Liquidity Risk: What is it? How to Measure it?

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The financial and economic environment

- We are living through the most severe financial crisis since the Great Depression, with large repercussions on the real economy.
- Banks had to write down around 400 billion dollars in bad loans caused by mortgage delinquencies.
- These losses are large in absolute value but they are relatively small when compared to the $8 trillion of U.S. stock market wealth lost between October 2007 and October 2008.
- Another example is the Russian default and LTCM collapse in 1998. Compared to the market capitalization of the US stock and bond markets, the losses due to the Russian default were tiny, but the world financial markets were in turmoil.
- What mechanisms are behind this amplification of losses?
- I will present a model proposed by Brunnemeier and Pedersen (2008) that provides an explanation for these events.
What is Liquidity Risk?

- One needs to distinguish between Market Liquidity and Funding Liquidity.
  - Asset’s Market Liquidity: the ease with which it is traded.
  - Traders’ Funding Liquidity: the ease with which they obtain funding.

- Liquidity Risk:
  - Market Liquidity Risk: The risk that the market liquidity worsens when one needs to unwind a position.
  - Funding Liquidity Risk: The risk that a trader cannot fund his position and is forced to unwind.
Market Liquidity

- Market Liquidity is low when it is difficult to raise money by selling an asset, that is when selling depresses the sale price.

- Three forms of market liquidity:
  - Bid-ask spread: how much a trader can lose by selling an asset and buying it back right away.
  - Market depth: how many units traders can sell or buy at the current bid or ask price without moving the price.
  - Market resiliency: how long it takes for prices that have fallen to bounce back.
Funding Liquidity

- Funding liquidity is high when it is easy to borrow money to purchase assets. Margin lending is short term since margins can be adapted to market conditions on a daily basis.

- Three forms of funding liquidity:
  - Margin funding risk: risk that margins will change.
  - Rollover risk: risk that it will be more costly or impossible to roll over short-term borrowing.
  - Redemption risk: risk that demand depositors of banks or say equity holders of hedge funds withdraw funds.

- Different customers have offsetting demand shocks, but arrive sequentially to the market, creating a temporary order imbalance.
- Speculators smooth price fluctuations, thus providing market liquidity.
- Speculators finance their trades through collateralized borrowing from financiers who set the margins to control their value-at-risk.
- Since financiers can reset margins in each period, speculators face funding liquidity risk due to the risk of higher margins or losses on existing positions.
- Market liquidity is defined as the difference between the transaction price and the fundamental value. Funding liquidity is the speculator’s scarcity of capital.
Brunnermeier and Pedersen (2008):  
"Market Liquidity and Funding Liquidity"

- So traders provide market liquidity, and their ability to do so depends on their availability of funding. Conversely, traders’ funding (their capital and the margins they are charged) depend on the assets’ market liquidity.

- Under certain conditions, margins are destabilizing and market liquidity and funding liquidity are mutually reinforcing, leading to liquidity spirals.
Liquidity Spirals

- Liquidity is provided by market makers, hedge funds, or investment banks. They must fund their positions (long and short):
  \[
  \sum_j \left( x_t^j m_t^j + x_t^j m_t^j \right) \leq W_t
  \]

- If speculators are well funded (large capital $W$ and/or low margins $m$):
  - They can trade more (larger $x^+$ and $x^-$), which enhances liquidity
  - Funding liquidity is a driver of market liquidity

- There is also feedback in the other direction. Better market liquidity can lower margins
  - because financiers are more willing to lend when they can more easily and quickly sell the collateral
  - and because market liquidity can lower volatility

- This mutual feedback can give rise to liquidity spirals when some traders hit or are near their margin constraints or risk limits.
Liquidity Spirals

- initial losses
- funding problems for speculators
- reduced positions
- prices move away from fundamentals
- higher margins
- losses on existing positions
Liquidity Spirals

- A loss spiral arises for leveraged investors: a decline in asset value erodes their net worth more than their gross worth and the amount they can borrow falls.
- The investor is forced to reduce its overall position to maintain its leverage ratio. The sales depress the price further inducing more selling and so on.
- A margin spiral reinforces the loss spiral. As margins rise, the investor has to sell even more to reduce its leverage ratio.
- Margins spike in times of large price drops leading to a general tightening of lending.
Figure 1: Margins for S&P500 Futures. The figure shows margin requirements on S&P500 futures for members of the Chicago Mercantile Exchange as a fraction of the value of the underlying S&P500 index multiplied by the size of the contract. (Initial or maintenance margins are the same for members.) Each dot represents a change in the dollar margin.
Investment Banks and Procyclical Leverage

Total Assets and Leverage

Source: Adrian and Shin (2008)
Balance Sheet Activity and Repo Market

Source: Adrian and Shin (2008)
The Repurchase Agreement (Repo) Market

- In a repurchase agreement (repo), an institution sells a security while simultaneously agreeing to buy it back at a pre-agreed price on a fixed future date.
- Such an agreement is tantamount to a collateralized loan, with the interest on the loan being the excess of the repurchase price over the sale price.
- From the perspective of the funds lender - the party who buys the security with the undertaking to re-sell it later - such agreements are called reverse repos.
- For the buyer, the transaction is equivalent to granting a loan, secured on collateral.
- Repos and reverse repos are important financing activities that provide the funds and securities needed by investment banks to take positions in financial markets.
- Adjustments in total assets and hence leverage are primarily done via repos.
Commonality of Liquidity across Securities

- The model provides a natural explanation for the commonality of liquidity across assets since shocks to speculators’ funding constraint affect all securities.
- Some empirical evidence about market liquidity correlation across stocks or across stocks and bonds.
- Evidence that money flows account for part of the commonality in stock and bond market liquidity.
- Evidence that during crisis periods, monetary expansions are associated with increased liquidity.
- Documented substantial increase in the co-movement among credit default swaps during the GM/Ford rating downgrade in May 2005 when dealer funding was stretched.
Other Empirical Implications

- Negative correlation between liquidity and fundamental volatility.
- Flight to quality: episodes in which risky securities become especially illiquid, when speculator capital deteriorates.
- Comovement with the market: market-making firms are often net long in the market, which implies that capital constraints are more likely to be hit during market downturns.
- Overall liquidity funding explanation suggests that monetary factors are more important than other macroeconomic factors in explaining liquidity.
The two papers presented this afternoon

- Fontaine and Garcia (2007): "Bond Liquidity Premia".

The two papers focus on the bond market liquidity, with an emphasis on on-the-run (recently issued) and off-the-run (seasoned bonds) securities.

- The first uses pairs of on-the-run and off-the-run bonds to identify a liquidity factor in a term structure model, therefore measuring the liquidity premium for bonds of various maturities.
- The second studies the term structure of illiquidity (measured by the bid-ask spread) for on-the-run and off-the-run bonds separately in a VAR model with a set of macroeconomic and financial variables.
They find that an increase in the value of liquidity predicts not only lower risk premia for both on-the-run and off-the-run bonds but also higher risk premia on Libor loans, swap contracts and corporate bonds.

They also find that liquidity covaries with changes in aggregate uncertainty, as measured by the volatility implied in S&P500 options, and with changes in monetary stance, as measured by bank reserves and monetary aggregates.
They find that illiquidity increases and the difference between spreads of long- and short-term bonds significantly widens during recessions, suggesting a "flight to liquidity" phenomenon wherein investors shift into the more liquid short-term bonds during economic contractions.

Bond returns across all maturities are forecastable by off-the-run short-term illiquidity but not by illiquidity of other maturities or by on-the-run bond illiquidity.

Thus, short-term off-the-run liquidity, by reflecting macro shocks first, is the primary source of the liquidity premium in the Treasury bond market.