International Review of Financial Analysis 35 (2014) 190–206

Contents lists available at ScienceDirect

International Review of Financial Analysis

How does trading volume affect financial return distributions?☆

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ARTICLE INFO

Article history:
Received 12 August 2014
Received in revised form 1 September 2014
Accepted 6 September 2014
Available online 16 September 2014

JEL classification:
C5
F3
G15

Keywords:
Intraday data
Higher moments
Information theory
Fractional integrated VAR

ABSTRACT

We assess investors' reaction to new information arrivals in financial markets by examining the relationships between trading volume and the higher moments of returns in 18 international equity and currency markets. Our volume-volatility results support extant information theories and further contribute new evidence of cross market relations between volume and volatility. We also find that the direct impact of volume on the level of negative skewness is less significant for more diversified regional portfolios. Furthermore, the negative interaction between volume and kurtosis can be explained by the differences of opinion in financial markets. We observe stronger interdependence among higher moments in reaction to significant events, but the strength is dampened by trading volume. This result is consistent with trading volume being a source of heteroskedasticity in asset returns.
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1. Introduction

Understanding the role of trading volume in the reactions of financial market participants has long been an interesting area of research within Finance. That research contributes prominently to the knowledge of how investors process and react to unobservable information arrivals within different financial markets. A number of previous studies have highlighted the role of trading volume as a signal of informed trading.[1] However, the extant research has mainly focused on the explanatory power of trading activities for return volatility. This narrow focus can limit our understanding of different aspects of market participants' reactions. While the volume–volatility analysis can explain the sensitivity of investor behaviour towards new information, different reactions towards good or bad news (captured by skewness) and levels of "over-reaction" (captured by kurtosis) may be overlooked. Hence, there may be crucial, yet not well analysed, information transmission channels driven by the relationships between trading activities and skewness/kurtosis.

Our study provides an improved understanding on the influence of trading activities on the higher moments in financial return distributions that capture different aspects of market reactions. Fundamentally, these potential interactions between trading volume and the higher moment risks (volatility, skewness and kurtosis) characterizing empirical return distributions can be explained by three relevant information-based theories in the extant literature — specifically the mixture of distributions hypothesis (MDH), the sequential arrival of information hypothesis (SAIH) and the differences of opinion hypothesis (DOH).[2]

For the volume–volatility relation, the theories of MDH (e.g., Andersen, 1996; Clark, 1973; Epps & Epps, 1976; Tauchen & Pitts, 1983) and DOH (e.g., Harris & Raviv, 1993; Shalen, 1993) suggest a positive contemporaneous link; whereas, a lead–lag relationship

☆ We are grateful to the Australian Research Council for funding support (ARC Discovery Grant DP1093344). Hung Do acknowledges the Postgraduate Publication Award funded by Monash University. We thank the Securities Industry Research Centre of Asia-Pacific (SIRCA) for providing access to data employed in our study. We are also thankful to Prof. Katsumi Shimotsu for kindly sharing his code to estimate the degree of fractional integration in our data series.

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[1] For example, Kyle (1985) emphasizes order imbalance as an indication of informed trades and Chan and Fong (2000) conclude that order imbalance can account for a substantial portion of daily stock returns. Jones, Kaul, and Lipson (1994) find that daily volatility is primarily explained by the number of trades and Giot, Laurent, and Petitjean (2010) also find that the number of trades plays an important role in the volume–volatility relationship.

[2] The DOH hypothesis can be alternatively referred to as the dispersion of beliefs hypothesis (see Chen & Daigler, 2008) or the investor heterogeneity hypothesis (see Hutson, Kearney, & Lynch, 2008). For further discussion of the three theories, see Chan and Fong (2006); Girard and Biswas (2007); Chen and Daigler (2008) and Giot et al. (2010). Furthermore, the main explanations of these theories are provided in conjunction with our empirical results presented in Section 4.

http://dx.doi.org/10.1016/j.irfa.2014.09.003
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between them is added by an implication of SAIH (e.g., Copeland, 1976, 1977). Empirically, these theories have been widely tested and accepted in many studies conducted within stock or Foreign Exchange (FX) markets (e.g., Bauwens, Omrane, & Giot, 2005; Bjønnes, Rime, & Solheim, 2005; Chan & Fong, 2000; Chan & Fong, 2006; Gallant, Rossi, & Tauchen, 1992; Giot et al., 2010; Kalev, Liu, & Pham, 2004; Karpoff, 1987). While stock market reactions are well explained by information-based trading models (e.g., Andersen, 1996; Copeland, 1976; Epps & Epps, 1976), there is also much evidence to suggest that FX trading activities also convey information for currency market participants (see Evans & Lyons, 2002; Ito, Lyons, & Melvin, 1998; Naranjo & Nimalendran, 2000 among others). Similarly, equity and currency futures contract volume (among other futures contracts) are known to be informative for information flow in futures markets (Eastman & Lucey, 2008). However, little is known about the cross asset market (i.e., cross stock-FX market) relation between volume and volatility. Yet investor's cross-market investment and hedging activities are likely to form the basis of an information transmission mechanism between stock and FX markets. This explanation is supported by Francis, Hasan, and Hunter (2006), who emphasize the role of FX trading activities as an economic mechanism through which information is transmitted between stock and FX markets.

In terms of the volume–skewness relationship, the DOH theory predicts that the degree of negative skewness in returns is conditional on higher trading volumes (see Hong & Stein, 2003). However, in contrast to the volume–volatility literature, empirical studies on the volume–skewness relationship shows mixed results. The theory of Hong and Stein (2003) is supported by Chen, Hong, and Stein (2001) and Hutson et al. (2008) but not supported by Hueng and McDonald (2005) and Charoenrook and Daouk (2008). While a direct volume–skewness relationship is verified with firm-level data, the use of market level data shows little support for the relationship. Even though Hutson et al. (2008) provide empirical evidence on the theory postulated in Hong and Stein (2003) with national stock market data, the direct effect of volume on skewness only exists in 3 out of 11 cases. Albuquerque (2012) suggests that these conflicting results relating to skewness may be due to the different nature of skewness in firm- and aggregate market returns. While firm-level returns are always right-skewed, market-level skewness is almost always negative due to the "cross-sectional phenomenon". As firm- and market-level data clearly exhibit different degrees of diversification, it is also possible that portfolio diversification is responsible for the conflicting results. We verify the rationale of our conjecture by investigating the direct volume–skewness relationship with a particular focus on a regional portfolio context.

We further contribute to the literature by testing for the existence of volume–kurtosis interactions and whether it is consistent with the aforementioned information-based theories. New information arrival and the mechanism that incorporates information in the market are primary factors causing movements of asset prices (Andersen, 1996). Hence, the occurrence of extreme returns on the up- or down-side may be influenced subsequently. Wagner and Marsh (2005) support this assertion by uncovering the role played by "surprise volume" (i.e., unanticipated above-average trading activity) for volatility persistence and excess kurtosis. However, they exploit kurtosis as an additional variable in an attempt to extend knowledge about the relationship between trading volume and volatility clustering (see Lamoureux & Lastrapes, 1990), rather than emphasizing the importance of kurtosis per se. We differentiate our analysis with Wagner and Marsh (2005) in a sense that we focus on the importance of the volume–kurtosis relationship per se in light of the information-based theories.

Furthermore, instead of re-examining volume's impacts on higher moments separately, we allow for the possibility of interactions among them due to several reasons. The recent financial turbulence as well as a growing integration of national economies with their own geographical regions and the rest of the world consistently suggests that evaluation of financial risks needs to be conducted not in isolation. We should rather allow for the possibility that one risk can interact with and spillover to amplify other risks. For example, a sequence of recent financial crises, including the Sub-prime Mortgage Crisis in 2007 in the U.S., the 2008 Global Financial Crisis and most recently, the European Sovereign Debt Crisis suggest that the assessment of financial risks needs involve a systemic approach. A higher degree of integration between national economies leads to faster and stronger contagion effects with recent evidence that a downgrade of U.S. treasury bonds in mid-late 2011 significantly affected global financial markets. The contagion effects should not only highlight the transmission of risk across countries but also allow the probability of interaction between risks across markets. Empirically, some preliminary examinations using the correlation approach have revealed interdependence among higher-moment risks (e.g., Cooley, Roenfeldt, & Modani, 1977; Gupta & Chatiras, 2004). Recently, Caporale, Hunter, and Ali (2014) found evidence of causality-in-variance across stock and currency markets in advanced countries during the 2007–2010 crisis period. In our study, we support potential interdependence among higher-moment risks in both static (impulse response analysis) and dynamic (spillover index) approaches.

Additionally, this evidence of interconnections among higher moments motivates the need to investigate the influences of trading volume on the dynamic structure of cross-moment inter-relationships. The appearance and importance of higher-moment risks have been increasingly recognized in many financial activities, such as asset pricing, value-at-risk calculations and asset allocation (see Athayde & Flôres, 2003; Mandelbrot & Hudson, 2004 among others). Therefore, such financial activities can benefit from our analysis since the results from our study can help to evaluate volatility risk, downside risk and fat-tail risk under influences of new information arrival more precisely.

We base our study on intraday data to produce a better representation and more robust estimates for higher moments of asset returns. Furthermore, the use of intraday data is also consistent with the aforementioned market microstructure perspective as this literature is mainly focused on intraday patterns rather than inter-day dynamics.

We find that there is an unambiguously positive and significant relationship between trading volume and realized volatility both within and cross-stock and FX markets. Spillover of higher moment risks is stronger during more volatile periods and the spillover effects of trading volume onto particularly second and fourth moments are also amplified during times of market uncertainty. However, we find that the relationship between trading volume and negative skewness is starkly different in the context of a well-diversified regional portfolio as is the dampened effect of trading volume on skewness. Lastly, we observe that the strength of the linkages among higher moment risks varies over time with intra-regional and global developments.

The remainder of this paper is organized as follows. Section 2 explains the construction of variables used for analysis. Section 3 outlines the econometric framework. Section 4 discusses the empirical results of the impact of trading volume on financial return distribution. Section 5 analyses the influence of trading volume on the dynamic structure of the inter-relationships among higher moments and finally, Section 6 concludes.

2. Data

We extract 5-minute intraday data for stock market indexes and FX transactions in 18 countries from the Thomson Reuters Tick History (TRTH) database provided by the Securities Industry Research Centre of Asia-Pacific (SIRCA). The use of 5-minute intervals is suggested by Andersen, Bollerslev, Diebold, and Ebens (2001), Andersen, Bollerslev, Diebold, and Labys (2001), who demonstrated that simulations of this sampling interval produce mean square errors relatively close to the optimal interval. In the FX market, we use the US dollar (USD) as the

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