Modelling multifractality and efficiency of GCC stock markets using the MF-DFA approach: A comparative analysis of global, regional and Islamic markets☆

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HIGHLIGHTS

- This paper studies the multifractality and efficiency of international stock markets.
- We apply the MF-DFA approach.
- The results show evidence of multifractal features in all markets.
- Long memory is higher in the long-term than in the short-term in small fluctuations.
- GCC stock markets are least efficient in both the short- and long-term.

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ABSTRACT

This paper studies the multifractality and the dynamic weak-form efficiency of five GCC stock markets, comparing them to global, Islamic and regional markets, using a Multifractal Detrended Fluctuation Analysis (MF-DFA) approach. The results show that all stock market returns exhibit multifractal features. Most importantly, we find evidence of time-varying persistence, which is higher in the short-term than in the long-term. The persistence decreases as the time scale increases. Moreover, the efficiency is sensitive to time horizons (short- and long-term). GCC stock markets are less efficient than the global, regional and Islamic markets. Our results have important policy implications for investors and portfolio managers.

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1. Introduction

The efficiency market hypothesis (EMH) in its weak form is crucial for investors, portfolio managers and policy makers. It implies that all available and relevant information (i.e. historical sequence prices or returns) are immediately embodied in

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asset prices.[1] This guides the decisions of investors and allows potential investors to formulate decisions based on specific information. For this reason, testing this hypothesis has important implications for optimal asset allocation, investment strategies and forecasting. In fact, price predictions are impossible in an efficient market since there are no accurate patterns in asset price dynamics—the best prediction is that the process is random. Thus, investors may not be able to beat the market to gain excess returns on their investments.

Since the seminal work of Fama [1], a large body of literature has addressed the efficiency of stock markets. These studies assume that the level of market efficiency remains stable. In the last decade, however, researchers have demonstrated that the efficiency in financial markets is time varying. To date, the question of whether a stock market is efficient remains open despite the use of different empirical methods on the part of researchers. The dynamic efficiency of international stock markets has been investigated using advanced econophysics approaches, including the Hurst exponent, Shannon entropy, detrended fluctuation analysis and unit root tests. For instance, Cajueiro and Tabak [2] measure the Hurst exponent to evaluate the dynamic efficiency of developed (US and Japan) and emerging stock markets. Risso [3] uses the Shannon entropy formula to assess the weak-form efficiency for five stock market indices (Japan, Malaysia, Russia, Mexico and the US). These studies provide evidence of time-varying efficiency and of higher efficiency levels in developed stock markets, as compared to emerging markets.

This study aims to analyse the weak-form efficiency of the Gulf Council Cooperation (GCC) stock markets (Bahrain, Kuwait, Oman, Qatar and UAE). We also include global and regional stock markets for comparison. The global stock market is reflected by the Morgan Stanley Capital Index (MSCI), while the regional indexes include MSCI GCC, MSCI emerging market, MSCI emerging Asia, MSCI Europe, MSCI North America. We also include the Dow Jones Islamic stock markets (DJIM) index, as the Islamic stock market has grown over the last decade and offers a new investment opportunity. The DJIM index acts as a hedge and safe haven asset during financial meltdowns [4].

This paper contributes to the existing literature by expanding the empirical literature on efficiency theory by examining the multifractality and dynamic weak-form efficiency of stock markets in the oil-rich economies. However, it uses global, regional and Islamic stock markets as a reference for investors so that policy makers can compare the status of their market to conventional benchmarks and Islamic stock markets, allowing for the option to diversify. We decided to include these markets to gauge the efficiency of GCC markets compared to the global, regional and Islamic markets. It is worth mentioning that the GCC countries have similar economic, geographical and religious characteristics. Furthermore, the Gulf economies implement a unified economic agreement and are gradually moving toward a single market and monetary union [5]. A series of financial reforms have been adopted to develop the GCC stock markets by making the banking sector more competitive, deepening and broadening local equity markets, improving Shariah-compliant financing and promoting more efficient debt markets, among other things.[2] Most importantly, these countries have opened their stock markets to foreign investors. Empirically, we use the MF-DFA method developed by Kantelhardt et al. [6], which is useful for detecting trends. This method allows for a reliable multifractal characterisation of multifractal nonstationary time series [7]. It also considers long-range dependence and evolving efficiency through stock price dynamics. The robust MF-DFA technique makes it possible to quantify the multiple scaling exponents within a financial time series. It is worth noting that this method allows us to examine the multifractality in nonstationary financial time series. The MF-DFA method provides useful information on the long-range memory, persistence and efficiency of markets.

Our results show strong evidence of multifractal features for global, regional, Islamic and GCC stock returns. The dynamics in the small fluctuations of the considered stock markets show a more definite long-memory feature than the large ones. Moreover, the persistence is higher in the short-term than in the long-term for small fluctuations compared to larger ones. Furthermore, the efficiency of stock markets is dynamic and varies under different timeframes. In the long-term, the global stock market is most efficient, followed by the region North America, DJIM index and European markets; Bahrain has the least efficient market. In the short-term, we find that the Kuwaiti stock market is the most efficient market, followed by regional, global and Islamic markets. The Islamic stock markets are ranked 7 in the short-term and 3 in the long-term. The heterogeneity of the efficiency levels among the considered markets indicates a possibility of diversifying investments and improving asset allocation.

The remainder of this paper is structured as follows: Section 2 presents the literature review; Section 3 discusses the methodology; Section 4 describes the data and summary statistics; Section 5 reports and discusses the empirical results; Section 6 concludes the paper.

2. Literature review

The efficiency theory remains a controversial theory despite the large body of studies that have examined the EMH. Abraham et al. [8] examine the random walk behaviour in Gulf countries, Grech and Mazur [9] use the Hurst exponent to investigate the DJIA index behaviour, and Lim [10] examines the existence of nonlinear serial dependence in five Middle Eastern and African stock markets using a series of nonlinearity tests. The results reveal that after removing all short-term linear dependence, the stock returns still contain predictable nonlinearities that contradict the unpredictable criterion of

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[1] Fama [1] distinguishes three forms of efficiency, namely weak-form efficiency, semi-strong-form efficiency, and strong-form efficiency.

[2] https://www.deutschebank.nl/nl/docs/DB_Research_-_GCC_financial_markets.pdf.