A million metaorder analysis of market impact on the Bitcoin

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Data

- Anonymous source: 13~14M trades with 1M uniquely identified (08/2011-11/2013)

- Claim: Largest and complete market on Bitcoin so far

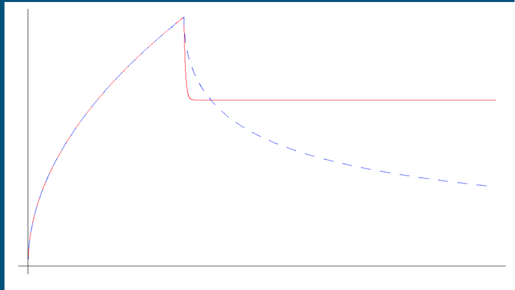
Presenting Points

- Long-term power-law decay?

- Square-root law?

- Y-ratio

- Permanent impact?



Power-law decay?

- Not power-law decay

- Execution speed is constant

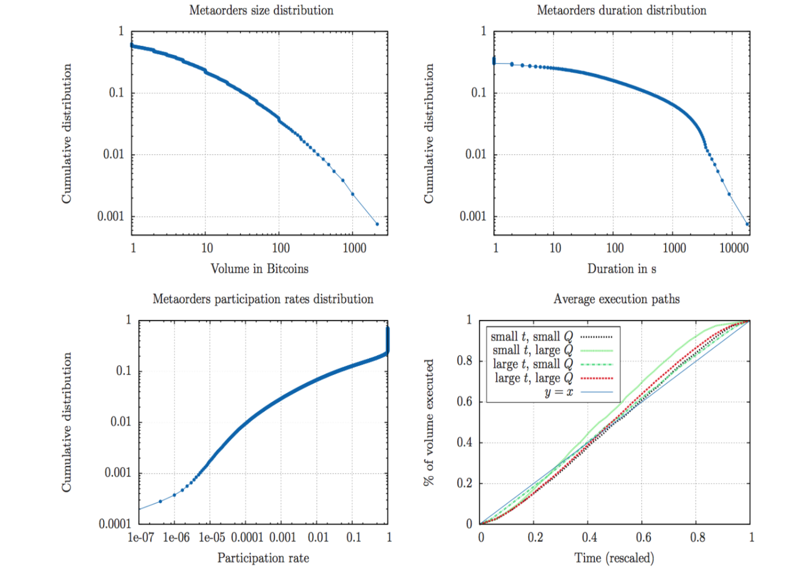


FIG. 3: *(top and bottom left)* Metaorder size, duration and participation rate distributions for the whole market, with no clear power-law fit for any. Note that the durations are much shorter than usual metaorder durations on financial markets. *(bottom right)* Percentage of volume executed vs time elapsed since the start of the metaorder, which appears to grow roughly linearly for all ranges of volume and duration (here the volume threshold between small and large has been fixed at 200BTC and the time threshold at 100s).

Square-root law?

$$I(Q) \approx \pm Y\sigma\left(\frac{Q}{V_D}\right)^{\delta}$$

$$\langle \mathcal{I}(Q,\mu)\rangle_{\mu} \approx \widetilde{Y} Q^{\delta}$$

- Execution speed is constant
- Peak impact is consistent with square root law
- Y-ratio: ~0.9 close to "mature" financial markets
- Square root impact trajectories

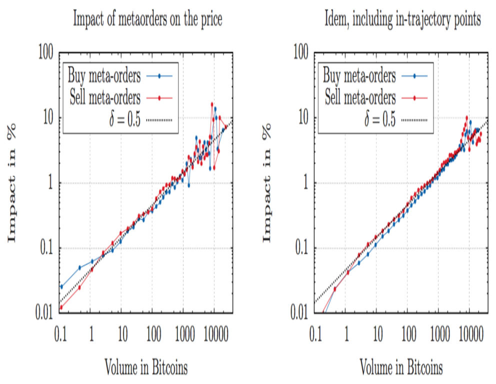


FIG. 5: Market impact $\langle \mathcal{I}(Q,\mu)\rangle_{\mu}$ (averaged over all execution rates μ), follows the same square root law as is observed by banks and hedge funds on financial markets (plots in log-log scale). Each point represents the average impact of all metaorders in a given range of volume. The impact exponent δ is found to be very close to 0.5, and the Y-ratio is around 0.9. One should emphasize that this power-law behaviour appears at the smallest scales and holds over 4 decades. *(left)* Only end points of metaorders (~1M data). *(right)* 41 point per metaorder (every 2.5% quantile of volume), giving 27M data points. Part of these points being degenerate, one can assess the number of effective points around a few millions.

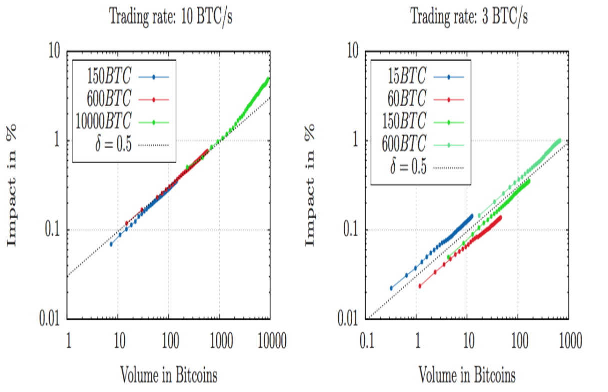


FIG. 6: Impact paths $\mathcal{I}^{\text{path}}(p,Q,\mu)$ in decimal loglog plot, for different metaorder volumes (cf. legends), for *(left)* $\mu = 10BTC/s$ and *(right)* $\mu = 3BTC/s$, and for $r \in [0,1]$ for each couple (Q,μ). The first value has intentionally been chosen high, so that it survives the criticism raised in Section 5 5.2 that on average other metaorders in the same direction are observed, which tends to artificially increase impact measures. One can observe a liquidity breakdown leading to an asymptotically linear impact when important pressures are maintained for too long on the same side of the order book.

Brokmann 2014 and Toth 2011a

Y-ratio

$$I(Q) \approx \pm Y \sigma \left(\frac{Q}{V_D} \right)^{\delta}$$

- Less studies on pre-factor or Y-ratio
- Non-stationariness of Pre-factor $\sigma_D/\sqrt{V_D}$ is well encoded in the ration
- Y-ratio is normal distributed

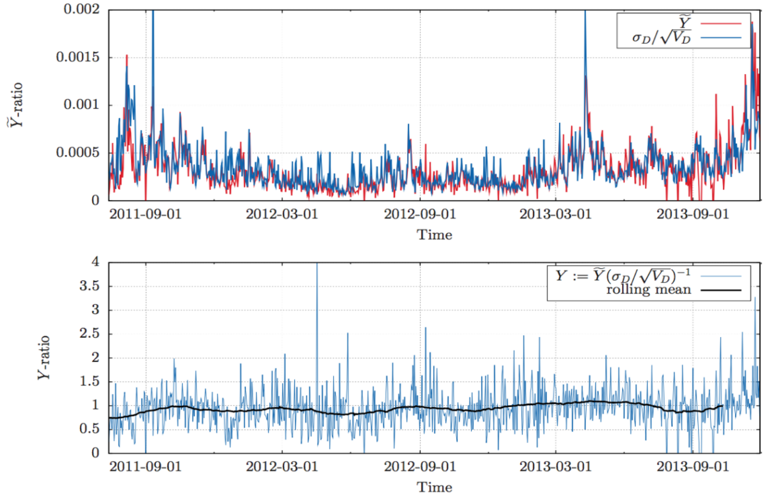
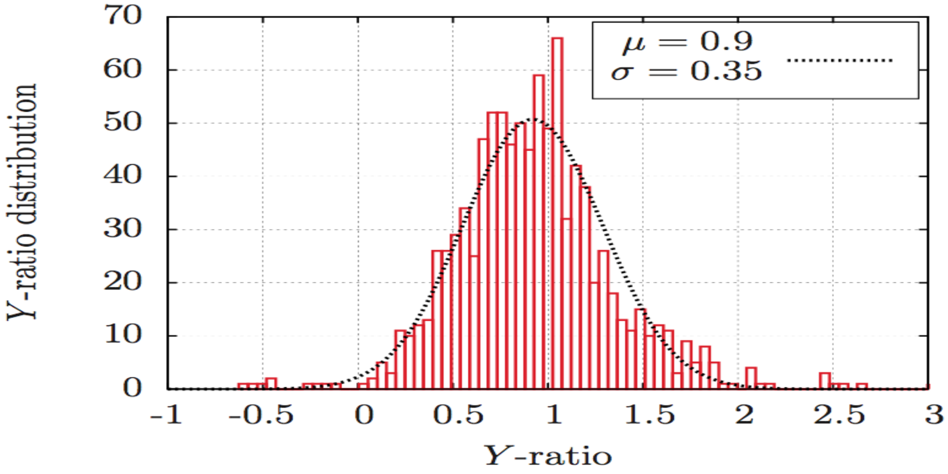


FIG. 7: *(top)* Raw impact pre-factor $\widetilde{Y}$ vs time. We also plot the usual normalization $\sigma_D\sqrt{V_D}$ to show that it accounts for the major part of the non-stationariness, particularly during extreme market events (e.g. April 10, 2013 major crash). *(bottom)* *Y-ratio* as defined in Eq. 1, which oscillates around its mean value $Y_0 \simeq 0.9$.



Grinold and Kahn 2000, Torre 1997, and Toth 2011a

Permanent impact?

$$\mathcal{I}^{\infty}_{\mathrm{mec}}(Q,\mu) \approx \mathcal{I}(Q,\mu) - \mathcal{I}^{\infty}(Q,\mu)$$

- Informed: positively correlated to the rest of the market
- Uninformed: uncorrelated
- Permanent impact of uninformed order is 0 or very small
- Mechanical peak impact

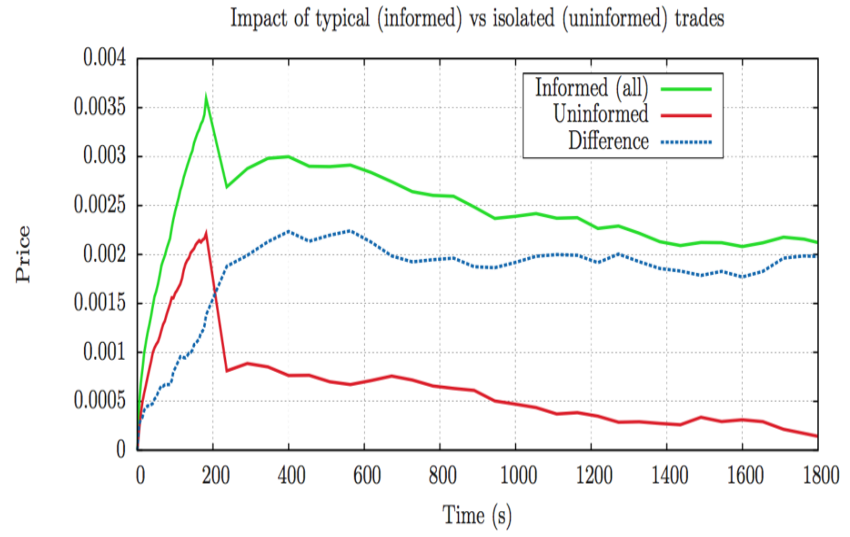


FIG. 12: Impact of "informed" metaorders vs. "uninformed" metaorders (i.e. isolated metaorders) on the opposite best price. While the former have a permanent impact due to their correlation with the residual order flow, the latter do not affect the price in the long run – or very few.

Gomes and Waelbroeck 2015

Questions?