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Calendar Anomalies, Market Regimes, and the Adaptive Market Hypothesis in African Stock Markets

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Abstract

Purpose: This paper examines the changing behavior of two calendar anomalies in African stock returns – the month-of-the-year and the intra-month effects – and their implications for the adaptive market hypothesis (AMH).

Methodology: We applied two-stage Markov switching models (MSMs) instead of the conventional single state regression model. The sample period includes the daily index return of Nigerian, South African, Mauritian, Moroccan, and Tunisian stock exchanges from January 1998 to February 2018.

Findings: We found that (i) all the markets except for the Johannesburg Stock Exchange (JSE) have a higher tendency to be in bearish state than bullish state, (ii) month-of-the-year and intra-month effects appear in one regime and disappear in another regime, and (iii) the behavior of calendar anomalies is affected by market conditions and conforms to AMH rather than the efficient market hypothesis (EMH).

Practical Implications: We present that (i) calendar anomaly is a characteristic that changes under different regimes or market conditions in African stock markets, (ii) active investment management may yield profits for market participants, depending on the market conditions and the anomaly in question, and (iii) the right approach would be for investors to consider each market with its own peculiarity even when they are in the same continent.

Originality/Value: The sensitivity of the month-of-the-year and the intra-month effects to market conditions has not been documented in African stock markets, especially with the use of regime-switching models.

Keywords: calendar effect, intra-month, AMH; African stock markets, Markov switching model

JEL: G10, G14

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Introduction

The efficient market hypothesis (EMH) holds that a systematic forecast of security returns is impossible. In other words, changes in security prices should be random, independent, and identically distributed processes (Fama, 1965; 1970). Consequently, any efforts to forecast expected security prices will be futile. Thus, if a market is efficient, the prevailing prices incorporate all historical prices, and it will be impossible to earn profit by relying on price history to predict expected future prices. Lo, Blume, and Durlauf (2007) hold that market anomalies present an important problem for the EMH. Market anomalies represent a systematic pattern in stock price changes, which is reliable, common, and inexplicable. The regularity and reliability of the pattern mean a degree of predictability, and the common knowledge of the pattern means that market participants can exploit it. Sedeaq (2016) defines stock market anomalies as the existence of abnormal patterns of stock returns in stock markets. A market anomaly is further defined as a price or profit distortion, which evidences the inefficiency in financial markets (Magnus, 2008). Lo and Hasanhodzic (2010) state that technical analysis is essentially a form of human pattern recognition, which is an application of behavioral finance. Calendar anomalies are those that show deviations from normal behavior and continuously return patterns at certain periods during the year, month, week, or day (Archana, Kevin and Safeer, 2014).

The advent of the adaptive market hypothesis (AMH) seems to end the controversy between the proponents of EMH and behavioral finance. By drawing insight from evolutionary principles, Lo (2004) presented a framework called the AMH, which accommodates the coexistence of EMH and behavioral finance in an intellectually consistent manner. Lo (2005) states that there sometimes appear arbitrage opportunities; otherwise, there will be no price discovery because there will be no rationale for participants to process information (Grossman and Stiglitz, 1980). Based on the evolutionary explanation, active liquid market ecology requires the existence of profit opportunities that will evaporate as soon as they are exploited (Lo, 2017). Instead of the rising trend towards a higher efficiency expected by the EMH, the AMH explains relatively complex market dynamics, characterized by cycles, trends, panics, manias, bubbles, crashes, and other common features of the real market (Lo, 2005). Investment strategies under AMH may be profitable in one environment and unprofitable in another. Unlike EMH – in which profit opportunities are eliminated by competition – the AMH implies that strategies may fail and then return to profitability when favored by environmental conditions (Lo, 2005). While EMH does not rule out such cycles, EMH studies failed to investigate these dynamics in practice, assuming instead a perpetually stationary and balanced market (Lo, 2005).

Beginning with the late 1990s, evidence abounds on the disappearance of the most popular calendar anomalies from markets in which they were initially identified, such as the day-of-the-week and January/monthly effects (Yamori and Kurihara, 2004; Martin, 2011). In the wake of the AMH, which supports the disappearance and reappearance of market efficiency due to changing market conditions, researchers now face the task of determining a framework or model that accommodates efficiency and anomaly with a view to bringing out the effect of changes in an episode. Various economic and financial time series usually go through periods in which the movement of the series (e.g. in mean or volatility or both) significantly varies relative to what appeared in the past (Brooks, 2014). A one-off change in behavior is often called a structural break. Where the behavior changes for a period of time and returns to its previous behavior or shift to new behavior, it is known as a regime shift or switch (Brooks, 2014); typical of the behavior described by the recently developed AMH. Brooks (2014) notes that regime shift can occur regularly and result in significant variation in equity return behavior. Obviously, in the presence of such "regime changes," a linear model estimated over the entire sample that covers the change would be unsuitable. In this study, we examine two calendar anomalies in stock returns – the month-of-the-year and the intra-month/half of the month effects – by applying Markov switching models (MSMs) which, while permitting the estimation of entire observations on a series, are also adequately flexible to permit different types of behavior at different points in time. The main objective of the study is to examine whether month-of-the-year and half-of-the-month, and their associated calendar effects, are present under different market conditions.

Literature Review

The month-of-the-year anomaly or monthly effect holds that the average return for stock depends on the month-of-the-year (Rahele, Fereydoun and Mohammad, 2013). This anomaly is evident when returns in some months are higher than others (Oba, 2014). For example, Aylin (2014) holds that the January effect is the likelihood that security returns in January are larger than or exceed those of other months of the year. It is simply the presence of abnormally high returns in January. A large number of empirical results on this effect have indicated the presence of higher return in January relative to other months of the year, hence, the name January effect. The turn of the year effect explains the possibility of estimated returns to be larger in January, especially during the first few trading days of the month than the returns obtainable in other months of the year (Rozeff and Kinney, 1976; Keim, 1983; Gultekin and Gultekin, 1983). The monthly effect also includes the bimonthly anomaly, which shows the changes in return within a month as days elapse (Rahele et al., 2013). It reflects

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the market tendency to generate higher returns on the early days than the rest of the month. Thus, the intra-month effect involves the existence of nonnegative/higher returns during the first half of the month (Martin, 2011).

Literature offered various explanations for month-of-the-year anomalies, yet there still is no consensus. Tax-loss selling hypothesis asserts that – at the end of the tax year –investors sell stocks that perform badly in order to realize capital losses. They do it to offset gains on other stocks and thereby reduce tax liability. Since the tax year in most countries ends in December, tax-loss-selling causes prices to go down at the end of the year. When investors start buying stocks again in January, prices go up, and there appears the January effect (Branch, 1977; Dyl, 1977; Aylin, 2014; Márcio, 2015). Liquidity hypothesis is associated with Ogden (1990), which holds most investors have access to cash reception at the end of the month, receive additional cash via holiday payments and annual salary bonuses at year ending, and become liquid. They reinvest these funds in the stock market, which leads to an increase in demand, prices, and stock returns. The increase in cash flows at the turn-of-the-month and year explain the January, turn of the year, month-of-the-year, turn-of-the-month, and intra-month anomalies. According to investor recognition and new information hypothesis, investors tend to buy more stocks when firms release new information, because this type of information increases their awareness. As new information is typically released at the beginning of the year, investors will be induced to place more buy orders in this period and – as a result – the returns of stocks will be significantly larger in January (Chen and Singal, 2004; Merton, 1987). The investor recognition hypothesis holds that stocks will be traded more frequently in January than in December, because traders will postpone investments until the New Year when many firms publish new information (Aylin, 2014).

Rozeff and Kinney (1976) study the January effect in 1904–1974 in the New York Stock Exchange (NYSE) to find that the January average return is significantly higher than in other months. Using the same data set between 1963 and 1979, Keim (1983) establishes that just about 50% of the average magnitude of the risk-adjusted premium of small firms relative to large firms was caused by the abnormal January returns. Above 50% of excess January returns were traceable to the first week of January. Gultekin and Gultekin (1983) provide international evidence in 17 countries from a 1959–1970 sample to identify January and April effects in all the countries, including the UK. Choudhry (2001) evaluates month-of-the-year (MOY) anomalies in three developed countries in 1870–1913. The result of Choudhry's generalized autoregressive conditional heteroscedasticity concludes that both the MOY and January effects appear in the USA and the UK only and not in Germany. Wing-Keung, Aman, and Nee-Tat (2006) investigate calendar anomalies in Singapore by using the full period in 1993–2005 and sub-periods 1993–1997 and 1998–2005. Their results show that there appears a January effect in the post-crisis period, while the turn-of-the-month is present in both periods. Furthermore, some international studies (Rubinstein 2001; Maberly and Waggoner, 2000; Schwert, 2001; Steeley, 2001; Kohers et al., 2004; Hui, 2005) argue that both day-of-the-week and month-of-the-year effects grew weaker. Between 1915 and 2009, Martin (2011) conducted a comprehensive review of the literature on calendar anomalies. He found that the intra-day, holiday, and intra-month effects still exist, while the January effect halved.

Moreover, some studies combine both the MOY and day-of-the-week (DOW) effects. For instance, Lei and Gerhard (2005) investigate calendar effects in the Chinese stock market, especially monthly and daily effects. Their results reveal that the highest returns could be achieved after the Chinese year-end in February, while Mondays are seen to be weak, with Fridays showing significant positive average returns. However, the daily effect has a minor magnitude and relevance for determining average returns compared to monthly effects. Similarly, Rossi (2007) examines calendar anomalies in stock returns in South America in 1997–2006. Overall, there is an absence of monthly anomalies in full period and first sub-period, but the January effect appears in Argentina in the second sub-period. With reference to part-of-the-month anomalies, Ariel (1987) discovers that the average return in the first half of the month is significantly higher than the remaining half of the month. This finding is supported by Jaffe and Westerfield (1989) in Australia, Arsad and Coutts (1997) in the UK, and Bildik (2004) in Istanbul. Similarly, using daily returns of the US composite index from 1962–1990, Kohli and Kohers (1992) find that the first week in the month possesses higher average returns than other weeks. Moreover, Lukas (2012) investigates seasonality in the US stock market across six (6) major industrial sectors with the use of descriptive statistics, the GARCH (1,1) model, and Wald Chi-squared test. Lukas rejects the DOW and January effects in the US stock market but cannot reject the presence of the part-of-the-month anomaly. Mouselliand Al-Samman (2016) finds a May effect in the Damascus stock market. More recently, Rossi and Gunardi (2018) study the monthly effect in Spain, France, Italy, and Germany for 2001–2010. They report a significant presence of a positive April effect in Italy, a January effect in Spain, and a negative September effect in Germany. Moreover, Aziz and Ansari (2018) report the presence of the turn-of-the-month effect in 11 out of 12 markets examined in Asia for 2000–2015. Moreover, Vatrushkin (2018) reports changing May and October effects in Brazil, a February effect in Russia, and a December effect in South-Africa. Furthermore, Podgorski (2018) reports on the existence of the January effect in the European Union (EU) markets. Before the accession to the EU, the January effect reduces over time but grows stronger afterward. We can see that many studies confirm a significant presence of calendar anomalies in developed and emerging markets. On the other hand, some sub-period studies (Bush and Stephen, 2016; Podgorski, 2018) reveal different behaviors in different sub-periods, while others observe the weakening and disappearing of calendar anomalies in some quarters. Overall, the evidence is mixed.

The hype of calendar anomaly would mean that African emerging and frontiers markets are not overlooked in the investigation of calendar effects. In African markets, Alagidede and Panagiotidis (2006) analyze the calendar effect of the Ghana Stock Exchange to find the presence of the April effect, as opposed to the usual January effect. Brishan (2012) examines calendar anomalies in nine sectors of the Johannesburg stock market and concludes that there is the presence of day – and month effects, a reduction in pre-holiday effects, and the absence of the January anomaly. Oba (2014) studies the Nigerian stock index return for 1996–2013 by using a dummy regression and GARCH(1,1) to find evidence for a January, July, August, September, and November effect with January return being positive and the highest. Bundoo (2011) examines the indices of ten companies in the stock exchange of Mauritius for 2004–2006 to find a significant September effect. A dummy variable regression is adopted by Alagidede (2013) in an examination of calendar effects in African countries' stock markets by using data from their inception to 2006. A holiday effect was reported in South Africa, a February effect in Morocco, Kenya, Nigeria, and South Africa, and a January effect in Egypt and Zimbabwe. There are few studies of the month-of-the-year effect on African markets, and the evaluation of the intra-month effect is rare. However, most of the available studies support the significant presence of the monthly calendar effect in African stock markets.

In line with the time-varying efficiency of the AMH, Urquhart and McGroarty (2014) investigate the time-varying calendar anomaly in the USA by using daily and monthly indices for 1900–2013. The results of GARCH (1,1), Kruskal–Wallis test, 19-years-long equal length sub-samples, and five-years-long fixed-length rolling window disclose that calendar anomalies vary over time and are influenced by such conditions as up, down, bull, bear, normal, expansionary and contractionary, or republican and democrats dispensation. Similarly, eight Dow Jones Islamic indices are studied by Osamah and Ali (2017) by using sub-period mean-variance and stochastic dominance analyses. Their findings support the varying behavior of calendar effects in line with the AMH. Further, Agnani and Aray (2011) apply two state MSMs to document the time-changing January effect in the USA. The effect is found to be pronounced during the period of high volatility. Recently, Rich (2018), in Johannesburg Stock Exchange (JSE), applies MSMs to find a negative January effect in bull, negative July effect in bear, and positive August effect in bull regimes. Thus, the results of MSM from Agnani and Aray (2011) and Rich (2018) seem to corroborate the position of AMH that market condition matters. Therefore, AMH offers a theoretical basis for a new financial model for the investigation of stock returns, as supported by recent empirical studies. Most of the existing studies examine anomalies as an all-or-nothing phenomenon by employing a single-state model. The few sub-period analyses – such as Wing-Keung et al. (2006) – show that certain anomalies appear in one sub-period and not in other sub-periods, while some appear in all periods. Such sub-period studies use a piecewise linear model, which may be taken as globally non-linear. However, every component part is a linear model; hence, it is expected to be wasteful of information and result in loss of efficiency (Brooks, 2014). In a word, there is a dearth of study of calendar anomalies cum market conditions in the context of AMH.

Research Methods

Data

This study used daily stock indices' returns of the major stock markets in Africa. The data covered a period of 20 years (1998:1–2018:2) subject to data availability. The data were sourced from the Bloomberg database. The study used a sample of five African stock markets in Nigeria, South Africa, Mauritius, Morocco, and Tunisia. The selection of these markets is based on data availability and their relative size on the continent. Based on market capitalization and listing, the selected markets account for over 70% of the total market capitalization in the continent (Africa Tax, Law, Finance Hub, 2016). We use the simple returns from Nigerian Stock Exchange All Share Index (NGSEINDX), JSE All Share Index (JALSH), Stock Exchange of Mauritius All Share Index (SEMDEX), Casablanca Stock Exchange All Share Index (MOSENEW), and Tunisia Stock Exchange All Share Index (TUSISE), which are obtained as:

$$IR_t = \log\left(\frac{P_t}{P_{t-1}}\right) \quad (1),$$

in which IR_t is the time t return of stock index, log is the natural logarithm, and P_t and $P_{t-1}$are the price index at time t and t–1.

Figure 1 presents the time plot of simple returns, which revealed the presence of volatility clustering that indicates a nonlinearity of the data. Thus, the application of a single--state model by existing studies will fail to reflect the nonlinear nature of the return series. In this context, Brooks (2014) identifies MSM as ideal in handling volatility clustering.

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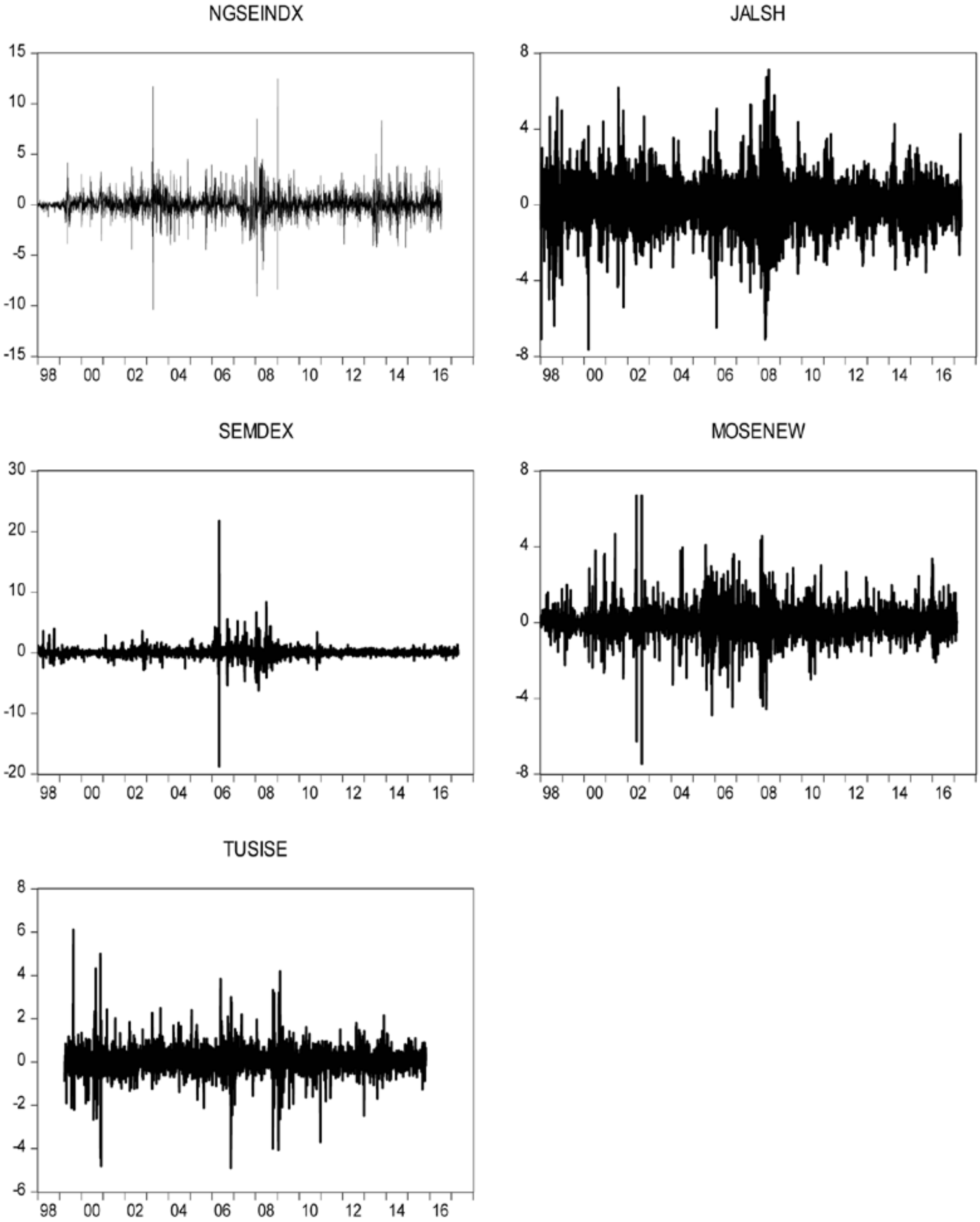
Figure 1. NGSE, JSE, SEM, MOSE and TSE Daily Stock Returns from 1998:1-2018:2



Source: Authors estimation (2018).

Dummy Variable Regression Model

The popular methodology used in examining the month-of-the-year effect involves estimating an OLS regression with dummies to capture monthly seasonality. MOY effect regression equation[3] is given thus:

$$MR_t = \sum_{i=1}^{12} \theta_i D_{it} + \varepsilon_t \qquad (2),$$

$$H_0: \theta_i = 0 \ldots\ldots H_1: \theta_i \neq 0$$

in which MR_t = Index returns of month t, D_{it} = dummies such that, D_{1t} = 1 if month t is January and 0 otherwise, D_{2t} = 1 if the month is February and 0 otherwise and so forth, $\boldsymbol{\theta}_i$ = (in which i=1,2,...12) parameters to be estimated. The hypothesis is tested for each month using the t-statistic.

$\boldsymbol{\theta}_1$ must be positive and greater than other $\boldsymbol{\theta}$ for January effect to hold. Similarly, the presence of the intra-month anomaly is normally examined with the use of a regression model with dummy variable specified as follows:

$$MR_t = \alpha_1 D_1 + \alpha_2 D_2 + \varepsilon_t \qquad (3),$$

$$H_0: \alpha = 0 \quad and\ H_1: \alpha \neq 0$$

in which MR_t represents index return, D_1 is a dummy equal to 1 for the first 15 days of the month and 0 if otherwise, α_1 is the coefficient representing the mean returns of the first half of the month, and ε_t is a stochastic error term. The intra-month effect is indicated by the greater and significant positive value of α_1 relative to α_2. Note that the intercept is not included in the above equations to avoid the dummy variable trap.

Regime Switching Model

An alternative method of analyzing calendar anomalies under different market conditions (bull, bear) is to subject stock market returns to the regime-switching model. Suppose that the stock return R_t follows a process that depends on the value of an unobserved discrete state variable S_t. We assume that there are M possible regimes and that the process is said to be in the state or regime m, in period t, when $S_t = m$,

3 The lags of dependent variables (MR_{t-i}) are added in the estimation of equations (2) and (3) to take care of the autocorrelations.

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for $m = 1, 2, , \ldots , M$. The switching model associates different regression model with each regime.

We specified simple MOY and half-of-the-month (HOM) models with regime-switching intercepts and regressors:

$$MR_t = \mu_{s_t} + \sum_{i=1}^{12} \alpha_{s_t} D_{it} + \varepsilon_{s_{t,t}} \quad (4),$$

$$MR_t = \mu_{s_t} + \alpha_{1s_t} D_1 + \alpha_{2s_t} D_2 + \varepsilon_t \quad (5),$$

in which MR_t is index returns, μ_{st} is a state-dependent intercept, S_t are states; D_{it} ($i = 1, 2\ldots 12$) for MOY calendar dummy variables with state-dependent coefficients α_{st}, $\varepsilon_{st,t}$ is error term. Markov switching regression is capable of generating M regression models by associating different models with each regime (bull or bear) and showing under which regime calendar anomalies are significant. Since we introduce as many dummy variables as the number of categories of those variables (calendar months), we must drop the intercept in equation 4 and 5 to avoid the dummy variable trap from equation. Hence, the equations become:

$$MR_t = \sum_{i=1}^{12} \alpha_{s_t} D_{it} + \varepsilon_{s_{t,t}} \quad (6),$$

$$MR_t = \alpha_{1s_t} D_1 + \alpha_{2s_t} D_2 + \varepsilon_t \quad (7),$$

The persistence of each regime follows the first-order Markov process given by the transition probability matrix. The first-order Markov assumes that the probability of being in a state depends on the most recent state, so that

$$P(s_t = j \mid s_{t-1} = i) = p_{ij}(t) \quad (8),$$

in which the ij-th element is the probability of moving from regime i in period $t-1$ to regime j in period t. The probabilities are assumed to be constant, so that $p_{ij}(t) = p_{ij}$ for all t. For a two-regime model, the matrix assumes the form:

$$P = \begin{bmatrix} P(s_t = 0 / s_{t-1} = 0) & P(s_t = 1 / s_{t-1} = 0) \\ P(s_t = 0 / s_{t-1} = 1) & P(s_t = 1 / s_{t-1} = 1) \end{bmatrix} = \begin{bmatrix} P00 & P01 \\ P10 & P11 \end{bmatrix} \quad (9),$$

in which $P00$ is the probability that the return is at state 0 (low) at time $t-1$ and remains there at time t, $P01$ is the probability that the return is at state 0 at time $t-1$ and move to 1 (high) at time t, $P10$ is that the return is at state 1 at time $t-1$ and move to state 0 at time t, and $P11$ is the probability that the return is at state 1 at time $t-1$ and remains there at time t.

The probability of a change from regime i to j follows the logistic model. Since each row of the specified transition matrix contains a full set of conditional probabilities, a separate multinomial logit model can be specified for each row of the transition matrix as given in equation (10):

$$P_m(G_{t-1}, d_i) = \frac{\exp(G'_{t-1},\ \ d_{ij})}{\sum_{s=1}^{M} \exp(G'_{t-1},\ \ d_{is})} \quad (10),$$

for $j = 1, \ldots, M$ and $i = 1, \ldots, M$ with the normalisations $d_{iM} = 0$. MSMs were normally and generally specified with constant probabilities, so that G_{t-1} contains only a constant. Hamilton's (1989) popular example of a constant transition probability specification is adopted in this study being a benchmark in this class of models (Perlin, 2015).

Empirical Results

Analyses of Variance (ANOVA) Tests

Results of the tests of difference in mean and variance results are reported in Table 1.

Table 1. ANOVA Results

Indices	MOY			HOM		
	ANOVA	Kruskal--Wallis Stat	Levene	ANOVA	Kruskal--Wallis Stat	Levene
NGSEINDX	3.929093***	52.69568***	4.846235***	3.504036*	1.296156	1.482347
JALSH	0.836070	13.86597	1.573238*	0.208138	1.841337	1.802235
SEMDEX	1.205283	27.07974***	1.305379	1.683186	0.694571	0.054090
MOSENEW	2.620027***	45.26267***	3.859451***	0.113953	0.304826	0.002228
TUSISE	2.336475***	2.336475**	4.470864***	0.585093	0.455855	4.777500**

Source: Authors estimation.

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T-test results show that returns and variances are significantly different across the months of the year in all the markets except for the JSE and the SEM, while Kruskal-Wallis (KW) and Levene tests show that the hypothesis of no significant difference in MOY returns and variance can only be rejected in JSE. However, the hypothesis of no difference in returns and variances of the first and second half of the month is accepted in the five markets, except for the Tunisian Stock Exchange (TSE), in which variances of the first and second half of the months are significantly different. The main objective of the study is to examine whether MOY, HOM, and their associated calendar effects are present under different market conditions.

The two calendar anomalies, namely month-of-the-year and intra-month calendar effects, are hereby subjected to regime-switching regression with the aim of determining the regime (market condition) that provides significant calendar anomalies, and vice versa. First, we determine the probability of a market moving from one state to another, along with the probable expected duration in a particular state. The results are presented in Table 2.

Transition Probabilities and Constant Expected Durations

Table 2. Transition probabilities & Constant expected durations

Transition probabilities	Regime 1 $_{(t-1)}$	Regime 2 $_{(t)}$	Regime 1 $_{(t-1)}$	Regime 2 $_{(t)}$
	NGSEINDX		JALSH	
Regime 1 $_{(t-1)}$	0.955858	0.044142	0.968184	0.031816
Regime 2 $_{(t)}$	0.119906	0.880094	0.013423	0.986577
Constant expected durations	22.65396	8.339853	31.43073	74.49844
	SEMDEX		MOSENEW	
Regime 1 $_{(t-1)}$	0.966459	0.033541	0.854576	0.145424
Regime 2 $_{(t)}$	0.196519	0.803481	0.043971	0.956029
Constant expected durations	29.81447	5.088576	6.876462	22.74225
	TUSISE			
Regime 1 $_{(t-1)}$	0.798889	0.201111		
Regime 2 $_{(t)}$	0.027131	0.972869		
Constant expected durations	4.972386	36.85858		

Source: Authors estimation.

Table 2 contains the transition probability of being in a bullish or bearish market for each of the markets under consideration. We can see that the probability of being in a bear regime (0.955858) is higher than the probability of being in a bull regime (0.880094). Thus, the NGSEINDX has a higher tendency to undergo a bearish trend than a bullish trend. Hence, the NGSEINDX is expected to spend approximately 23 days in the bear regime and eight days in the bull regime, as revealed by the constant expected duration. Table 2 shows that the transition probabilities of the JALSH following bearish and bullish trends are 0.968184 and 0.986577, respectively. This implies that the JSE spends more time in the bull market than in the bear market condition. This is corroborated by the constant expected duration of approximately 74 days in regime 2 compared to 31 days in regime 1. Therefore, JSE spends more than double of the period in the bear regime. For the SEMDEX index return, the probability of remaining in the bear period (0.966459) is greater than that of being in the bull period (0.803481). Moreover, the tendency for the market to transit from the former (0.033541) to the latter is also lower than the other way around (0.196519). The bear regime lasts about 30 days, while the bull regime lasts for just five days. Thus, the SEM has a higher likelihood of continuing in bearish trend or market, a similar behavior to the NGSE.

Table 2 disclosed that the likelihood of the MOSE to be in an up period (0.854576) is lower than being in a down period (0.956029). However, the probability of moving from the up regime (0.145424) to the down regime is higher. The market is expected to stay in a bull state for about seven days compared to 23 days in bear condition. Noteworthy, there is a high tendency of moving from the bull to the bear regime in all the analyzed stock exchanges except for the JSE. The TUSISE results show that the probability that stock return stays in a bullish and bearish state are 0.798889 and 0.972869, respectively. This means that the TSE has a tendency to remain in bear market conditions longer than in bull market conditions. Moreover, the market shows a higher likelihood of moving from the bull condition to the bear condition. This agrees with the constant expected duration, which revealed that TSE remains in the bearish state for approximately 37 days and in the bullish state for about five days. Determining the effect of market condition on calendar anomalies becomes necessary, since the investigation of AMH requires the establishment of the changing behavior and the condition that informed the changes.

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The Month-of-the-Year (January) Effects

The regime-switching results of the month-of-the-year effects are presented in Table 3.

Table 3. Markov switching regression results of Month of the year effect

Variable	Coefficient	z-Statistic	Coefficient	z-Statistic	Coefficient	z-Statistic
	NGSEINDX		JALSH		TUSISE	
	Regime 1 BEAR		Regime 1 BULL		Regime 2 BULL	
JAN	0.025640	0.686916	0.096164*	1.909970	0.231008	1.385961
FEB	-0.015667	-0.411849	0.097771*	1.939349	-0.217563	-1.248127
MAR	-0.018695	-0.556200	0.146418*	2.742693	0.522094*	2.205830
APR	0.005751	0.182144	0.132386*	2.512358	0.446451*	2.867897
MAY	0.058823	1.697869	0.061754	1.246956	-0.017182	-0.093337
JUN	0.059908	1.526604	-0.014222	-0.273682	-0.304921	-1.337153
JUL	-0.006572	-0.201848	0.116961*	2.306372	-0.071259	-0.235764
AUG	-0.037929	-1.047447	0.118969*	2.296052	0.215477	0.936039
SEP	-0.024205	-0.733893	0.082304	1.539905	0.012979	0.073355
OCT	-0.035057	-1.103974	0.139252*	2.649535	-0.173853	-1.070833
NOV	-0.029632	-0.942668	0.052320	1.069731	-0.118323	-0.604137
DEC	0.110708*	3.170947	0.156241*	2.892113	0.112702	0.467218
LOG(SIGMA)	-0.645776*	-32.83909	-0.188050*	-10.85339	0.200674*	4.500473
	Regime 2 BULL		Regime 2 BEAR		Regime 2 BEAR	
JAN	-0.014570	-0.100909	0.000446	0.002630	0.051030*	2.134916
FEB	0.221692	1.461481	-0.082502	-0.490917	0.039634	1.772157
MAR	0.088883	0.491882	-0.043632	-0.247817	0.007529	0.347549
APR	0.571499*	2.551934	0.058638	0.272512	0.024369	1.016631
MAY	0.575323*	2.977772	0.029182	0.156768	0.037288	1.678864
JUN	0.111435	0.813146	-0.133229	-0.745280	0.068265*	3.193112
JUL	-0.136954	-0.769253	-0.123349	-0.660086	0.067400*	3.362111
AUG	-0.063371	-0.429532	-0.162767	-0.990273	0.053152*	2.673946
SEP	0.164459	0.826433	-0.169476	-0.857334	0.022307	0.944687
OCT	0.156637	0.728621	0.158263	0.978535	0.020459	0.904613

NOV	-0.134496	-0.659128	0.083535	0.439727	0.013579	0.619530
DEC	0.141796	0.810554	0.083718	0.491124	0.006190	0.289371
LOG(SIGMA)	0.539131*	20.40784	0.620247*	25.52110	-1.029240*	-56.89071
	SEMDEX		**MOSENEW**			
	Regime 1 BULL		**Regime 1 BEAR**			
JAN	0.510345*	2.229745	0.056469*	2.009972		
FEB	-0.061087	-0.283823	0.061588*	2.214337		
MAR	0.252769	1.065166	-0.023052	-0.931174		
APR	0.276267	1.216448	0.042748	1.642868		
MAY	0.150346	0.598779	0.028165	1.105210		
JUN	0.480812	1.705186	-0.069427*	-2.920595		
JUL	0.137193	0.595528	-0.008854	-0.361030		
AUG	0.005059	0.021325	0.080383*	3.289585		
SEP	0.176008	0.831093	-0.002165	-0.078567		
OCT	0.132804	0.638304	0.007461	0.303571		
NOV	0.243454	0.933355	-0.054002*	-1.977583		
DEC	0.182278	0.676727	-0.027133	-0.997419		
LOG(SIGMA)	0.601832*	18.69252	-0.889275*	-46.03725		
	Regime 2 BEAR		**Regime 2 BULL**			
JAN	0.054430*	3.130311	0.205683	1.850223		
FEB	0.010052	0.527668	0.168270	1.337344		
MAR	0.010462	0.605140	0.017911	0.127684		
APR	0.000690	0.040355	0.113367	0.765219		
MAY	0.024407	1.509824	-0.033686	-0.239992		
JUN	0.031892*	1.940265	0.315426	1.873108		
JUL	0.011956	0.704741	-0.122529	-0.720447		
AUG	0.006637	0.411254	0.317880	1.770931		
SEP	0.052540*	2.929611	-0.175433	-1.228512		
OCT	0.006731	0.386054	-0.060675	-0.420124		
NOV	0.017334	1.036507	0.144756	1.036350		
DEC	0.044136*	2.644570	0.186251	1.557348		
LOG(SIGMA)	-1.227096*	-75.96907	0.273782*	9.730039		

P-values are symbolized as * signifying significance at conventional 5% significant level.
Source: Authors estimation.

For the NGSEINDX returns, we see that the popular January effect is absent in both bull and bear periods, as indicated by the large *p*-values of the coefficients. Instead, the results revealed a significant positive December effect in the bear period and positive April/May effects in the bull period. This revealed that the popular January effect is absent in the NGSEINDX in both regimes. Hence, the market regime or condition has no significant effect on the January effect. However, the results suggest a shift from the December effect in the bear regime to the May effect in the bull regime. The JALSH results revealed the presence of the month-of-the-year effect in a bullish market with all months other than May, June, September, and November showing significant positive returns. The January effect is not dominant, as the December return is significantly higher than in other months of the year. However, the month-of-the-year effect disappeared in the bearish market, since all the month-of-the-year coefficients are insignificant at 5% level of significance. This suggests that the MOY effect is associated with bull market conditions in the JSE.

From the SEMDEX month-of-the-year regime-switching results in Table 3, the January calendar effect is present in the bull regime, because the January return is positive, significant, and higher than in other months of the year. The January effect persists in the bear regime, in which the January return remains significantly positive and higher than in other months of the year, notably September and December, which are also significant and positive. Therefore, the popular January effect remains unchanged in both bull and bear markets; however, the effect is stronger in the bull than in the bear market (after comparing the coefficients). This implies that the January effect performs well under bull market conditions. Furthermore, the September/December effects appear in the bear regime and disappear in the bull regime.

The regime-switching results for the MOSENEW show that the MOY effect is significantly present in a bearish market. There are significant positive January, March, and August effects, along with negative June and November effects. The January effect is dominated by the August effect. The MOY anomalies identified under the bear condition disappeared as the market transitioned to the bull period. We see that the bull period is not associated with a significant MOY effect, as virtually all calendar month coefficients have *p*-values larger than 0.05. Suffice to state that the bear market condition favors MOY effects in the MOSE, while the effects vanish as markets become bullish. We can infer from the TUSISE switching regression results that March and April effects appear in the bull market, while January, June, July, and August appear in the bear market. Therefore, the popular January effect is not present in the bull market. Where the January effect is found, the effect is not as strong as the June and July effects. In a word, the effect observed in one regime disappeared in the other regime, and vice versa.

Intra-Month (Half-of-the-Month) Effect

The intra-month Markov switching regression results are presented in Table 4.

Table 4. Markov switching regression results of Intra-month effect in selected African stock markets

Variable	Coefficient	z-Statistic	Coefficient	z-Statistic
	NGSEINDX		**JALSH**	
	Regime 1 BEAR		**Regime 1 BEAR**	
FIRST	0.003605	0.254054	-0.087909	-1.234177
SECOND	0.005370	0.392391	0.045218	0.636109
LOG(SIGMA)	-0.647565*	-32.42241	0.617653*	25.58081
	Regime 2 BULL		**Regime 2 BULL**	
FIRST	0.189467*	2.721863	0.139377*	6.451663
SECOND	0.046495	0.674129	0.058547*	2.819396
LOG(SIGMA)	0.538955*	20.53851	-0.189622*	-11.00656
	Transition Matrix Parameters		**Transition Matrix Parameters**	
P11-C	3.080279	24.59123	3.415453	16.65401
P21-C	-2.009900	-14.52210	-4.297264	-21.74071
	SEMDEX		**MOSENEW**	
	Regime 1 BEAR		**Regime 1 BULL**	
FIRST	0.027591*	3.893752	0.101241	1.726059
SECOND	0.023271*	3.337511	0.093496	1.597869
LOG(SIGMA)	-1.214801*	-76.18881	0.285302	9.758830
	Regime 2 BULL		**Regime 2 BEAR**	
FIRST	0.238189*	2.507652	0.006985	0.646107
SECOND	0.076493	0.787303	0.004642	0.444340
LOG(SIGMA)	0.598743*	18.91952	-0.875212	-43.08692
	Transition Matrix Parameters		**Transition Matrix Parameters**	
P11-C	3.348295	29.50115	1.765369	13.59712
P21-C	-1.404541	-10.59893	-3.102299	-24.31510

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	TUSISE	
	Regime 1 BULL	
FIRST	0.077938	0.975978
SECOND	0.042121	0.512852
LOG(SIGMA)	0.230794*	5.034297
	Regime 2 BEAR	
FIRST	0.038091*	4.105005
SECOND	0.031775*	3.655450
LOG(SIGMA)	-1.023321*	-56.62616
	Transition Matrix Parameters	
P11-C	1.403640	8.137227
P21-C	-3.558932	-23.04963

P-values are symbolized as * signifying significance at conventional 5% significant level.
Source: Authors estimation.

The NGSEINDX result indicates the absence of the half-of-the-month effect in stock returns during the bull market as the average return in the first and second half of months are not significant at the conventional 5% level. However, a look at the bear market results shows the presence of the half-of-the-month effect, because the average return in the first fifteen days of the month is significantly greater than the remaining days of the month. The JALSHHOM results are similar to the NGSEINDX. The coefficient of both halves of the month is insignificant with large *p*-values during the bull period, which suggests the absence of the half-of-the-month effect in the bull period. When we consider the bear results, we see that the returns are positive, significant, and larger in the first half of the month than in the second half of the month. The implication is that the profit opportunity in one period suddenly disappears in another regime.

Regime switching results for the SEMDEX revealed that the intra-month calendar effect appears in the bearish market, since the first half of the month returns are positive, significant, and higher than in the second half of the month. Both first and second halves' coefficients are significant. In the same vein, the bullish market results show the persistence of the intra-month effect, in which returns for the first fifteen days of the month are averagely and significantly greater than the remaining half of the month, regardless of the insignificance of the latter. The MOSENEW results reveal that the intra-month calendar effect is neither present in bull nor the bear markets. Although the first half returns are greater than the second half returns in both the bull and the bear period, the insignificance of the coefficient estimates undermines the persistence of the said calendar effect. This means that the market condition has no relationship with the HOM effect in the MOSE. Lastly, the HOM results for the TUSISE show that the bearish market is associated with the intra-month effect, since the first-half-of-the-month returns are significant and more positive relative to the second-half-of-the-month results. This effect cannot be found in the bull market, in which the estimated coefficient for the first – and second-half-of-the-months is not statistically significant. This agrees with the AMH, which implies that profit opportunities change, as do market conditions.

Discussion of Findings

We estimated the transition probabilities and constant expected durations to find that all the markets – except for the JSE – have a higher tendency to be in a bearish state. Hence, they are expected to stay in the bear market more than in the bull market. We found that the popular January effect is dominant in the SEM and stronger in the bull market. Its absence in other markets suggests that it is not prevalent in African stock markets. The little evidence of January effect in all the markets agrees with Bundoo (2011) for Mauritius and Alagidede (2013) for the JSE, who note that January effects identified in many advanced markets are non-existent in the African stock markets. This may be connected to the peculiar features of the trading systems and market microstructure of the African stock markets. Alagidede (2013) notes that tax arrangements in these markets do not drive holders to sell shares at the tax year-end to generate a loss for tax purposes, the reason usually mentioned for the January effect in advanced markets. Moreover, tax regulation and the undeveloped legal structure of the African stock markets may also account for the absence of proof for the tax-loss-selling hypothesis. This study supports Urquhart and McGroarty (2014) who suggest that market condition has no significant effect on the behavior of the January effect in the USA. Our findings disagree with Oba (2014), who documents a significant January effect in Nigeria, although suggesting that the study may have sampled periods when the effect appeared.

We found that the month-of-the-year effect changes with the regime in the JSE and the MOSE. The effect is associated with – respectively – the bull and bear condition in the two markets. However, the effect appears in both regimes in other markets; although, the specific effect observed in one regime disappeared in another. We confirmed that month-of-the-year effect anomalies are prevalent in the African stock markets – as noted by Alagidede (2013) and Brishan (2012) – but the particular effect is sensitive to regime-switching. The sensitivity of the month-of-the-year effect to

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market conditions has not been documented before the current article. We also established that the NGSE, the JSE, and the TSE exhibit the intra-month effect in the bear regime, while the effect disappears in bull regime; the SEMDEX shows the intra-month effect in both regimes, but the effect is stronger under bull condition, while market regimes have no relationship with the intra-month effect in the MOSE. In a word, the calendar anomalies considered in this study change along with market conditions, as explained by AMH, which supplements the recent findings by Obalade and Muzindutsi (2019) that calendar anomalies in the African stock markets change along with market conditions. Therefore, we conclude that the calendar anomaly is a characteristic that changes under different regimes in African stock markets, so we argue that the behavior of calendar anomalies conforms to AMH rather than to EMH.

Concluding Remarks

This article examined the changing behavior of two calendar anomalies in the African stock markets: the month-of-the-year and the intra-month effects and their implications for the AMH. We applied the two-stage MSM rather than the conventional single-state regression model, which treats market efficiency as an all-or-nothing phenomenon. We showed that the MOY effect changes with the regime in all the markets, since the specific effect observed in one regime disappeared in the other. Similarly, the intra-month effect appears in one regime and disappears in the other in most of the markets. This implies that – this effect completely changes under market conditions in some markets – it is stronger in one condition than others in some stock markets, and it does not exist at all under both conditions in some markets. We conclude that active investment management may yield profits for stock market participants when some stock markets are in the bear regime while other stock markets are in the bull regime, depending on the anomalies. Therefore, the right approach would be for investors to consider each stock market with its own peculiarity even when the considered stock markets are on the same continent. Our results disagree with the results of single-state models, which fail to bring out the dynamic behavior of the market anomaly.

The study is unique in numerous ways. First, it is the first published paper to investigate calendar anomalies under AMH with the use of a regime-switching model. Second, it is the first study to evaluate the presence of the calendar anomaly – specifically the month-of-the-year and the intra-month – under different regimes in order to establish the market regime that is associated with a particular anomaly. This positions the study among the few studies on the African stock markets, which examine the behavior of calendar anomalies within the framework of the new AMH. Finally, this article shows that MSM is the appropriate model for investigating calendar anomalies compared to the conventional single-state regression model. Consequently, we provide more evidence on the validity of the new AMH in explaining the calendar anomaly behavior. For future research, scholars should examine other anomalies within the AMH framework.

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