

Discussion of “Supply-Demand Symmetry”

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Agenda

- Summary
- Discussion
- Conclusion

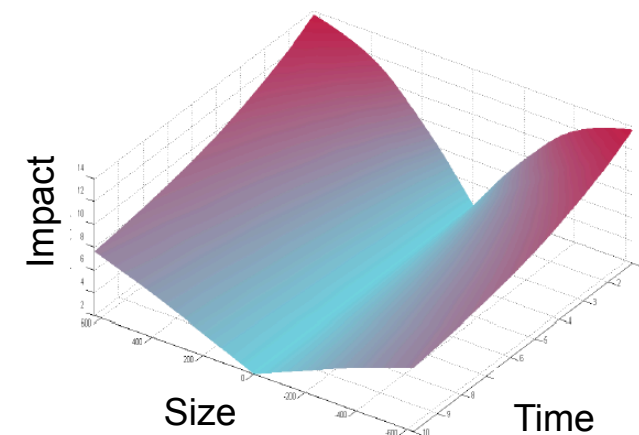
Summary

Motivation

- Question: what properties must a liquidity surface (LS) possess, when supply and demand are symmetrical?
- Initial intuition: even market impact $\bar{\mu}(s, T) = \bar{\mu}(-s, T) \quad \forall s, T$ as a function of order size s and execution time horizon T
- Does not make sense, e.g. stock price floored at zero, upside uncapped

➔ *Need definition based on invariance principle assuming equivalent liquidity on buy and sell side*

Liquidity Surface:



Source: Acerbi et. al, 2012

Summary

Defining Supply-Demand Symmetry

- Dual representation in FX market
- Insight extended to general securities where in a regular LS, supply and demand are symmetrical if

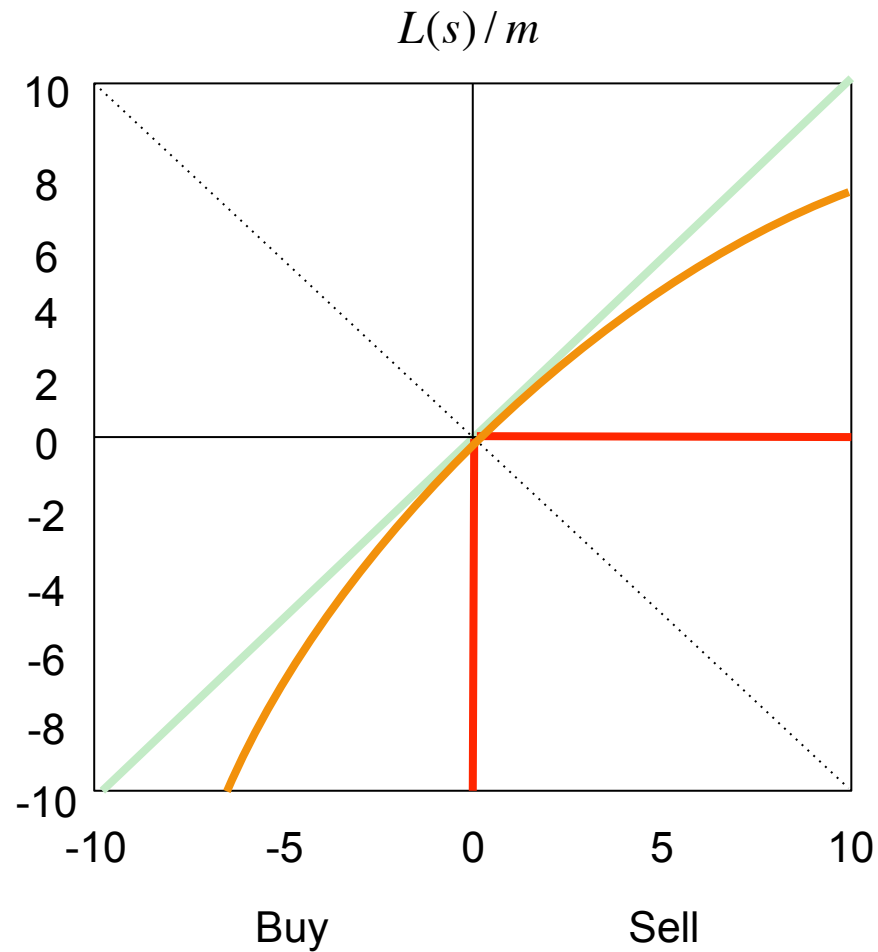
$$L(s) = -m\phi(s)$$

Where m is the fair value and the function $\phi : D \rightarrow D$

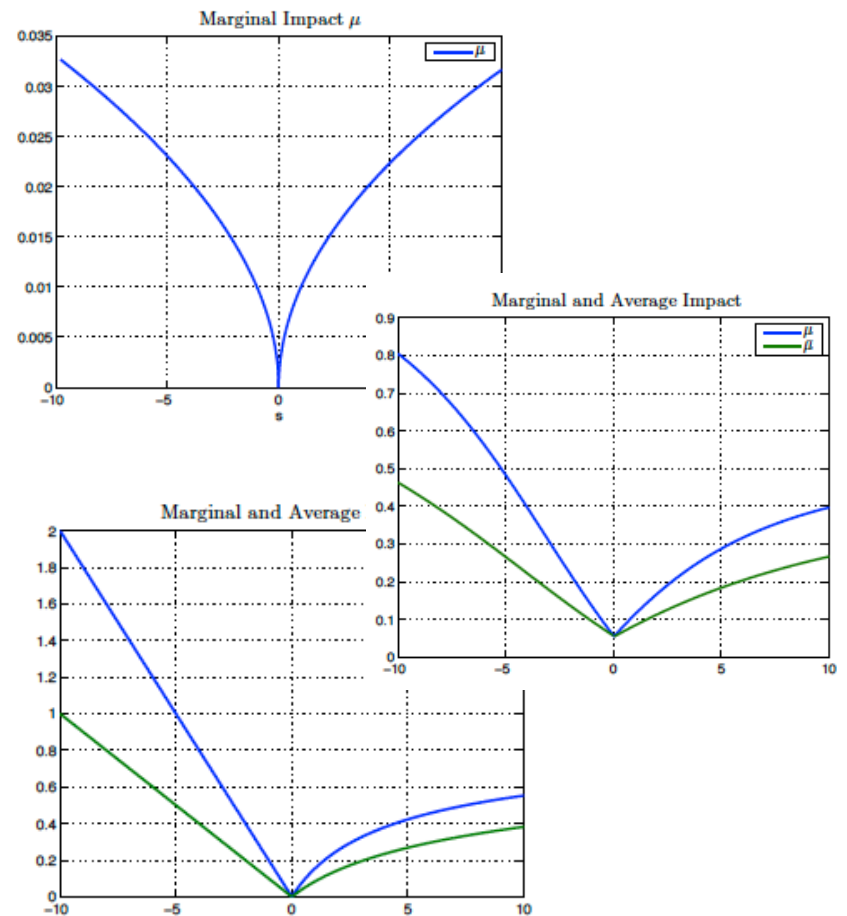
1. Is an involution $\phi = \phi^{[-1]}$
 2. Convex and strictly decreasing
 3. And $\phi(0) = 0$
- Conjugation relationship $s \leftrightarrow \tilde{s}$
 - Deviations from symmetry are excess of supply or demand

Summary

Supply-Demand Symmetry



Marginal and Average Impact:



Discussion

Contribution of this paper

- Formalization of supply-demand symmetry of liquidity surface
- Even impact function good approximation of symmetry only for small size scales and highly liquid markets
- Many cases possible where buy and sell side of security have the same liquidity, yet impact function not even
- Even impact always corresponds to excess supply, except in a perfectly liquid market
- Model independent definition, no assumptions
- Key claim: supply-demand equilibrium should be understood as symmetry not as even impact! Current impact models are biased to underestimating ask-side impact and overestimating bid-side impact.

Discussion

Open questions

- The proof of the pudding: can the theory be validated empirically?
- Data challenges: order book information, unrevealed orders
- Will it help devise better market impact models?
- At the moment theoretical contribution not risk management tool

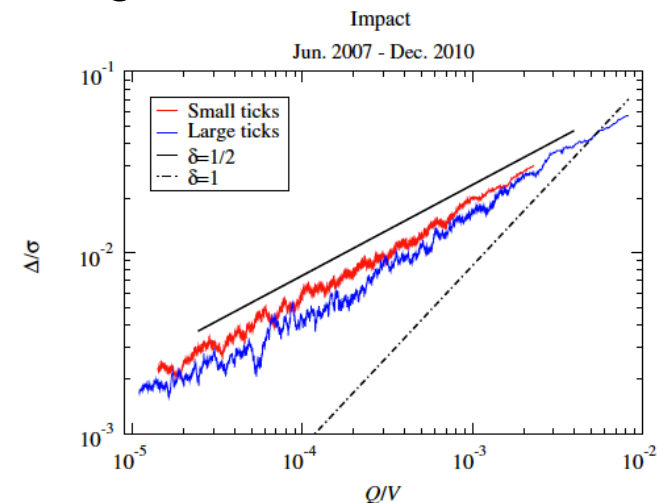
Discussion

Supply-Demand at Criticality

- Toth *et al.*, “Anomalous Price Impact and the Critical Nature of Liquidity in Financial Markets” (2011)
 - Analysis of impact of meta-orders, 500'000 trades in futures market
 - Average supply/demand V-shaped curve: locally linear latent order book, liquidity vanishes at current price
 - Anomalous high impact of small trades => markets close to critical state where small perturbations lead to strong non-linear effects

Square-root impact

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

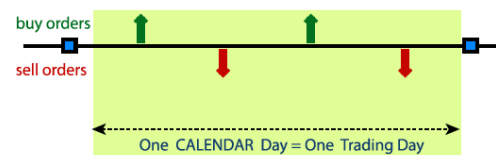


Discussion

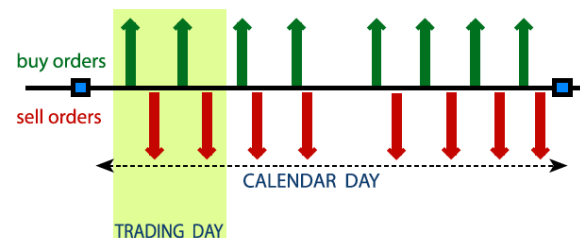
Market Impact under Invariance to Business Time

- Kyle and Obizhaeva, Market Microstructure Invariance and Stock Market Crashes (2011, 2012)
 - Scaling trades in units of business time rather than calendar time
 - Order flow imbalances (fraction of volume) result in greater price impact in larger liquid markets than in less liquid small markets
 - Speed of liquidation magnifies short term price effects
 - Quantification of systemic risks resulting from sudden liquidations

Benchmark Stock with Volume V^*
(γ^* , \tilde{Q}^*)



Stock with Volume $V = 8 \cdot V^*$
($\gamma = \gamma^* \cdot 4$, $\tilde{Q} = \tilde{Q}^* \cdot 2$)



Source : Presentation by A. Kyle and A. Obizhaeva "Market Microstructure Invariance", available under http://www.usc.edu/schools/business/FBE/seminars/papers/F_9-17-10_KYLEslides.pdf

Conclusion

- Symmetry as formal definition of supply demand equilibrium for liquidity surface
- Current models treating equilibrium as even impact biased to underestimating ask-side impact overestimating bid-side impact
- Challenge to apply insight to devise risk management tools (market impact, liquidity and systemic risk)

References

- B. Toth, y. Lempérière, C. Deremble, J. de Lataillade, J. Kockelkoren, and J.-P. Bouchaud, *Anomalous Price Impact and the critical Nature of Liquidity in Financial Markets*, Physical Review X 1, 021006 (2011)
- Kyle, Albert S. and Obizhaeva, Anna A., *Market Microstructure Invariants: Theory and Implications of Calibration* (December 12, 2011). Available at SSRN: <http://ssrn.com/abstract=1978932>
- Kyle, Albert S. and Obizhaeva, Anna A., *Large Bets and Stock Market Crashes* (August 1, 2012). Available at SSRN: <http://ssrn.com/abstract=2023776> or <http://dx.doi.org/10.2139/ssrn.2023776>