



Are exchange rate movements predictable in Asia-Pacific markets? Evidence of random walk and martingale difference processes

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ABSTRACT

This study investigates the random walk (RW) and the martingale difference sequence (MDS) processes for the Australian dollar and seven Asian currencies relative to three benchmark currencies between 1993 and 2008. We use Kim's (2009) Automatic Variance Ratio (AVR) test for the RW and Kuan and Lee's (2004) test for the MDS. The null of RW or MDS hypotheses is not rejected for three currencies: Australian dollar and Korean won for the post-Asian financial crisis period tested by MDS, and Malaysian ringgit for the entire test period as well as the pre-Asian financial crisis period when the currency is evaluated by the AVR. As for the post-Asian crisis, six other Asian currencies including Malaysian ringgit show no discernible improvement toward market efficiency. Our findings have broad policy implications – investors may be able to exploit time-varying movements of the returns of the five currencies which can be identified by technical trading rules for profitable trading.

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1. Introduction

Since Meese and Rogoff's (1983) seminal work on the predictability of foreign exchange rates based on a random walk model, there has been a proliferation of economic and time series models in the literature, which tried to beat the forecasting accuracy of the random walk model. However, as reported by Kilian and Taylor (2003) and Lee, Kim, and Newbold (2004), the results of these competing models have been mixed in disproving Meese and Rogoff's finding that exchange rates essentially follow a random walk. In fact, in the world of foreign exchange trading, both academics and practitioners have long embraced the attributes of trading models, such as "technical analysis," and "filter trading," which have purportedly yielded risk-adjusted excess profits in foreign exchange markets.³

Strong evidence in the literature indicates that nominal exchange rates generally follow a random walk process or its change follows a martingale difference sequence – the two patterns of currency movement analyzed under the two common names; the random walk hypothesis (henceforth RWH) or the martingale difference hypothesis (henceforth MDH). Under both hypotheses, markets are weak-form efficient so that future changes of foreign exchange rate are unpredictable from past prices or return. Thus, it is not possible for currency traders to consistently beat the market by "technical" or "filter" rules except for one phenomenon

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³ Time-varying movements of currency can be exploited by mechanical rules such as "moving average cross-over rules" or "filter rules" derived from an ARIMA or a Markov process. See Neely et al. (2007) for their exhaustive evaluation of technical trading rules and Lee, Gleason, and Mathur (2001) and Martin (2001) for emerging country currencies.

unique to foreign exchange markets, namely opportunities associated with interventions by monetary authorities that may or may not provide predictable moves in the exchange rates.

The empirical validity of the RWH is still debated in the foreign exchange literature, and variance ratio (henceforth VR) analysis has been most widely used in testing the hypothesis. For instance, Fong, Koh, and Ouliaris (1997), and Kilian and Taylor (2003) support RWH and Liu and He (1991) reject it, while Yilmaz (2003) and Lee, Kim, and Newbold (2004) partially support RWH. It should be noted that all these studies employ parametric VR tests of Lo and MacKinlay (1989) or its multiple versions of Chow and Denning (1993), which are asymptotic tests, which are valid when the sample size is large. It is well known that, in small samples, these tests often erroneously reject RWH (see, for example, Lee, Kim, & Newbold, 2004).

In general, the martingale process is tested using information contained in the second moments of a process, and the property of the martingale difference sequence is known as mean-independence or conditional-mean-independence (Dominguez & Lobato, 2003). In this sense, tests of MDH evaluate the empirical validity of the assumption implicit in the “technical” or “filter” rules that returns revert to their historical or time-varying means. In short, the key feature of MDH is that, in contrast to most previous studies of RWH, which test time series of asset returns that are assumed linearly uncorrelated, MDH tests mean-independence or conditional-mean-independence of linear or non-linear combinations of past asset returns.

In this study, we use the wild bootstrapped automatic variance ratio test of Kim (2009) and the martingale difference sequence test of Kuan and Lee (2004). Kim's (2009) test is an extension of Choi's (1999) automatic variance ratio test where the holding period is selected optimally using a fully data-dependent procedure. It is a non-parametric test in which the sampling distribution of the automatic variance ratio test is approximated using a bootstrapped procedure valid under conditional heteroskedasticity. As shown in Kim (2009), it has more desirable small sample properties than other variance ratio tests. Kuan and Lee (2004) demonstrate that their test is more powerful than several other tests of MDH, for their test is insensitive to the assumption of conditional homoskedasticity and requires a weaker moment condition.

We examine the weak-form market efficiency of the Australian dollar and seven Asian emerging markets' currencies against the three world reserve currencies: the U.S. dollar, the Japanese yen and the Euro during the period between January 1993 and December 2008. The seven Asian currencies are the Indonesian rupiah, the Malay ringgit, the Philippine peso, the Singapore dollar, the South Korean won, the Taiwanese dollar, and the Thai baht. We analyze the sixteen year period with the Asian financial crisis in 1997 as a structural break point.

Our study is significant to not only academics, but also to government policy-makers and private investors for the following five reasons. First, following the Asian financial crisis in 1997, the seven Asian emerging economies changed their exchange rate regimes from de facto pegs to floating systems.⁴ Second, there is strong evidence that the implicit reference currencies against which the currencies of these Asian countries are measured under the floating regimes have significantly shifted from the U.S. dollar to the Euro and the Japanese yen. (Patnaik, Shah, Sethy, & Balasubramaniam, 2011). Third, a strong trading bloc has recently emerged in Asia and Pacific, which is dominated by the Japanese yen and to some extent by the Australian dollar for cross-border trade and financial transactions. The movements of the seven Asian currencies are increasingly tied to the Japanese yen and the Australian dollar, especially for their financial transactions related to forward, futures, options and offshore derivative markets.⁵ Fourth, the strength of the currencies of Australia and the seven Asian countries has been significantly altered by recent governments' actions aimed at the repositioning of their massive official reserves from U.S. dollar-denominated assets to Euro-denominated assets. Fifth, there has been active discussion regarding the integration of regional currencies in East Asia (Eichengreen & Park, 2004 and Kearney & Muckley, 2008). Successful integration of regional currencies requires empirical assessments of not only the relative efficiency of individual currencies in the region, but also the sustainability of government policies related to foreign exchange markets.

The major findings of our study are: (i) Kuan-Lee's martingale and Kim's automatic VR tests, both of which are non-parametric, are useful tools in evaluating a time series of returns against a random walk or martingale difference hypothesis when the series has a conditionally heteroskedastic variance and a small sample size. (ii) Despite increasing evidence that the influence of the U.S. dollar on pegging their currencies has declined and that the influence of Japanese yen has increased, especially after the Asian financial crisis, there appears little evidence that the overall efficiency of foreign exchange markets for these currencies has markedly improved. Our findings show that only the Australian dollar and the Korean won have behaved as a random walk and a martingale difference in the post-Asian crisis period; and the other six Asian emerging currencies – the Indonesian rupiah, the Malay ringgit, the Philippine peso, the Singapore dollar, the Taiwanese dollar, and the Thai baht – have shown no discernible improvement toward weak-form efficiency in the post-Asian crisis.

The remainder of this paper is organized as follows. Section 2 provides a brief review of relevant literature. Section 3 discusses the data and Section 4 outlines the methodology. Section 5 presents the empirical findings. Section 6 concludes the paper.

⁴ Malaysia temporarily issued a moratorium immediately following the onset of the crisis in 1997. By most accounts, the exchange rate systems in the seven Asian emerging economies are still evolving within the broad framework of managed or independent float systems. The so called “managed floating” and “independent floating” regimes involve at least two key issues: (i) The optimal currency basket as the anchoring reference currency and (ii) the announced or unannounced band within which the basket currency value may be allowed to fluctuate. It appears that Singapore pursues a managed floating with a basket of currencies (Lee, Lee, & Robinson, 2004), and that Korea was under a managed floating regime until April 2002, but is now under “free floating” or “complete liberalized regimes” query, see Kim and Ryou (2001), Ryou (2001) and Eom et al. (2008).

⁵ Bowman (2005), Ma, Ho, and MacCauley (2004) and <http://www.cme.com/trading/prd/fx>.

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