Journal of Empirical Finance 25 (2014) 134–148

Contents lists available at ScienceDirect

Journal of Empirical Finance

journal homepage: www.elsevier.com/locate/jempfin

Intraday asymmetric liquidity and asymmetric volatility in FTSE-100 futures market

Ju Xiang [a,b,*], Xiaoneng Zhu [b]

[a] South University of Science and Technology of China, 1088 Xueyuan Ave, Nanshan, Shenzhen, Guangdong, China
[b] Chinese Academy of Finance & Development, Central University of Finance and Economics, 39 South College Road, Haidian District, Beijing 100081, China

ARTICLE INFO

Available online 2 November 2013

JEL classification:
G11
G12

Keywords:
Asymmetric volatility
Intraday
Bid–ask match
Ask depth
Order book

ABSTRACT

In this study, we use both quote and trade data for the FTSE-100 futures for 2001–2004 in order to examine asymmetric volatility in the context of extreme sells. We define extreme sells as ask quotes that involve large percentages of total depth, selling orders executed at prices much closer to bids than to asking prices, and consecutive sell-initiated trades. Sell trades tend to demand higher liquidity than buys, while extreme trading conditions demand more liquidity than non-extreme ones. In extreme sells, liquidity demand surpasses supply. We show that asymmetric liquidity (quote demand vs. supply) better explains the asymmetric volatility observed in high-frequency data than trade information does. Ask-depth share plays a dominant role in asymmetric volatility, while order flow (sell-initiated volume share) makes a far smaller contribution.

1. Introduction

Volatility clustering and asymmetric volatility effect on financial returns are two established results of financial econometrics. Large price changes tend to be followed by additional large changes, and the volatilities of most financial asset returns are negatively correlated with lagged returns (Alexander, 2001; Cao and Tsay, 1992; Heynen and Kat, 1994; Koutmos and Booth, 1995; Pagan and Schwert, 1990).

The two prevailing economic explanations of asymmetric volatility involve the financial (operational) leverage effect (Schwert, 1989) and the impact of time-varying expected volatility on expected returns (Campbell and Hentschel, 1992; French et al., 1987). Volatility feedback suggests that a stock price declines because it has to be anchored to a lower price level, which corresponds to the higher equity return required by an expected increase in volatility.

Bekaert and Wu (2000) and Wu (2001) have examined both hypotheses in a unified framework. They both find that volatility feedback is an important determinant of asymmetric volatility. However, Avramov et al. (2006) argue that neither leverage nor volatility feedback explains asymmetric volatility for daily or high-frequency data, because daily or intraday changes in firm leverage and expected returns are negligible. Instead, they link intraday asymmetric volatility to trade behaviors and show that liquidity-driven selling trades increase daily volatility following price declines for NYSE-listed stocks.

In our study, we examine five-minute FTSE-100 futures quotes and trading behaviors, and test the asymmetric volatility effect by using regressions similar to those used in Avramov et al. (2006), who show that order flow can explain volatility asymmetry. Our explanation based on quote flow expands on Avramov et al.'s (2006) findings and existing literature in several ways.

The first contribution of our work is that it extends the concept of trade impact (order flow in Avramov et al. (2006)) to that of trade pressure (quote flow). Existing research has only examined one part of trading impact, associated with *realized* trades, while ignoring the impact induced by *unrealized* trades through quote flows. Avramov et al. (2006) find that the share of sell-initiated

* Corresponding author at: South University of Science and Technology of China, 1088 Xueyuan Ave, Nanshan, Shenzhen, Guangdong, China.
E-mail address: xiangfin@gmail.com (J. Xiang).

0927-5398/$ – see front matter © 2013 Published by Elsevier B.V.
http://dx.doi.org/10.1016/j.jempfin.2013.10.008

trade volume in total trading volume, when examined without quotes, significantly explains asymmetric volatility. However, we show that the ask-depth share as a percentage of total best-quote depth is much more significant in explaining asymmetric effects in FTSE-100 futures data than sell-volume share does.

In our study, we measure selling pressure with ask-depth share; selling eagerness, which is a trade price's relative position in the bid–ask spread; and the consecutiveness of sell-initiated trades. We find that, under heavy selling pressure, ask-depth share associated with negative lagged unexpected returns significantly increases return volatility. Sell-initiated volume shares, when similarly explored, are much less significant in explaining asymmetric volatility. These regression results show that quote flow can be more informative than order flow data.[1] This result has methodological implications, as it suggest that statistical models that ignore quote flow, such as that in Chordia et al. (2002), may not be well-specified.

Our second contribution to research is the examination of sell- and buy-run situations. A sell-run (buy-run) is defined as three or more consecutive sell-initiated (buy-initiated) trades. We find that trade and quote behaviors in runs are different from those in non-runs, and that those in sell-runs are different from those in buy-runs. Avramov et al. (2006) do not explicitly examine extreme-selling situations, even though asymmetric volatility is, by definition, much more related to large negative returns, while Huang and Wang (2009) link the asymmetric price effect in extreme market crashes to liquidity.

The documented liquidity asymmetries and the significance of ask-depth share in affecting volatility regressions help us propose a liquidity-based explanation for the asymmetric volatility effect, which complements Avramov et al.'s (2006) trade-based explanation for high-frequency data. First, quote data (ask and bid depth, spread, and quote money flow) are intrinsically good proxies for liquidity. Second, when there is a negative unexpected return associated with heavy selling pressure, sell orders tend to compete with each other for limited liquidity-supplying buying orders, causing prices to dive and volatility to spike. Selling orders following positive returns, however, are more likely to provide liquidity for buyers, and thus could dampen market volatility. Third, as quotes are three times more active than trades in terms of count and volume, our methodology allows us to capture a more detailed picture of financial market trading.

Our results are consistent with intuition. We find that when selling pressure is severe, the worst consequence of an asymmetric liquidity scenario is that sell orders can barely be filled at all, rather than that they can be filled eventually. When high selling pressure is combined with low bid depth, sellers must wait less long and sell at prices closer to bids.

Fire sales (like the three to six runs of sell-initiated trades examined in this paper) leave the market with little time to recover from the resulting lack of liquidity, and tend to drive buyers out of the market. This is because in the face of such relentless selling, most would-be buyers are worried about the private information behind the trades, and want to wait until information is released or prices stabilize. We find that sell-run eagerness increases in extremity from three to six runs. An avalanche effect of the simultaneous exhaustion of liquidity and price drops can occur, until most investors believe that the market is stable. Thus, the asymmetry between liquidity demand and supply produces asymmetric volatility, in that the price plummets initially but then rebounds as soon as investors realize that the market is oversold.

The rest of this paper is organized as follows. The next section introduces the data sample and presents descriptive statistics. Section 3 discusses hypotheses and methodologies. We present the results and robustness checks in Section 4, and Section 5 concludes.

2. Data

The FTSE-100 futures contract comprises the London International Financial Futures and Options Exchange's (LIFFE) electronically traded futures for the FTSE-100 equity index, which consists of the 100 most influential stocks listed on the London Stock Exchange (LSE). Our data of index futures and large stocks come directly from the LIFFE. Both trade and quote ticks are stamped in seconds from January 2001 to October 2004. The data consist of 958 trading days with recorded times from 6:00 to 17:30 for each day. We separate the data into five-minute intervals, starting at 6:00.[2]

Trades and quotes are not evenly distributed from 6:00 to 17:30. The electronic trading platform CONNECT™ opens trading at 8:00, but investors can start submitting orders at 6:00. Table 1 shows that much less trading occurs after 16:30, which is the daily settlement time for futures and the closing time for the LSE's regular equity trading. After 16:30, the mean (median) number of transactions is 54 (39) per five-minute period and the mean (median) number of traded contracts is 203 (123) per period. By contrast, the five-minute intervals between 8:00 and 16:30 experience a mean (median) of 95 (73) transactions and a mean (median) of 303 (221) contracts, which is roughly 50% more than during post-floor trading hours.

We also find that the best quotes change more frequently than trades execute, implying that quotes can be more informative than trades. Table 2 shows a mean (median) of 341 (269) total quotes[3] per five-minute period between 8:00 and 16:30, which is more than triple the trade counts of 95 (73) for the same span of time. The corresponding mean (median) inside depth (sum of inside ask- and bid-depth) is 6670 (4280) contracts, which is about 20 times the trade volume of 303 (221). There are fewer quotes after 16:30, with a mean (median) of 165 (136) quotes and mean (median) inside depth of 2627 (1664), which is less than half the amount between 8:00 and 16:30. Almost no quotes are made before 8:00.

1 Engle and Patton (2003) show that trades have impacts on quote prices for 100 NYSE stocks with varying trade frequencies.

2 Contract details are described in Appendix A. The LIFFE was acquired by the Euronext group in 2002. The raw data identify trade records as “T,” and bid and ask records as “A” and “B.” We choose data from 2001 to 2004 in order to minimize the impact of single stock futures (SSFs). SSFs began to trade on both the LIFFE and OneChicago exchanges in 2001 for the largest FTSE-100 component stocks, and the two exchanges have different yet overlapping trading hours, making measuring liquidity very difficult. The data period in this paper overlapped with the continuous introduction of SSFs. However, before 2005 they were thinly traded, without taking much liquidity from FTSE-100 index futures. This period covers both bear and bull markets, with a turning point in March, 2003.

3 As only quote data for best bid and ask were available, this number is the total count of best quote changes.