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Fat tails and volatility clustering in experimental asset markets

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Abstract

This paper presents results from experimental asset markets with asymmetric fundamental information. We observe leptokurtic returns and a slowly decaying autocorrelation function of absolute returns. In contrast to results from heterogeneous agent models (HAMs), we find that noise has no significant influence on the emergence of fat tails. Instead, we observe a significantly positive relationship between the degree of heterogeneity of fundamental information and absolute returns, which suggests that heterogeneous fundamental information is the source of fat tails. With respect to volatility clustering, we discover an intra-periodical pattern where absolute returns decrease after the arrival of new asymmetric fundamental information.

JEL classification: C16; C91; D82; D83

Keywords: Asymmetric information; Experimental economics; Fat tails; Volatility clustering; Stylized facts

1. Introduction

In this paper, we want to tackle the question of the origins of the leptokurtic distribution of returns and the volatility clustering property, the most common cited stylized facts in the literature.

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The studies of Mandelbrot (1963a, b) and Mandelbrot and Taylor (1967) were the first to show that returns on financial markets are not Gaussian, but exhibit excess kurtosis ('fat tails'). This is supported by more recent work by Bouchaud and Potters (2001), Cont (1997, 2001), Dacorogna et al. (2001), Mantegna and Stanley (2000), Plerou et al. (1999), Rachev (2003), Voit (2003), and others. Mandelbrot suggests that returns in financial markets are non-Gaussian stable Levy processes, which was later called Stable Paretian Hypothesis (Rachev, 2003, p. ix). Press (1967) suggests compound Poisson processes for the variance parameter of normal distributions as reason for the emergence of fat tails and Clark (1973) claims that finite-variance distributions like the lognormal–normal distribution fit data in financial markets better than any stable regime. He explains his statement with the different evolution of price series on different days due to varying information. Trading may be slow on days when no information is available. When new information appears on the market, the price process evolves much faster.

Over the past 10 years, many different approaches have been developed to reproduce these stylized facts in artificial markets with heterogeneous agents, the so-called HAMs—heterogeneous agent models—(e.g. Brock and Hommes, 1998; Brock and LeBaron, 1996; Hommes, 2002; Iori, 2002; Kirman and Teyssière, 2002; LiCalzi and Pellizzari, 2003; Lux, 1995, 1998; Lux and Marchesi, 1999, 2000; Raberto et al., 2001; Youssefmir and Huberman, 1997). In two seminal papers, Lux and Marchesi (1999, 2000) attribute volatility clustering and the emergence of fat-tailed returns mainly to the agents' switching between fundamentalist and chartist strategies. Other models (e.g. Youssefmir and Huberman, 1997; Brock and Hommes, 1998) find similar results. Once a certain threshold value of chartists is exceeded, the system becomes unstable and extreme returns occur. During these regimes, prices deviate strongly from their fundamental values, creating bubbles or crashes. As a consequence, the fundamentalist strategy becomes more profitable, inducing more and more agents to switch from a chartist to a fundamentalist strategy. This switching behaviour slowly brings prices back towards the fundamental value and is the stabilizing device of the system, causing a slow decay in the autocorrelation function of absolute returns.

Plott and Sunder (1982) were the first one to report excess kurtosis and the lack of autocorrelation of returns in price data generated in an experimental market. However, they do not deliver an explanation of the observed properties.

Our experimental asset markets show that noise trading (trading not based on fundamentals) does not play a major role for the fat-tail property of returns which stands in contrast to HAMs that use a chartist/fundamentalist framework. Instead, heterogeneity of fundamental information is the driving force for trading, volatility, and ultimately the emergence of fat tails. Furthermore, in HAMs the slow decay of the autocorrelation function of absolute returns is usually caused by increasing numbers of chartists switching back to a fundamentalist strategy. Our results do not corroborate this, but we find an intra-periodical pattern of decreasing absolute returns after the arrival of new fundamental information. Again, noise does not play a role for the emergence of this stylized fact.