Evaluation of the main African Stock Exchanges Markets for Foreign Direct Investments. A Statistical Approach

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Abstract

The purpose of this paper is to examine the central stock market indices of the main African Stock Exchanges after the implementation of the global financial crisis in 2009 and whether it was affected positively or negatively. We examine also if there is a correlation among them and we calculate the height of their market risk. Our paper in the introduction, deals with the theoretical framework of the Stock Exchange Market, that is, its role and function, the basic theory of stock market indices, their usefulness, the advantages of stock market operation, the factors that influence the demand for stocks, as well as the basic objects of brokerage transactions, such as stocks, bonds and bond loans. In the literature review we present the opinions of other scientists about the specific subject. In the methodology section we present the statistical methods and types we have used to analyze the central indices of the main African Stock Exchanges such as moving average, standard deviation, coefficient of variation, annual percentage change, the

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change range, correlation coefficient and Sharpe index. Finally, we display the results of our statistical analysis with eight figures and we explain what they represent and we write down our conclusions.

1. Introduction

A stock market is the place where values or objects are traded, whose prices are adjusted according to the rules of supply and demand. Today's stock markets are rooted in organized antiquity markets, where traders gather to buy and sell commodities. The process of financial intermediation (stock market) is considered to be the most important sector for a country's economy [4].

Financial markets are distinguished by the maturity of receivables in:

i. Money markets which include short term financial claims (less than one year). The most important products in this market are 6:
1. Treasury Bills,
2. Repurchase agreements (Repos),
3. Negotiable Certificates of Deposits,
4. LIBOR (London InterBank Offer Rate),
5. Eurodollars
6. Commercial Paper.

ii. Capital markets which include long-term financial claims (greater than one year). The typical products in this market are bonds (fixed or variable income) and stocks. The bond is a security that incorporates the bearer's claim against the issuer. The bond has a definite life span and is transferred like movable objects with the delivery of its body title. The shares are a share in the capital of a public limited company and are securities, thus enabling the company to raise the required funds for investment.

Financial markets are also classified according to whether the financial assets are newly issued or not.

So financial markets are also distinguished in:
a. Primary market: in this category newly-issued financial assets are traded.
b. Secondary market: this category deals with the existing financial requirements of older ones' versions.

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[4] Cholevas (1995). "What we need to know about the stock market". Athens, Interbooks Editions

The main factors affecting the demand for stocks, bonds and derivatives are:
1. The financial situation of the country,
2. Inflation,
3. The real income of individuals,
4. The tax treatment of securities,
5. The organization and operation of the Stock Exchange,
6. The level of return on equity capital compared to the equity options,
7. The psychology, information and stock market education of the investing public,
8. Fluctuations in the exchange rates of currencies,
9. The political situation in the country,
10. The various international economic, political and social contexts.[5]

Africa is a continent of 53 countries. All West African countries belong to the Economic Community of the West African States or ECOWAS, whose mission is to promote economic integration. The continent is different in economic and cultural terms, with different regional economic coalitions. The financial systems in these countries are just as different as in the other countries. A particularly significant explosion of widespread financial sector reforms in Africa, including policy measures to develop capital markets, has increased the interest in establishing stock markets in African countries, but all African markets are characterized by low liquidity problems. Organizations such as the World Bank, the African Stock Exchange, the Capital Advisory Council (CMAC) and the East African Stock Exchange (EASEA) have provided financial and advisory support for the creation of stock markets in the region. In addition, in order to support the stock markets in the sub-Saharan Africa, the African Stock Exchange Association was established in Kenya in 1993, with the aim of providing a formal framework for mutual stock exchange cooperation in the sub-region. Its functions include sharing information and helping to develop member exchanges. African stock exchanges face serious challenges in terms of the depth measured by market capitalization and the launch of new ventures. Apart from South Africa and Egypt, Africa's stock markets remain the smallest of any region, both in terms of number of listed companies and market capitalization. The viability of African stock markets as investment opportunities depend on the extent to which they are able to improve the risk - return transactions faced by global investors.[6]

In this paper we examine the central stock market indices of the stock markets of Kenya, Egypt, South Africa, Nigeria, Morocco, Tanzania, Zambia and Uganda. This choice was made due to the availability of data over time.
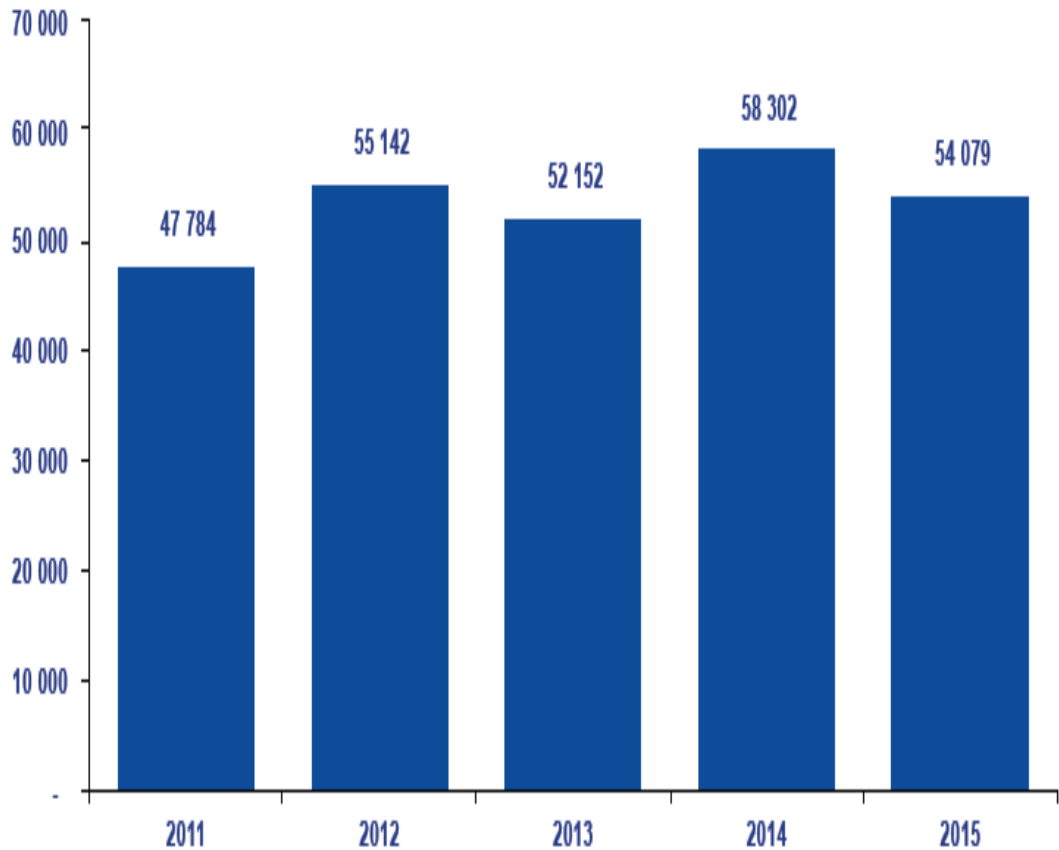
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[5] Vassiliou D. - Heriotis N. (2015). "Investment Analysis and Portfolio Management", Editions Rosili.
[6] https://www.sciencedirect.com/science/article/pii/S1879933711000042 (retrieved 6/12/2019).

Below in the Graph 1, we can see the FDI from 2011-2015 into Africa.

Graph 1: Total FDI into Africa in USD millions

Source: World Investment Report, 2016 and KPMG calculations

Below in the Graph 2, we can see the percentage of increase or decrease in FDI inflows by region between 2011 and 2015 into Africa.

Graph 2: Total percentage increase/decrease in FDI inflows by region between 2011 and 2015
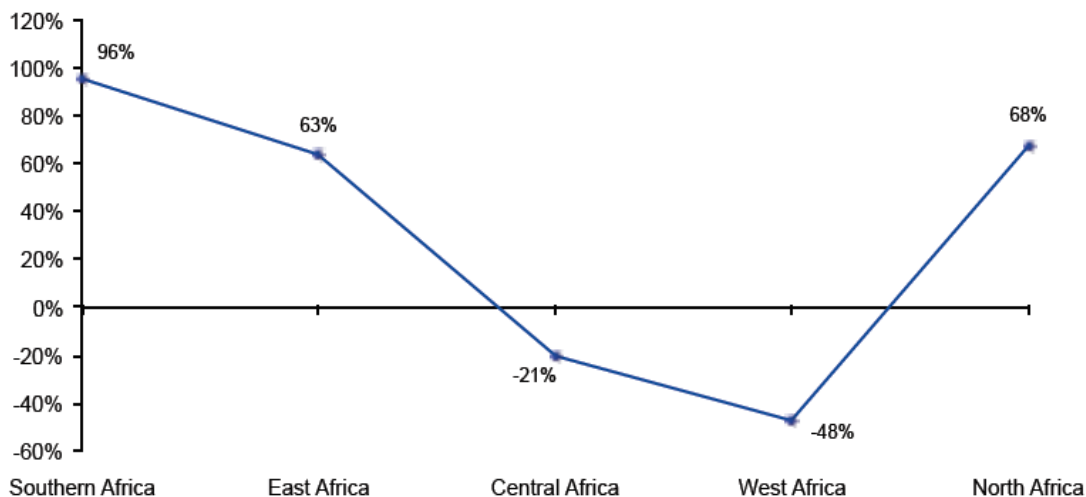
Source: World Investment Report, 2016 and KPMG calculations

The Graph 2 above indicates that FDI inflows to Central and West Africa have declined over the five year period from 2011 to 2015. The reduced oil price and on-going political instability are two of the factors that have impacted on FDI inflows to the African countries. West African countries have the biggest percentage decrease in FDI and Southern African countries have the biggest percentage increase in FDI[7].

2. Literature review

Smith et al. (2002) simply categorizes African stock markets into four groups based on their stage of development: (1) South Africa which is larger, more developed in terms of regulatory framework and more advanced in terms of technical infrastructure than its counterparts; (2) Medium-sized markets which have been established for a long time (e.g. Egypt, Nigeria and Morocco); (3) Small-sized new markets which have grown rapidly (e.g. Ghana; Mauritius and Botswana); and (4) Small-sized markets that are still at an early stage of development (e.g. Swaziland, Zambia and Malawi).

It is often documented that the apparent substantial increase in stock markets in Africa can be attributed to the extensive financial sector reforms undertaken by a number of African countries (Kenny and Moss, 1998). These financial reforms

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[7] African Capital Markets Series from www.kpmg.com/africa

provide a platform for revamping dormant financial sectors in some of the African countries. They included the liberalization of their financial 14 sectors, privatization of state-owned enterprises, the improvement of the investment climate, introduction of a more robust regulatory framework and improvements in the basic infrastructure for capital market operations. (De la Torre and Schmukler, 2005). However, as Yartey and Adjasi (2007) put it, 'the rapid development of stock markets in Africa does not mean that even the most advanced African stock markets are mature'. Maturity here denotes market capitalization in close comparison to market capitalization of other developed stock markets. It is relevant to note that albeit African stock markets have increased in numbers over the past years, it is still considered to be small 'by world standards and of limited local interest' (Tolikas, 2007). The South African Stock Exchange is seen to control a lion's share of the total market capitalization of African stock markets. The Johannesburg Securities Exchange (JSE) in South Africa has about 90 percent of the combined market capitalization of the entire continent (Yartey and Adjasi, 2007). This is followed by other giant African stock exchanges such as Nigeria, Egypt and Zimbabwe. This is not to disregard the fact that other African stock markets have been performing superbly on the world table. For instance, in 2004 the Ghana Stock Exchange was honored as the best stock market with the performance of 144 percent end-of-year return in USD terms compared with 30 percent return by Morgan Stanley Capital International Global Index (Mensah at al., 2012).

Yartey and Adjasi (2007) dedicated a whole section to immensely discuss the contribution of stock markets in the financing of corporate growth in Africa as an important function of national economic growth. Without going in-depth on this, it is conclusive that 'corporate financing patterns in certain African countries suggest that stock markets are an important source of finance (Yartey and Adjasi, 2007). A typical example is seen in Ghana where within the period of 1995-2002, the about 12 percent of total asset growth of listed companies were financed by the stock market (Yartey and Adjasi, 2007).

Investments in African stock markets, as they are emerging markets, have a lot of risks for the investors. there are risk factors that are beyond the control of these markets, which largely stem from instabilities in the economic systems as well as political systems' (Senbet and Otchere, 2008).

Market integration and informational efficiency of stock markets in Africa are not independent policy goals because a globally integrated stock market is also a globally information efficient market. Its pricing process swiftly responds and incorporates global common information rather than local market-specific common information (Godfred M. Aawaar, Devi Datt Tewari, Zhiyong, John Liuc 2017).

Shocks or changes on the JSE stock exchange have less impact on the given East African stock markets. The less market response behaviour is justified by the impulse response function results. This is because JSE is the performance benchmark in Africa, one would expect the changes from this market to influence the other African markets, but this is not the case here. This could be because of the geographical concentration of the East African stock markets (Marselline Kasiti

Atenya 2019).

The findings of Collins G. Ntim 2012, generally suggest that the 8 African continent-wide share price indices returns display better normal distributional properties than any of the 8 individual national stock price indices studied. Second, we find evidence of statistically significant improvements in the informational efficiency of the African continent-wide share price indices over their individual national share price indices. Third and in contrast, none of the individual national share prices indices investigated are efficient, especially when the empirically robust non-parametric tests are implemented. The policy implication of this evidence is that formally harmonizing and integrating African stock markets operations may improve their informational efficiency (Collins G. Ntim 2012).

Godfred Aawaar and others analysed the time-varying nature of the correlations of African stock markets with the world securities market. The results largely point to lower intra-regional and inter-regional co-movements amongst African stock markets, although the relative strengths differ across markets and regions. We conclude that co-movements between stock markets in African and the world securities market are time-varying. An important implication of the findings in this study is that potential international and regional diversification advantages still exist in Africa's emerging and frontier markets, but vary considerable over time (Godfred Aawaar, Daniel Domeher, Charles Nsiah 2018).

Gail Ncube and others found that arbitrage opportunities exist between the African stock markets. Also, a weak stochastic trend was evidenced between African stock markets and the rest of the world, except for the JSE, as evidenced by the impulse response results. Further, obtained results show that African stock markets are not interlinked and they are not affected by world events as the well-established world stock markets (Gail Ncube, Kapingura Forget Mingiri 2015).

The empirical findings of Saidi Atanda Mustapha show some instructive and interesting highlights:

a. Mispricing of portfolio returns in Africa's equities, are caused by low trading frequency of stocks. This is due to the 'buy and hold' strategy used by speculative investors and increased ignorance to trade in equities among individual investors, who constitute a large proportion of the total investors in equities.

b. In frequently traded stock portfolios, it was seen that mispricing is short-lived. Therefore, it has been concluded that mispricing in Africa's equity portfolios regardless of the size and volatility effects remain a 'low trading frequency phenomenon'.

c. The transient mispricing observed in stock portfolios can cause divestment in stock portfolios, especially the big-size portfolios. (Saidi Atanda Mustapha 2017).

3. Methodology

As we have already stated in this paper we present a statistical analysis of the central indices of the main African Stock Exchanges. For this statistical analysis we use:

3.1   Moving Average (MA)

It is mainly used in stock market indices and consists of the average of a stock's close to a specified time horizon. It is an important tool of technical analysis. If the stock curve breaks up to the moving average, this is considered a significant indication that the stock is entering an upward channel. If the opposite happens, that is, if the stock curve breaks down moving average, this is a strong indication that the stock is entering a downward channel. It should also be noted that the more days the stock is playing above its moving average, the healthier its direction is. If it concerns the central Stock Index, under certain conditions, it can show us the general market trend. It is even thought to reflect the general psychology of the market at a given time. Moving average calculation:[8]

$$MA = (P_1 + P_2 + P_3 + P_4 + P_5) / 5 \qquad\qquad (1)$$

Where: P_j is the price of a stock or stock index for a time period. All the time periods j=1,2,3,4,5 must be equal.

3.2   Standard Deviation

The Standard Deviation mostly represented by the Greek letter sigma **σ** is a measure of the amount of variation or dispersion of a set of values. A low standard deviation indicates that the values tend to be close to the mean (also called the expected value) of the set, while a high standard deviation indicates that the values are spread out over a wider range.[9]

The standard deviation of a random variable, statistical population, data set, or probability distribution is the square root of its variance. It is algebraically simpler, though in practice less robust, than the average absolute deviation. A useful property of the standard deviation is that, unlike the variance, it is expressed in the same units as the data.[10,11]

The standard deviation is also important in finance, where the standard deviation on the rate of return on an investment is a measure of the volatility of the investment.

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[8] Galiatsos K., (2010). "Basic Investment Banking Knowledge" 4th Revised Version, Published by Hellenic Bank Association, Athens

[9] Bland, J.M.; Altman, D.G. (1996). "Statistics notes: measurement error." *BMJ* Clinical Research Journal Vol. 312 (7047): 1654.

[10] Gauss, Carl Friedrich (1816). "Bestimmung der Genauigkeit der Beobachtungen". *Zeitschrift für Astronomie und Verwandte Wissenschaften*. 1: 187–197.

[11] Walker, Helen (1931). "Studies in the History of the Statistical Method". Baltimore, MD: Williams & Wilkins Co. pp. 24–25.

The formula for the sample standard deviation is:

$$\sigma = \frac{\sqrt{\sum_{i=1}^{N}(Xi-M)}}{N-1} \qquad (2)$$

Where: X_i are the observed values of the sample items, M is the mean value of these observations, and N is the number of observations in the sample.

Its main feature is that it captures the dispersion of the values of a distribution around its average value.

The lower the resulting value, the more concentrated the values around the average of the distribution and, consequently, the more representative the statistical measure is the average. To arrive at even safer conclusions about homogeneity of distribution, we need to calculate an auxiliary indicator, the coefficient of variation.

3.3 Coefficient of Variation (CV)

The Coefficient of Variation (CV) is a statistical measure of the dispersion of data points in a data series around the mean. The coefficient of variation represents the ratio of the standard deviation to the mean, and it is a useful statistic for comparing the degree of variation from one data series to another, even if the means are drastically different from one another. In finance, the coefficient of variation allows investors to determine how much volatility, or risk, is assumed in comparison to the amount of return expected from investments[12].

The coefficient of variation can determine the volatility of an investment. The coefficient of variation is a ratio between the standard deviation of a data set to the expected mean. When used in the stock market, it helps to determine the amount of volatility in comparison to the expected return rate of investment. Dividing the volatility, or risk, by the absolute value of the investment's expected return, determines the coefficient of variation.[13] The higher the coefficient of variation, the greater the level of dispersion around the mean. It is generally expressed as a percentage. Without units, it allows to comparison between distributions of values whose scales of measurement are not comparable.[14]

The formula for the Coefficient of Variation (CV) is[15]:

$$CV = \frac{\sigma}{M} \qquad (3)$$

Where: σ is the standard deviation M is the mean value.

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[12] https://www.investopedia.com/terms/c/coefficientofvariation.asp
[13] https://www.investopedia.com/ask/answers/031715/what-can-coefficient-variation-cov-tell-investors-about-investments-volatility.asp
[14] https://www.insee.fr/en/metadonnees/definition/c1366
[15] *Everitt, Brian (1998).* The Cambridge Dictionary of Statistics. *Cambridge, UK New York: Cambridge University Press.*

3.4 Annual Percentage Change

The Annual Percentage Change is a simple mathematical concept that represents the degree of change over time. It is used for many purposes in finance. Percentage change can be applied to any quantity that you measure over time. This formula is used both to track the prices of individual securities and of large market indexes, as well as comparing the values of different currencies. Balance sheets with comparative financial statements will generally include the prices of specific assets at different points in time along with the percentage changes over the accompanying periods of time.[16]

Therefore the annual percentage change is essentially financial ratio that shows the annual changes in all financial figures and accounts of a company.

The formula for the Annual Percentage Change (APC) is[17]:

$$APC = [(\Pi_2 - \Pi_1) / \Pi_1]*100 \qquad (4)$$

Where: Π_2 is the value of a financial figure or account in the present time (year, month, etc) and the Π_1 is the value of a financial figure or account in the past time (year, month, etc).

3.5 The Change Range

The Change Range is the simplest measure of dispersion. It is calculated as the difference between the largest and the lowest price over a specific time period such as a day, month, or year. The change range is not considered totally reliable because it depends only on their two extreme values data. If the difference in extreme prices is too great, then the range will be similar. It is used mainly to the Stock Exchange Market. The Change Range is a measure of dispersion. It is also affected by extreme prices. Technical analysts closely follow ranges since they are useful in pinpointing entry and exit points for trades. Investors and traders may also refer to a range of several trading periods, as a price range or trading range. Securities that trade within a definable range may be influenced by many market participants.[18]

$$E = X_{max} - X_{min}$$

Where: E is the change range, X_{max} is the largest price and X_{min} is the lowest price.

3.6 Correlation Coefficient

Correlation coefficients are used in statistics to measure how strong a relationship is between two variables. The correlation coefficient also can be used to compare measurements of different quantities. There are several types of correlation coefficient: Pearson's correlation (also called Pearson's *R*) is a correlation

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[16] https://www.investopedia.com/terms/p/percentage-change.asp
[17] Kantzos C., (2002) Financial Statements Analysis Ed. Nikitopoulos E. and Sia OE
[18] https://www.investopedia.com/terms/r/range.asp

coefficient commonly used in linear regression. In fact, when anyone refers to the correlation coefficient, they are usually talking about Pearson's.

$$\rho = \frac{Cov\ (X,Y)}{\sigma x \sigma y} \tag{5}$$

Where: σ_X and σ_Y are the standard deviations of the X and Y variables, that is for us the standard deviations of the stock markets of South Africa and Nigeria. The correlation coefficient has the same sign as the co-variance since the standard deviations are always positive.

Pearson Correlation between sets of data is a measure of how well they are related. The most common measure of correlation in stats is the Pearson Correlation. The full name is the Pearson Product Moment Correlation (PPMC)**.** It shows the linear relationship between two sets of data. In simple terms, it answers the question, Two letters are used to represent the Pearson correlation: Greek letter rho (ρ) for a population and the letter "r" for a sample.[19]

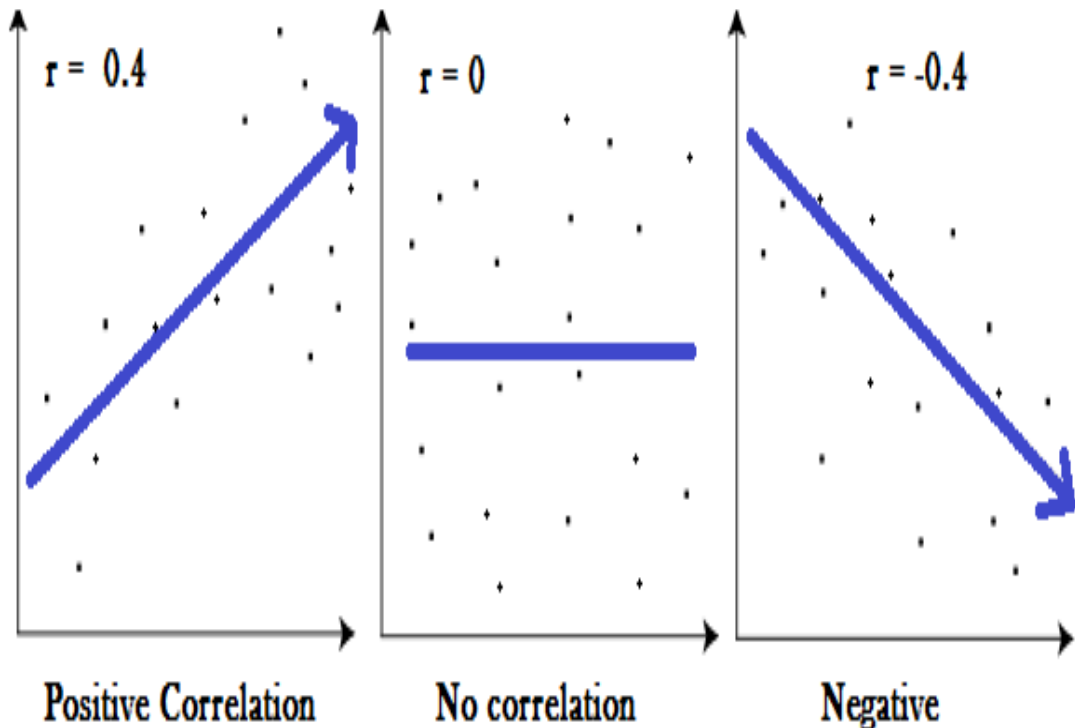Below in graph 3 we present the correlation coefficient value between -1 and +1. Meaning

- A correlation coefficient of 1 means that for every positive increase in one variable, there is a positive increase of a fixed proportion in the other. For example, shoe sizes go up in (almost) perfect correlation with foot length.
- A correlation coefficient of -1 means that for every positive increase in one variable, there is a negative decrease of a fixed proportion in the other. For example, the amount of gas in a tank decreases in (almost) perfect correlation with speed.
- Zero means that for every increase, there isn't a positive or negative increase. The two just are not related.

The Correlation Coefficient characteristic are:

➢ If p = 1 (-1) then the variables Xi and Yi have a linear dependency function such as y= a + (-) bx. The opposite is also true.
➢ If p = 0 then the variables Xi and Yi are irrelevant.
➢ In order to have a linear correlation, r must have a tendency at 1
➢ If $|p| \leq 0.3$ then we have no linear correlation
➢ If $0.3\ |pp| \leq 0.5$ then we have a weak correlation
➢ If $0.5 \leq |p| \leq 0.7$ then we have an average correlation
➢ If $0.7\ |p| \leq 0.8$ then we have a strong correlation
➢ If $|p| \geq 0.8$ then we have a very strong correlation
➢ If $|p| = 1$ then we have a complete correlation

There are cases where p = 0, but the variables show a diagrammatic correlation. This is due to the regression coefficient.

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[19]https://www.statisticshowto.datasciencecentral.com/probability-and-statistics/correlation-coefficient-formula/#Pearson

Graph 3: Shows the correlation coefficient value between -1 and +1

Source: https://www.statisticshowto.datasciencecentral.com/probability-and-statistics/correlation-coefficient-formula/#Pearson

3.7   Sharpe Index

The Sharpe ratio was developed by Nobel laureate William F. Sharpe who developed it in 1966 and is used to help investors understand the return of an investment compared to its risk. The ratio is the average return earned in excess of the risk-free rate per unit of volatility or total risk. Volatility is a measure of the price fluctuations of an asset or portfolio[20]. In finance, the Sharpe ratio also known as the Sharpe index, the Sharpe measure, and the reward-to-variability ratio measures the performance of an investment compared to a risk-free asset, after adjusting for its risk.[21] It is defined as the difference between the returns of the investment and the risk-free return, divided by the standard deviation of the investment (i.e., its volatility). It represents the additional amount of return that an investor receives per unit of increase in risk. It calculates the reward risk of the examinee portfolio, per unit of total risk. It seeks to measure the overall risk of the portfolio, including standard deviation, instead of considering only systematic risk. The Sharpe ratio can be used either to calculate past performance or expected

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[20] https://www.investopedia.com/terms/s/sharperatio.asp

[21] https://en.wikipedia.org/wiki/Sharpe_ratio

performance in the future, using expected return and the expected risk-free rate.[22] Essentially, the ratio shows how much excess return you are receiving in return for the extra volatility endured as the 'price' for holding a riskier asset. Portfolios that have a higher return, but also come with significantly higher risk, are not necessarily the best portfolio for an investor. Both traders and investors should think of volatility as the price they pay for holding assets with potentially large returns. As in most things in life, there is no 'free lunch' in markets, and higher returns usually imply higher volatility as well. It is up to each investor to determine whether they are happy to bear the potential risk for the higher return. This is a matter of personal preference.[23]

$$Sp = (Rp - Rf) / \sigma_\rho \qquad\qquad (6)$$

Where: The standard deviation σ_p is the portfolio's returns during the period under review and shows the total risk of this portfolio.

Rp is the return of the portfolio during the period under review,
Rf is the return of the asset without risk at the same time and
The difference (Rp - Rf) is the risk reward for the period under review.
The standard deviation of the portfolio's returns during the period under review and the difference is the risk reward for the period under review.

4. Results

Moving average preference depends on objectives, analytical style, and time horizon. Most moving averages are based on closing prices.[24] As it is known a moving average (MA) is a widely used technical indicator that smooths out price trends by filtering out the "noise" from random short-term price fluctuations. But the most common applications of moving averages are to identify trend direction and to determine support and resistance levels. When asset prices cross over their moving averages, it may generate a trading signal for technical traders.[25]
Using moving average can be fundamental for technical analysis strategies, and using a combination of techniques can result in long and short-term forecasts. While using MAs can be useful, it is important to note that nothing in financial markets is for certain when using technical indicators, and things can change quickly. While MAs can be helpful and provide great analysis, they're not a magic formula that can predict which way to trade[26].

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[22] https://corporatefinanceinstitute.com/resources/knowledge/finance/sharpe-ratio-definition-formula/

[23] https://www.ig.com/en/trading-strategies/the-sharpe-ratio-explained-190117

[24] https://school.stockcharts.com/doku.php?id=technical_indicators:moving_averages

[25] https://www.investopedia.com/articles/active-trading/052014/how-use-moving-average-buy-stocks.asp

[26] https://www.ig.com/en/trading-strategies/moving-averages--how-to-calculate-them-and-use-them-in-your-trad-181008

In the figure 1 below we present the course of Moving Average of the stock exchange indices of the examined main African stock exchanges. We can see that the Moving average with the largest price is the FTSE/JSE All Share of South African stock exchange index. Second became the Moving Average of NSE All Share Nigeria stock exchange index. We also observe that the South African stock exchange index shows the highest upward trend in the period 2009-2018, second was the Nigerian stock exchange index. The third place is occupied by MOROCCAN ALL Share of Morocco, which is the most stable from the other two without volatility.
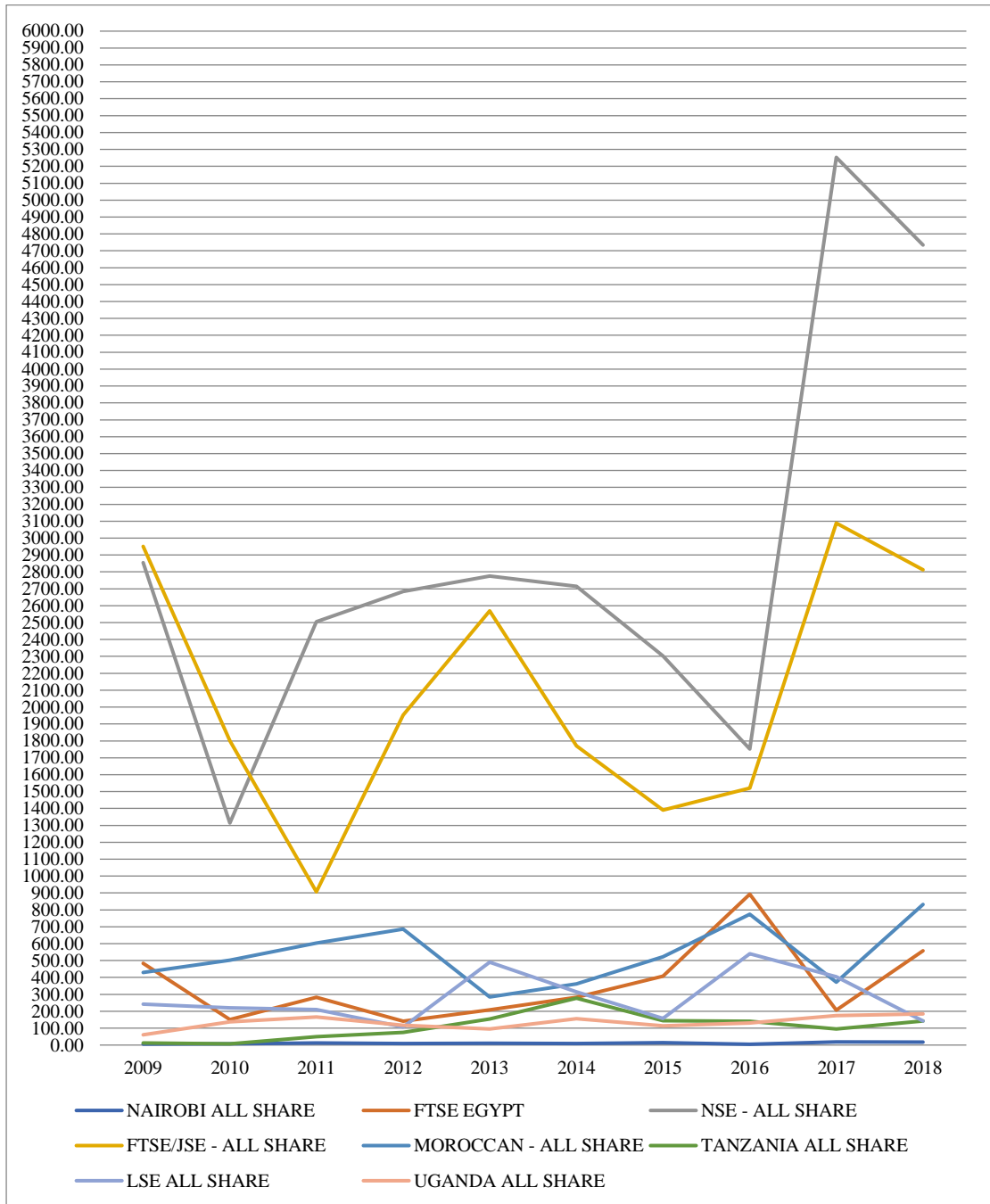
Figure 1: Moving Average of the Stock Exchange Indices of the examined African Stock Exchanges 2009-2018
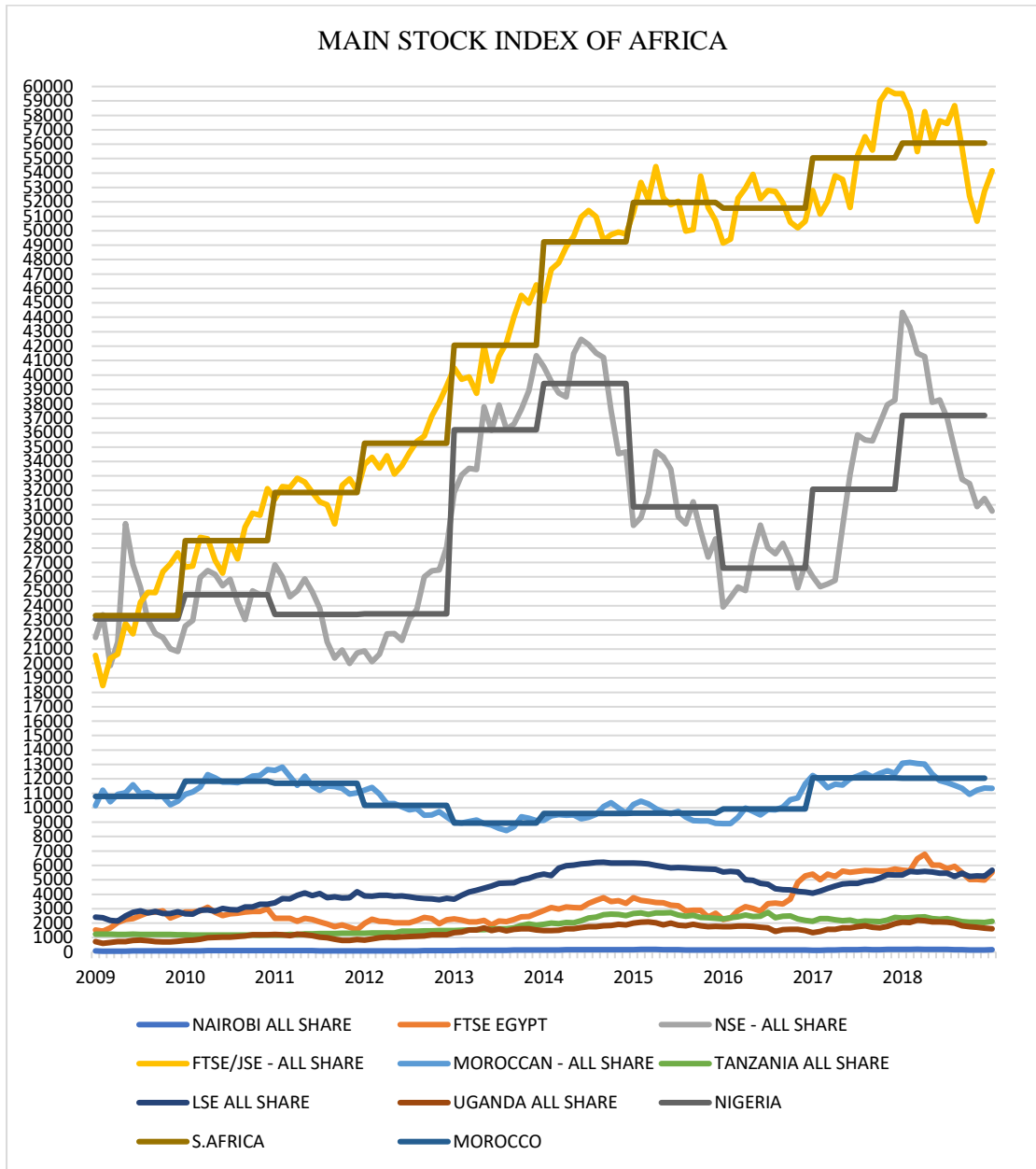
Source: Authors calculation and construction from data extract from investing.com

In the figure 2 below we present the results for Standard Deviation of the Stock Exchange Indices of the examined African Stock Exchanges 2009-2018. As we can see the biggest prices of Standard Deviation belong to Nigeria Stock Exchange Index and second became South African Stock Exchange Index. The higher the standard deviation the more variability or spread we have in our data. Small standard deviations mean that most of our data is clustered around the mean.

Figure 2: Standard Deviation of the Stock Exchange Indices of the examined African Stock Exchanges 2009-2018

Source: Authors calculation and construction from data extract from investing.com

In the figure 3 below we can observe the range of variation of the Central Indices of the examined African Stock Exchange 2009-2018. As we can observe the stock exchange index of Egypt has the biggest Coefficient of Variation and with the biggest duration. From years 2009-2012 in the second place is Uganda's stock exchange index. From years 2013-2014 in the second place is Tanzania's stock exchange index. In year 2015 in the second place is Moroccan's stock exchange index and in year 2016 in the second place is Zambia's stock exchange index. From years 2017-2018 in the second place is Nigeria's stock exchange index.

When the stock market rises and falls more than one percent over a sustained period of time, it is called a "volatile" market. Volatility represents how large an asset's prices swing around the mean price - it is a statistical measure of its dispersion of returns. Volatility often refers to the amount of uncertainty or risk related to the size of changes in a security's value. A higher volatility means that a security's value can potentially be spread out over a larger range of values. This means that the price of the security can change dramatically over a short time period in either direction. A lower volatility means that a security's value does not fluctuate dramatically, and tends to be more steady. One way to measure an asset's variation is to quantify the daily returns (percent move on a daily basis) of the asset. Historical volatility is based on historical prices and represents the degree of variability in the returns of an asset. This number is without a unit and is expressed as a percentage. While variance captures the dispersion of returns around the mean of an asset in general, volatility is a measure of that variance bounded by a specific period of time. Thus, we can report daily volatility, weekly, monthly, or annualized volatility.[27]

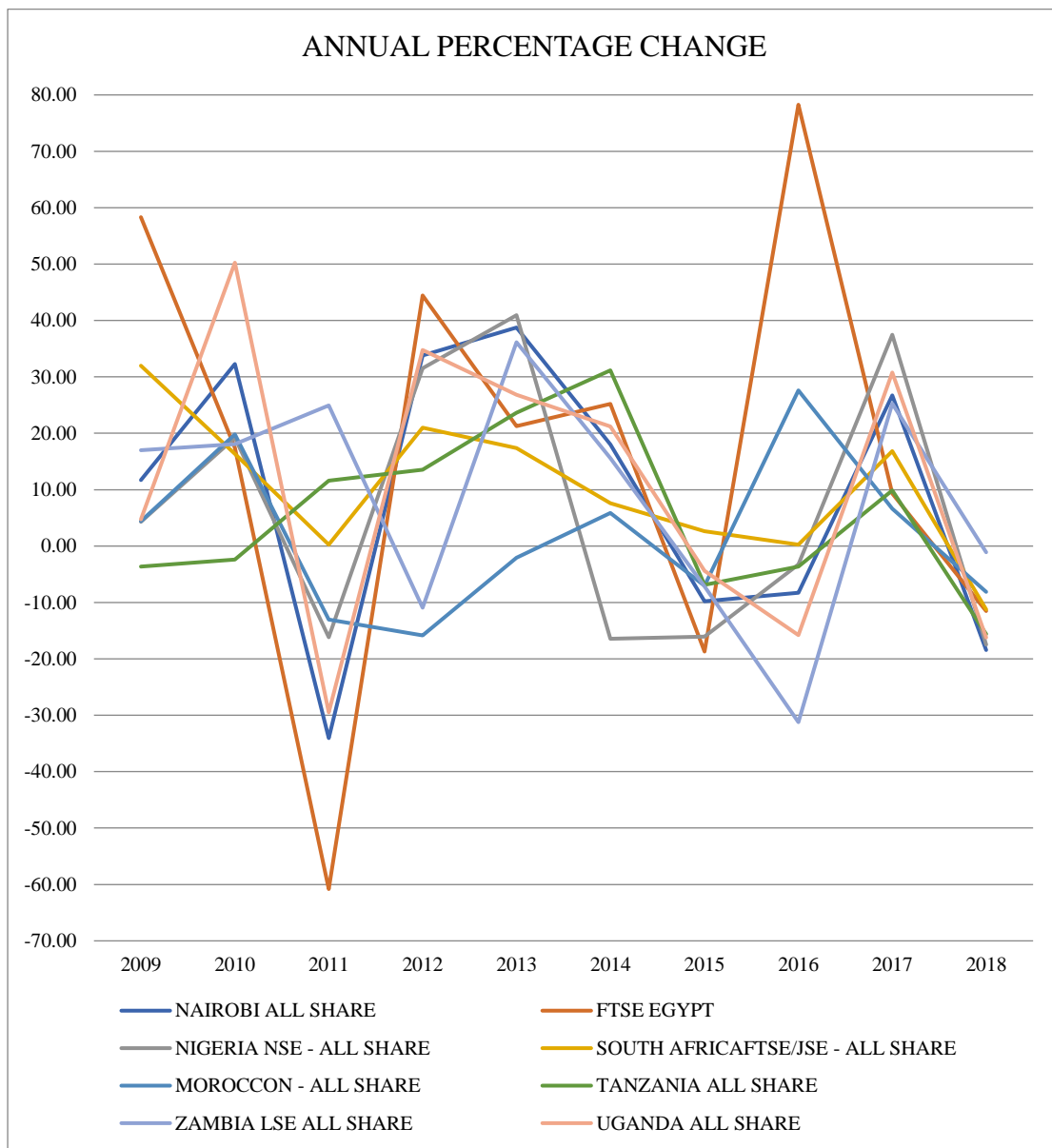[27] https://www.investopedia.com/terms/v/volatility.asp

Figure 3: The Coefficient of Variation of the Stock Exchange Indices of the examined African Stock Exchanges 2009-2018
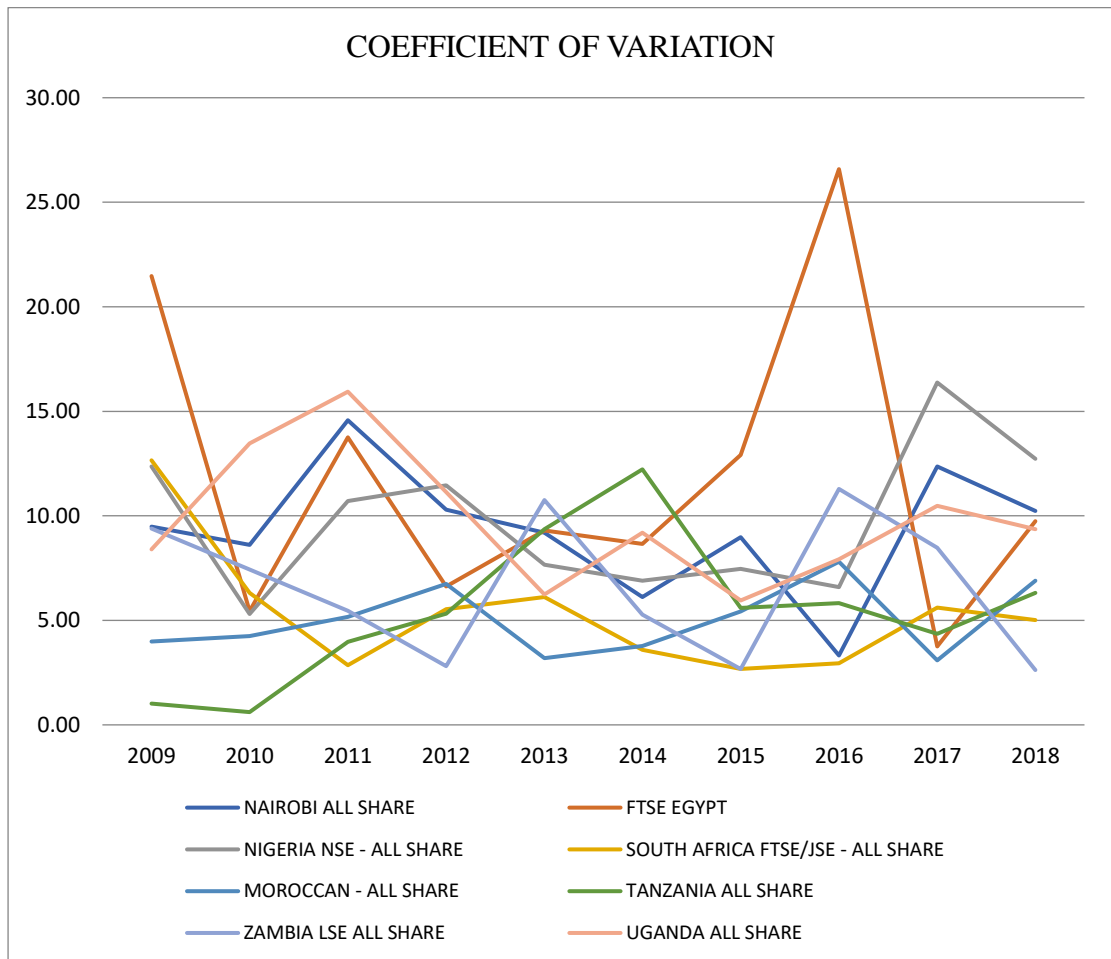
Source: Authors calculation and construction from data extract from investing.com

In the figure 4 below we present the Annual percentage change of the stock exchange indices of the examined African Stock Exchanges. We can see that the Egypt stock exchange index has the biggest annual percentage price of all the other African stock exchanges indices in year 2016 from 2015 and also has the lower annual percentage price in year 2011 from 2010. It has also created the biggest annual percentages upper or lower during the examined time period 2009-2018. Second bigger was the annual percentage change of Uganda stock exchange index in year 2010. Second lower annual percentage change had Kenya stock exchange index in year 2011.

Figure 4: Annual Percentage Change of the Stock Exchange Indices of the examined African Stock Exchanges 2009-2018

ANNUAL PERCENTAGE CHANGE

Legend:
- NAIROBI ALL SHARE
- FTSE EGYPT
- NIGERIA NSE - ALL SHARE
- SOUTH AFRICAFTSE/JSE - ALL SHARE
- MOROCCON - ALL SHARE
- TANZANIA ALL SHARE
- ZAMBIA LSE ALL SHARE
- UGANDA ALL SHARE

Source: Authors calculation and construction from data extract from investing.com

In the figure 5 below we present the monthly range of variation of examined African's Stock Exchange Indices for years 2009-2018. As we can observe Nigeria NSE All Share Index has the highest range of variation every month. The second place belongs to Moroccan All Share Index.

Figure 5: Monthly Range of Variation of examined African's Stock Exchange Indices from 2009-2018
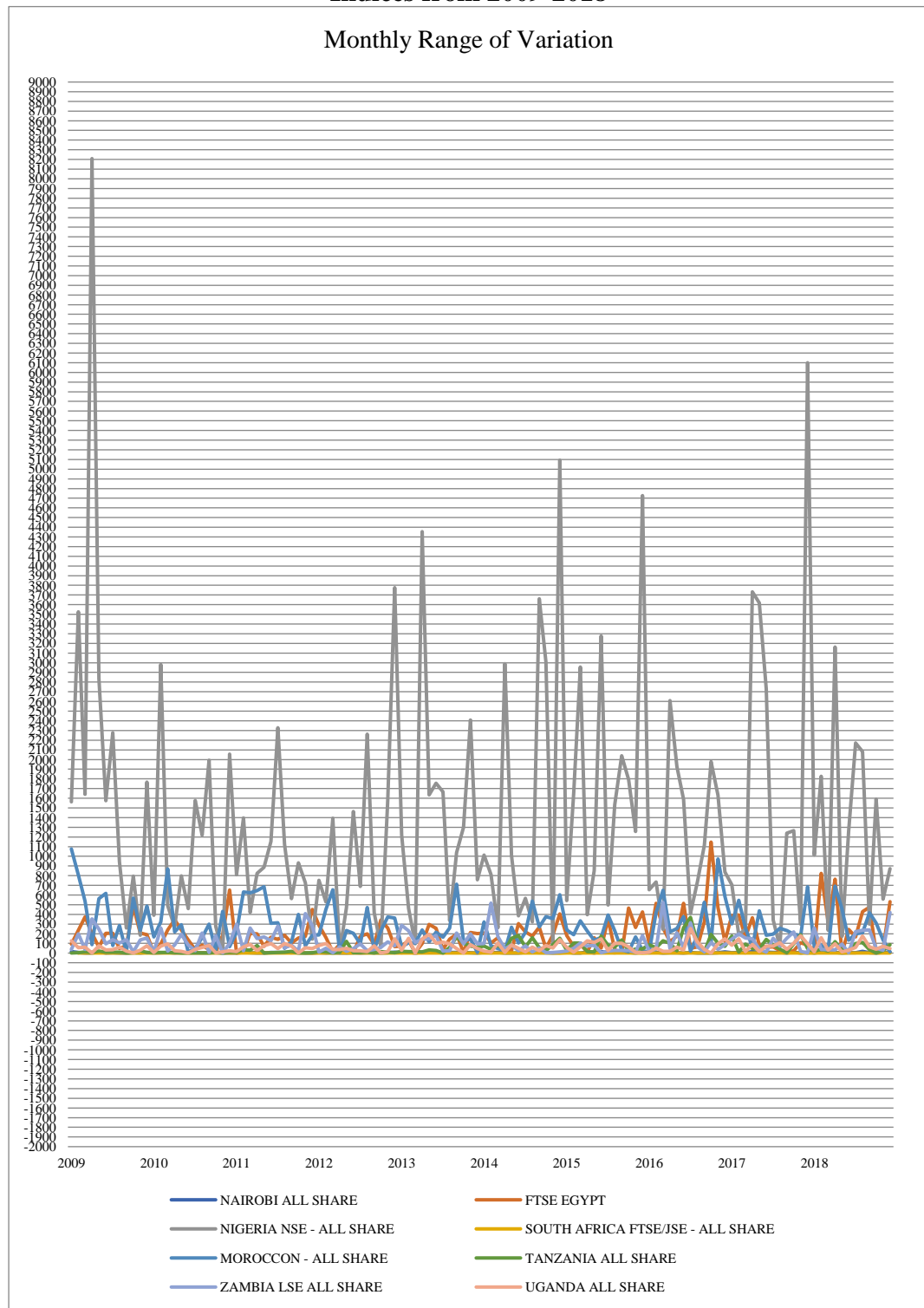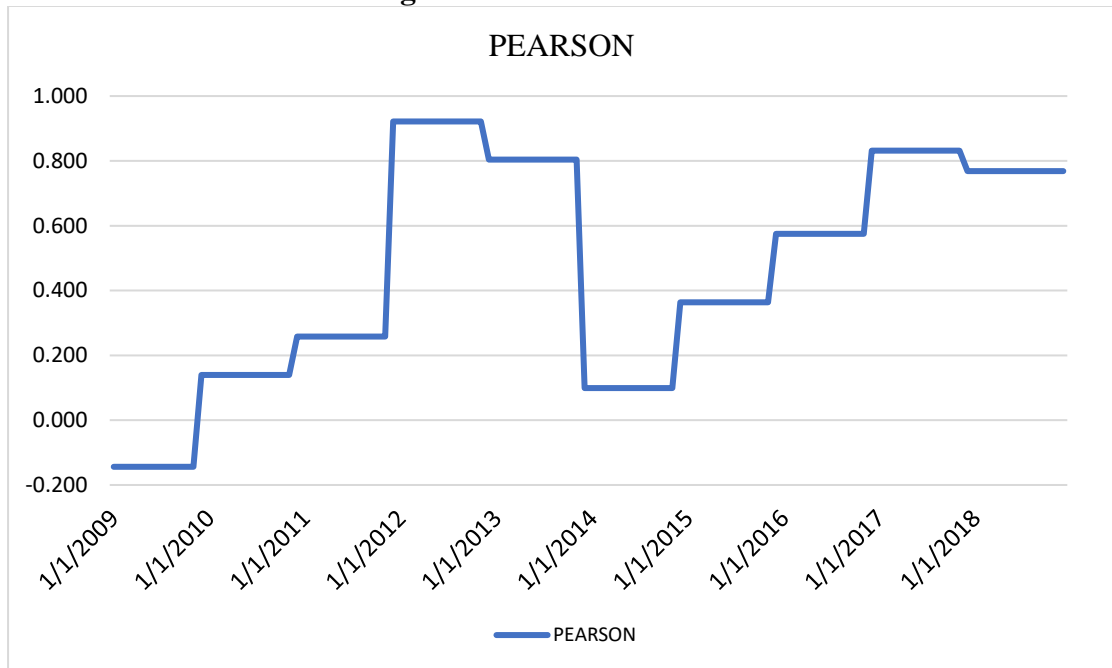

Source: Authors calculation and construction from data extract from investing.com

In the figure 6 we examine the Correlation Coefficient between the South African stock market index and the Nigerian stock market index 2009-2018. From 2009 - 2012 we can see that the Pearson Correlation Coefficient follows an upward positive trend. The highest Correlation Coefficient between the South African stock market index and the Nigerian stock market index are in year 2012.

Correlation coefficients are used to measure the strength of the relationship between two variables. Positive correlation is a relationship between two variables in which both variables move in tandem—that is, in the same direction. Negative correlation or inverse correlation is a relationship between two variables whereby they move in opposite directions. Negative correlation is a key concept in portfolio construction, as it enables the creation of diversified portfolios that can better withstand portfolio volatility and smooth out returns.

Figure 6: Correlation Coefficient between the South African stock market index and the Nigerian stock market index 2009-2018
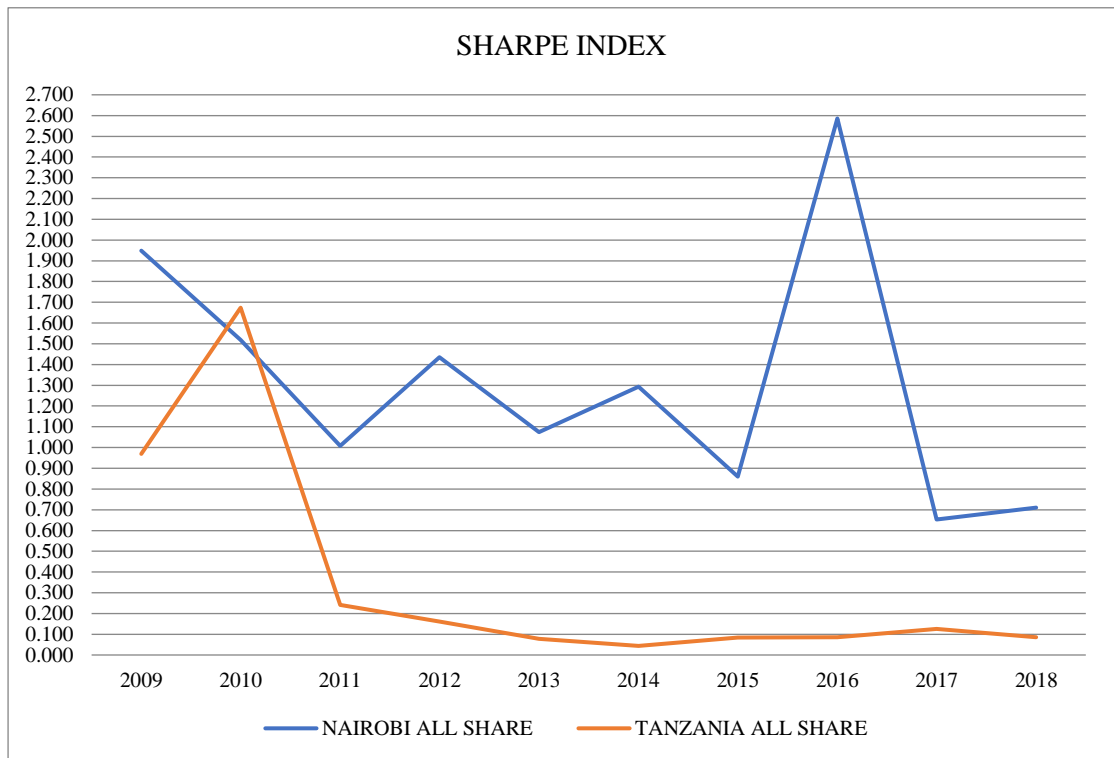

Source: Authors calculation and construction from data extract from investing.com

In the figures seven and eight below we present the Sharpe index of African Stock Market divided in two parts. We made this distinction because we had very high prices of the Sharpe index in two stock markets, while the prices of the rest were relatively close to each other. To better illustrate the values, the figures were divided into two. So in the figure 7 we present the course of Sharpe index for Nairobi All Share index and Tanzania All Share index which have the highest prices of the Sharpe index of all the Africans Stock Exchange. The higher price of Sharpe index belongs to Nairobi All Share index. In the figure 8 we present the Sharpe index of all the other Africans Stock Market. The higher prices of Sharpe index in figure 8

belongs to Uganda All Share index and the second place of the Sharpe high prices belongs to Zambia LSE All Share Index.

The higher the Sharpe index of a portfolio, the better the portfolio during the period under review. A negative Sharpe ratio means the portfolio has under-performed its benchmark. All other things being equal, an investor wants to increase a positive Sharpe ratio, by increasing returns and decreasing volatility. However, a negative Sharpe ratio can be brought closer to zero by either increasing returns (a good thing) or increasing volatility (a bad thing). Thus, for negative returns, the Sharpe ratio is not a particularly useful tool of analysis.[28]
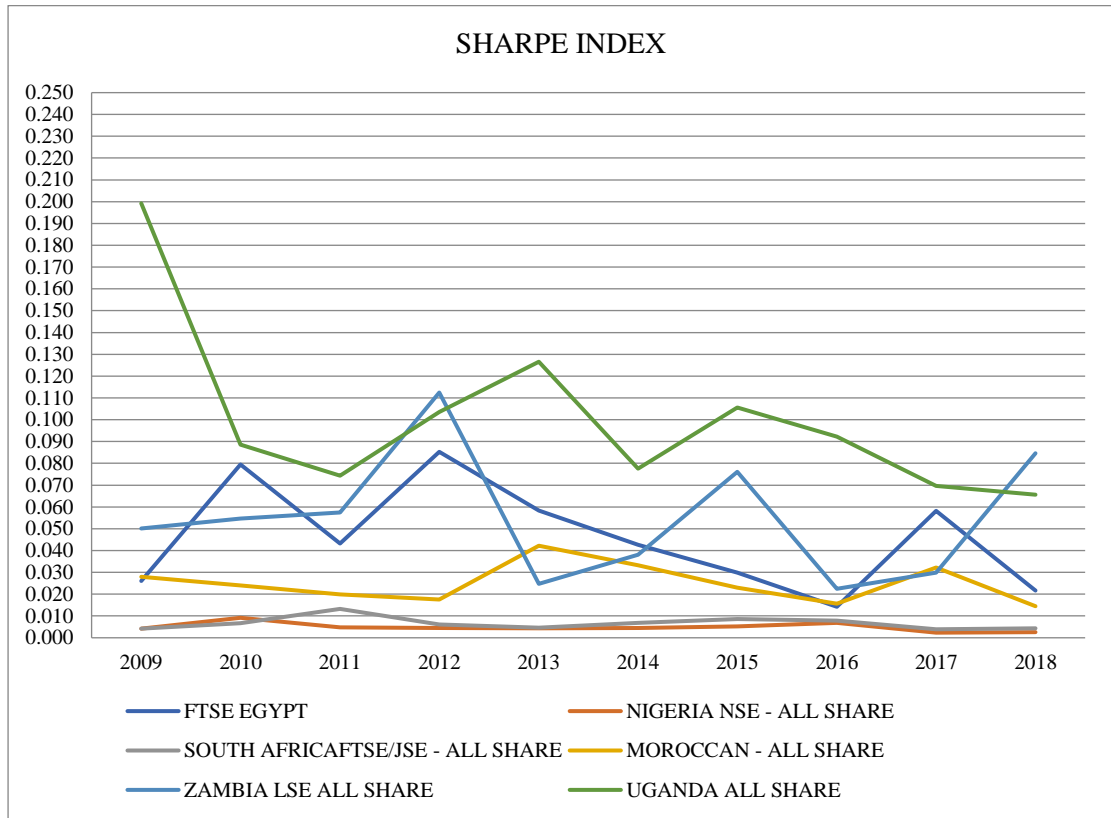
Figure 7: Sharpe Index of Nairobi All Share and Tanzania All Share

Source: Authors calculation and construction from data extract from investing.com

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28 https://en.wikipedia.org/wiki/Sharpe_ratio

Figure 8: Sharpe Index of the rest examined Africans Stock Exchange Market

Source: Authors calculation and construction from data extract from investing.com

5. Conclusion

The purpose of the present study was to present a statistical analysis of the main stock market indices of African countries after the 2009 global financial crisis year until 2018. We try to help investors presenting some main statistical index useful to stock market. We also try to figure out if capital from other stock market during the global financial crisis move to Africans Stock Exchange.

As we have seen from this statistical analysis, the most important African stock market indices were those of South Africa and Nigeria.

The statistical analysis also showed that the stock market indexes of South Africa and Nigeria not only were they not affected by the international financial crisis, but also had a significant upward trend.

From this observation we could probably say that some major investment funds of the large institutional investors may have found refuge in the stock markets of South Africa and Nigeria.

This has resulted in an increase in the wealth of the major shareholders of the companies as well as in the value of those companies whose shares were traded on these two stock market exchanges.

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