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Causality between trading volume and returns: Evidence from quantile regressions

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ABSTRACT

We analyse the causality between past trading volume and index returns in the Pacific Basin countries. OLS results indicate no causal link between volume and returns. However, the quantile regression method reveals strong nonlinear causality: positive for high return quantiles and negative for low ones. Causality in quantiles is not a statistical artefact of causality in periods of high volatility, i.e., causality does not occur in a clustered manner. Causality in quantiles helps to explain the lack of causality between volume and raw returns on the one hand and a strong causal relationship between volume and return volatility on the other.

1. Introduction

Trading volume, despite its intensive use by practitioners, has long been playing second fiddle to stock returns in academic research. For instance, the development of asset pricing models such as the CAPM dates back to the early 1960s, but trading volume was incorporated into this theoretical framework only relatively recently.[2] Several theoretical models have been developed, including the sequential information arrival hypothesis (Copeland, 1976), the mixture of distribution hypothesis (Clark, 1973), and market models of asymmetry in information endowment (Gallmeyer et al., 2005; He & Wang, 1995; Kyle, 1985; Llorente et al., 2002), information precision (Schneider, 2009), or interpretation of news (Harris & Raviv, 1993; Kandel & Pearson, 1995), which allow us to derive testable hypotheses about both contemporaneous as well as lagged relationships between trading volume and stock prices. In addition, Blume et al. (1994) have shown analytically that trading volume might act as an indicator of the quality of information revealed by prices, hence providing a theoretical explanation for a wide use of volume

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[2] For instance, Acharya and Pedersen (2005) derive an asset pricing model in which illiquidity, a concept related to trading volume, is priced in equilibrium.

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in forecasting future stock returns, e.g., by technical traders. Kramer (1999) shows that trading volume, through its impact on transaction costs, is a risk factor, hence a relationship between returns and volume emerges in equilibrium.

A related branch of the literature which includes theoretical works by Campbell et al. (1993); Wang (1994), and Llorente et al. (2002) has argued that volume is in a complex relationship with stock prices: rather than linearly causing one another, volume interacting with contemporaneous price movements was shown to influence the subsequent stock returns, with this relationship depending additionally on the agents' predominant motive to trade. In a nutshell, if trading is motivated by private information (liquidity/hedging needs), prices on days of heavy trading should display continuations (reversals) on subsequent days, resulting in positive (negative) stock return autocorrelation.

Despite strong theoretical underpinnings, the evidence in favour of a contemporaneous correlation between trading volume and returns is mixed and weak at best (Karpoff, 1987 offers a review of the relevant literature on this matter). More relevant to this study, the equally well theoretically grounded notion of causality from past trading volume to returns does not find a strong empirical support, either. For instance, Lee and Rui (2000) report that volume does not predict the next day's index returns on the Chinese A and B markets in Shanghai and Shenzhen. Chen et al. (2001) report no causal link in France, Italy, Japan, the UK or the US. No volume–return causality is found by Lee and Rui (2002) for Japan, the US and UK, by Rashid (2007) for Pakistan, and by Pisedtasalasai and Gunasekarage (2007) for five South-East Asian emerging markets, either. Chuang et al. (2012) find volume to cause returns in only two out of ten Asian markets analysed, and Chen (2012) reports for S&P500 trading activity to affect subsequent returns only in bear markets but no volume–return causality when both market phases are considered jointly. However, some studies do report the existence of volume–return causality, e.g., Saatcioglu and Starks (1998) for Latin America.

Moreover, predictions of a more complex, nonlinear relationship between volume and subsequent returns find some empirical support (Hiemstra & Jones, 1994; Moosa & Silvapulle, 2000), albeit Diks and Panchenko (2006) show the Hiemstra and Jones's (1994) methodology to suffer from statistical problems and the volume–return causality to be very weak once these issues have been accounted for. A recent paper by Chuang et al. (2009) uses quantile regressions to show that for the NYSE, S&P 500 and FTSE 100 indices past trading volume exerts a positive (negative) impact on returns from the top (bottom) of return distribution, and Lin (forthcoming), using the same methodology, confirms these findings for six emerging Asian markets. The failure of previous literature to account for this nonlinear causality might have resulted in incorrect inference about the (non-existence of the) volume–return relationship.

In this paper, we further investigate the nature of the volume–return causality. First, we investigate the intertemporal nature of the nonlinear causality revealed by Chuang et al. (2009): do the cases of positive (negative) causality cluster in time, rendering the causality phenomenon useful for predicting returns based on past volume? Or are these cases of significant positive and negative causality emerging randomly in the sample, hence impossible to predict and to act upon? Second, is the phenomenon described in Chuang et al. (2009) and further investigated in our paper a universal feature of the financial markets worldwide, i.e., do their and our results hold for markets outside the original sample? Third, we investigate whether any of the existing theoretical frameworks can offer an interpretation of the nonlinear causality findings, and come to the conclusion that in light of some theoretical models they should have come as no surprise.

The contributions of this paper are as follows. Firstly, for a set of mature and emerging Pacific Basin countries we show that positive (negative) volume–return causality in high (low) return quantiles is not limited to one market but seems to be a common feature across countries. Secondly, volume–return causality is demonstrated to be of non-persistent nature, implying its limited use for return forecasting and support for the efficient market hypothesis. Thirdly, we demonstrate how the uncovered pattern of causality in quantiles can be understood within the theoretical framework of price responsiveness to informed and liquidity trading, as described by Campbell et al. (1993); Wang (1994) and Llorente et al. (2002). Lastly, we show how the finding of volume–return causality in quantiles helps to understand a widely reported phenomenon of linear volume-volatility causality.

The remainder of this paper is organised as follows. Section 2 describes the empirical methods applied in this study. Section 3 presents the data and empirical results. In Section 4, we discuss the theoretical models which, in our opinion, predict the positive (negative) volume return causality in high (low) quantiles. Section 5 offers a summary of this study.

2. Methodology

2.1. Causality

According to Granger (1980), a random variable Y_t causes another random variable X_{t+1} if, for a set A,

$$\text{Prob}(X_{t+1} \in A | \Omega_t) \neq \text{Prob}(X_{t+1} \in A | \Omega_t - Y_t) \quad \text{for some} \quad A.$$

Ω_t denotes the information set containing all the knowledge available up to and at time t. Hence, the causal relationship exists if Y_t has got some unique information about X_{t+1}. An operational form of this definition can be derived, too. Hence, Y_t will not cause X_{t+1} with respect to an information set J'_t if $F(X_{t+1}|J_t) = F(X_{t+1}|J'_t)$,where F is a distribution function, J_t includes all past and current values of X_t but not of Y_t and J'_t includes past and current values of both X_t and Y_t. Hence, the above definition states that Y_t does not cause X_{t+1} if Y_t does not contain any information about X_{t+1} beyond that contained in the past values of X_t. Based on