

# Report on Bachelor/Master Thesis

Institute of Economic Studies, Faculty of Social Sciences, Charles University in Prague

<b>Student:</b>	Jakub Jeřábek
<b>Advisor:</b>	prof. Ing. Miloslav Vošvrda, CSc.
<b>Title of the thesis:</b>	Multifractal nature of financial markets and its relationship to market efficiency

## **OVERALL ASSESSMENT** (provided in English, Czech, or Slovak):

The thesis focuses on presence of long-range dependence in financial time series. The theoretical part (Chapters 2 to 5 – 37 pages) provides quite extensive review of relevant methods whereas the applied part (Chapters 6 and 7 – 17 pages) focuses on Monte Carlo simulations and application on several exchange rates, DJIA and PX.

As already mentioned, the theoretical part shows many methods for estimation of Hurst exponent  $H$  or integration parameter  $d$ , which are interconnected, together with description of different AR(F)IMA methods. Even though the whole part is well interconnected and structured logically, it contains several formal issues. Firstly, the referencing of charts is completely omitted. Secondly, the description of estimation methods is usually provided only with the basic referencing (e.g. Hurst, 1951 for R/S, Lo, 1991 for M-R/S and Peng et al., 1994 for DFA). However, such approach leaves out several important points of Hurst exponent estimation and mainly the choice of optimal scales which has crucial influence on the estimate. Thirdly, the section 5.1.1 focuses on R/S analysis but is inconsistent. The method presented is not in hand with the one that is normally used in the literature (Figure 5.1 presents classical method and is thus out of context with the rest of the section). Fourthly, the thesis contains “multifractal” in its title, yet it neither presents nor uses any multi-fractal method.

The applied part is divided into two chapters – one shows Monte Carlo simulations for chosen methods and the other shows estimates for several exchange rates, DJIA and PX together with bootstrapped confidence intervals. There are several interesting results (mainly superiority of R/S to other methods with strong AR component) which are, however, only weakly interpreted and not compared to the results of literature on the topic. Moreover, even though the author claims that simulations took only several minutes, he provides only 100 simulations for each method whereas 10 000 simulations are standard in relevant literature. As for the bootstrapped confidence intervals, the chosen parameters are not explained (number of simulations, length of blocks). Overall, reader gets a “black-box” feeling not only from mentioned bootstrapped method but also from the R/S and DFA methods where the different scales and scales in general are not discussed at all.

In the conclusion, the author states that the goal of the thesis was to show relationship between persistence and efficiency, yet there was no such attempt in the text as there was no connection between efficiency and long-range dependence shown. Generally, the thesis uses advanced methods and shows interesting results. Unfortunately, the interpretation is poor and author missed a chance to uncover more interesting implications.

Possible questions for defense:

- „What are the possible reasons for difference between simulated Monte Carlo simulations and bootstrapped confidence intervals for specific exchange rates/stock indices?“
- „How is long-range dependence specifically connected to market efficiency?“

In the case of successful defense, I recommend “**velmi dobře**” (good, 2).

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## **SUMMARY OF POINTS AWARDED** (for details, see below):

<b>CATEGORY</b>	<b>POINTS</b>
<i>Literature</i> (max. 20 points)	12
<i>Methods</i> (max. 30 points)	22
<i>Contribution</i> (max. 30 points)	20
<i>Manuscript Form</i> (max. 20 points)	16
<b>TOTAL POINTS</b> (max. 100 points)	<b>70</b>
<b>GRADE</b> (1 – 2 – 3 – 4)	<b>2</b>

**NAME OF THE REFEREE:** Ladislav Krištoufek

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