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Testing assets pricing models on Africa's mutual fund industry

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Abstract

This paper concentrates on testing various asset pricing models on mutual fund returns in six African countries. The various asset pricing models include the CAPM, the Fama-French three-factor model, the Carhart four-factor model, the Fama-French five-factor model and the Fama-French six-factor model. The models performances were evaluated using a range of performance measures and the best performing asset pricing model was identified in each country as well as across the African mutual fund industry as a whole. With the CAPM being deemed as unable to fully explain returns, it led to the development of new models including more factors that were thought to be vital in explaining returns.

The top performing asset pricing model across the African mutual fund industry is the Fama-French five-factor model as it outperforms both the CAPM and the Fama-French three-factor model. Diving deeper and looking at the performances of the models in each country, the results tend to differ. For South Africa, different models outperform the others across the different metrics, however, for the remaining sample countries, the Fama-French five-factor model outperforms the other models across most performance measures.

Across all countries, except South Africa, the profitability factor, RMW, is the only non-redundant factor. All the other factors jointly explain one another. For South Africa, the momentum factor is non-redundant for both the Carhart four-factor model and the Fama-French six-factor model.

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List of Abbreviations

CAPM Capital Asset Pricing Model

FF3FM Fama-French three-factor model

C4FM Carhart four-factor model

FF5FM Fama-French five-factor model

FF6FM Fama-French six-factor model

APM(s) Asset pricing model(s)

NAV Net Asset Value

1. Introduction

In the 1990's, with the exception of certain Asian countries, there was a sharp increase in the growth of mutual funds globally (Fernando, et al., 2003). The sudden growth in mutual funds is believed to be as a result of the establishment of multinational financial organisations in multiple countries and the improvement of both equity and bond markets during the 1990's (Fernando, et al., 2003). A mutual fund is defined as a collective investment opportunity that consists of stocks, bonds and other financial securities which allows for investors to pool their money together and invest in these financial securities (Amadeo, 2021). Mutual funds are considered advantageous to investors as they provide both diversification and liquidity by allowing investors to distribute their money across various financial assets at a low cost and allowing for shares in the funds to be sold and bought instantly (Rouwenhorst, 2004). Furthermore, they offer attractive retirement investment opportunities as well as facilitating investments into money and capital markets which aid in the financing of governments and play a significant role in economic development (World Bank, 2015). The funds are also formulated, managed and monitored by professionals who are dedicated to ensuring investor success and thus simplifies and reduces individual risk of investing.

Numerous different types of mutual funds exist and many are classified according to the specific type of financial securities they invest in. The World Bank (2015) categorizes mutual funds into four main types namely: funds that invest mostly in equity securities, funds that invest in mostly in debt securities, hybrid funds that invest in both debt and equity and lastly, funds that invest in short-term debt securities. The different types of funds cater to different risk and return objectives to meet the differing goals held by investors. Funds can invest in either more long-term or more short-term investments which provides investors with a choice between long-term gain, short-term gain or both.

It is important for investors to evaluate mutual fund performance and this can be done through the use of asset pricing models (APMs) (Sha & Gao, 2019). Huij et al, (2011) perceives emerging markets to be less efficient in comparison to developed markets, providing active fund managers in emerging markets a competitive advantage over those in developed markets in identifying abnormal returns. Research into APMs best suited for emerging market funds thus becomes prevalent in aiding to find these abnormal returns benefitting both the fund managers and the investors.

APMs prove to be useful in obtaining the expected returns around various assets. These models provide beneficial information to investors in the sense that they give them an idea of the expected returns they can achieve when they invest their money (Mcclure, 2020). There are multiple APMs, some of which consider one or multiple factors to obtain the expected return. These differing models, by making use of different factors, will output different expected returns. The different models to be included in the study are the CAPM, the Fama-French three-factor model (FF3FM), the Fama-French five-factor model (FF5FM), the Carhart four-factor model (C4FM) and the Fama-French six-factor model (FF6FM).

Multiple performance measures will be executed to assess each asset pricing models performance. The performance measures will allow for the identification of the best performing APM in pricing African mutual funds. The performance measures will include the GRS statistic, which measures the extent to which the asset pricing model can explain the funds returns, alpha values and dispersion measurement, which measures the dispersion of the models and the adjusted R^2 value. These performance measurements are gone into more detail in the 'Performance measurement' section of the report. All these measurements are vital in accurately assessing which of the APMs best explains the African mutual fund industry.

Whilst there has been a significant amount of research on testing APMs on international and on local stock exchanges, as well as research done by Tan (2015) on the performance of equity funds and funds managers' performance in South Africa, there is little research on mutual funds in emerging markets. Despite the large growth in emerging market mutual funds, research into these funds and their performance is inadequate (Huij & Post, 2011). Mutual funds are deeply rooted in developed markets and most of the research surrounding emerging markets focuses on USA funds that invest in emerging markets (Ramasamy & Yeung, 2003). There has been significant size growth in the mutual fund industries of emerging markets and further research into these funds will prove to be beneficial in attracting international funds in developed markets to make enquiries into emerging markets.

African countries are grouped amongst emerging markets and thus the lack of research pertaining to mutual funds and particularly APMs performance with respect to mutual funds is prevalent. Testing APMs on mutual funds throughout the continent will provide helpful insight to investors both locally and globally into pricing these funds.

2. Context of study

This section will dive into the African mutual fund industry, present stylized facts about the sample countries mutual fund industries and in essence serve as a motivation for the study.

The development of mutual funds in a region is key in aiding economic growth, thus the development of the mutual fund industry in emerging markets, like those found all over Africa, is vital. Securing financing is crucial to promoting development in Africa and a well-established mutual fund industry can significantly enhance the much-needed development. Mutual funds provide a means to transfer liquidity from bank deposits into money and capital markets which can provide a significant source of funding to governments and corporations (World Bank, 2015). Research shows that in 2019, the US, Europe and Asia Pacific countries accounted for 47%, 34% and 13% of the assets in open funds, leaving just 6% to the rest of the world (Milena, 2021). This indicates the dominance of the mutual fund industry by developed markets and the small size of the mutual fund industries in emerging markets, Africa included.

World bank (2015) describes lack of awareness as one of the factors that contribute to hindering the development of mutual fund industries in emerging markets. The lack of awareness and understanding of mutual funds by government and regulators results in them receiving less attention in financial strategies and fiscal policies that inhibit their development and prevent them from achieving their maximum potential. This has far reaching effects into lowering investor confidence and reduces the demand for funds, slowing industry growth. The author also mentions that the lack of public awareness with regards to mutual funds, understanding what they are, how they work and how they can benefit individuals. South Africa is presented as an example to show case the lack of public awareness. The results from survey returned that only 33% of the sample have previously heard about mutual funds and that a mere 2% invest in mutual funds (World Bank, 2015). Kenya further displays this lack of awareness in that newspapers, websites or magazines do not provide consistent, comprehensive information on mutual funds, leaving the public somewhat in the dark (World Bank, 2015). Additionally, Kenya has an absence of independent data providers which can provide unbiased information on fund performances and costs to increase demand and confidence (World Bank, 2015).

Distribution channels serve as a means to sell mutual funds to the public within a region. Khorana et al. (2005) regard distribution channels as a supply-side factor that plays a role with regards to public interest and mutual fund industry size. The number of different types of distribution channels used is higher in developed markets in comparison to emerging markets

(World Bank, 2015). The number of main distribution channels for Kenya, Morocco and South Africa at the end of 2012 was three, two and three respectively, whereas there were at least six or more distribution channels for a sample of selected European countries (World Bank, 2015). The number of distribution channels in emerging markets thus needs to be increased to aid in the growth of the industry within these markets.

Africa has become an exciting prospect for corporations to expand their operations into and will consequently draw the attention of investors and fund managers. Wright (2015) observes that less liquid, emerging markets grant more fund managers more chances to outperform the benchmark index, making actively managed funds more attractive to investors. This results in the African mutual fund industry having an advantage over those of developed countries, an advantaged that must not be left to waste.

The African mutual fund industry is considerably behind the mutual fund industries of developed markets and a telling factor of this is the difference in expenses between the different markets. Wright (2015) establishes that African mutual funds face considerably higher expenses in comparison to international developed markets. This further confirms Maturana and Walker's (1999) research that emerging markets have significantly higher operating costs and expense ratios. Similar findings are also discussed in Okungu (2020) which describes high costs as a "barrier to entry for investors" in addition to highlighting a number of reasons which contribute to the constriction of the number of mutual funds available. Khorana et al. (2005) argue that regions who have higher barriers to entry tend to contain small mutual fund industries. Thus, progress towards implementing an improved expensing and fee framework in emerging markets is necessary to promote local and foreign investment to stimulate the growth of the mutual fund industry (Wright, 2015).

The African mutual fund industry in comparison to the mutual fund industries of countries like the US, Europe and Asia is fairly young with a significantly smaller number of funds available, thus limiting the investment opportunities for fund managers (Okungu, 2020). It is important to encourage expansion and growth of the industry to enable Africa to compete with the already well-established mutual fund industries of developed countries. Policy makers and regulators are at the forefront of promoting growth in mutual fund industries. They are required to have an in depth understanding of the industry in order to efficiently supervise and enable mutual funds (World Bank, 2015). Okungu (2020) argues the need for well-established rules, laws and regulations that protect both investors and fund managers to promote the growth of the industry.

However, it must be ensured that the regulations put in place are not excessive which will force fund managers to move their operations elsewhere. This will inevitably result in a loss of investment which will increase the expenses of the already established funds to make up for the loss (Wright, 2015).

World Bank (2015) states that although emerging markets have small mutual fund industries, there has been noticeable growth and the industry is gaining popularity. Data collected displays that mutual fund assets under management increased from 2.3% to 6.3% between 2001 and 2012 in middle-income countries (World Bank, 2015). Within the Sub-Saharan African region, South Africa is seen to contain the largest mutual fund industry, which began in 1965 (World Bank, 2015). The industry has shown considerable growth within the past decade with the total value of assets managed growing from R2.7 trillion in December 2009 to R6.3 trillion in June 2020 (Buthelezi, 2021).

The statistic, mutual fund assets as a percentage of GDP in a country, displays the ratio of the value of a country's mutual fund assets under management to a country's GDP. The statistic serves as a good indication of the contribution made by the mutual fund industry within a country to its economy. Data for four African countries showcasing their mutual fund assets as a percentage of GDP in 2017 ranks South Africa as having the highest value at 52.02%, followed by Namibia at 31.70%, Uganda at 2.13% and lastly, Nigeria at 0.35% (TheGlobalEconomy.com, 2017).

The first mutual funds in Egypt were established in 1994 and there were an estimated 90 mutual funds in the country as of 2013 (Stefea, et al., 2013). More recent data indicates that as of 2018, the Egyptian mutual fund industry has grown to 192 mutual funds. Egyptian mutual funds are considered to be transparent and are overseen by multiple regulation and oversighting bodies (Oxford Business Group, n.d.). The value of funds under management in Egypt in 2019 exceeded EGP 50.4 billion, marking a growth of 14.3% from 2018 (Halbawi, 2019). The significant growth in value was traced back to the growth of Islamic funds and Money Market funds in particular (Halbawi, 2019). The most recent data found for Egypt's value of assets under management as a percentage of GDP was from 2015. Egypt had a 0.78% value of assets under management to GDP (Lemeshko & Rejnus, 2015).

In Morocco, the first mutual funds were established in 1995 (Oxford Business Group, 2009). The Moroccan mutual fund industry's assets under management grew 19% between the years 2002 and 2011 (World Bank, 2015). In 2011, the Moroccan mutual fund industry consisted of

333 mutual funds with a total value of assets under management equating to DH 230 billion. According to data from 2012, Debt Funds made up the majority of Moroccan mutual funds, providing substantial liquidity to the banking industry, followed by Money Market funds. These two fund types dominated the industry with a believed 85% of the total value of assets under management invested in them (World Bank, 2015). The impressive growth of the industry was catalysed by Moroccan institutional investors who own majority of the total assets under management (World Bank, 2015). This is seen as a result of Morocco containing the largest and most developed insurance sector in Africa (Okungu, 2020). The following table displays the different mutual fund types found in the Moroccan fund industry and the value of assets under management pertaining to that class.

Table 1: Number of funds for each fund type and respective value of assets under management for Morocco

	Equity funds	**Bond (Debt) funds**	**Money market funds**	**Other**	**Total**
Number of funds	79	153	40	61	333
AUM in 2012 $. Billions	2.58	15.77	7.04	1.26	26.65

Source: (World Bank, 2015)

The Mauritian mutual fund industry, established at the start of the 1990s, has since experienced impressive growth, allowing for it to compete with other emerging market countries mutual fund industries (Nitish, et al., 2009). The country was estimated to have 1070 global funds in October of 2020 (Rajahbalee, et al., 2021). The Mauritian government is playing a substantial role in promoting the growth of the mutual fund industry, attracting the interest of investors. The success of the Mauritian mutual fund industry and the attraction of fund managers is tied to its legal and regulatory systems, its tax laws, the presence of skilled professionals and international corporations and its infrastructure and political stability (Bedell Cristin, 2012). The value of total assets under management as of December 2013 was estimated to be around MUR 12.38 billion (Wright, 2015).

The Nigerian mutual fund industry began with the establishment of the first fund in the 1990s and consists of a range of different types of mutual funds (Okungu, 2020). The Nigerian fund industry displayed a growth rate of 24% between 2002 and 2012, greater than both Morocco and South Africa (World Bank, 2015). The total value of assets under management in Nigeria in December 2013 was estimated at NGN 165.1 billion (Wright, 2015). The industry has since displayed noteworthy growth, with total assets under management growing by 43% in the year 2020 to arrive at value of NGN 1.49 trillion at the end of the year (Endurance, 2021). However, over the course of the first four months of 2021, the value was dropped to NGN 1.37 trillion (Endurance, 2021). The industry introduced 12 new funds resulting in the total number of funds reaching 128 (Ndimele, 2021).

This study will both individually assess and group together the data from the above listed countries, and Namibia, in order to compare the performances of the different APMs and identify which of the models is best recommended to explain African mutual fund returns. The has been previous studies within the context of these listed countries on measuring the performance of mutual funds in their relevant mutual fund industries. However, no study is yet to identify, from a variety of APMs, the best performing model in the African region as a whole.

3. Problem Statement

Sha and Gao (2019) describe APMs as the framework used to understand the returns across various assets. They serve as a reliable means to measure the performance of investors investments. Additionally, APMs can be used to ensure whether or not assets are correctly priced and identify abnormal returns for investor gain (Huij & Post, 2011). APMs are frequently made use of to measure mutual fund performance. It thus becomes vital to have a reliable, tested framework in place to reliably measure the performance of these funds in specific markets.

To the researcher’s knowledge, there is yet to be theoretical and empirical investigations into APMs in the African mutual fund industry. There has been significant research in developed markets around APMs and their performance surrounding stock exchanges and mutual funds, however, emerging markets and in particular their mutual fund industries have not been given equal attention.

In order to prevent emerging markets, like those in Africa, from falling far behind developed markets, it is important to keep up to date with the progress made in developed markets. Thus, comparing and identifying the best APM to price mutual funds in Africa will be an important contribution to the already existing literature on APMs as a whole and African countries and their mutual fund industries. The research will provide investors with information as to which is the best suited model to the African mutual fund industry and resultingly by extension, which risk factors best resonate with the industry. Furthermore, it can also prove useful in investment companies expanding their investments or funds into Africa as they now have a framework to accurately measure fund performance to ensure investor satisfaction. It can also aid in diversifying developed market investment companies' offshore investment opportunities, which will benefit emerging markets.

This paper differs from other papers in that it focuses on testing APMs on mutual funds in emerging markets, in particular Africa. The absence of information in this area makes it more difficult for fund managers to accurately measure the performance of mutual funds and can result in misleading information on fund managers performances. It is thus important to identify the best performing APM to be used in the African mutual fund industry.

4. Objectives

The objectives of this research paper involve:

- To compare the various APMs within the context of the African mutual fund industry.
- To recommending the best asset pricing model to use for pricing African mutual funds.

5. Literature Review

5.1 Theoretical literature

5.1.1 CAPM

The Capital Asset Pricing Model, also known as CAPM, provides a means to relate an assets risk to its expected return (Perold, 2004). The model was derived by William Sharpe, Jack Treynor, John Lintner and Jan Mossin (Perold, 2004). The CAPM is frequently used to measure mutual fund performance (Fama & French, 2004). Conferring to Fama and French (2004), the model makes two key assumptions in accordance with the mean-variance model which are: borrowing and lending occur at the risk-free rate and that investors are in complete agreement with regards to the distributions of returns. The basis of the CAPM's application to portfolios is that investors should not be rewarded for risk that is diversifiable i.e. risk that can be eliminated through a diversified portfolio. Thus, the CAPM measures the return of a risky portfolio based only on its undiversifiable risk. The algebraic expression of the model suggests that the larger the beta value of an asset, the larger the expected return of the asset.

The algebraic expression for the CAPM is:

$$E(r_i) = r_f + \beta_i (E(r_M) - r_f)) \quad (1)$$

Where $E(r_i)$ is the expected return of an asset, $E(r_m)$ is the expected return of the market, r_f is the risk-free rate and β_i is the portfolio risk.

The CAPM can also serve as a means to evaluate fund managers (Womack & Zhang, 2003). Managers that create and add value are managers whose portfolios have higher returns than that predicted by the CAPM (Womack & Zhang, 2003). In order to measure and ensure that a fund manager is adding value, we make use of the alpha variable which is a measure of excess return (Womack & Zhang, 2003). A positive alpha value provides a signal of the managers performance in the sense that the portfolio has an excess return and lies above the Security Market Line (Womack & Zhang, 2003). By making use of the CAPM and regression and the outputted alpha value, one can assess whether or not a fund manager should be recognised for adding value (Womack & Zhang, 2003). The CAPM is estimated using the following regression expression:

$$r_{it} - r_{ft} = \alpha_{it} + \beta_{it}(r_{mt} - r_{ft}) + \varepsilon_{it} \quad (2)$$

The CAPM is still to this day popularly used for a wide range of applications as a result of its simplicity, however, it tends to have multiple shortcomings that may undermine its practical use (Fama & French, 2004). In the case of individual asset returns, the CAPM provides imprecise results as obtaining estimates of beta proves to be a difficult task (Fama & French, 2004). Furthermore, interference problems arise as a result of the correlation of residuals when running a regression (Fama & French, 2004). The CAPM makes various other unrealistic assumptions that deem it be considered as impractical by many (Mokgele, 2018). These assumptions include and are not limited to: assuming no insider trading and that all investors have the same information i.e. markets are highly efficient, no taxes or transaction costs, all investors borrow and lend at the risk-free rate and that the returns of all assets follow a normal distribution (Fama & French, 2004) (Mokgele, 2018). Lastly as mentioned by Womack & Zhang (2003), many researchers question the single risk factor used by the CAPM for explaining the returns of financial securities and thus has resulted in further research and development of other models to improve the accuracy and reliability of security pricing.

5.1.2 FF3FM

Following the heavy criticisms of the CAPM, Fama and French formulated an extension of the model in the form of the FF3FM (Bello, 2008). Kenneth French and Eugene Fama realised that the CAPM did not include two factors which they found to be pertinent in explaining the expected returns of assets (Rehnby, 2016). These factors were the book-to-market equity ratio and market capitalization (Rehnby, 2016). The inclusion of these two factors on the already established CAPM formed the FF3FM. The model explains that the risk premium (r_{it}-r_{ft}) on an asset is a function of the beta measured on three different factors namely, the difference in return between the market portfolio and the risk-free rate, the difference in returns of a portfolio that represents small firms against large firms and the difference in returns of a portfolio that represents high against low book-to-market value ratio firms (Bello, 2008).

The algebraic expression for the FF3FM is given below:

$$E(r_i) = r_f + \beta_i(E(r_{mt} - r_{ft}) + \beta_{iSMB}(SMB) + \beta_{iHML}(HML) \qquad (3)$$

Where SMB is small minus big firm returns and HML is high book-to-market value firms minus low book-to-market value firms.

The SMB coefficient is a measurement of the historical excess returns received by investing in small market firms over that of big market firms (Womack & Zhang, 2003). A positive value of SMB is indicative of small cap stocks outperforming large cap stocks for that time period (Womack & Zhang, 2003). The HML coefficient is a measurement of the value received by investing in high book-to-market value firms over low book-to-market value firms (Womack

& Zhang, 2003). The testing done surrounding these two factors indicate that these factors work in explaining the returns of an asset (Womack & Zhang, 2003). The advantages of the FF3FM can be explained through the above presented equation. It provides investors with the opportunity to construct their portfolios in such a manner that they can decide how much weight to allocate to each of the above identified risk factors (Womack & Zhang, 2003). This enables investors to more accurately achieve different levels of expected return (Womack & Zhang, 2003). Womack & Zhang (2003) claim that the model can be used to classify funds and enables investors to decide on the amount of exposure to each risk factor they are willing to take on when investing in funds. Furthermore, funds can be classified according to their risk and their differing investment strategies (Womack & Zhang, 2003).

The same concept in evaluating fund managers as previously discussed under the CAPM model can be used to evaluate fund managers with regard to the FF3FM (Womack & Zhang, 2003). A positive value of alpha implies that fund managers are indeed adding value to their constructed portfolios. The regression equation associated with the FF3FM is presented below:

$$r_{it} - r_{ft} = \alpha_{it} + \beta_{it}(r_{mt} - r_{ft}) + \beta_{iSMB}(SMB_t) + \beta_{iHML}(HML_t) + \varepsilon_{it} \tag{4}$$

Multiple benefits have been seen when using regression of the three-factor model ahead of the CAPM model when looking at the returns of stocks on international stock markets as well as the Chinese mutual fund industry. The three-factor model displays higher R^2 values, of 0.95 and higher, according to Womack & Zhang (2003), indicating that the model tends to better explain the variations in return. More importantly, Womack & Zhang (2003) explain that a positive alpha value outputted by the regression of the CAPM is not a direct indication of manager performance but instead as a result of SMB or HML factors that were not considered. The CAPM only takes into account one risk factor, market risk, and thus the expected returns must either be a result of market risk or fund managers ability. This leaves room for inaccuracies to be drawn about fund manager performance. However, with the three-factor model, we are now able to assess whether the returns pertain to the fund managers performance or to size and value risk measured by the two new incorporated factors (Womack & Zhang, 2003).

Rehnby (2016) further explains that results prove that the FF3FM, in comparison to the CAPM, provides a clear improvement in explaining the portfolio returns on the Swedish stock market. Other research conducted such as that of Bello (2008), Gokgoz (2007), Shaker and Elgiziry (2014) all display that the FF3FM model displays a significant improvement in performance in comparison to the CAPM when tested on multiple global stock exchanges. Sha and Gao (2019) however conclude through their research on the Chinese mutual fund industry that the cross-sectional differences between the R^2 values outputted by the models are not statistically significant. Sha and Gao (2019) further elaborate that the CAPM has advantages over the other models, the FF3FM included, in explaining funds performances consisting of a lower proportion of stock.

5.1.3 C4FM

The Carhart four-factor model was formulated by Mark M. Carhart in 1997 as an extension of the FF3FM (Rehnby, 2016). This model was presented as a means to evaluate mutual funds and incorporates an extra risk factor in comparison to the FF3FM, a momentum factor (Rehnby, 2016). This fourth factor is described as one-year return momentum which will explain the inclination of a fund with negative past returns to keep earning negative returns in the future and funds with positive past returns to keep earning positive returns in the future (Bello, 2008). Carhart (1997) explains that the C4FM greatly improves the average pricing errors that were achieved by the CAPM and FF3FM. Furthermore, Carhart (1997) elaborates on how the model evidently reduces the pricing errors of the CAPM and FF3FM from 35% and 31% respectively, to just 14%, thus concluding that the model is successful in explaining cross-sectional differences in stock returns.

Carhart (1997) also tested the model performance on estimating the lagged one-year returns of mutual fund portfolios. He measured the model's performance in comparison with the CAPM and the FF3FM. The results depict that the CAPM fails to explain the returns of mutual fund portfolios as the model produces significant abnormal returns (Carhart, 1997). Contrastingly, the C4FM's factors of size and momentum provide explanations for the spread of returns in the portfolios (Carhart, 1997). The regression equation associated with the C4FM that will be used in evaluating its performance is presented below:

$$r_{it} - r_{ft} = \alpha_{it} + \beta_{it}(r_{mt} - r_{ft}) + \beta_{iSMB}(SMB_t) + \beta_{iHML}(HML_t) + B_{iPMF}(PMF_t) + \varepsilon_{it} \quad (5)$$

The PMF factor represents the one-year momentum in stock returns (Carhart, 1997). It is calculated as the top thirty percent of returns minus the bottom thirty percent of returns (Carhart, 1997).

Further studies conducted by Bello (2008) display improved performance of the C4FM over both the CAPM and FF3FM when explaining the returns of equity funds. Studies conducted on the Swedish stock market display that the C4FM outperforms the CAPM and FF3FM and is the best model, out of the three tested, to price stock on the Swedish stock market (Rehnby, 2016).

5.1.4 FF5FM

Criticisms of the FF3FM dubbing it as incomplete resulted in the birth of the FF5FM. Fama and French (2015), identified suggested evidence that two factors, namely profitability and investment, aid in explaining stock returns. Additional evidence suggests that variation in returns that was unexplained by the FF3FM is due to the lack of inclusion of profitability and investment factors (Fama & French, 2015). As a result of the evidence brought forward, investment and profitability factors are added to the market, size and book-to-market value factors that formulate the earlier proposed FF3FM. Fama and French (2015) explain the reasoning behind the addition and inclusion of these vital factors and draw relations back to the dividend discount model and the market value of a company's stock. Analysis of the algebraic expression of the market value of a company's stock suggests that stock's return is not only determined by the price-to-book ratio, but also on its future expectations of investment and profitability (Fama & French, 2015). Factors like size and momentum aid in explaining future returns and there is a relation between these factors and the profitability and investment factors (Fama & French, 2015).

Fama and French (2015) provided evidence that the FF5FM outperformed the FF3FM in explaining returns for portfolios constructed on book-to-market value, size, investment and profitability. Sha and Gao (2019) reiterate this fact with their comparative test of APMs on the Chinese mutual fund industry. Their findings make use of empirical tests to identify which of the models performs the best in pricing Chinese mutual funds and their results concluded that the FF5FM surpasses the rest within the industry. Sha and Gao (2019) test the APMs on a variety of different classes of mutual funds in China.

The regression expression relating the FF5FM is presented below:

$$r_{it} - r_{ft} = \alpha_{it} + \beta_{it}(r_{mt} - r_{ft}) + \beta_{iSMB}(SMB_t) + \beta_{iHML}(HML_t) + \beta_{iRMW}(RMW_t) + \beta_{iCMA}(CMA_t) + \varepsilon_{it} \quad (6)$$

The factor RMW represents the difference in returns between robust and weak profitability stocks, whereas CMA represents the difference in returns between conservative and aggressive portfolios of stocks (Fama & French, 2015).

5.1.5 FF6FM

In a paper published by Fama and French (2018), they study the capability of the maximum squared Sharpe ratio as a means to rank APMs. In the paper, they mention a six-factor model, an extension of the already proposed FF5FM. The FF6FM consists of an additional momentum factor in comparison to the FF5FM (Fama & French, 2018). The momentum factor was incorporated in the C4FM as an extension of the FF3FM and the factor is explained under the C4FM section. The regression equation for the FF6FM is provided below:

$$r_{it} - r_{ft} = \alpha_{it} + \beta_{it}\left(r_{mt} - r_{ft}\right) + \beta_{iSMB}(SMB_t) + \beta_{iHML}(HML_t) + \beta_{iRMW}(RMW_t) + \beta_{iCMA}(CMA_t) + \beta_{iPMF}(PMF_t) + \varepsilon_{it} \quad (7)$$

Fama and French (2018) results from their research display that the FF6FM performs the best out of all the nested models. The tests were conducted on stock portfolios in the USA. The six-factor model will be tested on South African mutual funds to see its position with regards to other APMs in terms of its performance.

5.2 Performance Measures

Sha and Gao’s (2019) work with APMs in the Chinese mutual fund industry presented the use of several performance measurement metrics used to identify the best performing asset pricing model. These soon to be identified performance measurements will fully assess the different APMs performance and highlights areas in which the models excel and can be improved in relation to one another and the data.

The first performance measurement mentioned by Sha and Gao (2019) is the GRS statistic. The GRS statistic, developed by Gibbons, Ross and Shanken (1989), is a test of the mean-variance efficiency of asset returns (Kamstra & Shi, 2020). The F-test is very commonly used in assessing APMs. The test is applied to verify the ability of an APM to explain the return of an asset in addition to providing a result that can be used comparatively to assess which of the APMs performs the best (Kamstra & Shi, 2020). The APM that returns the lowest GRS test statistic is considered to be the model that best explains the asset returns and performs the best with regards to that particular asset (Kamstra & Shi, 2020). The strength of the GRS test lies in its ability to rank APMs when comparing their performance, not in testing the models (Kamstra & Shi, 2020). Kamstra and Shi (2020) go on to describe that incorrect execution of the GRS test results in the test being unfavourable to the models consisting of more factors. They further elaborate on how when making use of data of twenty years and less, the presence of errors in empirical tests grows. Kamstra and Shi (2020) in their paper also highlight the work done by Sha and Gao (2019), and their sample size of less than twenty years, and indicate that there is a large chance of bias existing from an incorrectly executed GRS test.

The general formula for the GRS test is given as:

$$F = \frac{T(T-N-K)\hat{\alpha}'\hat{\sum}^{-1}\hat{\alpha}}{N(T-K-1)1+\bar{r}'_{p}\hat{\Lambda}^{-1}\bar{r}_{p}} \tag{8}$$

Where N represents the number of test portfolios, T represents the sample size and K represents the number of risk factors in each model.

As a result of the risk of bias results due to the possible arise in issues mentioned in the paragraph above with regards to the GRS test, further performance measurements are necessary. These performance measurements will ensure the empirical testing and results produced are fair.

The second performance metric identified by Sha and Gao (2019) is the average absolute values of the alphas obtained from the regression analysis of the different models. The alpha value outputted from the regression analysis will serves as a means to measure the mispricing of the models or to measure an assets variation from the model (Sha & Gao, 2019). There will be three different measures of dispersion, the absolute average alpha value, the ratio of the average absolute value of the alphas to the average absolute value of the average excess return on a fund minus the average excess return on the market portfolio and finally the squared values of the two aforementioned factors (Sha & Gao, 2019).

The formulas for the three dispersion measures are as follows:

$$A|\alpha_i| = \frac{1}{N}\sum_{N=1}^{N}|\alpha_i| \tag{9}$$

$$\frac{A|\alpha_i|}{A|r_i|} \tag{10}$$

$$\frac{A\alpha_i^2}{Ar_i^2} \tag{11}$$

Where r_i is defined as the average excess return on a fund minus the average excess return on the market portfolio and α_i is the intercept term obtained from the regression analysis. The lower the values of the measures of dispersion, the better the performance of the asset pricing model in pricing mutual funds (Sha & Gao, 2019).

The next performance metric is a measurement of the proportion of the alpha value dispersion as a function of sampling error (Sha & Gao, 2019). The formula for this performance metric is provided below:

$$\frac{As^2(\alpha_i)}{A\alpha_i^2} \tag{12}$$

With,

$$As^2(\alpha_i) = \frac{1}{N-1}\sum_{N=1}^{N}(\alpha_i - \bar{\alpha}_i)^2 \tag{13}$$

Where α_i is the intercept term obtained from the regression analysis.

The final performance metric used to measure the performance of the models is the average adjusted R^2 value, $A(R^2)$. The higher the values of these two performance metric values, the better the model is at pricing mutual funds (Sha & Gao, 2019).

5.3 Empirical literature

The lack of substantial empirical evidence on multiple countries stock markets led to a wide variety of studies regarding APMs and their pricing of stocks on specific stock exchanges in a country being carried out. There has been a sizeable number of studies conducted on international stock exchanges to evaluate the performance of specific APMs on that stock exchange. In addition, this also provides information on APMs within the context of that particular country which could provide a vital framework for investors going forward.

Gokgoz (2007) tested and compared the performance of the CAPM and FF3FM on the Turkish stock exchange. The study outlines the reasoning behind the extension of the CAPM to formulate the FF3FM and describes the two additional factors included in determining the expected returns of assets. Gokgoz (2007) carried out the investigation on the Istanbul Stock Exchange, thereby providing Turkey with some empirical research surrounding a single and multifactor asset pricing model. The tests were carried out on basic Istanbul Stock Exchange indices between the period of 2001-2006. The paper also carried out both time series and cross-sectional regression to measure the performance of the models in addition to using the GRS test to disclose pricing errors. The study proved the superior performance of the FF3FM over the CAPM.

Shaker and Elgiziry (2014) carried out a comparative study of APMs on the Egyptian stock exchange. The study makes use of the GRS test as a means of comparing the different models.

The study compared five different models namely: the CAPM, the FF3FM, the C4FM, the liquidity-augmented four-factor model and the FF5FM. Shaker and Elgiziry (2014) made use of data from the Index of the most 100 active stock ranging from 2003-2007. The study concludes that the FF3FM performs the best on the Egyptian stock market. Shaker and Elgiziry (2014) further question the inclusion of a momentum factor in emerging markets.

Rehnby (2016) conducted a study on the Swedish stock exchange in which they compared the CAPM, FF3FM and the C4FM. The study was conducted between 2010 and 2015 and consisted of 106 listed companies. The study compares the models based on the adjusted R^2 value. The study concluded that the C4FM performs the best in explaining the portfolio returns.

Sha and Gao (2019) carried out a comparative study of five APMs on the Chinese mutual fund industry in order to clear up previous contradictory results. The study compared the CAPM, FF3FM, C4FM, FF5FM and lastly the FF6FM. The study makes use of a number of performance metrics to thoroughly assess the performances of the different pricing models on Chinese mutual funds. Sha and Gao (2019) classified Chinese mutual funds into various fund classes and assessed the performance of the models on these fund classes. They conclude in their research that choosing the asset pricing model is tied to the fund type and that multifactor models return higher R^2 values than the likes of the CAPM model, with the C4FM in particular on average across all fund types producing the highest R^2 value.

Bello (2008) researched and compared “the statistical goodness of fit and quality prediction” of three APMs namely, the CAPM, FF3FM and C4FM on equity mutual funds in the USA. The study was carried out on fund returns between 1986 and 2006. Bello (2008) made use of the adjusted R^2 value along with Amemiya’s criterion in order to measure and evaluate the statistical goodness of fit of the APMs. Bello (2008) also used the error variance, S^2, as a measure of the quality prediction of the model. Furthermore, the study made use of the PRESS statistic and Mallow’s C_p to compare the models to find the best performing model. The results depicted small changes in the adjusted R^2 value between the three models, indicating that the goodness of fit between the models is insignificant. When looking at Mallow’s C_p to evaluate the best performing model in explaining equity mutual fund returns in the USA, the results displayed that C4FM is superior, followed by the FF3FM and then the CAPM.

Kildahl and Lunde (2018) conducted research on the US mutual fund industry with the intention of identifying the most applicable asset pricing model for performance evaluation. The most applicable model was found using the GRS-test. The authors believed that recognizing and thereafter making use of the most applicable model will prove to be beneficial in correctly assessing fund managers and value addition. Seven APMs were tested on mutual fund returns between 1999 and 2018 and conclusions were drawn that the FF5FM can ultimately be regarded as the most suitable model in explain US mutual fund returns. Their findings also somewhat praised the performance of the CAPM model despite its simplicity and wide criticism. Furthermore, the authors highlighted that those models including the profitability factor and investment factor seem to outperform those disregarding those factors.

Chiah et al. (2016) study the performance of the FF5FM on the Australian equity market between 1982 and 2013. The study compared various models: the FF3FM, C4FM and two combined models formulated by the augmentation of US and Australian factors. The authors concluded that the FF5FM contained the lowest pricing errors and was selected as the best performing model. This is as a result of the inclusion of the profitability factor and investment factor in the model, which other models in the study lack. The authors explain that extensive research of Australian equities has been conducted and that there have been significant pricing errors which has now been improved by the FF5FM.

Tan (2015) carried out a study on evaluating equity funds in South Africa and the selection skills of fund managers. The study sample included ten equity funds and the time period considered was January 2009 to November 2014. The study made use of several measurements of performance namely the Sharpe ratio, the Treynor ratio and Jenson's alpha to identify the top performing funds from the sample.

This is just some of the international and local research conducted into APMs and pricing stocks or mutual funds. Further research conducted by Mokgele (2018) on testing the CAPM on the Johannesburg Stock Exchange, Wright (2015) on the fund fees and expenses of African mutual funds, Nitish et al. (2009) on analyzing the performance of Mauritian mutual funds and Ilo et al. (2018) on examining the performance of Nigerian mutual funds has also been done. Mokgele (2018) concluded that the CAPM was unable to explain stock returns in South Africa and suggested further research into the use of models incorporating more factors such as the likes of the FF3FM, Wright (2015) concluded that mutual fund industry in Africa has higher costs attached to it in comparison to developed international industries, Nitish et al. (2009) made us of the Sharpe and Treynor ratio to concluded that majority of the funds have an adequate performance and are less risky than the market and Ilo et al. (2018) who also make use of the Sharpe and Treynor ratio to evaluate fund performance concluded that the funds underperform the market in Nigeria. In light of all these studies being conducted, it is clear that APMs have been given inadequate attention in the African mutual fund industry and there has yet to be a study that, from a range of APMs, identifies the best suited model for the continent as a whole. Thus, leaving a scope for research.

6. Methodology

6.1 Introduction

The research paper compares five APMs and identifies the top performing one in the African mutual fund industry. There are five APMs included in the study namely the CAPM, the FF3FM, the C4FM, the FF5FM and the FF6FM. Each of the models will undergo a regression analysis and thereafter, using various performances measures, will be compared and conclusions will be drawn as to the best performing model. Six African countries have been listed in the sample to be used in the study.

6.2 Population

The population of this research includes African countries' mutual funds. All mutual funds used in the study are equity mutual funds according to the data pulled off Bloomberg. The time frame for the study is between February 2013 and August 2021. All necessary data required for the analysis was collected for the above stipulated period.

6.3 Sample

The sample for the study includes six emerging market African countries, South Africa, Morocco, Egypt, Nigeria, Mauritius and Namibia. The sample countries were initially identified through previous studies, in which the author was aware of the availability of data. Furthermore, multiple databases were sorted through to find more countries to include in the study, however, no other countries with relevant data were found. The number of mutual funds for which data was found differed across the different countries and a full summary can be found in Table 2 below.

Table 2: Sample characteristics for the study

Country	**Number of Funds**
South Africa	602
Egypt	38
Mauritius	131
Morocco	388
Namibia	11
Nigeria	10

6.4 Data

The study mase use of secondary, time-series data, acquired from professional databases. Monthly returns of mutual funds used in the analysis was obtained from Bloomberg. The study makes use of monthly mutual fund returns from 28 February 2013 to 31 August 2021, resulting in a total of 103 observations. All countries, except for Nigeria, fell in this time period. Nigerian mutual fund returns obtained from the Bloomberg database were only available between 30 April 2014 and 31 August 2021, resulting in a total of 89 observations. All other relevant information required as an input in the regression equations for the specified models such as the risk-free rate of return and the various factors were obtained from the Peresec website and the Kenneth R. French Data Library. The Peresec website provided historical data for all six Fama-French factors required as inputs for all the models, including the risk-free rate for South Africa for the study time period. All Bloomberg returns were in USD and the factors from the Peresec website were in ZAR. In order to keep currency consistency throughout the study, the factors had to be converted to USD to avoid discrepancies in the results. The factors were converted from ZAR to USD using the following formula as presented in Daul, et al., 2010:

$$r_{USD} = r_{ZAR} + r_{FX} + r_{ZAR} r_{FX} \tag{14}$$

Where r_{FX} is the return in the exchange rate between the two currencies i.e USD and ZAR, and r_{ZAR} is the total return in ZAR.

The Kenneth R. French Data Library provided historical data for all five Fama-French factors for emerging markets. The remaining five countries, Egypt, Morocco, Mauritius, Namibia and Nigeria are all considered as emerging markets and thus enabled the use of this data. The data library, however, only provided factors that could be used for the CAPM, FF3FM and FF5FM. Thus, South African mutual fund returns were tested using all five specified APMs and the rest of the sample countries mutual fund returns were tested using the aforementioned three models. The data for mutual funds used is from mutual funds that are domiciled in Africa and not funds Global funds that invest in African securities.

6.5 Analysis

After the collection of all relevant data, portfolios were formed for each country's mutual funds as a result of the high number of funds and to make the analysis easier and efficient. Portfolios were formed by making used of the Net Asset Value, NAV, for each fund. The NAV for the funds were found on Bloomberg. The funds were sorted from highest to lowest NAV. Thereafter, portfolios were formed by calculating percentile groups based on the NAV. Gokgoz

(2007) made use of market capitalization values in order to form portfolios of stock, using upper and lower market capitalization values to categorize the stock that would form part of a given portfolio. Shaker and Elgiziry (2014) made us of market capitalization and BE/ME ratio to construct portfolios of stock. They also made use of percentile values to classify which stock would fall in a given portfolio. As a result of all this aforementioned data not being available for all funds used in this study, the author decided to make use of the NAV of the funds and follow the same logic applied in other literature to form portfolios.

Both Namibia and Nigeria, due to their lower number of funds, required only one portfolio each. The remaining four countries comprised of ten portfolios each, which represented the different percentile groups. Tables A1-A6 in Appendix A display the number of portfolios formed per country and the number of mutual funds within each portfolio.

After the formation of portfolios, weighted NAV portfolio returns were created. The weights of each fund were taken as its NAV over the total NAV for all the funds in the portfolio. The weighted returns were calculated by multiplying the weight for the particular mutual fund by its monthly return. The equation below better represents how the portfolio returns were calculated:

$$r_p = \sum \frac{NAV_i}{NAV_T} \cdot r_i \tag{15}$$

Where NAV_i is the Net Asset Value of a fund, NAV_T is the total for all the funds in a portfolio and r_i is the monthly return for a fund.

The portfolios were continuously rebalanced for the inclusion of the presence of mutual fund returns within that portfolio that began at different dates within the time period of the study. NAV for all the Nigerian mutual funds under consideration were unavailable and this resulted in the portfolio returns being calculated as an equal-weight return.

After the creation of portfolios, portfolio returns were calculated and time series regression of excess returns on the portfolios was carried out for the respective APMs. Thereafter, through the use of performance measures, evaluation of the individual performance of the models occurred. The performance measurement values are used as a comparison between models in order to rank the models and name the best performing model. Table 3 and Table 4 below present summaries of the models and the performance measures used in the study.

Table 3: APMs regression equations used in the analysis

Asset pricing model	**Regression equation**
CAPM	$r_{it} - r_{ft} = \alpha_{it} + \beta_{it}(r_{mt} - r_{ft}) + \varepsilon_{it}$
FF3FM	$r_{it} - r_{ft} = \alpha_{it} + \beta_{it}(r_{mt} - r_{ft}) + \beta_{iSMB}(SMB_t) + \beta_{iHML}(HML_t) + \varepsilon_{it}$
C4FM	$r_{it} - r_{ft} = \alpha_{it} + \beta_{it}(r_{mt} - r_{ft}) + \beta_{iSMB}(SMB_t) + \beta_{iHML}(HML_t) + B_{iPMF}(PMF_t) + \varepsilon_{it}$
FF5FM	$r_{it} - r_{ft} = \alpha_{it} + \beta_{it}(r_{mt} - r_{ft}) + \beta_{iSMB}(SMB_t) + \beta_{iHML}(HML_t) + \beta_{iRMW}(RMW_t) + \beta_{iCMA}(CMA_t) + \varepsilon_{it}$
FF6FM	$r_{it} - r_{ft} = \alpha_{it} + \beta_{it}(r_{mt} - r_{ft}) + \beta_{iSMB}(SMB_t) + \beta_{iHML}(HML_t) + \beta_{iRMW}(RMW_t) + \beta_{iCMA}(CMA_t) + \beta_{iPMF}(PMF_t) + \varepsilon_{it}$

Table 4: Performances measures

Performance measure	**Expression**
GRS statistic	$F = \frac{T(T-N-K)\hat{\alpha}'\hat{\sum}^{-1}\hat{\alpha}}{N(T-K-1)1+\bar{r}'_p\hat{\Lambda}^{-1}\bar{r}_p}$
Average absolute value of alpha	$A\lvert\alpha_i\rvert = \frac{1}{N}\sum_{N=1}^{N}\lvert\alpha_i\rvert$
Ratio of dispersion to average excess return	$\frac{A\lvert\alpha_i\rvert}{A\lvert r_i\rvert}$ $\frac{A\alpha_i^2}{Ar_i^2}$
Proportion of intercept dispersion due to sampling error	$\frac{As^2(\alpha_i)}{A\alpha_i^2}$
Average adjusted R^2	$A(R^2)$

Each performance measure is looked at individually as a means to assess the model's performance according to the specific criterion the particular performance measure aims to look at. A comprehensive discussion on each model's performance will be provided and thereafter conclude which model can be considered as the best performing model in the African mutual fund industry.

6.6 Limitations

The study will be aiming at identifying the best performing asset pricing model for mutual funds in Africa, meaning that only funds domiciled in Africa will be used. Those funds that are managed by international fund managers that invest in African funds will not be considered.

Factor data required for the C4FM and the FF6FM was also unavailable for all other sample countries except for South Africa, thus, results surrounding these two models had to be compared to existing literature and could not be compared internally within the study itself.

7. Results

This chapter of the study first presents an overview of the data used in the study, by looking at their descriptive statistics. Thereafter, it provides the regression results in the form of alpha values and their t-statistics and assesses the capability of each factor model in explaining mutual fund portfolio returns. Lastly, it assesses all the models using various performance measures in hopes of identifying the best performing model within the context of each country and the broader African mutual fund industry. It also provides results from factor spanning tests that identifies the presence of redundant factors in the models.

7.1 Descriptive statistics

7.1.1 APMs factors

The tables below present descriptive statistics for the excess portfolio returns for the six countries as well as for the factor returns. Egypt, Mauritius, Morocco and Namibia share the same factor returns and thus the descriptive statistics can be applied to all four of the countries. Nigeria makes use of the same factor returns, however, due to the availability of monthly returns beginning at a latter period, it has its own descriptive statistics. South Africa makes use of a different set of factor returns and thus also, has its own set of descriptive statistics.

Table 5: Descriptive statistics of six countries factor returns

		CMA	**HML**	**PMF**	**RMF**	**RMW**	**SMB**
South Africa	**Mean**	0.61	0.03	1.84	0.87	0.54	0.12
	Std. Dev.	5.76	3.74	8.60	5.56	4.74	4.22
	Skewness	0.3569	0.1152	1.1957	0.7111	0.0544	0.0004
	Kurtosis	3.3684	3.3429	7.8588	4.4906	3.0183	2.3649
Egypt Mauritius Morocco Namibia	**Mean**	0.0743	0.1740		0.5407	0.1906	0.0629
	Std. Dev.	1.5002	2.1705		4.5529	1.1762	1.5433
	Skewness	0.4592	0.1258		-0.3880	-0.2872	0.2689
	Kurtosis	5.0303	3.5184		4.3805	2.9164	2.7056
Nigeria	**Mean**	0.0478	0.2585		0.6352	0.1900	-0.0235
	Std. Dev.	1.5941	2.2717		4.6839	1.2278	1.5529
	Skewness	0.4919	0.0622		-0.4373	-0.2733	0.2783
	Kurtosis	4.6013	3.3174		4.4279	2.7746	2.6729

Note: CMA is the investment factor, HML is the value factor, PMF is the momentum factor, RMF is the market factor, RMW is the profitability factor and SMB is the size factor.

Average CMA returns range from 0.0478% to 0.61% with the standard deviations ranging from 1.5002% to 5.76% for all countries in the study. Nigeria is the only country that has a negative average SMB return of -0.0235%. Average HML factor returns range from 0.03% to 0.2585% with the standard deviations ranging from 2.1705% to 3.74%. Average RMF returns ranged from 0.5407% to 0.87% with the standard deviations ranging from 4.5529% to 5.56%. RMW returns ranged from 0.19% to 0.54% with standard deviations ranging from 1.1762% to 4.74%. South Africa had the largest CMA, RMF, RMW and SMB returns in addition to having the largest standard deviations for these factor returns.

The momentum factor, PMF, has the highest mean value amongst all the factors for South Africa, shown in Table 5. This is indicative of the highest performing firms on average outperforming the lowest performing firms in South Africa over this time period. The mean SMB value in Nigeria is negative which indicates that on average, over the duration of the study, the superior performance of large cap stocks over small cap stocks, which goes against the traditional norm of large cap stocks underperforming small cap stocks (Mosoeu & Kodongo, 2020). The reverse of that is seen in the remainder of the countries, which display a positive mean SMB value, indicating that on average, small cap stock outperformed large cap stock during the study time period. The remainder of the factors all have positive mean values for all the sample countries. The positive mean value for the value factor, HML, indicates that for all sample countries, there is a positive value premium for the study time period. Furthermore, both the profitability factor, RMW, and the investment factor, CMA, have positive mean values indicating that on average, robust portfolios outperformed weak portfolios and conservative portfolios outperformed aggressive portfolios in the sample countries for the study time period. The findings of the investment factor suggests that firms that invest conservatively are favoured in emerging markets. This phenomenon is not consistent with the behaviour of international investors who aim to diversify their portfolio risk by investing in emerging markets to achieve higher returns, returns that are not achievable by solely investing in their local markets (Mosoeu & Kodongo, 2020).

All the factors are positively skewed except for the RMF and RMW factors for Egypt, Mauritius, Morocco, Namibia and Nigeria. These two factors represent a distribution in which the tail tends more towards negative values. In the presence of skewed data, the tail section acts as an outlier which affects the efficiency of regression-based models and may result in misleading results (Sharma, 2019). The skewness values range from -0.4373 to 1.1957 for all factors in all sample countries. Most of the skewness values for the data fall between -0.5 and 0.5 except for two factors, PMF and RMF, both in found in Table 5. Excluding these two factors, the distributions of the other factors can all be considered to be 'approximately symmetric' (Klima, 2021). Thus, it is a possibility that the PMF and RMF factors for South Africa might contribute to a slight mislead in the results. All factors for all the countries display positive kurtosis.

The next set of tables, Table 6 through to Table 10, displays the descriptive statistics for each portfolio tested for the sample countries. Each portfolio within a particular country contains a similar number of funds, however, the portfolios across the different countries contain different numbers of funds. The tables in Appendix A display the total number of funds in each portfolio.

7.1.2 South Africa

Table 6: Descriptive statistics of South African mutual fund portfolios excess return

	Mean	Std. Dev.	Skewness	Kurtosis
P1	0.9166	2.9092	-0.1549	3.8558
P2	0.7048	2.6931	-0.1216	5.6823
P3	0.6611	2.4165	-0.5577	8.4126
P4	0.6766	2.4992	-0.8017	9.1143
P5	0.7445	2.6249	0.2931	4.1550
P6	2.5732	19.3655	9.7413	97.6024
P7	2.5314	19.0415	9.7683	97.9654
P8	0.6626	2.0112	0.5049	6.5200
P9	0.4813	1.3667	-1.9058	16.9597
P10	2.3297	19.3427	9.9724	100.6414

The average excess return for South Africa's mutual fund portfolios ranges from 0.6611% to 2.5732% and the standard deviations range from 1.3667% to 19.3655%. The highest average excess return is P6, which represents the 40^{th}-50^{th} percentile of funds based on NAV. The general trend of the data reflects that the riskier portfolios, those with higher standard deviation values, do provide higher average excess returns than the less risky portfolios. The only discrepancy in this trend is seen by P7 and P10, whereby P10 has a higher risk and lower average excess return than P7. Therefore, aside from this exception, South African mutual fund portfolios agree with the CAPM theory.

The excess portfolio returns for P1-P4 and P9 are negatively skewed, whereas the excess portfolio returns for P6-P9 and P10 are positively skewed as seen by the skewness values in the table above. All excess portfolio returns display positive kurtosis.

7.1.3 Egypt

Table 7: Descriptive statistics of Egyptian mutual fund portfolios excess return

	Mean	Std. Dev.	Skewness	Kurtosis
P11	0.7711	1.8148	-0.7488	21.3966
P12	0.9128	4.5069	0.3032	6.8805
P13	0.8899	0.4301	3.2942	21.4148
P14	0.8151	4.3181	0.4811	6.3470
P15	0.7005	3.1860	-1.0287	8.3890
P16	0.8997	6.0283	0.2551	6.6678
P17	0.8554	0.2915	5.2297	42.4620
P18	0.7757	2.7136	0.0637	5.9510
P19	0.6279	4.0551	-0.3662	6.8646
P20	0.0892	1.0986	-1.2080	6.7845

The average excess return for Egypt's mutual fund portfolios varies from 0.0892% to 0.9128%, while the standard deviation ranges from 0.4301% to 6.0283%. The highest average excess return is P12 which represents the 80^{th}-90^{th} percentile of funds based on NAV. When analysing the average excess return and corresponding standard deviation for each portfolio, one can see that the portfolios average excess returns do not agree with the CAPM theory. The riskier funds do not necessarily return higher average excess returns than the less risky funds. Take for example P15 and P18, P15 is riskier, yet has a lower average excess return than P18.

P11, P15, P19 and P20 all have negatively skewed distributions as seen by their skewness values, whereas the rest of the portfolios are positively skewed.

7.1.4 Mauritius

Table 8: Descriptive statistics of Mauritian mutual fund portfolios excess return

	Mean	Std. Dev.	Skewness	Kurtosis
P21	-0.0552	3.6384	-0.4444	4.4316
P22	0.8988	4.8171	-1.6030	11.2340
P23	0.6690	3.0058	-1.2447	8.1675
P24	0.8293	3.4863	-1.4926	10.9345
P25	0.7693	4.5066	-0.9467	7.2286
P26	0.5383	3.1669	-2.2737	17.8398
P27	0.2101	2.2109	-2.3722	13.3213
P28	0.3219	2.7100	-1.0938	6.4881
P29	0.5791	5.9397	-1.0103	7.0097
P30	-0.3950	7.4148	-3.3442	25.5671

The average excess return for Mauritius's mutual fund portfolios varies from -0.0552% to 0.8988%, with standard deviations ranging from 2.2109% to 7.4148%. Mauritius's two portfolios, P21 and P30, are the only two portfolios from the entire sample that display negative average excess returns. The riskiest portfolio, P30, returns one of the lowest average excess returns. Again, it is seen that the riskier portfolios do not necessarily result in higher average excess returns. The highest average excess return is P22 which represents the 80th-90th percentile of funds based on NAV.

All portfolio excess returns are negatively skewed and display positive kurtosis.

7.1.5 Morocco

Table 9: Descriptive statistics of Moroccan mutual fund portfolios excess return

	Mean	**Std. Dev.**	**Skewness**	**Kurtosis**
P31	0.3296	0.5993	1.0027	11.1766
P32	0.2390	0.8194	-1.5975	11.7425
P33	0.3318	1.2131	-1.8755	14.6485
P34	0.3880	1.2722	-1.8423	14.6950
P35	0.4060	1.1160	-1.9429	14.8523
P36	0.2999	0.4627	-0.4078	7.6425
P37	0.2645	0.7394	-1.5288	12.0198
P38	0.3265	1.5175	-1.5069	11.9692
P39	0.2784	1.1829	-1.8005	12.4701
P40	0.2160	0.6489	-1.6001	10.4102

The average excess return for Morocco's mutual fund portfolios varies from 0.2160% to 0.4060%, whilst the standard deviation ranges between 0.4627% and 1.2722%. The riskiest portfolio fails to perform the best, providing only the second highest average excess return and once again the data is not in agreement with the CAPM theory. The highest average excess return is P35 which represents the 50th-60th percentile of funds based on NAV. All portfolio excess returns are negatively skewed except for P31, and all portfolio excess returns display positive kurtosis.

7.1.6 Namibia and Nigeria

Table 10: Descriptive statistics of Namibia and Nigeria's mutual fund portfolio excess return

		Mean	**Std. Dev.**	**Skewness**	**Kurtosis**
Namibia	**P41**	0.5944	2.3301	-0.2764	7.0376
Nigeria	**P42**	0.1858	5.8280	0.4883	3.7394

As a result of there only being one portfolio for each of these two countries, the results will be compared alongside one another. Applying the CAPM theory in comparing the statistics for these two countries, one can see that the results blatantly disregard the theory. The average excess return by the Namibian portfolio is higher than the average excess return seen by the Nigerian portfolio despite having a significantly lower standard deviation.

7.1.3 Combined

When looking at all the countries as a group, representing the African mutual fund industry, the average excess portfolio returns ranges from -0.0552% to 2.5732%, with the largest average portfolio excess return coming from P6 in the South African sample of fund portfolios. The low mean values, of all portfolios for all countries, display that the funds are on average providing little extra returns over that of the risk-free rate. The standard deviations range from 0.4301% to 19.3655%. The largest standard deviation value comes from P6 in the South African sample of fund portfolios. All excess portfolio returns in the entire sample display positive kurtosis. All portfolios, except P21 and P30, have positive average excess returns.

7.2 Regression results

Linear regression was run for each portfolio and the resulting alpha values were recorded. The South African mutual fund portfolios were tested using all five models according to the regression formulas presented in Table 3 under the Methodology section. Due to the lack of available data, the remaining sample countries mutual fund portfolios were tested with the CAPM, FF3FM and FF5FM. The alpha values and respective t-statistics for each model are reported in the tables below. The alpha values tell us two things, whether or not all the factors acting together in the associated APMs have the ability to explain the portfolios' excess returns and it also indicates portfolio managers performance in being able to provide excess returns that lie above the security market line.

7.2.1 CAPM

Table 11: Regression results for the CAPM

		alpha	t-statistic		alpha	t-statistic
South Africa	**P1**	0.5791	2.9487***	**P6**	1.9945	1.0466
	P2	0.3701	2.2449**	**P7**	2.0803	1.1025
	P3	0.4230	2.2438**	**P8**	0.4422	3.0643***
	P4	0.4302	2.2075**	**P9**	0.3792	3.1472***
	P5	0.3804	3.0907***	**P10**	2.1725	1.1219
Egypt	**P11**	0.7623	4.2155***	**P16**	0.5762	1.0744
	P12	0.6740	1.6757*	**P17**	0.8538	29.404***
	P13	0.8813	20.840***	**P18**	0.6453	2.6078**
	P14	0.5934	1.5282	**P19**	0.4121	1.1400
	P15	0.5399	1.8768*	**P20**	0.0181	0.1967
Mauritius	**P21**	-0.3924	-1.7292*	**P26**	0.2466	1.2370
	P22	0.4681	1.4807	**P27**	0.0292	0.1827
	P23	0.4136	1.9750*	**P28**	0.1430	0.6366
	P24	0.5229	2.2369**	**P29**	0.0983	0.2268
	P25	0.3481	1.2557	**P30**	-0.7932	-1.2028
Morocco	**P31**	0.3092	5.3994***	**P36**	0.2833	6.4400***
	P32	0.1999	2.6720***	**P37**	0.2342	3.3835**
	P33	0.2701	2.4707**	**P38**	0.2494	1.8231*
	P34	0.3220	2.8216***	**P39**	0.2186	2.0478**
	P35	0.3519	3.4631***	**P40**	0.1844	3.1234***
Namibia	**P41**	0.4524	2.2686**			
Nigeria	**P42**	-0.1417	-0.2482			

Note: *indicates significance at 10% level, **indicates significance at 5% level and ***indicates significance at 1% level.

Table 12: Failure rate of the CAPM model in explaining portfolio returns

	Total number of portfolios	Statistically significant portfolios	Statistically insignificant portfolio	Percentage of portfolios unexplained
South Africa	10	7	3	70%
Egypt	10	6	4	60%
Mauritius	10	3	7	30%
Morocco	10	10	0	100%
Namibia	1	1	0	100%
Nigeria	1	0	1	0%
Total	**42**	**27**	**15**	**64.3%**

Looking at the regression results for South African mutual fund portfolios in Table 11, with exception to P6, P7 and P10, the rest all have statistically significant alphas at either the 1% or 5% level. These statistically significant alpha values indicate that the included factor in the CAPM, the market factor, fails to fully explain the portfolio returns. In general, the market factor fails to fully explain 70% of South African mutual fund portfolio returns, as seen by the calculations presented in Table 12. All the alpha values for the South African mutual fund portfolios are positive, indicating positive excess returns.

Egyptian mutual fund portfolios have statistically significant alpha values at the 1%, 5% and 10% level. The market factor in the CAPM fails to fully explain 60% of Egyptian mutual fund portfolio returns and thus might require the inclusion of more factors to fully explain the returns. All Egyptian mutual fund portfolios have positive alpha values, indicating positive excess returns.

Mauritian mutual fund portfolios excess returns are mostly explained by the market factor. There are only three portfolios, P21, P23 and P24 that are at the 10%, 10% and 5% level of significance respectively. This indicates that the CAPM and its market factor cannot fully explain 30% of mutual fund portfolio returns in Mauritius. P21 and P30 have negative values of alpha indicating negative excess returns, however, the rest of the portfolios display positive alpha values and thus, positive excess returns.

All the Moroccan mutual fund portfolios have alphas that are significant at either the 1%, 5% or 10% level of significance. This indicates that alone, the market factor fails to fully explain the return on these portfolios. The CAPM performs poorly in the Moroccan context as it fails to explain 100% of the mutual fund portfolio returns, thereby indicating that a model with more factors and more explanatory power is necessary.

The Namibian mutual fund portfolio has an alpha value at the 5% level of significance. This further indicates the inability of the market factor alone to fully explain mutual fund returns. Contrastingly, the Nigerian mutual fund portfolios alpha value is not significant and it thus can be said that the market factor is sufficient in explaining the portfolio return. Furthermore, the Nigerian mutual fund portfolio has a negative alpha value implying that the portfolio experiences negative excess returns.

In summary, the CAPM with the market factor fails to explain 64.3% of mutual fund portfolio returns in the African context, as displayed in Table 12. This agrees with Womack & Zhang (2003) whereby the use of a single risk factor used by the CAPM for explaining the returns of financial securities is questioned.

7.2.2 FF3FM

Table 13: Regression results for the FF3FM

		alpha	t-statistic		alpha	t-statistic
South Africa	**P1**	0.5851	3.7050***	**P6**	1.9238	1.0024
	P2	0.3829	2.7101***	**P7**	1.9192	1.0272
	P3	0.4382	3.0599***	**P8**	0.4563	3.3728***
	P4	0.4505	2.9791***	**P9**	0.3933	4.0880***
	P5	0.3880	3.2510***	**P10**	2.4758	1.3001
Egypt	**P11**	0.7687	4.2047***	**P16**	0.4908	0.9374
	P12	0.6101	1.5509	**P17**	0.8530	29.1052***
	P13	0.8883	21.3280***	**P18**	0.6141	2.5337**
	P14	0.5452	1.4176	**P19**	0.3484	0.9989
	P15	0.5066	1.78170*	**P20**	-0.0047	-0.0550
Mauritius	**P21**	-0.3996	-1.7440*	**P26**	0.1799	1.0118
	P22	0.3892	1.3060	**P27**	0.0024	0.0153
	P23	0.3653	1.8470*	**P28**	0.1179	0.5262
	P24	0.4553	2.1281**	**P29**	0.0054	0.0129
	P25	0.2914	1.0856	**P30**	-0.8586	-1.29980
Morocco	**P31**	0.3064	5.3320***	**P36**	0.2821	6.3921***
	P32	0.1977	2.61670**	**P37**	0.2302	3.3123***
	P33	0.2643	2.39590**	**P38**	0.2422	1.7565*
	P34	0.3145	2.7375***	**P39**	0.2200	2.0471**
	P35	0.3453	3.3761***	**P40**	0.1842	3.1277***
Namibia	**P41**	0.4214	2.1458**			
Nigeria	**P42**	-0.1309	-0.2282			

Note: *indicates significance at 10% level, **indicates significance at 5% level and ***indicates significance at 1% level.

Table 14: Failure rate of the FF3FM model in explaining portfolio returns

	Total number of portfolios	Statistically significant portfolios	Statistically insignificant portfolio	Percentage of portfolios unexplained
South Africa	10	7	3	70%
Egypt	10	5	5	50%
Mauritius	10	3	7	30%
Morocco	10	10	0	100%
Namibia	1	1	0	100%
Nigeria	1	0	1	0%
Total	**42**	**26**	**16**	**61.9%**

The FF3FM includes two added factors in comparison to the CAPM. They are the size, SMB, and value, HML, factors. Upon looking at its performance in explaining South African mutual fund portfolio returns in Table 14, it is noticed that it still fails to explain 70% of portfolio returns, with P6, P7 and P10 having alpha values that are not statistically significant. It should also be noted that P2, P3 and P4 are now at the 1% level of significance, where they were previously at the 5% level under the CAPM. The remaining alpha values stay at the 1% level, displaying that there is no improvement in explaining South African mutual fund portfolio returns under the FF3FM. All the alpha values are once again positive, which indicate positive excess returns. The consistent positive alphas under both models may now confirm fund manager performance. Womack & Zhang (2003) argued that under the CAPM, positive alpha values may not accurately represent fund manager performance due to the neglection of the size factor and value factor, but under the FF3FM, performance measurement is more accurate.

When looking at the regression results for Egypt in Table 13, one can see a slight improvement in performance under the FF3FM. P12 that was previously significant at the 10% level under the CAPM, is now not statistically significant, indicating that the presence of the size factor and value factor results in its return being fully explained for the study period. The FF3FM fails to explain 50% of Egyptian mutual fund portfolio returns, in comparison to the CAPM's 60%. This improvement highlights the importance of the size and value factor in explaining returns in the Egyptian context. These results are also in common with Shaker and Elgiziry (2014) who found that the FF3FM outperforms the CAPM on the Egyptian stock market.

Table 13 displays that there is no change in performance from the CAPM to the FF3FM in explaining mutual fund portfolio returns in Mauritius. P21, P23 and P24 remain statistically significant at their exact same previous levels as seen in Table 11. The FF3FM also fails in explaining 100% of Moroccan mutual fund portfolio returns. However, there is one change worth noticing. P32 that had an alpha value at a 1% level of significance is now at a 10% level.

Namibia's mutual fund portfolios alpha value, as seen in Table 13, remains at the same level of significance in Table 11 and thus implies no improvement of the size factor and value factor in explaining the return. Nigeria's mutual fund portfolio return is already fully explained by the market factor under the CAPM and thus the addition of the size and value factor does not result in any further differences.

In summary, the FF3FM fails to explain 61.9% of mutual fund portfolio returns in the African context. This is a slight improvement over the CAPM model and thus the findings are somewhat in agreement with Rehnby (2016), Shaker and Elgiziry (2014) and Gokgoz (2007) who all drew conclusions that the FF3FM better explains portfolio returns on various international stock markets, can now be extended to various countries mutual fund industries.

The explanatory improvements seen in the Egyptian context agrees with Huij and Post (2011) who found in their study the presence of both a size effect and value effect in emerging markets. Thus, the result adds to international evidence of the improvements brought along by the inclusion of size and value factors in explaining returns. However, the size and value effects are only seen in Egypt and in none of the other sample countries.

7.2.3 C4FM

Table 15: Regression results for the C4FM

		alpha	t-statistic		alpha	t-statistic
South Africa	**P1**	0.7579	5.6198***	**P6**	2.2199	1.1321
	P2	0.5252	4.2118***	**P7**	1.9140	0.9996
	P3	0.6165	5.4010***	**P8**	0.5271	3.9418***
	P4	0.6328	5.4162***	**P9**	0.4933	5.8748***
	P5	0.3880	3.2510***	**P10**	1.8184	0.9463

Note: *indicates significance at 10% level, **indicates significance at 5% level and ***indicates significance at 1% level.

Table 16: Failure rate of the C4FM model in explaining portfolio returns

	Total number of portfolios	Statistically significant portfolios	Statistically insignificant portfolio	Percentage of portfolios unexplained
South Africa	10	7	3	70%

The alpha values reported in Table 15 for South African mutual fund portfolios remain at the same level of significance as reported in Table 13. This indicates that there are no explanatory improvements with the addition of the momentum factor. This result conflicts the results stipulated by Huij and Post (2011) who find that the momentum factor explains a substantial part of the performance of emerging market funds. The result also contrasts Carhart (1997) findings which showed that the C4FM significantly reduces the pricing errors of the CAPM and FF3FM from 35% and 31% respectively to just 14%. For all ten portfolios, the one-year momentum factor provides no explanatory increase over the FF3FM and thus, it reinforces the question posed by Shaker and Elgiziry (2014) surrounding the need for a momentum factor in emerging markets.

7.2.4 FF5FM

Table 17: Regression results for the FF5FM

		alpha	t-statistic		alpha	t-statistic
South Africa	**P1**	0.6497	4.8527***	**P6**	1.7963	0.9358
	P2	0.4417	3.7675***	**P7**	2.0549	1.0936
	P3	0.5082	4.6949***	**P8**	0.4973	4.0134***
	P4	0.5206	4.4443***	**P9**	0.4342	5.7523***
	P5	0.4261	3.9647***	**P10**	2.4644	1.3071
Egypt	**P11**	0.7200	3.8014***	**P16**	0.4446	0.8125
	P12	0.5359	1.3058	**P17**	0.8587	28.2544***
	P13	0.8965	21.1305***	**P18**	0.5443	2.1617**
	P14	0.5076	1.2630	**P19**	0.2471	0.6820
	P15	0.5112	1.7229*	**P20**	-0.0148	-0.1671
Mauritius	**P21**	-0.4856	-2.0615**	**P26**	0.0688	0.3806
	P22	0.2070	0.6831	**P27**	-0.0420	-0.2583
	P23	0.2065	1.0486	**P28**	-0.0545	-0.2432
	P24	0.3866	1.7435*	**P29**	-0.2429	-0.5721
	P25	0.0874	0.3248	**P30**	-0.7248	-1.0602
Morocco	**P31**	0.3057	5.0948***	**P36**	0.2784	6.0422***
	P32	0.2052	2.6071**	**P37**	0.2181	3.0225***
	P33	0.2576	2.2423**	**P38**	0.2394	1.6665*
	P34	0.3165	2.6371***	**P39**	0.2229	1.9851**
	P35	0.3370	3.1652***	**P40**	0.1933	3.1781***
Namibia	**P41**	0.3608	1.7741*			
Nigeria	**P42**	-0.0783	-0.1307			

Note: *indicates significance at 10% level, **indicates significance at 5% level and ***indicates significance at 1% level.

Table 18: Failure rate of the FF3FM model in explaining portfolio returns

	Total number of portfolios	Statistically significant portfolios	Statistically insignificant portfolio	Percentage of portfolios unexplained
South Africa	10	7	3	70%
Egypt	10	5	5	50%
Mauritius	10	2	8	20%
Morocco	10	10	0	100%
Namibia	1	1	0	100%
Nigeria	1	0	1	0%
Total	**42**	**25**	**17**	**59.5%**

Table 17 displays the regression results under the FF5FM. This is an extension of the FF3FM, by including the investment factor and profitability factor. The levels of statistical significance for the alpha values in the South African portfolios remain the same. This concludes that with the addition of the factors, there fails to be any explanatory improvements. The FF5FM also fails to explain 70% of South African mutual fund portfolio returns, as seen in Table 18, with P6, P7 and P10 having been fully explained by the market factor under the CAPM.

The same can be said about Egypt. The alpha values remain at the same level of statistical significance in Table 17 as they were in Table 13 under the FF3FM. The model is yet again unable to fully explain 50% of mutual fund portfolio returns.

Mauritius notes a slight improvement under the FF5FM. P23's alpha value is not statistically significant, indicating that the model, with the inclusion of the investment and profitability factors, has the ability to fully explain the mutual fund portfolios return. P24 is now at the 10% level of significance as seen in Table 17 in comparison to having been at the 5% level in Tables 11 and 13.

There is also a change in the level of significance in alpha value pertaining to the Namibian mutual fund portfolio. In Table 17, it is significant at the 10% level in comparison to its previous values of 5% significance. However, this still indicates that with the inclusion of the investment factor and profitability factor the model is still yet to fully explain the portfolios return.

In summary, the FF5FM fails to explain 59.5% of mutual fund portfolio returns in the African context. This is a slight improvement over the FF3FM and the CAPM in that the inclusion of more factors yields improvements in explanatory power.

7.2.5 FF6FM

Table 19: Regression results for the FF6FM

		alpha	t-statistic		alpha	t-statistic
South Africa	**P1**	0.7450	5.9072***	**P6**	2.2892	1.1782
	P2	0.5112	4.5085***	**P7**	1.8527	0.9661
	P3	0.6008	6.1416***	**P8**	0.5150	4.0779***
	P4	0.6171	5.7713***	**P9**	0.4833	6.7021***
	P5	0.4569	4.1820***	**P10**	1.7828	0.9435

Note: *indicates significance at 10% level, **indicates significance at 5% level and ***indicates significance at 1% level.

The FF6FM includes all the factors of the FF5FM but with an additional momentum factor. The alpha values in Table 17 remain at the same level of significance as Table 16 despite the addition of the factor. This indicates that the FF6FM provides no improvements in explaining the portfolios returns.

The results in Table 13 through to Table 19 clearly depict that the APMs fail to explain the majority of mutual fund portfolio returns in the sample countries and therefore by extension, fail to explain mutual fund returns in the African context. Furthermore, the discussion showcases that there are very few improvements in explanatory power between models with the inclusion of more risk factors. Harvey (1995) highlights that emerging market returns are likely affected by local information variables; thus, the standard global APMs are unable to explain emerging market returns. Further possible reasonings behind the lack in ability of the APMs in explaining the returns could be due to the assumption that world capital markets are integrated, whereas in reality, emerging markets are suspected to be segregated from world capital markets (Harvey, 1995). It is with this in mind that potential alternate factors should be investigated that are not considered by the global standard APMs. These are factors that might better reflect the specific risks experienced in emerging markets and might result in the adjusted models carrying more explanatory power. Factors to consider include a commodity factor, an agricultural factor, a currency factor and a factor developed to account for specific emerging market country effects as presented in Huij and Post (2011). The commodity factor is relevant in emerging markets as a result of many assets being resource based as well as emerging market countries economies, like South Africa, being commodity based. An agricultural factor is relevant as a result of emerging market economies containing in proportion, a larger agricultural sector than developed market economies (Harvey, 1995). Lastly the currency factor to account for the ever-changing exchange rate risks.

With regards to South Africa, Flint (2016) describes a wide range of risk factors applicable for the South African equity market. Some of these factors can be considered as input risk factors for APMs with the hopes of improving their explanatory power for mutual fund returns in South Africa, and possibly by extension, Africa. Factors mentioned that are applicable to the South African market include liquidity and quality factors (Flint, 2016). The liquidity factor is applicable due to fund managers facing capacity problems and high levels of concentration (Flint, 2016). Low volatility and low beta factors are also applicable and can be considered.

Another possible reason as to why the APMs fail in fully explaining the fund portfolio returns in Egypt, Mauritius, Morocco and Namibia could be as a result of the risk factors having been constructed broadly, for all emerging markets rather than the factors being country specific. Griffin (2001) presents results that indicate the improved accuracy in the pricing and explaining of portfolio returns when using country specific factors as opposed to global factors. Making use of country specific factors derived from country specific information for the APMs may result in improved results.

7.3 Model performance measures

This section provides results of the six performance measures used on the respective models for each country individually, as well as them grouped together. The performance measures will serve as a means to rank the different models performances according to the specific criteria they measure. The first performance measure to be analysed is the GRS test. GRS tests were run on each countries mutual fund portfolios as well as on the combined portfolios of Egypt, Mauritius, Morocco, Namibia as a result of the common data shared between these countries. The null hypothesis of the GRS test states all intercepts from regression of a factor model should be jointly indistinguishable from zero. The rejection of the null hypothesis indicates that the alpha values are significantly different from zero and the model thus fails to explain the returns of the mutual fund portfolios. Tables 20-23 evaluate the performance of the various APMs on ten mutual fund portfolios for each country.

7.3.1 South Africa

Table 20: Performance measures on all five models for South African mutual fund portfolios

Model	CAPM	FF3FM	C4FM	FF5FM	FF6FM
GRS	4.9371	5.0495	6.1445	6.1318	6.9703
GRS(p)	0.0000	0.0000	0.0000	0.0000	0.0000
$A\lvert\alpha_i\rvert$	0.9251	0.9413	0.9893	0.9794	0.9854
$\frac{A\lvert\alpha_i\rvert}{A\lvert r_i\rvert}$	0.7244	0.7371	0.7747	0.7669	0.7716
$\frac{A\alpha_i^2}{Ar_i^2}$	0.5248	0.5433	0.6001	0.5881	0.5954
$\frac{As^2(\alpha_i)}{A\alpha_i^2}$	0.4482	0.4509	0.3453	0.4140	0.3469
$A(R^2)$	0.3456	0.4641	0.5234	0.5443	0.5642

Looking at Table 20, we can see the GRS test statistic and its associated p-value. All models are rejected by the GRS test at the 1% significance level. As a result of the rejection of the models by the GRS test, it can be said that none of the models are able to fully explain the returns of the portfolios. The rejection of the models by the GRS test might not be an accurate representation of the truth. Firstly, the GRS test on the models were run on Stata. Kamstra and Shi (2020), who derived a new formula for the GRS test related to the multifactor case, highlight in their paper that their formula is different to the formula implemented on software such as Stata. The authors go on to explain how the use of the incorrect formulation of the GRS test may lead to the 'over-rejection of the null hypothesis'. Secondly, errors in the formulation of the GRS test surrounding the application of the degree of freedom correction is seen to impact data spanning twenty years or less. This study falls within that time frame making the results prone to that error.

Next, we look at the average absolute value of the alphas as well as the two other measures of dispersion, $\frac{A|\alpha_i|}{A|r_i|}$ and $\frac{A\alpha_i^2}{Ar_i^2}$ presented in Table 20. Lower values of these three performance models indicate better performance of a model. The CAPM performs the best under these three metrics, producing the lowest values. This advocates that the CAPM capsulates the returns of the mutual fund portfolios while producing the least dispersion. These findings are similar to that of Sha and Gao (2019) who find that the CAPM controls alpha dispersion better than the other models. In contrast, the C4FM produces the largest values for the three dispersion measures. This suggests that the C4FM is more disperse than the other four models. These results agree with the results presented by Sha and Gao (2019) for Enhanced Index funds.

The next performance measure, $\frac{As^2(\alpha_i)}{A\alpha_i^2}$, is a measure of the dispersion of alpha because of sampling error. The higher the value of this metric, the better the performance of the APM. The C4FM has the lowest value of 0.3453, indicating that just over a third of the dispersion of the alpha is due to sampling error. Sha and Gao (2019) for Enhanced index funds also find that the C4FM presents the lowest value for this specific performance measure. The FF3FM has the highest value amongst all models for this performance measure with a value of 0.4509 as seen in Table 20.

The last performance measure evaluated is the average value of the adjusted R^2 value. The higher the value, the better the model. The FF6FM provides the highest average adjusted R^2 value of 0.4641 and in contrast, the CAPM provides the lowest value of 0.3456. The CAPM value is significantly lower than the other model's values.

In summary, although the GRS test rejected all models, the CAPM performs the best according to this performance measure. The CAPM displays the lowest values for the absolute average value of alphas and the two dispersion measures while the FF3FM performs the best according to the $\frac{As^2(\alpha_i)}{A\alpha_i^2}$ measure.

South Africa had the largest sample of funds in the study but has a high sampling error compared to that of Morocco, Egypt and Nigeria. These three countries had very low sampling errors indicating that the sample of the mutual funds used in the study well represents the population. Consequently, the sample of South African funds is not a good representation of the population of South African funds.

7.3.2 Egypt

Table 21: Performance measures on all three models for Egyptian mutual fund portfolios

Model	**CAPM**	**FF3FM**	**FF5FM**
GRS	108.8605	109.5609	103.7005
GRS(p)	0	0	0
$A\lvert\alpha_i\rvert$	0.5956	0.5630	0.5281
$\frac{A\lvert\alpha_i\rvert}{A\lvert r_i\rvert}$	3.0853	2.9162	2.7354
$\frac{A\alpha_i^2}{Ar_i^2}$	9.5194	8.5044	7.4824
$\frac{As^2(\alpha_i)}{A\alpha_i^2}$	0.1504	0.1808	0.2155
$A(R^2)$	0.1380	0.1700	0.1656

Looking at the GRS test for Egyptian mutual fund portfolios presented in Table 21, it is seen that all three models are rejected by the GRS test, with the weakest rejection occurring on the FF5FM. All three models are rejected at a 1% level of significance. Yet again, all models fail to explain the mutual fund portfolio returns. These results contradict Shaker and Elgiziry (2014) who found that the FF3FM performed the best according to the GRS test on the Egyptian stock exchange. Furthermore, the model is not rejected at the 1% level. However, the results also somewhat agree with Shaker and Elgiziry (2014) who found the inability of the CAPM and the FF3FM to explain returns in an Egyptian context.

We observe that for the average alpha and two dispersion measures, the FF5FM outperforms the other models, having the lowest value for all three of the performance measures.

Additionally, the FF5FM also provides the highest $\frac{As^2(\alpha_i)}{A\alpha_i^2}$ value of 0.2155. This indicates that just over a fifth of the alpha dispersion is as a result of sampling error. Lastly, assessing the average adjusted R^2 values, one can see that the FF3FM has the highest value of 0.17, thereby outperforming the other two models.

The results in Table 21 depict that the FF5FM outperforms the other two models in five out of the six performance measures. The FF3FM performs the best in the average adjusted R^2 performance measure and comes second in all other performance measures aside from the GRS test.

7.3.3 Mauritius

Table 22: Performance measures on all three models for Mauritian mutual fund portfolios

Model	**CAPM**	**FF3FM**	**FF5FM**
GRS	1.7879	1.7168	1.6712
GRS(p)	0.0737	0.0889	0.1002
$A\lvert\alpha_i\rvert$	0.3455	0.3065	0.2506
$\frac{A\lvert\alpha_i\rvert}{A\lvert r_i\rvert}$	3.3192	2.9442	2.4073
$\frac{A\alpha_i^2}{Ar_i^2}$	11.0169	8.6684	5.7952
$\frac{As^2(\alpha_i)}{A\alpha_i^2}$	1.0324	1.0891	1.0746
$A(R^2)$	0.4860	0.5219	0.5366

Analysing the GRS test results in Table 22, for Mauritian mutual fund portfolios, one can see the rejection of the CAPM at the 10% level of significance, the FF3FM is also rejected at the 10% level, whereas the FF5FM fails to be rejected by the GRS test. This indicates that the FF5FM performs better in measuring the portfolio returns. It can thus be said that the FF5FM is able to explain the mutual fund portfolio returns in Mauritius.

The FF5FM also performs better than the other two models when looking at the average alpha and two dispersion performance measures. It records values of 0.2506, 2.4073 and 5.7952 respectively which are the lowest for each performance measure for all three models. The model also outperforms the other models in the average adjusted R^2 measure, recording a value of 0.5366.

The FF3FM has the highest $\frac{As^2(\alpha_i)}{A\alpha_i^2}$ value across all three of the models. It has a value of 1.0891, which is slightly higher than the FF5FM. Thus, to summarise, the FF5FM outperforms the other models in five out of the six performance measures, with it performing second best in the $\frac{As^2(\alpha_i)}{A\alpha_i^2}$ measure. The CAPM consistently performed the worst across all six of the performance measures.

7.3.4 Morocco

Table 23: Performance measures on all three models for Moroccan mutual fund portfolios

Model	**CAPM**	**FF3FM**	**FF5FM**
GRS	10.5936	10.5240	9.0362
GRS(p)	0.0000	0.0000	0.0000
$A\lvert\alpha_i\rvert$	0.2623	0.2587	0.2574
$\frac{A\lvert\alpha_i\rvert}{A\lvert r_i\rvert}$	1.1270	1.1115	1.1060
$\frac{A\alpha_i^2}{Ar_i^2}$	1.2702	1.2354	1.2232
$\frac{As^2(\alpha_i)}{A\alpha_i^2}$	0.0421	0.0405	0.0365
$A(R^2)$	0.1442	0.1392	0.1288

Table 23 displays the rejection of all three of the models by the GRS test at the 1% level of significance, resulting in the conclusion that all three models fail in explaining the returns of mutual fund portfolios.

When assessing the average alpha and the two dispersion measures, it is clear to see that the FF5FM has the lowest values of the three models and the CAPM has the highest. This indicates that the FF5FM outperforms the other three models and induces the least dispersion. Contrastingly, in the remaining two performance measures, $\frac{As^2(\alpha_i)}{A\alpha_i^2}$ and $A(R^2)$, it performs the worst out of the three models. The CAPM model outperforms the other two models across these two performance measures, displaying values of 0.0421 and 0.1442 respectively, as seen in Table 23. The FF3FM is the second-best performing model in all six of the performance measurements, coming very close to FF5FM in the average absolute value of alphas performance metric. The FF3FM value is 0.2587 in comparison to the five-factor models value of 0.2574.

The next two tables, Table 24 and Table 25, evaluate the CAPM, FF3FM and FF5FM performances on one mutual fund portfolio per country.

7.3.5 Namibia

Table 24: Performance measures on all three models for Namibian mutual fund portfolios

Model	**CAPM**	**FF3FM**	**FF5FM**
GRS	5.0974	4.5604	3.1195
GRS(p)	0.0261	0.0352	0.0805
$A\lvert\alpha_i\rvert$	0.4524	0.4214	0.3608
$\frac{A\lvert\alpha_i\rvert}{A\lvert r_i\rvert}$	8.4167	7.8407	6.7140
$\frac{A\alpha_i^2}{Ar_i^2}$	70.8416	61.4769	45.0772
$\frac{As^2(\alpha_i)}{A\alpha_i^2}$	5.0974	4.5604	3.1195
A(R^2)	0.0261	0.0352	0.0805

All three models are rejected by the GRS test for the Namibian mutual fund portfolio, as displayed by Table 24. The CAPM and the FF3FM are rejected at a 5% level of significance, whereas the FF5FM is rejected at the 10% level. Again, the FF5FM displays the weakest rejection from the models with a GRS(p) value of 0.0805. However, all of the models are considered by the GRS to be unable to explain the return of the Namibian mutual fund portfolio.

The FF5FM performs the best when looking at the average alpha and two dispersion performance measures. For the three measures, $A\lvert\alpha_i\rvert$,$\frac{A\lvert\alpha_i\rvert}{A\lvert r_i\rvert}$ and $\frac{A\alpha_i^2}{Ar_i^2}$, it has values of 0.3608, 6.714 and 45.0772 respectively, which are the lowest across all three models. This indicates that the model induces the least dispersion once again. Additionally, the FF5FM records the highest A(R^2) value of 0.0805, ranking it the best of the three according to the performance measure. The model does however perform the worst in the $\frac{As^2(\alpha_i)}{A\alpha_i^2}$ performance measure with a value of 3.1195, while the CAPM model outperforms both models with a value of 5.0974.

Overall, the FF5FM outperforms the other two models in five out of the six performance measures, with the FF3FM consistently performing second best across all six performance measures.

7.3.6 Nigeria

Table 25: Performance measures on all three models for Nigerian mutual fund portfolios

Model	**CAPM**	**FF3FM**	**FF5FM**
GRS	0.0609	0.0515	0.0169
GRS(p)	0.8056	0.8210	0.8969
$A\lvert\alpha_i\rvert$	0.1417	0.1309	0.0783
$\frac{A\lvert\alpha_i\rvert}{A\lvert r_i\rvert}$	0.3153	0.2912	0.1743
$\frac{A\alpha_i^2}{Ar_i^2}$	0.0994	0.0848	0.0304
$\frac{As^2(\alpha_i)}{A\alpha_i^2}$	0.0609	0.0515	0.0169
$A(R^2)$	0.8056	0.8210	0.8969

Table 25 displays that all three models are not rejected by the GRS test, with the FF5FM containing the highest GRS(p) value, 0.8969, thus regarding it as the best performer. All three APMs are considered to fully explain the return of the mutual fund portfolio in Nigeria.

The FF5FM outperforms the other two models across four of the remaining five performance measures. It records the lowest average absolute alpha value of 0.0783. It also records the lowest $\frac{A|\alpha_i|}{A|r_i|}$ and $\frac{A\alpha_i^2}{Ar_i^2}$ of 0.1743 and 0.0304 respectively, as seen in Table 23. Lastly, it has the highest $A(R^2)$ value of 0.8969.

The CAPM performs the worst in five out of the six performance measures, however, it has the highest $\frac{As^2(\alpha_i)}{A\alpha_i^2}$ value of 0.0609, outperforming the other two models in this measure. The FF3FM again performs the second best between the three models across all six performance measures.

7.3.7 Select countries

Table 26: GRS test results performed on Egyptian, Mauritian, Moroccan and Namibian mutual fund portfolios

Model	**CAPM**	**FF3FM**	**FF5FM**
GRS	43.117361	42.31848	39.783193
GRS (p)	0	0	0

As mentioned above, as a result of the similarities in data, a combined GRS test was performed on four countries that serve to represent the African mutual fund industry. The GRS test rejects all three models at a 1% level of significance, displaying that the models are unable to explain the returns. It is all noticeable that the weakest rejection is the FF5FM. This behaviour is similar in nature to the GRS test results presented in Tables 21, 22 and 23 in which all models were rejected, but the FF5FM experienced the weakest rejection. These results are alike to the results presented in Sha and Gao's (2019) study on the Chinese mutual fund industry. The results from the GRS test conducted on all types of funds found that all models were rejected, with the FF5FM experiencing the weakest rejection by the test. The similarities in the results can be attributed to China, as well as all the sample countries in the study, being classified as emerging market countries. Thus, mutual fund industry similarities exist between China and the combination of the six sample countries which ends with alike results.

7.3.8 All countries

Table 27: Performance measures on all three models for all sample countries

Model	**CAPM**	**FF3FM**	**FF5FM**
$A\lvert\alpha_i\rvert$	0.4577	0.4395	0.4121
$\frac{A\lvert\alpha_i\rvert}{A\lvert r_i\rvert}$	2.0006	1.9427	1.9289
$\frac{A\alpha_i^2}{Ar_i^2}$	4.0023	3.7740	3.7205
$\frac{As^2(\alpha_i)}{A\alpha_i^2}$	0.5961	0.6304	0.6697
$A(R^2)$	0.2751	0.3189	0.3375

Table 27 presents the performance measures results for the CAPM, FF3FM and the FF5FM for all six sample countries. This table represents the performance of the three models on the African mutual fund industry as a whole. Looking at the first performance measure, $A|\alpha_i|$, one can see that the CAPM model has the highest value of 0.4577, the FF3FM has the second highest value of 0.4395 and lastly the FF5FM has the lowest value of 0.4121.

The next two performance measures, $\frac{A|\alpha_i|}{A|r_i|}$ and $\frac{A\alpha_i^2}{Ar_i^2}$, are measures of dispersion and Table 27 displays that the FF5FM has the lowest values for both these measures in comparison to the other two models. This insinuates that the FF5FM induces the lowest dispersion when measuring mutual fund returns in the African mutual fund industry. Furthermore, it implies that the model has the most control over alpha dispersion between the three models. On the other hand, the CAPM has the least control over alpha dispersion and induces the most dispersion when measuring fund portfolio returns in the African mutual fund industry.

The next performance measure, $\frac{As^2(\alpha_i)}{A\alpha_i^2}$, also identifies the FF5FM as the top performing model and the CAPM as the worst performing model. Looking at the values in Table 27 for this particular measure, the FF5FM's value is 0.6697, which indicates that 67% of the second moment of the alpha estimate is as a result of sampling error. The last performance measure, $A(R^2)$, also identifies the FF5FM as the best performing model, with the highest value of 0.3375. The higher $A(R^2)$ displayed by the FF5FM implies that the model better explains the variations in return. The CAPM is ranked the worst model according to this measure and the FF3FM performed second best across all five of the performance measures.

The results from Table 27 agree with other international studies that also conducted tests to identify the best performing asset pricing model in differing mutual fund industries. The studies in which similarities can be drawn to include: Kildahl and Lunde (2018) which also identified the FF5FM as the most suitable model in pricing US mutual fund returns, Sha and Gao (2019) who conclude that the FF5FM surpasses all other models in the Chinese mutual fund industry and Chiah et al. who found the FF5FM to perform the best on the Australian market.

7.4 Factor spanning tests

Factor spanning tests were run to identify the presence of redundant factors in the models. Furthermore, the tests serve as a means to distinguish between the factors, which of them is most useful in explaining mutual fund returns in Africa. Factor spanning tests were run on the FF3FM, C4FM, FF5FM and the FF6FM. Due to the differences in factor data for the different countries, tests were run on all the factor data to accommodate the differences. Discrepancies and similarities in the results amongst the different countries will be identified and discussed as well as any parallels with existing literature. Table 28 through Table 31 below present the data for all the factor spanning tests that were run. The results differ for each country.

In Fama and French (2015) research into their five-factor model, they found an interesting result. For U.S. data between the years of 1963 and 2013, the HML factor was considered a redundant factor when explaining the average returns. Fama and French (2015) explain that when regressing all the factors on one another, the results depict that the inclusion of the HML factor fails to improve the mean-variance-efficient tangency portfolio. Assessment of the intercept from the regression results is key in deciphering whether or not the factor is redundant. Fama and French (2015) are curious about this unprecedented behaviour and enquire whether or not this behaviour will be mimicked internationally.

7.4.1 FF3FM

Table 28: Factor spanning tests for the FF3FM

		Coefficient				**t-statistic**
South Africa		*Intercept*	*RMF*	*SMB*	*HML*	*Intercept*
	RMF	0.8327		0.191	0.5329	1.6867
	SMB	0.0172	0.1003		0.5126	0.9622
	HML	-0.1883	0.2001	0.3666		-0.6149
Egypt, Mauritius, Morocco, Namibia		Intercept	RMF	SMB	HML	Intercept
	RMF	0.4499		-0.5159	0.7084	1.0659
	SMB	0.0849	-0.0663		0.0798	0.5587
	HML	0.0758	0.1648	0.1443		0.3705
Nigeria		Intercept	RMF	SMB	HML	Intercept
	RMF	0.444		-0.4658	0.6969	0.9409
	SMB	-0.0129	-0.0567		0.0987	-0.0781
	HML	0.1581	0.1652	0.1919		0.6865

The results displayed in Table 28 indicates that for South Africa, the market factor is important in describing returns. The market factor is the only non-redundant factor with a t-statistic value of 1.6867. The other two factors, size and value, are considered redundant factors with intercept t-statistic values of 0.9622 and -0.6149 respectively. This indicates that for South Africa, the SMB and HML factors are separately explained by the combination of the other factors.

For the remainder of the countries shown in Table 28, when analysing the t-statistic values, it displays that all the factors are considered as redundant. This indicates that jointly, the factors may explain the returns of mutual funds, however, each factor is explained by the other to a certain extent and that is why their t-statistic values are non-significant.

7.4.2 C4FM

Table 29: Factor spanning tests for the C4FM

		Coefficient					**t-statistic**
		Intercept	*RMF*	*SMB*	*HML*	*PMF*	*Intercept*
South Africa	*RMF*	0.1894		-0.4025	0.8688	0.3829	0.4273
	SMB	-0.3501	-0.1547		0.6711	0.3179	-1.2835
	HML	0.1507	0.3031	0.6089		-0.2489	0.5763
	PMF	1.1311	0.6595	1.4242	-1.2289		1.99

Table 29 displays the factor spanning test results for the C4FM for South Africa. What is fascinating to take note of is with the inclusion of the momentum factor, the market factor is now redundant whereas previously in the FF3FM it was not. Furthermore, the momentum factor is non-redundant indicating that it is not explained by the other three factors. This phenomenon replicates the behaviour found by Fama and French (2015) which showcases that the adding of the profitability factor and investment factor causes the value factor to become redundant.

7.4.3 FF5FM

Table 30 displays the factor spanning tests for the FF5FM. The results for South Africa indicate that all the factors are considered as redundant factors. This means that although jointly the factors explain the returns, each factor included in the model is explained by the other factors. This goes against Fama and French (2015) which finds that the inclusion of the profitability and investment factors results in further explanatory power.

For the remained of the countries, the profitability factor, RMW, is considered as a non-redundant factor. This is seen by the intercepts t-statistic values of 2.6222 for Egypt, Mauritius, Morocco and Namibia and 2.3776 for Nigeria. This indicates that the profitability factor is not explained by the remaining factors included in the model. Parallels can be found between this result and Mosoeu & Kodongo (2020) results which found the profitability factor to be the best performing factor. The profitability factor emerging as non-redundant from the factor spanning tests insinuates that investors for Egypt, Mauritius, Morocco, Namibia and Nigeria base investment decisions on firms accounting performances (Mosoeu & Kodongo, 2020)

Table 30: Factor spanning tests for the FF5FM

		Coefficient						t-statistic
South Africa		*Intercept*	*RMF*	*SMB*	*HML*	*RMW*	*CMA*	*Intercept*
	RMF	0.4363		-0.4793	0.544	0.3633	0.4611	1.0171
	SMB	-0.126	-0.1742		0.3874	0.3019	0.367	-0.4852
	HML	-0.1174	0.2587	0.507		-0.2321	-0.0215	-0.395
	RMW	0.2064	0.2643	0.6044	-0.355		0.0718	0.5622
	CMA	0.1694	0.3501	0.7667	-0.0343	0.075		0.4514
Egypt, Mauritius, Morocco, Namibia		Intercept	RMF	SMB	HML	RMW	CMA	Intercept
	RMF	0.6034		-0.4817	1.2983	-0.7147	-1.6439	1.5614
	SMB	0.1599	-0.0765		-0.0013	-0.2993	0.0217	1.0313
	HML	0.0903	0.1542	-0.001		-0.3678	0.9484	0.6715
	RMW	0.2645	-0.051	-0.1346	-0.2211		0.0016	2.6222
	CMA	0.0388	-0.1135	0.0094	0.5512	0.0016		0.3782
Nigeria		Intercept	RMF	SMB	HML	RMW	CMA	Intercept
	RMF	0.4737		-0.4921	1.3859	-0.6641	-1.7216	1.0972
	SMB	0.0654	-0.0748		0.064	-0.291	-0.0564	-0.3866
	HML	0.1738	0.1586	0.0482		-0.3216	0.9683	1.1911
	RMW	0.2725	-0.0493	-0.1421	-0.2083		-0.0144	2.3776
	CMA	-0.0246	-0.117	-0.0252	0.5748	-0.0132		-0.2175

7.4.4 FF6FM

The results in Table 31 for the factor spanning test for the FF6FM display that all factors, with exception to the momentum factor, PMF, are redundant. The momentum factor has an intercept t-statistic value of 1.8285 and is significant. There is a consistency maintained with the South African data with regards to the momentum factor. In both the C4FM and the FF6FM the momentum factor is not redundant and is thus not explained by the other factors.

Table 31: Factor spanning tests for the FF6FM

		Coefficient							t-statistic
South Africa		*Intercept*	*RMF*	*SMB*	*HML*	*RMW*	*CMA*	*PMF*	*Intercept*
	RMF	0.2053		-0.5895	0.7243	0.2127	0.3243	0.2193	0.4832
	SMB	-0.2587	-0.2062		0.5053	0.1794	0.2526	0.1592	-1.0342
	HML	0.1529	0.27738	0.5462		-0.0218	0.1094	-0.2617	0.5858
	RMW	-0.0672	0.141	0.34	-0.0384		-0.0657	0.2645	-0.194
	CMA	-0.0706	0.2339	0.521	0.2088	-0.0715		0.2407	-0.1956
	PMF	0.9162	0.3147	0.6534	-0.9937	0.5727	0.479		1.8285

8. Conclusion

This research paper compares various asset pricing model's abilities to price mutual fund returns in six different African countries. The paper looks at the ability of the models for each country, as well as the countries grouped together to serve as a representation of the African mutual fund industry. The model list encompasses the CAPM, the FF3FM, the C4FM the FF5FM and the FF6FM. Due to the data availability constraints, only South African mutual funds were tested with all five models, whereas the rest of the sample countries and the grouped together data were tested using only the CAPM, the FF3FM and the FF5FM. Six performance measures were made use of to gauge the performances of the APMs. Portfolios were formed for each country by sorting the NAV value for each fund from highest to lowest and thereafter, calculating the percentile groups in multiples of ten from the zeroth percentile to the one hundredth percentile.

The alpha values and their corresponding t-statistic values were analysed for each model after the regression analysis. The results depicted that the CAPM failed to explain 64.3% of mutual fund portfolio returns across the African mutual fund industry. The FF3FM failed to explain 61.9% of mutual fund returns whereas the FF5FM failed to explain 59.5% of mutual fund portfolio returns. Assessing the results indicates that the explanatory performance of the models increases from the CAPM to the FF3FM and from the FF3FM to the FF5FM. These results lead one to conclude that the FF5FM best explains African mutual fund portfolio returns. However, all models have low explanatory power and further research into the inclusion of other more factors, more relevant to emerging markets, can be done.

Mixed results were attained by the performance measures in assessing the APMs in pricing South African mutual fund portfolio returns. Although all models were rejected by the GRS test, the CAPM outperformed the other four models by the GRS test standard. Furthermore, the CAPM also outperformed the other models according to the absolute average alpha value and the two other dispersion measures. The FF6FM outdid the other models by the $A(R^2)$ measure indicating that it best explains variations in returns of the mutual fund portfolios. Lastly, the FF3FM performed best according to the last remaining performance measure. According to these results, the CAPM can be said to be the top performing model for South African mutual fund portfolios, outperforming the other models in four out of the six performance measures.

The GRS test rejected all three of the tested models for Egypt, Mauritius, Morocco and Namibia with the weakest rejection experienced by the FF5FM. Contrastingly, when applying the GRS test in the Nigerian context, all three models are not rejected by the test with the FF5FM outperforming the other two. Furthermore, the GRS test results performed on the grouped data of Egypt, Mauritius, Morocco and Namibia display that the FF5FM experiences the weakest form of rejection.

Assessing the remaining performance measures, the FF5FM performed better than the other two models for majority of the performance measures across the five remaining countries. The FF5FM performs poorly in the proportion of intercept dispersion due to sampling error measure, with the FF3FM outperforming it for Mauritian mutual fund portfolios and the CAPM outperforming it for Moroccan, Namibian and Nigerian mutual fund portfolios. The FF3FM also better explains the variations in portfolio returns in Egypt and the CAPM better explains the variations in portfolio returns in Morocco.

Looking at the African mutual fund industry as a whole and its accompanying results, it can thus be said that the FF5FM outperforms the CAPM and the FF3FM and can be considered as the best model in pricing African mutual fund returns.

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Appendix A

Table A1: Displaying number of funds in each portfolio for South African mutual funds

Portfolio	**Number of mutual funds**
P1	60
P2	60
P3	60
P4	61
P5	60
P6	60
P7	61
P8	60
P9	60
P10	60

Table A2: Displaying number of funds in each portfolio for Egyptian mutual funds

Portfolio	**Number of mutual funds**
P11	3
P12	4
P13	4
P14	4
P15	4
P16	4
P17	4
P18	4
P19	4
P20	3

Table A3: Displaying number of funds in each portfolio for Mauritian mutual funds

Portfolio	**Number of mutual funds**
P21	13
P22	13
P23	13
P24	13
P25	14
P26	13
P27	13
P28	13
P29	13
P30	13

Table A4: Displaying number of funds in each portfolio for Moroccan mutual funds

Portfolio	**Number of mutual funds**
P31	38
P32	39
P33	39
P34	44
P35	34
P36	39
P37	39
P38	39
P39	39
P40	38

Table A5: Displaying number of funds in each portfolio for Namibian mutual funds

Portfolio	**Number of mutual funds**
P41	11

Table A6: Displaying number of funds in each portfolio for Nigerian mutual funds

Portfolio	**Number of mutual funds**
P42	10