Global Finance Journal 20 (2009) 119–127

Contents lists available at ScienceDirect

Global Finance Journal

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

Empirical study on relationship between persistence-free trading volume and stock return volatility☆

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ARTICLE INFO

Article history:
Received 15 May 2008
Accepted 30 November 2008
Available online 10 June 2009

JEL classification:
G14

Keywords:
Information flow
Trading volume
Heteroskedasticity
Persistence-free trading volume
Stock return

ABSTRACT

A large body of literature finds that the unexpected trading volume, which is obtained by filtering out time trend, autocorrelation, can be used as a proxy of the information flow and can explain the heteroskedasticity of stock return in some degrees. In this paper, we find that the heteroskedasticity exists in the unexpected trading volume, and we further generate a new information proxy by filtering out the heteroskedasticity from the unexpected trading volume, termed "persistence-free trading volume". Our empirical results indicate that the persistence-free trading volume can explain the heteroskedasticity of the return better than the unexpected trading volume; moreover, the explanatory power of the persistence-free trading volume is positively related to market maturity.

1. Introduction

The price–volume relationship has been a hot research topic in finance for several decades. A large body of literature indicates that there exists a positive correlation between contemporaneous trading volume and price variability. In 1973, Clark first proposed the Mixture Distribution Hypothesis (MDH) to explain this positive correlation; later, Epps and Epps (1976), Tauchen and Pitts (1983) and Harris and Raviv (1993) further developed the theory based on the hypothesis. MDH assumes that asset price movement and trading volume are both determined by an unobservable flow of information; different pieces of information flowing into security markets will cause trading volume and price to move. Both trading volume and absolute return rate depend upon the same event, a positive correlation therefore arises between them. Clark regarded asset price

☆ This project was supported by the Natural Science Foundation of China (70425004, 70701035), Hunan Natural Science Foundation(09JJ1010) and the Key Research Institute of Philosophies and Social Sciences in Hunan Universities. The authors are grateful to the referee's insightful comments which made a big improvement of the paper.

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doi:10.1016/j.gfj.2008.11.002

as a subordinated stochastic process that varies with an inflow of unexpected information. Trading volume itself can thus serve as a proxy of the unobservable information flow and better explains the positive correlation between trading volume and price volatility.

Lamoureux and Lastrapes (1990) proposed that random information flow causes the price to move, and at the same time changes trading volume. Although information flow cannot be observed, trading volume can be used as a proxy variable. If trading volume is used as explanatory variable for heteroskedasticity of return rate sequence, it will absorb heteroskedasticity of variability of return sequence. Therefore in the GARCH model with trading volume introduced, the ARCH effect and the GARCH effect which represent the persistence of the heteroskedasticity of the return variability will decrease or even disappear; and the coefficients on the trading volume should be greater than 0. They chose 20 stocks of which options were traded in the Chicago Board Options Exchange as a sample to conduct an empirical research, and their results showed that the sum of the estimated coefficients for the ARCH term and the GARCH term changed from the previous value of about 1 to nearly 0 for all selected stocks. Later, the similar results were obtained in different security markets of different countries or regions. For example, Brailsford (1996), Phylaktis, Kavussanos, and Manalis (1996), Sharma, Mougoue, and Kamath (1996), Omran and Mckednzie (2000), Soo, Lee and Nam (2000), Tarun Chordia and Bhaskaran Swaminathan (2000), Bohl and Henke (2001), Ramaprasad Bhar and Shigeyuki Hamori (2004), Ho-Mou Wu and Wen-Chung Guo (2004) and etc. Some researchers further studied positive relationship between return variability and trading volume in terms of financial economy. For example, Andrew W. Lo and Jiang Wang (2000), Guillermo Llorente, Roni Michaely, Gideon Saar, and Jiang Wang (2002), Vicentiu and Lilian (2004), Jeff Fleming, Chris Kirby and Barbara Ostdiek (2006), Anirut Pisedtasalasai and Abeyratna Gunasekarage (2006).

A large body of literature documents that there exists a time trend and an autocorrelation in trading volumes, and therefore researches on trading volume and price variability generally filter out time trend and autocorrelation from trading volume. However, in our study we find that there still exists a clustering of volatility in trading volume even after filtering out time trend and autocorrelation. Therefore, in this paper we filter out time trend, autocorrelation and clustering of volatility from trading volume sequence and use the new sequence as a proxy of information flow to study the relationship between trading volume and price volatility. We find that the new sequence of trading volume can better explain heteroskedasticity of stock return, and its explanatory power is related to maturity of markets.

2. Models

For the return rate, this paper takes the logarithm of continuous compounding interest: $R_t = 100 * \ln(P_t / P_{t-1})$, where P_t is closing price at time t. The regression model for return rate is: $R_t = \mu_{t-1} + \varepsilon_t$, where μ_{t-1} represents conditional average of R_t based on all previously available information. The model is an ARCH model if ε_t satisfies the following condition:

$$\varepsilon_t = \sqrt{h_t} \cdot \upsilon_t, h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 \tag{2.1}$$

Where υ_t is a white noise. In order to capture volatility clustering of return rate sequence, ARCH model often has a very large regression order q, which makes the model quite complicated. To overcome the difficulty, Bollerslev (1986) proposed the GARCH model:

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \theta_j h_{t-j} \tag{2.2}$$

In light of MDH, Epps and Epps (1976), Lamoureux and Lastrapes (1990) proposed to adopt trading volume as proxy variable for information flow in the GARCH model, and proposed a GARCH-V model to study the price–volume relationship:

$$h_t = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^{p} \theta_j h_{t-j} + \beta V_t \tag{2.3}$$

In the early stage, researchers directly input trading volume into the above model to estimate relationship between trading volume and price variability. But Admati and Pfleiderer (1986) discovered