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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:

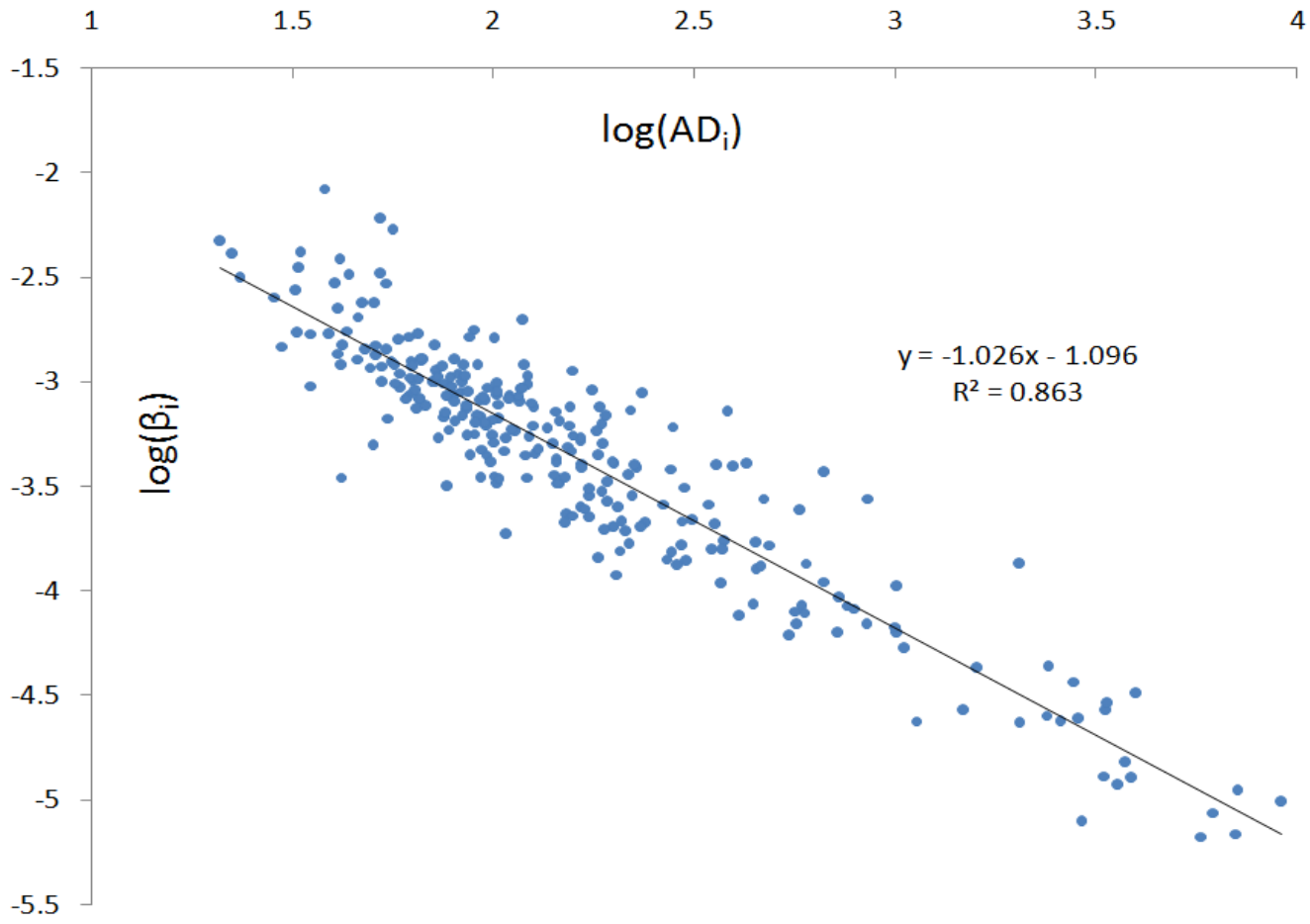
Regression:

$$\Delta p = \beta OFI + \text{error}$$

$$\beta = \frac{1}{\text{LIQUIDITY}} = \frac{1}{\text{Average Depth}}$$

Source:

Cont et al., 'The price impact of order book events', JFE, 2014.



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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 **μ** often close to **3**):

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

- 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).

Model: speculation, volatility dynamics, and liquidity

- 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 $\mathbf{\Delta p^e}$.
- 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 $\mathbf{\omega_{ht}}$ 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.

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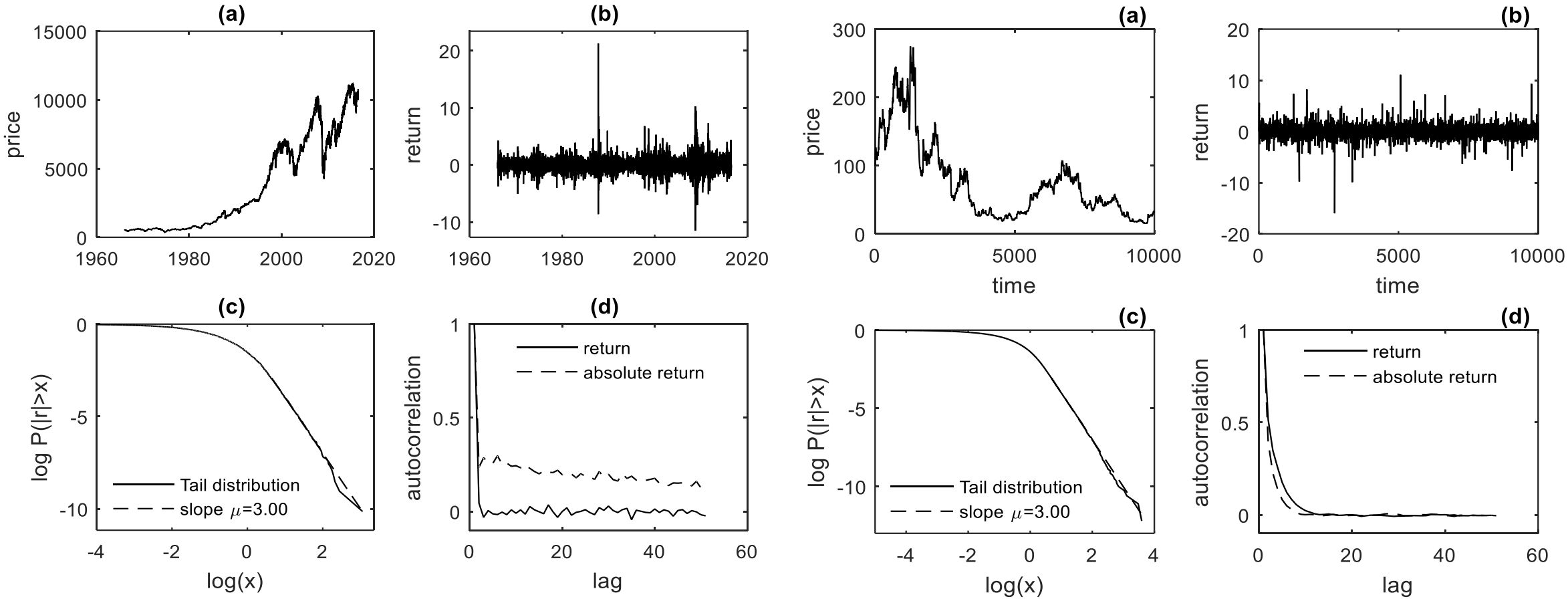
DATA (left: NYSE daily index) versus MODEL (right): power law explained, but not volatility clustering!



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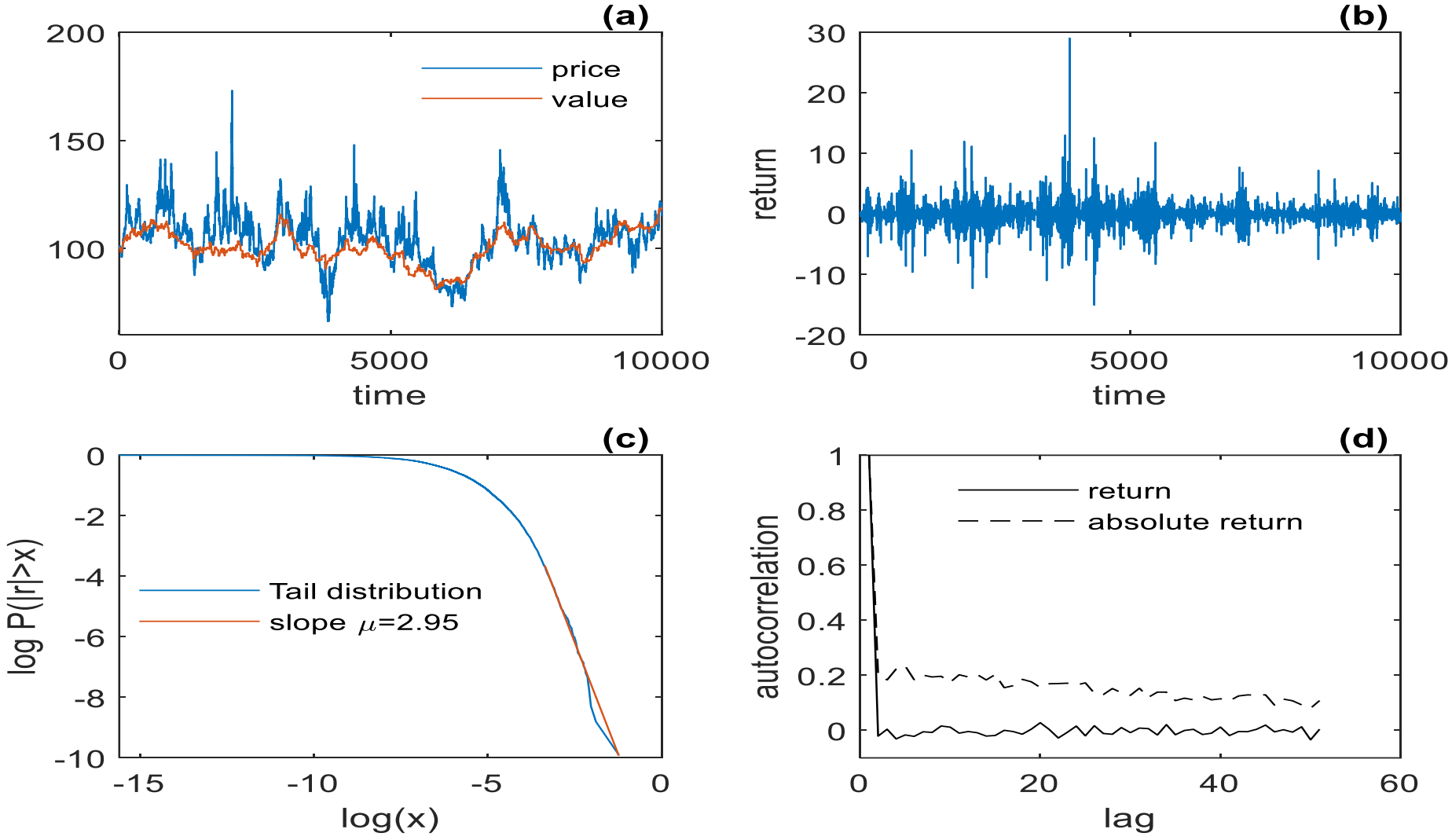
Accounting for volatility clustering:

- 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 loose 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



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- Sabiou M. Inoua (2016b). The Random Walk behind Volatility Clustering. arXiv preprint arXiv:1612.09344.
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- Sabiou M. Inoua and Vernon L. Smith (2020). Classical Economics: Lost and Found. Working Paper, ESI, Chapman University (to appear in *The Independent Review*)

Related work in progress:

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- Vernon L. Smith and Sabiou M. Inoua, Power Law and Volatility Clustering in Experimental Markets?

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THANK YOU FOR YOUR ATTENTION