

Price Impact of Large Metaorders

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Definition

J. P. Bouchaud: *Price impact* refers to the correlation between an incoming order (to buy or to sell) and the subsequent price change.

Different definitions

Farmer D. J.: Metaorders are large trading orders that are split into pieces and executed incrementally.

Gatheral J.: Metaorder is an order that is sufficiently large that it cannot be filled immediately without eating into the order book.

Lillo F.: Hidden orders (packages) are large orders that are executed incrementally over an extended period of time.

Problem

Metaorders are invisible. How to distinguish metaorders from an usual trading?

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

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.

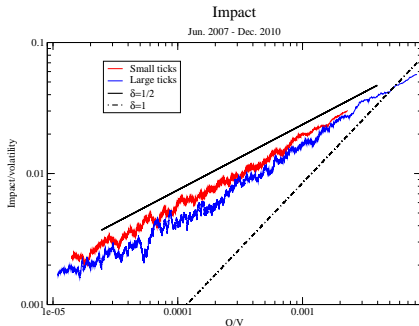


Figure 1. Volatility-adjusted price impact vs the ratio Q/V (from *Toth B. et al. Anomalous price impact and the critical nature of liquidity in financial markets*, 2011)

Specificity

Intraday agent resolved data.

Only the most liquid shares and the most active agents have been chosen:

- MICEX 30;
- 228 agents with daily average volume exceeding 0.01% of total daily average volume for each share;
- 164 trading days from 01.09.2012 to 30.04.2013.

Main distinctions of metaorders:

- Child orders are close in time.
- Agents trade metaorders in order to buy or sell some large amount of securities, consequently metaorders have direction.

Net inventory:

$$NI_i = \sum_{j=1}^i (BV_j - SV_j), \quad (2)$$

where NI_i is a net inventory at the moment i ; BV_j is a buy volume in the j -th second; SV_j is a sell volume in the j -th second.

$$NI = \{NI_i\}, \quad i = \overline{1, N} \quad (3)$$

where NI is a daily agent's net inventory profile; NI_i is a net inventory at the moment i ; N is a number of trade seconds in the day.

- 1 There has been made a learning sample including 120 metaorders.
- 2 A distribution of some metaorders' characteristics was computed.
- 3 So, there were chosen the values of metaorders' criteria:
 - maximal time between two child orders is equal 2 hours;
 - minimal net inventory increment between two child orders is equal 0.001;
 - minimal deals frequency is equal 1 deal/minute;
 - minimal size of metaorder is equal 16 shares.
- 4 An R program was written.
- 5 Finally, the program detected 141 420 metaorders.

Example of the Program Output

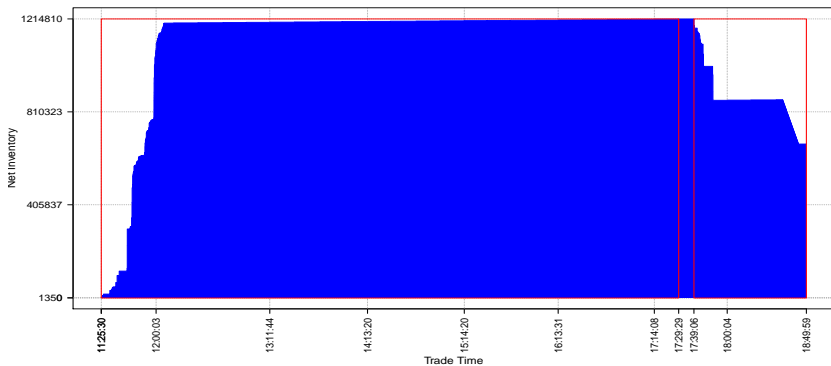


Figure 2. Metaorders (to buy and to sell)

- 1 Empirical value of metaorder's price impact:

$$I = \frac{p_T}{p_0} \varepsilon - 1, \quad (4)$$

where p_T is price of the last metaorder's child order; p_0 is price of the last deal before metaorder's execution; ε is the sign of metaorder, $\varepsilon = \pm 1$.

- 2 Only large metaorders were chosen:

$$I > 0, \quad (5)$$

$$\frac{Q}{V} > \frac{1}{n} \sum_{i=1}^n \frac{Q_i}{V_i}, \quad (6)$$

where Q_i is the size of i -th metaorder; V_i is the daily trade volume for share of i -th metaorder; $n = 141\,420$.

- 3 Chosen metaorders were split into a learning sample and a control sample as 9:1. So, the learning sample included 12 042 metaorders.

Finally, there have been obtained coefficients' estimates $\hat{Y} \approx 1.4$ and $\hat{\delta} \approx 0.4$, e. d.

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

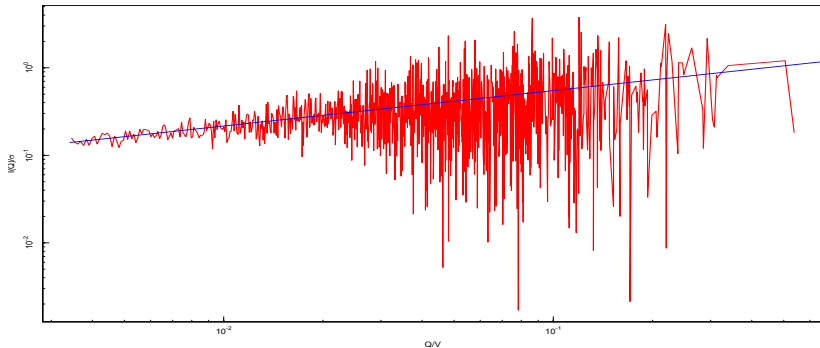


Figure 3. Price Impact of Large Metaorders

- Dependence of Price Impact on market's liquidity concepts (tightness, depth, resiliency);
- Further investigation of Price Impact law (E.g., see *E Zarinelli, M Treccani, JD Farmer, F Lillo. Beyond the square root: Evidence for logarithmic dependence of market impact on size and participation rate*);
- Price Impact of HFT's order flow.



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