FOREIGN EXCHANGE MARKET EFFICIENCY IN SELECTED SUB-SAHARAN AFRICAN COUNTRIES: A TEST FOR MARTINGALE DIFFERENCE HYPOTHESIS WITH STRUCTURAL BREAKS

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Abstract. *Not much attention has been given to the efficiency of forex markets in African countries, as most existing studies have focused on a single country and only one study seem to have tested the forex market efficiency of a group of sub-Saharan African countries comprising Nigeria, Ghana, Uganda, South Africa and Zambia. Therefore, this study constructs a larger sample consisting of foreign exchange (forex) markets of 10 countries in sub-Saharan Africa by testing for martingale difference hypothesis with structural breaks. It uses data on the average official exchange rate of currencies of the concerned countries to the US dollar from November 1995 to October 2015(i.e. 1995M11 – 2015M10). The study accounts for the break period/point in each return series to determine when the structural change occurred in the forex market by employing the Perron's unit root test that endogenously determines the most significant break period in the return series in an Innovative Outlier (IO) model. Due to the tendency for structural breaks to make the test for martingale difference hypothesis misleading, the study divides the full sample period into before structural break (pre-break period) and after the structural break (post-break period). The pre-break period spans from November 1995 to the month before the structural break while the post-break period extends from the month after the structural break to October 2015. The empirical results reveal that the forex markets of the selected countries are not weak form efficient in the full sample period except for Burundi and Ghana. Dividing the full sample period into pre-break and post-break periods, it discovers that the forex markets of Burundi, Ghana, Mauritius, and Mozambique are weak form efficient in both periods while the forex markets of Gambia and Madagascar are weak form inefficient in both periods. However, the forex markets of Mauritania, Sierra Leone, Uganda, and Zambia show inconsistent results in the pre-break period compared to the post-break period.*

Keywords: *foreign exchange market efficiency; martingale difference hypothesis; wild bootstrap variance ratio test; structural break; sub-Saharan Africa.*

Introduction

Investors in the foreign exchange (forex) market are concerned about the efficiency of the market in order to determine whether there is a possibility to outperform the market based on past market information. Messe and Rogoff (1983) pioneered research into the predictability of forex rate based on a random walk model. The ability to predict forex rate behavior supports the assertion of the long-run purchasing power parity model. In empirical literature, the quest to determine the predictability of the forex market is underpinned to the efficient market hypothesis (EMH) propounded by Fama (1970). The EMH states that current price is the best predictor of future price, and return is expected to be zero (Fama, 1970).

Currency traders in an efficient forex market cannot use technical analysis to earn returns above the average market returns because the forex rate follows a random walk (non-predictable patterns). Baffes (1994) argue that an efficient forex market does not mean forex are not predictable, but it implies that arbitrage opportunities cannot be exploited. Based on the dependence structure of increment series, Campbell, Lo and Mackinlay (1997) distinguish the random walk model into three variant models namely: Random Walk 1(RW1), Random Walk 2(RW2) and Random Walk 3(RW3). RW1 model assumes that price increments are independently and identically distributed with a zero mean and constant variance. RW2 model assumes that price increments are independently but not identically distributed with zero mean and constant variance. Escancianio and Labato (2009) argue that a financial time-series is a martingale if it corresponds to RW2. The RW2 model is a stochastic model that is applicable to financial time-series that tends to volatile or heteroscedastic, hence the model is usually an appropriate framework to examine the predictability of forex rate. RW3 model assumes that price increments are not correlated.

The martingale hypothesis and the martingale difference hypothesis (MDH) are two theorems to assess the efficiency of the forex market. The martingale hypothesis states that the best forecast of tomorrow's price is the price of today while MDH posits that changes in price (returns) are not correlated with past market information. Under both hypotheses, the forex market is said to be weak-form efficient. A market is weak-form efficient if the price at time t is orthogonal with the price at t-1,......t-n, thus making forecasting efforts vain.

Numerous studies such as Azar (2014), Belarie-Franch and Opong (2005), Charles, Darné and Kim (2012), Escanciano and Lobato (2009), Lazăr, Todea and Filip (2012), Lee and Hu (1991), Salisu and Oloko (2015), Yang, Su and Kolari (2012), and Wright (2000) tested for MDH rather than martingale hypothesis. Escanciano and Labato (2009) argue that it is easier to deal with returns because price tends to be non-stationary, thus making it common to test for MDH when assessing the efficiency of the forex market. Assessing the efficiency of the forex market is an attempt to examine whether changes in forex rate follows a stochastic process (i.e. forecast is impossible based on historical market information). Understanding the behavior of the forex rate is crucial in designing policies targeted at macroeconomic stability (Mbululu, Auret & Chiliba, 2013).

Not much attention has been given to the efficiency of forex markets in African countries. Most studies in Africa such as Aron (1997), Mabakeng and Sheefeni (2014), Mbululu et al. (2013), Sifunjo, Ngugi, Ganesh and Gituro (2008), Tweneboah, Amanfo and Kumah (2013) focused on a single country. However, to the best of our knowledge, Aron, and Ayogu (1997) seem to be the only existing study that has tested the forex market efficiency of a group of sub-Saharan African countries (Nigeria, Ghana, Uganda, South Africa and Zambia). Therefore, this study constructs a larger sample consisting forex markets of sub-Saharan African countries.

Belarie-Franch and Opong (2005) acknowledge that academics, practitioners, and regulators are interested in the randomness of forex rate. Implicitly, this study examines the random behavior or conditional mean independence of returns on the US dollar against currencies of countries in sub- Saharan Africa in order to provide empirical assertion to validate or negate MDH. The US dollar is a benchmark currency in the global market and trade transactions of most African countries with countries outside Africa are mostly denominated in US dollar. Salisu and Oloko (2015) advocate that accounting for a structural break in financial time-series is necessary when testing for MDH to provide meaningful findings, thus this study accounts for structural breaks in the return series. The rest of this study is organized as follows. Section 2 deals with the literature review. Section 3 provides the data and preliminary analyses. Section 4 and Section 5 present the estimation and conclusion respectively.

Literature review

Myriad of studies have provided evidence on the efficiency of the forex market by examining whether forex rate is a martingale or random walk. Yang et al. (2007) noted that martingale and random walk have been used interchangeably despite not being synonymous. A series is a martingale if innovations or error terms are independent but not identically distributed (i.e. $\varepsilon_t \sim INID$) while it is a random walk if error terms are independent and identically distributed (i.e. $\varepsilon_t \sim IID$). Below is the chronological review of the empirical studies.

The pioneering work of Messe and Rogoff (1983) showed that the behavior of forex rate conforms to the random walk hypothesis (RWH). Liu and He (1991) employed the variance ratio (VR) test and observed that there are autocorrelations of weekly increments in the nominal forex rate series between August 7, 1974, and March 29, 1989, thus the study rejects the MDH. Ogiogio (1994) found evidence to negate RWH using monthly data of the Nigerian forex market from 1989 to 1993. Aron (1997) used co-integration methodology to examine whether forex returns are predictable in South Africa. Utilizing monthly parallel (black) market and official forex rates, the study found that forex returns are predictable, thus affirming that the forex market of South Africa is not weak-form efficient. Belaire-Franch and Opong (2005) used the VR test based on ranks and signs on Euro exchange rates and offered evidence in support of MDH.

Yang et al. (2007) accepted MDH for the Euro relative to the 3 major currencies (Japanese yen, British pound and US dollar) and observed nonlinear predictability in the Euro against several smaller currencies. Sifunjo et al. (2008) employed a battery of tests consisting of run, unit root, and Ljung-Box Q-statistic tests to examine whether returns on Kenyan shillings to US dollar are predictable. The findings rejected the MDH. Al-Khazali and Pyun (2009) examined RWH and MDH for the Australian dollar and currencies of 7 Asian currencies against the Euro, US dollar and Japanese yen. The results rejected both hypotheses for all the currencies over the period January 4, 1993, to December 31, 2008.

Charles and Darné (2009) tested the random walk behavior of daily and weekly data of Euro against currencies of 11 countries from January 4, 1999, to May 30, 2008. Using VR tests, the RWH was accepted for 8 countries (Australia, Canada, Japan, United Kingdom, US, New Zealand, Korea and Switzerland). However, RWH was rejected for daily data for Singapore and Norway and accepted for their weekly data while it was rejected for Sweden for both data frequencies. Azad (2009) utilized daily and weekly frequency post-Asian crisis spot exchange rate data of 12 Asia-Pacific forex markets from January 1998 to July 2007. The VR provided mixed results. For the daily data, the majority of the forex rates exhibited martingale behavior while the test on weekly data showed that majority of the forex rates are not a martingale. This study shows that the randomness of forex rate may be dependent on data frequency. Gradojević, Djaković, and Andjelić (2010) invalidated RWH for the Euro/Serbian dinar between January 2005 and December 2008 using VR tests.

Chiang, Lee, Su and Tzou (2010) employed series of VR tests to examine the efficiency of the forex markets of Japan, South Korea, Taiwan, and Philippines. The results provided evidence in support of RWH in the all the forex markets except for Taiwan. Kumar (2011) applied VR tests on the Indian rupee against the IMF's Special Drawing Rights in indexed form between April 1993 and June 2010 and found that the Indian forex market is weak form inefficient, thus rejecting RWH. Charles et al. (2012) used daily and weekly data to examine the returns predictability of the Australian dollar, Canadian dollar, Japanese yen and Swiss franc against the US dollar from January 2, 1974, to July 17, 2009. Employing the wild bootstrap automatic VR test, generalized spectral test, and consistent tests, the findings suggested that forex returns are predictable from time to time depending on the changing market conditions. The study offered support to the adaptive market hypothesis put forward by Lo (2004).

Lazăr et al. (2012) evaluated the impact of the 2008 global financial crisis on the forex market efficiency of 6 Central and Eastern European (CEE) countries from January 2004 to February 2011. Adopting the generalized spectral test in a rolling window approach, the study showed that the global financial crisis negatively affected the efficiency of most of the CEE forex markets. Phillips and Jin (2013) applied the Kolmogorov-Smirnov and Cramér-von Mises tests on major forex rates data and found strong evidence in support of the martingale hypothesis. Tweneboah et al. (2013) examined the behavior of Ghanaian cedi/US dollar between January1963 and May 2013 using the conventional VR test and the VR test based on ranks and signs. The outcome did not obey RWH.

Shalari and Stringa (2013) tested the efficiency of the Albanian forex market by using data on the Albanian Lekë/Euro between January 1, 2002, and December 31,

2012. Employing the Kolmogorov-Smirnov-Lilliefors and Shapiro-Wilk tests for normality, the study found that the forex rate is not consistent with the martingale process, thus suggesting that the market is not weak-form efficient. Mbululu et al. (2013) showed that RWH is rejected for daily returns on US dollars/Zambian kwacha between August 1, 2003, to December 31, 2005, using the conventional VR and the ranks and signs VR tests. Mabakeng and Sheefeni (2014) provided evidence based on unit root tests that the Namibian forex market was weak form efficient between January 1993 and December 2011.

Azar (2014) assessed the martingale behavior of the Lebanese pound against the Australian dollar, Canadian dollar, Swiss franc, Euro, British pound and Japanese yen from January 4, 2010, to January 31, 2014, using the VR test. The study provided support for MDH. Almudhaf (2014) investigated the randomness of currencies of CIVETS (Colombia, Indonesia, Vietnam, Egypt, Turkey and South Africa) relative to the US dollar using weekly data from February 2, 2007, to April 13, 2012. The results of the VR tests indicated the forex rates of all the countries follow a random walk except Vietnam and Egypt. Salisu and Oloko (2015) examined the MDH in currencies of 9 countries in the Asia-Pacific region against the Euro on weekly basis from April 1, 2005, to September 12, 2014. Utilizing the wild bootstrap automatic VR test and wild bootstrap generalized spectral test, the results showed that all the currencies aligned to MDH over the whole period. However, after accounting for a structural break, the results revealed that the South Korean won rejected MDH prior to its break date while the Chinese yuan did not support the MDH after its break date.

Data and preliminary analyses

This study constructs a sample consisting of 10 single-user currencies in sub-Saharan Africa. Data on the average official rate of the currencies against US dollar as numeraire from November 1995 to October 2015 (i.e. 1995M11 – 2015M10) are obtained from the World Bank Global Economic Monitor. The return series is obtained from the forex rate and is calculated as:

(1) $$R_t = 100 \times \log(E_t - E_{t-1})$$

where R_t is return at time t, the log is natural logarithm, $E_t - E_{t-1}$ is the first difference of exchange rate.

Table 1. Currency description

Currency	ISO 4217 Code	User
Burundian franc	BIF	Burundi
Ghana cedi	GHS	Ghana
Dalasi	GMD	The Gambia
Malagasy ariary	MGA	Madagascar
Ouguiya	MRO	Mauritania
Mauritian rupee	MUR	Mauritius
Mozambican metical	MZN	Mozambique
Leone	SLL	Sierra Leone
Ugandan shilling	UGX	Uganda
Zambian kwacha	ZMW	Zambia

Table 2. Descriptive statistics

Series	Mean	Median	Maximum	Minimum	Std.Dev.	Skewness	Kurtosis	Jarque-Bera
R_BIF	0.738672	0.173609	26.91585	-23.00850	4.412176	0.895865	18.79233	2515.553*
R_GHS	1.381807	0.554335	21.23800	-16.03053	3.089346	1.129946	15.98617	1730.238*
R_GMD	0.586438	0.330443	14.26651	-15.01448	2.964887	-0.206821	10.96015	632.7043*
R_MGA	0.566421	0.253427	23.22857	-8.395489	3.273893	1.664295	12.57926	1024.132*
R_MRO	0.342758	0.217975	8.600377	-5.175366	1.525883	0.785706	8.986141	381.4362*
R_MUR	0.283042	0.267522	7.393133	-6.139624	1.712627	0.208919	6.327144	111.9762*
R_MZN	0.575632	0.253908	15.22991	-10.98918	2.392248	0.939289	11.24251	711.7025*
R_SLL	0.632990	0.290490	18.61851	-11.22481	2.990893	0.981953	11.91884	830.5516*
R_UGX	0.535913	0.384717	9.258722	-7.980215	2.251793	0.139417	4.776655	32.20776*
R_ZMW	1.067860	0.685240	22.80642	-16.44690	4.283228	0.500054	7.660162	226.2266*

Note: * implies a rejection of null hypothesis at 1% significance level.

From Table 1, the mean values of return series for all the currencies are positive, thus implying that forex rate return of the currencies under consideration depreciated on the average over the period under review. GHS and MUR have the highest and lowest mean values respectively in terms of return. BIF records the highest maximum and lowest minimum values of return among the currencies, thus indicating that it has the largest variance. The standard deviation indicates that R_BIF and R_MRO have the highest and lowest statistic respectively, thus implying that return on BIF is the most volatile while return on MRO is the least volatile. The skewness statistic shows that all the return series are positively skewed except R_GMD. The Kurtosis coefficient indicates that all return series have a leptokurtic (high-peaked and fat-tailed) distribution. The Jarque-Bera statistic invalidates the null hypothesis of normal distribution for all the return series (Table 2).

Table 3. Residual diagnostics

Series	Q-statistic(5)	Q-statistic(10)	Q^2-statistic(5)	Q^2-statistic(10)	ARCH LM(5)	ARCH LM(10)
R_BIF	12.376**	17.981***	52.211*	92.933*	7.660413*	5.891018*
R_GHS	67.942*	91.253*	36.860*	56.473*	6.994783*	4.967068*
R_GMD	14.575**	24.819*	22.814*	29.410*	3.886439*	2.248240*
R_MGA	25.627*	35.404*	16.753*	17.605*	3.180009*	1.640611***
R_MRO	25.151*	30.309*	33.008*	33.960*	6.882392*	3.629929*
R_MUR	56.148*	65.509*	44.476*	64.565*	5.853200*	3.196870*
R_MZN	50.624*	57.600*	13.259*	71.989*	2.369036**	6.504206*
R_SLL	39.876*	54.308*	72.866*	86.759*	12.51853*	6.519923*
R_UGX	41.172*	44.497*	39.947*	43.963*	6.106988*	3.392364*
R_ZMW	41.914*	47.500*	28.169*	29.012*	6.576927*	3.372881*

Note: *, ** and *** implies a rejection of null hypothesis at 1%, 5% and 10% significance level respectively, *F*-statistic is reported for the ARCH LM test.

From Table 3, Ljung-Box Q-statistic and Q^2-statistic reject no autocorrelation of residuals and squared residuals in all the return series respectively at lags 5 and 10. In addition, the ARCH LM test rejects no ARCH effects in all the return series at lags 5 and 10, thus confirming the presence of conditional heteroscedascity in all the return series.

As mentioned earlier, this study accounts for the break period/point in each return series to determine when the structural change occurred in the forex market. The study employs the Perron (2006) unit root test that endogenously determines the most significant break period in the return series in an Innovative Outlier (IO) model. The unit root test is performed using the *t*-statistic for testing the null hypothesis that δ =1 in the regression model below.

(2)

$$y_t = \mu + \theta DU_t + \beta_t + \lambda DT_t^* + \gamma D(T_b)_t + \delta y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-1} + \varepsilon_t,\ \varepsilon_t \sim IID(0, \sigma^2)$$

where DU_t = 1, DT_t^* = $t - T_b$ if $t > T_b$ and 0 otherwise, $D(T_b)_t$ =1 if $t = T_b + 1$ and 0 otherwise.

Table 4. Unit root test with structural break

Series	Break Period	Coefficient	*t*-statistic
R_BIF	1998M07	-0.970580	-15.463718*
R_GHS	2000M06	-0.755491	-13.049654*
R_GMD	2007M09	-0.934440	-14.861336*
R_MGA	2004M03	-0.688797	-12.578222*
R_MRO	2008M09	-0.770496	-12.256203*
R_MUR	2010M04	-0.585005	-10.170324*
R_MZN	2005M04	-0.663189	-11.815286*
R_SLL	1997M12	-0.672087	-10.985025*
R_UGX	2008M09	-0.637910	-10.783004*
R_ZMW	2000M11	-0.641189	-10.413725*

Note: * denotes *t*-statistic exceeds 1% critical value. In addition, the critical value is obtained from Table 1(e) model 2 in Perron (1997).

It can be observed from Table 4 that all the forex rate return series are stationary series as expected, hence this study overcomes the problem of using non-stationary series. Level series of forex rate tends to be non-stationary, thus making it more complex to test for foreign market efficiency.

Due to the tendency for structural breaks to make the test for martingale difference hypothesis misleading, the study divides the full sample period into before structural break (pre-break period) and after the structural break (post-break period). The pre-break period spans from November 1995 to the month before the structural break while the post-break period extends from the month after the structural break to October 2015. The results of the sub-sample periods are then compared to the full sample period. Table 5 reports the time span for the pre and post-break periods for each return series.

Table 5. Sub-sample periods for return series

Series	Pre-Break Period	Post-Break Period
R_BIF	1995M11 – 1998M06	1998M08 – 2015M10
R_GHS	1995M11 – 2000M05	2000M07 – 2015M10
R_GMD	1995M11 – 2007M08	2007M10 – 2015M10
R_MGA	1995M11 – 2004M02	2004M04 – 2015M10
R_MRO	1995M11 – 2008M08	2008M10 – 2015M10
R_MUR	1995M11 – 2010M03	2010M05 – 2015M10
R_MZN	1995M11 – 2005M03	2005M05 – 2015M10
R_SLL	1995M11 – 1997M11	1998M01 – 2015M10
R_UGX	1995M11 – 2008M08	2008M10 – 2015M10
R_ZMW	1995M11 – 2000M10	2000M12 – 2015M10

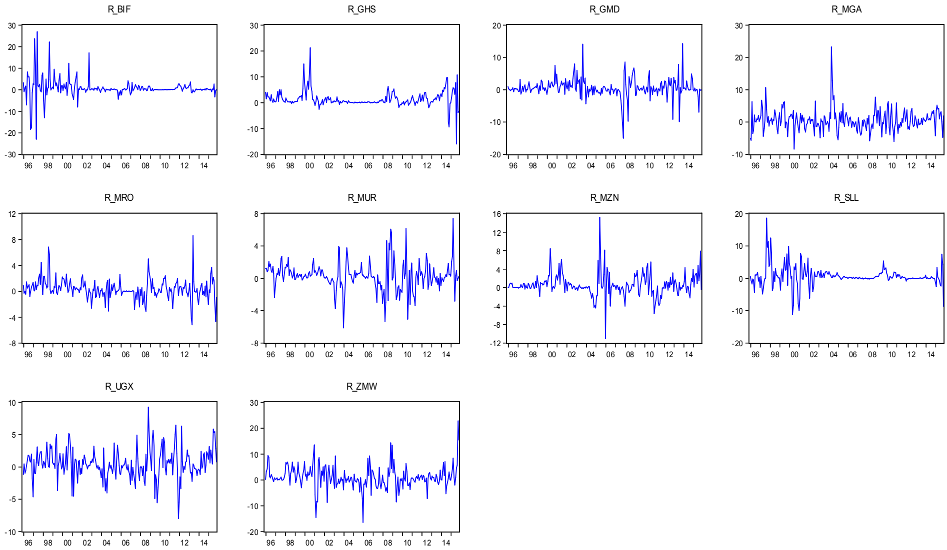

Figure 1. Graph of return series

Estimation

When forex rate return is non-predictable, it can be said that the forex market follows a martingale difference sequence (MDS) process. Return follows a MDS process when the best prediction of tomorrow's return is the return of today and it is impracticable to use linear and non-linear combinations of past returns to forecast future return. The MDS process has implication for the efficiency of the forex market. The martingale stochastic model is suitable for determining whether returns are predictable (Lazăr et al., 2012). The model can be stated as:

(3) $$E\left(R_{t+1} \middle| R_t, R_{t-1}, \cdots R_{t-n}\right) = 0$$

where R_{t+1} is future return, R_t is current return, R_{t-1} is immediate past return, R_{t-n} is return lagged by n periods, n is the lag operator.

The variance ratio (VR) test is used to test whether return follows the MDS process. When VR is equal to 1 or not statistically different from 1, it implies that the return series has martingale behavior and the forex market is weak form efficient. The VR at lag p is calculated as:

(4) $$VR(p) = \frac{\sigma^2(p)}{\sigma^2(1)}$$

where $\sigma^2(p)$ is $\frac{1}{p}$ times the variance of $(x_t - x_{t-p})$ and $\sigma^2(1)$ is the variance of $(x_t - x_{t-1})$.

(5)
$$\sigma^2(p) = \frac{1}{m}\sum_{t=p}^{np}\left(x_t - x_{t-p} - p\hat{\mu}\right)^2$$
$$\sigma^2(1) = \frac{1}{np-1}\sum_{t=1}^{np}\left(x_t - x_{t-1} - \hat{\mu}\right)^2$$

(6)
$$\hat{\mu} = \frac{1}{np}\left(x_{np} - x_0\right)$$
$$m = (np - p + 1)\left(1 - \frac{p}{np}\right)$$

where x_0 is the first observation in the series and x_{np} is the last observation in the series. Kim (2006) wild bootstrap VR test is employed for this study and it follows three steps:

a. Construct a bootstrap sample of T observations $x_t^* = \eta_t x_t$ $(t = 1, \ldots, T)$ where η_t is a random sequence with zero mean and unit variance.

b. Calculate the maximum absolute value (MV^*) with x_t^*.

c. Repeat a and b sufficiently m times to form a bootstrap distribution of $\left(MV^{*j}\right)_{j=1}^{m}$.

The normal bootstrap distribution with bootstrap replications m set at 1000 and the lag periods for the sub-sample and full sample periods was set at 2, 4, 8 and 16. The test hypothesis is that the series is martingale and this hypothesis can only be rejected when the p-value of MV^* is greater than 0.1. *Table 6* reports the results of the VR test.

Table 7. Kim (2006) Wild bootstrap VR test results

Series	**Sub-sample periods**		**Full sample period**
	Pre-break period	**Post-break period**	
R_BIF	[1.156574] (0.4910)	[2.272798] (0.1410)	[1.693409] (0.1730)
R_GHS	[1.328302] (0.3460)	[1.507687] (0.2840)	[1.623171] (0.1790)
R_GMD	[2.660273] (0.0400)**	[2.609951] (0.0330)**	[3.379695] (0.0110)**
R_MGA	[3.055487] (0.0230)**	[2.595752] (0.0430)**	[3.789037] (0.0000)*
R_MRO	[3.259055] (0.0060)*	[1.639891] (0.2070)	[2.764543] (0.0160)**
R_MUR	[1.977614] (0.1200)	[1.894660] (0.1190)	[2.740733] (0.0290)**
R_MZN	[2.097665] (0.2800)	[2.299809] (0.1160)	[2.534291] (0.0340)**
R_SLL	[1.381913] (0.4820)	[2.950385] (0.0770)***	[3.032697] (0.0250)**
R_UGX	[3.054371] (0.0270)**	[1.977919] (0.1470)	[3.424977] (0.0040)*
R_ZMW	[1.942606] (0.1490)	[3.634135] (0.0020)*	[3.768713] (0.0020)*

Note: *, ** and *** indicate the rejection of null hypothesis at 1%, 5% and 10% significance level respectively, MV* in [ ] and p-value in ( ).

From Table 6, R_BIF and R_GHS follow the MDS process in the sub-sample and full sample periods. Conversely, R_GMD and R_MGA do not follow the MDS process in the sub-sample and full sample periods. The hypothesis that R_MRO is a martingale is rejected in the pre-break period but is accepted after the break. However, R_MRO is not a martingale in the full sample period. R_MUR and R_MZN fail to invalidate MDH in the sub-sample periods but rejects MDH in the full sample period. R_SLL and R_ZMW are martingale prior to structural break; however, they do not exhibit martingale behavior subsequent to a structural break. In the full sample period, R_SLL and R_ZMW reject MDH. R_UGX is non-martingale in the pre-break and full sample periods but a martingale in the post-break period.

Conclusion

This study assessed the efficiency of the forex markets of 10 countries in sub-Saharan Africa by testing for MDH using the forex rate of currencies of the countries against US dollar from November 1995 to October 2015. Using the Kim (2006) wild bootstrap variance ratio test, it can be observed that only the forex markets of Burundi and Ghana are weak form efficient before and after the structural break as well as in the full sample period. On the contrary, the forex markets of Gambia and Madagascar are not weak form efficient prior to and after structural breaks as well as in the full sample period. The forex markets of Mauritania and Uganda are not weak form efficient before the structural break but are efficient in the weak form after the structural break. However, in the full sample period, the markets are not weak form efficient. The forex markets of Mauritius and Mozambique are weak form inefficient in the period before and after the structural break but weak form efficient in the full sample period. Before the structural break, the forex markets of Sierra Leone and Zambia are weak form efficient but became weak form inefficient after the structural break. The forex markets are not weak form efficient in the full sample period. This study provides evidence to support that accounting for a structural break is necessary when testing for MDH. This is because some markets provide mixed results before and after the structural break period.

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