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Physica A 344 (2004) 221–226

PHYSICA A

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# Large price changes on small scales

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Received 15 December 2003

Available online 23 July 2004

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## Abstract

In this study we examine the evolution of price, volume, and the bid–ask spread after extreme 15 min intraday price changes on the NYSE and the NASDAQ. We find that due to strong behavioral trading there is an overreaction. Furthermore, we find that volatility which increases sharply at the event decays according to a power law with an exponent of  $\approx 0.4$ , i.e., much faster than the autocorrelation function of volatility.

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PACS: 89.65.Gh

Keywords: Price evolution; Volatility outburst; Behavioural finance

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## 1. Introduction

Research in the past years has revealed that extreme price changes are not outliers, they are significantly frequent. Analyzing how markets react to such extreme events

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is crucial in order to understand the price formation process on the market. Economists have analyzed how markets react to large daily price changes and significant overreaction was found in the past, although markets seem to be getting more and more efficient over time [1]. These extreme price changes may at least partially be due to news arriving on the market, although not all events can be easily attributed to major events [2]. Previous studies have revealed that the autocorrelation of returns on the stock markets is significant for only 15–20 min [3]. Thus it seems reasonable that major events take place within the trading day and daily data is not appropriate to fully understand market reaction. We will thus investigate the intraday market evolution of prices, volume and the bid–ask spread after extreme price changes of 15 min.

Furthermore, the effect of external price shocks has been analyzed on multi-agent model simulation of stock markets [4] and these studies show that in case there is behavioral trading on the stock market there is an overreaction to external price shocks and market volatility increases sharply at the event [5]. Thus if we are able to localize extreme intraday price changes, we will probably get an insight into the process in which the agents of different behaviors form the new equilibrium market price.

## 2. Defining large intraday events

The dataset used is the Trades and Quotes (TAQ) database of the NYSE for the years 2000–2002. The TAQ database is that supplied by the NYSE: it includes all transactions and the best bid and ask price for all stocks traded on the NYSE and on the NASDAQ. We include all stocks in our sample traded on the first trading day of 2000 both on NASDAQ and on the NYSE. A minute-to-minute dataset is generated using the last transaction, and the last bid and ask prices during every minute. Since we examine intraday price formation, we will only include liquid stocks in our sample. We define liquid stocks as those for which at least one transaction was filed for at least 90% of the trading minutes of the stocks included in the DJIA during the 20 pre-event trading days.

We are studying the intraday reaction to large price shocks but we have not yet defined what we mean under the term “large price changes on small scales”. Defining intraday 15 min events is not an easy task because volatility is higher on average at the beginning and at the end of the day. Two trivial methods are at hand:

1. *Absolute filter*: Using this first method, we look for intraday price changes bigger than a certain level of let us say 4% within 15 min. In this case, we have to face several problems. Most of the events we find will occur during the first or last couple of minutes of the trading day because of the U-shape intraday volatility distribution of prices. These events represent the intraday trading pattern instead of extreme events. Another problem is that a 4% price jump may be an everyday event for a volatile stock while an even smaller price move may indicate a major event in case of a low volatility stock.

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