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The use of the Hurst exponent to investigate the global maximum of the Warsaw Stock Exchange WIG20 index

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ABSTRACT

The WIG20 index – the index of the 20 biggest companies traded on the Warsaw Stock Exchange – reached the global maximum on 29th October 2007. I have used the local DFA (Detrended Functional Analysis) to obtain the Hurst exponent (diffusion exponent) and investigate the signature of anti-correlation of share price evolution around the maximum. The analysis was applied to the share price evolution for variable DFA parameters. For many values of parameters, the evidence of anti-correlation near the WIG20 maximum was pointed out.

1. Introduction

To meet the challenge of the evaluation of the models predicting behavior of financial markets [1] the research based on an analogy between a financial market and a complex dynamical system was performed and the scaling invariance was discussed [2,3]. Further, the Hurst exponent [4] in connection with the scaling invariance was examined [5–8]. Hence the log-periodic oscillation characteristic for the system before it reaches the phase transition point (crash) was investigated [9–14]. Finally, the local properties of the time series and the local Hurst exponent were used [15–22] to investigate financial markets and search for signals of coming crashes.

The WIG20 index reflects the behavior of 20 major and most liquid companies traded on the Warsaw Stock Exchange [23]. The index since 14th April 1994 has been generated; its first value equaled 1000 points. The WIG20 is a price-based index and accounts only for prices of underlying shares. Its value – at the trading point t – is calculated according to the following equation [23]:

$$WIG20(t) = \frac{M(t)}{K(t)M(t=0)} I(t=0) = \frac{\sum_{i=1}^{20} P(i,t)S(i,t)}{K(t)\sum_{i=1}^{20} P(i,t=0)S(i,t=0)} I(t=0), \tag{1}$$

where $M(t=0)$ is the capitalization of the WIG20 portfolio at the baseline date of 14th April 1994; $I(t=0)=1000$ is the basic index value at the baseline date; $S(i,t=0)$ is the emitted number of shares of the ith company at the baseline date; $P(i,t=0)$ is the share price of the ith company at the baseline date; $S(i,t)$ is the emitted number of shares of the ith company; $P(i,t)$ is the share price of the ith company and finally $K(t)$ is the index adjustment factor at time t. The companies

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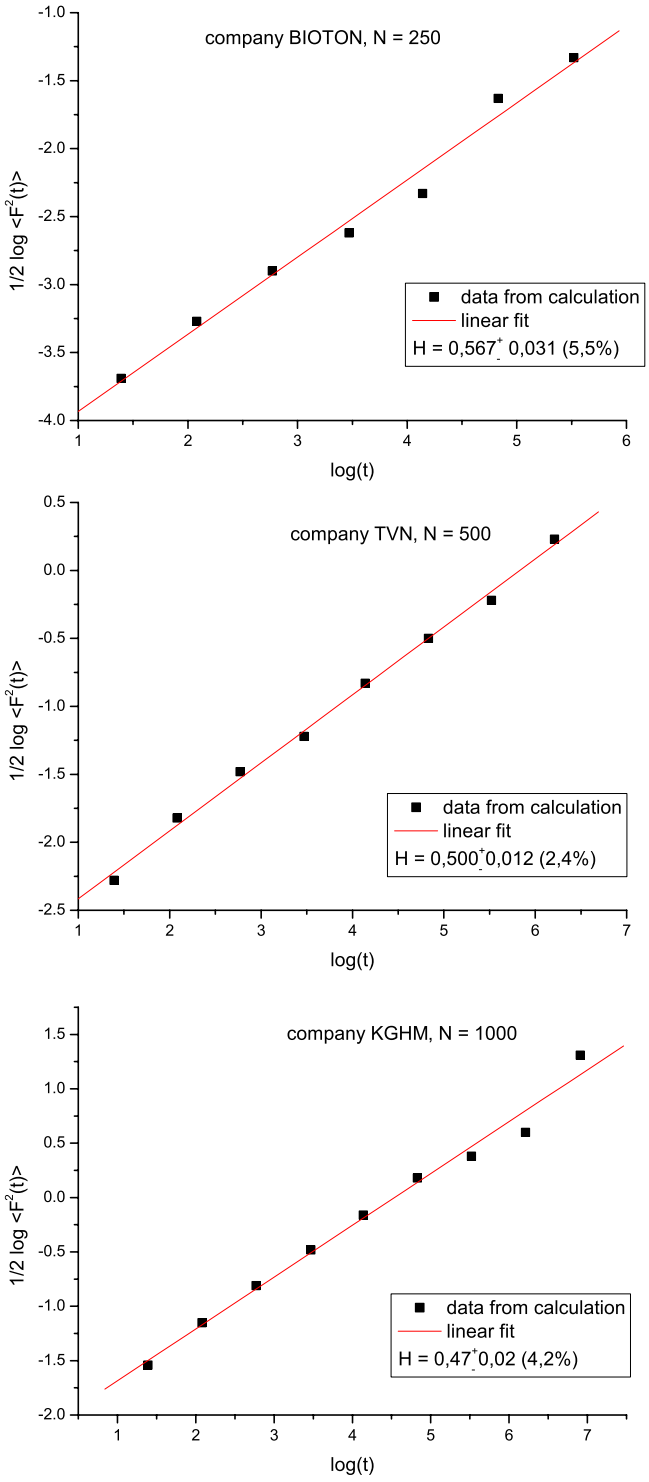

Fig. 1. Examples of the linear fitting log $\langle F^2(t)\rangle$ vs log(t) used to calculate the Hurst exponent.

involved in the WIG20 are selected on the base of data of the last trading session on the Warsaw Stock Exchange in January, April, July and October each year, however there may also be some extraordinary alternations. When changes in the WIG20 composition are made, the index adjustment factor $K(t)$ will be recalculated [23],

$$K(t) = \frac{M(t)}{M(t')}K(t'), \tag{2}$$