Volatility Dynamics and Liquidity

THE AMBIVALENT ROLE OF LIQUIDITY IN ECONOMIC STABILITY

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OUTLINE:

• Two meanings of ‘liquidity’: micro versus macro
• A micro view: liquidity as a stabilizing factor
• A macro view: (excess) liquidity as a destabilizing force
• A model of speculative volatility dynamics
DEFINITION: TWO MEANINGS OF ‘LIQUIDITY’

• (Micro view) Liquidity: easiness with which an asset can be traded with little price impact

• (Macro view) Liquidity: cash and cash equivalents in the economy (notably through bank credit)
MICRO(STRUCTURE) VIEW: VOLATILITY VS LIQUIDITY

• The more liquid an asset, the less volatile: inverse relationship supported by theory (Kyle’s model,...) and large body of empirical evidence:

\[
\text{price change} = \frac{\text{excess demand}}{\text{liquidity}}.
\]

• Proxy of Excess Demand: Order Flow Imbalance (OFI); Proxy of Liquidity: Market Depth.

• Here liquidity is synonymous with price stability.
Example of empirical evidence:

Regression:

\[ \Delta p = \beta OFI + \text{error} \]

\[ \beta = \frac{1}{\text{LIQUIDITY}} = \frac{1}{\text{Average Depth}} \]

Source:
MACRO VIEW: BANK CREDIT AND BUSINESS CYCLES

Classical view of business cycles: bank credit is the key variable

• Adam Smith (Wealth of Nations, 1776 [1904]): destabilizing role of debt-financed speculation (‘prodigals and projectors’, or speculators using ‘other’s people’s money’). Allusions to South Sea and Mississippi bubbles.

• J.-B. Say (Cours complet, 1828 [2010], part III, ch. XIX): excessive bank credit explains economic crises: e.g. the financial and commercial crisis in England, 1825-26.

• J. S. Mill (Principles, 1848 [1909], bk. III, ch. XII): speculation is destabilizing, but macroeconomically significant only when financed by credit, notably bank credit.

This old view has been rediscovered many times over:
BANK CREDIT AND BUSINESS CYCLES

Rediscoveries of the classical view of business cycles:

• Fisher’s debt-deflation theory (1933): a more sophisticated version of the old view, ...

• Minsky, Kindleberger, Keen: synthesis of Fisher, Keynes, ...

• Monetarism? Yes, but centered, not on banks as such, but on the Central Bank as the key player

• Experimental evidence (Vernon Smith and co-authors, ...): liquidity fuels bubbles in retradable asset markets. Balance Sheet Recessions (Djerstad and Smith, *Rethinking Housing Bubbles*, 2014).

But still not the dominant view! Why?

• In the 1930s: Keynes eclipsed Fisher

• How about today? Aggregate credit as an autonomous spending power? Or double counting? Bank credit merely a transfer of spending power from depositors to borrowers, only mediated through a bank? Or something more than that?
PUTTING THE PREVIOUS INSIGHTS TOGETHER FORMALLY:
A MODEL OF SPECULATION, VOLATILITY DYNAMICS, AND LIQUIDITY

- A universal empirical regularity of speculative financial price changes (known since Mandelbrot 1963) is their extreme (non-Gaussian) randomness: the relative price change (or return) has a power law tail distribution (with exponent $\mu$ often close to 3):

$$\text{prob}(\Delta p \geq x) \sim \text{constant} / x^\mu.$$  

- A second universal regularity is volatility clustering: large price changes tend to be clustered in time (small-magnitude price changes tend to be followed by small-magnitude price changes, and large-magnitude price changes by large-magnitude price changes): formally, while the return process is serially uncorrelated, its magnitude (or absolute value) is long-ranged correlated.

- Many interesting models suggested in the literature (notably agent-based models) to account for these two regularities, but these models are often intractable and hence handled computationally (via simulations).

- From the previous insights, we can offer a natural explanation of the extreme randomness: the model is parsimonious and simple (in terms of number of assumptions needed and tractability).
Assumption 1: a financial market populated entirely by speculators (N in number)--a speculator being a trader solely motivated by expectation of capital gain (no regard to fundamentals): thus speculative demand (supply) for a unit of the asset is based on anticipated future resale price change $\Delta p^e$.

Assumption 2: all speculators are trend-followers (extrapolative expectations): their anticipated future price change is a weighted average of past price changes, where the weights $\omega_{ht}$ are random variables.

Assumption 3: previous linear price impact function.

Assumption 4: unbounded availability of credit: so that speculation be macroeconomically significant (recall the classical argument: J.S. Mill, ...).

Implication: all in all, asset price change follows a random-coefficient autoregressive process:

$$\Delta p_t = \sum_{h=1}^{H} \left( \frac{\omega_{ht} N_t}{LIQUIDITY_t} \right) \Delta p_{t-h} + \text{error}_t .$$

Theorem (Kesten, 1973): under mild conditions, such process converges to a strictly stationary distribution with power law tails.
DATA (left: NYSE daily index) versus MODEL (right): power law explained, but not volatility clustering!
Accounting for volatility clustering:

• No autoregressive model of the previous type could explain clustered volatility (by a theorem by Basrak-Davis-Mikosch, 2002).

• **Alternative model of expectations**: assume, besides speculators, investors motivated solely by fundamentals; assume each trader’s expectation follows a random walk, driven by exogenous news (you hold on to your view, until a news comes to the market, which leads you to revise your view upward or downward by some random amount).

• This random walk of beliefs accounts easily for volatility clustering (next slide).

• Owing to the random walk, however, we lose the nice strict stationarity of the return process, which in the previous model was guaranteed by Kesten’s theorem.
Modified model: news-driven expectations imply clustered volatility
Working papers:


Related work in progress:

- Vernon L. Smith and Sabiou M. Inoua, The Classical View on Crises and Depressions
- Vernon L. Smith and Sabiou M. Inoua, Power Law and Volatility Clustering in Experimental Markets?

On Kesten processes:


A review of agent-based models:

THANK YOU FOR YOUR ATTENTION