Liquidity crises in the limit order book: a tale of two time scales

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We present an empirical analysis of the microstructure of financial markets and, in particular, of the static and dynamic properties of liquidity. We tracked the limit order book dynamics of four highly traded stocks for one year, finding that price movements can be explained in terms of liquidity crises and that, more importantly, the quantitative definition of liquidity should depend on the considered time scale.

Indeed, we find that on relatively large time scales (15 min) large price fluctuations are connected with the failure of the subtle mechanism of compensation between the flows of market and limit orders. In other words, the missed revelation of the latent order book breaks the dynamical equilibrium between the flows, triggering the large price jumps. This behavior naturally leads to a dynamical definition of liquidity. On smaller time scales (30 s), instead, the static depletion of the limit order book is a useful indicator of a possible intrinsic fragility of the system which, when present, leads to a strongly nonlinear enhancement of the response, in terms of price impact, to incoming orders, even if their volume is small. In order to quantify this phenomenon, we introduce a static measure of the liquidity imbalance present in the book and we show that this quantity is correlated to both the sign and the magnitude of the next price movement. For instance, when the liquidity imbalance is equal to 0.8 (in a scale from 0 to 1) one finds a number of positive returns which is roughly double than the number of the negative ones. We point out that the imbalance is calculated at the beginning of the time window which defines the price movement.

These empirical findings prove that large price fluctuations are due to different mechanisms that act at different time scales. In both cases, the volumes of the incoming orders play a minor role with respect to the fragility of the system and, in particular, to the possible typologies of liquidity crises we discuss. In conclusion, the effective liquidity should be defined in relation to the time interval one wants to consider.

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