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Seasonal effects: Evidence from emerging African stock markets

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The paper investigates seasonal effects in seventeen indices on nine African stock markets using regression analysis and the Kruskal-Wallis and Chi-square Median tests. Significant seasonal effects are found on some, but not all indices. The strongest effect observed is the month-of-the-year effect followed by the day-of-the-week effect. The West African Regional stock Exchange (BRVM) exhibited a reversed 'December decline - January rise' pattern, while the turn-of-the-month effect observed for Egypt disappeared after the turn-of-the-year effect was removed. Using the Kruskal-Wallis test, no seasonal effects for Namibia were found. For the other markets, at least one seasonal effect was observed, suggesting some exploitable trading opportunities.

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Introduction

Seasonal anomalies are the greatest challenge to the Efficient Market Hypothesis (EMH). Anomalies are basically irregularities or inconsistencies that conflict with the whole idea that security prices behave in a random manner. It is also hypothesised that any predictable opportunity for abnormal returns, once made public, will be arbitraged away into non-existence. However, some seasonal effects have been in existence for a number of decades. These seasonal effects include the weekend effect identified by Fields (1931), the holiday effect (Fields, 1934) and the turn-of-the-year/January effect (Wachtel, 1942).

While seasonal patterns in stock returns have been documented in the United States and other markets around the world, in Africa, to our knowledge, only the Johannesburg Securities Exchange (JSE) has received significant attention, compared to the other African stock markets. Studies on the JSE include Bhana (1985) who found significantly negative average returns for Mondays and the highest positive returns on Wednesdays for shares traded on the JSE for the period 1978 to 1983. Davidson and Meyer (1993) found that the Monday effect was no longer significant on the JSE using the All Share Index for the period 1986 to 1991. Bhana (1994) found mean pre-holiday returns to be much higher than for the other days on the JSE for the period 1957 to 1990. Bradfield (1990) found significant July and December month-of-the-year effects for the period January 1974 to December 1984. Watson and Smit (1994) found at least one significant seasonal effect on each of the South African share market indices they studied for the period 4 January 1988 to 20 April 1993.

The latest evidence on the JSE, to our knowledge, is from Roux and Smit (2001) who examined if some seasonal patterns still exist on the JSE using the All Share Index, the All Gold Index and the Financial Index. By comparing two periods 1978 to 1989 and 1990 to 1998, they found that most of these anomalies no longer exist on the South African share market.

For other African stock markets, Ayadi, Dufrene and Chatterjee (1998) investigated the January effect on the equity markets of Nigeria, Zimbabwe and Ghana for the periods 1984 to 1995, 1987 to 1995 and 1991 to 1996, respectively. The results showed no January effect in the stock markets of Nigeria and Zimbabwe. For Ghana, the results from the Friedman test showed that the January average return was significantly higher than the average returns of February and May and significantly lower than the average returns of June, August, October and December.

Given the little research on seasonal anomalies on the emerging African stock markets, this paper examines the existence of seasonal patterns on selected African stock markets. These markets include Botswana, the BRVM, Egypt, Ghana, Mauritius, Morocco, Namibia, Tunisia and Zimbabwe.

Data and Methodology

The paper uses continuously compounded returns computed from daily closing price indices from nine African stock markets. The data for these indices was obtained from the respective stock exchanges. The periods of analyses range from 4 years 3 months (September 1998 to December 2002) for the West African Regional Exchange (Bourse Regionale des Valeurs Mobilieres) – abbreviated BRVM – in Cote d'Ivoire to 6 years (January 1997 to December 2002) for Egypt, Morocco and Zimbabwe. All the markets covered were trading daily at the end of the period except Ghana, which was trading only three times a week. For the BRVM, although the period covered begins at inception, the market only shifted to daily trading beginning November 2001. The same applies for Mauritius, which shifted to daily trading beginning November 1997. However, unlike for the BRVM, most of the data for Mauritius came from the period of daily trading. While Ghana was excluded from the day-of-the-week/weekend analysis, the BRVM and Mauritius were only analysed for the respective periods of daily trading.

Table 1 reports the descriptive statistics for the calculated daily returns. The number of data points (returns) ranges from 753 for Ghana to 1499 for Zimbabwe. The mean returns were positive for all the indices except Namibia's Local Index, the BRVM and Egypt.

Table 1: General and Descriptive Statistics for the Index Returns

		(a)						(b)
Stock market	**Stock Index**	**Descriptive Statistics**						**Period Investigated**
		# Obs.	**Mean (%)**	**SD (%)**	**Skewness**	**Kurtosis**	**K-S***	
Botswana	Domestic	1177	0,098	0,622	2,270	16,569	6,940**	23-Mar-98 to 31-Dec-02
	Foreign	1177	0,044	2,547	-1,447	25,919	11,053**	
	All	1177	0,049	2,403	-1,421	25,979	10,978**	
BRVM	BRVM-10	752	-0,027	0,970	-0,750	6,122	4,139**	16-Sep-98 to 31-Dec-02
	BRVM-C	752	-0,040	0,692	-0,158	5,225	3,292**	
Egypt	HFI	1489	-0,047	1,317	0,160	1,158	2,806**	02-Jan-97 to 31-Dec-02
	EFGI	1489	-0,047	1,398	0,106	1,085	2,616**	
Ghana	GSE	753	0,133	1,251	2,506	39,098	6,733**	02-Jan-98 to 30-Dec-02
Mauritius	SEMDEX	1401	0,009	0,441	0,703	8,692	3,396**	06-Jan-97 to 31-Dec-02
	SEMTRI	1401	0,037	0,441	0,756	8,815	3,563**	
Morocco**	CFG25	1493	0,002	0,634	0,821	8,327	3,892**	02-Jan-97 to 31-Dec-02
Namibia	Overall	1459	0,022	2,219	-1,542	111,866	7,019**	06-Jan-97 to 31-Dec-02
	Local	1459	-0,081	2,130	-0,820	145,739	10,988**	
Tunisia	BVMT	1249	0,043	0,858	0,154	1,541	3,226**	02-Jan-98 to 31-Dec-02
	TUNINDEX	1249	0,009	0,535	1,017	12,617	3,231**	
Zimbabwe	Industrial	1499	0,164	1,741	-0,581	12,973	4,575**	02-Jan-97 to 31-Dec-02
	Mining	1499	0,118	3,165	-0,335	11,627	6,716**	

* All Kolmogorov-Smirnov Z-statistics are significant at less than the 1% level suggesting a strong rejection of the normality assumption
**For Morocco only one index was used in the analysis, the CFG25. This is because the MASI and MADEX are fairly new and data for the no-longer-existent IGB could not be obtained.
The mean and standard deviation statistics were multiplied by 100 to give a percentage return since in their numerical values, the mean figures were almost identically zero when rounded to decimal 3.

Table 1 also shows that the returns for all the indices are mostly skewed and have excess kurtosis. The Kolmogorov-Smirnov test statistics also suggest a rejection of the normality assumption (at the 1% level of significance) for all the indices in the 9 countries. However, since the regression analysis used here is on 'dummy' variables, a manipulation of the coefficients will give the mean daily returns, and thus enable a descriptive interpretation of the results. The results are substantiated with those from the nonparametric Kruskal-Wallis test.

Regression results

Day-of-the-week/Monday effect

The day-of-the-week (DOW) effect suggests that Mondays provide the lowest mean daily returns and Fridays the highest. The weekend effect, therefore, implies a tendency for higher Friday and lower Monday mean daily returns. To examine the DOW effect using regression analysis, the following model is estimated:

$$R_t = \beta_1 + \beta_2 Tue_t + \beta_3 Wed_t + \beta_4 Thu_t + \beta_5 Fri_t + \varepsilon_t \qquad \ldots (1)$$

where R_t is the return on day t, the constant β_1 represent the Monday mean daily return, β_2, β_3, β_4 and β_5 are the response coefficients for the dummy variables Tue_t, Wed_t, Thu_t and Fri_t, respectively. The dummy variable Tue_t takes the value of 1 on Tuesdays and 0 otherwise, Wed_t takes the value of 1 on Wednesdays and 0 otherwise, and similarly for Thu_t and Fri_t. The mean daily returns for Tuesday, Wednesday, Thursday and Friday will be equal to the values of the coefficients for the respective days plus the intercept or Monday mean daily return. The null

hypothesis is that there are no differences between mean returns for each day of the week. The results of the regression model are presented in Panel (a) of Table 2.

To further examine the Monday effect, which suggests that Monday mean daily returns are lowest and/or more negative than returns for all the other days of the week, equation (1) is simplified by using only one dummy variable, taking the value of 1 on Mondays and 0 otherwise. The following regression model is estimated:

$$R_t = \alpha_0 + \alpha_1 Mon_t + e_t \quad \ldots (2)$$

where the constant α_0 represent returns for all the other days of the week, except Monday, and α_1 is the response coefficient for the dummy variable Mon_t that takes the value of 1 on Mondays and 0 otherwise. The results for this regression equation are presented in Panel (b) of Table 2.

Table 2: Regression results for Day-of-the-Week/Monday Effect

			(a)						(b)		
Stock Exchange	**Index**		**(C=MON)**	**TUE**	**WED**	**THU**	**FRI**	**F-stat**	**(C=ROW)**	**MON**	**F-stat**
Botswana	Domestic	coef (%)	0,045	0,097	**0,106**	***-0,018***	0,079	2,033	0,110**	***-0,066***	2,060
		t-stat	1,090	1,687	1,839	-0,315	1,369		5,468	-1,435	
	Foreign	coef (%)	***-0,330****	0,358	0,556*	0,278	**0,673****	2,440*	0,135	***-0,465****	6,171*
		t-stat	-1,966	1,522	2,368	1,183	2,844		1,632	-2,484	
	All Companies	coef (%)	***-0,307***	0,340	0,530*	0,258	**0,648****	2,542*	0,135	***-0,443****	6,284*
		t-stat	-1,941	1,529	2,393	1,167	2,902		1,736	-2,507	
BRVM	BRVM-10	coef (%)	0,069	**0,063**	0,019	***-0,189***	0,014	0,656	0,045	***0,024***	0,030
		t-stat	0,569	0,370	0,111	-1,102	0,082		0,742	0,174	
	BRVM-Comp	coef (%)	**0,069**	-0,029	-0,001	***-0,125***	-0,016	0,404	***0,026***	0,043	0,225
		t-stat	0,842	-0,248	-0,008	-1,080	-0,138		0,620	0,474	
Egypt#	HFI	coef (%)	-0,087	0,052	***-0,059***	0,068	**0,137**	0,934	-0,037	***-0,049***	0,333
		t-stat	-1,133	0,479	-0,544	0,630	1,267		-0,981	-0,577	
	EFGI	coef (%)	-0,111	0,130	***-0,071***	0,104	**0,158**	1,415	-0,032	***-0,079***	0,767
		t-stat	-1,369	1,124	-0,620	0,909	1,376		-0,782	-0,876	
Mauritius	SEMDEX	coef (%)	-0,004	-0,010	0,008	***-0,012***	**0,039**	0,588	0,003	***-0,006***	0,042
		t-stat	-0,135	-0,256	0,217	-0,329	1,018		0,186	-0,205	
	SEMTRI	coef (%)	0,029	***-0,019***	0,000	-0,011	**0,035**	0,587	0,030*	***-0,002***	0,003
		t-stat	1,071	-0,492	0,012	-0,279	0,925		2,263	-0,052	
Morocco	CFG25	coef (%)	-0,067	***-0,018***	0,103*	**0,158****	0,103*	4,214**	0,020	***-0,087****	4,546*
		t-stat	-1,836	-0,345	1,996	3,063	1,999		1,089	-2,132	
Namibia	Overall	coef (%)	-0,015	0,013	**0,277**	***-0,193***	0,083	1,710	0,027	***-0,025***	0,029
		t-stat	-0,116	0,073	1,511	-1,051	0,449		0,410	-0,171	
	Local	coef (%)	-0,057	***-0,096***	**0,056**	0,014	-0,095	0,302	***-0,088***	0,035	0,060
		t-stat	-0,457	-0,546	0,319	0,081	-0,535		-1,413	0,246	
Tunisia	BVMT	coef (%)	0,030	***-0,043***	**0,070**	0,045	-0,007	0,678	0,047	***-0,016***	0,072
		t-stat	0,561	-0,566	0,913	0,581	-0,091		1,717	-0,268	
	TUNINDEX	coef (%)	0,032	***-0,067***	-0,033	**0,016**	-0,032	0,909	***0,004***	0,029	0,584
		t-stat	0,959	-1,397	-0,687	0,340	-0,672		0,207	0,765	
Zimbabwe	Industrial	coef (%)	***0,031***	0,136	**0,182**	0,165	0,177	0,558	0,196**	***-0,165***	2,110
		t-stat	0,308	0,951	1,277	1,154	1,229		3,918	-1,452	
	Mining	coef (%)	***-0,072***	0,144	0,289	0,039	**0,478**	1,140	0,164	***-0,236***	1,305
		t-stat	-0,388	0,553	1,116	0,149	1,830		1,800	-1,142	

Panel (a) and panel (b) present the regression results, that is, the regression coefficients, t and F statistics for the following equations, respectively:

$R_t = \beta_1 + \beta_2 Tue_t + \beta_3 Wed_t + \beta_4 Thu_t + \beta_5 Fri_t + \varepsilon_t$

$R_t = \alpha_0 + \alpha_1 Mon_t + e_t$

All coefficients have been presented as percentages (multiplied by 100) since most of them became almost zero after rounding to decimal 3. This could have been avoided from the outset by calculating rates of return as percentages rather than as fractions.

** and * imply statistical significance for a two-tailed test at the 1% and 5% levels, respectively

Bold and "Bold Italic" denote the regression coefficients for the days of the week that give the highest and lowest mean daily returns, respectively. Note that in Panel (b) only the coefficients that give the lowest mean daily returns have been marked in bold italic.

The trading week for Egypt runs from Sunday to Thursday such that Monday in the table refers to Sunday, Tuesday to Monday, Wednesday to Tuesday, etc. on the Egyptian Stock Exchange

The results indicate that Mondays give the lowest mean daily returns for Botswana's Foreign Companies Index (FCI) and the All Companies Index (ACI), and for Zimbabwe's Industrial and Mining indices, consistent with the literature. However, only the Monday returns for the FCI are significant at the 5% level. The lowest mean daily returns are observed on a Tuesday for Mauritius' SEMTRI, Morocco's CFG25, Namibia's Local Index, and Tunisia's BVMT and TUNINDEX, consistent with evidence from the Australian and Asian markets (e.g. Jaffe and Westerfield, 1985; Kim, 1988; Aggarwal and Rivoli, 1989; Ziemba, 1993; Dubois and Louvet, 1996). For the Egyptian Financial Group Index (EFGI) and the Hermes Financial Index (HFI), the lowest mean daily returns are observed on the third trading day of the week, that is, on a Tuesday according to the trading week for the Egyptian Stock Exchange which runs from Sunday to Thursday.[1] For the remaining indices,

[1]For the Egyptian Stock Exchange, the dummy variables for the day-of-the-week effects are used in such a way that they refer to the previous calendar day. For example, Mon_t refers to Sunday, Tue_t to

that is, the BRVM-Composite and BRVM-10 indices, Botswana's Domestic Companies Index (DCI), Mauritius' SEMDEX, and Namibia's Overall Index, the lowest mean daily returns fall on a Thursday. However, none of the lowest mean daily returns are observed on a Friday for all the indices.

The largest mean daily returns are observed on a Friday for the FCI and ACI (significant at the 1% level), Zimbabwe's Mining Index, Egypt's HFI and EFGI[2], and Mauritius' SEMTRI and SEMDEX. Although not all of them are significant, the evidence support the literature that Fridays offer the highest mean daily returns as compared to the other days of the week. For the other indices, the highest mean daily returns are observed on Monday for the BRVM-Composite, Tuesday for the BRVM-10, Wednesday for Botswana's DCI, Namibia's Overall and Local indices, the BVMT and Zimbabwe's Industrial Index, and on a Thursday for the TUNINDEX and Morocco's CFG25 (significant at the 1% level). For the CFG25, Wednesday and Friday also provide positive and significant mean daily returns. The mean daily returns for the FCI and ACI are also positive and significant on a Wednesday.

In Panel (b) of Table 2, a significant Monday effect is observed for the ACI, FCI and CFG25 indices. A Monday effect (but not significant at the 5% level) is also observed for all the other indices, except, the BRVM-Composite, Namibia's Local Index and the TUNINDEX. The rest-of-the-week (ROW) mean daily returns are significantly positive for the DCI, the SEMTRI, and Zimbabwe's Industrial Index.

End/Turn-of-the-Month Effect

The end-of-the-month (EOM) refers to the last trading day of the month while the turn-of-the-month (TOM) refers to the last trading day of the previous month plus the first four trading days of the current month. These five consecutive trading days are hypothesised to distinctly outperform the rest of the month (Merrill, 1966) due to investors' tendency to operate on a monthly fiscal basis (Hirsch, 1986). Merrill (1966) suggested that buying for profit before the last 3 days of the month and selling after the first 3 days of the month could be profitable. The turn-of-the-month effect is examined in this study using the following regression analysis:

$$R_t = \beta_0 + \beta_1 EOMN1_t + \sum_{i=1}^{4} \beta_{i+1} EOMPi_t + \varepsilon_t \quad \ldots (3)$$

where the constant β_0 represent the mean daily return for all the other days of the month, β_1 is the response coefficient for the dummy variable $EOMN_t$ that takes the value of 1 on the last day of the previous month and 0 otherwise, β_{i+1} is the response coefficient for the dummy variable $EOMPi_t$ that takes the value of 1 on the i^{th} day of the current month and 0 otherwise. The null hypothesis is to test that there are no differences between mean returns for each of the turn-of-the-month days and all the other days of the month. The results of this regression model are presented in Panel (a) of Table 3.

The TOM effect is further investigated using a regression equation with one dummy explanatory variable taking the value of 1 on each of the TOM days and 0 otherwise. This regression equation is specified as follows:

$$R_t = \alpha_0 + \alpha_1 TOM_t + e_t \quad \ldots (4)$$

where the constant α_0 represent the mean daily returns for all the other days of the month that are not TOM and α_1 is the response coefficient for the dummy variable TOM_t that takes the value of 1 on a TOM day and 0 otherwise. The estimated coefficients for this equation are presented in Panel (b) and (c) of Table 3. The results in Panel (c) are the TOM effects after extracting the January TOM/turn-of-the-year (TOY) effect.

As shown in Panel (a) of Table 3, none of the markets have significant EOM effects. However, most of the indices exhibit positive mean-daily returns for the EOM, except for Botswana's DCI, Namibia's Local Index and Tunisia's BVMT. The EOM mean daily returns are highest only for the BRVM-10, BRVM-Composite and the GSE Index and lowest for the BVMT. The EOM effect is, therefore, very weak on the African markets. Of the TOM days, significantly positive mean daily returns (at the 5% level) are observed only on Botswana's FCI and ACI on the second trading day of the month and on Mauritius's SEMTRI on the fourth trading day of the month. For Morocco's CFG25, the first day of the month provided significantly negative (at the 1% level) mean daily returns. The other days of the month seem to significantly explain the mean daily returns for Botswana's DCI, the Ghana Index and Zimbabwe's Industrial Index (positive at the 1% level), and for Egypt's HFI and EFGI (negative at the 5% level).

The TOM analysis in Panel (b) of Table 3, suggests a significant TOM effect for Botswana's FCI and ACI (at the 1% level), Egypt's HFI and EFGI, and Mauritius's SEMDEX and SEMTRI (at the 5% level). No significant TOM effect is observed for the BRVM, Ghana, Morocco and Tunisia's BVMT. For Namibia's Local Index, the TOM seems to give the highest, but not significant, mean daily return. After extracting the TOY effect from the series, the TOM effect remains significant for Botswana's FCI and ACI, but becomes insignificant for all the other markets (see Table 3 Panel (c)). The results, therefore, suggest that apart from Botswana, the TOM effect observed on the other markets is driven by the TOY effect.

Monday, Wed_t for Tuesday, and so forth. This is because trading on this stock exchange runs from Sunday to Thursday.

[2]Literally, on a Thursday according to the trading week for the Egyptian Stock Exchange which runs from Sunday to Thursday.

Table 3: Regression results for end/turn-of-the-month effect

Stock Exchange	Index		(a)							(b)			(c)		
			(C=ODM)	EOMN1	EOMP1	EOMP2	EOMP3	EOMP4	F-stat	(C=ROM)	TOM	F-stat	(C=ROM2)	TOM2	F-stat
Botswana	Domestic	coef (%)	0,096**	-0,029	**0,071**	***-0,046***	0,002	0,036	0,271	0,096**	**0,007**	0,024	0,096**	**0,008**	0,035
		t-stat	4,602	-0,343	0,831	-0,544	0,025	0,419		4,607	0,155		4,650	0,186	
	Foreign	coef (%)	***-0,064***	0,193	0,486	**0,731***	0,401	0,424	1,597	-0,064	**0,446****	6,673**	-0,059	**0,457****	6,647**
		t-stat	-0,752	0,559	1,398	2,104	1,155	1,219		-0,753	2,583		-0,697	2,578	
	All Companies	coef (%)	***-0,055***	0,179	0,470	**0,689***	0,417	0,400	1,656	-0,055	**0,430****	6,974**	-0,050	**0,442****	6,983**
		t-stat	-0,690	0,551	1,433	2,102	1,271	1,221		-0,691	2,641		-0,636	2,643	
BRVM	BRVM-10	coef (%)	-0,016	**0,173**	-0,070	-0,098	-0,033	***-0,135***	0,677	**-0,016**	-0,032	0,180	**-0,013**	-0,044	0,336
		t-stat	-0,376	1,223	-0,488	-0,688	-0,228	-0,945		-0,376	-0,424		-0,313	-0,580	
	BRVM-Comp	coef (%)	-0,024	**0,084**	-0,072	***-0,139***	-0,013	-0,103	0,816	**-0,024**	-0,048	0,810	**-0,020**	-0,064	1,373
		t-stat	-0,767	0,833	-0,704	-1,361	-0,130	-1,009		-0,768	-0,900		-0,665	-1,172	
Egypt	HFI	coef (%)	***-0,090****	0,189	0,194	0,072	0,190	**0,230**	1,084	-0,090*	**0,175***	4,835*	-0,066	**0,086**	1,095
		t-stat	-2,285	1,180	1,214	0,451	1,187	1,435		-2,288	2,199		-1,713	1,046	
	EFGI	coef (%)	***-0,096****	0,222	0,224	0,106	0,152	**0,302**	1,299	-0,096*	**0,201***	5,678*	-0,077	**0,133**	2,324
		t-stat	-2,312	1,305	1,321	0,626	0,896	1,778		-2,314	2,383		-1,874	1,524	
Ghana	GSE Index	coef (%)	0,155**	**0,140**	-0,009	-0,140	***-0,294***	0,030	0,925	**0,155****	-0,055	0,347	**0,158****	-0,067	0,498
		t-stat	2,639	0,813	-0,051	-0,817	-1,711	0,175		2,638	-0,589		2,753	-0,705	
Mauritius	SEMDEX	coef (%)	***-0,007***	0,072	0,086	0,001	0,034	**0,103**	1,464	-0,007	**0,059***	4,789*	-0,003	**0,051**	3,322
		t-stat	-0,478	1,342	1,589	0,014	0,627	1,916		-0,478	2,188		-0,247	1,823	
	SEMTRI	coef (%)	0,021	0,070	0,103	***-0,005***	0,031	**0,107***	1,717	0,021	**0,061***	5,138*	0,025	**0,050**	3,271
		t-stat	1,541	1,311	1,906	-0,098	0,569	2,001		1,542	2,267		1,847	1,809	
Morocco	CFG25	coef (%)	0,013	0,051	***-0,226****	-0,084	**0,070**	-0,037	2,307*	**0,013**	-0,045	1,363	**0,007**	-0,022	0,318
		t-stat	0,706	0,668	-2,926	-1,094	0,907	-0,484		0,705	-1,167		0,399	-0,564	
Namibia	Overall	coef (%)	0,016	0,044	0,130	***-0,168***	-0,016	**0,134**	0,188	0,016	**0,024**	0,033	0,015	**0,031**	0,051
		t-stat	0,234	0,163	0,477	-0,622	-0,060	0,496		0,234	0,181		0,221	0,227	
	Local	coef (%)	-0,086	-0,056	0,078	***-0,457***	**0,323**	0,215	1,171	-0,086	**0,020**	0,025	-0,087	**0,025**	0,034
		t-stat	-1,341	-0,216	0,298	-1,766	1,249	0,831		-1,341	0,158		-1,367	0,185	
Tunisia	BVMT	coef (%)	0,047	***-0,144***	**0,111**	0,012	0,063	-0,108	0,789	**0,047**	-0,014	0,056	**0,046**	-0,014	0,055
		t-stat	1,674	-1,261	0,968	0,107	0,548	-0,944		1,674	-0,237		1,688	-0,235	
	TUNINDEX	coef (%)	0,009	0,024	**0,064**	***-0,034***	-0,026	-0,016	0,281	0,009	**0,002**	0,004	**0,010**	-0,003	0,006
		t-stat	0,504	0,342	0,894	-0,471	-0,366	-0,226		0,504	0,066		0,579	-0,075	
Zimbabwe	Industrial	coef (%)	0,163**	0,021	-0,141	**0,257**	0,121	***-0,227***	0,721	0,163**	**0,007**	0,004	**0,180****	-0,073	0,455
		t-stat	3,151	0,100	-0,662	1,214	0,570	-1,071		3,152	0,063		3,540	-0,675	
	Mining	coef (%)	0,115	0,149	***-0,278***	-0,005	**0,428**	-0,238	0,486	0,115	**0,012**	0,004	**0,138**	-0,091	0,214
		t-stat	1,227	0,388	-0,718	-0,012	1,112	-0,618		1,227	0,063		1,492	-0,463	

Panel (a) and panels (b) and (c) present the regression results, that is, the regression coefficients, t and F statistics for the following equations, respectively:

$$R_t = \beta_0 + \beta_1 EOMN1_t + \sum_{i=1}^{4} \beta_{i\ 1} EOMPi_t + \varepsilon_t$$

$$R_t = \alpha_0 + \alpha_1 TOM_t + e_t$$

All coefficients have been presented as percentages (multiplied by 100) since most of them became almost zero after rounding to decimal 3. This could have been avoided from the outset by calculating rates of return as percentages rather than as fractions.

** and * imply statistical significance for a two-tailed test at the 1% and 5% levels, respectively

Bold and "Bold Italic" denote the regression coefficients for the days of the month that give the highest and lowest mean daily returns, respectively. Note that in Panel (b) only the coefficients that give the highest mean daily returns have been marked in bold.

End/turn-of-the-year effect

The pattern suggested by the January effect is that stock returns are, on average, higher in the first few trading days of the year ranging from about four to ten trading days in January. The end-of-the-year (EOY) effect refers to the last trading day of the year while turn-of-the-year (TOY) effect refers to the last trading day of the year plus the first four trading days in January. In this study, the EOY/TOY effects are examined using regression equations similar to those used for the EOM/TOM effects, with the only difference being the definitions of the dummy variables. The effects are examined using the following regression equation:

$$R_t = \beta_0 + \beta_1 JANN1_t + \sum_{i=1}^{4} \beta_{i+1} JANPi_t + \varepsilon_t \quad \ldots (5)$$

where the constant β_0 represent mean daily return for all the other days of the year, β_1 is the coefficient of the dummy variable $JANN1_t$ that takes the value of 1 on the last day of the previous year and 0 otherwise, β_{i+1} is a coefficient for the dummy variable $JANPi_t$ that takes the value of 1 on the i^{th} day in January and 0 otherwise. The null hypothesis is to test that there are no differences between the mean daily returns for each of the TOY days and all the other days of the year. The results of this regression model are presented in Panel (a) of Table 4.

The TOY effect is further investigated using a regression equation with one dummy explanatory variable, TOY_t, that takes the value of 1 on each of the TOY days and 0 otherwise, specified as follows:

$$R_t = \alpha_0 + \alpha_1 TOY_t + e_t \quad \ldots (6)$$

where the constant α_0 is the mean daily return for all the non-TOY days and α_1 is the response coefficient for the dummy variable TOY_t. The results for this equation are presented in Panel (b) of Table 4.

A significant EOY effect is observed on the BRVM's two indices, the BRVM-10 and the BRVM-Composite, and on Zimbabwe's Mining Index. In both cases the coefficients are significant at the 1% level suggesting a strong EOY effect for these indices on the two markets. For the other TOY days, the highest and significantly positive (at the 1% level) mean daily returns are observed on the first trading day in January for Egypt's HFI and EFGI Indices, and on the third trading day in January for Namibia's Local Index. Namibia's Local Index, however, exhibits the lowest and significantly negative mean daily return on the second trading day in January. Morocco's CFG25 also has the lowest and significantly negative mean daily return on the first trading day in January.

Panel (b) of Table 4 confirms the TOY effect for Egypt's two indices at the 1% level. Zimbabwe's Industrial Index also exhibits the TOY effect at the 5% level, using regression equation (6) but the Mining Index cease to be significant. Weak TOY effects are also observed on other indices but they are not significant. Therefore, of all the indices in this analysis, only the Egyptian indices and Zimbabwe's Industrial Index seem to have strong TOY effects.

Month-of-the-Year Effect

With the month-of-the-year (MOY) effect, evidence from the US markets (see Cataldo and Savage, 2000) suggests that the three-month sequence, November, December and January provide the most favourable mean daily returns. Another MOY related hypothesis is the 'December decline followed by January rise' sequence observed on some markets[3]. To examine the MOY effect using regression analysis, the following model is estimated:

$$R_t = \beta_1 + \beta_2 Feb_t + \beta_3 Mar_t + \beta_4 Apr_t + \beta_5 May_t + \ldots + \beta_{12} Dec_t + \varepsilon_t \quad \ldots (7)$$

where the constant β_1 represent the January mean daily return, β_2 is the response coefficient of the dummy variable Feb_t that takes the value of 1 in February and 0 otherwise, β_3 is the response coefficient for the dummy variable Mar_t that takes the value of 1 in March and 0 otherwise, and so forth. The null hypothesis is that no differences exist between the mean returns for each month of the year. The results are presented in Panel (a) of Table 5.

The literature suggests that January provides the highest and significantly positive mean daily returns compared to the other months of the year. To further examine if January provides significantly higher returns than all the other months of the year, a simplified, one dummy variable regression model is used. This is formulated as follows:

$$R_t = \alpha_0 + \alpha_1 Jan_t + e_t \quad \ldots (8)$$

where the constant α_0 represent mean returns for all the other months of the year and α_1 is the response coefficient for the dummy variable Jan_t that takes the value of 1 in January and 0 otherwise. The estimated coefficients for this equation are presented in Panel (b) of Table 5.

[3]The hypothesis also suggests that the decline in December takes place in the last few days of the month, and the rise in January take place in the first few days in January.

Table 4: Regression results for end/turn-of-the-year effect

Stock Exchange	Index		(a)							(b)		
			(Ct=ODY2)	JANN1	JANP1	JANP2	JANP3	JANP4	F-stat	(C=ROY)	TOY	F-stat
Botswana	Domestic	coef (%)	0,098**	**0,264**	-0,015	-0,039	***-0,241***	-0,097	0,322	**0,098****	-0,012	0,007
		t-stat	5,340	0,945	-0,047	-0,125	-0,772	-0,311		5,346	-0,086	
	Foreign	coef (%)	0,042	***-1,063***	-0,042	1,128	-0,628	**1,560**	0,679	0,042	**0,131**	0,055
		t-stat	0,560	-0,931	-0,033	0,884	-0,492	1,222		0,560	0,234	
	All Companies	coef (%)	0,047	***-1,001***	-0,043	1,071	-0,613	**1,441**	0,671	0,047	**0,115**	0,047
		t-stat	0,664	-0,929	-0,036	0,889	-0,509	1,196		0,665	0,217	
BRVM	BRVM-10	coef (%)	-0,030	**1,192****	0,121	-0,143	***-0,550***	-0,454	1,983	-0,030	**0,088**	0,169
		t-stat	-0,829	2,746	0,250	-0,294	-1,135	-0,936		-0,826	0,411	
	BRVM-Comp	coef (%)	-0,043	**1,099****	0,042	-0,125	***-0,369***	-0,353	3,026**	-0,043	**0,108**	0,499
		t-stat	-1,699	3,564	0,121	-0,363	-1,070	-1,026		-1,687	0,706	
Egypt	HFI	coef (%)	***-0,065***	0,795	**1,552****	0,780	1,153*	0,093	3,423**	-0,065	**0,875****	13,060**
		t-stat	-1,888	1,482	2,891	1,452	2,149	0,173		-1,888	3,614	
	EFGI	coef (%)	-0,062	0,926	**1,470****	0,641	0,822	***-0,320***	2,566*	-0,062	**0,708****	7,570**
		t-stat	-1,691	1,623	2,577	1,124	1,441	-0,561		-1,690	2,751	
Ghana	GSE Index	coef (%)	0,131**	**0,747**	-0,009	-0,085	-0,123	***-0,167***	0,387	0,131**	**0,076**	0,086
		t-stat	2,816	1,328	-0,014	-0,150	-0,218	-0,297		2,820	0,294	
Mauritius	SEMDEX	coef (%)	0,006	***-0,033***	-0,012	0,124	0,182	**0,247**	0,674	0,006	**0,105**	1,622
		t-stat	0,538	-0,184	-0,060	0,686	1,008	1,365		0,538	1,273	
	SEMTRI	coef (%)	0,034**	0,131	***-0,021***	0,123	0,155	**0,230**	0,667	0,034**	**0,129**	2,419
		t-stat	2,856	0,726	-0,108	0,680	0,861	1,275		2,859	1,555	
Morocco	CFG25	coef (%)	0,007	-0,359	***-0,624****	-0,223	**0,121**	-0,121	1,578	**0,007**	-0,228	3,685
		t-stat	0,418	-1,384	-2,200	-0,860	0,468	-0,469		0,418	-1,920	
Namibia	Overall	coef (%)	0,023	**0,931**	-0,096	***-0,836***	-0,394	0,135	0,425	**0,023**	-0,051	0,015
		t-stat	0,386	1,024	-0,096	-0,921	-0,433	0,148		0,387	-0,122	
	Local	coef (%)	-0,081	1,001	-0,461	***-5,054*****	**4,327****	-0,017	12,500**	-0,081	**-0,026**	0,004
		t-stat	-1,458	1,171	-0,493	-5,914	5,064	-0,019		-1,430	-0,065	
Tunisia	BVMT	coef (%)	0,043	-0,141	***-0,181***	-0,050	0,011	**0,301**	0,189	**0,043**	-0,005	0,001
		t-stat	1,771	-0,366	-0,422	-0,129	0,028	0,783		1,773	-0,028	
	TUNINDEX	coef (%)	0,008	0,145	-0,090	***-0,108***	-0,086	**0,350**	0,588	0,008	**0,048**	0,188
		t-stat	0,549	0,605	-0,334	-0,451	-0,356	1,457		0,549	0,433	
Zimbabwe	Industrial	coef (%)	0,150**	1,219	1,057	**1,356**	0,138	***-0,085***	1,680	0,150**	**0,726***	4,960*
		t-stat	3,309	1,713	1,357	1,907	0,194	-0,119		3,310	2,227	
	Mining	coef (%)	0,100	**4,044****	1,580	-0,223	***-0,305***	-0,274	2,233*	0,100	**0,943**	2,528
		t-stat	1,211	3,130	1,116	-0,173	-0,236	-0,212		1,209	1,590	

Panel (a) and panel (b) present the regression results, that is, the regression coefficients, t and F statistics for the following equations, respectively:

$$R_t = \beta_0 + \beta_1 JANN1_t + \sum_{i=1}^{4} \beta_{i\ 1} JANPi_t + \varepsilon_t$$

$$R_t = \alpha_0 + \alpha_1 TOY_t + e_t$$

All coefficients have been presented as percentages (multiplied by 100) since most of them became almost zero after rounding to decimal 3 This could have been avoided from the outset by calculating rates of return as percentages rather than as fractions

** and * imply statistical significance for a two-tailed test at the 1% and 5% levels, respectively

Bold and "Bold Italic" denote the regression coefficients for the days of the year that give the highest and lowest mean daily returns, respectively Note that in Panel (b) only the coefficients that give the highest mean daily returns have been marked in bold

From the results in Panel (a) of Table 5, January seems to give significantly positive mean daily returns for Egypt's HFI and EFGI indices, Mauritius' SEMDEX and SEMTRI, Tunisia's BVMT and TUNINDEX, and for Zimbabwe's Industrial Index. Although most of the indices, except the BRVM-10, BRVM-Composite and Namibia's Local Index, have negative coefficients for the December dummy, none of them are significant, except for the TUNINDEX (at the 5% level) and Zimbabwe's Industrial index (at the 1% level). All the indices have at least one significant coefficient, except for Botswana's FCI and ACI, Namibia's Local Index and Zimbabwe's Mining Index, suggesting the absence of the MOY effect for these indices. The BRVM's two indices exhibit a reversed 'December decline followed by January rise' pattern. The other significant coefficients for the BRVM are for the months of May, September and October, and they are all positive. Other indices exhibiting significantly positive mean daily returns in months other than January are Botswana's DCI and Morocco's CFG25 (highest in August), and the GSE Index (highest in April). For all the other indices, the significant coefficients for the months February to November are all negative.

The results described above, and those in Panel (b) of Table 5, suggest the presence of a significant January effect in the Egyptian indices, Mauritius, Tunisia and Zimbabwe's Industrial Index. January provides the highest (but not significant) mean daily returns for Botswana's FCI and ACI, Morocco's CFG25 and Namibia's Overall and Local Indices. A significantly negative January effect is observed for the BRVM indices.

Table 5: Regression results for month-of-the-year/January effect

Stock Exchange	Index		(a)													(b)		
			(C=JAN)	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	F-stat	(C=OMY)	JAN	F-stat
Botswana	Domestic	coef (%)	0,050	0,165	0,117	0,066	0,078	-0,029	0,166	**0,275****	***-0,178***	-0,066	0,011	-0,020	4,031**	**0,101****	-0,051	0,514
		t-stat	0,730	1,705	1,258	0,724	0,853	-0,325	1,797	3,068	-1,947	-0,724	0,119	-0,213		5,383	-0,717	
	Foreign	coef (%)	0,340	**0,116**	-0,497	-0,232	-0,163	-0,469	-0,378	***-0,617***	-0,613	-0,155	-0,081	-0,316	0,829	0,022	**0,318**	1,174
		t-stat	1,201	0,289	-1,283	-0,609	-0,430	-1,245	-0,983	-1,657	-1,616	-0,411	-0,216	-0,819		0,292	1,084	
	All Companies	coef (%)	0,322	**0,119**	-0,462	-0,213	-0,148	-0,446	-0,347	-0,564	***-0,586***	-0,149	-0,074	-0,273	0,826	0,029	**0,294**	1,126
		t-stat	1,207	0,315	-1,263	-0,592	-0,416	-1,254	-0,957	-1,605	-1,637	-0,419	-0,208	-0,749		0,397	1,061	
BRVM	BRVM-10	coef (%)	***-0,305****	0,168	0,298	0,294	0,668**	0,278	-0,106	0,082	0,351*	0,329*	0,199	**0,670****	3,772**	**-0,004**	-0,301*	5,269*
		t-stat	-2,461	0,944	1,724	1,662	3,785	1,571	-0,607	0,468	2,044	1,986	1,194	4,048		-0,096	-2,295	
	BRVM-Comp	coef (%)	***-0,255****	0,088	0,217	0,238	0,452**	0,185	-0,109	0,061	0,309*	0,255*	0,153	**0,618****	5,627**	**-0,022**	-0,233*	6,221*
		t-stat	-2,926	0,699	1,786	1,911	3,638	1,488	-0,888	0,495	2,553	2,191	1,304	5,307		-0,835	-2,494	
Egypt	HFI	coef (%)	**0,322****	-0,428*	-0,465**	-0,423*	-0,465**	***-0,582****	-0,565**	-0,302	-0,333*	-0,355*	-0,309	-0,220	1,789	-0,080*	**0,402****	10,429**
		t-stat	2,699	-2,514	-2,765	-2,449	-2,775	-3,481	-3,351	-1,825	-2,002	-2,132	-1,853	-1,318		-2,251	3,229	
	EFGI	coef (%)	**0,274***	-0,380*	-0,415*	-0,329	-0,402*	-0,495**	***-0,508****	-0,318	-0,323	-0,360*	-0,204	-0,128	1,378	-0,076*	**0,350****	6,992**
		t-stat	2,159	-2,101	-2,319	-1,795	-2,258	-2,783	-2,836	-1,809	-1,829	-2,035	-1,153	-0,719		-2,012	2,644	
Ghana	GSE Index	coef (%)	0,218	0,017	0,328	**0,570***	-0,411	-0,140	-0,001	-0,317	***-0,417***	-0,293	-0,232	-0,025	3,624**	0,126**	**0,092**	0,305
		t-stat	1,387	0,074	1,480	2,555	-1,884	-0,633	-0,006	-1,455	-1,898	-1,342	-1,059	-0,110		2,642	0,553	
Mauritius	SEMDEX	coef (%)	**0,113****	-0,116	-0,134*	-0,106	***-0,160****	-0,042	-0,111	-0,120*	-0,149*	-0,145*	-0,088	-0,072	1,273	0,000	**0,113***	6,424*
		t-stat	2,635	-1,882	-2,255	-1,799	-2,717	-0,722	-1,908	-2,037	-2,518	-2,478	-1,484	-1,240		0,005	2,535	
	SEMTRI	coef (%)	**0,125****	-0,128*	-0,115	-0,054	-0,142*	-0,027	-0,089	-0,131*	***-0,146****	-0,130*	-0,076	-0,027	1,551	0,029*	**0,096***	4,661*
		t-stat	2,936	-2,076	-1,944	-0,921	-2,425	-0,463	-1,533	-2,242	-2,466	-2,224	-1,284	-0,457		2,404	2,159	
Morocco	CFG25	coef (%)	0,055	0,078	0,031	-0,037	-0,129	-0,049	***-0,173****	**0,161***	-0,173*	-0,156*	-0,061	-0,087	3,384**	-0,002	**0,057**	0,899
		t-stat	0,960	0,961	0,385	-0,458	-1,621	-0,608	-2,169	1,985	-2,173	-1,976	-0,752	-1,092		-0,124	0,948	
Namibia	Overall	coef (%)	0,170	-0,005	-0,134	-0,045	-0,246	-0,099	-0,209	***-0,627****	-0,410	-0,032	**0,038**	-0,011	0,974	0,008	**0,162**	0,595
		t-stat	0,846	-0,016	-0,475	-0,154	-0,843	-0,346	-0,753	-2,206	-1,443	-0,116	0,133	-0,038		0,134	0,771	
	Local	coef (%)	-0,041	-0,080	0,020	-0,072	**0,196**	0,003	-0,069	-0,154	0,120	-0,290	***-0,201***	0,105	0,522	-0,085	**0,044**	0,047
		t-stat	-0,213	-0,291	0,075	-0,258	0,699	0,012	-0,258	-0,565	0,440	-1,085	-0,740	0,379		-1,454	0,216	
Tunisia	BVMT	coef (%)	**0,288****	-0,204	-0,263*	***-0,504****	-0,180	-0,392**	-0,126	-0,206	-0,224	-0,336**	-0,287**	-0,213	2,306**	0,022	**0,266****	8,874**
		t-stat	3,373	-1,693	-2,173	-4,161	-1,521	-3,287	-1,063	-1,735	-1,881	-2,860	-2,411	-1,782		0,877	2,979	
	TUNINDEX	coef (%)	**0,169****	-0,063	-0,202**	***-0,268****	-0,144	-0,266**	-0,123	-0,129	-0,149*	-0,223**	-0,192**	-0,147*	2,201*	-0,005	**0,173****	9,689**
		t-stat	3,166	-0,840	-2,682	-3,542	-1,946	-3,578	-1,656	-1,739	-2,008	-3,041	-2,577	-1,969		-0,288	3,113	
Zimbabwe	Industrial	coef (%)	**0,725****	-0,766**	-0,414	-0,750**	-0,579**	-0,260	-0,282	-0,799**	-0,688**	-0,739**	***-0,857****	-0,623**	2,960**	0,114*	**0,611****	13,914**
		t-stat	4,634	-3,454	-1,896	-3,340	-2,620	-1,189	-1,303	-3,612	-3,148	-3,419	-3,918	-2,777		2,449	3,730	
	Mining	coef (%)	0,201	-0,039	0,012	-0,445	0,109	0,033	-0,209	**0,197**	0,173	-0,109	-0,187	***-0,581***	0,670	0,111	**0,090**	0,091
		t-stat	0,700	-0,095	0,030	-1,080	0,270	0,084	-0,525	0,487	0,433	-0,274	-0,467	-1,414		1,297	0,301	

Panel (a) and panel (b) present the regression results, that is, the regression coefficients, t and F statistics for the following equations, respectively:

$R_t = \beta_1 + \beta_2 Feb_t + \beta_3 Mar_t + \beta_4 Apr_t + \beta_5 May_t + \quad + \beta_{12} Dec_t + \varepsilon_t$

$R_t = \alpha_0 + \alpha_1 Jan_t + e_t$

All coefficients have been presented as percentages (multiplied by 100) since most of them became almost zero after rounding to decimal 3 This could have been avoided from the outset by calculating rates of return as percentages rather than as fractions

** and * imply statistical significance for a two-tailed test at the 1% and 5% levels, respectively

Bold and "Bold Italic" denote the regression coefficients for the months of the year that give the highest and lowest mean daily returns, respectively Note that in Panel (b) only the coefficients giving the highest mean daily returns have been marked in bold

Week-of-the-month effect

In this study, the week-of-the-month (WOM) effect is defined as in Roux and Smit (2001) in which the first trading week of the month consists of the first five trading days of the month, the second and third trading weeks consist of the sixth to the tenth, and the eleventh to fifteenth, trading days of the month, respectively. All the remaining days of the month are classified as week 4. The WOM effect is defined differently only for Ghana. Since the market was trading only three times a week for the period under investigation, the first trading week of the month is defined as the first three trading days of the month, the second week as the fourth to the sixth trading day of the month, and so forth. To examine the WOM effect using regression analysis, the following equation is estimated:

$$R_t = \beta_1 + \sum_{i=2}^{4} \beta_i WKi_t + \varepsilon_t \quad \ldots (9)$$

where the constant β_1 represent the mean return for week 1, β_i is the response coefficient for the dummy variable WKi_t that takes the value of 1 in week *i* and 0 otherwise, for *i =2, 3 and 4*. The null hypothesis is that there are no differences in the mean returns for each week of the month. The results of this regression model are presented in Table 6.

The results in Table 6 suggest that there are no strong week-of-the-month effects on the African stock markets studied. The only significant coefficients observed are the week 1 mean returns for Botswana's DCI and Zimbabwe's Industrial index (positive at the 5% level of significance), the week 3 mean daily returns for Egypt's HFI and EFGI, and the week 4 mean daily returns for Botswana's FCI and ACI (negative at the 1% and 5% levels of significance, respectively). Although not significant, week 1 provides the largest mean daily returns for Botswana's FCI and ACI, Egypt's HFI and EFGI, and Zimbabwe's Industrial Index. The mean daily returns are highest in week 2 for the GSE Index, the CFG25, and Namibia's Overall Index, and in week 3 for Botswana's DCI, Mauritius's SEMTRI and SEMDEX, Namibia's Local Index, and Tunisia's BVMT. The mean daily returns are highest in week 4 for both of the BVRM indices, the TUNINDEX and Zimbabwe's Mining Index. Considering the F-statistic, only the BRVM and Egypt have significant WOM effects.

Table 6: Regression Results for Week-of-the-Month Effect

Stock Exchange	Index		(C=WK1)	WK2	WK3	WK4	F-stat
Botswana	Domestic	coef. (%)	0,094*	-0,014	**0,023**	0,005	0,176
		t-stat	2,552	-0,278	0,440	0,104	
	Foreign	coef. (%)	**0,264**	-0,161	-0,270	-0,422*	1,473
		t-stat	1,752	-0,756	-1,268	-2,039	
	All Companies	coef. (%)	**0,263**	-0,161	-0,261	-0,407*	1,528
		t-stat	1,846	-0,802	-1,301	-2,083	
BRVM	BRVM-10	coef. (%)	-0,068	-0,103	0,081	**0,167**	2,731*
		t-stat	-0,946	-1,011	0,795	1,696	
	BRVM-Comp	coef. (%)	-0,087	-0,051	0,107	**0,121**	2,760*
		t-stat	-1,697	-0,704	1,485	1,714	
Egypt	HFI	coef. (%)	**0,073**	-0,038	-0,265**	-0,170	3,113*
		t-stat	1,053	-0,392	-2,700	-1,795	
	EFGI	coef. (%)	**0,093**	-0,075	-0,294**	-0,186	3,067*
		t-stat	1,263	-0,721	-2,820	-1,849	
Ghana	GSE Index	coef. (%)	0,006	**0,206**	0,099	0,191	1,073
		t-stat	0,067	1,562	0,752	1,508	
Mauritius	SEMDEX	coef. (%)	0,019	-0,043	**0,024**	-0,023	1,455
		t-stat	0,809	-1,264	0,710	-0,689	
	SEMTRI	coef. (%)	0,046	-0,037	**0,027**	-0,026	1,437
		t-stat	1,940	-1,087	0,792	-0,805	
Morocco	CFG25	coef. (%)	-0,037	**0,064**	0,048	0,047	0,690
		t-stat	-1,122	1,364	1,009	1,022	
Namibia	Overall	coef. (%)	0,045	**0,027**	-0,004	-0,110	0,278
		t-stat	0,382	0,164	-0,023	-0,674	
	Local	coef. (%)	-0,137	-0,017	**0,120**	0,119	0,440
		t-stat	-1,222	-0,107	0,752	0,759	
Tunisia	BVMT	coef. (%)	0,056	-0,014	**0,030**	-0,058	0,601
		t-stat	1,126	-0,198	0,430	-0,864	
	TUNINDEX	coef. (%)	0,005	-0,005	0,009	**0,014**	0,076
		t-stat	0,147	-0,106	0,194	0,325	
Zimbabwe	Industrial	coef. (%)	**0,199***	-0,021	-0,118	-0,007	0,365
		t-stat	2,171	-0,164	-0,908	-0,052	
	Mining	coef. (%)	0,222	-0,147	-0,295	**0,008**	0,763
		t-stat	1,329	-0,622	-1,249	0,037	

The table presents the regression results, that is, the regression coefficients, t and F statistics for the equation:

$$R_t = \beta_1 + \sum_{i=2}^{4} \beta_i WKi_t + \varepsilon_t$$

All coefficients have been presented as percentages (multiplied by 100) since most of them became almost zero after rounding to decimal 3. This could have been avoided from the outset by calculating rates of return as percentages rather than as fractions.

** and * imply statistical significance for a two-tailed test at the 1% and 5% levels, respectively

Bold denotes the regression coefficient for the week of the month that gives the highest mean daily return.

Kruskal-Wallis and Chi-square median tests

The regression results are substantiated with results from the more robust Kruskal-Wallis and Chi-square Median tests. The Kruskal-Wallis and Median tests for the TOM and TOY effects emulate those for the regression equations that make use of only one dummy explanatory variable.

The results (presented in Table 7) suggest a significant DOW effect for Botwana's FCI and ACI, Morrocco's CFG25 and Zimbabwe's Industrial index, using the Kruskal-Wallis test. In addition to these indices, Egypt's HFI and EFGI also exhibit significant DOW effects, using the Chi-Square Median test. Significant TOM effects are only observed on Egypt's HFI and EFGI, using the Kruskal-Wallis test, and only on the EFGI, using the Chi-square Median test. When the TOY effect is extracted from the return series, the TOM effect observed in the Egyptian indices disappears. This tends to indicate that the observed TOM effect is in actual fact a TOY effect. The two Egyptian indices are also the only indices with significant WOM effects, observed using the Kruskal-Wallis but not with the Chi-square Median test.

Interestingly, even with such robust tests, the TOY and the MOY effects persist on some indices. A significant TOY effect is observed on Egypt's HFI and EFGI, and on Zimbabwe's Industrial index using both nonparametric tests. The TOY effect is also observed on Mauritius' SEMTRI and SEMDEX using the Kruskal-Wallis and the Chi-square Median tests, respectively. The relatively more persistent seasonality is the MOY effect. This is observed on Botswana's DCI, the BRVM-10 and BRVM-Composite, the GSE Index, the CFG25 and Zimbabwe's Industrial Index, using both nonparametric tests, and on Tunisia's BVMT and Zimbabwe's Mining Index, using the Kruskal-Wallis and Chi-square Median tests, respectively.

Summary and concluding remarks

Stock market seasonal effects on seventeen indices from nine African stock markets are investigated. Using regression analysis, significant Monday effects are found on two of Botswana's indices, the FCI and the ACI, and on Morocco's CFG25. Significant TOM effects are also found on the FCI and ACI, and on the Egyptian and Mauritian indices, using regression analysis. The TOM effects disappeared for Egypt and Mauritius after removing the TOY effects, suggesting that the TOM effects on these markets could be TOY effects. However, the TOY effects are significant only for Egypt and Zimbabwe's Industrial Index, but not for Mauritius. Significant MOY effects were observed on the BRVM, Morocco, Tunisia, Ghana, Botswana's Domestic Index and Zimbabwe's Industrial Index. A reversed December/January pattern was observed for the BRVM to indicate the highest mean daily returns in December and the lowest mean daily returns in January. For Egypt, Mauritius, Tunisia and Zimbabwe's Industrial Index, January provides the highest, positive and significant mean daily returns as compared to all the other months of the year. Significant WOM effects are evident only for the BRVM and Egyptian indices.

The seasonal effects are almost just as strong using the nonparametric Kruskal-Wallis and Chi-square Median tests except the TOM and WOM effects in which the effects are only significant for the Egyptian indices. In addition to the markets exhibiting significant effects under the regression analysis method, Egypt and Zimbabwe's Industrial Index also exhibit significant DOW effects using the Chi-square Median test. Significant TOY effects are also observed on Mauritius' SEMDEX and SEMTRI using the Chi-square Median and Kruskal-Wallis tests respectively. The MOY effects, observed using regression analysis, are confirmed on most indices using the Kruskal-Wallis test.

While the indices for most markets exhibit at least one seasonal effect, no significant seasonal effects are observed for the Namibian indices using the nonparametric tests. On the other markets, the presence of these predictable seasonal patterns seems to suggest exploitable trading opportunities.

This study only presented the evidence on the existence of seasonal patterns on African stock markets. It is also important to investigate the dynamics of these patterns on African stock markets. While the weekend effect is said to have disappeared or been reversed for the U.S. market, it would be important to investigate whether the seasonal patterns observed in this study are persistent or only specific to the periods investigated. It would also be interesting to investigate if seasonal patterns exist on African stock markets for the same reasons they exist on stock markets elsewhere. Such an investigation might reveal new factors that are specific only to African stock markets. These, and other issues, shall be covered in a follow-up study.

Table 7: Nonparametric Kruskal-Wallis ANOVA and median# tests results for seasonal effects

Stock Market	Stock Index	Day-of-the-week		Turn-of-the-month		Turn-of-the-month2		Turn-of-the-year		Month-of-the-year		Week-of-the-month	
		Kruskal Wallis H	Chi-Square	Kruskal Wallis H	Chi-Square	Kruskal Wallis H	Chi-Square	Kruskal Wallis H	Chi-Square	Kruskal Wallis H	Chi-Square	Kruskal Wallis H	Chi-Square
Botswana	Domestic	2,222	1,457	0,003	0,258	0,001	0,677	0,084	0,899	35,213**	27,618**	2,243	5,366
	Foreign	46,002**	66,984**	2,526	0,905	3,297	1,806	0,335	1,340	7,258	10,172	1,475	1,423
	All Companies	43,005**	31,402**	2,164	1,039	2,561	1,822	0,080	0,914	9,859	10,902	0,985	0,317
BRVM	BRVM-10	4,272	4,200	0,621	0,527	0,744	0,743	0,026	0,114	47,071**	33,517**	4,352	5,556
	BRVM-Comp	1,584	0,594	0,932	1,161	0,630	0,501	0,295	1,225	60,733**	46,796**	4,162	2,211
Egypt	HFI	6,576	13,079*	6,302*	2,523	1,852	0,151	13,160**	13,635**	18,054	16,548	11,359**	4,882
	EFGI	7,606	16,928**	7,357**	5,933*	3,239	2,284	8,677**	8,731**	16,614	17,275	11,020*	7,689
Ghana	GSE Index	n/a	n/a	0,118	0,721	0,037	0,502	0,186	0,178	40,036**	26,115**	0,734	2,605
Mauritius	SEMDEX	4,297	4,006	2,812	1,692	1,308	0,415	3,007	4,277*	18,793	14,449	5,039	7,297
	SEMTRI	4,149	2,560	2,820	1,692	1,043	0,593	4,435*	2,865	18,636	13,397	3,627	4,431
Morocco	CFG25	22,409**	23,096**	0,122	0,463	0,021	0,263	0,411	0,321	41,920**	29,347**	1,145	2,847
Namibia	Overall	7,607	8,780	0,535	0,562	0,628	0,510	0,014	0,030	12,535	10,514	2,915	5,498
	Local	2,149	5,787	2,311	1,036	1,671	0,788	0,667	0,232	9,026	12,563	5,099	1,811
Tunisia	BVMT	3,444	4,749	0,026	0,007	0,059	0,007	0,055	0,000	24,531*	17,955	0,187	0,671
	TUNINDEX	4,439	3,819	0,171	0,030	0,032	0,098	0,550	0,162	17,369	11,000	1,111	2,295
Zimbabwe	Industrial	12,303*	12,319*	0,257	0,851	0,201	0,000	8,524**	7,932**	30,448**	21,148*	0,719	1,237
	Mining	0,840	2,403	0,142	0,316	0,007	0,078	2,009	0,813	15,694	24,123*	1,966	2,018

[#] The Median test statistic in the table is labelled "Chi-square"

** and * imply statistical significance for a two-tailed test at the 1% and 5% levels, respectively

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