decision making should allow for each and interactions between them
- Liquidity breakdowns should be expected but may not be predicted
- Liquidity has a cost to the investor which is an option on future flexibility. Investors should value this for themselves.
- At a macro level too much liquidity is harmful



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What do we mean by liquidity?

- Many definitions but in markets: “The ability to trade quickly at low cost” (O'Hara, 1995)
- **Moneyness** is the degree to which an asset approximates to cash... and thus is useful as a medium of exchange.
- Liquidity driven by the velocity of circulation of this money, not the stock levels ($MV = PQ$).
- Credit and liquidity overlap:
 - Credit is the expectation of future liquidity (provided by the return of notional and coupons)
 - Collateralised transactions have lower effective net liquidity flows, as collateral itself has some liquidity.



Market observable measures

Type	Description
Depth	Ability to execute large transactions without influencing prices unduly
Tightness	Gap between bid and offer prices
Immediacy	Speed with which transactions can be executed
Resilience	Speed with which underlying prices are restored after a disturbance

Trading volume usually a good proxy of these

Source: Andrew Crockett, BIS

What makes instruments and markets liquid?

Instrument liquidity:

- Simplicity; norms and conventions
- Ease of valuation (low information asymmetry)
- Information insensitive



- High credit rating
- Low duration

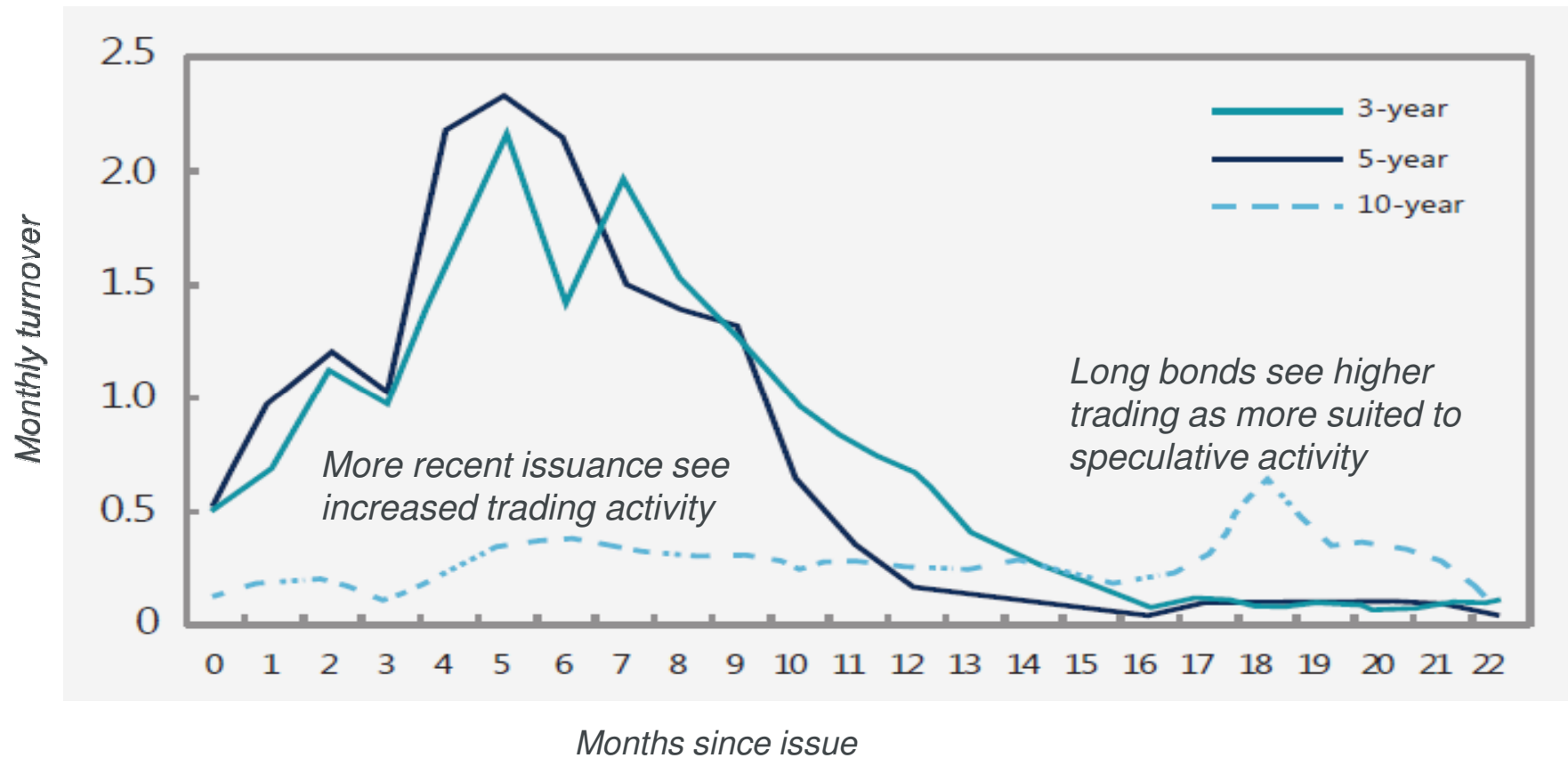
Market liquidity:

- Active trading



- Market makers
- Deep market, larger issue sizes
- Speculation (eg high duration)

Turnover since issue date

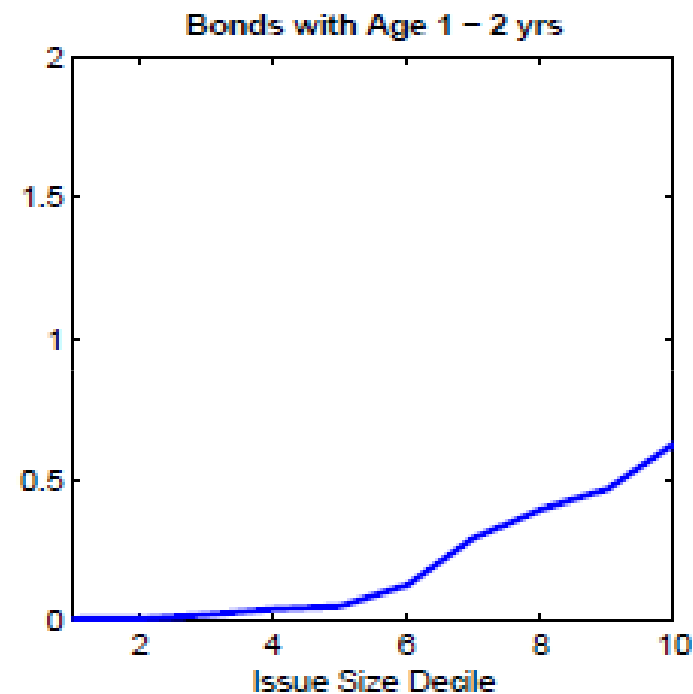
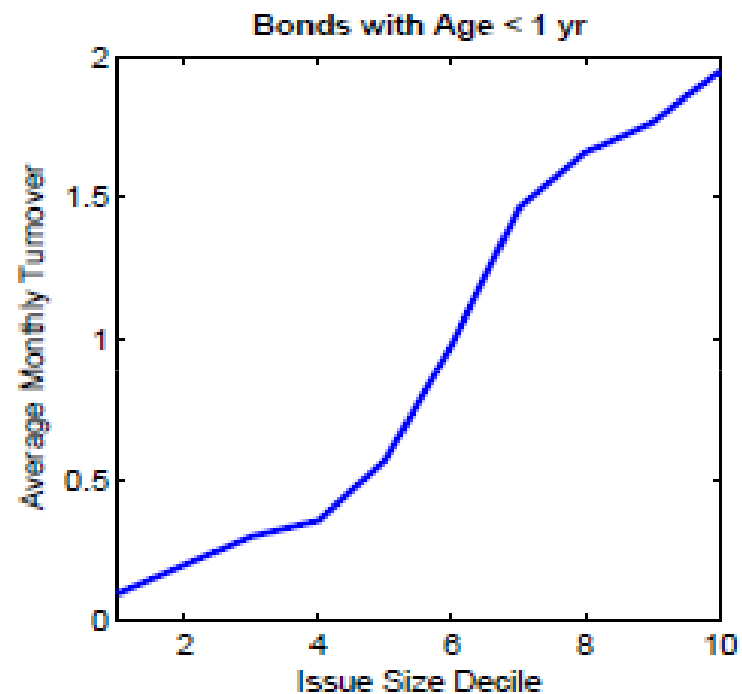


➔ Turnover usually exponentially decays with time since issue



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Turnover by issuer size



➔ Largest issues most liquid

Source: "Determinants Corporate Bond Trading: A Comprehensive Analysis" 2007 (Hotchkiss, Jostova)



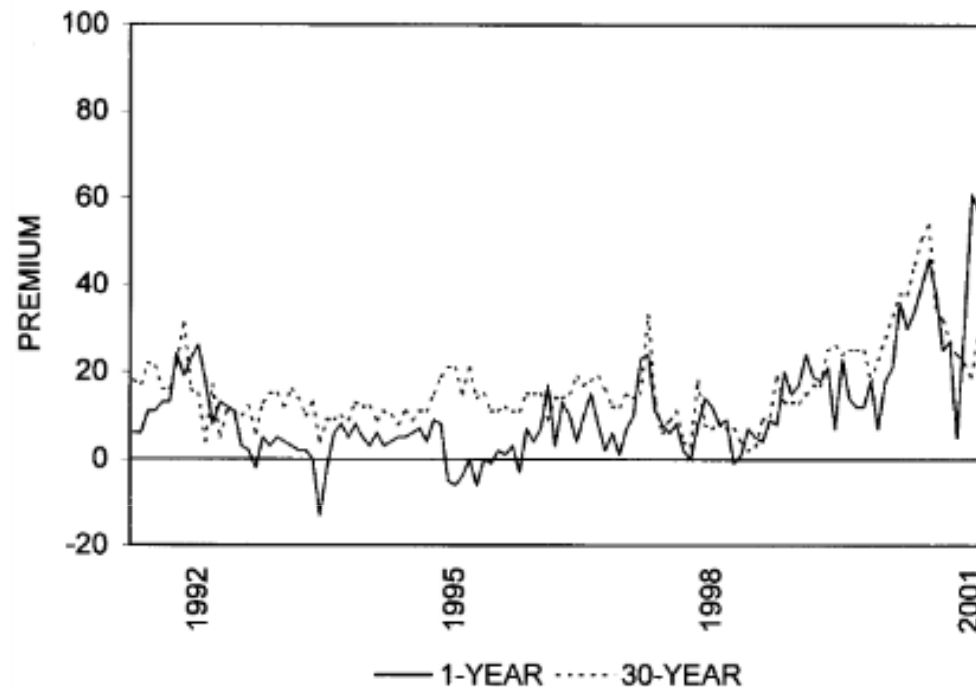
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Liquidity has a cost

- Liquidity has a cost to the investor because liquid assets cost more.
- It is cheaper to offer large issue sizes than small
- This is strange – demand increases with supply and the price also increases. The market is paying for trading “liquidity” and the issues yield less.
- Concept of an illiquidity premium common... but equivalently there is a liquidity cost when paying more for liquid assets.
- If decomposing spreads at a point in time, the two concepts are equivalent but there are some useful aspects to the liquidity cost view:
 - Price movement of liquid assets the driver
 - Force recognition of liquidity option not just costs of illiquidity.
 - Standard Corp Bond spread decompositions relative not absolute



Market examples: UST



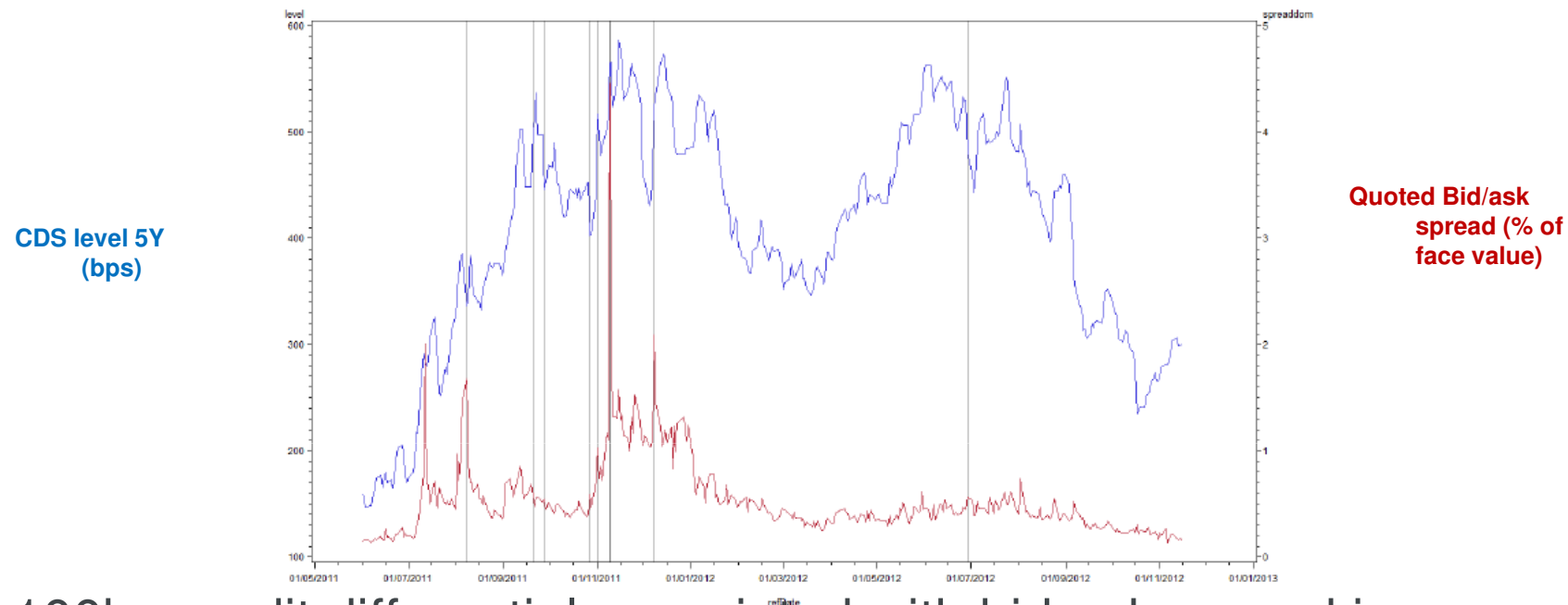
- Liquidity premium in US Treasuries compared with Refcorp, US Gov Agency.
- Controlling for credit risk, material liquidity premium related to changes in consumer confidence, ownership of government debt and flows into equity markets.

The flight to Liquidity Premium in US Treasury Bond Prices (longstaff, 2001)



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Market examples: Italy and CDS



- 100bp credit differential associated with bid-ask spread increase of 131bps
 - Granger causality test: prior to LTRO credit risk drives liquidity. Post LTRO liquidity changes granger-cause CDS movements
- ➔ LTRO intervention both improved liquidity and decreased credit risk

The Microstructure of the European Sovereign Bond Market: A Study of the Euro-zone Crisis (Pelizzon, Subrahmanyam, Tomio, Uno, 2013)



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Liquidity breakdowns

Systemic breakdowns are usually effects in the **velocity aspect**

Changes in 1. **uncertainty perceptions** or 2. **risk/liquidity preferences**

1. **Uncertainty perceptions:** eg “Lemons” problem (Akerlof, 1970*):



- Buyers doubt quality of asset → Sellers with good assets don't sell → equilibrium with no trade
- Breakdowns re-enforced by spiral effects:
 - High proportion of the market not being traded.
 - Capital requirements based on credit quality/market measures of risk
 - Using assets to fund on repo (MBS in 2008)
 - Liquidity is hoarded rationally. Liquidity genuinely has more value as 1) shocks more likely 2) profits to be made from market dislocations



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Liquidity breakdowns

2. Risk/liquidity preferences

- Short squeeze of Volkswagen shares in 2008. Porsche announced control of 75% of VW stock. 20% owned by state of Lower Saxony... leaving **5%** .
- Short sellers rushed to cover positions. VW shares spiked to make it the most valuable company in the world. Liquidity shocks do not always lead to price falls.



Liquidity breakdowns: looking forward

- Listed credit markets less liquid. Banks withdraw as intermediaries (USD stock in trading books has fallen from \$260bn to \$50bn)
- Future examples: what markets at risk from uncertainty perceptions, reliant on intermediaries or vulnerable to risk/liquidity preference changes?
- **Liquidity will vary through time. We cannot know which markets will breakdown... but some will.**
- Danger is when investors expect more liquidity than markets deliver and when feedback loops magnify breakdowns.



Does high frequency trading enhance liquidity?

- 50-75%* of all trades on Wall St at microsecond frequency. High frequency traders like market makers? Evidence of some improvement to liquidity measures
- However, trading volume positively correlated with higher volatility. **Potential for less alignment with fundamental cashflows (also problem with excess global liquidity)**
- Noise traders act in liquid stocks; informed traders are active in illiquid stocks.
- ➔ **If liquidity is a distribution, high frequency trading may be improving the average but not necessarily the tails?**

**Economist, Aug 6th 2011*

"Does Algorithmic Trading Improve Liquidity?" (Hendershott, Jones, and Menkveld 2011)



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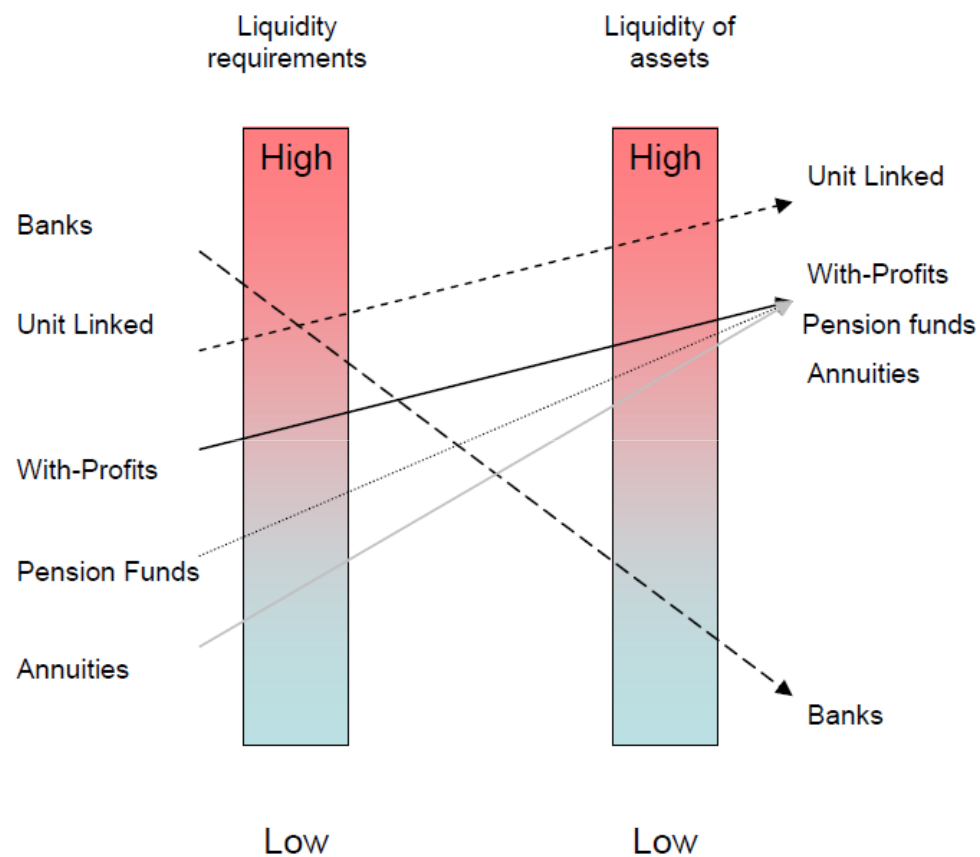
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Many institutions appear to have excess liquidity



Source: How valuable is Liquidity? Working paper, May 2008



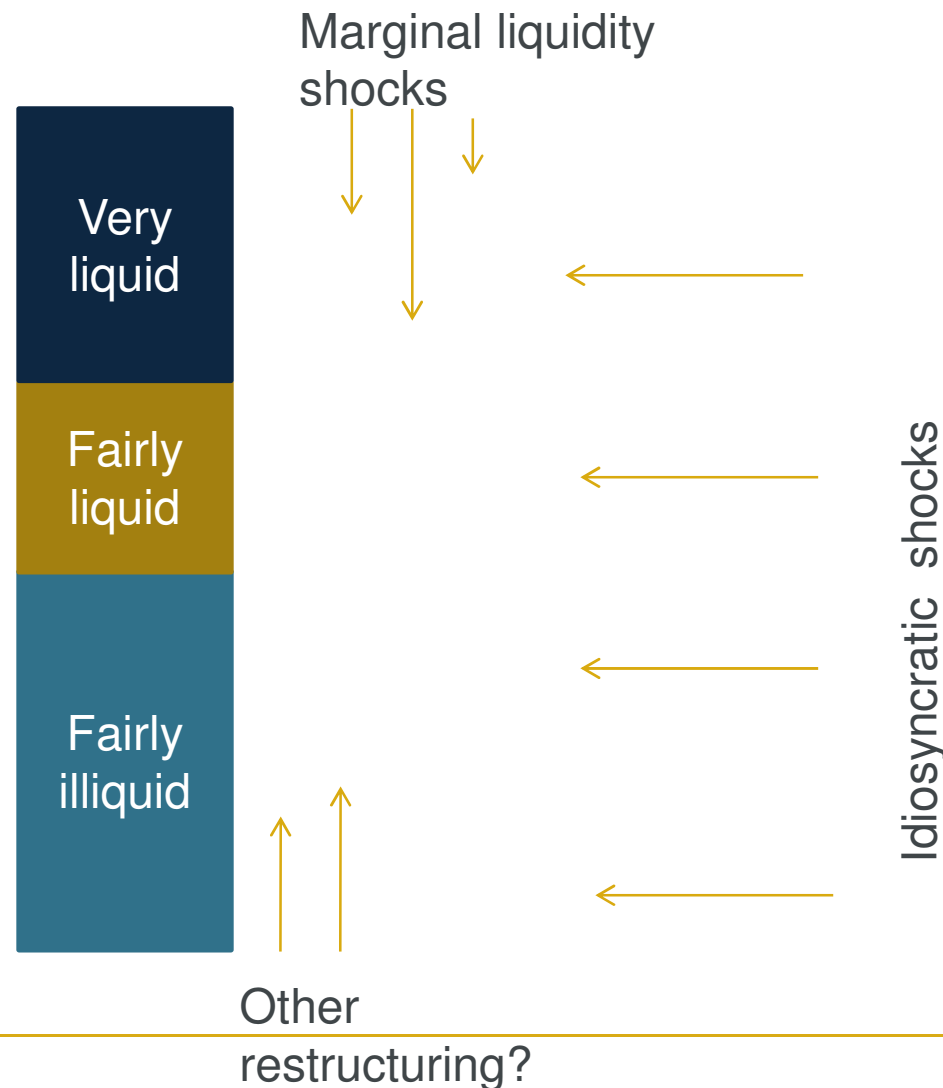
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Why institutions need liquidity?

- Cannot and (often) do not want to perfectly match liabilities
 - Maturity (& other) transformation
- Payment of liabilities as they arise
- Restructure portfolio (views, stock selection, regulatory, marketing, ...)
- Use assets as collateral
- Access markets without direct investment
- Funds to invest in projects/working capital



Valuing the liquidity option:



Need to consider, in addition to marginal liquidity costs, all other causes for sale of asset and costs/benefits of doing so in the future.



Should I pay the market price for liquidity?

- Market gives increased return from illiquid assets
- Does this compensate for institutions own costs of investing in illiquid assets (or benefits of liquid assets)?
 - Depends overall portfolio, asset strategy (e.g. collateral for swaps, and/or liquid part of portfolio), risk preferences and future environment
 - Need joint distribution over time of probability of sale and loss given sale
 - Also opportunity costs of an inflexible investment strategy if in a liquid market

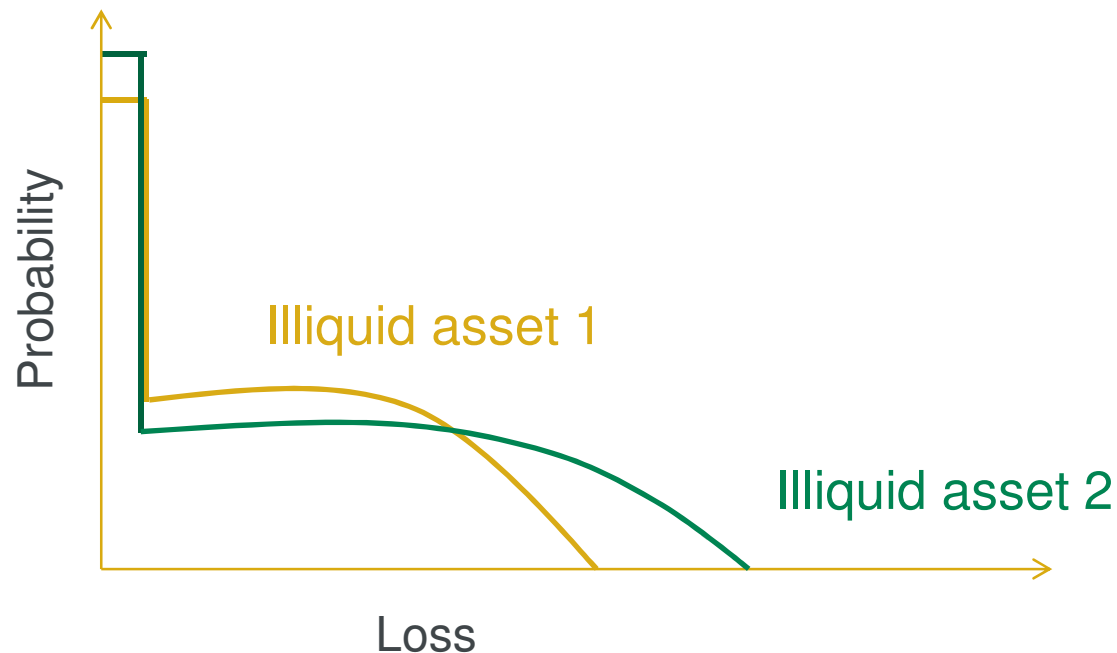
Determining an economic liquidity charge

- Can express costs/benefits of a liquid asset vs an illiquid one as a charge...
- Annual probability of sale of illiquid asset is 5%
- Expected shortfall given early sale is 5% of value
- → Hurdle rate is then $5\% \times 5\% = 25\text{bps pa}$



Profit/loss distribution due to liquidity

- Previous example is summarising in one number the loss (or profit) distribution due to holding the illiquid asset, which might actually look like:



Summary: continuum of investors

Short term
speculation

Buy and hold
vs liabilities



*Holding period of days...
or seconds.*

*Many years
zero probability of sale*

- ‘Buy and hold’ avoids reliance on liquid markets.. but few institutions can genuinely ignore the possibility of wanting to sell if assessing value
- Probability of sale in future does not need to be very high for liquidity considerations to be as relevant as expected losses on default.



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Holmstrom & Tirole framework

- Traditionally NPV project appraisal does not consider liquidity considerations
- Holmstrom & Tirole framework quantifies liquidity uncertainty throughout a project.
- Differentiate between pledgable and non-pledgable income that a project generates.
- Private sector will not supply liquidity at times



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Liquidity Risk Management

- Regulatory environment (e.g. GENPRU, INSPRU, BIPRU, SYSC, Basel II/III,Solvency II)
 - Risk Policy
 - Clear ownership – CIO, Treasury, CRO?
 - Interaction between business units
 - Definitions – risk, assets, requirements
 - Liquidity contingency plan

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Liquidity Risk Management

- Liquidity supply.....
 -cash, money market funds, government bonds, corporate bonds, equities.....
 -income from non-liquid assets
 - Additional considerations, e.g. apply caps, consider proportion of issue held
- Liquidity demand.....
 -claims, expenses, collateral and margin calls, FX, dividends, interest payments.....



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Liquidity Risk Management

- Risk appetite
 - Time horizon (1 day, 1 month, 1 year?)
 - Normal and stressed conditions
 - Market – interest rates, credit, equity....
 - Insurance – new business, renewals, catastrophe,expense offset?
 - Risk measures
 - Monitoring and reporting

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Liquidity & Institutions

Liquidity Risk Management

- Liquidity contingency plan
 - Ownership, approval and responsibilities
 - Definition of an adverse event
 - Clear mitigating actions
 - Switch between portfolios (fungibility?), redefine investment mandates, synthetic vs cash assets, repo, contingent funding facilities, apply deferral period for unit linked.....asset sales

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Liquidity Risk Management

- Get it right.....
 - Match liquidity demand with liquidity supply
 - Within a well defined, transparent, approved risk appetite that is understood by key stakeholders, including the Board (allows for liquidity demands in a stress scenario)
 - Clear contingency plan in place
 - Optimise (minimise) liquid asset position
 - Increased investment return.....

- Get it wrong.....

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‘An Accident Waiting to Happen’: The Failure of HBOS

- Parliamentary Commission on Banking Standards - April 2013
- HBOS Treasury Division
 - Consistently maintained significant liquidity, government bonds and bank certificates of deposits....
 -but from 2004, reduced its “over reliance” on these and invested in credit derivatives and structured investment products
 -FSA’s attention to HBOS liquidity “weakened dramatically” between 2004 and 2007 — focus was capital....Basel II distraction?



‘An Accident Waiting to Happen’: The Failure of HBOS

- Meant to offer some protection against the reliance on wholesale funding as well as providing liquidity elsewhere
- But when the financial crisis developed, liquidity of the Treasury’s portfolio evaporated.....
- Losses of £7.2bn between 2008 and 2011 – failure to understand the nature of the risks, credit and liquidity
- “HBOS was structurally illiquid”
- “The problems of liquidity were the occasion for the failure of HBOS, not the cause....failure was fundamentally one of solvency.”

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Lender of Last Resort.....Historical Development

- 19th Century
 - 1847 and 1857 crises – Bank Charter Act of 1844
 - Overend Gurney crisis – 1866
 - 1873 – “Lombard Street” and Bagehot’s “principles”
 - Lending should be carried out freely
 - Collateral needs to be high quality
 - Use of high interest rates

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Macro Liquidity

Lender of Last Resort.....More Recent Developments

- 2007 – Northern Rock
- 2008 – Special Liquidity Scheme
- 2009 – Bank of Japan conference
- 2012 – Court of the Bank of England reviews
 - Winters – The Provision of Emergency Liquidity Assistance in 2008/9
 - Plenderleith – The Bank's framework for providing liquidity to the banking system as a whole

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Macro Liquidity

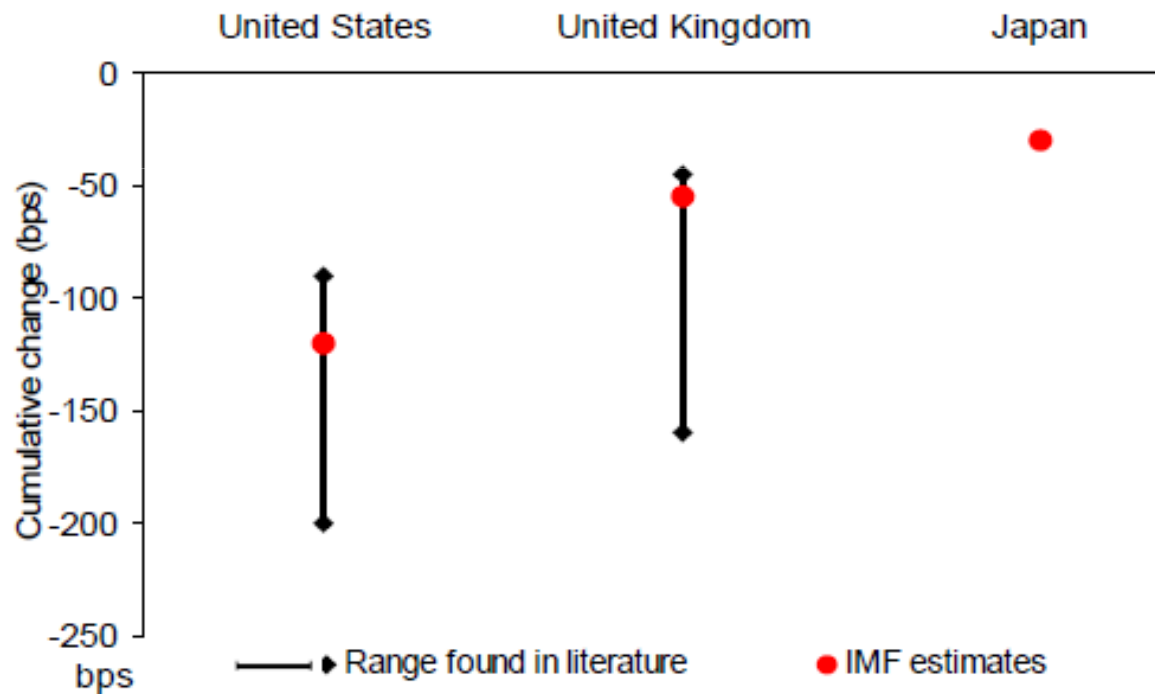
Central Banks

- “Traditional” actions
 - First, reduce interest rates.....
 - Then, implement quantitative easing.....
 - Followed by application of negative rates on short term reserves (e.g. Denmark)
- Exceptional actions
 - BoE – Collateral swaps
 - Federal Reserve supply of dollars to Switzerland



Quantitative Easing

Cumulative effects of bond purchases on 10-year domestic government bond yields



Source: IMF, DB Global Market Research



Quantitative Easing

- “Distributional Effects of Asset Purchases” – BoE July 2012
- QE has had a broadly neutral impact on pension schemes
-main contributor to widening pension scheme deficits is fall in equity prices relative to gilt prices....not caused by QE
- BoE defensive stance – ‘most people’ in the UK would have been worse off....gilt prices have risen, but so too have other assets
- Annuity rates reduced, but value of pension fund assets has increased



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Macro Liquidity

Quantitative Easing

- Additional liquidity not feeding into M2
- “Tapering” – slowing down of QE-related bond buying as global economy recovers. Speculation over timing can result in volatile markets.

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Questions

Comments

Expressions of individual views by members of the Institute and Faculty of Actuaries and its staff are encouraged.

The views expressed in this presentation are those of the presenter.



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Capital Markets and Instruments

- “The Microstructure of the European Sovereign Bond Market: A Study of the Euro-zone Crisis” – 2013
- “The Flight to Liquidity Premium in US Treasury Bond Prices” – Longstaff, 2001
- “Discussion Paper on Defining Liquid Assets in the LCR under the draft CRR” – European Banking Authority,
- “Determinants Corporate Bond Trading: A Comprehensive Analysis” 2007 (Hotchkiss, Jostova)
- “Does Algorithmic Trading Improve Liquidity?” (Hendershott, Jones, and Menkveld 2011)

Liquidity and Institutions

- “Liquidity and Investment Strategy” – Andrew D Smith and Grigory Spivak, IoA conference 2011
- “How Valuable is Liquidity” – Paul Stanworth et al, Institute Working Party Paper 2008
- “An Accident Waiting to Happen: The Failure of HBOS” – Parliamentary Commission on Banking Standards, April 2013



Macro Economy and Regulation

- “The Development of the Bank of England’s Market Operations” – BoE consultative paper, Oct 2008
- “Bagehot for Beginners: The Making of Lending of Last Resort Operations in the mid-19th Century” – Norges Bank Working Paper, Bignon, Flandreau and Ugolini, Oct 2009
- “Basel III: International framework for liquidity risk measurement, standards and monitoring” – BIS, Dec 2010
- “The Distributional Effects of Asset Purchases” – BoE, Jul 2012
- “Review of the Bank of England’s Framework for Providing Liquidity to the Banking System” – Winters, Oct 2012
- “Understanding Global Liquidity” – BIS Working Paper no 402, Feb 2013

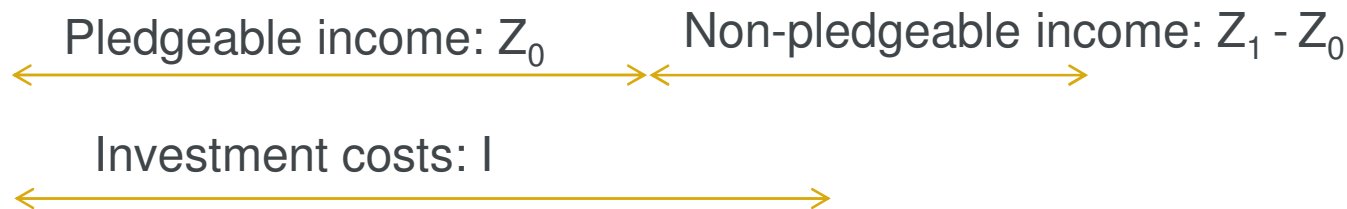
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Appendix: Holmstrom & Tirole framework

- Firms constrained as total value is not pledgeable (i.e. liquid)
 - E.g. agency costs
- Limit to liquidity => limits to positive NPV projects undertaken
=> limit to wealth below socially optimal level
- Creates demand for store of value over time/states of nature
- Firms credit rationed at start and over projects – key difference is you can hedge future liquidity needs...at a cost
- Liquidity is a separate consideration to value in judging projects – less well explored



Discrete investment choice model



- Risk neutral entrepreneur needs assets $A > I - Z_0$
- In states with credit rationing ($A < Z_1 - Z_0$)
 - Less risky projects with lower expected returns increase pledgeable income, which is more attractive when credit is rationed for the firm.
 - Diversification can increase pledgeable income, essentially by lowering the risk of a suite of projects.
 - Intermediation (e.g. loan covenants and other monitoring) can increase pledgeable income by lowering agency costs.



Adding a liquidity shock

- Three time period model, $t = 0, 1, 2$. At time 1 a liquidity shock occurs with value $r = r_H$ or r_L (H for high shock, L for low shock), and probabilities f_H or f_L respectively.
- Given a liquidity shock r , can continue production at rate $i(r) \leq 1$. I.e. r is the additional cost per unit of investment. So the firm requires I at time zero, plus $r i(r)$ at time 1 and returns $(r_1 - r_0)$ to the entrepreneur and $r_0 i(r)$ to the investors.
- $I - i(r)$ is discarded and returns nothing (i.e. if investment is scaled back due to the liquidity costs, that is a sunk cost).
- To get interesting behaviour we consider $0 \leq r_L < r_0 < r_H < r_1$.
- In the low liquidity shock state, we have more than enough liquidity to continue investment at rate 1. In the high liquidity shock state, we may or may not have enough.
- We find that the project continues in the high liquidity shock state iff $r_H < c$. We can interpret c as the unit cost of investment, while r_H is the cost of liquidity. c is given by:
- $c = \min\{1 + f_L r_L + f_H r_H, (1 + f_L r_L) / f_L\}$
- The firm will continue in both the low and the high state iff $f_L(r_H - r_L) \leq 1$. The intuition is that:
 - If f_L is lower, the likelihood of the low state is lower and the NPV of only continuing in the low state is lower.



Agency costs with liquidity shock

- This all assumes that the entrepreneur does what investors want, and has no other options. In practice, one of the key reasons for illiquidity in the first place is agency costs. For instance:
 - It might be more desirable for investors if the firm maximises initial investment but can only afford to continue in the low liquidity shock state. However, the entrepreneur might hedge their bets so that at time 1 they can continue even in the high shock state, but at a lower level of overall production.
 - It might be more desirable for investors if the firm does not maximise initial investment but keeps assets back to ‘self insure’ against a high liquidity shock. However, the entrepreneur might maximise the initial investment anyway in hope of a low liquidity shock.
- Either way at time 1 the entrepreneur leaves the investors with a fait accompli – if continuation makes sense the firm will do so and if not it has no liquid assets left to raise more funds.



Continuous investment choices

- r_1 is the expected return and r_0 the pledgable income per unit invested in a project.
- I is the scale of investment. The firm has assets A . Per unit of investment r_0 is raised from outside investors, while $1 - r_0$ is covered by its own funds.
- $A \geq (1 - r_0) I$ is a budget constraint limiting the overall scale of the investment (credit rationing).
- We can transform to this to $I = A/(1 - r_0)$ which is the maximum scale of investment. If the entrepreneur chooses this maximum investment scale their net utility is $U = \frac{A(r_1 - 1)}{(1 - r_0)}$.
- We find that the entrepreneur will invest totally in the illiquid portion of the investment (which has greater return, by assumption), while the investors will only hold the liquid portion (by design).
- Interestingly, the entrepreneur does not maximise the expected return to maximise utility, rather they maximise the ratio $\frac{(r_1 - 1)}{(1 - r_0)}$. In some cases they will sacrifice an increase in NPV per unit of investment for an increase in pledgable income.
- In theory, if there could be a greater transfer of wealth from investors at time zero that would increase the overall output in the system, but there is no way (due to the lack of liquidity of the

