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On the persistence and volatility in European, American and Asian stocks bull and bear markets

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A B S T R A C T

In this paper we examine the statistical properties of several stock market indices in Europe, the US and Asia by means of determining the degree of dependence in both the level and the volatility of the processes. In the latter case, we use the squared returns as a proxy for the volatility. We also investigate the cyclical pattern observed in the data and in particular, if the degree of dependence changes depending on whether there is a bull or a bear period. We use fractional integration and GARCH specifications. The results indicate that the indices are all nonstationary I(1) processes with the squared returns displaying a degree of long memory behaviour. With respect to the bull and bear periods, we do not observe a systematic pattern in terms of the degree of persistence though for some of the indices (FTSE, Dax, Hang Seng and STI) there is a higher degree of dependence in both the level and the volatility during the bull periods.

1. Introduction

This paper deals with the analysis of the persistence in the level and in the volatility of several stock market prices in different countries. In particular, we focus on the behaviour of three US stock markets (Standard and Poor 500; Dow Jones and Nasdaq), three European markets (FTSE; CAC and DAX) and three Asian (Nikkei, Hang Seng and STI) indices. However, instead of focussing exclusively on their behaviour across the whole sample period, we also examine the properties in the bull and bear periods,

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testing if the degree of persistence is different in these periods in our series. In the same line we also investigate the volatility of the series and the subseries according to the bull and bear periods.

Many empirical papers have studied stock market volatility during bull and bear periods. A number of authors have found that volatility is higher during bear markets than in bull periods, including Maheu and McCurdy (2000), Edwards et al. (2003), Gomez Biscarri and Perez de Gracia (2004), Jones et al. (2004), Gonzalez et al. (2005), Guidolin and Timmermann (2005), Nishina et al. (2006), Tu (2006), etc. On the other hand, persistence is highly related with volatility. Various authors have found that periods of high volatility are also persistent and occur during periods of stock market declines. The analysis of persistence in the level and in the volatility of stock markets is important for several reasons: first, if stock market prices are persistent, either with mean reverting behaviour or alternatively with long memory returns it means that there is margin for prediction in its behaviour showing clear inefficiencies in the markets. Second, volatility is a proxy for investment risk. Thus, persistence in volatility implies that the risk and return trade-off changes may also be predicted over the business cycle. Moreover, persistence in volatility can be used to predict future economic variables (Campbell et al., 2001). Thus, we examine in this paper the degree of dependence in the series not only in the level but also in the squared returns which are taken as proxies for the volatility series. For these purposes we will employ fractional integration or I(d) models, along with GARCH specifications. Note that the use of long memory techniques to describe financial prices may be of interest for market analysts as well as mutual fund managers and portfolio managers since they can get benefits from the inefficiencies in the markets. Thus, for example, investors can potentially improve the risk-adjusted performance of their portfolios by using long memory models, which are more flexible and general than other standard models as we will explain in the following section.

The outline of the paper is as follows: Section 2 briefly describes the methodology employed in the paper. Section 3 presents the data and the empirical results, conducting the analysis first for the whole sample period, and then for each bull and bear sub-period in each series. Section 4 contains some concluding comments.

2. Methodology

We model persistence by means of long range dependence (LRD) or long memory techniques. This is more general than other approaches employed in the literature such as the sum of the AR coefficients (Andrews and Chen, 1994) or the largest AR root, as we will show below. There are two definitions of LRD, one in the time domain and the other in the frequency domain. The former states that given a covariance stationary process $\{x_t, \ t = 0, \pm 1, \ldots\}$, with autocovariance function $E[(x_t - Ex_t)(x_{t-j} - Ex_t)] = \gamma_j$, x_t displays LRD if

$$\lim_{T\to\infty} \sum_{j=-T}^{T} \left|\gamma_j\right| \tag{1}$$

is infinite. A frequency domain definition may be as follows. Suppose that x_t has an absolutely continuous spectral distribution, and therefore a spectral density function, denoted by $f(\lambda)$, and defined as

$$f(\lambda) = \frac{1}{2\pi} \sum_{j=-\infty}^{\infty} \gamma_j \cos\lambda j, \quad -\pi < \lambda \le \pi. \tag{2}$$

Then, x_t displays LRD if the spectral density function has a pole at some frequency λ in the interval $[0, \pi]$, i.e.,

$$f(\lambda) \to \infty, \quad \text{as} \quad \lambda \to \lambda^*, \quad \lambda^* \in \quad [0, \pi], \tag{3}$$

(see McLeod and Hipel, 1978). Most of the empirical literature has focused on the case when the singularity or pole in the spectrum occurs at the zero frequency ($\lambda^* = 0$). This is the case of the standard $I(d)$ models of the form: