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Volatility and market structure☆

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Abstract

This study examines volatility within three related intra-day series – transaction returns, quote midpoint returns, and limit order book midpoint returns – for a set of NYSE-listed stocks. We document statistically significant GARCH effects both overall and surrounding earnings announcements in all three series for the majority of stocks in the sample. We then compare the extent of volatility clustering among the series. In addition, the relation between volatility and market structure is examined via a set of cross-sectional regressions, and relations among the series over time are studied in a vector autoregressive framework. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

The fact that the variance of stock returns changes over time is well documented in the finance literature. Much of the existing research describes

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the time-variation in volatility using some form of ARCH or GARCH model (Engle, 1982; Bollerslev, 1986).[1] For example, French, Schwert, and Stambaugh (1987) find GARCH effects in monthly S&P returns and Cheung and Ng (1992) and Engle and Mustafa (1992) find ARCH effects in daily returns for individual stocks. While the existence of conditional heteroskedasticity in asset returns is well documented, this phenomenon is not well understood.

In addition to documenting volatility clustering in financial series, the work in this area has focused on determining its cause. One commonly offered explanation is a similar clustering of news or information arrival. There is some evidence in support of this hypothesis (e.g. Engle et al., 1990); however, the underlying cause of the news clustering is not known. The possibility that changes in macroeconomic conditions affect volatility has also been investigated. For example, Campbell (1987) and Glosten et al. (1993) find a relation between volatility and interest rate levels. A third explanation, which has received less attention, relates conditional heteroskedasticity to micro-level factors. Lamoureux and Lastrapes (1990) find that the ARCH coefficient (α) is no longer significant when trading volume is incorporated into a GARCH model. Bollerslev and Domowitz (1991) examine the relation between price volatility and trading mechanisms in a futures market setting. They find that returns for transactions executed via the Globex futures trading system exhibit GARCH effects, while returns for transactions accomplished through an open outcry mechanism do not.

Despite this extensive literature, little conclusive evidence has emerged regarding the underlying cause of volatility clustering. Consequently, we adopt a slightly different approach to increase our understanding of this phenomenon. Rather than directly studying a particular cause, we compare the degree of volatility clustering across a set of financial series that provide a natural controlled experiment. Specifically, we examine three distinct, yet related return series – a transaction series, a quote midpoint series, and a limit order book midpoint series – for each individual stock in our sample. As a result, we are able to examine the way in which the three series relate to one another and to isolate differences in their relation to the market structure. This comparison is unique because it analyzes the properties of conditional variance series for the same asset over the same time period. The only differences among the three series are the participants (liquidity providers versus liquidity demanders) and the private information they each possess.

Our analysis documents conditional heteroskedasticity in all three return series overall, as well as surrounding earnings announcements. In other words,

[1] See Bollerslev et al. (1992) for a detailed survey of the application of ARCH models to stock market data. Stochastic volatility models are an alternative to ARCH-type models. See, for example, Andersen (1996).

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