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Article

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Calendar anomalies in African stock markets

El Mehdi Ferrouhi^{1*}, Omar Kharbouch¹, Samir Aguentaou² and Muhammad Naeem³

Abstract: In this paper, we investigate the day of the week and the month of the year effects in African stock markets, both in the Gregorian and the Hijri calendars. Specifically, we investigate Monday effect, Friday effect, January effect and Ramadan effect, from January 2009 to December 2019, using OLS regression with robust standard errors. January is the first month of the Gregorian calendar, while Ramadan is the 9th and the most sacred month of the lunar calendar, used in Muslim countries. The results obtained show the existence of Monday effect in BRVM and Namibia, Friday effect in Kenya and Namibia, January effect in Botswana and Zambia, December effect in Botswana, BRVM and Egypt and Ramadan effect in Tunisia.

Subjects: Economic Psychology; Economics; Finance

Keywords: Monday effect; Friday effect; January effect; Ramadan effect; DOW; MOY; Day of the Week effect; Month of the Year effect; African stock markets

JEL Classifications: C22; G10; G11; G15; G17

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PUBLIC INTEREST STATEMENT

Stock markets may be characterized by the existence of abnormal variations in some days of the week, some weeks or some months. Abnormal variations mean that they are excessively higher or lower on some days (e.g., day of the week effect, week-end effect, holiday effect), weeks (e.g., Turn of the Year effect, Week of the Year effect) or months (January effect, December effect). These abnormal variations related to time are called calendar anomalies. In this paper, we analyze the existence of calendar anomalies related to the Gregorian calendar and those related to the Hijri calendar (the Islamic calendar) in the African stock markets. The existence of these calendar anomalies in a stock market are very important and crucial as it influences portfolios strategies of the investors. Our study shows strong evidence of the existence of calendar anomalies (Day of the Week effect, Month of the year effect and Ramadan effect) in African stock indices.

1. Introduction

While efficient market hypothesis EMH indicates that stock markets are efficient, stock prices follow a random walk and are thus unpredictable (Fama, 1965, 1970, 1995), several authors found that stock markets are characterized by calendar anomalies. These anomalies are time related (Floros & Salvador, 2014) and may depend on days, weeks or months. Indeed, calendar anomalies imply that stock returns are different (higher or lower) on some days (day of the week effect, week-end effect and holiday effect), weeks (Turn of the Year effect, Week of the Year effect), months (January effect, Ramadan effect, Halloween effect) than other days, weeks and months of the year. In this paper, we investigate the Day of the Week (Monday and Friday), January and Ramadan effects in African stock markets. The January and Ramadan effects are related to months and are detected in two different calendars: the Gregorian calendar and the Hijri calendar.

The majority of countries adopt the Gregorian calendar as official calendar. The Gregorian calendar is a solar calendar composed from 12 months. Precedent research works show that some months (generally January or April) may be characterized by abnormal returns. This effect is called the January effect and implies that stock returns in January are higher than the others months of the year (Moller & Zilca, 2008; Shen et al., 2020). Wachtel (1942) is the first to find evidence of seasonal movements during December and January in the DJIA between 1927 and 1942. Several authors find evidence of January effect in the US (Haug & Hirschey, 2006; Poterba & Weisbenner, 2001; Reinganum, 1983; Rendon & Ziemba, 2007; Rozeff & Kinney, 1976), in the UK (Reinganum & Shapiro, 1987), in Canada (Berges et al., 1984) and in Ireland (Lukey & Whelan, 2004)). In Asia, different authors found evidence of January effect in Japan (Kato and Schallheim (1985), in China (Zhang & Li, 2006) and in Taiwan (Chien & Chen, 2008; Shen et al., 2020). In Africa, Brishan (2012) find evidence of January effect in nine industrial sector (oil and gas, basic materials, industrials, consumer goods, health care, consumer services, telecommunications, financials and technology) indices in South Africa, between 1995 and 2012. Bundoo (2011) find evidence of January effect in Mauritius stock exchanges. Other papers investigate January effect at international level. Thus, Gultekin and Gultekin (1983) find evidence of January effect in major industrialized countries (Australia, Austria, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Singapore, Spain, Switzerland, the UK and the US). Chui and Wei (1998) find evidence of January in Hong Kong (large firms) and in South Korea (small firms). Choudhry (2001) find evidence of January effect in the UK and the US and no evidence in Germany. However, Raj and Thurston (1994) find evidence of April effect in New Zealand. This effect is explained by the « tax loss selling » hypothesis (Reinganum, 1983). According to this hypothesis, investors sell, before the end of the year, stocks that prices have declined during the year to reduce their taxes, which impacted negatively their prices. In January, stocks sale decreases and prices increases. Thus, Paul and Theodore (2006) find evidence of Month of the year effect (April) in Ghana as the end of the year and the date of the submission of company reports is March, which confirms the tax-loss hypothesis. In the UK, Arsad and Andrew Coutts (1997) find evidence of January and April effects. Recent papers also documented calendar anomalies in cryptocurrencies (Kinatader and Papavassiliou (2019) find reverse January and March effects; Kaiser (2019) find reverse January effect; and Baur et al. (2019) find no evidence of January effect.

Another calendar anomaly that has been investigated in Muslim majority countries is the Ramadan effect. Ramadan is the 9th month of the Hijri calendar. Also known as the Islamic calendar, the Arabic calendar or the Hijriyah calendar, the Hijri calendar is a lunar calendar is used in Islamic countries (in addition to the Gregorian calendar). Indeed, Muslim countries use both the Gregorian calendar for business and the Hijri calendar for religious observance (Sonjaya & Wahyudi, 2016). The Hijri calendar is composed from 12 months (Muharram, Safar, Rabi' al Awwal, Rabi' al-Thani, Jumada al-Awwal, Jumada al-Thani, Rajab, Shaaban, Ramadan, Shuwwal, Dhu al-Qadah and Dhu al-Hijjah). While the number of days in the Gregorian calendar is 30 or 31 days per month (except February, 28 or 29 days), the number of days in the Hijri calendar is 29 or 30 days. Ramadan is a Holy month when Muslims fast from the sunset to the sunrise. According to Kavanagh and Bower (1985) and Hirshleifer and Shumway (2003), outcomes are determined by emotional states. Thus, as Muslims in Ramadan are more religious and have a good mood, Ramadan is supposed to have an effect on stocks in Muslim majority countries. Seyyed et al. (2005) investigate Ramadan effect, during the period 1985–2000, on the overall Saudi stock market and six sector indices

and find that volatility declines during the month of Ramadan while there was no evidence of stock returns changes during and after Ramadan. Al-Hajjeh et al. (2011) investigate Ramadan effect in Middle Eastern countries (namely Bahrain, Egypt, Jordan, Kuwait, Qatar, Saudi Arabia, Turkey and UAE) between 1992 and 2007 and find evidence of Ramadan effects in the majority of stock markets (except Bahrain and Saudi Arabia). Ramadan effect in these markets is attributed, according to the authors, to the positive mood of investors during Ramadan. Ariss et al. (2011) find evidence of Ramadan and December effects on GCC (Gulf Cooperation Council) stock markets. Białkowski et al. (2012) investigate Ramadan effect in 15 markets (Bahrain, Egypt, Indonesia, Jordan, Kuwait, Malaysia, Morocco, Oman, Pakistan, Qatar, Saudi Arabia, Tunisia, Turkey and UAE). Results obtained show that stock returns during Ramadan were higher and less volatile and the authors conclude to the existence of Ramadan effect. Al-Khazali (2014) investigates Ramadan effects in the same sample as Al-Hajjeh et al. (2011), over the period 1989–2012 and five sub-periods. Results confirm results of Białkowski et al. (2012) and show evidence of Ramadan effects. Khan et al. (2017) investigate Ramadan effect on the Karachi Stock Exchange (Pakistan) using GARCH and OLS models. While results obtained using GARCH model show a minor positive impact of Ramadan on the stock market, results obtained using OLS model show that stock market variations during this month are less volatile. Gavrilidis et al. (2016) find evidence of herding behavior in seven stock markets (Bangladesh, Egypt, Indonesia, Malaysia, Morocco, Pakistan and Turkey). Sonjaya and Wahyudi (2016) find evidence of Ramadan effect in 10 countries (8 Asian countries namely Bahrain, Indonesia, Jordan, Malaysia, Kuwait, Oman, Qatar and Saudi Arabia; and 2 African countries namely Morocco and Tunisia). Lai and Windawati (2017) find evidence of Ramadan effect in the Indonesian and Malaysian stock markets. Wasiuzzaman and Al-Musehel (2018) investigate Ramadan effect in Saudi and Iranian stock markets and find evidence of Ramadan effect on Saudi Arabia market while they find no evidence of Ramadan effect in the Iranian stock market. Yousaf et al. (2018) find no evidence of herding behavior during Ramadan in the Pakistani stock exchange. Also, Hassan and Kayser (2019) investigate the effect of Ramadan on Dhaka stock exchange (Bangladesh) and find no evidence of Ramadan effect on market volatility.

The day of the week has also been well documented. Thus, Dubois and Louvet (1996) find evidence of day of the week effect in nine countries (Australia, Canada, France, Germany, Hong Kong, Japan, Switzerland, the UK and the US). Results show low return in the first days of the week but not necessary on Monday. Also, Chiah and Zhong (2019) find evidence of Monday effect (positive returns) and Friday effect (negative returns) in 24 developed countries. Zhang et al. (2017) find evidence of Monday effect (on Argentina, China, Italy, Poland, Singapore, the US «Dow Jones Industrial index»), Tuesday effect (on Canada and the US «S&P 500»), Wednesday effect (on Australia, Germany, Indonesia, Japan, Mexico, New Zealand, Switzerland), Thursday effect (on Czech Republic, the Philippines) and Friday effect (on Brazil, Chile, Hong Kong, India, Malaysia, Russia, Spain, Turkey). In Asia, Wong et al. (1992) find evidence of Monday and Tuesday effect (negative returns) and Friday effect (positive returns) in Hong-Kong, Malaysia, Singapore and Thailand stock markets. Basher and Sadorsky (2006) find evidence of day of the week effect on Pakistan, Taiwan and the Philippines. Ke et al. (2007) find evidence of day of the week effect on the three first days of the week on Taiwan. Ariss et al. (2011) investigate day of the week effect on Gulf Cooperation Council (GCC) stock markets, and as the weekend on these countries is on Friday and Tuesday, the authors find evidence of Wednesday effect (Wednesday in GCC is last day of the week before the weekend). H. Berument and Kiyamaz (2001) find evidence of Wednesday and Monday effect (low returns) and Friday and Wednesday effect (low returns) on the S&P 500 index. Keef and Roush (2005) find evidence of weekend effect in pre-holiday returns on the S&P 500 index. Caporale and Zakirova (2017) find evidence of Monday and Friday effects in the Russian stock market. Evidence of calendar anomalies was also detected in the Thai stock market (Wuthisatian, 2021). Ma and Tanizaki (2019) investigate day of the week effect Bitcoin and observe Monday and Thursday effects while Caporale and Plastun (2019) find evidence of Monday effect on Bitcoin and no day of the week effects on other cryptocurrencies. Aharon and Qadan (2019) find evidence of Monday effect on Bitcoin and confirm precedent results. Also, Kinatader and Papavassiliou (2019) find no evidence of day of the week effect on Bitcoin returns.

Previous studies that investigate aspects of the behavioral finance in African stock exchanges concerned specific stock markets—e.g., the Ghana Stock Exchange (Paul & Theodore, 2006), the Mauritius Stock

Exchange (Agathee, 2012), the Casablanca Stock Exchange (Ferrouhi, 2021), the South African stock exchange (Bhana, 1985; Brishan, 2012; Du Toit et al., 2018), the Tunisian Stock exchange (Derbali & Hallara, 2016)—or a panel of stock markets (Chukwuogor, 2008; Guney et al., 2017; Kalidas et al., 2013).

African stock markets are members of the African Stock Exchanges Association (ASEA). According to Table 1, the oldest African stock market is the Egyptian Exchange, created in 1883, then the South African stock market “Johannesburg Stock Exchanges, four years later; in 1887. The Namibian stock market has also more than one hundred years (created in 1904). The youngest African stock markets are Lusaka stock exchange (1994), Dar Es Salam Stock Exchange (1996), Uganda Securities Exchange (1997) and Rwanda Stock Exchange (2005). The big five African stock markets (using market capitalization) are the Johannesburg Stock Exchange (867,2 billion \$), the Namibian stock Exchange (130,3 billion \$) and the Moroccan stock market “Casablanca Stock Exchange” (56 billion \$). Three stock markets have more than one hundred listed companies: Johannesburg Stock Exchange (352), Egyptian Exchange (245) and Nigerian Stock Exchange (159).

This paper is a replication the study of Obalade and Muzindutsi (2019), in which the authors investigate calendar anomalies in African stock markets. However, while the authors use Markov switching models, we apply in the present paper the usual approach that permit the detection of calendar anomalies in financial markets (Gibbons & Hess, 1981; Peterson, 1990; Solnik & Bousquet, 1990; Raj & Thurston, 1994; Keef & Roush, 2005; Ariss et al., 2011; M. H. Berument & Dogan, 2012; Caporale & Zakirova, 2017; Aharon & Qadan, 2019). We extend the sample to 16 African stock indices.¹ Also, while Obalade and Muzindutsi (2019) study two calendar anomalies (the month of the year and the intra-months effects) in the Gregorian calendar, we extend the calendar anomalies studied and investigate the Day of the week effect (Monday effect and Friday effect) and the Month of the year effect (January effect and Ramadan effect) both in the Gregorian and the Hijri calendars.

In this paper, we investigate the existence of calendar anomalies in African stock markets (Botswana, Cote d’Ivoire, Egypt, Kenya, Mauritius, Morocco, Namibia, Nigeria, Rwanda, South Africa, Tanzania, Tunisia, Uganda and Zambia) for the period post-subprime crisis and pre-Covid-19 crisis (for the period 2009–2019). We focus on three main anomalies, namely the Day of the Week effect (DOW) and the Month of the Year effect MOY (in both the Gregorian and Hijri calendars). The originality of the present paper lies to the inexistence, to the best of our knowledge, of a paper that examines calendar anomalies in a panel of 14 African countries, for the period post-subprime crisis and pre-Covid-19 crisis. This study presents two main contributions. First, as our literature review shows that there is a lack of studies on calendar anomalies in African markets, this paper contributes to extending the existing literature and its contribution cannot be underestimated. Second, results of this study have practical implications both for researchers, investors and authorities since the existence of calendar anomalies in African stock markets influences optimal portfolios strategies. One of the specificities of African markets is that they are relatively recent. In fact, 50% of the markets studied are less than 50 years old. The rest of this paper is organized as follows: section 2 presents the methodology adopted and data used, section 3 discusses obtained results and section 4 presents our conclusions.

2. Methodology and data

In this paper, we investigate the day of the week and the month of the year effects, using OLS regression with Huber-White robust standard errors. Thus, following the papers of Gibbons and Hess (1981), Peterson (1990), Solnik and Bousquet (1990), Raj and Thurston (1994), Keef and Roush (2005), Ariss et al. (2011), M. H. Berument and Dogan (2012), Caporale and Zakirova (2017), and Aharon and Qadan (2019), we investigate the Day of the week (Monday and Week-end), January and Ramadan effects by estimating the following equations:

3. For january effect

$$R_{it} = \beta_{1i}M_{1i} + \beta_{2i}M_{2i} + \dots + \beta_{11i}M_{11i} + \beta_{12i}M_{12i} + \varepsilon_{ti}$$

Table 1. Presentation of African stock exchanges

Country	Stock Exchange	Market capitalization (USD)	N° of listed companies	Date of creation
Botswana	Botswana Stock Exchange (BSE)	33,57 billion	32	1989
Benin, Burkina Faso, Cote d'Ivoire (Headquarter), Guinea-Bissau, Mali, Niger, Senegal, Togo	Bourse Régionale des Valeurs Mobilières (BRVM)	6,77 billion	46	1966
Egypt	Egyptian Exchange (EGX)	43,06 billion	245	1883
Kenya	Nairobi Securities Exchange (NGSEINDEX)	19,81 billion	63	1954
Mauritius	Stock Exchange Of Mauritius (SEM)	5,84 billion	95	1989
Morocco	Casablanca Stock Exchange (CSE)	56 billion	75	1929
Namibia	Namibian Stock Exchange (NSX)	130,3 billion	39	1904
Nigeria	Nigerian Stock Exchange (NGSEINDEX)	37,75 billion	159	1960
Rwanda	Rwanda Stock Exchange (RSE)	3,62 billion	10	2005
South Africa	Johannesburg Stock Exchange (JSE)	867,2 billion	352	1887
Tanzania	Dar Es Salaam Stock Exchange	6,5 billion	27	1996
Tunisia	Bourse De Tunis (BVMT)	8,25 billion	82	1969
Uganda	Uganda Securities Exchange (USE)	5,04 billion	17	1997
Zambia	Lusaka Stock Exchange (LUSE)	1,52 billion	22	1994

where R_{it} is the daily return of index i , M_{ti} are dummy variables for months. M_{1i} is equal to 1 when day t is in January and 0 otherwise. M_{2i} is equal to 1 when day t is in February and 0 otherwise, and so on. The parameters β are estimated using OLS regression with Huber-White robust standard errors. The January effect is detected if the coefficient β_{1i} is significantly positive or higher than other coefficient β estimated. ε_{ti} is the error term.

4. For ramadan effect

To detect the existence of Ramadan effect, we first convert our Gregorian calendar data to a lunar calendar data.² Then, we generate new dummy variables for Hijri months and estimate the following equation:

$$R_{it} = \beta_{1i}M_{1i} + \beta_{2i}M_{2i} + \dots + \beta_{11i}M_{11i} + \beta_{12i}M_{12i} + \varepsilon_{ti}$$

where R_{it} is the daily return of index i , M_{ti} are dummy variables for months. M_{1i} is equal to 1 when day t is in Muharram and 0 otherwise. M_{2i} is equal to 1 when day t is in Safar and 0 otherwise, and so on. The parameters β are estimated using OLS regression with Huber-White

robust standard errors. The Ramadan effect is detected if the coefficient β_{1i} is significantly different than other coefficient β estimated. ε_{ij} is the error term.

5. For day of the week effect

We also investigate the existence of day of the week effect. Thus, we estimate the following equation:

$$R_{it} = \beta_{1i}D_{1i} + \beta_{2i}D_{2i} + \beta_{3i}D_{3i} + \beta_{4i}D_{4i} + \beta_{5i}D_{5i} + \varepsilon_{ij}$$

where R_{it} is the daily return of index i , D_{1i} are dummy variables for days. D_{1i} is equal to 1 when day t is in Monday and 0 otherwise. D_{2i} is equal to 1 when day t is in Tuesday and 0 otherwise, and so on. The parameters β are estimated using OLS regression with Huber-White robust standard errors. The existence of Monday effect is detected if the parameter β_{1i} is significantly different than other and a coefficient β_{5i} significantly different than the other parameters indicates the existence of Friday effect.

The aim of this paper is to investigate day of week and month of the year effects, using both the Gregorian and the Hijri calendars, in African stock market. Thus, we selected 14 main African stock markets. Our sample is defined according to the availability of data (Table 2). Data are drawn from Investing.com database. We do not consider 2008 and 2020 to isolate bias from the 2007–2008 financial crisis and Covid-19 pandemic crisis. Initially, we investigate the existence of calendar anomalies in African stock markets for the period 2009 to 2019, but for some stock markets (Cote d'Ivoire, Egypt, Namibia, Nigeria, Rwanda, Tanzania, Uganda and Zambia), data are available for shorter periods.

To investigate Ramadan effect, we choose four countries (Egypt, Morocco, Nigeria and Tunisia), which are Muslim majority countries, as they are more exposed to Hijri calendar anomalies. Daily stock return is calculate as follows:

$$R_t = [\log(P_t) - \log(P_{t-1})] * 100$$

where P_t is closing price of day t . The conduction of Augmented Dickey-Fuller unit root test show that African indices time series are stationary.

6. Results

Figure 1 gives an overview of the evolution of African stock indices during the period of the study. We remark that indices of Egypt, Kenya, Mauritius, Namibia, South Africa, Tunisia and Uganda have experienced a growing trend during the last decade, while stock indices of Botswana, Morocco and Nigeria exhibit an up-down cycle. Table 3 presents descriptive statistics of daily African indices returns. We remark that, during the period of the study, Rwanda All Share exhibit the highest mean return and standard deviation while “La Bourse Régionale des Valeurs Mobilières Composite” and BSE Domestic Company exhibit, respectively, the lowest mean return and standard deviation. As presented above, we estimate equations 1, 2 and 3 using OLS regression with Huber-White robust standard errors, to detect the month of the year (Gregorian and Hijri months) and day of the week effects.

Results of the estimation of equation 1 are presented in Table 4 and show that Monday returns are statistically significant and negative (BRVMC) and on positive in FTN098; Wednesday returns are positive in BRVMC, Egypt, Kenya, Mauritius and Morocco. Thursday returns are negative on BRVMC and positive in DSEI, TUNINDEX, Uganda; Friday effect on Kenya, Mauritius, Nigeria and Mauritius. Thus, as the existence of a day of the week effect implies that returns on some days are different (higher or lower) than other months, our results show evidence of Monday effect is detected in BRVMC and FTN098 and Wednesday effect on BRVM, Egypt, Mauritius and Morocco. Results show also evidence of Friday effect in Kenya and Namibia. While market indices of Botswana, Rwanda, South Africa and Zambia show no evidence of day of the week effect.

Table 2. Presentation of data

Country	Index	Ticker	Availability of data	
			From	To
Botswana	BSE Domestic company	DCIBT	January 2009	December 2019
Cote d'Ivoire	BRVM Composite	BRVMCI	March 2014	December 2019
Egypt	MSCI Egypt	MIEG00000PEG	July 2012	December 2019
Kenya	Nairobi All Share	NASI	January 2009	December 2019
Mauritius	SEMDEX	MDEX	January 2009	December 2019
Morocco	MASI	MASI	January 2009	December 2019
Namibia	FTSE NSX Overall	FTN098	October 2013	December 2019
Nigeria	NSE All Share	NGSEINDEX	January 2012	December 2019
Rwanda	Rwanda All Share	ALSIRW	February 2013	March 2019
South Africa	FTSE South Africa	FTWIZAFI	January, 2009	December, 2019
Tanzania	Tanzania All Share	DSEI	August 2011	December, 2019
Tunisia	Tunindex	TUNINDEX	January 2009	December, 2019
Uganda	Uganda All Share	ALSIUG	August 2011	December, 2019
Zambia	LES All Share	LASILZ	July 2012	December, 2019

Results of the month of the year effect, using the Gregorian calendar, are presented in [Table 5](#). We remark that January returns are positive for indices of Botswana and Mauritius and negative in BVRMCI (Regional stock exchange); February returns are positive in BVRMCI, MASI (Morocco), ALSIUG (Uganda), LASILZ (Zambia) and negative in Mauritius. We also remark that March returns are positive in Egypt, Kenya, Mauritius, Uganda and Zambia and negative in Morocco; April returns are positive in Kenya, Tunisia; May returns are positive in Nigeria, Tunisia and negative in BVRMCI and Namibia; June returns are positive in Tanzania and Tunisia and negative in Egypt, Zambia; July returns are positive in Botswana, Egypt, South Africa, Tunisia; August returns are positive in Tunisia and negative in BVRMCI and Uganda All Share index; September returns are positive in Mauritius and negative in BVRMCI and Tunisia; October returns are positive in Morocco and negative in BVRMCI, Nigeria, Rwanda; November returns are negative in Nigeria and December returns are positive in Botswana, BVRMCI, Egypt, Mauritius, Nigeria. As the existence of a Month of the Year effect implies that returns are different (higher or lower) in some months than others, we remark the existence of January effect in Botswana and Zambia, and February effect in Mauritius, Morocco and Uganda. We also remark the existence of March effect in Kenya and Morocco, April effect in Kenya and Nigeria, and May effect in Namibia, Tanzania and Tunisia. June effect is detected in Egypt and South Africa, July effect in Botswana and Uganda, August effect in Tunisia, September effect in Mauritius, Nigeria and Rwanda, and December effect in Botswana, BRVM and Egypt. We conclude that there is a month of year effect, in African stock indices, that differs from one country to another.

Regarding the Month of the Year in the Hijri calendar, and as the exposed stock markets are Muslim majority countries, we select four stock exchanges: Egypt, Morocco, Nigeria and Tunisia. Precedent studies show that, generally, stock exchanges in majority Muslim majority countries are more exposed to Ramadan effect. According to [Table 6](#), our results show that the Egyptian index is characterized by a significant and positive returns on Safar, Jumada al-Thani and Shuwwal (the month after Ramadan). Our results show also significant and negative returns in Morocco in Jumada al-Thani and Rajab. The Tunisian index Tunindex is also characterized by positive returns in Rabi' al-Thani, Jumada al-Awwal, Shaaban, Ramadan and Shuwwal, which confirms precedent results (Białkowski et al., 2012; Sonjaya & Wahyudi, 2016). However, the Nigerian index does not

Figure 1. The evolution of African stock indices during the period 2009–2019. From right to left: Botswana, BRVM, Egypt, Kenya, Mauritius, Morocco, Namibia, Nigeria, Rwanda, South Africa, Tanzania, Tunisia, Uganda and Zambia.

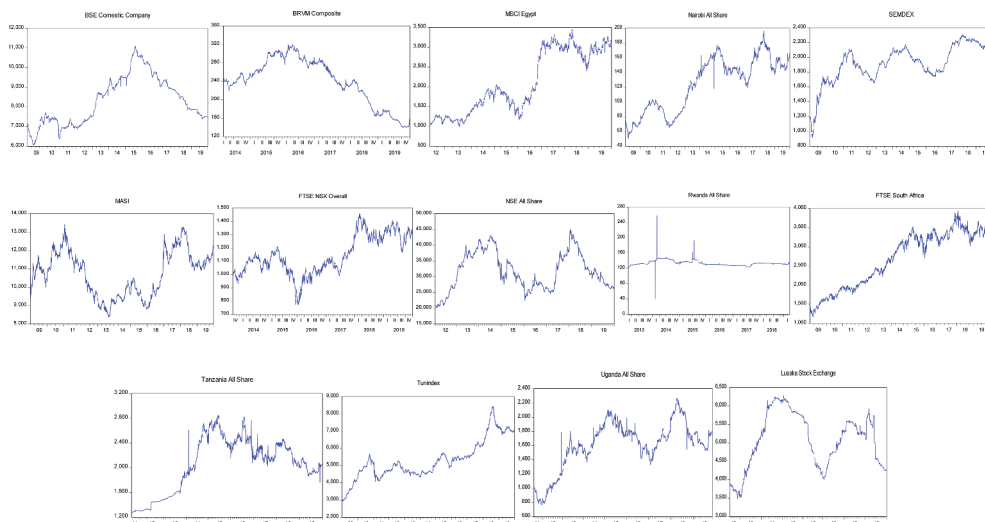


exhibit any Hijri calendar anomaly. We conclude to the existence of Ramadan effect in Tunisia while other Muslim majority countries do not present any Hijri calendar anomaly.

7. Conclusion

Calendar anomalies are time related and depend on days, weeks or months. The existence of these anomalies suggest that abnormal returns are predictable for some days, weeks and months, contrary to the EMH hypothesis which suppose that stock prices follow a random walk and stock returns are thus unpredictable. Calendar anomalies in stock markets are well documented. In this paper, we investigate the day of the week and the month of the year effects in African stock markets. Specifically, we investigate January effect and Ramadan effect. January is the first year of the Gregorian calendar while Ramadan is the 9th and the most sacred month of Muslims calendar.

In this replication study, we confirm precedent results of Obalade and Muzindutsi (2019) regarding the Mauritian Index. Indeed, we detect the presence of January, September and December effects. However, we also detect the existence of February and March effects. This paper confirms precedent results regarding the existence of May and December effects in Nigeria. Also, both studies find no evidence of January effect. However, contrary to the precedent study, we find evidence of October and November effects. Also, unlike the precedent study, we find evidence of July effect in South Africa. Concerning Morocco, our study confirms precedent results as we find evidence of March effect. However, we find also evidence of February, March, and October effect (precedent paper find evidence of January, June, August and November effects). Results regarding Tunisia confirm the existence of April, June, July and August effects. We also find new evidences of May and September effects, while the precedent study find evidence of January effect). Our results confirm those of Bundoo (2011) regarding the Wednesday effect. Also, unlike precedent studies that found evidence of Ramadan effect in Egypt and Morocco (Al-Hajieh et al., 2011; Białkowski et al., 2012; Sonjaya & Wahyudi, 2016), we find no evidence of Ramadan effect in these stock markets. However, we find evidence of Ramadan effect in Tunisia, which confirms results obtained by Białkowski et al. (2012) and Sonjaya and Wahyudi (2016). We believe that these discrepancies in the results are due to the differences of the studied periods. Thus, while we investigate calendar anomalies during the period post-subprime crisis and pre-Covid-19 crisis, other studies used different periods (Al-Hajieh et al., 2011; Białkowski et al., 2012; Bundoo, 2011; Sonjaya & Wahyudi, 2016).

Thus, our results show strong evidence of the existence of calendar effects in African stock indices. Regarding the day of the week effect, results show evidence of Monday effect in BRVMC

Table 3. Descriptive statistics of daily African indices returns

	DCIBT	BVRMCI	MIEG00000PEG	NASI	MDEX	MASI	FTN098
N° Obs.	2695	1445	1522	2728	2736	2738	1550
Mean	0.0000301	-0.000263	0.000865	0.000377	0.000235	7.06E-05	0.000261
Median	0.000000	-0.000476	0.000185	0.000208	2.93E-05	0.000114	8.38E-05
Max	0.044649	0.045780	0.138468	0.377221	0.079551	0.033504	0.050516
Min	-0.046624	-0.047267	-0.069277	-0.286266	-0.040543	-0.045584	-0.079613
Std. Dev.	0.003634	0.007991	0.016136	0.012832	0.004918	0.006221	0.012720
Skewnes	-0.570144	0.137923	0.180163	5.736123	1.945705	0.103035	-0.180021
Kurtosis	66.30194	7.747613	8.631933	391.3499	41.01594	6.888660	5.261661
JB	450113.9	1361.667	2019.726	17,157,671	166,480.4	1729.976	338.7230
	NGSEINDEX	ALSIRW	FTWIZAFI	DSEI	TUNINDEX	ALSIUG	LASILZ
N° Obs.	1959	1457	2850	2051	2732	1984	1811
Mean	0.000182	0.001604	0.000384	0.000389	0.000339	0.000482	7.25E-05
Median	-0.000225	0.000000	0.000130	0.000000	0.000211	0.000000	0.000000
Max	0.083123	2.476261	0.056928	0.388366	0.041941	0.527479	0.050959
Min	-0.042598	-0.712048	-0.041884	-0.274530	-0.040592	-0.331897	-0.088021
Std. Dev.	0.009980	0.072716	0.010620	0.017792	0.005208	0.020213	0.006812
Skewnes	0.401213	27.20422	0.004336	3.956812	-0.437008	6.983803	-1.709239
Kurtosis	8.457865	939.0882	4.651198	160.6854	14.96532	280.7074	35.63486
JB	2484.026	53,376,068	323.7755	2,130,246.	16,384.36	6,391,495.	81,247.49

Table 4. Day of the week effect

	DCIBT	BRVMC	MIEG00000PEG	NASI	MDEX	MASI	FTN098
Monday	-0.000227	-0.002317	0.001900	0.000878	2.30E-05	-3.61E-05	0.001173
Tuesday	0.000163	(0.000501)***	0.000729	0.000852	0.000229	0.000271	(0.000707)*
	0.000347	0.000313	-0.001353	-0.000294	-9.72E-05	7.36E-05	0.000253
Wednesday	0.000201	0.000413	0.001079	0.000446	0.000200	0.000253	0.000705
	-2.51E-05	0.001629	0.002038	0.000711	0.000519	0.000403	-0.000255
	0.000158	(0.000457)***	(0.000763)***	(0.000315)**	(0.000239)**	(0.000246)*	0.000721
Thursday	0.000107	-0.001556	0.001027	3.65E-05	0.000219	-1.24E-05	0.000383
	0.000109	(0.000453)***	0.000751	0.000618	0.000192	0.000253	0.000760
Friday	-5.39E-05	0.000440	-0.000327	0.000566	0.000512	-7.66E-05	-0.000222
	0.000137	0.000490	0.001830	(0.000342)***	(0.000187)***	0.000303	0.000718
	NGSEINDEX	ALSIRW	FTWZAFI	DSEI	TUNINDEX	ALSTUG	LASILZ
Monday	-0.000503	0.011413	0.000257	0.000925	0.000239	-0.000465	0.000305
	0.000472	0.009309	0.000468	0.001128	0.000227	0.000748	0.000463
Tuesday	-0.000229	-0.000494	0.000594	-0.001104	-0.000114	7.14E-05	0.000106
	0.000486	0.001605	0.000414	0.000904	0.000229	0.000760	0.000311
Wednesday	3.05E-05	0.001229	0.000331	0.000870	5.43E-05	-0.000666	0.000406
	0.000606	0.001146	0.000439	0.000875	0.000231	0.000753	0.000332
Thursday	0.000258	-0.000824	0.000464	0.001342	0.000441	0.000369	-0.000127
	0.000495	0.000900	0.000445	(0.000798)***	(0.000226)**	(0.001511)**	0.000347
Friday	0.001332	-0.002895	0.000273	-7.46E-05	0.001071	7.92E-05	-0.000315
	(0.000438)***	0.002532	0.000457	0.000604	(0.000196)***	0.001063	0.000329

Parameters statistically significant at the *** 1% level, ** 5% level and * 10% level

Table 5. Month of the year effect—Gregorian calendar

	DCIBT	BVRMCI	MIEG00000PEG	NASI	MDEX	MASI	FTN098
January	0.000220	-0.002364	0.001882	0.000342	0.000442	0.000635	0.000873
February	(1.547376)*	(0.000858)***	0.001550	0.000509	(0.000269)*	0.000589	0.001227
	0.000313	0.002670	-0.000139	0.000207	-0.001203	0.000766	0.001561
March	-0.430422	(0.000814)***	0.001331	0.001227	(0.000413)***	(0.000469)*	0.001298
	0.000156	0.000254	0.002379	0.001759	0.000639	-0.000658	0.000668
April	0.817789	0.000601	(0.001330)**	(0.000645)***	(0.000337)**	(0.000382)**	0.001208
	0.000164	-0.000241	0.001685	0.000681	0.000454	0.000425	0.001455
May	1.278886	0.000664	0.001405	(0.000414)*	0.000472	0.000424	0.000988
	0.000216	-0.002056	-0.000807	0.000258	0.000491	-0.000399	-0.001995
June	0.193886	(0.000982)**	0.001259	0.000472	0.000364	0.000408	(0.000977)**
	0.000209	0.000104	-0.002368	0.000660	0.000564	-0.000482	-0.000314
July	0.292095	0.000641	(0.001469)*	0.000489	0.000371	0.000372	0.001123
	0.000149	-0.000552	0.002772	-6.41E-05	0.000317	-0.000100	0.001008
August	(1.632669)*	0.000638	(0.001525)**	0.000398	0.000274	0.000368	0.000958
	0.000195	-0.000725	0.000659	-0.000913	-0.000161	6.59E-05	-0.000736
September	-0.468302	(0.000447)*	0.001330	0.000621	0.000332	0.000360	0.001152
	0.000389	-0.000959	0.001638	-0.000255	0.000711	-0.000180	-0.000892
October	-0.090684	(0.000536)**	0.001257	0.000553	(0.000307)***	0.000358	0.001118
	0.000147	-0.001529	-5.87E-05	0.000726	6.41E-05	0.000637	0.001213
November	1.134875	(0.000600)***	0.001197	0.000544	0.000242	(0.000374)**	0.000964
	0.000221	-0.000323	-0.000870	0.000576	-0.000250	-0.000164	-0.000210
December	0.791471	0.000747	0.001876	0.000499	0.000229	0.000317	0.000942
	0.000372	0.002717	0.003161	0.000552	0.000536	0.000349	0.000417
	(1.973702)**	(0.000981)***	(0.001449)***	0.002293	(0.000193)***	0.000449	0.001414
		ALSIRW	FTWIZAFI	DSEI	TUNINDEX	ALSIUG	LASILZ

(Continued)

Table 5. (Continued)

	DCIBT	BVRMCI	MIEG00000PEG	NASI	MDEX	MASI	FTN098
January	-0.000830	5.81E-05	-0.000372	0.000485	0.000659	0.000161	0.000228
	0.001113	0.000778	0.000732	0.001304	0.000475	0.001213	0.000795
February	9.40E-05	0.014777	0.000279	0.001825	0.000156	0.001584	0.001332
	0.000771	0.020824	0.000764	0.003083	0.000477	(0.000831)**	(0.000471)**
March	0.000297	0.002919	0.001012	4.61E-05	0.000539	0.003448	0.000938
	0.000647	0.006158	0.000684	0.001073	0.000392	(0.001482)***	(0.000585)*
April	0.000536	-5.66E-05	0.000811	0.000474	0.000681	0.000568	-0.000305
	0.000843	0.000169	0.000594	0.000780	(0.000324)***	0.001004	0.000642
May	0.002709	5.36E-06	1.88E-05	-0.000854	0.000503	-0.000278	0.000382
	(0.000869)**	0.000119	0.000737	0.000790	(0.000293)**	0.001289	0.000535
June	0.000343	0.001399	-0.000797	0.001311	0.001015	-4.04E-05	-0.001456
	0.000989	0.001580	0.000704	(0.000834)*	(0.000261)***	0.001498	(0.000832)**
July	-0.000478	-0.000229	0.001679	0.000689	0.000743	0.000467	7.45E-05
	0.000586	0.003848	(0.000622)***	0.000828	(0.000251)***	0.000725	0.000256
August	-0.000798	-0.000244	-2.77E-05	-0.000200	0.000671	-0.001315	-0.000717
	0.000660	0.000201	0.000682	0.001609	(0.000234)***	(0.000730)**	0.000502
September	0.000725	-6.96E-05	-0.000142	0.000222	-0.000543	-0.000103	0.000202
	0.000648	0.000491	0.000690	0.000673	(0.000344)*	0.001574	0.000469
October	-0.001061	-0.000584	0.000839	0.000601	-0.000505	9.99E-05	-6.53E-05
	(0.000522)**	(0.000265)***	0.000633	0.000634	0.000410	0.000885	0.000473
November	-0.001020	0.000345	0.000398	0.000355	-5.49E-05	0.000499	5.33E-05
	(0.000628)*	0.000609	0.000676	0.001789	0.000306	0.000920	0.000445
December	0.001683	-1.95E-05	0.000815	-0.000137	0.000206	0.001257	0.000326
	(0.000971)**	0.000207	0.000744	0.001153	0.000283	0.003883	0.000492

Parameters statistically significant at the *** 1% level, ** 5% level and * 10% level

Table 6. Month of the year effect—Hijri calendar

	MIEG00000PEG	MASI	NGSEINDEX	TUNINDEX
Muharram	-0.002117	0.000402	-0.000672	-0.000438
	0.001620	0.000470	0.000684	0.000335
Safar	0.003160	-7.40E-05	-0.000611	-0.000208
	(0.001754)**	0.000397	0.000787	0.000448
Rabi' al Awwal	0.001690	0.000442	0.000290	-0.000130
	0.001359	0.000488	0.000878	0.000375
Rabi' al-Thani	0.000172	0.000590	0.000173	0.001300
	0.001394	0.000430	0.000873	(0.000375)***
Jumada al-Awwal	0.000488	0.000609	0.000168	0.000655
	0.001444	0.000426	0.000707	(0.000354)**
Jumada al-Thani	0.003222	-0.000378	0.001703	0.000186
	(0.001345)***	(0.000402)*	0.000880	0.000245
Rajab	0.000504	-0.000609	0.000400	0.000463
	0.001376	(0.000381)**	0.000673	0.000325
Shaaban	-0.000267	-0.000651	0.001113	0.001005
	0.001553	0.000352	0.000791	(0.000230)***
Ramadan	-0.000153	-2.10E-05	0.000784	0.001002
	0.001304	0.000364	0.000990	(0.000296)***
Shuwwal	0.002862	4.78E-05	-0.000317	0.000766
	(0.001280)**	0.000376	0.000553	(0.000374)***
Dhu al-Qadah	-0.000179	-9.44E-05	0.000170	-0.000700
	0.001293	0.000365	0.000799	(0.000353)***
Dhu al-Hijjah	0.001263	0.000554	-0.001091	0.000204
	0.001217	0.000438	0.000550	0.000321

Parameters statistically significant at the *** 1% level, ** 5% level and * 10% level

and FTN098, Wednesday effect in BRVM, Egypt, Mauritius and Morocco and Friday effect in Kenya and Namibia. However, stock indices of Botswana, Rwanda, South Africa and Zambia show no evidence of day of the week effect. Regarding Gregorian calendar effects, January effect is detected in Botswana and Zambia, and February effect in Mauritius, Morocco and Uganda. Stock indices of Kenya and Morocco exhibit March effect, Kenya and Nigeria exhibit April effect while we find evidence of May effect in Namibia, Tanzania and Tunisia. June effect is detected in Egypt and South Africa, July effect in Botswana and Uganda, August effect in Tunisia, September effect in Mauritius, Nigeria and Rwanda, and December effect in Botswana, BRVM and Egypt. We conclude that there is a month of year effect (Gregorian calendar) in African stock indices. Regarding Hijri calendar anomalies, the Tunisian stock index is the only Muslim majority index that exhibits Ramadan effect. We conclude to the existence of calendar anomalies that characterize African stock exchanges, both in the Gregorian and Hijri calendar.

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Notes

1. Obalade and Muzindutsi (2019) investigate calendar anomalies in five African stock markets: Mauritius, Morocco, Nigeria, South Africa and Tunisia
2. We use the converter of the website: <https://www.islamicfinder.org/>

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