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Full Length Research Paper

The odyssey of South African multinational corporations (MNCs) and their impact on the Southern African development community (SADC)

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It has been observed that the pressures of globalisation and the lure for increased profitability have continued to motivate South African multinational companies (MNCs) to invest across international borders, especially in the Southern African Development Community (SADC). Furthermore, the deliberate policy to integrate the region has necessitated most of the governments of the SADC to encourage their largest companies to invest within the region, in order to tap from improved incentives created by the regional economic integration arrangement. Using both aggregate and firm level dataset from various sources between the period 1980 and 2011 in various econometric estimations, this study uncovers that there is correlation between the value of South African MNCs' contribution to regional economic development and investment in the SADC. The main results from this study shows that South African MNCs contributes positively to regional economic development and investment in the region. Similarly, the findings of this study indicate that South Africa-originated MNCs operation within the region triggers the growth of the cumulative GDP of this region. The causality test affirmed the statistical significance of these relationships, and also ensured that spurious correlations did not impede the econometric estimation procedure.

Key words: Multinational corporations, South Africa Development Community (SADC), foreign direct investment, macroeconomic dynamics, regional trade agreements, regional economic integration.

INTRODUCTION

Odyssey literally means a long and eventful or adventurous journey; this study therefore reflects the significance of South African multinational companies (MNCs) sojourn in the Southern African Development Community (SADC). Numerous South African MNCs have ventured into global markets after the successful ending of apartheid and the institution of a majority government in South Africa. Although this expedition outwards by South African MNCs into the SADC has been widely acclaimed in several articles, little research presents an aggregate view of this development. This article attempts to fill the literature and empirical gap.

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As well as, investigate if there is an Odyssean 'Penelope'[1] impact.

The economic capacity of a country, particularly its industrial in frastructure, banking and agricultural capabilities, determines the trend that its exports follow (Ahmed et al., 2004; AGRA, 2013; UN-OHRLLS, 2013; World Investment Report, 2014). It has been observed that the increasing levels of political, religious, xenophobic and economic crises in the SADC have resulted in wars (including currency wars), which in the long run have negatively impacted on the aggregate levels of productivity and infrastructure (Fontyn, 2013; Freeth, 2015; Mubangizi, 2015; Xie, 2015). Most researchers (Lawson, 2010; SADC, 2012; Tekere, 2012; Moyo, Sill and O'Keefe, 2013) have continually viewed economic growth experienced in the region as jobless growth. These in essence have continued unabated despite government support for economic equality, which is expected to lead to a reduction in the level of poverty.

Rising trade and current account deficits in predominantly all SADC countries have further weakened the ability of member states to tackle these problems, especially with an increasing debt burden (SADC, 2015) passed on by poorly managed state owned enterprises (SOE). As a direct consequence, most SADC countries have not been able to build or repair deteriorated and/or destroyed infrastructure. The resultant effect of this trend is that the SADC economy is increasingly dependent on South African MNCs to provide cheap and affordable goods and services (Mthombeni, 2006; Gorp, 2008).

This study measures the strategic impact of South African originated MNCs on the level of regional economic development and investment within the SADC region. The article probes the relevance of the six gaps hypothesis that form the basis for the perviousness of underdevelopment, which keeps these countries (especially most of the countries in the SADC region, save for South Africa and Botswana) trapped perpetually in low-growth incarceration (Gerring and Thacker, 2008; Yusuf, 2009; Dunning, 2010). Although, quite a number of studies have been conducted to investigate the strategic importance of regional economic integration on the expansion strategies of multinational corporations (Mthombeni, 2006; Pradhan, 2010; Hunya, 2012; Acquaah et al., 2013), there are few documented studies on the SADC region in specific. Furthermore, while a number some of these studies (Mthombeni, 2006; Balaam and Veseth, 2008; Chanmongkolpanich and Panthong, 2009; Tambunlertchai, 2009; Banner and Papathanakos, 2014; Zhou et al., 2016) have also been centred on the benefits of foreign investment to the host nation, specific studies that investigates the impact of South Africa- originated MNCs on the host nations economic development have not been documented. This research intends to fill those voids.

[1] In ancient Greek mythology, the epic poem traditionally ascribed to Homer, described Penelope as the wife of Odysseus who is beset by suitors when he did not return home after the fall of Troy.

The impact of South African MNCs in the SADC

Contemporary research (Msuya, 2007; Draper and Freytag, 2008; Gerring and Thacker, 2008; Erasmus and Breier, 2009; Yusuf, 2009; Aswathappa, 2010; Blanchard and Miller, 2010; Dunning, 2010; Sen, 2011; Okeyika, 2012; Pawar, 2013) points out that an exhaustion of the "six gaps" problem (that is, savings, trade, budgetary, revenue, skills, and innovation gap), will eventually lead to proffering a common solution for the SADC to break out of the vicious circle of poverty, and the trap of a low growth scenario. Also, numerous studies, such as those conducted by Chingono and Nakana (2009) and Dunning (2010) have espoused that countries could emancipate from the "six gaps" through the spillover effects of MNCs activities in the host country. To test the validity of this hypothesis, the study begins reviewing available literature on the application of this (emancipation) theory within the SADC regional bloc.

The first important contribution of South African MNCs according to Msuya (2007) is their role in filling the resource gap between targeted or desired investment and domestically mobilised savings. For example, to achieve a 7% growth rate of national output if the required rate of saving is 21% but if the savings that can be domestically mobilised is only 16% then there is a "saving gap" of 5%. If the country can fill this gap with foreign direct investments from these MNCs, it will be in a better position to achieve its target rate of economic growth.

The second contribution relates to filling the foreign exchange or trade gap. An inflow of foreign capital can reduce or even remove the deficit in the balance of payments, if the MNCs can generate a net positive flow of export earnings (Blanchard and Miller, 2010; Lalnunmawia, 2010; Sen, 2011; Okeyika, 2012; Pawar, 2013). It therefore means that while MNCs exports increase, the level of nominal imports decreases, thus allowing for a favourable balance of payment.

According to the Organisation for Economic Co-operation and Development (OECD, 2013) a contributing factor to the financial crises of 2007 to 2010 was the record imbalance in elements of the Balance of Payments BoP, such as the current account, financial account, and capital account plus or minus the balancing items. Many studies reveal that a fundamental problem common within the SADC region is that despite improvements in commodity prices, the current account balances of most SADC member states remain wide. The region's current account deficit in 2009 was 10.5 per cent and has further widened to 12.3% in 2010, from a conservative 2% deficit in 2006. This according to recent research by the SADC (2012) and the International Monetary Fund (IMF) World Economic Outlook – WEO

(2012) was largely due to rising imports supported by a weak domestic economy in these countries.

International business literatures reveal that, often, primary raw materials are bought from SADC countries at low prices, then converted into finished products, and a significant amount of value is added, then exported back to these countries by foreign MNCs at higher prices. Consequently, intra-regional flows within the SADC account for about 20% cent of total trade. This according to the UNCTAD (2011) will however increase largely due to the growing presence of South African MNCs in these countries, and the success of these firms in telecommunications, retail, breweries, banking, and specialised service sector.

Likewise, the third important role South African MNCs play in the SADC is filling the gap between targeted governmental tax revenues and locally raised taxes. By taxing these MNC profits, member state governments are able to mobilise public financial resources for development projects (Lalnunmawia, 2010; Okeyika, 2012; Pawar, 2013).

Similarly, the fourth major contribution of South African MNC's is that apart from the fact that these MNCs provide financial resources to further production, they also supply a "package" of needed resources that includes management experience, entrepreneurial abilities, and technological skills. According to Erasmus and Breier (2009) the SADC's skills shortages are widely regarded as a key factor preventing the achievement of targeted growth rates. The findings of so many studies reveal that these resources can be transferred to local firms by means of training programmes and the process of "learning by doing" that only occurs through practice.

However, apart from skills shortage, another factor of great value that needs attention in SADC countries is innovation which Schumpeter (2013) describes as the creative gale of destruction. According to Anthony (2013) innovation is simply the key to long-term economic growth. Therefore, for today's MNCs to be successful, they have to invent product offerings that exceed current expectations of consumers. Recent research findings (Moore et al., 2013; KEN, 2013) reveals that due to the significance of innovation, there is a dire need for innovation and technology agencies to renew their mandate in order to focus on innovation replication in commercially viable areas (World Investment Report, 2014; World Bank, 2016; Zhou et al., 2016), as well as to promote social entrepreneurship models because the address most of the development challenges facing the region. According to Vernon (1979), product innovation gives the innovative firm a monopolistic advantage, which it first exploits at home and then abroad. More so, Chan and Pretorius (2007) posit that countries and regions have tended to stimulate innovation as a fundamental source of competitiveness by building on locally generated intellectual property. The SADC must not be left out of this unfolding global trend, as South African MNCs' are well positioned to give them that advantage.

Evidence from the findings of Aswathappa (2010) suggests that South African MNCs bring with them the most sophisticated technological knowledge about production processes within the SADC. Moreover, these firms transfer modern machinery and equipment to capital poor LDCs. Such transfers of knowledge, skills, and technology are assumed to be both desirable and productive for the recipient country to kick-start economic development (World Investment Report, 2012; Heritage Foundation, 2016; Zhou et al., 2016). For instance, Sasol's proprietary Fischer-Tropsch (FT) technology was responsible for advances in the production of cleaner liquid fuels within the SADC (Sasol, 2013).

Also, it has been observed that AngloGold Ashanti's deep mining technologies and safety standards with its low economic costs were responsible for an increase in company profits within the region (AngloGold Ashanti, 2010). Likewise, MTN's fibre-optic backbone network helped the company to meet an increasing demand for bandwidth from its customers, skyrocketing profits that have consistently assisted the company to spread its operations all over the SADC region (SA Info, 2007).

Despite all the favourable arguments for MNCs, scholars such as Rao (2008), Majeed and Ahmad (2009), Dosanjh (2010), Giuliani (2010) and Teixeira and Grande (2012) have observed potential negative impacts of MNCs in host countries. Although the initial short-run impact of MNC investment is to improve the foreign exchange position of the recipient nation, its long-run impact may reduce foreign exchange earnings on both current and capital accounts (Wei, 2009). Existing literature suggests that the current account of host nations may deteriorate as a result of substantial importation of intermediate and capital goods, while the capital account of the country may worsen because of the repatriation of profits, interest and royalties overseas (Singh, 2012). An adept analysis of the behavioural pattern of South African MNCs reveals that these MNCs have been very instrumental in the development of host countries' economies, with minimal observable negative effects.

South Africa-originated MNCS and the SADC economy

Many literature studies have concluded that South Africa is the economic giant of Africa, contributing nearly 40% to the continent's total GDP (Vilakazi, 2009). In the manufacturing sector, 75% of Africa-originated MNCs are from South Africa. Although South Africa accounts for only 6% of Africa's population, it acclaims about 40% of Africa's industrial output, over 45% of Africa's mineral production, 50% of Africa's purchasing power and over 50% of Africa's energy consumption (World Investment Report, 2010). Studies conducted by Martin (2008) and the World Bank (2012), has also suggested that by

contrast to the rest of the continent, South Africa possesses comparatively higher industrial, commercial, infrastructural and financial power.

Ngwawi (2012) posits that since the SADC embarked on a number of short- and long-term projects to bolster its power generation capacity by more than 42,000 megawatts, many MNCs have started taking this sector serious. This has triggered new research into cheap ways to generate and transmit power. For instance, Sasol's use of R 1.8 billion to generate 140 MW of electricity in its new gas-fired plant is about a third of estimated cost of nuclear power construction and half the cost of a coal-fired plant (Sasol, 2013). This have signaled to the stakeholders that low power generation costs ultimately revolutionises the power sector's efficiency levels and will significantly improve productivity levels in the SADC (Ngwawi, 2006; TMSA, 2011; TMSA, 2012).

More so, many literature and empirical studies have indicated that South Africa-originated MNCs have contributed meaningfully to the transport sector of the SADC. According to Sapa (2012) Transnet's indication that it will need 1064 locomotives in the next seven years – or 152 locomotives a year – as part of its R 300 billion market demand strategy, is expected to significantly improve the ailing transport sector in both South Africa and the SADC. This will definitely help to further integrate the SADC market by reducing transport time, distance and cost of travel for both goods and services, and lower the cost of human capital as well. Also, the actualisation of this goal is expected to lead to the development of ancillary industries such as the hotel and tourism sectors of the economy, generate new jobs, and also, lead to sustainable growth and development in the region.

Furthermore, data provided by Statistics South Africa (2012) reveal that the investment of South African companies operating in the SADC is yielding substantial benefits for Africa. This achievements have been predominantly in the areas of job creation; upgrading of existing and building of new infrastructure, including but not limited to investment in backbone services, and technology transfer through human resource development (National Planning Commission, 2011), increased tax revenues; increased consumer choice; and boosting general investor confidence in host countries (Draper et al., 2011; Landsberg and Wyk, 2012). Consequently, South African companies have directly contributed to the slow build-up of crucial productive infrastructure in the region (Draper et al., 2011).

The Famine Early Warning Systems Network - FEWSNET (2012) notes that despite the high levels of acute food insecurity in Africa, the SADC remains generally food secure. Recent empirical evidence from Statistics South Africa (2012) database shows that the vertically backward integration strategies of fast-moving consumer goods companies in South Africa such as Shoprite, Massmart, Spar and Game has sufficiently helped to build and acquire farms that meet the food deficit levels in cereals, legumes and other cash crops, largely due to the commercialised and mechanised kind of agriculture that is being practiced (FAO, 2008; Mudhara, 2010; Neves, 2014).

Given the large number of portfolio inflows into South Africa from the rest of the world, recent studies by the Johannesburg Stock Exchange - JSE (2013) suggests that these inflows are recycled as FDI outflow to the region; in other words, South Africa's sophisticated financial markets are being used to channel resources across the SADC, thereby aiding regional trade.

According to Whitfield et al. (2013, 2015) South African companies conceptualised the largest-ever foreign direct investment in Mozambique; that was used to build MOZAL aluminium smelter in Maputo. This investment has aided the on-going economic reconstruction in Mozambique. According to industry watcher's (Jordaan and Kanda, 2011), the milestone achievement was that the capitalisation of the MOZAL project, estimated at US $1.3 billion, was about half of the estimated Mozambican GDP of US $2.8 billion in 1998 (Gqada, 2013). Consequently, this move has further increased the trust and support for South African MNCs by SADC countries that want complete integration by 2018 (Warren-Rodríguez, 2008; Stephan and Hervey, 2008; Gqada, 2013).

Apart from the Mozal investment, South African MNCs have also entered the Mauritius market to explore potentials inherent in the nation's economic sector. New research carried out by the SADC (2012) concludes that in 2006, there was a huge increase in South Africa's outward FDI to Mauritius, accounting in that year for 33% of total FDI. Although this FDI was concentrated in the IT and Business Process Outsourcing (IT/BPO) services sector (Overseas Development Institute, 2011), there is a drive towards investment in the private non-banking sector that specifically deals in long-term capital (World Investment Report, 2012).

On an aggregate level, South African MNCs have made significant investments in the banking, retailing, tourism and mining sectors of the SADC's economy. For instance, Standard Bank and SABMiller have investments in all 14 SADC countries. Also, some of the new investments in Information and Communications Technology (ICT), particularly in the Global System for Mobile telecommunication (GSM) sector have been dominated by South African MNCs, with investments made by MTN Group of Companies, Telkom SA and Vodacom running into billions of dollars, followed by the Industrial Development Corporation (IDC's) $600 million in Mozambique and Gencor's $500 million in Mozambique (Carmody, 2012; Valsamakis, 2012).

It has been observed that South African retail companies such as Wimpy (fast food), Engen (service station), Kwikserve (mini-supermarket), Woolworths (food and clothing), Game (general merchandise) and the huge regional multinational food retailer, Shoprite-Checkers

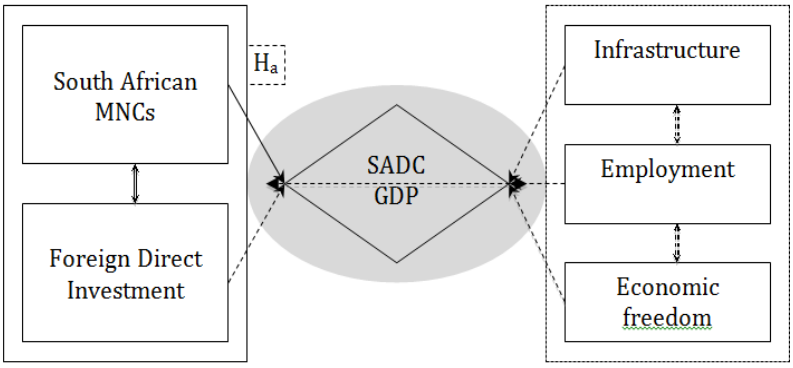

Figure 1. Conceptual model of the study.

(food supermarket), are building on regional economies of scale to penetrate regional markets with a host of new consumer goods and services sourced primarily from South Africa (Miller, 2008; Miller, Saunders and Oloyede, 2008; SARB, 2012).

According to Louw et al. (2008) agro-allied companies contribute 67% of the SADC's GDP and 62% of the total value of SADC countries' external trade. The perennial success of this sector have also made the country an "anchor economy" for both South African agribusinesses and international subsidiaries of foreign MNCs based in South Africa venturing into the SADC region. New studies by Miller (2008) and the South African Reserve Bank - SARB (2012) posit that retail migration into SADC region has benefited from the "pull" supporting services sectors such as property rental, banking and auditing. It has been further observed that local linkages to the supply chain are highly attractive and currently unexploited in the region, and as such portend a great incentive to invest in this sector.

Studies conducted by World Investment Report (2012) reinforces earlier evidence by showing that South African MNCs have performed well in the fast food, retail and wholesale sectors of the region's economy. Steers, Shoprite Checkers, Pick 'n Pay, Pep and Pepkor/Metro have also carried out an aggressive expansion strategy that has led to these MNCs opening branches in almost all countries within the SADC. Moreover, SABMiller (Africa's number one brewing and bottling company) has considerably grown its business within the SADC. As a result, the company now sells about 213 million hectolitres (hl) per annum (SABMiller, 2012). In the finance sector banks such as Standard Bank, First National Bank and Nedbank have grown their balance sheet through their expansion programmes within the SADC. However, there is an expansion gap within the insurance, investment banking and asset management sub sector, which South African MNCs will soon fill. Furthermore, in the mining sector, De Beers, BHP Billiton and AngloGold Ashanti remain the dominant players within the sub-region (SABPP, 2012).

Likewise, recent studies conducted by the SARB (2012) suggest that South African banks play an important role in regional integration. This has been clearly stated in the vision, mission and strategic statement of these companies. A study carried out by the JSE (2013) observes that there is a positive link between South African multinational banks' acquisitions in the SADC and the exchange's growth. This has given rise to higher revenues and profit ratios by banks such as ABSA, Nedbank, Standard Bank, Investec and First National Bank despite high-level losses that are being experienced by foreign competitors. Consequently, South African banks coverage in the SADC; is now providing an avenue to finance big-ticket transactions in the region. Further analysis of the activities of South African MNCs shows that they have performed creditably well and empirical evidence have also revealed that these firms have positively contributed to the growth of the SADC zone.

After a comprehensive literature review and discussion concerning related concepts and findings of the previous studies, the study developed an integrated conceptual framework (Figure 1) for the purpose of this study. The effervescence effect of this model is that shows the relationships that exist between the construct variables. However, to formulate appropriate measures and otherwise manage the relationship, information regarding South African MNCs activities, as well as the impact of factors such as the rate of economic freedom in the SADC, the level of infrastructure development, the level of foreign direct investment (FDI) net inflows, and the employment to population ratio, in order to gain knowledge of their impact on the GDP of the SADC.

Consistent with theorists (Mthombeni, 2006; Balaam and Veseth, 2008; Chanmongkolpanich and Panthong, 2009; Tambunlertchai, 2009; Banner and Papathanakos, 2014) who emphasised the importance of South African MNCs operations in the SADC, by stating categorically that these firms have transcended from being explorative

to exploitative in this region, having utilised their location bound firm specific advantages (FSA), and overcoming the liability of foreignness (LOF) challenges, as well as recognising the disruptive effect of psychic distance, while taking advantage of the incentives that is provided by the SADC (Leonidou et al., 2014), the study suggest that South African MNCs contribute to regional economic growth and investment in the SADC.

HYPOTHESIS

Based on the model conceptualisation for the study, the study examine the effects of South African MNCs contribution to regional economic growth and investment in the SADC based on the relationship that exist between five variables that are important to achieving the objective of this study. Based on the literature review the following hypothesis has been formulated to examine the relationships:

H_o: South African Multinational companies do not contribute to regional economic growth and investment in the SADC.

H_a: South African Multinational companies contribute to regional economic growth and investment in the SADC.

Variable identification and deconstruction

$GDPSADC_t$ is the GDP of the SADC in year t. It is calculated based on the market value of goods and services produced within the SADC region from 1980 to 2011. The GDP data can be accessed from Statistics South Africa's and other relevant database. This econometrics variable was selected after careful consideration by the authors of this study, since it is consistent with the methodology of similar studies (Statistics South Africa, 2013; UNCTAD, 2013; World Investment Report, 2014).

$MNCSAv_t$ measures the value of South African MNCs' contribution to regional economic growth and investment in year t. The cumulative value of MNCs in South Africa was measured by the Market capitalisation of the Johannesburg Stock Exchange from 1980 to 2011 (Ritholtz, 2011). The dataset was assessed from the Johannesburg Stock Exchange (JSE, 2013).

$INFRASSADC_t$ is the level of Infrastructure development in year t. It can be defined as the basic physical systems of a business or nation. It includes investments in transportation, communication, sewage, water and electric systems. Although these systems tend to be high-cost investments, they are vital to a country's economic development and prosperity. Infrastructure projects may be funded publicly, privately or through public-private partnerships. The data for the level of infrastructure development of the SADC can be assessed from the World Bank, World Development Indicators (WDI) using aggregate datasets from 1980 to 2011 (World Bank, 2012a).

$ECFREEDOMSADC_t$ is the rate of Economic freedom in the SADC in year t. It is concerned with the level that the cornerstones of economic freedom such as personal choice, voluntary exchange, freedom to compete, and the security of privately owned property. It measures the size of government; expenditures, taxes, and enterprises, legal structure and security of property rights, access to sound money, freedom from corruption, financial and investment freedom, freedom to trade internationally, regulation of credit, labour, and business. Variables of the rate of economic freedom were collected from a number of different sources such as the World Bank, the International Monetary Fund and the Economist Intelligence Unit. The aggregate dataset for this proxy variable was assessed from the Fraser Institute portal, using data from 1980 to 2011 (Fraser Institute, 2014).

$EMPtoPOPrSADC_t$ is the Employment to Population ratio in year t. The employment to population ratio for persons aged fifteen and above was compared to the total population of the SADC. This data can be assessed under the Labour and Social Protection column of the World DataBank, World Development Indicators (WDI) issued annually by the World Bank. The time period covered is between 1980 and 2011 (World Bank, 2012b).

$FDInetinBOPSADC_t$ is the Foreign Direct Investment, net inflows (Balance of Payments (BoP) at current US $) in year t. It is the net inflows of FDI into the SADC, which is estimated as the BoP, which is the difference in total value between payments into and out of the SADC over a time period. This data can be assessed under the Economic Policy & External Debt column of the World DataBank, World Development Indicators (WDI) issued annually by the World Bank. The time period covered was between 1980 and 2011 (World Bank, 2012c; World Investment Report, 2014).

EMPIRICAL STUDY

This study employs secondary datasets to test the validity of the proposition that South African Multinational companies contribute to regional economic development and investment in the SADC. The MNC firm-level dataset was obtained from the McGregor BFA database, while the SADC country/aggregate dataset will be elicited from both the African Development Indicators database, and the World Enterprise Survey, which is provided by the World Bank, as well as other relevant sources to estimate the econometric models. However, firm level datasets will only be elicited for MNCs that originate from South Africa, and have an operational footing in the SADC region. The study incorporates both sources of data for the sake of validity and reliability of findings. This will promote the objectivity, accuracy, validity and reliability of the study.

The datasets cover a period between 1980 and 2011

and for consistency sake; other set of data is generated for the same period. The data collection process adopted by the original source of the datasets (that is, the databanks) attests to the reliability and accuracy of this set of data. The data is generated for various series and estimations, which have been used in previous studies (JSE, 2013; Department of Trade and Industry, 2013; Statistics South Africa, 2013). However, because of the uniqueness of this analysis (being both firm-level and policy related estimation, and also, the dynamic nature of the issue being investigated), some macroeconomic variables (like the rate of Economic freedom in the SADC) will be collected from a number of different sources such as the World Bank, the International Monetary Fund and the Economist Intelligence Unit. The data will be assessed from the Fraser Institute from 1980 to 2011.

As indicated in the introduction section, this study focuses on the impact of South African MNCs contribution to regional economic development and investment. In other to achieve this objective, the study adopts a series of regression techniques using the best regression model. Apart from the test for robustness, various diagnostic measures were undertaken. Some of the diagnostics techniques are not reported, but their statistical implications are mentioned. The author chooses to report the results for robust estimations only.

In addition, Granger causality tests will be conducted since the ordinary least square (OLS) model employed only measures correlation. In order to measure precedence, and determine whether adding lagged values of a variable will help in the prediction of another variable, thereby causing it to change. The model specification for this study is depicted in the equation below:

$$\begin{aligned}\mathrm{GDPSADC}t = {} & \beta_0 + \beta_1(\mathrm{MNCSAv}t) \\ & + \beta_2(\mathrm{INFRASSADC}t) \\ & + \beta_3(\mathrm{ECFREEDOMSADC}t) \\ & + \beta_4(\mathrm{EMPtoPOPr}tSADC) \\ & + \beta_5(\mathrm{FDInetinBOPSADC}t) + \varepsilon\end{aligned}$$

Where: $\mathrm{GDPSADC}_t$ is the dependent variable; it stands for the GDP[2] of the SADC in year *t*;

MNCSAv_t[3] measures the value of South African MNCs contribution to regional economic development and investment in year *t*; Similarly,

$\mathrm{INFRASSADC}_t$ is the level of Infrastructure development in year *t*;

$\mathrm{ECFREEDOMSADC}_t$ stands for the rate of Economic freedom in the SADC in year *t*;

$\mathrm{EMPtoPOPrSADC}_t$ is the Employment to Population ratio in year *t*;

$\mathrm{FDInetinBOPSADC}_t$ stands for the Foreign Direct Investment, net inflows (BoP at current US $) in year *t*;

While:

β_0 = Constant factor or term (known as y–Intercept), β_1 = Coefficient of $\mathrm{MNCSAv}t$, β_2 = Coefficient of $\mathrm{INFRASSADC}t$, β_3 = Coefficients of $\mathrm{ECFREEDOMSADC}t$; β_4 = Coefficients of $\mathrm{EMPtoPOPr}tSADC$; β_5 = Coefficients of $\mathrm{FDInetinBOPSADC}t$;

ε stands for the error term, that will predict the matrix of other control variables, including variables of SADC Literacy rate, SADC mortality rate, SADC population and SADC poverty gap at for instance $2 a day that are not represented in the model.

DATA ANALYSIS

The data generated for this study is analysed using EViews statistical package (EViews 7.2). This statistical package is generally used in studies for regression analysis and diagnostics. It predicted current values of the dependent variable based on the current values of an explanatory variable and the lagged values of this explanatory variable. The parameters were estimated by ordinary least squares (OLS); nevertheless, such estimation was anticipated to give very imprecise results due to extreme multicollinearity among the various lagged values of the independent variable. Therefore, various tests were carried out to ensure that both the coefficients and residuals were stable using data diagnostics testing procedures such as the Breusch-Godfrey Serial Correlation LM Test, Heteroskedasticity Test (Breusch-Pagan-Godfrey), and Histogram Normality Test (can be assessed from the author). Granger Causality tests using bivariate regression form was conducted in order to determine whether correlation imply causation. This ensured that all spurious correlations that eventually become meaningless during real life analysis are eliminated.

In this analysis, after testing for regression analysis, the Breusch–Godfrey (BG) serial correlation LM test is then conducted afterwards. The test is used to measure autocorrelation in the errors in the regression model. It makes use of the residuals from the model being considered in a regression analysis, and a test statistic is derived from these (Godfrey, 1996). The null hypothesis is that there is no serial correlation of any order up to *p*. It is widely accepted in modern statistics that the test is more general than the Durbin–Watson statistic, which is only valid for nonstochastic regressors and for testing the possibility of a first-order autoregressive model (for example, AR(1)) for the regression errors. The BG test

[2] Gross domestic product (GDP) is the market value of all officially recognised final goods and services produced within a country in a given period of time (IMF, 2011).

[3] The total value of MNCs (market capitalisation) is calculated by multiplying the number of shares outstanding (this includes the value of all listed categories of a corporation's stocks – e.g. preferred stock, common shares) by the market price per share, which is the current value of a company.

Table 1. Cronbach alpha test.

Item	Obs	Sign	Item-test correlation	Item-rest correlation	Average interitem correlation	Cronbach alpha
GDPSADCt	32	+	0.8988	0.8497	0.6803	0.9141
FDInetinBOPSADCt	32	+	0.8740	0.8141	0.6932	0.9187
ECFREEDOMSADCt	32	+	0.8737	0.8137	0.6934	0.9187
EMPtoPOPrSADCt	32	+	0.7497	0.6440	0.7577	0.9399
INFRASSADCt	32	+	0.8509	0.7816	0.7052	0.9228
MNCSAvt	32	+	0.9429	0.9139	0.6575	0.9056
Test scale	-	-	-	-	0.6979	0.9327

has none of these restrictions, and is statistically more powerful than Durbin's *h* statistic (Godfrey, 1978).Under the classical assumptions, including homoscedasticity,ordinary least square is the best linear unbiased estimator (BLUE), that is, it is unbiased and efficient. It has been observed that the efficiency is lost, however, in the presence of heteroscedastic disturbances. The author therefore decided to conduct the Breusch–Pagan-Godfrey test to examine the presence of heteroscedasticity. In order to test whether the estimated variance of the residuals from a regression are dependent on the values of the independent variables.

After the Breusch–Pagan-Godfrey test is conducted, the Jarque–Bera (JB) test is used to test goodness-of-fit by ascertaining whether the sample data have the skewness and kurtosis matching a normal distribution. If the data comes from a normal distribution, the JB statistic asymptotically has a chi-squared distribution with two degrees of freedom, so the statistic can be used to test the hypothesis that the data are from a normal distribution. For small samples, the chi-squared approximation is overly sensitive, often rejecting the null hypothesis when it is in fact true. This leads to a large Type I error rate.

According to Jarque and Bera (1981, 1987), the JB test is a more advanced case of simultaneously testing the normality, homoscedasticity and absence of autocorrelation in the residuals from the linear regression model.

Therefore, this makes this test an indispensable aspect of the data analysis for this study. Statistical measures of accuracy tests were performed on all econometrics variables for this study, in order to examine the reliability and internal consistency of the dataset. The Cronbach alpha (α) values for each of the variables were computed. All the econometrics variables Cronbach α were above the recommended threshold of 0.70 for Cronbach alpha (Nunnally, 1978).

The minimum value of the item-total correlation among all the constructs surpassed the minimum ($\leq$0.3) level recommended by Dunn et al. (1994).

Table 1 provides evidence that each of the econometric variables exhibit satisfactory reliability with values ranging from 0.9056 to 0.9399 (Henseler et al., 2009; Hair et al., 2011).

Furthermore, principal component analysis (PCA) was carried out to ensure robustness of the econometric variables (Jackson, 2003). The PCA process takes cognisance of the leading eigenvectors from the eigen decomposition of the correlation of the variables, and also describe a series of uncorrelated linear combinations of the variables that contain most of the variance. From this data eigenvectors from the PCA are inspected to learn more about the underlying structure of the data (Anderson, 1963; Tyler, 1981).

Table 2 shows that the loadings of the principal components indicate a very good distribution of the correlated data, and since the unexplained variables is equal to zero, it then means that the model accurately predicted the PCA. More so, the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy has a range value that is between 0 and 1, with small values indicating that overall the variables have too little in common to warrant a PCA analysis.

According to Kaiser (1974), KMO value of 0.00 to 0.49 is unacceptable, 0.50 to 0.59 is miserable, 0.60 to 0.69 is mediocre, 0.70 to 0.79 is middling, 0.80 to 0.89 is meritorious, and 0.90 to 1.00 is marvellous. This implies that the KMO value of $FDInetinBOPSADC_t$ (that is, the level of FDI, net inflows (BoP at current US $)) is marvellous, while the KMO value of $EMPtoPOPrSADC_t$ (that is, the level of employment to the population ratio of the SADC) is meritorious, whereas, KMO of the remaining variables is middling or average.

Furthermore, the test for Unit Root was conducted using Augmented Dickey-Fuller (ADF) technique, and Difference-Stationary Process (DSP) was used to transform the time series data into a stationary trend (Woodward et al., 2012). The results of the Unit Root tests, suggest that the series did not exhibit any statistical indication of the presence of Unit Root, as all the variables tested were stationary at both the first and second difference. Likewise, the ritical values of the

Table 2. Principal component eigenvectors/KMO measure of sampling adequacy.

Item	Comp1	Comp2	Comp3	Comp4	Comp5	Comp6	Unexplained	kmo
GDPSADCt	0.4252	0.3024	-0.4477	-0.3064	-0.0788	0.6537	0	0.7253
FDInetinBOPSADCt	0.4129	-0.1177	-0.3229	0.8384	0.0861	-0.0320	0	0.9553
ECFREEDOMSADCt	0.4107	-0.4217	0.4167	-0.0264	-0.6819	0.1187	0	0.7327
EMPtoPOPrSADCt	0.3469	0.6018	0.6601	0.1448	0.2424	0.0452	0	0.8130
INFRASSADCt	0.4018	-0.5474	0.1105	-0.2998	0.6609	0.0066	0	0.7689
MNCSAvt	0.4453	0.2346	-0.2714	-0.3027	-0.1609	-0.7453	0	0.7464
Overall	-	-	-	-	-	-	-	0.7794

Table 3. Factor analysis, loadings and unique variance.

Item	Factor eigenvalue	Analysis difference	Correlation (unrotated) proportion	Cumulative	Loadings Factor1	Factor2	Pattern (matrix) Factor3	Uniqueness
GDPSADCt	4.35442	3.82582	0.8832	0.8832	0.9131	-0.3429	-0.1524	0.0254
FDInetinBOPSADCt	0.52860	0.36603	0.1072	0.9904	0.8332	0.0400	-0.0771	0.2982
ECFREEDOMSADCt	0.16256	0.16306	0.0330	1.0234	0.8603	0.3811	0.1332	0.0970
EMPtoPOPrSADCt	-0.00050	0.02499	-0.0001	1.0233	0.6824	-0.2057	0.3194	0.3899
INFRASSADCt	-0.02549	0.06395	-0.0052	1.0181	0.8391	0.3978	-0.1103	0.1255
MNCSAvt	-0.08944	-	-0.0181	1.0000	0.9574	-0.2522	-0.0383	0.0183

variables at their respective significance levels were at either 1% and/or 5% levels.

Similarly, Johansen Cointegration test indicated that there is a long run relationship or associationship between the econometric variables in this study (Kaya et al., 2010; Saka and Lowe, 2010; Bayar et al., 2014), and that the variables of this study move together (therefore, all the six variables are cointegrated). While, further establishing the usefulness of this study's hypothesis group statistic equation over a long period of time (Hatemi, 2008). These rules out any possibilities of a spurious relationship between them and also suggests that a causal relationship must exist in at least one direction (Johansen and Juselius, 1990).

Table 3 shows that the factor analysis/correlation, factor loadings (pattern matrix) and unique variance values reflect a fair distribution in the data. Likewise, Table 4 presents the descriptive statistics including mean, standard deviation, minimum and maximum values, as well as correlations for all the variables in this study. From Table 5, the regression model F-statistics of 29.19 indicates that the variables in this model exhibits high predictive ability, and the probability of the statistic; Prob. F-statistic (that is, 0.0000) represents the probability that the equation or model employed is statistically significant at 1% level of error. The p-value ofthe model (0.0000) indicates that the explanatory variables used are collectively significant in explaining the variations expressed by the dependent variable, and this asseveration is buttressed by the strong value of the Adjusted R-Squared (0.88). It therefore, suggests that 88% of the total change in the dependent variables can be attributed to the independent variables. We therefore accept the alternate hypothesis that South African multinational companies contribute to regional economic growth and investment in the SADC.

In order to find out whether residuals are serially correlated, residual diagnostics was performed on the residuals through a Breusch-Godfrey Serial Correlation LM Test (with 2 lags). The OBs*R-Squared corresponding P-value (Prob. Chi-Square (2)) of 0.1219 indicates that since the P-value is more than 5% means that the null hypothesis cannot be rejected, rather the study accept the null hypothesis which states that residuals are not serially correlated. This indicates that our model exhibits the feature of the best regression model, which is good. This fact is supported by the Durbin-Watson statistic figure of 1.926533 (approximately 2), which indicates that there is no serial correlation in the residuals.

The Breusch-Pagan-Godfrey Heteroskedasticity test was used to check whether the residual value is either efficient or unbaised. It was observed that the Obs*R-squared corresponding P-value Prob. Chi Square (5) value of 0.7186 is more than 5%. This means that the study cannot reject null the hypothesis; that the residuals

Table 4. Mean, standard deviations and correlations.

Item	Mean	s.d.	Min	Max	1	2	3	4	5	6
GDPSADCt	232.76	141	98.873	648.02	1.0000	-	-	-	-	-
FDInetinBOPSADCt	3.9824	4.64	0.0320	18.492	0.7674	1.0000	-	-	-	-
ECFREEDOMSADCt	5.3352	0.47807	4.81	6.21	0.6233	0.7295	1.0000	-	-	-
EMPtoPOPrSADCt	61.3374	0.69585	59.9077	62.7385	0.6486	0.5333	0.5746	1.0000		-
INFRASSADCt	116.84	7.0710	107.55	127.19	0.6521	0.7199	0.8925	0.4336	1.0000	
MNCSAvt	1.8264	2.12	0.0718	6.9085	0.9737	0.7858	0.7148	0.7009	0.7182	1.0000

Table 5. Least square regression test.

Item	Coefficient	Std. Error	t-Statistic	Prob.
C	43.49405	28.18406	1.543214	0.1436
ECFREEDOMSADCt	0.296006	1.259810	0.234961	0.8174
EMPtoPOPrSADCt	-3.634077	7.270737	-0.499822	0.6245
FDInetinBOPSADCt	-0.051393	0.076523	-0.671608	0.5120
INFRASSADCt	-3.484842	1.674850	-2.080689	0.0550
MNCSAvt	0.705029	0.128062	5.505360	0.0001
Adjusted R-Squared	0.875720	-	-	-
Durbin-Watson stat	-	1.926533	-	-
F-statistic	-	-	29.18541	-
Prob. F-statistic	-	-	-	0.0000

are homoskedastic, rather the study accept null hypothesis; as residuals are not heteroskedastic, which is desirable.

Since this study is prompted by the need to find out whether South African MNCs contribute to regional economic development and investment, the statistical evidence analysed so far suggests that their presence in the SADC compensates significantly, where member states have failed, especially as it concerns capital, innovation and strategic intent (Mthombeni, 2006; Pradhan, 2010; Hunya, 2012; Acquaah et al., 2013). Although various theories have been expatiated, in order to cope with the international business (IB) literature concerns such as location bound firm specific advantages (FSA), the liability of foreignness (LOF) or outsidership, as well as psychic distance (Rugman et al., 2011; Zhou et al., 2016), however, it is not well understood how MNCs in less developed countries (like the SADC) internationalise regionally (considering the enormous challenges faced by MNCs that operate in such markets), thus the study analysed the relationships that exist between the various econometric estimates for this study.

Additionally, in the Appendix section of this study, Appendix A specifies that the First difference line for the hypothesis mean value hovered around zero, which is desirable. While Appendix B revealed that the Pie graph for the hypothesis is fairly distributed amongst all econometric variables.

Relationship testing for the hypothesis

The relationship between the value of South African MNCs and the cumulative GDP of the SADC

The t-statistic p value of 0.0001 (00.01%) indicates that the value of South African MNCs contribution to regional economic development and investment; $MNCSAv_t$ is statistically significant to influence the value of the dependent variable (since sig f < 0.0500 is statistically significant). This means that the value of South African MNCs contribution to regional economic development and investment can individually cause a variation in the dependent variable Y, which is the cumulative GDP the SADC ($GDPSADC_t$). Furthermore, the coefficient of the regression equation (β_1) has a non-random known constant value of 0.705029. This means the coefficient of the regression equation (β_1) has a direct positive relationship with the dependent variable ($GDPSADC_t$). Since $MNCSAv_t$ is a continuous variable, $\beta_1$represents the difference in the predicted value of $GDPSADC_t$ for each one-unit difference in $MNCSAv_t$, if other independent (predictor) variables remain constant. However, the value of South African MNCs' contribution to regional economic development and investment can also individually cause a variation in the dependent variable $GDPSADC_t$. The relationship that exist between the two variable estimates indicate that the expansion in

South African MNCs activities in the SADC was large enough to more than offset for the countervailing measures caused by the negative impacts of the low level of infrastructural development in the SADC (Chingono and Nakana, 2009; Carmody, 2012; SADC, 2012), as well as the low level of skills and balance of payment (SADC, 2015) that is experienced in the region. This ultimately led to an increase in the cumulative GDP of the SADC. The results show that strengthening MNCs in SADC countries increases the production and exports of new products, without affecting existing exports (World Investment Report, 2010, 2014). This can be attributed to the incentive structure that is provided by the SADC to member nation MNCs (Department of Trade and Industry, 2013). It may also be (as our data suggest) due to South Africa MNCs exploiting their core competencies and location bound FSAs, which compensates for the negative impact of LOF, outsidership and psychic distance as elucidated by several IB scholars (Rugman et al., 2011; Zhou et al., 2016).

The relationship between the value of South African MNCs and the level of regional economic development (infrastructure)

The t-statistic p value of 0.0550 (05.50 per cent) indicates that the level of regional economic development (infrastructure); $INFRASSADC_t$ is statistically insignificant to influence the value of the dependent variable (since sig f < 0.0500 is statistically significant). This means that the level of regional economic development (infrastructure) cannot individually cause a variation in the independent variable Y, which is the cumulative GDP the SADC ($GDPSADC_t$).

Similarly, the coefficient of the regression equation (β_2) has a non-random known constant value of -2.080689. This means the coefficient of the regression equation (β_2) has a direct negative relationship with the dependent variable ($GDPSADC_t$). Since $INFRASSADC_t$ is a continuous variable, $\beta_2$represents the difference in the predicted value of $GDPSADC_t$ for each one-unit difference in $INFRASSADC_t$, if other independent (predictor) variables remain constant. More so, the level of regional economic development (infrastructure) cannot individually cause a variation in the dependent variable $GDPSADC_t$. The computed statistical evidence suggests that a high level of regional economic development can be attributed to standard infrastructural facilities, since it aids the trade formation process (World Bank, 2012a).

The relationship between the value of South African MNCs and the rate of economic freedom in the SADC

The t-statistic p value of 0.8174 (81.74 per cent) indicates that the rate of Economic freedom in the SADC; $ECFREEDOMSADC_t$ statistically insignificantly influences the value of the dependent variable (since sig f < 0.0500 is statistically significant). This means that the rate of Economic freedom in the SADC cannot individually cause a variation in the independent variable Y, which is the cumulative GDP the SADC ($GDPSADC_t$).

Likewise, the coefficient of the regression equation (β_3) has a non-random known constant value of 0.234961. This means the coefficient of the regression equation (β_3) has a direct positive relationship with the dependent variable ($GDPSADC_t$). Since $ECFREEDOMSADC_t$ is a continuous variable, $\beta_3$represents the difference in the predicted value of $GDPSADC_t$ for each one-unit difference in $ECFREEDOMSADC_t$, if other independent (predictor) variables remain constant. However, the rate of Economic freedom in the SADC cannot individually cause a variation in the dependent variable $GDPSADC_t$. Our findings demonstrate that the degree of economic freedom affects the scale of MNC activity in the SADC, and inform the argument of whether obtaining extensive information regarding the rent seeking activities of government, as well as the rate of corruption in the region results in an effective or ineffective policy (Fraser Institute, 2014; World Investment Report, 2014).

The relationship between the value of South African MNCs and the level of employment of the SADC population

The t-statistic p value of 0.6245 (62.45 per cent) indicates that the level of employment to the population ratio of the SADC; $EMPtoPOPrSADC_t$ statistically insignificantly influences the value of the dependent variable (since sig f < 0.0500 is statistically significant). This means that the value of employment to the population ratio in the SADC cannot individually cause a variation in the independent variable Y, which is the cumulative GDP the SADC ($GDPSADC_t$).

Relatedly, the coefficient of the regression equation (β_4) has a non-random known constant value of – 0.499822. This means the coefficient of the regression equation (β_4) has a direct negative relationship with the dependent variable ($GDPSADC_t$). Since $EMPtoPOPrSADC_t$ is a continuous variable, $\beta_4$represents the difference in the predicted value of $GDPSADC_t$ for each one-unit difference in $EMPtoPOPrSADC_t$, if other independent (predictor) variables remain constant. However, the level of employment of the SADC population cannot individually cause a variation in the dependent variable $GDPSADC_t$. The estimate for this econometric variable implies that the employment to population ratio matters (SADC 2012; 2015), as it affects the level of productivity, and the mode of operation that most MNCs utilises in achieving their objectives (that is, either through capital or labour intensive system of manufacturing). Due to the non-availability of a highly

Table 6. Pairwise Granger causality tests.

S/N	Null hypotheses	F-Statistics	Prob.	Direction of causality
1.	ECFREEDOMSADCt does not Granger cause GDPSADCt	0.90747	0.4164	≠>
2.	GDPSADCt does not Granger cause ECFREEDOMSADCt	2.40311	0.1110	≠>
3.	EMPtoPOPrSADCt does not Granger cause GDPSADCt	1.89181	0.1874	≠>
4.	GDPSADCt does not Granger cause EMPtoPOPrSADCt	0.11749	0.8900	≠>
5.	FDInetinBOPSADCt does not Granger cause GDPSADCt	17.8283	1.5427	≠>
6.	GDPSADCt does not Granger cause FDInetinBOPSADCt	4.73394	0.0181	→
7.	INFRASSADCt does not Granger cause GDPSADCt	0.20778	0.8138	≠>
8.	GDPSADCt does not Granger cause INFRASSADCt	0.74644	0.4843	≠>
9.	MNCSAvt does not Granger cause GDPSADCt	4.43421	0.0225	→
10.	GDPSADCt does not Granger cause MNCSAvt	2.48825	0.1034	≠>
11.	ECFREEDOMSADCt does not Granger cause MNCSAvt	1.15243	0.3327	≠>
12.	MNCSAvt does not Granger cause ECFREEDOMSADCt	1.55797	0.2311	≠>
13.	EMPtoPOPrSADCt does not Granger cause MNCSAvt	0.67837	0.5234	≠>
14.	MNCSAvt does not Granger cause EMPtoPOPrSADCt	0.60185	0.5614	≠>
15.	FDInetinBOPSADCt does not Granger cause MNCSAvt	4.34351	0.0240	→
16.	MNCSAvt does not Granger cause FDInetinBOPSADCt	12.6044	0.0002	→
17.	INFRASSADCt does not Granger cause MNCSAvt	1.56024	0.2299	≠>
18.	MNCSAvt does not Granger cause INFRASSADCt	0.09224	0.9122	≠>

skilled workforce in the region, critical skills visa issuance has been used to remedy the situation, although this short term measure negatively impacts on the rate of employment, over time, locals can be trained to take over from expatriates when necessary (Erasmus and Breier, 2009; SABPP, 2012; Valsamakis, 2012; Gqada, 2013; KEN, 2013).

The relationship between the value of South African MNCs and the level of FDI, net inflows (BoP at current US $)

The t-statistic p value of 0.5120 (51.20 per cent) indicates that the level of FDI, net inflows (BoP at current US $) in the SADC; FDInetinBOPSADC$_t$ statistically insignificantly influences the value of the dependent variable (since sig f < 0.0500 is statistically significant). This means that the level of FDI, net inflows (BoP at current US $) in the SADC cannot individually cause a variation in the independent variable Y, which is the cumulative GDP the SADC (GDPSADC$_t$).

Comparably, the coefficient of the regression equation (β_5) has a non-random known constant value of -0.671608. This means the coefficient of the regression equation (β_5) has a direct negative relationship with the dependent variable (GDPSADC$_t$). Since FDInetinBOPSADC$_t$ is a continuous variable, β_5 represents the difference in the predicted value of GDPSADC$_t$ for each one-unit difference in FDInetinBOPSADC$_t$, if other independent (predictor) variables remain constant. However, the level of FDI, net inflows (BoP at current US $) cannot individually cause a variation in the dependent variable GDPSADC$_t$. Our data suggest that although inward FDI can be considered beneficial to the region, outward FDI is usually associated with profit repatriation, as well as its negative impact on the BOP, which ultimately leads to budget deficits that compels most of the SADC member nations to borrow (due to worsening capital and current accounts) in order to balance the budget, and carry out public expenditure projects (Mthombeni, 2006; IMF World Economic Outlook, 2012; Economic Commission for Africa, 2013; World Investment Report, 2014).

Although regression and diagnostic tests were conducted in Table 5, it is considered important to investigate the Jarque-Bera Histogram Normality test. This is carried out to test if the study residuals are normally distributed (in this study, the results are only presented). The Jarque-Bera P-value of 43.55% means that the study cannot reject the null hypothesis, as it has more than five per cent significance level, rather the study accept null hypothesis, that is, residuals are normally distributed, which is desirable.

Granger Causality tests are generally used in estimations to examine whether there exists a long-run relationship between the macroeconomic variables under study (Baltagi, 2008). It is a known fact that the OLS model measures correlation; however, correlation does not imply causation. This necessitates the computation of Pairwise Granger Causality test (Table 6), in order to avoid spurious relationships in the regression estimate. The pairwise Granger causality for all combinations of the dependent and independent variables shows that each

variable does not Granger cause the other (except in three instances). Therefore, the study accept the null hypothesis in all cases, as the F-Statistic corresponding P-value is not significant enough to be rejected over 2 lag periods.

The data shows that: Granger Causes $MNCSAv_t$ as its P-value of 0.0240 is significant, and $MNCSAv_t$ Granger Causes $FDInetinBOPSADC_t$ as its P-value of 0.0002 is also significant. Therefore, both null hypotheses are rejected, while the alternate hypotheses are accepted. This means that the level of FDI, net inflows (BoP at current US $) causes the value of South African MNCs' contribution to regional economic development and investment in the SADC to either rise or fall over a lag length of 2, just as the value of South African MNCs contribution to regional economic development and investment in the SADC causes the level of FDI, net inflows (BoP at current US $) to either rise or fall over a lag length of 2. There is therefore, a bi-directional causality between $MNCSAv_t$ and $FDInetinBOPSADC_t$.

However, it was observed that there is a correlation between the value of South African MNCs' contribution to regional economic development and investment in the SADC, and the cumulative GDP of the SADC. More so, it was observed that $MNCSAv_t$ does Granger cause $GDPSADC_t$ as its P-value of 0.0225 is significant, but $GDPSADC_t$ does not Granger cause $MNCSAv_t$. There is therefore, a uni-directional causality between the value of South African MNCs contribution to regional economic development and investment in the SADC ($MNCSAv_t$) and the cumulative GDP of the SADC ($GDPSADC_t$).

Similarly, it was observed that there is a correlation between the cumulative GDP of the SADC and the level of FDI, net inflows (BoP at current US $). More so, it was observed that $GDPSADC_t$ does Granger cause $FDInetinBOPSADC_t$ as its P-value of 0.0181 is significant, but $FDInetinBOPSADC_t$ does not Granger cause $GDPSADC_t$. There is therefore, a uni-directional causality between the cumulative GDP of the SADC ($GDPSADC_t$) and the level of FDI, net inflows (BoP at current US $) ($FDInetinBOPSADC_t$).

DISCUSSION

It has been noted by researchers such as Nokaneng (2009) and Nshimbi and Fioramonti (2013) that prior to South African membership, the Southern African Development Co-ordination Conference (SADCC) failed in its endeavours to promote meaningful progress towards regional economic integration, with intra-regional trade standing at about five per cent or less. It has been noted that South Africa's SADC membership have had a profound impact on the organisation in general and the level of intraregional trade in particular, raising the level of international trade from five per cent in the 1980s, to 17 per cent in 1995, 20 per cent in 2000 and 25 per cent in 2003 (Hartzenberg, 2012; Economic Commission for Africa, 2013). A figure that could increase to 35% once the free trade area is fully implemented (UNCTAD, 2013). The introductory part of this study clearly stated that the main aim of this study is to determine the impact of South African MNCs contribution to regional economic development and investment. A quantitative research paradigm was adopted for this study, while ordinary least square technique is the method of analysis. The result of the econometrics analysis indicates that South African MNCs positively impacts on the GDP of the SADC and contributes to regional economic development and investment. Since the level of FDI, net inflows (BoP at current US $) is considered significant, we recommend that the SADC governments should adopt an investment friendly economic policy. In order to reinforce the potential profit expectations that lure these companies to the region, as well as aid the capital accumulation process that eventually leads to economic advancement in infrastructure, capital, skills and innovation (which are the building blocks of regional economic development and investment).

From the literature review, there is a consequent generalisation and deduction that the most important function of the SADC free trade area (FTA) is that it allows for the most efficient use of resources, which is of great benefit to all member countries. This reoccurring factor has led to improved trade levels, which have increased the cumulative SADC GDP from R104 billion in 1980 to R1.341 trillion in 2000 to about R4.190 trillion in 2010 (SADC, 2012). While the value of South African MNCs' value increased from R75 billion in 1980 to R1.334 trillion in 2000 to about R4.194 trillion in 2010 (JSE, 2013).

CONCLUSION

The study has come to the conclusion that SADC countries support the notion that South African MNCs' activities (that is, their odyssean journey) and international trade is largely beneficial to them and if practised, one can draw the same conclusion on the positive impact of South African MNCs contribution to regional economic development and investment. Both the literature study and the empirical study in this article establish that there is a relationship between the value of South African MNCs and the cumulative GDP of the SADC. Moreover, the study concludes that globalisation is unavoidable, and given the specialised competencies that MNCs possess; they become repositories of much of the technology and management skills that both the manufacturing and service sectors require to push both South Africa and the SADC towards sustainable growth and development.

Further research using firm-level data could deepen our understanding of the impact that South African MNCs operating within the SADC have on the region

(considering the array of market entry strategy that these companies use), and also identify other underlying changes, as well as challenges that may hinder the operation of these firms.

Conflict of Interests

The authors have not declared any conflict of interests.

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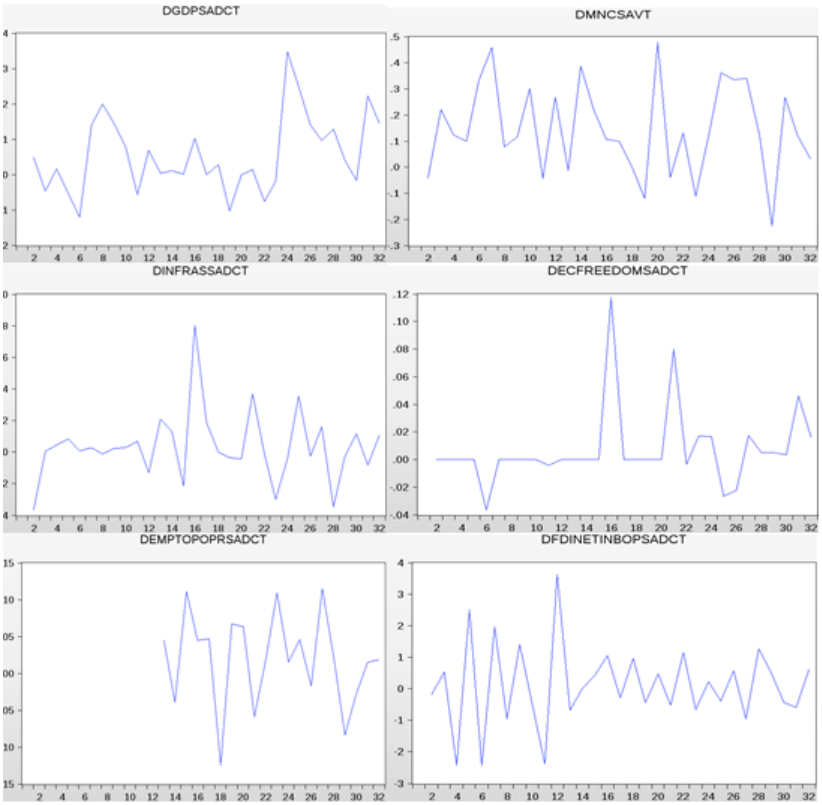
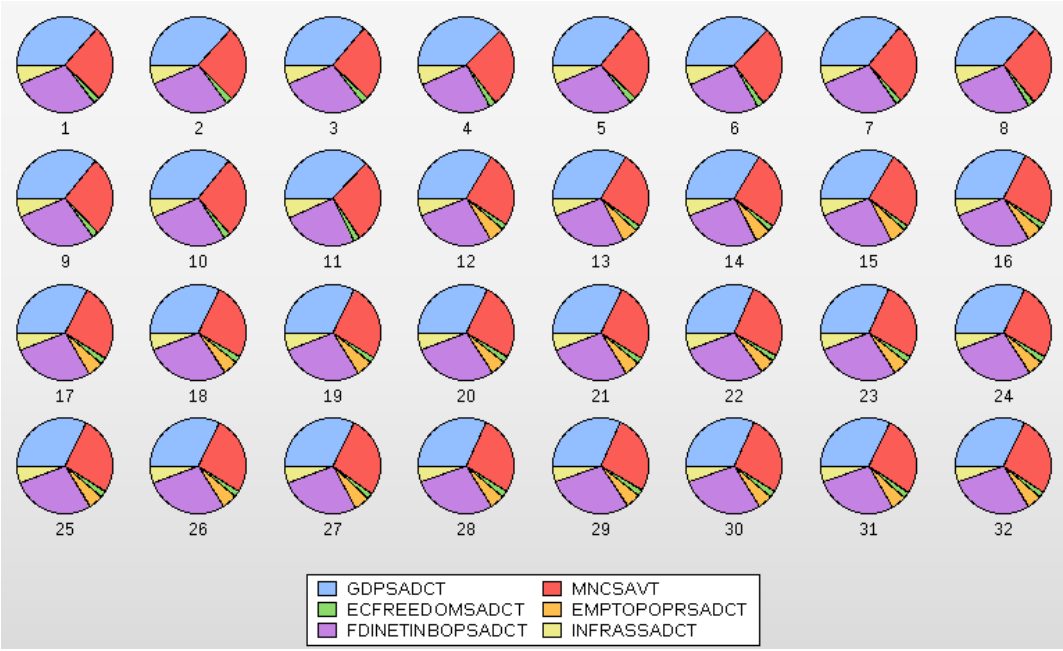


Appendix A. First difference line for the hypothesis.



Appendix B. Pie graph for the hypothesis.

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The contribution of the African capital markets in the diversification of investment global portfolios

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This study aims to evaluate the contribution of the African capital markets in the diversification of investment global portfolios. The study used the methodology based on the application of optimization models like mean variance (MV), resample michaud (RM), semi variance (SV), mean absolute deviation (MAD), and filtered historical simulation (FHS). In-sample and out-of-sample approaches were used to analyze the data. The study results suggested the existence of a strong correlation between some African capital markets and global capital markets, that is, they tend to move in the same direction. The most important being the diversification of global portfolio with assets of African capital markets generate benefits for both types of investors, risk averse and taker investors; that is, it provides benefits in the return and reduce investment risk. Still, the study results suggested that the foreign investors should look for African capital markets with a chance to maximize their wealth and diversify the investment risk in their portfolios. In the same order, the study result went further to elaborate on the advantages of the international diversification and furthermore contributes to the literature through application of the FHS method in the optimization portfolio. This methodology in addition to producing good results, is more restrained in the composition of investment portfolios than the other methods.

Key words: African capital markets, diversification, investment global portfolios.

INTRODUCTION

Globalization phenomenon has provided funds transfers between financial markets, with special attention given to the capital markets through the investor, and fund managers that are seeking to invest in order to maximize wealth.

However, there are financiers that are willing to invest their assets in both domestic and international markets. This is done in order to minimize possible loss in the case of adverse events occurring in the domestic region that can negatively influence the expected result of their investments. The investors use diversification strategies to minimize risk and maximize return of portfolios in order to protect their investments.

Thus, this study attempts to tackle the issues of diversification in the international context, considering the fact that global investors hold domestic portfolios where

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through diversification strategy, they include the African assets in their portfolios in order to reduce the exposure of risk and maximize the return. This study aims to identify how the African capital markets will contribute in the diversification risk of the investment global portfolios. Moreover, it compares capital markets to the level of dependency and exposure with respect to events that occur in these large markets.

Based on the weekly data collected from the main Europe and Africa markets and the methodology used, and in particular the application of the optimization models (mean variance, resample Michaud, semivariance, mean absolute deviation, and filtered historical simulation), with both *in-sample* and *out-of-sample* approaches, the study results suggest that African markets have a significant relationship with some of the world markets included in the study. The diversification of global portfolios with African assets generates benefits for the investor, that is, provides benefits in return and reduces investment risk for both types of investors.

The study contribution to the literature is to test empirically the application of the filtered historical simulation (FHS) methodology in the portfolio optimization and contributes to the discussion on advantage of international diversification context. FHS methodology in addition of producing good results, reveals being more cautious in the constitution of investment portfolios than the other methods. However, this model presents lesser returns and higher risk than other models, however their results follow the trend of the other models.

LITERATURE REVIEW

Several studies have shown that diversification in the international context is an advantage for investors holding composite portfolios with domestic and foreign securities.

According to Mansourfar et al. (2010) and Dimitriou and Kenourgios (2012), the arguement that diversification of the international portfolio has been a feature of the global capital market and potential benefits encourage the investors to diversify their investments. According to them, these benefits came from the fact that prices of international assets are less correlated and are derived from different fundamental economic factors.

In addition, they point out the benefits of international diversification the investor's bets in the emerging markets and consequently have huge gains in the short term. According to Baele and Inghelbrecht (2009) and Chiou (2009) based on strong empirical support, potential gains from international diversification are still sufficient to justify a global asset allocation strategy rather than industry/regional or local diversification.

Flavin and Panopoulou (2009) argue that diversification in the international context has long been advocated as an effective way to achieve a higher adjusted return on the investment risk in the domestic market, that is, facilitates risk sharing. Rezayat and Yavas (2006) examined short-term co-movements between the five major stock markets (USA, UK, France, Germany and Japan) to assess the benefits of International Portfolio Diversification (IPD) and concluded that despite the fact that there is still room for diversification, the benefits are minimal for American and European investors who would like to invest exclusively in these two major economic blocs (Europe and America).

Laopodis (2005) argued that analysts is of the opininon that financial integration among global capital markets has reduced IPD's benefits by increasing the correlation between equity markets. Coeurdacier and Guibaud (2011) argue that both theories and empirical evidence suggest that financial integration between countries has a positive impact on the correlation between equity markets, which tends to reduce IPD's benefits. The economic gains from international equity diversification are still substantial despite the growing markets correlation (Bouslama and Ouda, 2014).

The major focus of studies on IPD is focused on the portfolios of American, European and Asian investors which fixated on their diversification directed primarily at the assets of European and Asian capital markets, such as the studies[1] of Odier and Solnik (1993) on a global investment where they found that it was profitable for Japanese, British, German and American investors. Liljeblom et al. (1997) investigated the benefits of IPD from the point of view of Nordic investors; Ho et al. (1999) reported that reducing the risk of loss through IPD would be of substantial benefit to Canadian investors; Rowland and Tesar (2004) and Gerke et al. (2005) also examined the potential benefits of IPD from the perspective of the German investor; Dunis and Shannon (2005) who examined stock markets in Southeast Asia (Malaysia, Philippines and Indonesia) and Central Asia (China, Belize, Taiwan and India), found that IDP would be beneficial to investors in the USA; Kearney and Poti (2006) used two conditional and unconditional estimation methods and analyzed the dynamics of correlation in five leading European capital markets, and Égert and Kocenda (2007) analyzed the issue between Eastern European stock markets and Central Bank ,where they stated that there is no long-term bond between stock markets between these two blocs. Therefore, on the question of the International Portfolio Diversification in the African context, there are practically no studies done, except for the few references that however, did not have a great impact on the African capital markets.

The studies of Hassan et al. (2003), Bailey et al. (2005), Lagoarde-Segot and Lucey (2007), Yu and Hassan (2008) and Mansourfar et al. (2010) on the stock

[1] *Apud* Mansourfar *et al*. (2010).

markets in the Middle East and North Africa countries (MONA), concluded that there are many benefits to the portfolio diversification with titles of these regions which are both in dollars and local currency.

However, it was argued that these undervalued and under-investigated emerging markets could attract more value for portfolios in the future. According to Mansourfar et al. (2010), in the past years emerging equity markets have been subject of a large body of studies on international finance. Therefore, it makes sense to look at this issue as being relevant in the context of the financial markets and the major economic blocks, particularly for Africa given the dynamism of their capital markets combined with economic growth in recent years and due to the financial crisis, and confidence in other great world capital markets.

METHODOLOGY

Data

The sample consists of weekly data corresponding to the prices of the market index, collected in the Thomson Reuters Eikon. The database sample started 5th August, 2004 and ended on 7th July, 2016; making a total of 624 weekly observations collected of the forty two (42) major capital markets in the World, according to the classification given by MSCI World Index and thirteen (13) of the main African capital markets, as shown in Tables 1 to 3. Weekly returns measured in USA Dollar were considered. To measure the return, risk level, and composition of investment portfolios, we proposed the following optimization models: MV, RM, SV, MAD and FHS. To evaluate the relationship between capital markets, the correlation coefficient was used. Matlab was resorted to for the application of the optimization models and Excel to make the graphics of efficient portfolios and to estimate the performance indicators.

In-sample and out-of-sample approaches

In the first stage, the *in-sample* approach is used for the entire period T of returns observations, where the different investment strategies distribution is plotted and represented by curves of efficient frontiers. Then, to evaluate and measure portfolio performances and the contribution to diversification, we proposed Sharpe Ratio and Sortino Ratio according to the study of Lagoarde-Segot and Lucey (2007); and to measure the contribution of portfolio diversification, we proposed the measures suggested by Liang and McIntosh (1999).

In the second phase, in line with the works of DeMiguel et al. (2009), Daskalaki and Skiadopoulos (2011) and Bessler et al. (2014), we applied the rolling sample approach, in order to understand the contribution of African assets in the diversification of Europe´s portfolios. This rolling sample methodology consists of considering a window with M observations for a given sub-period. The next step is to add one (1) more observation to window M (we considered M=5 years, corresponding to the 260 observations), forgetting the first observation, and calculating tangential portfolios that maximizes performance.

The process is repeated by always adding one more observation in the window and dropping the oldest observation and so on, inorder to determine the optimum portfolios for each window bearing until it gets the total observation (the total of 363 portfolios weights for out-of-sample analyses). The following out-of-sample evaluation is based on the performance of the following statistics:

Excess return (ER), risk (R), sharpe ratio (SR) and Sortino ratio (S) in order to realize the contribution of African markets to the diversification of global portfolios.

However, before following this methodology, we need to divide the sample into two sub-periods of 5 years (first sub-period starting from 5th August, 2004 to 3rd July, 2009 and second sub-period from 3rd July, 2009 to 7th July, 2016). Therefore, for the out-of-sample analysis, we have *2* sub-periods to evaluate the performance of the investment distribution strategies.

To evaluate the contribution of African assets in the Global portfolio diversification, we defined some possible strategies that investors can follow. However, it is important to note that nothing assures us that foreign investors can adopt these strategies because as you know, each investor has his own profile when it comes to investment. We assume that a rational investor can choose these two strategies here presented:

Strategy 1: The investor makes an optimal distribution of 100 of his investment in global capital markets. We consider this portfolio composition such as domestic portfolios.
Strategy 2: The investor chooses to make an optimal distribution of 100 of his investment between global and African capital markets.

The in-sample analysis for each strategy are made of 50 optimal portfolios that include the efficient frontiers based on risk and return. To evaluate the performance of the strategies and test the statistical significance, we considered two (2) null hypotheses:

$$H_0: SR2 - SR1 = 0 \quad (1)$$

$$H_0: S2 - S1 = 0 \quad (2)$$

SR2 and S2 are the values of the Sharpe Ratio and Sortino Ratio index performances for strategy 2; SR1 and S1 are the values of the Sharpe Ratio and Sortino Ratio index performances for *Strategy 1*. The objective is to evaluate whether the differences between the performances of the strategies are statistically significant, considering a 1 significance level for both analyses. Therefore, we compare the diversification strategy with an undiversified strategy, that is *Strategy 1*.

Portfolio optimization models

Mean variance (MV)

The first work on portfolio optimization was developed by Markowitz (1952) known as Mean Variance model (MV). This model suggests that making decisions on portfolio composition risk and return must be a criteria. The risk measure is standard deviation and the return measure is given by the average value of assets returns. Although it is highly criticized, it is a model widely used in financial studies. The Markowitz paradigm expects return and volatility to be relevant aspects that investors take into consideration when making decisions about portfolio composition. Thus, for the risk adverse investors the expectation to minimize risk to a given return limit, according to Markowitz (1952), can be expressed as:

Table 1. African capital markets.

Country		Currency/code	Market index (Name)
Continent Africa	South Africa	Rand (R)	FTSE/JSE Africa top 40 index
	Egypt	Egyptian Pound (EGP)	Egyptian EGX30 index
	Morocco	Moroccan Dirham (MAD)	Moroccan All Share MASI
	Tunisia	Tunisian Dinar (TND)	Tunindex
	Botswana	Botswana Pula (BWP)	BSE Domestic Company DCIBT
	Malawi	Malawian Kwacha (MWK)	Malawi All share Index (MASI)
	Mauritius	Mauritian Rupi (MUR)	Semdex MDEX
	Namibia	Namibian Dollar (NAD)	Namibia Stock Exchange (NSX)
	Nigeria	Nigerian Naira (NGN)	NSE Index 30 (NSEINDX:IND)
	Kenya	Kenyan Shiling (KES)	Kenya NSE 20 (NSE20)
	Uganda	Ugandan Shiling (UGX)	Uganda All Share (ALSIUG)
	Zambia	Zambian Kwacha (ZMK)	LSE All Share (LASILZ)
	Rep Democratic of Congo	Congolese Franc (CDF)	All Share index
	Costa do Marfim/Cote D´ivoire	XOF	All Share index

This table shows all the African capital market included in this study. Therefore, the capital markets did not meet the requirements of the sample between periods of 5 August, 2004 to 7 July, 2016 they were excluded form the study. The first column shows the countries, second the local currency index quotation and the third column the main market index for each country.

Table 2. World developed markets.

Country		Currency/Code	Market index (Name)
Continent Europe and Middle East	Germany	Euro(€)	DAX INDEX
	United Kingdon	Euro(€)	FTSE 100 INDEX (FTSE)
	France	Euro(€)	CAC 40 INDEX
	Italy	Euro(€)	FTSE MIB INDEX
	Spain	Euro(€)	IBEX 35 INDEX
	Austria	Euro(€)	ATX (ATX)
	Switzerland	Swiss Franc (CHF)	SMI (SSMI
	Belgium	Euro(€)	BEL20 (BFX)
	Denmark	Danish Krone (DKK)	OMX COPENHAGEN 20 (OMXC20)
	Finland	Euro(€)	OMX Helsinki 25 (OMXH25)
	Ireland	Euro(€)	ISEQ Overall (ISEQ)
	Israel	Israeli Shekel (ILS)	Tel Aviv 25 Index (TA25)
	Netherlands	Euro(€)	AEX (AEX)
	Norway	Norwegian Krone (NOK)	Oslo Stock Exchange All Share Index (OSEAX:IND)
	Portugal	Euro(€)	PSI 20 (PSI20)
	Sweden	Swedish Krona (SEK)	OMX Stockholm 30 (0MXS30)
Continent American	Canada	Canadian Dolar (CAD)	S&P/ TSX (GSPTSE)
	United States	USA DOLAR (USD)	S&P 500 (SPX)
Continent Asia /Pacific	Australia	Australian Dolar (AUD)	S&P/ASX (AXJO)
	Hong Kong	Hong Kong Dolar (HKD)	Hang Seng (HSI)
	Japan	Japanese Yen (JPY)	Nikkei 225 (N225)
	New Zealand	New Zealand Dollar (NZD9	S&P/NZX 50 Index Gross (NZSE50Ffg:IND)
	Singapore	Singapore Dollar (SGD)	FTSE Singapore (FTWISGPL)

This table shows all the main global markets included in the study according to the MSCI Word Index classifed in the developed markets. Therefore, the capital markets did not meet the requirements of the sample between periods from 5 August, 2004 to 7 July, 2016 so they were excluded from study. The first column shows the countries, second the local currency index quotation and the third column the main market index for each country was found.

Table 3. World emergent markets.

Country		Currency/code	Market index (Name)
Continent Europe and Middle East	Czech Republic	Czech Koruna (CZK)	PX (PX)
	Greece	Euro(€)	Athens General (ATG)
	Hungary	Hungarian Forint (HUF)	Budapest SE (BUX)
	Poland	Polish Zloty (PLN)	WIG 20 (WIG20)
	Qatar	Qatari Riyal (QAR)	Stock Market DOHA (QSI)
	Russia	Russian Ruble (RUB)	MICEX (MCX)
	Turkey	Turkish Lira (TRY)	BIST 100 (XU100)
	United Arab Emirates	AED	ADX General (ADI)
Continent American	Brasil	Brasilian Real (BRL)	Ibovespa Brasil Sao Paulo SE Index (IBOV:iND)
	Chile	Chilean Peso (CLP)	IPSA (IPSA)
	Peru	Peruvian Sol (PEN)	S&P Lima General (SPBLPGPT)
	Mexico	Mexican Peso (MXN)	IPC (MXX)
	Colombia	Colombian Peso (COP)	Colombian COLCAP Index (COLCAP:IND)
Continent Asia /Pacific	China	Chinese Yuan Renminbi (CNY)	Shanghai SE Composite Index (SHCOMP:IND)
	India	Indian Rupee (INR)	BSE Sensex 30 (BSESN)
	Indonesia	Indonesian Rupiah (IDR)	IDX Composite (JKSE)
	Korea	South Korean Won (KRW)	KOSPI (KS11)
	Malaysia	Malaysian Ringgit (MYR)	FTSE Malaysia KLCI (KLSE)
	Philippines	Philippine Peso (PHP)	PSEI Composite (PSI)
	Taiwan	Taiwan Dollar (TWD)	Taiwn Weighted (TWII)
	Thailand	Thai Baht (THB)	FTSE SET All-Share (FTFSTHA)

This table shows all the emergent markets included in study according to the MSCI Word Index. Therefore, the capital markets did not meet the requirements of the sample between periods starting from 05 August, 2004 to 07July, 2016 they were excluded from the study. The first column shows the countries, second the local currency index quotation and the third column the main market index for each country.

$$Minimize\ portfolio\ risk = \sqrt{\sum_{i=1}^{N}\sum_{j=1,j\neq i}^{N}(x_i\, x_j\, \rho_{ij}\, \sigma_i \sigma_j)} \quad (3)$$

subject to a minimum expected return is given by:

$$\sum_{i=1}^{N} x_i\, \overline{r_i} \geq r_C \quad (4)$$

total investment in the portfolio is given by:

$$\sum_{i=1}^{N} x_i = 1 \quad (5)$$

and to ensure that there are no negative investment is given by:

$$x_i \geq 0\ \forall i \quad (6)$$

N is the number of assets; x_i and x_j are the weights of the assets in the portfolio; σ_i and σ_j are the standard deviations of the assets i and j; ρ_{ij} is the correlation between assets i and j; $\overline{r_i}$ corresponds to the average return of the asset and r_c corresponds to the minimum desired portfolio return.

Resample michaud (RM)

This method was developed by Michaud (1998) and according to Becker et al. (2015), the basic concept of Michaud (1998) comprises of three aspects:

(1) A generation of sequence of returns, which are statistically equivalent to the actual time series of returns, through a Monte Carlo Simulation.
(2) The subsequent determination of portfolio weights for every resample.
(3) The averaging over the obtained portfolio weights to obtain the optimal portfolio weights.

This method can be considered as a “sophistication” of the MV model but based on the simulation method.

The algorithm that explains how to implement this method is described as follows:

(1) From the original database, two parameters are estimated, the vector of expected excess returns (μ) and the variance-covariance matrix (∑).
(2) Resample applying multivariate normal distribution with mean μ and covariance ∑ considering T draws. For each resample that is generated, there is a new mean μ and covariance ∑ to estimate optimal portfolio weights over T draws; and
(3) Choosing the optimal portfolio weights depends on the required portfolio number. The portfolio risks and returns that make up the Efficient Frontiers by Michaud are then estimated.

***Semivariance* (SV)**

This model has emerged as an alternative to the mean-variance model (MV) which aims to remedy its shortcomings raised by scholars and researchers in the field of finance. Thus, Markowitz (1959) recognized the shortcomings of the MV model and proposed the SV model as the most appropriate measure of risk for investment portfolios. In general, according to Markowitz (1959), cited by Bond and Satchell (2002), the SV model for an individual asset is defined as follows:

$$\mathrm{SV} = \frac{\sum_{\mathrm{j}=1}^{\mathrm{T}}\{\min[0, (\mathrm{r_i} - \bar{\mathrm{r}}_i)]\}^2}{\mathrm{T}} \tag{7}$$

The standard deviation of the semi-variance of an asset is given by:

$$\mathrm{SV} = \sqrt{\frac{\sum_{\mathrm{j}=1}^{\mathrm{T}}\{\min[0, (\mathrm{r_{it}} - \bar{\mathrm{r}}_i)]\}^2}{\mathrm{T}}} \tag{8}$$

The semi-variance of an investment portfolio ($\mathrm{SV_C}$) is given as:

$$\mathrm{SV}_C = \frac{\sum_{\mathrm{j}=1}^{\mathrm{T}}\{\min[0, (\mathrm{r}_{Ct} - \bar{\mathrm{r}}_C)]\}^2}{\mathrm{T}} \tag{9}$$

However, there are authors (Estrada, 2008) that suggest the estimation portfolio semi-variance approach by the expression:

$$\mathrm{SV}_C \approx \sum_{\mathrm{i}=1}^{\mathrm{N}}\sum_{\mathrm{j}=1}^{\mathrm{N}}(\mathrm{x_i}\,\mathrm{x}_j\,SC_{ij}) \tag{10}$$

According to Estrada (2008) and Cumova and Nawrocki (2011), semi-covariance (SC) between the assets of the portfolios is estimated as:

$$SC_{ij} = \frac{1}{\mathrm{T}}\sum_{\mathrm{t}=1}^{\mathrm{T}}\left[Min(\mathrm{r_{it}} - \bar{\mathrm{r}}_i, 0).Min\left(\mathrm{r_{jt}} - \bar{\mathrm{r}}_j, 0\right)\right] \tag{11}$$

The expected return of an investment portfolio is obtained from the following expression:

$$\mathrm{E(R_C)} = \sum_{\mathrm{i}=1}^{\mathrm{N}}\mathrm{x_i}\;\bar{\mathrm{r}}_\mathrm{i} \tag{12}$$

The mathematical formulation of the portfolio optimization problem using this model has as objective function to minimize the SV subject to certain restrictions as:

Minimize

$$\mathrm{SV}_C \approx \sqrt{\sum_{\mathrm{i}=1}^{\mathrm{N}}\sum_{\mathrm{j}=1}^{\mathrm{N}}(\mathrm{x_i}\,\mathrm{x}_j\,SC_{ij})} \tag{13}$$

subject to a minimum expected return is given by:

$$\sum_{i=1}^{N} x_i\,\overline{r_i} \geq r_C$$

total investment in the portfolio is given by:

$$\sum_{i=1}^{N} x_i = 1$$

and to ensure that there are no negative investment is given by:

$$x_i \geq 0\ \forall i$$

where, T is the size of the observation period; t is the sample period over T; r_{it}, $\mathrm{r_{jt}}$ and r_{Ct} are the observed returns of assets i, j and portfolio c in the period t; $\bar{\mathrm{r}}_i$, $\bar{\mathrm{r}}_j$ and $\bar{\mathrm{r}}_C$ are the observed mean returns of the assets and portfolio. In the maximization problem, the objective function is that portfolio returns subjected to restrictions.

Mean absolute deviation (MAD)

To overcome the shortcomings of the model mean variance, Konno and Yamasaki (1991) suggested the model MAD as linear programming or linear optimization of portfolios, where the risk measure is the designed Average Deviation Absolute.

According to these authors, the MAD is based on dividing the distribution of a variable randomized into two groups, those afroementioned and below the average, and giving estimates for the absolute deviations of observations in each group from the average. MAD is

preferred over standard deviation because of its propertises, especially when the distribution is not normal. It can still be designated as a model used to measure risk in the portfolio optimization (Miller and Ruszczynski, 2008), taking into consideration that the relevance for investors is to minimize the risks and maximize returns for their portfolios. It is a general measure of risk and can be used in other risk management practices (Xue and Titterington, 2011). The linear formulation takes advantage of a less computational effort (unlike quadratic formulation) and more applicability in practical terms (Moon and Yao, 2011). The authors formulated it as follows:

$$MAD_C = \frac{1}{\mathrm{T}}\sum_{\mathrm{t}=1}^{\mathrm{T}}\left|\sum_{\mathrm{j}=1}^{\mathrm{n}}\left(\mathrm{r_{jt}} - \bar{\mathrm{r}}_{\mathrm{j}}\right)\mathrm{x_j}\right| \quad (14)$$

The mathematical formulation of the portfolio optimization problem posed by this model suggested by Konno and Yamazaki (1991) can be summarized by the following expressions:

$$Minimize\ MAD_C = \frac{1}{\mathrm{T}}\sum_{\mathrm{t}=1}^{\mathrm{T}}\left|\sum_{\mathrm{j}=1}^{\mathrm{n}}\left(\mathrm{r_{jt}} - \mathrm{r_j}\right)\mathrm{x_j}\right|$$

subject to a minimum expected return is given as:

$$\sum_{i=1}^{N} x_i\,\overline{r_i} \geq r_C$$

total investment in the portfolio is given as:

$$\sum_{i=1}^{N} x_i = 1$$

and to ensure there are no negative investments is given as:

$$x_i \geq 0\ \forall i.$$

Filtered historical simulation (FHS)

This method is quite credible and acceptable among scholars and researchers. Some articles have addressed this method and it is use in the estimation of portfolio risk, but yet, unknown articles have used the FHS in portfolio optimization, and this is one of the important contributions of this study. Thus, through a simple clear language all steps for implementing the FHS method can be shown (Giannopoulos and Tunaru, 2005). The FHS is one of the methods of Value-at-Risk (VaR) that combines the traditional method Historical Simulation (HS) with volatility models (Garch or EGARCH). The algorithm to implementation in determining the level of risk and portfolio optimization requires some steps:

(1) Application of the historical simulation method.
(2) Estimation of volatilities of returns series of the portfolios through the GARCH (1.1) model.
(3) Estimation of residual returns standardized, obtained by dividing the residual value of returns by the respective variance.
(4) Application bootstrapping method where each standardized return period t randomly multiplies the variance of the period t + 1; and finally
(5) Estimates the VaR through the percentile of returns, considering a certain confidence interval, significance level, and period of portfolio tenure.

Historical simulation (HS)

The application of VaR method is quite simple and requires some steps:

(1) The estimation of periodic returns of the assets that makes up the initial portfolio
(2) Periodic portfolios, adding the products of periodicals returns of each asset at its initial weight is estimated to be 1 / N, where N is the total number of assets.
(3) Considering a certain significance level and period detention portfolios, estimated VaR, which is given by the expression:

$$VaR\_HS = -Percentil\left\{\left\{\sum_{\mathrm{i}=1}^{\mathrm{N}}\mathrm{x_i}\ \mathrm{r}_i\right\}^m, \alpha\%\right\} \quad (15)$$

Where, r_i is the periodic return of the asset i and *m* refers to the observation period (m only illustrates the period that corresponds to summation, which does not have any mathematical effect on the formula) and α corresponds to the specified significance level.

The GARCH volatility model

It is assumed that the GARCH (1.1) model is to estimate periodic variances of portfolios. However, nothing ensures the possibility of the historical returns of the assets assuming a normal distribution or t-student. Considering the simple GARCH model, standardized residual returns are estimated by the expression:

$$z_{t+1} = \frac{R_{t+1}}{\sigma_{t+1}} \quad (16)$$

Where the variance is given as:

$$\sigma_{t+1}^2 = \omega + \varphi {R_t}^2 + \beta \sigma_t^2 \quad (17)$$

and, ω, φ and β are model parameters whose estimation can be by maximizing the sum of the function Maximum Likelihood Estimation (MLE) which is given by the expression similar to that of Aldrich (1997):

$$MLE_{t+1} = LN\left(\frac{1}{\sqrt{2\pi\sigma_{t+1}^2)}} * \exp\left(-0{,}5 * \frac{R_{t+1}^2}{\sigma_{t+1}^2}\right)\right) \quad (18)$$

Where R_{t+1} is the residual value of the return; ${R_t}^2$ is the residual value squared and σ_t^2 is the unconditional variance in period t.

Bootstrapping method

This method, given a certain period of detention portfolios from observations of standardized residual returns, randomly generates return for period t to be multiplied by the variance in period t + 1. Random returns of portfolios will be estimated with the FHS VaR, which can be given by the expression:

$$VaR\_FHS = -Percentil\{\{random\ returns\}^m, \alpha\%\} \quad (19)$$

The use of this method in portfolio optimization requires some care because the process is a little different from other methods, although apparently it has an almost similar mathematical formulation. There are two (2) objectives function to consider:

$$Minimizar\ VaR\_HS = -Percentil\left\{\left\{\sum_{i=1}^{N} x_i\ r_i\right\}^m, \alpha\%\right\}$$

$$VaR\_FHS = -Percentil\{\{random\ returns\}^m, \alpha\%\}$$

subject to a minimum expected return is given by:

$$\sum_{i=1}^{N} x_i\, \overline{r_i} \geq r_C$$

total investment in the portfolio is given by:

$$\sum_{i=1}^{N} x_i = 1$$

and to ensure there are no negative investment is given by:

$$x_i \geq 0\ \forall i$$

Performance measures and contribution of portfolio diversification strategies

Sharpe ratio (SR)

The SR index of a particular investment strategy is measured by the ratio between the risk premiums or excess return, and risk of strategy i as the expression (Sharpe, 1994):

$$IS_i = \frac{\hat{\mu}_i}{\sigma_i} \quad (20)$$

In that, μ_i corresponds to the risk premium (risk-free rate asset[2]) and σ_i is the risk of strategy i. This indicator shows how much the investor receives the strategy i defined for each unit of risk associated with the strategy i. The higher value for this measure indicate higher quality of the investment in the strategy i. Assuming a normal distribution, to determine whether SR, S, and PT between the strategies are statistically significant, we propose two-sample t-test according with the Matlab code in the appendices to test the null hypotheses.

Sortino ratio (S)

Just as Sharpe ratio, the Sortino ratio is also an important statistical indicator used to measure the investment portfolio performance. Dr. Frank Sortino proposed it in the 80s. However, it is different from Sharpe Ratio because it uses the standard deviation of negative returns; while Sharpe Ratio uses the standard deviation of positive and negative returns. This is one of the reasons appointed as insufficient of MV model. The Sortino ratio is a modification of the Sharpe ratio, and can be expressed by:

$$S = \frac{\hat{\mu}_i}{Downside\ risk^1} \quad (21)$$

Contribution measures of portfolio diversification

To measure the contribution of African capital markets assets in global portfolio, we propose three measures according to the study of Liang and McIntosh (1999):

[2] We propose as the benchmark risk-free rate asset, the average weekly interest rate of Treasury bills to monthly of USA bills during the data observation period.

Overall benefit (OB_i)

This indicator measures the general benefit of the investment diversification effect, that is, it measures benefits in reducing risk and return. It is given by the following expression:

$$OB_i = \left(R_i - R_f\right) - (\rho\sigma_i/\sigma_m)\left(R_m - R_f\right) \quad (22)$$

Diversification benefit (DB_i)

This indicator measures only the benefits of investment diversification in the risk reduction. It is given as follows:

$$DB_i = \left(R_m - R_f\right)(1 - \rho\sigma_i/\sigma_m) \quad (23)$$

Return benefit (RB_i)

This indicator measures only the benefits of investment diversification in the return. It is represented by the expression:

$$RB_i = R_i - R_m \quad (24)$$

Where, R_m= existing portfolio return m; σ_m= volatility of portfolio m; R_i= Return i proposed investment; σ_i = Volatility i proposed investment; ρ = correlation coefficient between portfolio m and investment i; and R_f = risk-free rate.

RESULTS AND DISCUSSION

In- sample analysis

In analyzing Table 4, strong positive and negative correlation between African and World capital markets can be found. However, African capital markets in general shows significant positive correlation with world capital markets.

The study results show that there are African capital markets with the tendencies to follow the behavior of World capital markets but also we can find African capital market with behaviors that are contrary to the global markets, such as Rep. Democratic Gongo, Cote D´ivoire, Nigerian, Morocco, Tunisia and Mauritius. The most important African capital markets like South African, Namibia, Egypt, Kenya, Botswana, Uganda and Zambia presents significant and positive correlation with World capital markets between periods of data analysis from 5th August, 2004 to 7July, 2016 as seen in the test p-value results correlation shown in Table 5 considering the significance level of 1.

For in-sample analysis, Tables 5 to 10 shows the results for each strategy based on trade-off risk and return, where we can find global portfolio optimization before and after diversification with their respective performances based on optimization models. The results shows that the global portfolio diversification with African assets contributes in reducing the risk and maximizing the return.

As Figures 1 and 2 shows, we can see different efficient frontiers for each of the optimization models used in this study that represents the two (2) investment strategies. To all optimization models, the strategy of the global portfolio diversification with assets of the African capital market show higher return than global portfolio without diversification as illustrated in Table 11.

On the other hand, on the same table for MV model, the global portfolio diversification with assets of African capital market increase the risk level but for SV, RM, MAD and FHS models, it does not increase. In other words, for these models, global portfolio diversification with assets of African capital markets reduces the risk level. However, the diversification strategy of global portfolio with assets of African capital markets presents better performance than global portfolio without diversification, according to the results of the Sharpe Ratio and Sortino Ratio performance in Figures 3 to 5 where the African capital markets in the diversification global portfolio was observed. These results are statistically significant for all models included in the study, since it rejects all null hypotheses according to the results on Table 12.

Therefore, the investment strategy 2 shows better performance than strategy 1. The real contribution of the diversification of global portfolio with assets of African capital markets is illustrated in Table 13. For all models, this strategy generates benefit in diversification and return benefit as shown in Table 13.

We can see weak contribution of the World capital markets in the diversification of global portfolio, being outweighed by large contributions of the African capital markets. According Tables 14 to 19, the African capital markets with great performance in the composition of the Europe portfolio diversifying with higher weights are; Cote D´ivoire, Republic Democratic Gongo, Zambia and Tunisia. Already with less weight, we found the following markets; Botswana, Mauritius, Egypt, Uganda, Nigerian, Egypt, Namibia and South Africa. According to MV, RM, SV and MAD models, the study data analyses shows that in general, the African capital markets are efficient in the global portfolio composition as we can see their weights in the first portfolios.

In summary, the study in-sample analysis of the database in the period considered allows the realization that the diversification of global portfolio with assets of African markets contributes in reducing risk and maximize the return of the portfolio, where investor prefer high level of risk at the expense of a high return.

Table 4. Correlation coefficients between African and global capital markets.

Country	Namibia	Nigerian	Gongo	Cote D´Ivoire	Egypt	Morrocco	Tunisia	Botswana	Mauritius	Kenya	Uganda	Zambia	South Africa
Germany	0.39	-0.17	0.74	0.64	0.41	0.28	0.47	0.58	0.74	0.33	0.86	0.73	0.82
UK	0.67	0.44	-0.04	-0.17	0.58	0.18	-0.2	0.5	0.2	0.81	0.54	0.38	0.51
France	0.61	0.71	-0.33	-0.37	0.73	0.37	-0.3	0.56	0.06	0.86	0.41	0.28	0.28
Italy	0.42	0.82	-0.69	-0.7	0.56	0.19	-0.59	0.29	-0.33	0.75	0.03	-0.08	-0.11
Spain	0.63	0.75	-0.41	-0.33	0.8	0.62	-0.13	0.63	0.13	0.79	0/27	0.32	0/24
Austrian	0.65	0.8	-0.52	-0.54	0.71	0.46	-0.32	0.49	-0.04	0.85	0.2	0.2	0.17
SWISS	0.31	-0.27	0.74	0.62	0.29	0.08	0.38	0.45	0.63	0.29	0.84	0.62	0.76
Belgium	0.53	0.7	-0.35	-0.44	0.68	0.24	-0.39	0.47	-0.04	0.84	0.38	0.19	0.21
Denmark	0.08	-0.3	0.75	0.57	0.21	-0.02	0.34	0.35	0.53	0.12	0.76	0.48	0.6
Finland	0.62	0.29	0.25	0.14	0.68	0.39	0.12	0.68	0.48	0.71	0.75	0.58	0.67
Ireland	0.26	0.66	-0.47	-0.62	0.41	-0.1	-0.66	0.19	-0.36	0.68	0.16	-0.12	-0.09
Israel	0.3	-0.43	0.86	0.78	0.27	0.31	0.73	0.5	0.84	0.07	0.75	0.69	0.82
Netherlands	0.62	0.64	-0.21	-0.31	0.72	0.33	-0.25	0.56	0.13	0.85	0.49	0.35	0.37
Norway	0.86	0.26	0.25	0.19	067	0.58	0.31	0.69	0.64	0.72	0.66	0.73	0.83
Portugal	0.58	0.83	-0.62	-0.55	0.66	0.52	-0.3	0.5	-0.08	0.74	0.02	0.12	0.04
Sweden	0.55	-0.23	0.68	0.57	0.32	0.2	0.44	0.55	0.7	0.4	0.79	0.64	0.88
Czech Republic	0.75	0.74	-0.42	-0.41	0.77	0.7	-0.05	0.6	0.18	0.78	0.2	0.35	0.29
Greece	0.38	0.9	-0.79	-0.75	0.57	0.3	-0.57	0.27	-0.36	0.69	-0.11	-0.1	-0.22
Hungary	0.69	0.62	-0.4	-0.42	0.68	0.55	-0.06	0.58	0.12	0.7	0.17	0.21	0.28
Poland	0.82	0.69	-0.32	-0.32	0.75	0.65	-0.05	0.66	0.24	0.85	0.32	0.43	0.41
Qatar	0.06	-0.13	0.42	0.35	0.31	-0.09	0.05	0.02	0.38	0.18	0.63	0.47	0.42
Russian	0.9	0.47	-0.09	-0.14	0.65	0.73	0.23	0.67	0.44	0.71	0.32	0.52	0.59
Turkey	0.78	-0.12	0.41	0.41	0.43	0.48	0.59	0.62	0.69	0.41	0.55	0.61	0.85
UAE	-0.1	0.22	-0.01	-0.05	0.39	-0.2	-0.37	-0.07	-0.02	0.32	0.45	0.17	0.03
Brasil	0.73	0.06	0.16	0.26	0.48	0.83	0.69	0.59	067	0.27	0.2	0.57	0.63
Chile	0.6	-0.44	0.63	0.61	0.09	0.47	0.85	0.45	0.8	0.01	0.34	0.57	0.81
Peru	0.72	-0.18	0.54	0.49	0.25	0.61	0.76	0.62	0.8	0.19	0.37	0.67	0.83
Mexico	0.62	-0.27	0.76	0.67	0.35	0.47	0.73	0.63	0.88	0.31	0.74	0.8	0.95
Canada	0.83	0.01	0.47	0.43	058	0.61	0.56	0.68	0.82	0.52	0.69	0.81	0.95
EUA	0.05	-0.3	0.67	0.47	0.12	-0.21	0.16	0.22	04	0.14	0.72	0.38	0.53
Australia	0.85	0.09	0.39	0.33	0.57	0.54	0.44	0.72	0.73	0.6	0.66	0.73	0.9
Hong Kong	0.6	-0.09	0.61	0.55	0.55	0.5	0.61	0.73	0.8	0.4	0.77	0.76	0.89
Japan	0.28	-0.05	0.41	0.23	0.33	-0.09	0.03	0.34	0.29	0.42	0.72	0.35	0.54
Newzealand	0.33	0.14	0.22	0.05	0.31	-0.13	-0.2	0.31	0.2	0.51	0.58	0.29	0.44
Singapore	0.7	-0.21	0.69	0.62	0.4	0.49	0.7	0.68	0.87	0.36	0.72	0.79	0.97
China	0.41	0.1	0.42	0.33	0.53	0.56	0.51	0.8	0.6	0.27	0.52	0.58	0.59
India	0.57	-0.15	0.63	0.57	0.55	0.54	0.7	0.72	0.82	0.31	0.71	0.72	0.86
Indonesia	0.57	-0.15	0.63	0.57	0.55	0.54	0.7	0.72	0.82	0.31	0.71	0.72	0.86
South Korea	0.7	-0.14	0.62	0.5	0.45	0.4	0.54	0.67	0.78	0.41	0.73	0.73	0.95
Malasya	0.46	-0.48	0.85	0.81	0.11	0.3	0.75	0.45	0.88	0.07	0.63	0.72	0.89
Philipine	0.12	-0.56	0.93	0.78	-0.02	-0.03	0.57	0.29	0.67	-0.07	0.68	0.54	0.71
Taiwan	0.6	-0.28	0.67	0.61	0.37	0.34	0.58	0.54	0.8	0.29	0.72	0.69	0.92

The correlation level between returns of African and European capital markets considering the significance level was presented. We recall that the returns was measured in dollar. We can find strong positive correlation between African capital market and European capital markets. However, in general , some African capital markets such as Nigerian, Democratic Republic Gongo, Mauritius, Tunisia and Cote D´ivoire show inverse correlation with global markets, particularly with European capital markets but they show strong and positive correlation with some American and Asia-pacific markets. The study results show that African capital markets have tendencies to follow the behavior of the global markets, in the same direction and opposite, as seen in negative values of correlation. The main African capital markets, such as South Africa, Namibia, Egypt, Morocco, Tunisia and Kenya presents high and positive correlation with European capital markets between periods of data analysis.

Table 5. P-value test of the correlation coefficients between African and global capital markets.

Country	Namibia	Nigerian	Gongo	Cote D´Ivoire	Egypt	Morrocco	Tunisia	Botswana	Mauritius	Kenya	Uganda	Zambia	South Africa
Germany	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
UK	0.000	0.000	0.271	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
France	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.161	0.000	0.000	0.000	0.000
Italy	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.498	0.049	0.006
Spain	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.001	0.000	0.000	0.000	0.000
Austrian	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.366	0.000	0.000	0.000	0.000
SWISS	0.000	0.000	0.000	0.000	0.000	0.053	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Belgium	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.355	0.000	0.000	0.000	0.000
Denmark	0.039	0.000	0.000	0.000	0.000	0.664	0.000	0.000	0.000	0.003	0.000	0.000	0.000
Finland	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.000	0.000
Ireland	0.000	0.000	0.000	0.000	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.002	0.025
Israel	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.086	0.000	0.000	0.000
Netherlands	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000	0.000
Norway	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Portugal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.046	0.000	0.664	0.004	0.302
Sweden	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Czech Republic	0.000	0.000	0.000	0.000	0.000	0.000	0.207	0.000	0.000	0.000	0.000	0.000	0.000
Greece	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.008	0.017	0.000
Hungary	0.000	0.000	0.000	0.000	0.000	0.000	0.113	0.000	0.002	0.000	0.000	0.000	0.000
Poland	0.000	0.000	0.000	0.000	0.000	0.000	0.257	0.000	0.000	0.000	0.000	0.000	0.000
Qatar	0.113	0.001	0.000	0.000	0.000	0.032	0.174	0.658	0.000	0.000	0.000	0.000	0.000
Russian	0.000	0.000	0.022	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Turkey	0.000	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
UAE	0.009	0.000	0.883	0.253	0.000	0.000	0.000	0.092	0.588	0.000	0.000	0.000	0.431
Brasil	0.000	0.149	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Chile	0.000	0.000	0.000	0.000	0.024	0.000	0.000	0.000	0.000	0.750	0.000	0.000	0.000
Peru	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Mexico	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Canada	0.000	0.845	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
EUA	0.180	0.000	0.000	0.000	0.003	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Australia	0.000	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Hong Kong	0.000	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Japan	0.000	0.209	0.000	0.000	0.000	0.023	0.498	0.000	0.000	0.000	0.000	0.000	0.000
Newzealand	0.000	0.001	0.000	0.184	0.000	0.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Singapore	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
China	0.000	0.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
India	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Indonesia	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
South Korea	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Malasya	0.000	0.000	0.000	0.000	0.005	0.000	0.000	0.000	0.000	0.090	0.000	0.000	0.000
Philipine	0.003	0.000	0.000	0.000	0.670	0.481	0.000	0.000	0.000	0.093	0.000	0.000	0.000
Taiwan	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

The result of p-value test of the correlation coefficients between the returns of the capital markets, considering significance level of 1 was illustrated. In general, there are significant correlation between markets in the world. The efficient frontiers of the investment strategies for each optimization model was presented. The Global Market portfolio without diversification considered as a strategy 1 and the Global Market portfolio diversified with African asset as strategy 2 was also seen. The following tables provide risk and return of 50 portfolios for each strategy and the performance measure through Sharpe Ratio (SR) and Sortino Ratio (S) for each optimization model and for each investment strategy was shown. The risk-free rate used in this study correspond with the monthly US treasury bills with a weekly rate of 0.0675%. In general, we can see in the next five (5) tables that diversification strategy of global investment portfolios with African assets show better performance than global investment portfolio for all optimization models.

Table 6. Efficient portfolios based in the Mean Variance model (MV).

Mean variance model										
Portfolio	Risk global market (%)	Return global market (%)	Sharpe ratio (%)	Downside deviation (%)	Sortino ratio (%)	Risk global market + Africa (%)	Return global market + Africa (%)	Sharpe ratio (%)	Downside deviation (%)	Sortino ratio (%)
MVP	1.718	0.083	0.911	1.169	1.338	1.062	0.122	5.109	0.685	7.921
P2	1.718	0.087	1.148	1.168	1.689	1.063	0.128	5.672	0.681	8.855
P3	1.720	0.091	1.385	1.168	2.038	1.067	0.134	6.222	0.681	9.742
P4	1.722	0.095	1.620	1.169	2.386	1.072	0.140	6.756	0.683	10.605
P5	1.726	0.099	1.853	1.171	2.732	1.079	0.146	7.272	0.686	11.438
P6	1.730	0.104	2.085	1.174	3.074	1.089	0.152	7.760	0.691	12.226
P7	1.736	0.108	2.314	1.177	3.413	1.103	0.158	8.215	0.699	12.967
P8	1.742	0.112	2.541	1.180	3.749	1.119	0.164	8.633	0.708	13.652
P9	1.748	0.116	2.765	1.185	4.080	1.140	0.170	9.007	0.720	14.271
P10	1.756	0.120	2.985	1.191	4.402	1.165	0.176	9.335	0.734	14.825
P11	1.765	0.124	3.202	1.198	4.718	1.193	0.182	9.620	0.750	15.314
P12	1.775	0.128	3.414	1.205	5.028	1.225	0.188	9.865	0.768	15.733
P13	1.786	0.132	3.621	1.213	5.330	1.261	0.194	10.062	0.790	16.068
P14	1.798	0.136	3.824	1.223	5.625	1.302	0.200	10.214	0.814	16.340
P15	1.811	0.140	4.022	1.232	5.913	1.346	0.207	10.327	0.840	16.554
P16	1.826	0.144	4.214	1.242	6.194	1.394	0.213	10.405	0.867	16.723
P17	1.841	0.149	4.402	1.253	6.468	1.446	0.219	10.450	0.897	16.845
P18	1.857	0.153	4.583	1.264	6.736	1.502	0.225	10.465	0.930	16.893
P19	1.874	0.157	4.760	1.275	6.997	1.561	0.231	10.454	0.966	16.904
P20	1.892	0.161	4.929	1.286	7.251	1.625	0.237	10.420	1.003	16.873
P21	1.912	0.165	5.093	1.299	7.497	1.691	0.243	10.369	1.043	16.815
P22	1.932	0.169	5.251	1.312	7.734	1.760	0.249	10.304	1.084	16.736
P23	1.954	0.173	5.402	1.325	7.964	1.833	0.255	10.229	1.127	16.639
P24	1.976	0.177	5.548	1.339	8.185	1.907	0.261	10.146	1.170	16.532
P25	1.999	0.181	5.687	1.354	8.398	1.984	0.267	10.059	1.215	16.418
P26	2.024	0.185	5.821	1.369	8.604	2.064	0.273	9.963	1.263	16.279
P27	2.049	0.189	5.949	1.385	8.801	2.148	0.279	9.855	1.312	16.128
P28	2.075	0.193	6.071	1.400	8.995	2.235	0.285	9.739	1.363	15.970
P29	2.102	0.198	6.187	1.413	9.206	2.326	0.291	9.619	1.416	15.807
P30	2.131	0.202	6.295	1.426	9.407	2.420	0.297	9.495	1.469	15.644
P31	2.161	0.206	6.397	1.440	9.598	2.517	0.303	9.372	1.522	15.496
P32	2.192	0.210	6.491	1.455	9.780	2.623	0.309	9.224	1.555	15.558

Table 6. Contd.

P33	2.225	0.214	6.579	1.470	9.958	2.743	0.315	9.041	1.594	15.561
P34	2.261	0.218	6.657	1.486	10.128	2.875	0.322	8.837	1.638	15.512
P35	2.298	0.222	6.726	1.503	10.284	3.017	0.328	8.620	1.687	15.421
P36	2.338	0.226	6.785	1.522	10.424	3.169	0.334	8.399	1.740	15.296
P37	2.381	0.230	6.836	1.543	10.547	3.334	0.340	8.166	1.782	15.276
P38	2.426	0.234	6.877	1.566	10.655	3.517	0.346	7.912	1.832	15.188
P39	2.474	0.238	6.910	1.590	10.751	3.717	0.352	7.649	1.884	15.090
P40	2.524	0.242	6.935	1.616	10.832	3.936	0.358	7.378	1.941	14.956
P41	2.576	0.247	6.952	1.643	10.899	4.170	0.364	7.108	2.008	14.759
P42	2.630	0.251	6.964	1.672	10.954	4.418	0.370	6.846	2.084	14.514
P43	2.687	0.255	6.969	1.703	10.998	4.678	0.376	6.595	2.167	14.235
P44	2.745	0.259	6.969	1.735	11.031	4.947	0.382	6.359	2.258	13.934
P45	2.806	0.263	6.965	1.768	11.055	5.224	0.388	6.138	2.354	13.620
P46	2.868	0.267	6.957	1.802	11.069	5.508	0.394	5.931	2.456	13.302
P47	2.931	0.271	6.946	1.839	11.068	5.798	0.400	5.739	2.562	12.985
P48	2.998	0.275	6.928	1.882	11.036	6.093	0.406	5.561	2.673	12.673
P49	3.079	0.279	6.878	1.930	10.971	6.392	0.412	5.395	2.788	12.370
P50	3.293	0.283	6.556	2.052	10.522	6.695	0.418	5.241	2.905	12.077

Source: Author.

Table 7. Efficient portfolios based in the resample Michaud model (RM).

	Resample michaud model									
Portfolio	**Risk global market (%)**	**Return global market (%)**	**sharpe ratio (%)**	**Downside deviation (%)**	**Sortino ratio (%)**	**Risk global market + Africa (%)**	**Return global market + Africa (%)**	**Sharpe ratio (%)**	**Downside deviation (%)**	**Sortino ratio (%)**
MVP	1.773	0.107	2.238	0.926	4.288	1.005	0.155	8.661	0.547	15.930
P2	1.774	0.113	2.593	0.925	4.975	1.006	0.160	9.152	0.547	16.841
P3	1.776	0.120	2.945	0.924	5.658	1.008	0.165	9.628	0.548	17.729
P4	1.779	0.126	3.294	0.925	6.335	1.012	0.170	10.088	0.549	18.595
P5	1.783	0.132	3.640	0.927	7.004	1.017	0.175	10.532	0.551	19.440
P6	1.789	0.139	3.980	0.928	7.675	1.023	0.180	10.955	0.553	20.268
P7	1.796	0.145	4.315	0.930	8.337	1.033	0.185	11.342	0.556	21.064
P8	1.805	0.151	4.645	0.932	8.990	1.045	0.190	11.683	0.561	21.775
P9	1.814	0.158	4.969	0.936	9.632	1.061	0.195	11.982	0.567	22.405
P10	1.824	0.164	5.286	0.940	10.262	1.080	0.200	12.239	0.576	22.950
P11	1.835	0.170	5.598	0.944	10.879	1.101	0.205	12.456	0.586	23.424
P12	1.847	0.177	5.902	0.950	11.482	1.125	0.210	12.641	0.596	23.848

Table 7. Contd.

P13	1.861	0.183	6.199	0.956	12.071	1.150	0.215	12.797	0.608	24.208
P14	1.874	0.189	6.489	0.962	12.643	1.177	0.220	12.926	0.621	24.513
P15	1.889	0.195	6.772	0.969	13.200	1.206	0.225	13.033	0.635	24.768
P16	1.905	0.202	7.047	0.977	13.740	1.236	0.230	13.119	0.649	24.975
P17	1.922	0.208	7.314	0.985	14.264	1.268	0.235	13.187	0.665	25.140
P18	1.939	0.214	7.573	0.994	14.772	1.301	0.240	13.238	0.682	25.265
P19	1.957	0.221	7.825	1.004	15.256	1.335	0.245	13.276	0.699	25.357
P20	1.977	0.227	8.067	1.015	15.715	1.370	0.250	13.300	0.717	25.432
P21	1.998	0.233	8.298	1.026	16.160	1.407	0.255	13.312	0.735	25.483
P22	2.020	0.240	8.519	1.038	16.579	1.445	0.260	13.303	0.754	25.509
P23	2.044	0.246	8.729	1.051	16.972	1.487	0.265	13.270	0.775	25.461
P24	2.069	0.252	8.928	1.065	17.339	1.531	0.270	13.211	0.798	25.349
P25	2.095	0.258	9.117	1.080	17.683	1.579	0.275	13.130	0.823	25.181
P26	2.122	0.265	9.296	1.095	18.013	1.629	0.280	13.029	0.849	24.999
P27	2.151	0.271	9.467	1.111	18.322	1.684	0.285	12.901	0.877	24.766
P28	2.180	0.277	9.628	1.128	18.601	1.743	0.290	12.753	0.908	24.482
P29	2.211	0.284	9.778	1.147	18.845	1.805	0.295	12.591	0.941	24.165
P30	2.244	0.290	9.917	1.167	19.063	1.871	0.300	12.418	0.975	23.818
P31	2.278	0.296	10.045	1.189	19.243	1.939	0.305	12.240	1.012	23.451
P32	2.314	0.303	10.161	1.213	19.390	2.010	0.310	12.059	1.050	23.073
P33	2.352	0.309	10.266	1.237	19.511	2.082	0.315	11.878	1.090	22.690
P34	2.391	0.315	10.361	1.263	19.609	2.160	0.320	11.682	1.133	22.273
P35	2.432	0.322	10.446	1.290	19.686	2.245	0.325	11.465	1.180	21.803
P36	2.474	0.328	10.521	1.319	19.745	2.335	0.330	11.235	1.232	21.300
P37	2.518	0.334	10.588	1.348	19.787	2.432	0.335	10.995	1.286	20.795
P38	2.564	0.340	10.647	1.378	19.814	2.534	0.340	10.751	1.343	20.286
P39	2.610	0.347	10.698	1.407	19.843	2.640	0.345	10.506	1.402	19.783
P40	2.660	0.353	10.736	1.438	19.863	2.752	0.350	10.262	1.465	19.283
P41	2.712	0.359	10.761	1.470	19.859	2.870	0.355	10.016	1.530	18.781
P42	2.767	0.366	10.774	1.503	19.833	2.992	0.360	9.773	1.599	18.285
P43	2.825	0.372	10.777	1.539	19.788	3.121	0.365	9.530	1.670	17.809
P44	2.886	0.378	10.770	1.575	19.737	3.270	0.370	9.248	1.758	17.206
P45	2.949	0.385	10.753	1.612	19.669	3.458	0.375	8.892	1.872	16.427
P46	3.014	0.391	10.728	1.651	19.586	3.677	0.380	8.497	2.007	15.569
P47	3.082	0.397	10.696	1.692	19.490	3.927	0.385	8.084	2.157	14.720
P48	3.153	0.403	10.657	1.733	19.385	4.235	0.390	7.615	2.336	13.805
P49	3.225	0.410	10.614	1.776	19.271	4.598	0.395	7.123	2.551	12.840
P50	3.300	0.416	10.565	1.822	19.134	5.066	0.400	6.564	2.825	11.768

Source: Author.

Table 8. Efficient portfolios based in the SEMIVARIANCE model (SV).

	Semi variance model									
Portfolio	**Risk global market (%)**	**Return global market (%)**	**Sharpe ratio (%)**	**Downside deviation (%)**	**Sortino ratio (%)**	**Risk global market + Africa (%)**	**Return global market + Africa (%)**	**Sharpe ratio (%)**	**Downside deviation (%)**	**Sortino ratio (%)**
MVP	1.146	0.089	1.917	1.146	1.917	0.647	0.132	9.930	0.647	9.930
P2	1.146	0.093	2.261	1.146	2.261	0.647	0.138	10.822	0.647	10.822
P3	1.147	0.097	2.605	1.147	2.605	0.650	0.143	11.672	0.650	11.672
P4	1.149	0.101	2.945	1.149	2.945	0.656	0.149	12.469	0.656	12.469
P5	1.151	0.105	3.283	1.151	3.283	0.663	0.155	13.224	0.663	13.224
P6	1.154	0.109	3.618	1.154	3.618	0.671	0.161	13.933	0.671	13.933
P7	1.158	0.113	3.946	1.158	3.946	0.681	0.167	14.591	0.681	14.591
P8	1.164	0.117	4.268	1.164	4.268	0.692	0.173	15.194	0.692	15.194
P9	1.169	0.121	4.585	1.169	4.585	0.705	0.179	15.736	0.705	15.736
P10	1.176	0.125	4.896	1.176	4.896	0.721	0.184	16.211	0.721	16.211
P11	1.183	0.129	5.200	1.183	5.200	0.739	0.190	16.606	0.739	16.606
P12	1.191	0.133	5.498	1.191	5.498	0.760	0.196	16.927	0.760	16.927
P13	1.200	0.137	5.789	1.200	5.789	0.782	0.202	17.185	0.782	17.185
P14	1.209	0.141	6.072	1.209	6.072	0.807	0.208	17.387	0.807	17.387
P15	1.218	0.145	6.349	1.218	6.349	0.833	0.214	17.539	0.833	17.539
P16	1.228	0.149	6.619	1.228	6.619	0.862	0.219	17.639	0.862	17.639
P17	1.239	0.153	6.882	1.239	6.882	0.892	0.225	17.693	0.892	17.693
P18	1.250	0.157	7.139	1.250	7.139	0.924	0.231	17.709	0.924	17.709
P19	1.261	0.161	7.388	1.261	7.388	0.958	0.237	17.692	0.958	17.692
P20	1.273	0.165	7.630	1.273	7.630	0.994	0.243	17.648	0.994	17.648
P21	1.286	0.169	7.865	1.286	7.865	1.031	0.249	17.582	1.031	17.582
P22	1.298	0.173	8.092	1.298	8.092	1.069	0.255	17.500	1.069	17.500
P23	1.312	0.177	8.312	1.312	8.312	1.108	0.260	17.405	1.108	17.405
P24	1.325	0.180	8.525	1.325	8.525	1.149	0.266	17.302	1.149	17.302
P25	1.339	0.184	8.731	1.339	8.731	1.190	0.272	17.191	1.190	17.191
P26	1.354	0.188	8.929	1.354	8.929	1.233	0.278	17.067	1.233	17.067
P27	1.369	0.192	9.120	1.369	9.120	1.278	0.284	16.930	1.278	16.930
P28	1.384	0.196	9.305	1.384	9.305	1.324	0.290	16.786	1.324	16.786
P29	1.400	0.200	9.482	1.400	9.482	1.371	0.296	16.637	1.371	16.637
P30	1.416	0.204	9.653	1.416	9.653	1.419	0.301	16.484	1.419	16.484
P31	1.433	0.208	9.818	1.433	9.818	1.468	0.307	16.331	1.468	16.331
P32	1.450	0.212	9.976	1.450	9.976	1.518	0.313	16.178	1.518	16.178
P33	1.467	0.216	10.126	1.467	10.126	1.569	0.319	16.027	1.569	16.027
P34	1.485	0.220	10.269	1.485	10.269	1.620	0.325	15.878	1.620	15.878

Table 8. Contd.

P35	1.504	0.224	10.406	1.504	10.406	1.673	0.331	15.731	1.673	15.731
P36	1.523	0.228	10.535	1.523	10.535	1.726	0.336	15.589	1.726	15.589
P37	1.544	0.232	10.651	1.544	10.651	1.779	0.342	15.449	1.779	15.449
P38	1.566	0.236	10.752	1.566	10.752	1.835	0.348	15.297	1.835	15.297
P39	1.590	0.240	10.840	1.590	10.840	1.894	0.354	15.130	1.894	15.130
P40	1.615	0.244	10.916	1.615	10.916	1.958	0.360	14.933	1.958	14.933
P41	1.642	0.248	10.980	1.642	10.980	2.029	0.366	14.700	2.029	14.700
P42	1.670	0.252	11.032	1.670	11.032	2.106	0.372	14.443	2.106	14.443
P43	1.699	0.256	11.072	1.699	11.072	2.188	0.377	14.166	2.188	14.166
P44	1.731	0.260	11.096	1.731	11.096	2.277	0.383	13.872	2.277	13.872
P45	1.765	0.264	11.107	1.765	11.107	2.371	0.389	13.567	2.371	13.567
P46	1.802	0.268	11.100	1.802	11.100	2.470	0.395	13.259	2.470	13.259
P47	1.842	0.271	11.076	1.842	11.076	2.573	0.401	12.953	2.573	12.953
P48	1.884	0.275	11.037	1.884	11.037	2.681	0.407	12.653	2.681	12.653
P49	1.933	0.279	10.964	1.933	10.964	2.792	0.413	12.360	2.792	12.360
P50	2.052	0.283	10.522	2.052	10.522	2.905	0.418	12.077	2.905	12.077

Source: Author.

Table 9. Efficient portfolios based on mean absolute deviation (MAD).

	Mean absolute deviation model									
Portfolio	**Risk global market (%)**	**Return global market (%)**	**Sharpe ratio (%)**	**Downside deviation (%)**	**Sortino ratio (%)**	**Risk global market + Africa (%)**	**Return global market + Africa (%)**	**Sharpe ratio (%)**	**Downside deviation (%)**	**Sortino ratio (%)**
MVP	1.232	0.091	1.931	0.771	3.085	0.427	0.143	17.669	0.175	43.037
P2	1.233	0.095	2.248	0.772	3.591	0.429	0.149	18.910	0.172	47.226
P3	1.233	0.099	2.565	0.772	4.099	0.439	0.154	19.750	0.179	48.503
P4	1.234	0.103	2.881	0.773	4.597	0.458	0.160	20.150	0.190	48.608
P5	1.235	0.107	3.195	0.776	5.089	0.482	0.165	20.307	0.205	47.755
P6	1.237	0.111	3.507	0.776	5.589	0.509	0.171	20.340	0.222	46.626
P7	1.240	0.115	3.817	0.778	6.083	0.537	0.177	20.309	0.240	45.409
P8	1.243	0.119	4.123	0.781	6.560	0.567	0.182	20.245	0.260	44.070
P9	1.247	0.123	4.424	0.785	7.028	0.597	0.188	20.162	0.281	42.883
P10	1.251	0.127	4.721	0.787	7.506	0.628	0.194	20.083	0.301	41.887
P11	1.256	0.130	5.014	0.789	7.981	0.658	0.199	20.003	0.321	41.072
P12	1.263	0.134	5.298	0.794	8.425	0.689	0.205	19.911	0.341	40.296
P13	1.271	0.138	5.571	0.799	8.865	0.721	0.210	19.813	0.361	39.609
P14	1.281	0.142	5.834	0.804	9.293	0.753	0.216	19.719	0.380	39.088

Table 9. Cont'd.

P15	1.292	0.146	6.091	0.810	9.708	0.785	0.222	19.631	0.400	38.555
P16	1.302	0.150	6.342	0.816	10.126	0.817	0.227	19.546	0.422	37.886
P17	1.314	0.154	6.584	0.823	10.512	0.850	0.233	19.465	0.442	37.426
P18	1.326	0.158	6.817	0.831	10.886	0.882	0.238	19.389	0.462	36.987
P19	1.340	0.162	7.042	0.838	11.256	0.914	0.244	19.317	0.483	36.558
P20	1.354	0.166	7.258	0.846	11.618	0.947	0.250	19.248	0.504	36.182
P21	1.368	0.170	7.467	0.854	11.964	0.979	0.255	19.182	0.523	35.900
P22	1.384	0.174	7.668	0.862	12.314	1.012	0.261	19.116	0.544	35.565
P23	1.400	0.178	7.859	0.871	12.636	1.045	0.267	19.054	0.565	35.256
P24	1.417	0.181	8.043	0.881	12.940	1.078	0.272	18.995	0.585	34.980
P25	1.434	0.185	8.219	0.889	13.252	1.111	0.278	18.938	0.606	34.713
P26	1.452	0.189	8.385	0.898	13.562	1.144	0.283	18.884	0.626	34.478
P27	1.472	0.193	8.539	0.908	13.848	1.177	0.289	18.833	0.647	34.252
P28	1.493	0.197	8.685	0.918	14.123	1.210	0.295	18.779	0.666	34.123
P29	1.513	0.201	8.825	0.929	14.380	1.244	0.300	18.710	0.687	33.916
P30	1.535	0.205	8.956	0.940	14.629	1.279	0.306	18.645	0.707	33.721
P31	1.558	0.209	9.077	0.950	14.884	1.314	0.312	18.582	0.727	33.569
P32	1.582	0.213	9.184	0.962	15.097	1.349	0.317	18.512	0.748	33.402
P33	1.608	0.217	9.279	0.974	15.327	1.384	0.323	18.445	0.768	33.244
P34	1.635	0.221	9.367	0.984	15.557	1.420	0.328	18.378	0.787	33.140
P35	1.663	0.225	9.445	0.997	15.758	1.456	0.334	18.310	0.808	32.996
P36	1.692	0.228	9.513	1.012	15.909	1.492	0.340	18.242	0.828	32.863
P37	1.723	0.232	9.569	1.025	16.095	1.528	0.345	18.177	0.849	32.742
P38	1.756	0.236	9.616	1.040	16.227	1.565	0.351	18.110	0.868	32.644
P39	1.790	0.240	9.652	1.058	16.331	1.602	0.357	18.043	0.888	32.550
P40	1.824	0.244	9.684	1.076	16.425	1.640	0.362	17.970	0.909	32.409
P41	1.861	0.248	9.706	1.096	16.471	1.679	0.368	17.887	0.930	32.298
P42	1.899	0.252	9.717	1.116	16.537	1.718	0.373	17.803	0.950	32.201
P43	1.939	0.256	9.719	1.135	16.603	1.759	0.379	17.712	0.972	32.055
P44	1.981	0.260	9.710	1.156	16.635	1.800	0.385	17.624	0.995	31.881
P45	2.024	0.264	9.695	1.178	16.657	1.842	0.390	17.525	1.014	31.845
P46	2.068	0.268	9.678	1.202	16.652	1.888	0.396	17.395	1.034	31.760
P47	2.115	0.272	9.650	1.227	16.630	1.939	0.402	17.231	1.057	31.617
P48	2.164	0.276	9.611	1.254	16.587	1.994	0.407	17.036	1.080	31.457
P49	2.241	0.279	9.459	1.295	16.365	2.062	0.413	16.747	1.120	30.827
P50	2.422	0.283	8.914	1.409	15.325	2.141	0.418	16.391	1.164	30.159

Source: Author.

Table 10. Efficient portfolios based on filtered historical simulation (FHS).

	Filtered historical simulation model											
Portfolio	Risk Europe HS (%)	Risk Europe FHS (%)	Return Europe (%)	Sharpe ratio (%)	Downside deviation FHS (%)	Sortino ratio (%)	Risk Europe + Africa HS (%)	Risk Europe + Africa FHS (%)	Return Europe+ Africa (%)	Sharpe ratio (%)	Downside deviation FHS (%)	Sortino ratio (%)
MVP	4.099	9.436	0.088	0.220	4.264	0.486	3.466	6.607	0.091	0.357	3.707	0.636
P2	4.111	8.637	0.088	0.232	4.281	0.468	3.514	7.728	0.101	0.439	3.890	0.872
P3	4.125	9.724	0.091	0.238	4.289	0.541	3.564	7.277	0.093	0.354	3.894	0.662
P4	4.137	7.905	0.086	0.229	4.307	0.420	3.576	7.487	0.090	0.305	3.895	0.586
P5	4.145	8.279	0.094	0.319	4.308	0.613	3.610	6.991	0.098	0.442	3.900	0.792
P6	4.148	8.476	0.089	0.248	4.311	0.489	3.614	7.763	0.091	0.306	3.901	0.608
P7	4.157	8.906	0.085	0.196	4.316	0.405	3.615	7.268	0.090	0.306	3.905	0.570
P8	4.159	8.562	0.088	0.240	4.319	0.476	3.619	8.081	0.097	0.359	3.912	0.742
P9	4.166	7.370	0.080	0.166	4.329	0.282	3.621	6.884	0.093	0.375	3.913	0.660
P10	4.167	9.377	0.087	0.211	4.332	0.456	3.624	7.194	0.091	0.321	3.918	0.589
P11	4.170	8.435	0.086	0.217	4.333	0.422	3.625	6.916	0.092	0.348	3.919	0.613
P12	4.172	8.519	0.087	0.231	4.334	0.455	3.626	5.524	0.090	0.411	3.923	0.579
P13	4.173	8.736	0.088	0.238	4.335	0.480	3.627	7.217	0.091	0.325	3.931	0.596
P14	4.175	8.208	0.082	0.180	4.345	0.340	3.630	8.093	0.100	0.402	3.932	0.827
P15	4.177	8.325	0.087	0.233	4.351	0.446	3.631	7.271	0.092	0.336	3.933	0.620
P16	4.180	8.283	0.082	0.176	4.357	0.334	3.632	7.173	0.091	0.322	3.936	0.586
P17	4.189	8.215	0.088	0.253	4.367	0.477	3.632	7.387	0.092	0.331	3.937	0.621
P18	4.189	8.754	0.089	0.248	4.367	0.498	3.633	7.368	0.093	0.351	3.938	0.656
P19	4.191	8.245	0.086	0.218	4.368	0.412	3.633	7.973	0.091	0.300	3.940	0.606
P20	4.195	7.559	0.079	0.152	4.369	0.263	3.634	7.212	0.091	0.332	3.940	0.607
P21	4.196	8.355	0.085	0.210	4.371	0.401	3.635	6.957	0.087	0.274	3.944	0.483
P22	4.196	8.285	0.091	0.280	4.373	0.530	3.637	6.470	0.081	0.214	3.944	0.351
P23	4.197	7.159	0.081	0.191	4.376	0.312	3.639	7.154	0.093	0.351	3.949	0.635
P24	4.201	8.992	0.083	0.172	4.377	0.353	3.640	5.215	0.084	0.310	3.959	0.408
P25	4.201	8.330	0.086	0.219	4.378	0.416	3.641	7.236	0.091	0.331	3.962	0.604
P26	4.202	8.265	0.086	0.220	4.381	0.416	3.645	7.023	0.089	0.311	3.963	0.551
P27	4.204	7.433	0.080	0.168	4.383	0.285	3.652	5.316	0.092	0.459	3.964	0.616
P28	4.205	8.361	0.086	0.217	4.385	0.414	3.652	9.100	0.097	0.329	3.964	0.755
P29	4.210	7.300	0.085	0.241	4.386	0.401	3.654	6.957	0.089	0.305	3.967	0.536
P30	4.211	7.586	0.082	0.192	4.387	0.331	3.655	7.283	0.092	0.336	3.969	0.617
P31	4.213	9.128	0.089	0.241	4.388	0.501	3.658	6.547	0.092	0.380	3.973	0.626
P32	4.213	6.684	0.081	0.202	4.388	0.307	3.660	7.406	0.090	0.307	3.982	0.571
P33	4.216	8.309	0.086	0.221	4.391	0.419	3.662	7.242	0.090	0.315	3.983	0.573
P34	4.223	7.437	0.083	0.212	4.393	0.358	3.663	7.589	0.092	0.323	3.984	0.615

Table 10. Contd.

P35	4.223	7.864	0.083	0.196	4.396	0.350	3.665	7.541	0.095	0.368	3.988	0.696
P36	4.225	7.904	0.085	0.221	4.399	0.397	3.665	6.576	0.083	0.232	3.988	0.383
P37	4.226	8.024	0.087	0.244	4.412	0.444	3.667	5.228	0.089	0.406	3.991	0.532
P38	4.228	8.114	0.088	0.248	4.419	0.456	3.672	7.254	0.090	0.307	3.992	0.558
P39	4.229	7.388	0.082	0.193	4.421	0.323	3.675	7.526	0.093	0.332	3.994	0.627
P40	4.231	8.492	0.085	0.200	4.424	0.384	3.677	5.873	0.087	0.324	3.996	0.476
P41	4.238	8.291	0.081	0.167	4.431	0.313	3.678	5.505	0.087	0.356	4.000	0.489
P42	4.245	7.821	0.081	0.173	4.433	0.305	3.678	6.477	0.087	0.302	4.004	0.488
P43	4.246	7.776	0.085	0.222	4.442	0.388	3.689	7.345	0.090	0.306	4.010	0.561
P44	4.250	8.333	0.086	0.217	4.447	0.406	3.690	6.257	0.089	0.336	4.015	0.524
P45	4.279	7.128	0.080	0.174	4.451	0.279	3.691	6.496	0.082	0.219	4.017	0.353
P46	4.284	10.122	0.093	0.249	4.455	0.567	3.695	7.335	0.090	0.311	4.039	0.565
P47	4.286	8.857	0.087	0.216	4.459	0.429	3.706	7.522	0.085	0.231	4.052	0.429
P48	4.296	7.098	0.085	0.247	4.462	0.393	3.708	7.215	0.086	0.254	4.071	0.451
P49	4.299	7.049	0.086	0.263	4.477	0.414	3.709	7.301	0.087	0.263	4.080	0.471
P50	4.344	8.518	0.078	0.127	4.580	0.236	3.770	5.893	0.087	0.331	4.093	0.477

Source: Author.

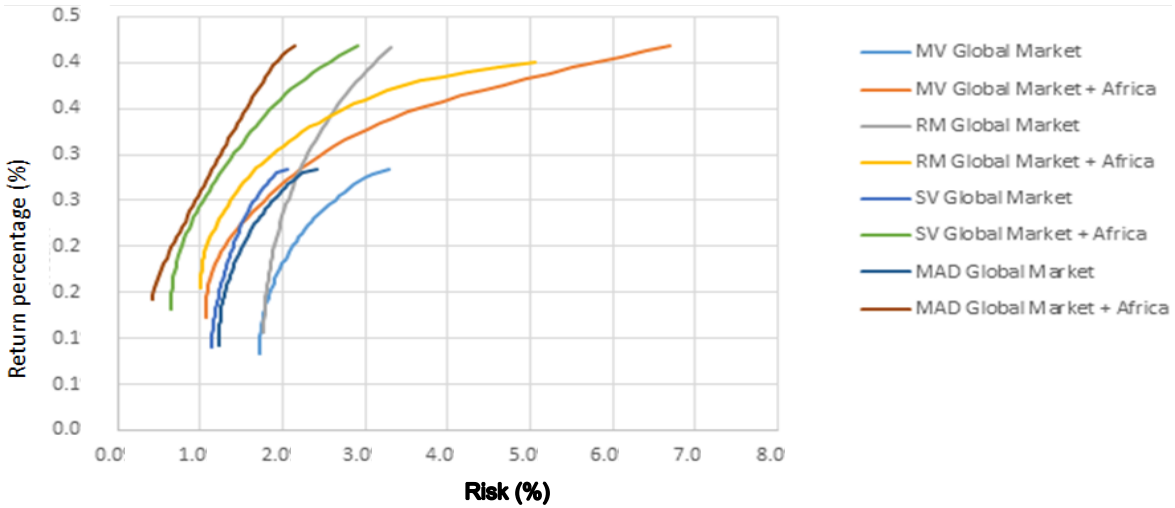

Figure 1. Efficient frontiers of the investment strategies. This figure shows us the efficient frontiers of the investment strategies for each optimization model form period 05/08/2004 to 07/07/2016 based in the criteria Risk and Return. Thus, we have the following models: Mean Variance (MV), Resample Michaud (RM), SemiVariance, Mean Absolute and Deviation (MAD)).

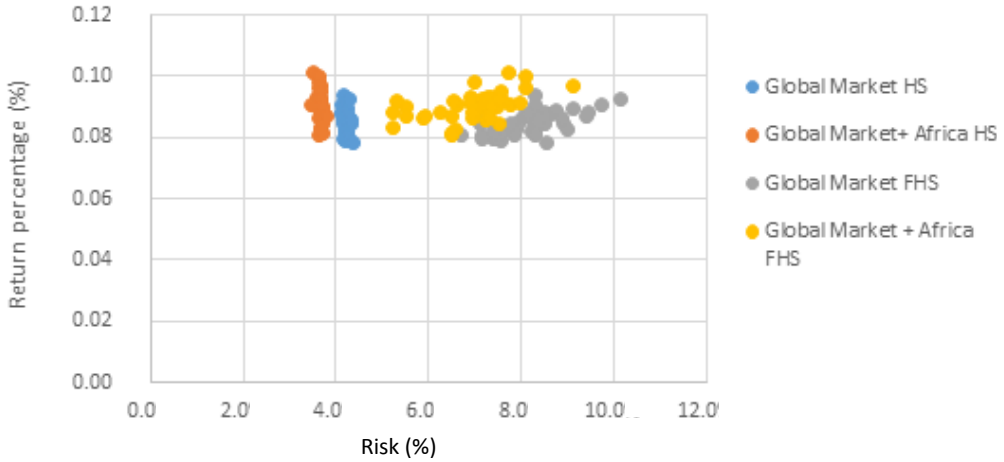

Figure 2. Efficient portfolios of the investment strategies using FHS model. This figure shows us the contribution to literature, application of the FHS methodology combine with the Historical Simulation method (HS) and Garch volatility model. We represent efficient portfolios through the point graphics instead of line because it shows better presentation due to convex properties of the model).

Table 11. The average performance of investment strategies.

Model	Mean variance		Resample Michaud		Semi variance		Mean absolute devition		Filtered historical simulation	
	Global market	Global market + Africa	Global market	Global market + Africa	Global market	Global market + Africa	Global market	Global market + Africa	Global market	Global market + Africa
Risk	2.152	2.611	2.251	1.982	1.410	1.378	1.548	1.159	8.207	7.005
Return	0.183	0.270	0.262	0.277	0.186	0.275	0.19	0.281	0.085	0.090
Sharpe ratio	5.083	8.431	8.199	11.291	8.024	15.39	7.36	18.785	0.216	0.329
Downside risk	1.420	1.390	1.188	1.059	1.410	1.38	0.94	0.620	4.381	3.960
Sortino ratio	7.730	14.631	15.540	21.302	8.024	15.39	12.15	36.645	0.406	0.581

The mean contribution in terms of risk and return of the investment strategies and their performances through Sharpe Ratio and Sortino Ratio was illustrated. With MV model, the diversification of the global investment portfolios with African assets is riskier than global investment portfolios but presents better return and performance. With RM, SV, MAD and FHS models, the diversification of European investment portfolios with African assets is seen to be more efficient than European investment portfolio. To all optimization models, the diversification strategy of the global investment portfolios with African assets is seen to have better performances than strategy not diversified.

However, the study results show that Tables 5 to 10 for all models even for investors that prefer Minimum Portfolio Variance (MPV), the diversification of global portfolio with African assets, reduce risk and maximize return. Even if the diversification of global portfolio with African assets increased risk, the benefits in return compensate for the increased risk.

Out-of-sample analysis

In this analysis, we also analyzed the contribution of the African capital market in the global portfolio

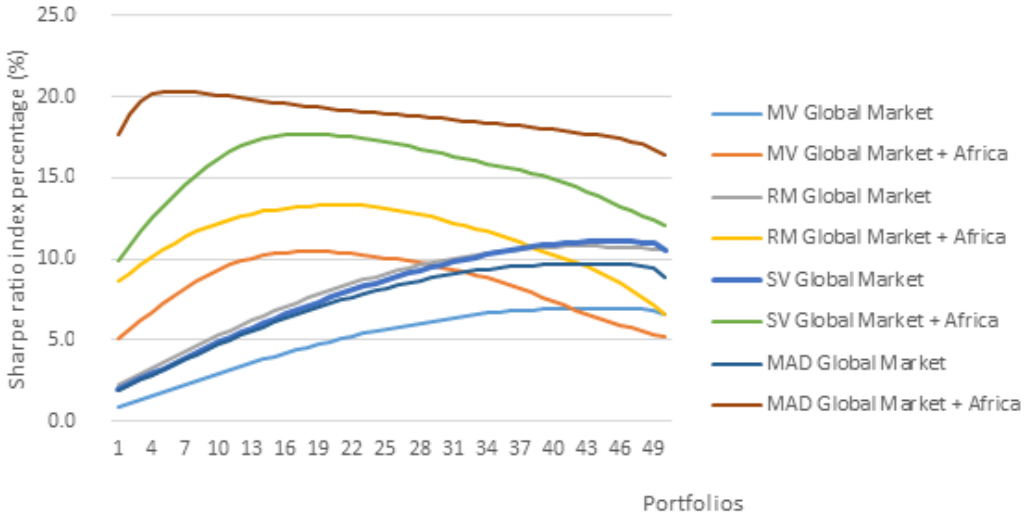

Figure 3. Portfolio performances of the investment strategies for each optimization models. This figure shows the portfolio performances of the investment strategies for each optimization model measured by Sharpe Ratio. However, investment strategy with higher value of Sharpe Ratio show better performance).

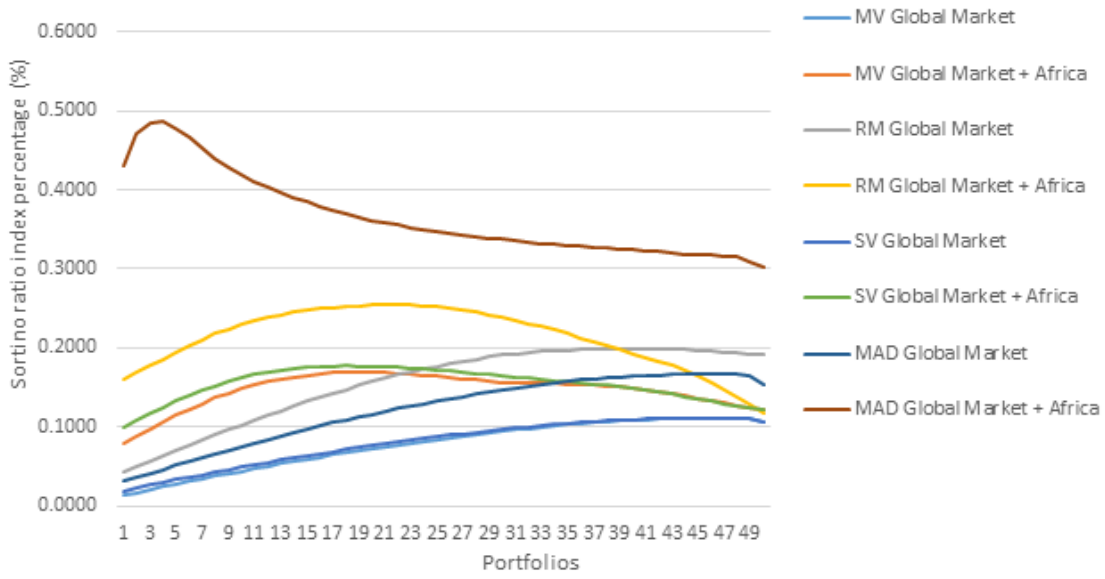

Figure 4. Portfolio performances of the investment strategies for each optimization models (This figure shows us the portfolio performances of the investment strategies for each optimization model measured by Sortino Ratio. However, investment strategy with higher value of Sharpe Ratio show better performance).

diversification using out-of-sample analysis. Furthermore, the objective of this methodology is to analyze the portfolio performance measured by ER, risk (R), SR and S over the period where it is applied by the rolling sample approach. The study out-of-sample results show that the strategy of diversification of global portfolio with assets of African market present better performance measured by ER, Risk, SR and Sortino Ratio than global portfolio according to the models as shown in Table 20 and Figures 6 to 9. To test statistically, the study investment performances was measured by SR *and* Sortino ratio, Table 21 provided the test results. For all optimization models, MV, RM, SV, MAD and FHS shows the rejection of the null hypotheses. The result shows high positive

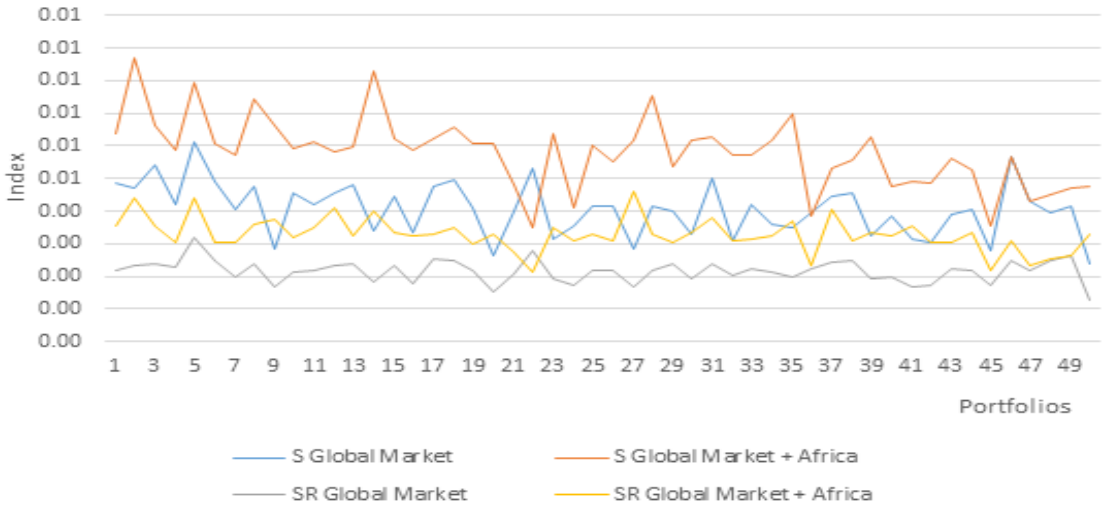

Figure 5. Portfolio performances using FHS model. This figure shows Sharpe Ratio (SR) and Sortino Ratio (S) like a portfolio performance through the FHS model. They were represented separately because the application of this model is the study contribution to the literature. Individual result were other models).

Table 12. Statistical test results of performances investment strategies.

Model	Test result of sharpe ratio portfolio performances			
	Null hypotheses	**t-statistic**	**P-value**	**Reject or No reject**
Mean variance (MV)	SR2-SR1=0	9.12	0.000	Reject
Resample Michaud (RM)	SR2-SR1=0	6.69	0.000	Reject
Semi variance (SV)	SR2-SR1=0	14.75	0.000	Reject
Mean absolute deviation (MAD)	SR2-SR1=0	30.52	0.000	Reject
Filtered historical simulation (FHS)	SR2-SR1=0	12.72	0.000	Reject
Models	**Null hypotheses**	**t-statistic**	**P-value**	**Reject or No reject**
Mean variance (MV)	S2-S1=0	13.00	0.0000	Reject
Resample Michaud (RM)	S2-S1=0	6.57	0.0000	Reject
Semi variance (SV)	S2-S1=0	14.75	0.0000	Reject
Mean absolute deviation (MAD)	S2-S1=0	25.60	0.0000	Reject
Filtered historical simulation (FHS)	S2-S1=0	9.08	0.0000	Reject

The statistical test result of performance investment strategies was presented, where SR2 corresponding to the *strategy 2* performance and SR1 is *strategy 1* performance. Thus, 1 was considered to have significance level. As seen, all null hypotheses have been rejected, this means that the higher performance of strategy 2 over strategy1 is statistically significant because high value of the t-statistic and p-value is lesser than 0.01.

Table 13. Contribution of Europe portfolio diversification with African capital market assets.

Contribuition measure	MV	RM	SV	MAD	FHS
Overall benefit	0.163	0.164	0.176	0.189	0.019
Diversification benefit	0.076	0.148	0.087	0.096	0.014
Return benefit	0.087	0.016	0.089	0.093	0.005

The real contribution of the Europe portfolio diversification with African capital market assets, based on equation 22, 23 and 24 considering all optimization models used in this study was presented. To all optimization models, the diversification of the global investment portfolios with African assets generates benefits in the returns and diversification that correspond with the overall benefits.

Table 14. Global portfolio weights diversified with African capital markets by mean variance model.

Portfolio	Namibia	Nigeria	Gongo	Cote D´Ivoire	Egypt	Morrocco	Tunisia	Botswana	Mauritius	Kenya	Uganda	Zambia	South Africa	Global markets	Total portfolio weight
MPV	0	1	26	2	0	0	23	13	10	3	1	3	0	18	100
P2	0	1	26	3	0	0	23	12	10	2	2	4	0	18	100
P3	0	1	26	3	0	0	24	12	10	1	2	4	0	17	100
P4	0	0	26	3	0	0	24	12	10	0	3	4	0	17	100
P5	0	0	26	3	0	0	24	11	10	0	3	5	0	17	100
P6	0	0	26	4	0	0	25	10	10	0	3	6	0	17	100
P7	0	0	27	4	0	0	25	9	9	0	3	6	0	17	100
P8	0	0	27	5	0	0	25	7	9	0	3	7	0	18	100
P9	0	0	27	5	0	0	26	5	8	0	3	8	0	19	100
P10	0	0	27	6	0	0	26	3	7	0	2	8	0	20	100
P11	0	0	27	7	0	0	26	1	6	0	2	9	0	22	100
P12	0	0	27	7	0	0	26	0	5	0	2	10	0	23	100
P13	0	0	27	8	0	0	25	0	3	0	2	11	0	24	100
P14	0	0	27	9	0	0	24	0	2	0	2	11	0	25	100
P15	0	0	27	10	0	0	23	0	0	0	2	12	0	26	100
P16	0	0	26	10	0	0	22	0	0	0	1	13	0	27	100
P17	0	0	26	11	0	0	20	0	0	0	1	14	0	28	100
P18	0	0	25	12	0	0	18	0	0	0	1	14	0	29	100
P19	0	0	25	13	0	0	16	0	0	0	0	15	0	31	100
P20	0	0	24	14	0	0	14	0	0	0	0	16	0	33	100
P21	0	0	23	15	0	0	11	0	0	0	0	16	0	35	100
P22	0	0	23	16	0	0	8	0	0	0	0	17	0	37	100
P23	0	0	22	17	0	0	6	0	0	0	0	17	0	39	100
P24	0	0	21	18	0	0	3	0	0	0	0	18	0	41	100
P25	0	0	20	19	0	0	0	0	0	0	0	18	0	43	100
P26	0	0	17	20	0	0	0	0	0	0	0	18	0	45	100
P27	0	0	13	21	0	0	0	0	0	0	0	19	0	47	100
P28	0	0	10	23	0	0	0	0	0	0	0	19	0	49	100
P29	0	0	7	24	0	0	0	0	0	0	0	19	0	51	100
P30	0	0	3	25	0	0	0	0	0	0	0	19	0	53	100
P31	0	0	0	26	0	0	0	0	0	0	0	19	0	54	100
P32	0	0	0	29	0	0	0	0	0	0	0	15	0	56	100
P33	0	0	0	31	0	0	0	0	0	0	0	12	0	57	100
P34	0	0	0	34	0	0	0	0	0	0	0	8	0	58	100

Table 14. Contd.

P35	0	0	0	36	0	0	0	0	0	0	0	4	0	60	100
P36	0	0	0	39	0	0	0	0	0	0	0	0	0	61	100
P37	0	0	0	43	0	0	0	0	0	0	0	0	0	57	100
P38	0	0	0	46	0	0	0	0	0	0	0	0	0	54	100
P39	0	0	0	51	0	0	0	0	0	0	0	0	0	49	100
P40	0	0	0	55	0	0	0	0	0	0	0	0	0	45	100
P41	0	0	0	60	0	0	0	0	0	0	0	0	0	40	100
P42	0	0	0	64	0	0	0	0	0	0	0	0	0	36	100
P43	0	0	0	69	0	0	0	0	0	0	0	0	0	31	100
P44	0	0	0	73	0	0	0	0	0	0	0	0	0	27	100
P45	0	0	0	78	0	0	0	0	0	0	0	0	0	22	100
P46	0	0	0	82	0	0	0	0	0	0	0	0	0	18	100
P47	0	0	0	87	0	0	0	0	0	0	0	0	0	13	100
P48	0	0	0	91	0	0	0	0	0	0	0	0	0	9	100
P49	0	0	0	96	0	0	0	0	0	0	0	0	0	4	100
P50	0	0	0	100	0	0	0	0	0	0	0	0	0	0	100

Table 15. Global portfolio weights diversified with African capital markets by resample Michaud model.

Portfolio	Namibia	Nigerian	Gongo	Cote D´Ivoire	Egypt	Morrocco	Tunisia	Botswana	Mauritius	Kenya	Uganda	Zambia	South Africa	Global markets	Total Port folio weight
MPV	0	2	26	1	0	0	24	12	10	0	4	4	0	17	100
P2	0	1	25	2	0	0	24	13	10	0	5	4	0	17	100
P3	0	1	24	2	0	0	25	13	10	0	5	4	0	16	100
P4	0	1	24	2	0	0	25	13	10	0	5	4	0	16	100
P5	0	0	23	2	0	0	25	13	11	0	5	4	0	16	100
P6	0	0	22	2	0	0	26	13	11	0	5	4	0	16	100
P7	0	0	20	3	0	0	27	12	11	0	6	5	0	17	100
P8	0	0	18	3	0	0	27	11	10	0	6	5	0	19	100
P9	0	0	16	3	0	1	28	10	10	0	6	6	0	19	100
P10	0	0	15	4	0	1	28	9	10	0	7	6	0	20	100
P11	0	0	13	4	0	2	28	8	10	0	7	6	0	21	100
P12	0	0	12	4	0	2	29	7	10	0	7	7	0	22	100
P13	0	0	10	4	0	3	29	6	9	0	8	7	0	23	100
P14	0	0	9	5	0	4	30	5	9	0	8	8	0	23	100
P15	0	0	8	5	0	4	30	4	9	0	8	8	0	24	100
P16	0	0	7	5	1	5	30	3	9	0	8	8	0	24	100

Table 15. Contd.

P17	0	0	5	5	1	5	31	2	8	0	8	9	0	25	100
P18	0	0	4	5	1	6	31	1	8	0	9	9	0	26	100
P19	0	0	3	6	1	6	31	0	8	0	9	9	0	26	100
P20	0	0	1	6	2	7	32	0	7	0	9	10	0	26	100
P21	0	0	0	6	2	7	32	0	7	0	9	10	0	27	100
P22	0	0	0	6	3	8	31	0	6	0	10	10	0	26	100
P23	0	0	0	7	4	9	30	0	4	0	10	11	0	26	100
P24	0	0	0	7	4	10	28	0	2	0	10	11	0	27	100
P25	0	0	0	7	5	11	27	0	1	0	10	11	0	27	100
P26	0	0	0	8	6	12	24	0	0	0	11	11	0	28	100
P27	0	0	0	8	7	13	21	0	0	0	11	11	0	30	100
P28	0	0	0	9	8	14	17	0	0	0	11	11	0	31	100
P29	0	0	0	9	9	14	14	0	0	0	11	11	0	32	100
P30	0	0	0	9	10	15	10	0	0	0	11	11	0	34	100
P31	0	0	0	10	10	16	7	0	0	0	11	11	0	36	100
P32	0	0	0	10	11	17	3	0	0	0	11	10	0	37	100
P33	0	0	0	11	12	17	0	0	0	0	11	10	0	39	100
P34	0	0	0	11	13	17	0	0	0	0	10	9	0	40	100
P35	0	0	0	12	15	16	0	0	0	0	10	7	0	41	100
P36	0	0	0	12	16	15	0	0	0	0	9	6	0	42	100
P37	0	0	0	13	17	14	0	0	0	0	8	4	0	44	100
P38	0	0	0	13	18	13	0	0	0	0	7	2	0	46	100
P39	0	0	0	14	20	12	0	0	0	0	6	1	0	48	100
P40	0	0	0	15	21	10	0	0	0	0	4	0	0	50	100
P41	0	0	0	15	22	8	0	0	0	0	2	0	0	53	100
P42	0	0	0	16	23	5	0	0	0	0	0	0	0	55	100
P43	0	0	0	17	24	1	0	0	0	0	0	0	0	58	100
P44	0	0	0	17	24	0	0	0	0	0	0	0	0	59	100
P45	0	0	0	17	23	0	0	0	0	0	0	0	0	60	100
P46	0	0	0	17	22	0	0	0	0	0	0	0	0	61	100
P47	0	0	0	16	18	0	0	0	0	0	0	0	0	65	100
P48	0	0	0	14	9	0	0	0	0	0	0	0	0	77	100
P49	0	0	0	12	0	0	0	0	0	0	0	0	0	88	100
P50	0	0	0	0	0	0	0	0	0	0	0	0	0	100	100

Table 16. Global portfolio weights diversified with African capital markets by semi variance model.

Portfolio	Namibia	Nigerian	Gongo	Cote D´Ivoire	Egypt	Morrocco	Tunisia	Botswana	Mauritius	Kenya	Uganda	Zambia	South Africa	Global Markets	Total Port folio weight
MPV	0	0	36	2	0	0	26	10	10	0	0	1	0	14	100
P2	0	0	37	3	0	0	26	9	10	0	0	2	0	13	100
P3	0	0	37	4	0	0	26	8	10	0	0	3	0	12	100
P4	0	0	37	4	0	0	26	7	10	0	0	3	0	12	100
P5	0	0	38	5	0	0	26	6	10	0	0	4	0	12	100
P6	0	0	38	6	0	0	26	5	10	0	0	4	0	11	100
P7	0	0	38	6	0	0	27	4	9	0	0	5	0	11	100
P8	0	0	39	7	0	0	27	2	9	0	0	5	0	12	100
P9	0	0	39	8	0	0	27	0	8	0	0	6	0	13	100
P10	0	0	39	9	0	0	26	0	7	0	0	6	0	13	100
P11	0	0	39	10	0	0	25	0	5	0	0	7	0	14	100
P12	0	0	39	11	0	0	24	0	4	0	0	7	0	16	100
P13	0	0	38	12	0	0	23	0	2	0	0	7	0	17	100
P14	0	0	38	13	0	0	22	0	1	0	0	8	0	18	100
P15	0	0	38	15	0	0	20	0	0	0	0	8	0	19	100
P16	0	0	38	16	0	0	18	0	0	0	0	8	0	20	100
P17	0	0	37	17	0	0	16	0	0	0	0	8	0	21	100
P18	0	0	36	19	0	0	14	0	0	0	0	8	0	22	100
P19	0	0	36	20	0	0	12	0	0	0	0	9	0	24	100
P20	0	0	35	21	0	0	10	0	0	0	0	9	0	25	100
P21	0	0	34	23	0	0	8	0	0	0	0	9	0	27	100
P22	0	0	33	24	0	0	6	0	0	0	0	9	0	28	100
P23	0	0	33	25	0	0	3	0	0	0	0	9	0	29	100
P24	0	0	32	27	0	0	1	0	0	0	0	9	0	31	100
P25	0	0	31	28	0	0	0	0	0	0	0	9	0	32	100
P26	0	0	28	30	0	0	0	0	0	0	0	9	0	33	100
P27	0	0	25	31	0	0	0	0	0	0	0	9	0	35	100
P28	0	0	23	33	0	0	0	0	0	0	0	8	0	36	100
P29	0	0	20	35	0	0	0	0	0	0	0	8	0	37	100
P30	0	0	18	36	0	0	0	0	0	0	0	8	0	38	100
P31	0	0	15	38	0	0	0	0	0	0	0	8	0	39	100
P32	0	0	12	39	0	0	0	0	0	0	0	7	0	41	100
P33	0	0	10	41	0	0	0	0	0	0	0	7	0	42	100
P34	0	0	7	43	0	0	0	0	0	0	0	7	0	43	100
P35	0	0	5	44	0	0	0	0	0	0	0	7	0	44	100
P36	0	0	2	46	0	0	0	0	0	0	0	6	0	45	100

Table 16. Contd.

P37	0	0	0	48	0	0	0	0	0	0	0	6	0	46	100
P38	0	0	0	51	0	0	0	0	0	0	0	3	0	47	100
P39	0	0	0	54	0	0	0	0	0	0	0	0	0	46	100
P40	0	0	0	58	0	0	0	0	0	0	0	0	0	42	100
P41	0	0	0	61	0	0	0	0	0	0	0	0	0	39	100
P42	0	0	0	65	0	0	0	0	0	0	0	0	0	35	100
P43	0	0	0	70	0	0	0	0	0	0	0	0	0	30	100
P44	0	0	0	74	0	0	0	0	0	0	0	0	0	26	100
P45	0	0	0	78	0	0	0	0	0	0	0	0	0	22	100
P46	0	0	0	83	0	0	0	0	0	0	0	0	0	17	100
P47	0	0	0	87	0	0	0	0	0	0	0	0	0	13	100
P48	0	0	0	91	0	0	0	0	0	0	0	0	0	9	100
P49	0	0	0	96	0	0	0	0	0	0	0	0	0	4	100
P50	0	0	0	100	0	0	0	0	0	0	0	0	0	0	100

Table 17. Global portfolio weights diversified with African capital markets by mean absolute deviation model.

Portfolio	Namibia	Nigerian	Gongo	Cote D´Ivoire	Egypt	Morrocco	Tunisia	Botswana	Mauritius	Kenya	Uganda	Zambia	South Africa	Global markets	Total portfolio weight
MPV	0	1	92	0	0	0	2	0	2	0	1	0	0	3	100
P2	0	0	93	0	0	0	2	0	1	0	1	1	0	3	100
P3	0	0	92	1	0	0	1	0	0	0	0	1	0	3	100
P4	0	0	91	3	0	0	1	0	0	0	0	2	0	3	100
P5	0	0	90	5	0	0	0	0	0	0	0	2	0	3	100
P6	0	0	88	6	0	0	0	0	0	0	0	2	0	4	100
P7	0	0	85	8	0	0	0	0	0	0	0	2	0	4	100
P8	0	0	83	10	0	0	0	0	0	0	0	2	0	4	100
P9	0	0	80	12	0	0	0	0	0	0	0	3	0	5	100
P10	0	0	77	14	0	0	0	0	0	0	0	3	0	5	100
P11	0	0	75	16	0	0	0	0	0	0	0	3	0	5	100
P12	0	0	73	18	0	0	0	0	0	0	0	4	0	5	100
P13	0	0	70	19	0	0	0	0	0	0	0	4	0	6	100
P14	0	0	68	21	0	0	0	0	0	0	0	4	0	6	100
P15	0	0	66	23	0	0	0	0	0	0	0	4	0	6	100
P16	0	0	63	25	0	0	0	0	0	0	0	5	0	7	100
P17	0	0	61	27	0	0	0	0	0	0	0	5	0	7	100
P18	0	0	58	29	0	0	0	0	0	0	0	5	0	8	100

Table 17. Contd.

P19	0	0	56	30	0	0	0	0	0	0	0	5	0	9	100
P20	0	0	53	32	0	0	0	0	0	0	0	5	0	9	100
P21	0	0	51	34	0	0	0	0	0	0	0	5	0	9	100
P22	0	0	49	36	0	0	0	0	0	0	0	6	0	10	100
P23	0	0	46	38	0	0	0	0	0	0	0	6	0	10	100
P24	0	0	44	40	0	0	0	0	0	0	0	6	0	11	100
P25	0	0	41	41	0	0	0	0	0	0	0	6	0	11	100
P26	0	0	38	43	0	0	0	0	0	0	0	6	0	12	100
P27	0	0	36	45	0	0	0	0	0	0	0	7	0	12	100
P28	0	0	34	47	0	0	0	0	0	0	0	7	0	12	100
P29	0	0	32	49	0	0	0	0	0	0	0	7	0	13	100
P30	0	0	30	51	0	0	0	0	0	0	0	7	0	13	100
P31	0	0	28	53	0	0	0	0	0	0	0	7	0	13	100
P32	0	0	25	55	0	0	0	0	0	0	0	7	0	13	100
P33	0	0	23	56	0	0	0	0	0	0	0	7	0	14	100
P34	0	0	21	59	0	0	0	0	0	0	0	7	0	13	100
P35	0	0	18	60	0	0	0	0	0	0	0	7	0	14	100
P36	0	0	16	62	0	0	0	0	0	0	0	7	0	14	100
P37	0	0	14	64	0	0	0	0	0	0	0	7	0	14	100
P38	0	0	12	66	0	0	0	0	0	0	0	7	0	14	100
P39	0	0	10	68	0	0	0	0	0	0	0	7	0	15	100
P40	0	0	8	71	0	0	0	0	0	0	0	7	0	14	100
P41	0	0	6	73	0	0	0	0	0	0	0	7	0	14	100
P42	0	0	5	75	0	0	0	0	0	0	0	6	0	14	100
P43	0	0	3	77	0	0	0	0	0	0	0	6	0	14	100
P44	0	0	0	79	0	0	0	0	0	0	0	6	0	14	100
P45	0	0	0	82	0	0	0	0	0	0	0	4	0	13	100
P46	0	0	0	85	0	0	0	0	0	0	0	3	0	12	100
P47	0	0	0	88	0	0	0	0	0	0	0	1	0	10	100
P48	0	0	0	92	0	0	0	0	0	0	0	0	0	8	100
P49	0	0	0	96	0	0	0	0	0	0	0	0	0	4	100
P50	0	0	0	100	0	0	0	0	0	0	0	0	0	0	100

value of t-statistic and p-value lesser than 1. It means that the superiority of the investment performances of the strategy of diversification of global portfolio with assets of African capital markets is statically significant. Finally, such in-sample analysis shows the out-of-sample

Table 18. Global portfolio weights diversified with African capital markets by filtered historical simulation model.

Portfolio	Namibia	Nigerian	Gongo	Cote D´Ivoire	Egypt	Morrocco	Tunisia	Botswana	Mauritius	Kenya	Uganda	Zambia	South Africa	Global markets	Total portfolio weight
MPV	2	2	1	2	1	2	2	2	2	2	2	2	2	75	100
P2	2	1	2	3	2	2	2	2	2	2	2	2	2	75	100
P3	2	2	2	3	2	2	2	2	2	2	2	2	2	74	100
P4	2	2	2	2	2	2	2	2	3	2	2	2	2	75	100
P5	2	1	3	1	2	2	2	0	2	2	2	2	2	76	100
P6	2	2	2	4	2	2	1	2	2	2	1	2	2	75	100
P7	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P8	2	2	2	2	1	2	1	0	2	3	2	4	2	74	100
P9	1	2	1	2	2	4	2	2	2	2	2	2	2	75	100
P10	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P11	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P12	2	1	2	2	2	2	2	2	2	2	2	2	2	77	100
P13	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P14	2	1	2	2	2	2	1	2	2	2	2	2	0	78	100
P15	2	1	2	2	2	2	2	2	2	2	2	2	2	76	100
P16	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P17	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P18	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P19	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P20	2	2	2	2	2	2	2	2	2	2	2	2	2	77	100
P21	2	2	4	1	2	2	2	2	2	1	2	2	2	75	100
P22	1	3	2	2	1	2	2	4	1	2	2	1	1	73	100
P23	2	2	2	2	2	2	2	2	2	1	2	2	2	76	100
P24	2	2	1	2	2	5	3	2	1	2	2	2	1	73	100
P25	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P26	2	2	2	2	2	2	2	2	2	2	2	2	2	77	100
P27	2	1	2	2	2	2	2	2	2	2	2	2	2	76	100
P28	3	2	3	2	2	0	2	2	0	0	2	2	1	79	100
P29	2	1	2	2	2	2	2	2	2	2	2	2	2	77	100
P30	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P31	2	2	2	2	2	2	2	2	2	2	2	2	2	77	100
P32	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P33	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P34	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100

Table 18. Contd.

P35	2	1	2	2	2	2	2	2	2	2	2	2	2	76	100
P36	2	2	2	1	2	2	2	2	2	2	2	2	2	75	100
P37	2	2	2	2	2	2	2	2	2	2	2	2	2	77	100
P38	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P39	2	2	2	2	2	2	2	2	2	2	2	2	2	77	100
P40	3	2	2	3	2	3	1	3	3	1	2	2	2	71	100
P41	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P42	2	2	2	1	2	2	2	2	2	2	2	2	2	77	100
P43	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P44	2	2	2	3	2	2	2	2	1	2	2	2	2	75	100
P45	1	1	2	1	2	2	2	2	2	1	2	1	1	80	100
P46	2	1	2	2	2	2	2	2	2	2	2	2	2	77	100
P47	2	2	2	0	2	2	2	2	2	2	2	2	2	77	100
P48	2	2	2	2	2	2	2	2	2	2	2	2	2	76	100
P49	1	2	1	3	2	1	3	2	2	2	1	2	1	77	100
P50	1	1	2	2	1	2	4	2	2	1	1	2	2	77	100

Table 19. The average weights of the global market portfolio diversified.

Market	MV	RM	SV	MAD	FHS	Market	MV	RM	SV	MAD	FHS	Market	MV	RM	SV	MAD	FHS
Namibia	0.00	0.00	0.00	0.00	1.77	Spain	0.00	0.00	0.00	0.00	1.84	Russian	0.00	12.63	0.00	0.00	1.79
Nigerian	0.06	0.10	0.01	0.01	1.67	Austrian	0.00	0.00	0.00	0.00	1.72	Turkey	0.00	0.00	0.00	0.00	1.84
Gongo	13.67	5.71	21.58	42.09	1.95	Swiss	0.00	0.00	0.00	0.00	1.87	UAE	1.38	1.90	0.21	0.15	1.77
Cote D´Ivoire	30.50	8.27	35.32	43.73	2.03	Belgium	0.00	0.00	0.00	0.00	1.79	Brasil	0.00	0.00	0.00	0.00	1.84
Egypt	0.00	7.68	0.00	0.01	1.78	Denmark	0.00	1.37	0.00	0.00	1.86	Chile	0.00	0.00	0.00	0.00	1.78
Morrocco	0.00	6.38	0.00	0.00	1.94	Finland	0.00	0.00	0.00	0.00	1.83	Peru	0.51	2.32	0.25	0.00	1.82
Tunisia	9.71	16.06	9.30	0.11	1.94	Ireland	0.00	0.00	0.00	0.00	1.74	Mexico	0.00	0.00	0.00	0.00	1.87
Botswana	1.89	3.12	1.03	0.00	1.83	Israel	0.44	1.91	0.33	0.01	1.90	Canada	0.00	0.00	0.00	0.00	1.78
Mauritius	2.23	4.23	2.13	0.06	1.85	Netherlands	0.00	0.00	0.00	0.00	1.74	Australia	1.05	0.65	0.81	0.06	1.90
Kenya	0.12	0.00	0.00	0.01	1.74	Norway	0.00	0.00	0.00	0.00	1.74	Hong Kong	0.00	0.00	0.00	0.00	1.81
Uganda	0.77	6.50	0.00	0.10	1.87	Portugal	0.00	0.00	0.00	0.00	1.76	Japan	0.00	0.00	0.00	0.00	1.86
Zambia	8.34	5.94	5.10	4.65	1.89	Sweden	0.00	0.00	0.00	0.00	1.78	Newzealand	0.00	10.66	0.00	0.00	1.75
South Africa	0.00	0.00	0.00	0.00	1.74	Czech Republic	0.00	0.00	0.00	0.00	1.81	Singapore	0.06	0.01	0.50	0.00	1.90
Germany	0.00	0.00	0.00	0.00	1.84	Greece	0.00	0.00	0.00	0.00	1.65	China	25.03	0.00	19.95	6.51	1.87
UK	0.00	0.00	0.00	0.00	1.75	Hungary	0.00	0.51	0.00	0.00	1.73	India	0.00	0.08	0.00	0.00	1.82
France	0.00	0.00	0.00	0.00	1.77	Poland	0.00	0.00	0.00	0.00	1.74	Indonesia	0.00	2.59	0.00	0.00	1.91
Italy	0.00	0.00	0.00	0.00	1.74	Qatar	0.00	1.24	0.00	0.00	1.82	South Korea	0.00	0.00	0.00	0.00	1.85

Table 19. Contd.

Malasya	4.00	0.00	3.49	2.45	1.87	Philipine	0.00	0.00	0.00	0.00	1.93	Taiwan	0.00	0.00	0.00	0.00	1.77
EUA	0.25	0.15	0.00	0.04	1.86												

Source: Author.

Table 20. The average out-of-sample performance.

Model	Global market					Global market + Africa				
	Excess return	Risk	Sharpe ratio	Downside risk	Sortino ratio	Excess return	Risk	Sharpe ratio	Downside risk	Sortino ratio
MV	0.038	2.804	1.215	1.809	1.779	0.047	2.531	1.707	1.642	2.460
RM	0.028	2.606	1.079	1.388	2.002	0.036	2.363	1.523	1.269	2.796
SV	0.038	1.809	1.779	1.809	1.779	0.047	1.642	2.460	1.642	2.460
MAD	0.038	2.068	1.720	1.229	2.728	0.047	1.878	2.399	1.123	3.762
FHS	0.039	5.356	0.686	4.507	0.753	0.047	4.872	0.947	4.159	1.018

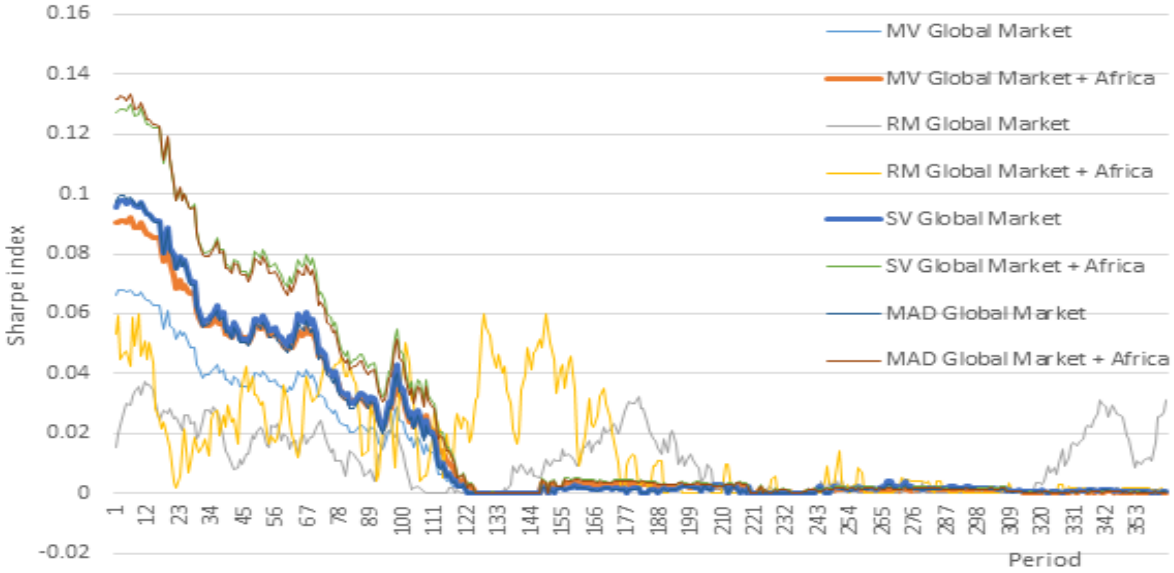

Figure 6. Out-of-sample sharpe ratio performance. This figure shows the out-of-sample portfolio performances of the investment strategies for each optimization model measured by Sharpe Ratio weekly. However, investment strategy with higher value of Sharpe Ratio, show better performance. For this analysis, we divide the database into two sub-period, being the first sub-period which started from 05/08/2004 to 23/07/2009 and the second sub-period started from 30/07/2009 to 07/07/2016).

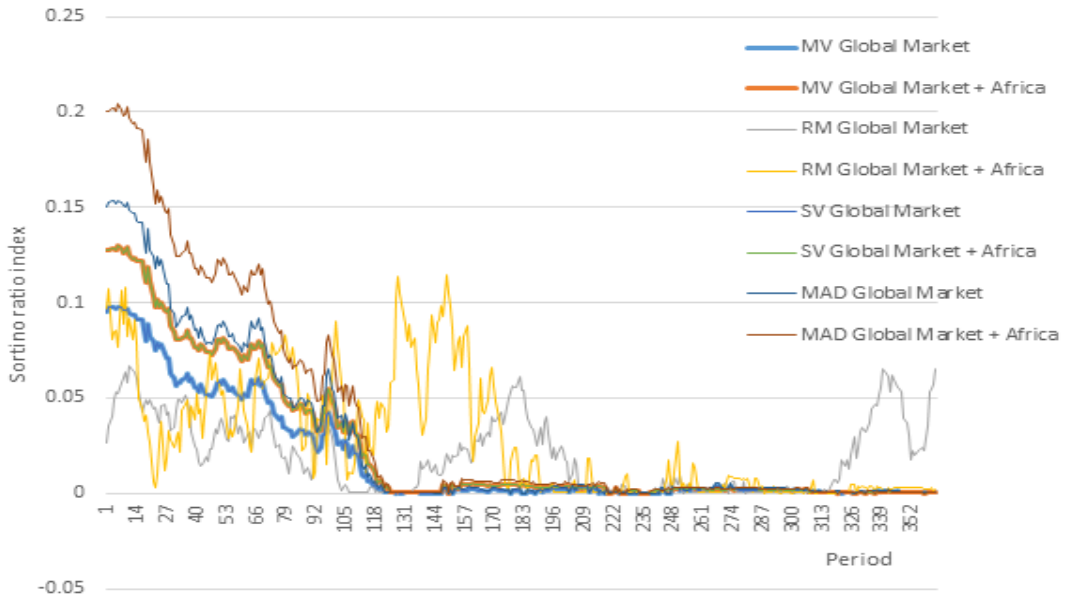

Figure 7. Out-of-sample sortino ratio performance. This figure shows the out-of-sample portfolio performances of the investment strategies for each optimization model measured by Sortino Ratio weekly. However, investment strategy with higher value of Sharpe Ratio show better performance. For this analysis, the database were divided into two sub-period, the first sub-period started 05/08/2004 to 23/07/2009 and the second sub-period started 30/07/2009 to 07/07/2016).

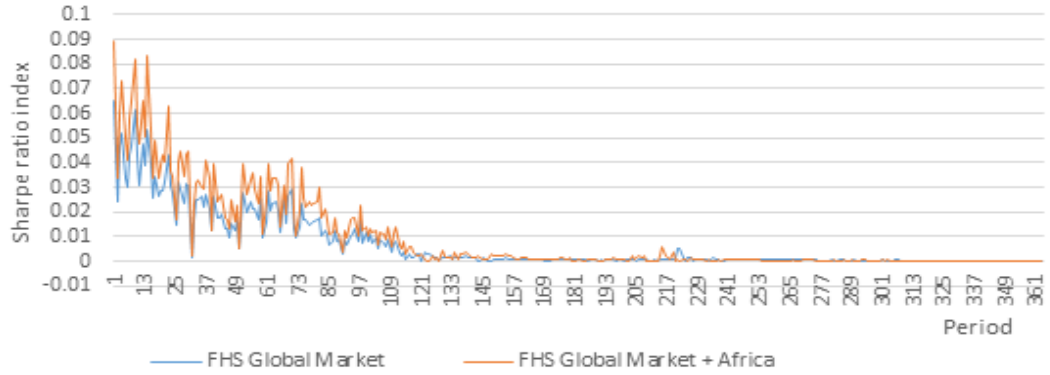

Figure 8. Out-of-sample sharpe ratio performance by FHS method. This figure show the out-of-sample portfolio performances of the investment strategies for each optimization model measured by Sharpe Ratio weekly.

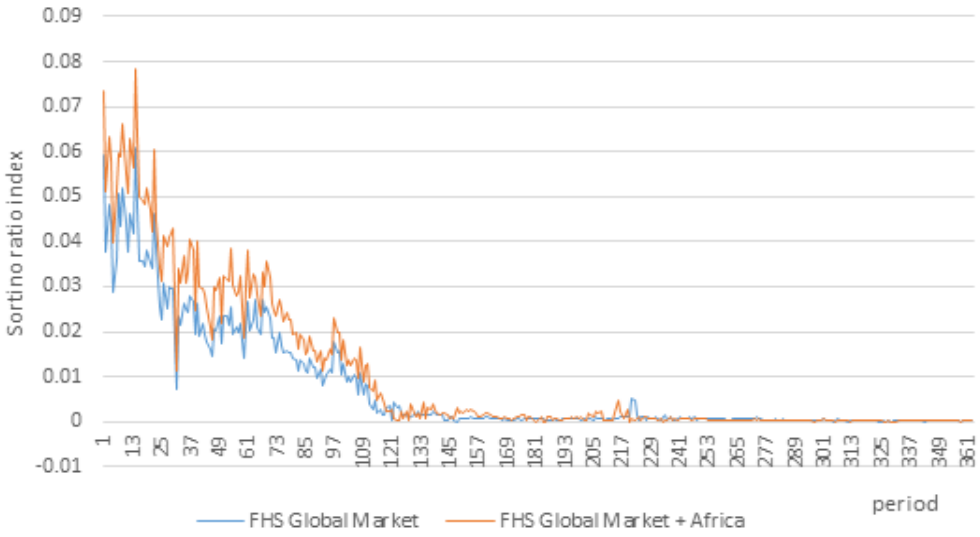

Figure 9. Out-of-sample sortino ratio performance by FHS method. This figure shows the out-of-sample portfolio performances of the investment strategies for each optimization model measured by Sortino Ratio weekly.

Table 21. Statistics test result for out-of-sample performance.

Model	Test result sharpe ratio performance			
	Null hypothesis	t-statistic	P-value	Reject or No reject
Mean variance (MV)	SR2-SR1=0	2.89	0.004	Reject
Resample Michaud (RM)	SR2-SR1=0	4.24	0.000	Reject
SemiVariance (SV)	SR2-SR1=0	2.78	0.006	Reject
Mean absolute deviation (MAD)	SR2-SR1=0	2.79	0.005	Reject
Filtered historical simulation (FHS)	SR2-SR1=0	2.49	0.013	Reject
Test result sortino ratio performance				
Mean variance (MV)	S2-S1=0	2.78	0.0056	Reject
Resample Michaud (RM)	S2-S1=0	4.10	0.0000	Reject
Semi variance (SV)	S2-S1=0	2.78	0.0056	Reject
Mean absolute deviation (MAD)	S2-S1=0	2.72	0.0066	Reject
Filtered historical simulation (FHS)	S2-S1=0	2.46	0.0141	Reject

analysis which is also a great contribution to the African capital market in the global portfolio composition as seen in Table 22.

Conclusion

The study data analysis from the period of 5th August, 2004 to 7th July, 2016 using the optimization models MV, RM, SV, MAD and FHS allowed the study to conclude that the diversification of global portfolio with assets of African capital market contributes in minimizing the risk and maximizing the return of the portfolio for the risk averse investors.

On the other hand, for risk loving investors, the diversification of global portfolio with assets of African capital markets increase the level of risk; but the benefit returns compensate for the risk increase. The study results are also in line with other studies (Lagoarde-Segot and Lucey, 2007; Yu and Hassan, 2008; Mansourfar et al., 2010) in the context of the international diversification.

The study results suggested that the foreign investors should look for an African capital market for an opportunity to maximize their wealth and diversify the investment risk. In the same order, the study result contributes to the discussion on the advantage of international diversification, even if it took place in the African context; and it further contributes to the literature

Table 22. The average weight of global market portfolio diversified with assets of African capital markets.

Markets	MV	RM	SV	MAD	FHS
Namibia	1	2	1	1	1
Nigerian	1	1	1	1	1
Gongo	2	2	2	2	2
Cote D´Ivoire	3	4	3	3	3
Egypt	1	2	1	1	1
Morrocco	1	2	1	1	1
Tunisia	1	2	1	1	1
Botswana	1	2	1	1	1
Mauritius	1	2	1	1	2
Kenya	1	2	1	1	1
Uganda	2	2	2	2	3
Zambia	2	3	2	2	2
South Africa	1	2	1	1	1
Germany	2	2	2	2	1
UK	1	2	1	1	1
France	1	2	1	1	1
Italy	1	2	1	1	1
Spain	1	2	1	1	1
Austrian	1	2	1	1	1
SWISS	2	2	2	2	2
Belgium	1	2	1	1	1
Denmark	7	3	7	7	7
Finland	1	2	1	1	1
Ireland	6	1	6	6	5
Israel	2	2	2	2	2
Netherlands	1	2	1	1	1
Norway	1	2	1	1	1
Portugal	1	2	1	1	1
Sweden	2	2	2	2	1
Czech Republic	1	2	1	1	1
Greece	1	2	1	1	1
Hungary	1	2	1	1	1
Poland	1	2	1	1	1
Qatar	2	2	2	2	2
Russian	1	3	1	1	1
Turkey	1	2	1	1	1
UAE	3	2	3	3	4
Brasil	1	2	1	1	1
Chile	1	2	1	1	1
Peru	1	2	1	1	1
Mexico	2	2	2	2	2
Canada	1	2	1	1	1
Australia	1	2	1	1	1
Hong Kong	1	2	1	1	1
Japan	1	2	1	1	1
Newzealand	1	2	1	1	1
Singapore	2	2	2	2	2
China	12	2	12	12	12
India	1	2	1	1	1
Indonesia	1	2	1	1	1

Table 22. Contd.

South Korea	2	2	2	2	1
Malasya	2	2	2	2	2
Philipine	2	2	2	2	1
Taiwan	1	2	1	1	1
EUA	3	2	3	3	3

through application of the FHS in the optimization portfolio. This methodology in addition of producing good results, reveals being more cautious in the constitution of investment portfolios than the other methods. However, this model presents lesser returns than others models.

The result of this study is important for Africa because it encourage the European, American, and Asia-Pacific investors to transfer part of their financial wealth to Africa by buying assets of African companies. These companies can help with the financial resources to develop new project which will pave way in improving the quality of lives of Africans.

On the other hand, these African companies can also use these financial resources to create new jobs that will encourage people to stay in their country, which will also reduce illegal immigration. For example, like the tragedy of deaths in the seas of the Mediterranean as it has been happening where thousands of people lose their lives trying to cross seas in small boat in the hope to find better quality of life in Europe and help their family that are in Africa. Many of these people could not get to Europe due to the bad traveling conditions, ruining their lives and dreams in the seas.

The result of this study encourages global investors to look at this problem and help Africa to solve it by buying African assets that can increase the value of their investment portfolios. The result of this study can contribute in the same way to provide transfer of knowledge or idea to Africa through canalization of these investments; this is because sometimes where there are money transfer new ideas are also shared. We can say that the result of this study can indirectly contribute to eliminate the inequality between other continents and Africa, through their investors that are looking for means to diversify their portfolios with African assets. On the other hand, this attitude on the part of global investors with the idea of buying African assets can contribute to poverty eradication in Africa.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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