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What drives the sensitivity of limit order books to company announcement arrivals?

Milla Siikanen [a,*], Juho Kanniainen [a], Arto Luoma [b,1]

[a] Department of Industrial Management, Tampere University of Technology, P.O. Box 541, FI-33101 Tampere, Finland
[b] School of Management, FI-33014 University of Tampere, Finland

HIGHLIGHTS

- We study illiquidity shocks following scheduled and non-scheduled announcements.
- We measure liquidity over multiple limit order book levels from high-frequency data.
- Recent losses amplify illiquidity shocks following non-scheduled announcements.
- Faster market reactions in terms of order book illiquidity lead to larger shocks.
- Larger asymmetry in the book before announcements is associated with larger shocks.

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ABSTRACT

We provide evidence that recent losses amplify order book illiquidity shocks caused by non-scheduled news. Moreover, the faster markets' reaction to scheduled and non-scheduled news arrivals is in terms of order book illiquidity, the more illiquid the order book becomes; that is, a fast reaction is a strong reaction. Additionally, order book asymmetry observed before announcement arrivals is positively associated with the magnitude of illiquidity shocks.

1. Introduction

Many studies show that information arrivals can cause liquidity shocks (see e.g. Erenburg and Lasser, 2009; Engle et al., 2012; Riordan et al., 2013; Rosa, 2016; Siikanen et al., 2017). However, to our knowledge there are no earlier studies investigating the factors which affect the magnitude of liquidity shocks in limit order books (LOB) caused by announcement releases. In this paper, we aim to explain the sensitivity of LOB liquidity to information arrivals using high-frequency LOB data for 75 companies from NASDAQ Nordic combined with set of scheduled and non-scheduled company announcements, for four-year period of 2006–2009.

LOB characteristics and the liquidity dynamics beyond the best levels are intriguing, especially around information arrivals, because high trading activity and investors' impatience may generate a sudden liquidity demand across multiple price levels. Thus, using the conventional bid–ask spread might lead to misleading results (Rosa, 2016; Sensoy, 2016; Siikanen et al., 2017). An appropriate method to characterise the LOB and to measure the LOB liquidity across multiple price levels should capture aspects with respect to both quantity (depth) over multiple levels and distances between the price levels. A popular approach is to estimate order book slope (see e.g. Deuskar and Johnson, 2011; Härdle et al., 2012; Malo and Pennanen, 2012; Siikanen et al., 2017), which in this paper is called Order Book Illiquidity (OBI).[2]

* Corresponding author.
E-mail address: milla.siikanen@tut.fi (M. Siikanen).
[1] Present address: Department of Mathematics and Statistics, P.O. Box 35, FI-40014 University of Jyväskylä, Finland.

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[2] Some other liquidity measures exist that incorporate data from multiple LOB levels, too, such as the Exchange Liquidity Measure (XLM). However, an issue arises with XLM, because this measure is determined for a specific trade size, yet the total

Siikanen et al. (2017) find that after the immediate illiquidity shock, scheduled announcements can improve LOB liquidity to exceptionally good level and provide evidence for pre-reaction in LOBs before scheduled announcements, which suggests the possibility of information leakage (see also Graham et al., 2006).[3] Additionally, Riordan et al. (2013) and Gomber et al. (2015) study liquidity over multiple LOB levels in equity markets around information arrivals. Apart from these studies, Erenburg and Lasser (2009), Engle et al. (2012), and Rosa (2016) combine multi-level LOB data with macro announcements, but with data from equity-index-linked securities market, the U.S. Treasury market, and futures market, respectively. However, none of these studies looks extensively into the factors driving the LOB sensitivity, which is the focus of this paper.

We use 20 order book levels to calculate OBI, and one should note that this may affect the results presented here. Specifically, Siikanen et al. (2017) show that spread behaves quite differently around announcement releases when compared to OBI, so it is also likely that OBI calculated for example over 5 or 10 levels behaves differently from OBI over 20 levels. Additionally, we restrict our analysis to liquid stocks, and the results for illiquid stocks may differ considerably.[4]

2. LOB parametrisation and liquidity measure

To parametrise the LOB, we follow Malo and Pennanen (2012). The shape of a LOB is linearly captured as follows:

$$r(h) = \mathrm{OBI} \cdot h,$$

where

$$r(h) := \ln(s(h/\bar{s})) - \ln(\bar{s}),$$

where $\bar{s}$ refers to mid-price, and $h = \bar{s}x$ is the mark-to-market value of a market order of x shares. Here OBI is positive and is considered to measure LOB liquidity (see Malo and Pennanen, 2012).[5] Obviously, the smaller the value of OBI, the more liquid the stock is.

We use simple linear regression to calculate the values of OBI based on snapshots of the LOB taken every 10 s including data from 20 best ask and bid price levels. In case there are not 20 different price levels available on one side of the book, we use as many as are available. We also eliminate the effects of the pre- and post-trading sessions and exclude the first and last trading hours from the data.[6] In addition, we de-seasonalise the observations of ln(OBI).

3. Data

We use LOB data from 1.1.2006 to 1.1.2010 for 75 frequently traded stocks listed on NASDAQ OMX Helsinki, Stockholm, and Copenhagen, which are continuous limit order based markets. The stocks in our sample have been involved at some point in OMX Helsinki 25, OMX Stockholm 30, or OMX Copenhagen 20. Out of the 75 stocks, 27 are traded in Helsinki, 28 are traded in Stockholm, and 20 are traded in Copenhagen.[7]

The news data in this study come from NASDAQ OMX Nordic's website.[8] The announcement times are given at one second precision in the data, but because we sample the LOB data every 10 s, the times of the announcements are rounded to the nearest 10 s. We do not restrict our study to any specific news class, such as earnings announcements, as many other studies do. Rather, we re-categorise the announcements into two specific groups: scheduled and non-scheduled announcements (see Siikanen et al., 2017 for the categorisation). The final sample contains 408 scheduled and 2,629 non-scheduled announcements: 35%, 45%, and 20% originate from NASDAQ OMX Helsinki, Stockholm, Copenhagen, respectively. Over 70% of the scheduled announcements in the final sample are financial announcements.

4. Empirical analysis

4.1. Framework of the empirical analysis

An estimation window comprises observations with 10-second frequency from 27 days preceding the day of an event. An event window consists of two sub-windows: a 30-minute pre-window and another 30-minute post-window. We denote the set of observation times from the estimation window by $\mathcal{E}$, from the pre-window by $\mathcal{A}^-$, and from the post-window by $\mathcal{A}^+$, and from the whole event window by $\mathcal{A}$.

4.2. Regression variables

The dependent variable measures the relative magnitude of LOB illiquidity shock due to the release of information:

$$\Delta\ln(\mathrm{OBI})^{\mathrm{Max}}_{\mathcal{E},\mathcal{A}+} = \max_{t\in\mathcal{A}^+}[\ln(\mathrm{OBI})_t] - \ln(\mathrm{OBI})^{\mathrm{Med}}_{\mathcal{E}},$$

where

$$\ln(\mathrm{OBI})^{\mathrm{Med}}_{\mathcal{E}} = \underset{t\in\mathcal{E}}{\mathrm{Median}}[\ln(\mathrm{OBI})_t],$$

is a median observation from the estimation window.

We choose the explanatory variables to capture pre-reactions in the LOB, the sign (positiveness/negativeness) of new information, and the markets' reaction times. The first explanatory variable, $\ln(\mathrm{OBI})^{\mathrm{Med}}_{\mathcal{E}}$, is used to control for the preceding level of ln(OBI) (for the ask and bid sides separately).

Second, the expectations of the effects of the announcements may be visible in the pre-announcement window, which can indicate information leakage (see e.g. Lee, 1992; Graham et al., 2006; Siikanen et al., 2017). Intuitively, if the liquidity available on the ask side is exceptionally low in comparison to the bid side, it might be that the markets are expecting a positive announcement and vice versa. So, our second explanatory variable is the maximum

multi-level depths on the bid and ask sides vary in time and consequently, the LOB is not always deep enough to allow us to calculate XLM for a given order size. This is an issue especially just before scheduled announcements.

[3] Siikanen et al. (2017) use largely the same data sets as we use in this study.

[4] We thank an anonymous referee for pointing out these important observations.

[5] Malo and Pennanen (2012) refer to LOB illiquidity as β, but for clarity, we refer to it as OBI, since in the finance literature β usually refers to CAPM β.

[6] For stocks traded on OMX Helsinki and OMX Stockholm, we remove an additional half-hour from the end of the trading day because of the different length of the trading day in comparison to OMX Copenhagen.

[7] We use data from Nordic markets instead of U.S. markets (the most liquid in the world) because the former are little fragmented in comparison to the latter. In the United States, fragmentation is clearly an important feature of equity markets (O'Hara and Ye, 2011). Another advantage of using Nordic data from less liquid markets is that, as Butt and Virk (2015) argue, "it is more appropriate to test liquidity-related models in markets that are sufficiently illiquid to diagnose the level and strength of bearing [...] risks".

[8] http://www.nasdaqomxnordic.com/news/companynews, see the page also for detailed information.