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Do Gold Market Returns Have Long Memory?

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Abstract

This study examines the long memory behavior in gold returns during the post-Bretton Woods period using a new rescaled range technique. Unlike the conventional rescaled range analysis, the new rescaled range analysis is robust to short-term dependence and conditional heteroscedasticity found in the gold data. Statistical results suggest that the long memory behavior in gold returns is rather unstable. When only few observations corresponding to major political events in the Middle East, together with the Hunts event, in late 1979 are omitted, little evidence of long memory can be found.

Introduction

A growing body of literature has explored the long memory (or long-term dependence) property of financial price series (e.g., [5, 9, 10, 12, 15, 21, 28, 32, 42]). The long memory property describes the intertemporal dependence between observations at long lags. Short memory series, which include standard autoregressive moving average processes, have the property that observations far apart in time exhibit little or no statistical dependence. For long memory series, however, they display persistent dependence even between distant observations; such series are characterized by nonperiodic long cycles. An oft-cited example of the long memory series is the class of fractionally differenced processes [15, 19, 20, 38].

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Short memory in asset prices can arise, for example, from stop-loss orders and margin calls. A decrease in the price can trigger stop-loss orders and margin calls, which lead to selling and further price declines. Short memory can also result from extrapolative expectations and noisy trading [6]. On the other hand, long memory in asset prices can arise from alternative sources. Kaen and Rosenman [28] extend Heiner's [23] competence-difficulty (C-D) gap hypothesis of human behavior to explain possible long memory in asset prices. The C-D gap measures a spread between the investor's competence to make optimal decisions and the complexity of decision problems under uncertainty. When the C-D gap is wide, investors are likely to follow some rule-governed behavior, which can produce persistent price movements in the same direction. Kaen and Rosenman [28] argue that, due to the irregular arrival of new important information to the market, persistent price movements will at times reverse direction suddenly, thereby yielding nonperiodic price cycles. The Kaen-Rosenman analysis has often been used to explain the potential presence of long memory in many speculative markets, including those of foreign exchanges, stocks, and gold. Furthermore, models of metal price dynamics developed by Chan and Mountain [11] and Heal and Barrow [22] suggest that changes in gold prices are a function of the lagged values of gold prices and the interest rate, among others. A recent empirical study by Shea [42] reports that interest rates display long memory dynamics. If the Chan-Mountain and Heal-Barrow models are relevant, changes in gold prices are expected to show long memory dynamics as well, reflecting similar dynamics in the interest rate.

Recent studies by Fama and French [17], Lo and MacKinlay [33], and Poterba and Summers [40] report that stock returns display positive correlation over short horizons and negative correlation over long horizons. The results point to the possible presence of long cycles and potentially predictable components in long-horizon stock returns. Lo [32] illustrates that the reported negative correlation at long lags can be a symptom of long memory dynamics.

In this paper we investigate the long memory be-

havior of gold returns. Empirical evidence on the presence of long memory in gold returns has been presented by Booth et al. [9]. The study employs the classical rescaled range, or R/S analysis, first proposed by Hurst [27] and later refined by, e.g., Mandelbrot [35, 36] and Mandelbrot and Wallis [38]. Mandelbrot [35, 36] demonstrates the robustness of R/S analysis relative to other usual methods such as autocorrelation and variance ratio analyses in detecting long-term dependence. A problem with the classical R/S analysis is that the distribution of its test statistic is not well-defined, and the analysis can be sensitive to heterogeneities of the underlying data-generating process. As a result, reliable statistical inferences are hard to make. The problem of heterogeneously distributed processes is relevant, since gold prices have been found to display conditional heteroscedasticity (Akgiray et al. [3] and Frank and Stengos [18]). The finding of conditional heteroscedasticity is common among many financial prices (Bollerslev [8] and Hsieh [24, 25, 26]). Moreover, Aydogan and Booth [5] and Milonas et al. [39] discuss the sensitivity of R/S analysis to nonstationarity. The concern about stationarity is important, since the long memory phenomenon can be spuriously caused by shifting means in the data process (e.g., [7, 29]). The preciseness of the classical R/S analysis has also been called into question by Aydogan and Booth [5] for the problem of preasymptotic behavior. Further, gold returns appear to display short-term dependence (see Booth et al. [9] and Solt and Swanson [44]), which can bias the classical R/S test toward finding long memory too often.

This study reevaluates the finding of long memory in gold returns using a new modified R/S technique suggested by Lo [32]. Unlike the classical R/S procedure, the modified one has well-defined distributional properties and is robust to short-term dependence and conditional heteroscedasticity. The modified R/S procedure can therefore circumvent some of the drawbacks associated with the conventional one.

A brief review of the related literature on financial price behavior is provided in the second section. The modified R/S test is discussed in the third section. The fourth section describes the data, and the fifth section