Price Impact Model

$$\Delta(Q) = Y\sigma\sqrt{\frac{Q}{V}}, \quad (1)$$

where Q is the size of metaorder; σ is the daily volatility; V is the daily volume; Y is a numerical constant of the order unity.

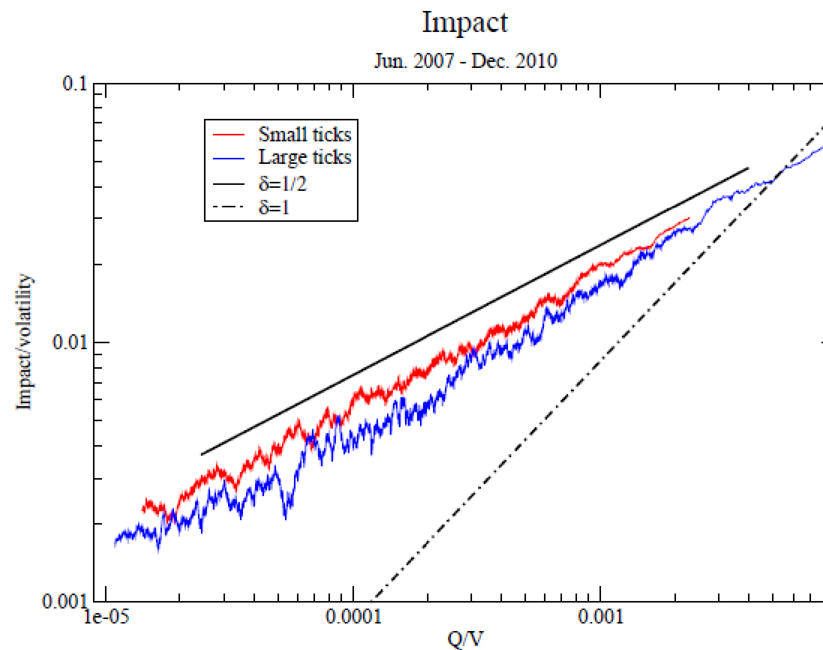

Figure 1. Volatility-adjusted price impact vs the ratio Q/V (from *Toth B. et al. Anomalous price impact and the critical nature of liquidity in financial markets*, 2011)

Study of price impact of large metaorders on MICEX (Smirnov, Ivliev)

141 420 large metaorders. Period: Sep 2012 – Apr 2013

$$I(Q) = \hat{Y}\sigma\left(\frac{Q}{V}\right)^{\hat{\delta}} \approx 1.4\,\sigma\left(\frac{Q}{V}\right)^{0.4}.$$

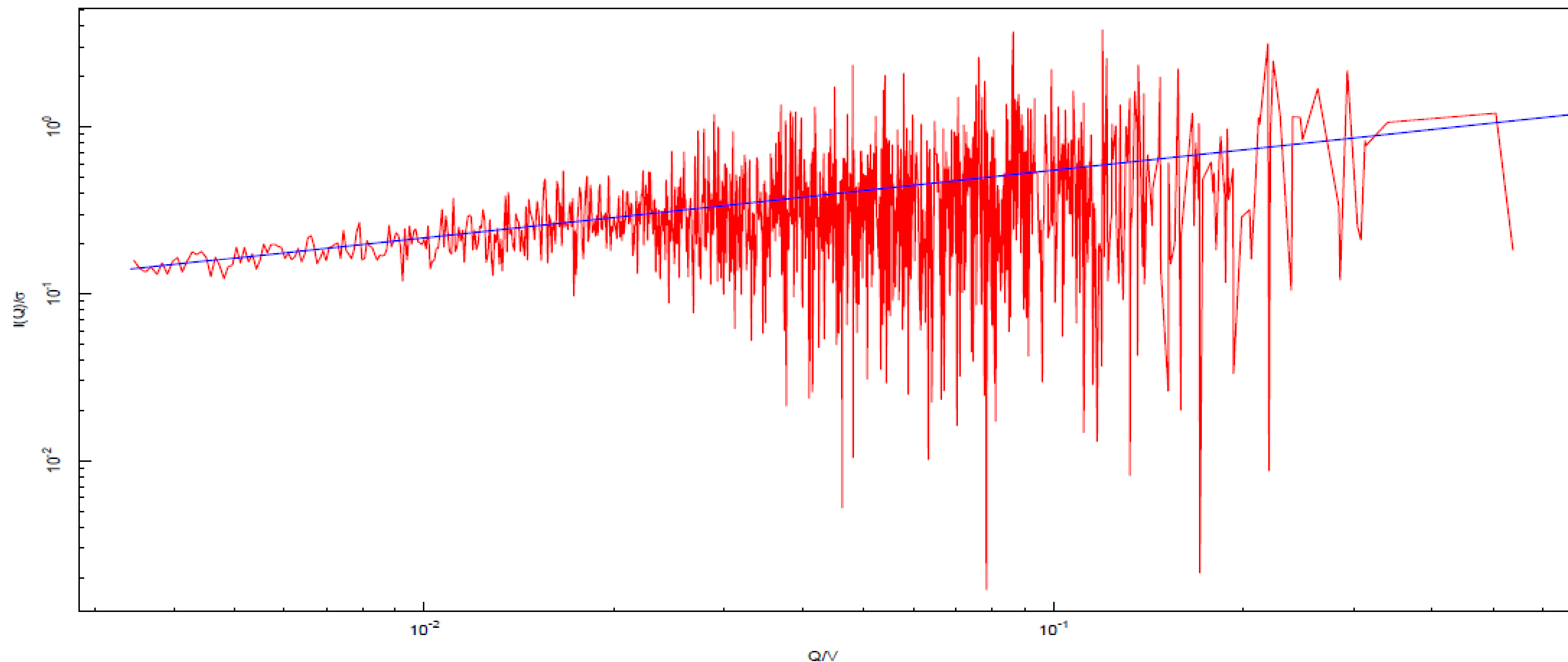

Figure 3. Price Impact of Large Metaorders

Example,

$$I(Q) = \hat{Y}\sigma\left(\frac{Q}{V}\right)^{\hat{\delta}} \approx 1.4\,\sigma\left(\frac{Q}{V}\right)^{0.4}.$$

$Q = 1{,}000{,}000$

$V = 10{,}000{,}000$

$\sigma = 1\%$

$\Delta P/P = I(Q) = 1.4\ \sigma\,(Q/V)^{0.4} = 1.4 * 1\% * 0.1^{0.4} = 0.56\%$

To summarize

- Local liquidity in the book is small (~1/1000 of trading volume)
- This imposes a splitting up of metaorders and long memory in the sign of trades
- …and leads to breakdown of linear price response (hidden liquidity) => concave impact (square root law)
- Due to liquidity fluctuations small trades may cause large price impact => price shocks without news

References

BARRA. Market impact model handbook, 1997.

Bouchaud J.-P. Price impact, 2009.

Bouchaud J.-P. The endogenous dynamics of markets: price impact and feedback loops, 2010.

Caccioli F., Bouchaud J.-P., Farmer J. D. Impact-adjusted valuation and the criticality of leverage, 2012.

Donier J. Market Impact with Autocorrelated Order Flow Under Perfect Competition, 2012.

Farmer D. J., Gerig A., Lillo F., Waelbroeck H. How efficiency shapes market impact, 2011.

Gatheral J. Market impact with autocorrelated order flow under perfect competition: the Donier moder, 2012.

Hasbrouck J. Empirical Market Microstructure. Oxford University Press, 2007.

Kyle A. S. Continuous auctions and insider trading, 1985.

Lillo F. Market microstructure (Lecture 2). Trading mechanisms, Roll model.

Moro E., Vicente J., Moyano L. G., Gerig A., Farmer J. D., Vaglica G., Lillo F., Mantegna R. N. Market impact and trading profile of large trading orders in stock markets, 2009.

Toth B., Lemperiere Y., Deremble C., de Lataillade J., Kockelkoren J., Bouchaud J.-P. Anomalous price impact and the critical nature of liquidity in financial markets, 2011.