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Why African Stock Markets Should Formally Harmonise and Integrate their Operations

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Abstract

Despite experiencing rapid growth in their number and size, existing evidence suggests that African stock markets remain highly fragmented, small, illiquid and technologically weak, severely affecting their informational efficiency. Therefore, this study attempts to empirically ascertain whether African stock markets can improve their informational efficiency by formally harmonising and integrating their operations. Employing parametric and non-parametric variance-ratios tests on 8 African continent-wide and 8 individual national daily share price indices from 1995 to 2011, we find that irrespective of the test employed, the returns of all the 8 African continent-wide indices investigated appear to have better normal distribution properties compared with the 8 individual national share price indices examined. We also report evidence of statistically significant weak form informational efficiency of the African continent-wide share price indices over the individual national share price indices irrespective of the test statistic used. Our results imply that formal harmonisation and integration of African stock markets may improve their informational efficiency.

Keywords: Harmonisation and integration, Efficiency, Share price indices, Stock markets, Africa

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1. Introduction

The past decades have seen a significant growth in the number and size of stock markets in Africa. For example, the number of active African stock markets increased from 5 in 1960 to 18 by the end of 2002 (UNDP, 2003; Ntim et al, 2011). Currently, there are 29 formal stock markets in Africa, and with further proposals to open new ones in a number of African countries (Moin, 2007; Databank Group, 2008; ASEA, 2012). The apparent substantial increase in stock markets in Africa can be attributed to the extensive financial sector reforms undertaken by a number of African countries (Kenny and Moss, 1998; Rambaccussing, 2010). It has been suggested that stock markets promote economic growth. For example, Schumpeter (1911), McKinnon (1973), Shaw (1973), Levine and Zervos (1996), and Levine (1997), amongst others, have argued that well-developed capital markets can promote economic growth through their ability to attract international investments, mobilise domestic savings, provide liquidity, and hence, facilitate efficient allocation of scarce economic resources.

However, despite the rapid development in the establishment of stock markets in Africa, with the exception of South Africa, stock markets in Africa not only remain comparatively different from their developed counterparts, but also, pale into insignificance in comparison to other emerging markets (Alagidede, 2009; 2010; Ntim et al, 2011). First, they are small in size (Kenny and Moss, 1998; Ntim et al, 2011). The total value of African stocks outside of South Africa was only 0.94% of world stock market capitalisation, and 2.14% of all emerging markets stocks at the end of 2011 (World Federation of Exchanges (WFEs, 2012)). Similarly, African markets excluding South Africa accounted for only 3.46% of the total global equity listings in contrast to 12.29% by India for instance alone (WFEs, 2012).

Second, the stock markets are also small compared with the size of their own economies (Kenny and Moss, 1998; Ntim et al, 2011). For example, market capitalisation in Mozambique is only 4.7% of nominal GDP, whilst Nigeria, Uganda and Tunisia's capitalisations are between 31-63% (WFEs, 2012). These figures are not only much less than developed markets, such as UK (145.6%), and US (122.8%), but also other emerging markets, such as Malaysia (183.7%), India (172.5%) and Brazil (110.8%) (WFEs, 2012). Third, their small size makes them

vulnerable to speculation and manipulation (Magnusson and Wydick, 2002; Ntim et al, 2011), by insiders at the expense of other investors. More critically, they remain extremely illiquid, and thinly traded, severely affecting their informational efficiencies (Mlambo and Biekpe, 2005; Ntim et al, 2007, 2011). However, their ability to effectively perform the above listed roles depends heavily on their level of allocative, operational, and in particular, informational efficiency (Kenny and Moss 1998; Smith et al, 2002).

This raises a crucial lingering policy question as to whether emerging African stock markets can improve their informational efficiency by formally harmonising and integrating their operations. Theoretically, formal harmonisation and integration of operations of emerging African stock markets may help in overcoming many of the current information challenges facing them (Irving, 2005; Okealaham, 2005). First, Lugangwa (2012) contends that integration can increase African stock markets visibility through a significant improvement in their size. Second, Fish and Biekpe (2002) indicate, for example, that regional integration can create expansion in trading volumes through economies of scale, which may deliver the required liquidity, thereby creating the enabling environment for companies to raise funding at a cheaper cost.

Third, Irving (2005) suggests that regional cooperation and integration of Eastern and Southern African stock exchanges, for example, will offer greater financial deepening and maximise investor choice as more financial products and services could be made available than before. Fourth, it can be expected that a larger stock market with robust regulatory, monitoring and enforcement framework would be less vulnerable to speculation and manipulation by insiders. This may enhance credibility and confidence of both local and international investors. Fifth, better communicational and technological infrastructure can minimise operational costs by reducing duplication and improve the flow of information unto the market, and thereby improving overall market efficiency (Ntim et al, 2007, 2011). Admittedly, while the idea of forming regional Pan-African Markets or even a grand Pan-African stock market led to its formation, and continues to be the main agenda of the African Securities Exchanges Association (ASEA) for almost two decades (Irving, 2000, 2005; Smith, 2003; SADC, 2007), it has so far not been implemented despite having explicitly acknowledged the potential benefits of integration (Lugangwa, 2012).

Given the potential benefits that an integrated and harmonised market could bring to Africa as already alluded to above, we investigate the behaviour of African continent-wide share price indices and compare them to some of their individual national share price indices. We conduct this study in the context of weak-form market efficiency. The weak form market efficiency posits that financial asset prices traded in a market cannot be predicted by using information contained in the sequence of past prices (Fama, 1965, 1970, 1991). The statistical implication of this assertion is that financial asset price series either follow a random walk or a martingale sequence difference. The behaviour of financial asset prices in the context of the weak-form efficiency has been, and continues to be, of immense interests to researchers, regulators, practitioners and investors alike. This is because if the future price of a financial asset can be modelled using information implicit in historical prices, it could make them exploitable. A greater economic implication, however, is that financial assets are not appropriately priced at their equilibrium values. This can distort the allocational efficiency of capital within an economy with its attendant consequences.

While the weak form market efficiency of the major developed stock and emerging markets of Latin America, Eastern Europe, and Asia have been the major focus of researchers in the past (Ayadi and Pyun, 1994; Claessens et al, 1995; Urrutia, 1995; Field et al, 2005), the weak-form hypothesis has received little attention from researchers in Africa. Prior studies that provide continent-wide analyses are also few (Magnusson and Wydick, 2002; Smith et al, 2002; Appiah-Kusi and Menya, 2003; Jefferis and Smith, 2005; Ntim et al, 2011). Further, the results of a limited number of studies on the efficiency of African stock markets are mixed (Parkinson, 1984; Dickinson and Muragu, 1994). Significantly, most of the extant African studies employ traditional techniques, such as autocorrelation tests, whose robustness have been questioned elsewhere (Savit, 1988; Hsieh, 1991; Ntim et al, 2007, 2011).

With the increasing importance of emerging African markets both in size and number, the need for reliable evidence on their informational efficiencies is particularly important. First, and unlike their developed counterparts, African countries have young economies in which market efficiency still has significant developmental implications. Second, emerging African markets excluding South Africa have low correlation with global stock markets (Moin, 2007; Alagidede,

2010; Ntim et al, 2011). While this indicates that these African stock markets have yet to formally integrate into the competitive global financial market place on the one hand, on the other hand, it offers significant portfolio diversification opportunities for international investors (Ntim et al, 2007, 2011). Current research by MSCI/ABRI (2007) shows, for example, that the recent sub-prime crisis within the global stock markets has had a minimal impact on emerging African markets excluding South Africa.

Our study, therefore, extends the extant literature by offering additional evidence on the African share return behaviour of continent-wide share indices, and thereby making new contributions. First, we employ specially constructed size and regional African share price composite indices, which tracks the average performance of all stock markets in Africa excluding South Africa from 1998 to 2011. Our study, therefore, extends the previous evidence of Ntim et al (2011). Second, we provide fresh evidence on the informational efficiencies of a sample of national indices as against African continent-wide constructed share price indices. The rest of the paper is structured as follows. Section 2 presents an overview of African stock markets and past studies. Section 3 describes the data. Section 4 presents empirical analyses, whereas section 5 concludes.

2. African stock markets and related past African weak-form efficiency studies

Over a short period of time, Africa appears to have developed an impressive stock market sector. With only 5 stock markets in 1960, the number of African stock markets increased significantly to 18 by the end of 2002 (UNDP, 2003), and is currently 29 (Moin, 2007; WFEs, 2012). Consequently, African stock markets vary substantially in institutional and market infrastructural characteristics. Smith et al (2002) offer a four-tier classification of African equity markets. With recent increase in their number, however, we extend their four-tier classification to a five-tier classification to reflect current developments. The first tier is formed solely by South Africa – the most infrastructurally developed, the largest, as well as one of the oldest stock markets in Africa. The second tier consists of a group of medium-size markets, which have been in existence for relatively longer time, consisting of Egypt, Kenya, Nigeria, Morocco, Tunisia and Zimbabwe.

The third tier is made up of a group of new and small, but rapidly growing markets, consisting of Botswana, Cote d'Ivoire, Ghana, Namibia and Mauritius. The fourth tier consists of a group of very new and small markets, including Libya, Malawi, Mozambique, Sudan, Swaziland, Tanzania, Uganda, and Zambia, whose existence have been widely acknowledged (at least recognised by ASEA), but are struggling to take-off. The final tier consists of a group of seven markets, namely; Algeria, Angola, Cameroon, Cape Verde, Gabon, Rwanda and Sierra Leone, which either despite having been in existence for relatively longer time like Algeria (1993), Cameroon (2001), Gabon (2001), and Cape Verde (2005), are not widely known (not even recognised by ASEA) or are not formally known because they are simply too young, such as Angola (September, 2007), Rwanda (January, 2008) and Sierra Leone (April, 2012).

With respect to the extant literature, the weak-form efficiency hypothesis has not been widely investigated in Africa, which may be due to lack of adequate data. Samuels and Yacout (1981) and Parkinson (1984) are among the first to investigate the weak-form efficiency in Africa employing autocorrelation test, although they provide mixed findings. Whereas the findings of Samuels and Yacout accept the weak-form market efficiency hypothesis for weekly share price series of 21 listed Nigerian firms from 1977 to 1979, that of Parkinson reject it in monthly share price series of 30 listed Kenyan firms from 1974 to 1978. Dickinson and Muragu (1994) examined the weekly stock price behaviour of 30 listed companies on the Nairobi Stock Exchange from 1979 to 1988. Their findings failed to provide support for previous evidence (Parkinson, 1984), that Kenyan listed shares are not weak-form efficient.

In contrast, Magnusson and Wydick (2002) utilise a partial-autocorrelation test to investigate monthly share price behaviour of eight African stock markets indices, including Botswana, Cote d'Ivoire, Ghana, Kenya, Mauritius, Nigeria, South Africa and Zimbabwe, in comparison with nine Asian and Latin American markets from 1989 to 1998. Their findings indicate that six out of the eight investigated African stock markets indices were weak-form efficient. Ghana and Zimbabwe were found not to be weak-form efficient. Smith et al (2002) and Jefferis and Smith (2005) have also examined the price behaviour of a group of African stock markets indices. While Smith et al (2002) use Chow and Denning's (1993) multiple variance-ratios test to examine the weak-form in weekly stock

market index series from 1990 to 1998 of eight African countries, Jefferis and Smith (2005) employ a GARCH model to examine serial-dependence in weekly stock indices of the same group of countries from 1990 to 2001. Their findings failed to provide support for the notion of weak-form efficiency in all the investigated markets except South Africa.

Appiah-Kusi and Menya (2003) apply an EGARCH-M model to examine the weak-form efficiency in weekly price series of eleven African stock market indices. Their findings suggest that weekly stock indices in Egypt, Kenya, Morocco, Mauritius, and Zimbabwe are weak-form efficient, whereas those of Botswana, Ghana, Ivory Coast, Nigeria, South Africa, and Swaziland are not efficient. Finally, employing autocorrelation, run, and the multiple variance-ratios tests, Simons and Laryea (2006) investigate the weak-form efficiency of weekly stock market indices of Egypt, Ghana, Mauritius and South Africa from 1990 to 2003. In line with past evidence, their findings failed to provide support for the notion of weak-form efficiency in all the examined markets except South Africa.

3. Data

We employ two types of datasets to investigate the weak-form efficiency. The first consists of Africa continent-wide (excluding South Africa) size (i.e., small, medium and large capitalisation share price indices) and regional (i.e., Africa All-Share, East-Africa, North-Africa, South-Africa, Sub-Sahara Africa, and West-Africa share price indices) daily closing share price indices (from 1998 to 2011) constructed and supplied by Africa Business Research Ltd, a UK-based independent professional data collection and research company that specialises in African stock markets. To be included, countries must meet the following criteria: (i) non-nationals must be allowed to fully invest in the stock market; and (ii) there must be no exchange controls preventing the repatriation of dividends or capital/gains. Botswana, Cote d'Ivoire, Egypt, Ghana, Kenya, Malawi, Mauritius, Morocco, Mozambique, Namibia, Nigeria, Swaziland, Tanzania, Tunisia, Uganda and Zambia are currently included. Zimbabwe is excluded because of exchange rate restrictions.

The main index computed is the Africa All-Share index, which is a composite measure of the average performance of all stock exchanges in Africa excluding

South Africa. It covers all companies listed on African stock exchanges that conform to the following minimum size and liquidity requirements: (i) must have a minimum market value of $10m at the quarterly index review date; and (ii) must achieve a traded turnover of at least 0.01% of its market capitalisation in the quarter preceding the index review date and in at least 2 of the 4 quarters prior to the quarterly review date. Currently, the Africa All-Share index is composed of by 7 Egyptian companies, 6 companies each from Morocco and Nigeria, 3 companies each from Botswana, Cote d'Ivoire, Ghana, Kenya, Mauritius, and Tunisia, as well as 2 companies each from Malawi, Mozambique, Namibia, Swaziland, Tanzania, Uganda and Zambia. The second set of data consists of daily national closing stock price indices (from 1995 to 2011), which is available in DataStream. Out of the 16 stock markets included in the Africa All-Share index, only eight, namely, Botswana, Egypt, Ghana, Kenya, Mauritius, Morocco, Nigeria and Tunisia currently have data available in DataStream.

4. Empirical analyses

4.1 Summary descriptive share return statistics

Table 1 reports descriptive statistics and diagnostics of daily returns for all 16 share price indices examined. Panels *A*, *B*, and *C* contain descriptive statistics and diagnostics of returns of African size, regional and individual national stock price indices, respectively.

Indices	Mean	Std. Dev.	Skewness	Kurtosis	K-S[1]	A-D[1]	N
Panel A: African Continent-Wide Size Share Price Indices							
Large	0.00065	0.01329	0.04	14.32	0.09*	34.56**	3124
Medium	0.00073	0.00954	-0.03	14.05	0.11*	50.21***	3124
Small	0.00089	0.00785	3.51	69.23	0.13*	45.00***	3124
Panel B: African Continent-Wide Regional Stock Price Indices							
All	0.00060	0.00954	0.08	8.59	0.09*	32.93***	3124
East	0.00052	0.00942	-0.24	10.93	0.13**	64.62***	3124
North	0.00048	0.01173	-0.09	8.84	0.11*	43.05***	3124
South	0.00089	0.01406	-0.07	220.32	0.19**	179.10***	3124
Sun-Sahara	0.00092	0.01028	0.11	4.86	0.12**	57.65***	3124
West	0.00108	0.01572	0.14	4.94	0.14**	68.42***	3124
Panel C: Individual African National Stock Price Indices							
Botswana	0.00120	0.01359	12.20	290.12	0.74**	1102.95***	4001
Egypt	0.00065	0.01810	4.83	85.40	0.66**	994.00***	3716
Ghana	0.00050	0.01104	5.94	146.52	0.72**	1126.43***	1001
Kenya	0.00067	0.01378	3.66	99.70	0.69**	1096.35***	4001

Indices	Mean	Std. Dev.	Skewness	Kurtosis	K-S[1]	A-D[1]	N
Mauritius	0.00062	0.01296	2.89	134.25	0.80**	1091.04***	4001
Morocco	0.00058	0.01360	2.93	98.86	0.94**	997.66***	3720
Nigeria	0.00020	0.09272	-88.30	7942.83	0.70**	3120.59***	9736
Tunisia	0.00014	0.00105	3.65	174.65	0.86**	1100.76***	4001

Table 1: Summary share price return statistics

[1]Notes: *A-D* and *K-S* represent Anderson-Darling and Kolmogorov-Smirnov goodness-of-fit absolute values with ***, **, and * means that the log-normality assumption is rejected at the 1%, 5%, and 10% levels, respectively. Panels A, B, and C, present descriptive statistics and diagnostics of returns of African continent-wide size, regional, and national share price indices, respectively. *N* refers to the number of time series observations.

The table shows that daily mean returns for all the 16 series examined are close to zero, with all depicting positive mean returns behaviour. The standard deviation is relatively small for all the 16 examined series. For symmetry, the standard normal distribution should have zero skewness. Apart from the small company in Panel *A*, and the *East-* and *West-Africa* in Panel *B*, all the African continent-wide series appear to be close to symmetry. By contrast, symmetry is rejected for all the national stock price series in Panel *C*. However, the null hypothesis of the kurtosis test statistic conforming to that of a normal distribution is rejected at any reasonable significance level for any of the series investigated.

In addition, Kolmogorov-Smirnov (*K-S*) and Anderson-Darling (*A-D*) non-parametric goodness-of-fit tests are implemented. Using the *K-S* absolute values, the log-normality assumption is rejected at the 0.10 level, but not at the conventional 0.01 and 0.05 levels for the African continent-wide size, and regional series in Panels *A* and *B*, respectively. The null is rather rejected for all the 8 national stock price series in Panel *C* at the conventional 0.05 level. The more powerful *A-D* statistic, however, consistently reject the null for all the 16 series at the 0.01 level. A critical revelation is that irrespective of the diagnostic used, on comparative basis, the 8 African continent-wide series show less departure from normality that the 8 individual national series. The evidence of a non-normal return behaviour in most of the series is consistent with findings of previous studies (Jefferis and Smith, 2005; Alagidede, 2009, 2010; Ntim et al, 2007, 2011). Crucially, it justifies the application of non-normality and especially, Wright's (2000) non-parametric variance-ratios test, which is robust to conditional-hetereoscedasticity.

4.2 Empirical results and discussion

Table 2 reports the results of the Lo and MacKinlay (1988) parametric and Wright (2000) non-parametric variance-ratios tests for the *African regional* stock price indices. For brevity, we avoid a detailed description of both procedures, as specified in Lo and MacKinlay (1988) and Wright (2000). Column 1 indicates the specific time period *k*. As previously indicated, and in this study, *k* refers to the number of days interval, where *k* = 15, 20, 25 and 30 days for each of the six series. Columns 2 to 7 report the test statistics of the M_1, M_2, R_1, R_2, S_1 and S_2 for each index return series examined. The M_1 shows the test statistics suggested by Lo and MacKinlay (1988) under the maintained hypothesis of homoscedasticity random walk (*RW*), whereas the M_2 reports similar critical values under the hetereoscedasticity martingale difference sequence (*MDS*) hypothesis.

Period	M_1	M_2	R_1	R_2	S_1	S_2
Africa-All Share (Excluding South Africa)						
k=15	0.20	0.54	2.42**	1.29	1.95*	2.50**
k=20	0.65	0.65	2.88***	1.76*	2.20**	3.32***
k=25	1.08	0.90	3.34***	2.30**	2.93***	3.80***
k=30	1.67	1.55	3.92***	2.71***	3.30***	4.45***
East-Africa						
k=15	2.80***	1.89*	10.71***	8.83***	8.00***	8.76***
k=20	3.43***	2.20**	11.30***	9.00***	8.29***	9.40***
k=25	3.76***	2.54**	11.52***	9.21***	9.36***	9.78***
k=30	3.90***	2.72***	11.61***	9.72***	9.45***	9.86***
North-Africa						
k=15	-0.06	-0.09	2.54**	1.39	3.70***	4.20***
k=20	0.30	0.31	2.70***	1.75	3.93***	4.45***
k=25	0.71	0.50	3.11***	2.00**	4.26***	4.91***
k=30	1.25	0.96	3.80***	2.40**	4.50***	5.47***
South-Africa						
k=15	-6.38***	-1.34	1.40	0.72	1.00	1.33
k=20	-5.65***	-1.53	2.09**	1.55	1.56	1.74*
k=25	-4.80***	-1.41	2.60***	1.99**	2.11**	2.16**
k=30	-3.92***	-1.29	3.00***	2.37**	2.60**	2.50**
Sub-Sahara-Africa						
k=15	-2.67**	-1.80*	4.22***	1.38	5.09***	4.60***
k=20	-1.89	-1.20	4.54***	2.00**	5.65***	4.89***
k=25	-1.05	-0.81	4.85***	2.40**	5.90***	4.70***
k=30	-0.87	-0.42	5.20***	2.72***	5.73***	5.46***
West-Africa						
k=15	-2.95***	-1.97*	3.65***	1.10	4.40***	4.90***
k=20	-2.63**	-1.50	3.89***	1.71	4.52***	5.32***
k=25	-1.90*	-1.22	4.10***	1.94*	3.98***	5.41***
k=30	-1.42	-0.96	4.34***	1.88*	3.75***	4.95***

Table 2: Variance Ratios Tests Results for African Regional Share Price Indices

Note: A test statistic with ***, **, and * indicates significance at 1%, 5%, and 10% levels respectively. Figures in columns 2-7 give the values of the test statistics M_1, M_2, R_1, R_2, S_1 and S_2 for each share price index series investigated. M_1 and M_2 are based on Lo and MacKinlay's (1988) parametric variance-ratio tests while R_1, R_2, S_1 and S_2 are based on Wright's (2000) non-parametric variance-ratio tests. The names in the rows are those of the respective regional share price indices used.

The reported results for the M_1 test suggests that the null hypothesis of random walk behaviour for the *Africa-All-Share* and *North-Africa* series cannot be rejected for all intervals of *k* tested in the study. The *RW* behaviour is rejected at the 0.01 level for *East-* and *South-Africa* return series at all lengths of *k*. For *Sub-Sahara-Africa*, the *RW* is only rejected when *k* equals 15, whereas it can only be accepted for *West-Africa*, when *k* = 30. The results obtained by implementing the M_2 indicate that the null hypothesis of martingale difference sequence behaviour is also accepted for all the return series except the *East-Africa* return series at the conventional 0.01 and 0.05 significance levels for all lags of *k*.

Given the mixed evidence from the conventional variance ratios test, the robust ranks (R_1, R_2) and signs-based (S_1, S_2) alternatives suggested by Wright (2000) are further applied to investigate the *RW* and the *MDS* hypotheses, respectively. These results are reported in Columns 4 to 7 in Table 2. With the exception of *South-Africa* for which the null cannot be rejected when *k* = 15, the *RW* is rejected when the R_1 is implemented for all six series examined at least at the 0.05 level. For the R_2, test, the null of *RW* is rejected for *East-Africa* for all lags of *k* at the 0.01 level. For the remaining 5 regions, the evidence is rather mixed as the *RW* is rejected for some intervals of *k*, but is we fail to reject for others. Unlike the ranks, the results obtained from using the sign-based test statistics, (S_1, S_2) consistently reject the *MDS* hypothesis for all six regions at all intervals of *k* at least at the 0.05 level, except for *South-Africa* when *k* = 15 and 20. In contrast to the mixed results of the traditional M_1 and M_2 statistics, all rejections are in the upper tail (have positive signs) of the distribution, which suggests that any dependence is positive.

Table 3 presents the variance-ratios tests results for the *African size* stock price indices. The null hypothesis of random walk cannot be rejected using the M_1 test for all lags of *k* for the *large capitalization* indices at any reasonable probability level. By contrast, the null is rejected for the *medium* and *small capitalizations* indices for all intervals of *k* at the 0.01 level. Generally, the results show that *large capitalization* returns series follow random walk, whereas the *medium* and *small capitalization* returns series are not. A big exception to this is

when k = 20, 25 and 30 for the *medium* series. Implementation of the M_2 shows that the acceptance of the *RW* is robust to hetereoscedasticity for the *large* and *medium capitalization* indices at any probability level. For the *small capitalization* indices, the M_2 indicates that the *MDS* is also rejected at the 0.01 level, which suggests that the rejection of the *RW* is not due to autocorrelation.

Period	M_1	M_2	R_1	R_2	S_1	S_2
Africa-Large Companies						
k=15	-0.20	-0.17	1.36	0.46	1.50	1.84*
k=20	0.10	0.09	1.59	0.60	1.69*	2.30**
k=25	0.42	0.35	1.87*	0.97	1.96**	2.85***
k=30	0.83	0.62	2.20**	1.38	2.38**	3.22***
Africa-Medium Companies						
k=15	-2.32**	-1.03	4.34***	2.36**	3.54***	4.90***
k=20	-1.36	-0.72	5.12***	3.20***	4.10***	5.64***
k=25	-0.58	-0.40	5.89***	3.88***	4.75***	6.33***
k=30	0.39	0.28	6.68***	4.54***	5.46***	7.42***
Africa-Small Companies						
k=15	3.06***	2.58**	7.05***	4.98***	6.92***	7.10***
k=20	3.90***	3.40***	7.96***	5.76***	7.89***	7.97***
k=25	4.45***	3.59***	8.50***	6.59***	8.46***	8.53***
k=30	4.96***	3.88***	9.14***	7.30***	8.98***	8.97***

Table 3: Variance Ratios Tests Results for African Size Share Price Indices

Note: A test statistic with ***, **, and * indicates significance at 1%, 5%, and 10% levels respectively. Figures in columns 2-7 give the values of the test statistics M_1, M_2, R_1, R_2, S_1 and S_2 for each share price index series investigated. M_1 and M_2 are based on Lo and MacKinlay's (1988) parametric variance-ratio tests while R_1, R_2, S_1 and S_2 are based on Wright's (2000) non-parametric variance-ratio tests. The names in the rows are those of the respective size share price indices used.

Employing the powerful ranks-based test statistics (R_1, R_2), the RW cannot be rejected at any reasonable significance level for the *large size* indices, except when k = 25 and 30 for the R_1. By contrast, the null is rejected for the *medium* and *small size* indices for all lags of k at the 0.01 level. Implementing the signs-based alternative test statistics (S_1, S_2), the MDS is rejected for all 3 series at any interval of k, except for the *large capitalization* series when k = 15. Again, unlike the mixed results of the conventional variance-ratios tests, all rejections by the ranks and signs-based test statistics are in the upper tail of the distribution, suggesting that the resulting variance-ratios are greater than unity for all the series examined. Overall, our results indicate that *large capitalization* stocks returns behaviour follow the *RW* and *MDS* while that of *medium* and *small* are not when Lo and MacKinlay (1988) variance-ratios tests are applied. Wright's (2000) ranks and

signs based alternatives, however, reject both the *RW* and *MDS* for the returns series of all 3 capitalization stocks.

In order to ascertain the potential improvements in the distributional properties of continent-wide stock indices compared with national indices, the tests employed are implemented using *national* stock indices data. Table 4 contains the variance-ratios tests results for a sample of *8 individual African national* stock price indices for which data was available, namely; Botswana, Egypt, Ghana, Kenya, Mauritius, Morocco, Nigeria and Tunisia.

Period	M_1	M_2	R_1	R_2	S_1	S_2
Botswana						
k=15	-1.61	-13.89***	135.37***	114.00***	163.55***	166.50***
k=20	-1.70*	-14.99***	157.54***	136.84***	189.04***	189.76***
k=25	-0.87	-2.42**	178.94***	140.97***	212.53***	216.73***
k=30	-0.09	-0.08	195.40***	163.72***	231.80***	236.60***
Egypt						
k=15	0.48	0.68	142.33***	120.00***	160.32***	167.54***
k=20	0.30	0.50	165.94***	142.98***	186.45***	189.80***
k=25	0.45	0.76	186.41***	160.32***	209.67***	210.32***
k=30	0.70	1.28	196.43***	170.64***	232.80***	230.27***
Ghana						
k=15	0.37	0.60	141.63***	124.56***	164.54***	169.46***
k=20	0.29	0.48	165.92***	147.55***	189.65***	195.48***
k=25	0.90	1.90*	180.34***	160.42***	211.00***	218.30***
k=30	1.76*	2.75***	208.94***	180.31***	235.85***	239.62***
Kenya						
k=15	-0.62	3.30***	145.63***	125.12***	168.53***	172.45***
k=20	-2.65	-3.72***	167.90***	148.30***	196.31***	197.66***
k=25	-0.08	-0.45	188.60***	160.71***	219.40***	219.80***
k=30	-0.39	0.80	210.92***	184.53***	242.38***	240.71***
Mauritius						
k=15	-0.50	-6.23***	140.54***	120.30***	166.52***	165.43***
k=20	-0.66	-7.49***	160.68***	137.65***	189.74***	193.51**
k=25	-0.32	-0.99	180.32***	154.34***	214.62***	216.35***
k=30	0.24	0.46	199.41***	168.71***	243.80***	238.90**
Morocco						
k=15	-0.46	-5.89***	142.88***	116.89***	159.65***	162.42***
k=20	-0.48	-6.78***	160.52***	137.94***	184.73***	180.59***
k=25	-0.20	-0.71	179.60***	150.73***	209.84***	207.60***
k=30	0.11	0.09	198.53***	172.80***	231.50***	229.43***
Nigeria						
k=15	0.09	0.34	16.51***	7.94***	168.54***	166.00***
k=20	0.08	0.38	19.00***	9.73***	186.00***	190.74***
k=25	0.05	0.19	21.83***	11.89***	215.42***	220.80***
k=30	0.07	0.22	25.65***	13.94***	236.90***	242.76***
Tunisia						
k=15	0.19	0.30	140.75***	123.65***	168.96***	169.65***
k=20	0.12	0.37	169.00***	144.70***	197.50***	197.70***
k=25	0.60	1.48	187.45***	160.85***	220.43***	220.84***
k=30	0.99*	1.80*	209.84***	180.22***	250.94***	245.93***

Table 4: Variance-Ratios Tests Results for a Sample of Individual African National Share Price Indices

Note: A test statistic with ***, **, and * indicates significance at 1%, 5%, and 10% levels respectively. Figures in columns 2-7 give the values of the test statistics M_1, M_2, R_1, R_2, S_1 and S_2 for each share price index series investigated. M_1 and M_2 are based on Lo and MacKinlay's (1988) parametric variance-ratio tests while R_1, R_2, S_1 and S_2 are based on Wright's (2000) non-parametric variance-ratio tests. The names in the rows are those of the respective African national share price indices used.

Generally, while the results of the traditional variance-ratios tests (M_1, M_2) are ambiguous, the results for the ranks (R_1, R_2) and signs (S_1, S_2) alternative are clear. Using the M_1, the null of *RW* cannot be rejected for any lags of *k* at the conventional 0.01 and 0.05 for all the 8 countries. The null is, however, rejected at the 0.10 level for Botswana when $k = 20$ and Ghana when $k = 30$. For Egypt and Nigeria, the M_2 suggests that the non-rejection of the null is robust to hetereoscedasticity, as the *MDS* cannot also be rejected for any lags of *k*, at any probability level.

The M_2 also shows that the *MDS* is rejected for Botswana, Kenya, Mauritius and Morocco at the 0.01 level when $k = 15$ and 20 and Ghana when $k = 30$. The *MDS* is further not only rejected at 0.10 level for Ghana when $k = 25$ and Tunisia when $k = 30$, but also for Botswana at the 0.05 level when $k = 25$. For Kenya, Mauritius and Morocco, the *MDS* is rather accepted at any probability level when $k = 25$ and 30. Unlike the ambiguous results of the conventional parametric variance-ratios tests (M_1, M_2), the ranks (R_1, R_2) and signs (S_1, S_2) alternative consistently reject the *RW* and the *MDS* hypotheses at the 0.01 level for all intervals of *k* for all the 8 countries examined. For Ghana, the rejection of the RW and the *MDS* is consistent with recent evidence (Ntim et al, 2007, 2011). Generally, the results obtained by implementing M_1 and M_2 fail to reject the *RW* and *MDS* hypotheses. However, with alternative estimation using the ranks and signs, we find a strong and consistent evidence to reject the *RW* and *MDS*.

A comparison of the results of the individual national share price indices (Table 4) with the African continent-wide constructed indices (Tables 2 and 3) indicate significant potential improvements in informational efficiency if the continental market can be harmonised and integrated in their operations. First, irrespective of the test statistic used, and the set of African continent-wide indices

that is compared with, the individual national indices indicate higher levels of rejections for the *RW* and *MDS* hypotheses. Second, the African continent-wide regional and size indices, either shows higher levels of weak-form market efficiency or tendencies towards weak form market efficiency when matched against the individual national indices. Finally, and generally, some of the African continent-wide share price indices returns are weak-form efficient even against the robust Wright (2000) non-parametric variance-ratios tests. By contrast, none of the individual national indices are weak form efficient against the ranks and signs tests.

5. Summary and conclusion

The last three decades has witnessed a rapid increase in the number and size of African stock markets. However, their fragmented existence and lack of economies of scale and operational efficiency render most of them extremely illiquid, small and on the fringes of the competitive global financial markets place. Consequently, their informational efficiency is greatly diminished, and this severely affects their ability to allocate capital efficiently. With a specific focus on the weak-form of the efficient markets hypothesis, we have attempted to empirically ascertain whether African continent-wide share price indices distributional properties differ from their national counterparts. First, our findings generally suggest that the 8 African continent-wide share price indices returns display better normal distributional properties than any of the 8 individual national stock price indices studied. Second, we find evidence of statistically significant improvements in the informational efficiency of the African continent-wide share price indices over their individual national share price indices. Third and in contrast, none of the individual national share prices indices investigated are efficient, especially when the empirically robust non-parametric tests are implemented.

The policy implication of this evidence is that formally harmonising and integrating African stock markets operations may improve their informational efficiency. This may generate economic benefits in the form more efficient allocation of capital and risk, which may facilitate faster economic growth. Finally, and since our data ends in 2011, future studies may extend our analyses by using

more recent data, as well as by investigating the share return behaviour of a larger number of national share price indices.

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