How to measure response functions in correlated financial markets

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1 Possible paper names (I will erase this when we choose a name)

The following are possible names for the paper:

– Details that influence the response functions results.
– Influence of the details in the response function measurement.
– Response function measurement in correlated financial markets.
– Response function calculation in correlated financial markets.
– Influence of the methodology in response functions results.

Or we can use another.

2 Introduction

The response function is used to study the mutual dependence between stocks. In [1], Bouchaud et al. use the response function

$$R(l) = \langle (p_{n+l} - p_n) \cdot \varepsilon_n \rangle \qquad (1)$$

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Where ε_n is the sign of the nth trade and the price p_n is defined as the mid-point just before the nth trade ($p_n \equiv m_{n^-}$). That means, the trade sign and the price have a shift of one second. The quantity $R(l)$ measures how much, on average, the price moves up (down) conditioned to a buy (sell) order at time zero, a time l later.

In a later work [3], S. Wang use the logarithmic return for stock i and time lag τ, defined via the midpoint price $m_i(t)$. The cross-response function is then defined as

$$R_{ij}(\tau) = \langle r_i(t-1, \tau) \cdot \varepsilon_j(t) \rangle_t \qquad (2)$$

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Finally, in [2], S. Wang et al. define the response function as

$$R_{ij} \left\langle \left(\ln m_i^{(f)}(t_j) - \ln m_i^{(p)}(t_j) \right) \cdot \varepsilon_j(t_j) \right\rangle_{t_j} \qquad (3)$$

For the price change of stock i caused by a trade of stock j.

Here, $m_i^{(p)}(t_j)$ is the midpoint price of stock i previous to the trade of stock j at its event time t_j and $m_i^{(f)}(t_j)$ is the midpoint price of stock i following that trade.

The difference between the definition in [3] and in [2], is that [3] measures how a buy or sell order at time t influences on average the price at a later time $t + \tau$. The physical time scale was chosen since the trades in different stocks are not synchronous (TAQ data). In [2], is used a response function on an event time scale (Totalview data), as the interest is to analyze the immediate responses. The time lag τ is restricted to one such that the price response quantifies the price impact of a single trade.

3 Data and time definition

In this study, we have analyzed trades and quotes (TAQ) data from the NASDAQ Stock Market in the year 2008.

4 Response functions

5 Time shift

6 Short- and long-response

7 Conclusion

8 Author contribution statement

All the authors were involved in the preparation of the manuscript. All the authors have read and approved the final manuscript.

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