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# Time-varying efficiency of developed and emerging bond markets: Evidence from long-spans of historical data<sup>☆</sup>

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## HIGHLIGHTS

- The paper analyzes the Adaptive Market Hypothesis (AMH).
- Monthly data on government bond for US and UK South Africa and India were used.
- Analyses were conducted using time varying and long memory approaches.
- The efficiency of the four markets has been changing over time.
- The change depends on the prevailing economic, political and market conditions.
- The US bond market exhibits the highest degree of market efficiency.

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## ABSTRACT

Bonds have become an important part of investment portfolios for individuals as well as for institutions, particularly after the recent financial crisis. This paper empirically investigates the Adaptive Market Hypothesis (AMH) in two of the most established bond markets in the world: the US and UK and two emerging markets: South Africa and India, using monthly data series spanning very long time periods. We examine the long memory properties of the series using several long memory estimations methods and multiple structural breaks techniques to examine the possibility of time varying market efficiency. We then examine the weak-form efficiency of government bond markets, using a time varying approaches namely the state-space generalized autoregressive conditional heteroscedasticity in mean (GARCH-M) to date the time varying behavior of bond market efficiency. Results show that efficiency of these markets has been changing over time, depending on the prevailing economic, political and market conditions. Further, we observe that the degree of the weak-form efficiency of these markets has been gradually improving recently. In particular, the US government bond market has been highly efficient, showing the highest degree of market efficiency among the four bond markets. Overall, our results suggest that the AMH provides a better description of the behavior of government bond returns than the Efficient Market Hypothesis (EMH).

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## 1. Introduction

Bond markets are divided into two categories, depending on the legal status of the issuer. Corporate bond markets refer to debt instruments issued by private and public corporations whereas sovereign bond markets include debt instruments whose borrowers are nation states. Bond markets play a central role in firm and government financing as well as in the asset allocation strategies. Bonds are issued by companies and government to fund their day-to-day operations or to finance specific projects. In a time of crisis, investors prefer safer and more liquid financial instruments. So as markets become volatile, especially during times of market turmoil, many investors turn to bonds as an alternative to stocks, since they are often deemed a “safe” asset. These effects are commonly known as flight to quality and flight to liquidity, as investors substitute safe assets for risky assets. Thus, bonds can play an integral role in portfolio selection and management. For bond investors looking for low risk investments, government bonds are typically the best bet, as they are backed by the full faith and credit of the government. Moreover, government bonds are more homogeneous in issuance characteristics than corporate bonds, which are different not only in the quality of the issuer but also in the characteristics of each bond. An efficient and well-functioning government bond market facilitates issuance and trading in such securities. It also facilitates the low-cost financing of government expenditures and the implementation of monetary policy through open market operations. Government securities’ creditworthiness and liquidity can also make them benchmarks for risk-free rates.

Market efficiency has attracted a lot of attention from traders, regulators, exchange officials and academics. Until recently, studies on market efficiency were principally focused on stock markets. The empirical studies on bond markets are less abundant and more recent than those on stock markets. Furthermore, the importance of fixed income instruments in the diversification of investment portfolios and in firm and government financing, gives a rationale for our study.

The aim of this paper is to analyze the evolution of the long memory in returns of government bonds indices of four countries. We contribute to the literature on Efficient Market Hypothesis (EMH) in several ways. First, we expand the empirical studies by analyzing the long memory of government bonds indices, since they have been much less studied than stock markets. Second, we tackle the issue of Adaptive Market Hypothesis (AMH) and we shed light on the evolving efficiency of these markets to determine whether the AMH is appropriate to explain the behavior of the government bond returns of these four countries. Third, the data covers a very long time series allowing us to reach consistent conclusions. The data series are monthly and cover a period more than 100 years. Such a long historical time series analysis of the efficiency of bond markets has not been previously undertaken. Fourth, another issue with time series data is that data tends to be characterized by structural breaks. Hence, we test and date structural breaks.

Using time varying approach namely the state-space generalized autoregressive conditional heteroscedasticity in mean (GARCH-M), we examine how the degree of market efficiency has evolved over time, depending on economic, political, and financial events. The analysis was conducted for the two of the most established bond markets in the world: the US and UK and two emerging markets: South Africa and India. We also conduct a robustness analysis using the rolling window technique. The main finding of the paper is that all four government bond markets show degree efficiency changing over time, due to changing market conditions and institutional factors, which is consistent with the implications of the AMH. Further, the US government bond market shows a strong tendency towards the market efficiency over time, confirming that it is arguably the most important and efficient market in the world.

The remainder of the paper is organized as follows. Section 2 presents a literature review on efficiency of bond markets. Section 3 presents the empirical methodology used in this paper. Section 4 exposes the data and empirical results. Finally, Section 5 draws the main conclusions.

## 2. Literature review

The efficient market hypothesis (EMH) is generally regarded as the cornerstone of modern finance. The origins of the EMH can be traced back to Samuelson [1], with his paper titled, “Proof that properly anticipated prices fluctuate randomly”, who proposed that stock prices should follow a random walk. The implication of Samuelson’s proposal was that stock returns should be entirely unpredictable due to market participants’ arbitrage motives. In another important and most cited paper titled “Efficient capital markets: a review of theory and empirical work.” Fama [2] defines market efficiency by “prices fully reflect all available information” and distinguishes between various information sets available to market participants. He identifies various levels of market efficiency based on the influence of information on stock price changes through EMH. These levels include weak-form efficiency, semi-strong form efficiency, and strong-form efficiency. As a basis for testing the random walk hypothesis, weak-form efficiency states that stock prices fully reflect historical prices; semi-strong form efficiency denotes that stock prices reflect public information; whereas strong-form efficiency emphasizes the reflection of all private and public information on stock prices. Grossman and Stiglitz [3] and many subsequent authors have criticized the EMH and even argue that a perfectly efficient market is impossible. The bulk of research in modern finance has been built on the notion that individuals maximize expected utility and have rational expectations. There are critiques on the behavioral finance who document irrational, but highly predictable, investor behaviors such as overreaction and overconfidence (see, for example, [4–7]). As a result, Campbell et al. [8] propose the concept of relative efficiency, which departs from all-or-nothing view. With relative market efficiency, the degree of market efficiency changes over time. With investor rationality at the heart of the controversy between advocates of the EMH and proponents of the behavioral finance, Lo [9] provides reconciliation through the adaptive markets hypothesis (AMH) in which market efficiency is explained from an evolutionary

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