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Stock (Mis) Pricing and Diversification in Africa: Evidence from Selected African Exchanges

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Abstract

This paper ascertains the extent of mispricing in equity portfolios, mispricing-divestment relation, and the role of African equities as risk diversification strategies during commodity market turbulence. Following Baur and Lucey (2010), one identifies an arbitrary commodity market crisis to be 1%, 5%, and 10% declining moments in returns. However, their approach is extended by using African equities as a safe haven against gold. A risk-augmented CAPM is specified to estimate the mispricing in equity portfolios, while the risk diversification model follows Baur and Lucey (2010). For all the estimations, the regressions are run on daily data from 5th January 2010 to 30th December 2015. First, the results show the presence of temporary mispricing in the portfolio's returns of African equities regardless of the firms' liquidity and volatility levels. More so, stronger mispricing is observed using an alternative specification. Second, mispricing causes significant divestment in big-size portfolios. Third, there is a clear manifestation of strong, safe havens between South Africa and Cocoa markets; Egypt and Platinum markets; and Morocco and Oil markets, respectively. However, Nigerian equities can successfully diversify oil and cocoa during market turmoil. The conclusion is that mispricing in a portfolio of equity returns is due to the low frequency of trading and that Africa's equity markets are risk diversifiers and safe havens for commodities. The paper recommends jettisoning investors' buy-and-hold trading strategy and encouraging the establishment of African commodity exchange to achieve the desired inclusive growth.

Keywords: Mispricing, Diversification, Safe-haven, Africa's Equity Markets.

JEL Classification: F21, G01, G12, G15.

1. Introduction

Before the 2008 global financial crisis, Africa received enormous private capital flows (PCFs) such that the value of the inflow to sub-

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Saharan African countries increased by over 300% between 2000 and 2007[1] (see IMF/World Bank World Economic and Financial Surveys, 2008). The advent of the 2008 global financial crisis has resulted in the decline of portfolio investment to Africa (Macias and Massa, 2009; World Bank Report, 2009; Osakwe, 2010 and UNCTAD Report, 2010), and consequently, an ample number of African stock markets did not only suffer from the contagious effect but also faced huge divestments and capital flow reversal (IMF Report, 2009). The former has been attributed to the over-valuation of stocks while the latter has been attributed to increased uncertainty on expected returns (AfDB Report, 2009; IMF Report, 2009; and Beck, Maimbo, Faye, & Triki, 2011). Studies have established that an over-valued stock price is sensitive downward to negative stock market shocks, as the price adjusts quickly to its intrinsic (or true) value and thus, reduces the value of stock investment (Ledoit and Wolf, 2003; Mohammed, 2006; Kan and Zhou, 2009; and Yan and Garcia 2014).

Within six months, African stock investors experienced an average loss of more than half the wealth invested at the end of July 2008 (AfDB Report, 2009). Losses recorded in most of the African stock markets are higher than those of the United States; Hong Kong and French markets (see Table 1). Although the American, French, and Hong Kong markets were adversely affected by the crisis, most of these markets have fully recovered (see Table 1). The post-crisis stock market performances showed the significant effect of over-valuation of equity portfolios and prices before the financial crisis in most of the sampled African countries: Morocco, Egypt, and Nigeria in particular (see Table 1 and Figure 1.1). On this note, the over-valuation (herein called positive mispricing) of investors' equity portfolios before the crisis, had heightened the effects of the financial crisis on the value of investors' equity portfolio in Africa.

Shortly after the financial crisis, there is rising susceptibility of equity markets to various forms of economic shocks which have led to the resurgence of investors' appetite for alternative means to diversifying and downside market risk. In the last decade, investors

1. In 2000 private capital flows to Africa was US$11billion and rose to US$53 billion in 2007.

have considered commodities as highly liquid financial assets (Buar and Lucey, 2010; Vivian and Wohar, 2012). A 2008 report by the US Commodities Futures Trading Commission (CFTC) showed that investment inflows to various commodity futures markets rose to US$200 billion in 2008 (CFTC Market Report, 2008). This value further increased by US$10 billion at the end of 2012[1]. Similarly, a significant number of commodities across the energy, metal, and agricultural sectors saw a consistent boom just around the global financial crisis in 2008-2009 (Cheng and Xiong, 2014). The huge inflow is premised on the fact that investors' potential to diversify can be improved with the inclusion of commodity futures in portfolios since commodities show equity-like returns and low correlation with traditional assets (Gorton and Rouwenhorst, 2006).

The recent substantial declining moments in commodity markets in 2014 and 2015[2] (see Figure 1.2) has offered investors new impetus to diversify their investment portfolios across economies[3]. For Africa equity markets to identify and benefit from the possible international cross-border portfolio investment flows and diversification opportunities, it requires appropriate pricing of equity portfolios and understanding of the correlations between its financial assets and global commodities. For these reasons, this paper raises three main questions: First, are African equity portfolio returns properly priced and if so, what is the extent of mispricing? Second, did the mispricing cause divestment on the exchange? Third, are African equities viable enough to proffer 'safe-haven'[4] during varying periods of global commodity market crashes? Answers to these require studies on mispricing of equity portfolio returns which is virtually non-existent for most African countries, and shreds of evidence for the second question for African equities remain scanty for post-financial crises daily data.

1. See CFTC Index Investment Data.
http://www.cftc.gov/MarketReports/StaffReportonMay6MarketEvents/index.htm
2. Following the sharp decline in 2014, commodity prices weakened further in 2015. The Prices of oil and metals, such as iron ore, copper and platinum, declined substantially. Prices of some agricultural commodities, such as cocoa and coffee also fell moderately.
3. Generally, modern portfolio theory encourages the holding portfolio of stocks to diversify idiosyncratic risks (Markowitz, 1959).
4. An asset is regarded as a 'safe-haven', if such asset increases or retains its value when there is market turbulence. That is, asset has no correlation or negative correlation with another asset or portfolio in times of market turmoil (see Doroodian and Caporale, 2000; Baur and Lucey, 2010).

Table 1.1: Impact of Financial Crisis on Select Equity Markets

Country	Index Name	Benchmarks	Market Value (Feb 2009)	Losses due to the financial crisis (%)	Market Value (Dec 2012)	Persistent losses/ Recoveries (%)
Africa Equities						
EGYPT	CASE 30 INDEX	9251.15	3600.79	-61.07	5417.59	-41.43
MOROCCO	CASA ALSI	14134.7	10352.81	-26.76	9388.83	-33.57
NIGERIA	NSE ALSI	52916.66	23814.46	-54.99	27866.51	-47.33
SOUTH AFRICA	JALSH	27552.65	20650.38	-25.05	40281.14	46.19
Selected Equities						
USA	DJ Industrial	11378.02	7850.41	-31.00	12938.11	13.71
HONG	HSIIND	21785.21	13194	-39.43	22666.59	4.05
FRANCE	CAC40 IND	4392.36	2997.86	-31.75	3620.25	-17.57

Source: Bloomberg Terminal and Countries' Equity Exchange Markets.

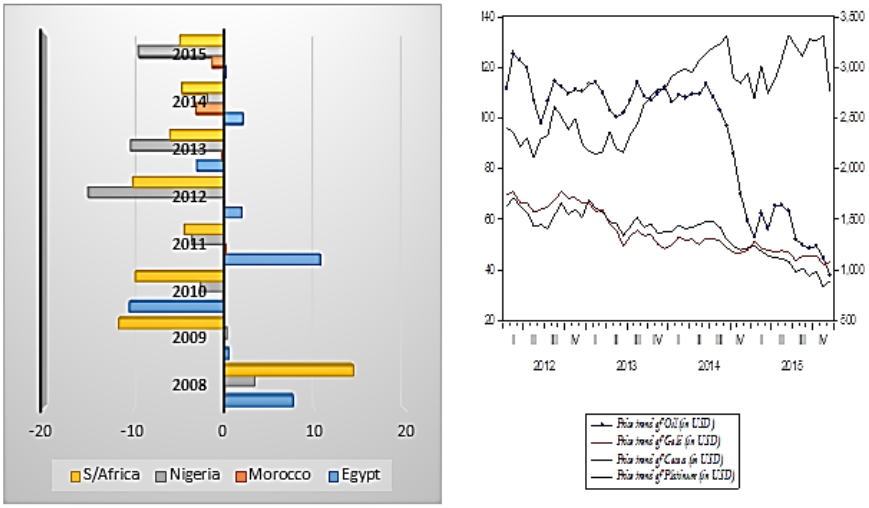

Figure 1.1: Portfolio Investment Flows to selected African Stock Markets
Source: Author's computation. Note: Underlying data are from the Bloomberg Terminal and World Bank database (http://data.worldbank.org/indicator/BN.KLT.PTXL.CD?locations=MA).

The concept of mispricing of equity portfolios has long been a major issue in the literature. Fama, for instance, reveals that tests of

classical asset pricing models such as CAPM, CCAPM, and ICAPM implicitly rely on an assumption of market efficiency, which permits the substitution of realized returns for expected returns. There is increasing evidence that common stocks are mispriced relative to these models[1]. The reasons for these mispricing vary across equity markets and therefore, remain inconclusive in the literature. Jegadeesh and Titman (1993) and Brennan and Wang (2006), for instance, find positive autocorrelation of individual stock returns at the 6-12 month horizon, which is consistent with the slow adjustment to firm-specific news documented in a large number of studies. Jegadeesh et al. (1995) find evidence that stock prices tend to over-react to firm-specific information. Some studies found that stock returns co-vary with the state of stock market liquidity (Pastor and Stambaugh, 2003; Acharya and Pedersen, 2005 and Sadka, 2006) while studies that show that unanticipated increase in market illiquidity and sentiment affect the level of equity prices include Lee and Swaminathan (1991), Swaminathan (1996) and Amihud (2002).

More studies affirm that investors consider commodities as highly liquid financial assets through hedging and risk management (see Vivian and Wohar, 2012). The increased interest of investors is premised on the assumption that the potential to diversify can best be enhanced with the inclusion of commodity futures in portfolios since commodities show equity-like returns and low correlation with traditional assets (Gorton and Rouwenhorst, 2006). Earlier studies by Bodie and Rosansky (1980) and Anson (1998) buttressed this claim[2]. Conversely, recent reports show that even though commodities can slightly reduce risk in portfolios, this effect becomes negligible in a balanced portfolio (Yan and Garcia, 2014). Other studies have also explained the cross-market correlations. Olson, Vivian, and Wohar (2014) reports that cross-market correlations between commodities and equities during crisis increases while equity-commodity correlations may be driven by herd behavior (see Demirer, Lee, and

1. French and Roll (1986) suggest that on average of 4 to 12% of the daily return variance of common stock returns is due to mispricing.
2. Bodie et al. (1980) in 'Risk and return in commodity futures' reveal that adding commodities in portfolios enhances investors' chances of reducing risk. This finding was supported by Anson (1998).

Lien, 2015).

All evidence shreds above show that the mispricing of portfolio returns has remained contentious in developed markets and less researched in African equity markets. There is also, a major research gap in African literature on investors taking positions in commodities and seeking diversification of portfolio risks during crises using African equities. Studies conducted in this area have often focused on developed markets with the perception of investors holding positions in commodities to act as a safe hub for equities. Meanwhile, studies on African equity markets remain limited. Therefore, the objective of this paper is to examine the presence of mispricing in equity portfolios and demonstrate the possibility of African stocks for diversifying risk and act as safe-havens during the global commodity market crash.

In this regard, this paper will focus on four African Exchanges – Johannesburg Stock Exchange (JSE), Nigerian Stock Exchange (NSE), Egyptian Stock Exchange (ESE), and Casablanca Stock Exchange (CSE). The paper is in five sections. The first is introductory; the second reviews relevant literature; the third provides the methodology and data requirements while estimation results, implications, and discussions come up in the fourth, and the fifth offers conclusions and policy recommendations.

2. Brief Review of Related Literature

This section is a summary of previous empirical studies on mispricing and risk diversification.

Mispricing of equities

The literature on mispricing is vast but this study will highlight a few of them. De Bondt and Thaler (1985 and 1987) find a long-run reversal of prior stock price changes. They interpret the reversal as corrections of over-reactions to the news. Jegadeesh and Titman (1993) buttress their position by using the NYSE and AMEX stocks. Jegadeesh and Titman (1995) reveal that stock prices tend to over-react to firm-specific information such as volatility, disbursement of dividends, and trading volume. Lee and Swaminathan (2000) show that low/high stock trading volume tends to be under/overvalued by the market. Meanwhile, Amihud (2002) demonstrates that an

unexpected increase in market illiquidity reduces the stock price level. Pastor and Stambaugh (2003) indicate that stock returns are affected by the state of stock market liquidity, a claim supported by Acharya and Pedersen and Sadka in 2005 and 2006, respectively.

Risk Diversification

Copious literature affirms gold as risk diversification, hedge, and safe-haven for financial assets, especially stocks and bonds. Studies in this regard include Jaffe (1989) that finds that gold remains a hedge against inflation and stocks. Johnson and Soenen (1997) show that gold is an attractive investment for diversification, only in specific periods. They remarked that between 1984 and 1995 gold yielded negative returns. More recent revelations by Baur and Lucey (2010) and Ciner, Gurdgiev, and Lucey (2012) hint at a discontinuous relation between gold and financial assets. The studies distinguish between a hedge and a safe-haven. After considering the declining moments in financial assets and representing them in quintiles, they found uncorrelated relationships between gold and stocks in the short run. This suggests that gold, on the average, is a safe-haven for stocks in the short run. Interestingly, investors' returns increase in the gold market as stock returns decline. All these researches focus on developed markets but studies on emerging and African markets are limited Gurgun and Unalmis (2014) and Bodington (2014).

Essentially, numerous researches have been conducted on mispricing and commodities as a risk diversification strategy for financial assets. Studies on mispricing have established that news, market liquidity, and firm-specific information such as volatility causes mispricing in stock prices and portfolio of equity returns. Furthermore, these studies concentrate on developed markets such that researches on developing markets remain indescribable. Gold, oil, and cocoa have been seen as a hedge, diversifiers, and safe-havens for stocks and bonds and financial assets. Studies examining stocks as hedge, diversifiers, and safe-havens for commodities during market calmness and turbulence are severely limited. This paper addresses these two issues using selected African equity markets.

3. Methodology and Data

3.1 Methodology

There are extant models of mispricing in the literature. They include models assuming that mispricing is independent of fundamentals, and follows a simple first-order autoregressive model (see Poterba and Summers, 1988). Models that assume that mispricing is due to slow adjustment of market prices to new information (Ball and Brown, 1968; Dimson, 1979; Brennan, Jegadeesh and Swaminathan, 1993, and Brennan and Wang, 2006), and models demonstrating that mispricing is associated with a market-wide mispricing factor (Fama and French, 1993; and Brennan et al., 2006). The models that assume mispricing is associated with market-wide mispricing factor is also called the model of systematic mispricing. One major focus of the paper is to ascertain the presence of mispricing in portfolios of equities in African markets. Therefore, it will be quite appropriate to consider market factors driving mispricing and generating a market-wide mispricing factor. Essentially, this paper adopts a 'systematic mispricing approach' to examine the existence of mispricing in portfolios of equities in selected African markets: JSE, NSE, ESE, and CSE.

Empirical pieces of evidence show that most prominent market factors driving mispricing in stocks are liquidity and volatility (Lee et al., 2000; and Acharya et al., 2005). According to Archarya et al. (2005), these factors have caused mispricing relative to a given rational pricing model. Again, studies have revealed that stocks are mispriced relative to the classical asset pricing models[1]. These pieces of evidence enable the study to specify a 'risk-augmented CAPM' to validate the presence of mispricing in the portfolio of selected African equities. The factors considered for the augmentation are average firms' liquidity and volatility. The principal regression model is, therefore, specified in equation (1) as follows:

1. Empirical studies have revealed that stocks are mispriced relative to the classical asset pricing models such as CAPM, CCAPM and ICAPM (see Fama and Roll, 1986; Jegadeesh and Titman, 1993 and 1995; Lee and Swaminathan, 2000 and Acharya and Pedersen, 2005). In view of these evidences, using the CAPM without augmentation may result in estimation bias.

$$R_{i,j,t}^{P} = \alpha_{i,j,0} + \beta_{1i,j,t} R_{mkt,t} + \beta_{2,i,j,t} liq_t + \beta_{3,i,j,t} vol_t + \varepsilon_{i,j,t} \quad (1)$$

where $R^P, R_{mkt}, liq\ and\ vol$ are excess portfolio returns, market returns, liquidity measure (proxy with the daily average change in volume of a firm's transactions), and average firms' systematic volatility. $\alpha, \beta's\ and\ \varepsilon$ are intercepts, sensitivities, and error terms. Signs $i, j\ and\ t$ represent selected stock markets, portfolios, and time dimensions. Equation (1) is estimated through the multivariate least square technique. For easier estimation, stocks are sorted into three different portfolios based on their sizes (average firm's capitalization) and the firm's volatility (standard deviation of daily stock prices). The market mispricing factor is the variance ratio of the risk-augmented CAPM residual which is measured by $VR(m) \equiv \left(\frac{\text{var}(e^m)/m}{\text{var}(e^1)} \right)$; this is line with Andersen, Bollerslev, and Das (2001); Brennan and Wang (2006); Li and Liu (2012); and Hong, Linton and Zhang (2015). Where e^m is the cumulative residual return over m-days. In the presence of short-lived mispricing, the residual of risk-augmented CAPM will be less than unity, so that $VR(m) \prec 1$. If the mispricing factor is very low, then the stronger is the mean reversion in mispricing; more so, when the mispricing factor is unity, there is the absence of mispricing (see Brennan, Jegadeesh and Swaminathan, 1993; and Brennan et al., 2006).

To analyze the second question, the study follows the works of Fahir and Panageas (2004) and Mohammed (2006). Previous studies have examined the relation between mispricing and investment with interest in undervalued firms (Baker, Stein and Wurgler, 2003) while the studies of Panageas (2003) and Gilchrist, Himmelberg, and Huberman (2004) considered overvaluation. Studies by Polk and Sapienza (2002), Fahir et al. (2004), and Mohammed (2006) consider both over and undervalued firms. However, Polk et al. (2002) model did not separate the type of mispricing and investment to verify the relationship between mispricing and form of investment (under and over-investments). The model adopted in this study is in line with Mohammed (2006), but modified by classifying stocks into different

portfolios and including for effect of past mispricing. The model estimated is specified in equation (2c).

$$\left(\Delta I/I_{t-1}\right)_{i,t} = a_1 + a_2 P_{(mis)i,t} + a_3 P_{(mis)i,t-5} + a_4 P_{(mis)i,t-10} + a_5 P_{(mis)i,t-15} + a_6 V^{+} + \xi_{(a)i,t} \quad (2a)$$

$$\left({}^{+}\Delta I/I_{t-1}\right)_{i,t} = b_1 + b_2 P_{(mis)i,t} + b_3 P_{(mis)i,t-5} + b_4 P_{(mis)i,t-10} + b_5 P_{(mis)i,t-15} + b_6 V^{+} + \xi_{(b)i,t} \quad (2b)$$

$$\left({}^{-}\Delta I/I_{t-1}\right)_{i,t} = c_1 + c_2 P_{(mis)i,t} + c_3 P_{(mis)i,t-5} + c_4 P_{(mis)i,t-10} + c_5 P_{(mis)i,t-15} + c_6 V^{+} + \xi_{(c)i,t} \quad (2c)$$

where the variables on the right $\left(\Delta I/I_{t-1}\right), \left({}^{+}\Delta I/I_{t-1}\right)$ *and* $\left({}^{-}\Delta I/I_{t-1}\right)$ are defined as a total change in investment in stock portfolio size, over-investment in stock portfolio size, and under-investment in stock portfolio size. The variables on the left consist of stock mispricing variables $P_{(mis)}$ and lags. The paper also controlled for over-valuation in stock portfolios, as earlier studies had demonstrated that the relatively high impact of financial crisis felt by stock markets in Africa is due to over-valuation (AfDB Report, 2009; IMF Report, 2009; and Beck, Maimbo, Faye and Triki, 2011). The control was done by introducing a dummy variable, V^{+}. In assigning the dummies, the paper allocated one (1) for periods with over-valuation (positive value of mispricing) in the mispricing series and zero (0) otherwise. 'i' and 't' are portfolio classes (Big, Medium and Small) and periods, respectively. Models specified are estimated through the least square estimation technique. The investment in listed stock is proxy by the daily value of stocks traded. The stock mispricing series remain the residual of the risk-adjusted CAPM model $\left[residual = R^{P}_{i,j,t} - \hat{R}^{P}_{i,j,t}\right]$ this is in line with Brennan et al. (2006); Mohammed (2006); and Wang, Zhao, and Wang (2013).

The third question of providing insights on whether African equities can offer safe-havens to commodities during varying periods of market crashes was also addressed. In tackling this issue, the study adopted the hedge-safe-haven model of Baur and Lucey (2010). Their model shows that the returns of a commodity (gold) depend on returns of other financial instruments such as stocks and bonds alongside varying declining moments in stocks and bonds. It is assumed that returns of gold would be uncorrelated with returns of stocks and bonds on the average for gold to be a safe-haven for both financial

instruments. In their specification, they examined commodities such as gold as safe-havens for stocks and bonds. Paradoxically, in this paper, the reverse is the case because African stocks are considered a safe-haven for investors holding positions in global commodities. The models used for the analyses are specified in equations (3) and (4). The paper separated the safe-haven and hedge parameters for clarity, and the study is more interested in the safe-haven parameters in equation (4), as it remains its focus in addressing the question.

$$R_{i,t} = \eta_{i,0} + \sum_{k=1}^{4} \eta_{i,k} R_{k,t} + \upsilon_{i,t} \tag{3}$$

$$R_{i,t} = \gamma_{i,0} + \sum_{k=1}^{4} \gamma_{1k} dum\left(R_{k(q=1\%),t}\right) + \sum_{k-1}^{4} \gamma_{2k} dum\left(R_{k(q=5\%),t}\right) + \sum_{k=1}^{4} \gamma_{3k} dum\left(R_{k(q=10\%),t}\right) \tag{4}$$

where $R_{i,t}$ *and* $R_{k,t}$ represent the returns of selected African equity markets and commodities at time t, respectively. η_0 *and* υ_t are intercept and error term at time t. In equation (3), the structure of the model assumes that African equity prices cannot drive prices of selected commodities because of the safe-haven rule. As stated earlier, equation (4) remains the focus of the estimation. In this model, the intercept γ_0 measures the average effect of the regressors on the regressand and can be used as a hedging indicator. γ_1, γ_2 *and* γ_3 are coefficients of the dummy variables and relevant to the safe-haven analysis. The dummy variables $dumm(...)$ measure the extreme return behavior of the selected commodities and assign zero (0) value when the commodities returns vary within the defined thresholds 1%, 5%, and 10%[1] , and one (1) otherwise. This is how the series for the quartiles (various declining moments of commodity markets) are generated. The series is the regressors in equation (4). The γs are

1. The choice of quantiles is arbitrary and depends on events. However, the procedure is still similar to Baur and Lucey (2010) and Ciner, Gurdgiev and Lucey (2012). Baur et al. (2010) and Ciner et al. (2012) used 1%, 2.5% and 5% as quantiles but in this paper we deviate slightly because of the return distribution of the select commodities.

interpreted accordingly, following Baur et al. (2010) and Ciner et al. (2012). If the coefficients in equation (4) $\gamma's$ are zero or negative, it is offered that, selected African equities are, on the average, a safe-haven for selected commodities. γ_0 is a hedge parameter which suggests that investors can use the African equity market as a hedge if it is significantly negative or zero and, if not, as a diversifier. The subscripts 'k' and 'i' denote the selected commodities (oil, gold, cocoa, and platinum) and African stock markets (South Africa, Nigeria, Egypt, and Morocco). Models are estimated through the least square technique. We specified the univariate GARCH (1,1) model to capture for heteroscedasticity in the data as shown in equation (5).

$$\sigma_{i,t} = \theta_i + \alpha_{i,1}\upsilon^2_{i,t-1} + \beta_{i,1}\sigma^2_{i,t-1} \quad (5)$$

3.2 Data

The data used for the first and second questions consist of daily average returns of selected equities of four African equity exchanges (South Africa, Nigeria, Egypt, and Morocco). The choice of these exchanges is premised on the fact that they highly attracted investors in the past (these exchanges received a large proportion of portfolio investment inflows during market calmness and experienced huge divestments when the market crashed). Also, the exchanges are more developed in comparison to others (see ASEA Annual report, 2014). In each of the four African equity exchanges, 60 firms were selected, making a total of 240 stocks. The choice in the selection of stocks is based on price continuity. The data were collected daily and stock returns generated from the prices using equation (6). Portfolios are sorted into big-size/high-vol., medium-size/medium-vol. and small-size/low-vol. based on the firm's capitalization and volatility. The analyses were done separately for each market and stock returns were averaged daily. Data on stock prices, volume, and capitalization and market capitalization were used and garnered from the websites of these stock exchanges, Egypt stock data are from Reuter's terminal, falling in the period 5th January 2010 to 30th December 2015.

Data used for the analyses of the third question comprise indices of the four African exchanges and spot prices of four global commodities

(oil, gold, cocoa, and platinum). The choice of the commodities was based on high rating and importance to investors and oil, gold and cocoa remain major export commodities on the continent. The data was collected from Bloomberg. The data is close to daily frequency and ranges from 5th of January, 2010 to 30th December, 2015. Commodity returns were also generated through equation (6).

$$R_t = \left(\ln\left(p_t\right) - \ln\left(p_{t-1}\right)\right) * 100 \quad (6)$$

where R_t, P_t *and* P_{t-1} are returns and prices/indices a time t and one period lag, respectively.

4. Estimation Results, Implications and Discussion

4.1 Descriptive Statistics

The summary statistics in Appendix 1 describe the behavior of the series used in the analysis. Apart from the descriptive statistics, the table also contains the stationary test results. The augmented Dickey-Fuller (ADF) test was employed as a stationary test. The results (in the table) show that even at a 99% confidence level, the Jarque-Bera test statistics for most of the variables are significant and therefore, indicates that there is no evidence to accept the null hypothesis of normal distribution. The stationary test also rejects the null hypothesis of non-stationary for all the variables at order zero, I(0). This indicates that the original series is stationary at the first order of difference. Furthermore, the descriptive statistics show that all the variables have greater kurtosis which is greater than normal. This suggests that the variables exhibit leptokurtic behavior. The skewness values are negative for almost all the variables except for variables like oil, gold, and market liquidity. The negatively skewed statistics of both selected African equity exchanges and commodities report that the probability of investor seeing positive returns from positively skewed assets are higher than those that are negatively skewed. While the selected commodities appear to have lower returns compared to the equity markets, they are also highly volatile[1]. This buttressed the findings of

1. Annexure 1 documents that among sampled commodities, platinum and cocoa have the highest returns 0.032% and 0.015% with lower volatilities. Going by the frequency of observation, gold and oil have the highest volatility value of 2.358% and 2.308%.

Buyuksahm and Robe (2014) that the returns on equities are less volatile than that on commodities.

4.2 Mispricing of Returns in African Equity Portfolios

Tables 2a and 2b show the results of the return mispricing in equity portfolios. Table 2a shows the estimated results of portfolios sorted by liquidity while Table 2b presents estimates of portfolios, having controlled for volatility. In Table 2a, the magnitude of the variance ratio declines monotonically from large to a small number of days, while the volatility of residual returns increased, accordingly. This relationship was expected and suggests that the volatility of residual returns is driven by the frequency of equity trading. For equity portfolios traded within a few days, the volatility of residual returns decreased, which implies that mispricing risk associated with equity returns of portfolios (regardless of portfolio size) declines as stocks are frequently traded. This behavior was found in all the countries except in some trivial cases *(such as Big and Medium Size portfolios in Egypt that move contrary to this relationship)*. The result is in line with the findings of Gemmill and Thomas (2002) and Brennan et al. (2006) which reported that mispricing return bias decreases (increases) in the variance ratio and to increase (decrease) in residual return volatility. Gemmill et al (2002) used closed-end funds as the underlying asset while the stocks registered on the New York Stock Exchange, AMEX, and NASDAQ were used in the work of Brennan et al (2006).

The mispricing analysis is based on the variance ratio using various numbers of days (5, 10, 15, and 20 days). The results in Panel A of Table 2a contain estimates of two countries (Egypt and Morocco). With the risk-augmented CAPM, the mispricing in the big-size portfolio declines drastically as the frequency of trading days rises in Egypt stocks. The mispricing attenuated when the portfolios are traded every five days, and reported as 0.925 in the cell. A similar trend was observed for small-size portfolio, whereas, the medium-size portfolio shows a different pattern with increased mispricing. This implies that investors taking positions in the Egyptian stock market should order portfolio with more big and small-size stocks to overcome the impact of mispricing on equity portfolio returns. In the Casablanca stock

market, the big and medium-size portfolio yielded better results compared to a small-size portfolio. Holders of a big-size portfolio should not bother about mispricing in their portfolios as long as they trade this portfolio regularly of, at least, 5 days interval on the average. Results for Nigeria and South Africa are documented in Panel B. In Nigeria, holders of medium and small-size portfolios that are frequently traded should not be scared of mispricing effects. The results of these two portfolios show that portfolio mispricing is transient on high-frequency trading and converge quickly to the mean as it is close to unity (the coefficients for both medium and small-size portfolios are 0.904 and 0.873, respectively). The big-size portfolio has low coefficients of the variance ratio compared to other portfolios and needs to be traded more frequently, especially daily, as it converges late to unity. For Nigeria, these results come as no surprise because of the poor rating system and the habit of buy and hold strategy of speculative investors. The situation differs in the South African market because the results of the big-size portfolio indicate the absence of mispricing. Here, mispricing in the portfolio disappears very quickly, even for speculative investors adopting a buy and hold strategy. Although for this portfolio, there is mispricing if trading delays for three weeks, however, this mispricing is short-lived and the effect is trivial on expected portfolio returns. Investors taking a position in medium-size may have their portfolio returns unaffected by mispricing (see Table 2a). The medium-size portfolio shows transient mispricing in all periods. There is an absence of mispricing if the portfolio is traded at less than 5 days intervals. For small-size portfolio, the mispricing result is not different from the medium-size. These findings suggest that it is possible for the mispricing in the portfolio to become negligible as long as the portfolio is traded daily. The mispricing behavior in South Africa shows that the Johannesburg Stock Exchange is likely to be more efficient to price discovery compared to other stock markets considered in the study.

Table 2b contains the estimates of mispricing when portfolio returns are sorted through systematic volatility for the four exchanges. Having controlled for market-specific volatility, the variance ratios for individual stocks are still very noisy, owing to increase volatilities in most cases and hence, portfolio average variance ratio estimates are

very wide-ranging from 0.078 to 0.885 for Egyptian Stock Exchange; from 0.510 to 0.904 for Casablanca Stock Exchange; from 0.105 to 0.987 for Nigerian stock exchange and 0.483 to 0.899 for South African Stock Exchange. From the results, the South African estimates change significantly in comparison to when portfolios are sorted based on liquidity. There is clear transient mispricing in all the three portfolios but the mispricing is short-lived as long as portfolios are frequently traded advisedly, within 24 hours.

The robustness of results in Annexure 2 was estimated through alternative specification, the black-CAPM. The black CAPM is a version of the CAPM that ignores the impact of the riskless assets. It is apparent from the results that mispricing in stocks is stronger for all portfolios except for the South African's Big-size portfolio. The results corroborate the French and Roll (1986) that found mispricing effects on the daily return variance of common stock to hover around 4 to 12% on average.

The estimates of the volatility of residual returns show that individual stocks on the JSE are very noisy compared to other select exchanges. This is evident with high levels of volatility in both liquidity and volatility sorted portfolios. Nevertheless, it is striking that for 20 out of 24 portfolios, the results of VR(5) show that mispricing is short-lived. This suggests that for constantly traded portfolios, the effect of mispricing is not pronounced using the post-2008/2009 crisis data. This may contradict the perception of most investors that have taken positions in African equities before the 2008/09 crisis. However, these results remain true only if investors can desist from their buy and hold trading strategy. The findings show that liquidity and volatility influence mispricing of portfolio returns in African equities which is consistent with the findings of Lee and Swaminathan (2000); Pastor and Stambaugh (2003); Acharya and Pedersen (2005); Sadka (2006) and Brennan et al. (2006)showing that equity returns are affected by the state of trading volume, volatility and market liquidity using developed equity markets.

4.3 Presentation and Analysis of the Mispricing-Divestment relation

Table 3 summarizes the divestment response to the mispricing and over-valuation of portfolios. The total and over-investment models are

also estimated. The results are available but not presented in the paper. The interest of the study is the divestment relation. Country specific results are presented in Panels. In Panel A, the divestment in big stocks is significantly determined by mispricing and overvaluation. While the mispricing is negative, overvaluation shows a positive relation in the model. This implies that in Egypt the transient mispricing did not induce divestment in a big stock portfolio. The positive overvaluation-divestment relation suggests that as overvaluation declines in stock portfolio returns, investment increases (as divestment falls). The results of the medium and small portfolios show positive mispricing effects on divestment which indicates that investors will significantly divest medium and small portfolios as mispricing increases. In this case, the transient mispricing causes divestment in medium and small stock portfolios. The overvaluation did not matter for medium and small portfolios as the coefficients are not significant.

Panel B shows the results of the Casablanca stock exchange. In big stocks, it is apparent that the transient mispricing and overvaluation discourage investment on the Exchange. These reflect in the significant positive coefficients. It indicates the extent of mispricing and overvaluation increase divestment in stock on the stock market. In both medium and small portfolios, overvaluation increase divestment in the market; meanwhile, mispricing shows a negative coefficient which implies that the transient mispricing cannot cause divestment in medium and small stocks. These results can be because the sample contains many undervalued stocks which, in effect, outweigh the effect of overvaluation. In a crisis, undervalued stocks appreciate and thus, increase returns. Holders of such stocks prefer to go long on it and even, wish to increase the stake, which in turn drives stock prices higher until the market equilibrium is attained. Therefore, it is expected that the mispricing effect could increase investment rather than reducing it.

In the Nigerian Stock Exchange, stock mispricing and overvaluation significantly increase divestment in big stocks. This manifests from the significant positive coefficients presented in Panel C. The transient mispricing and overvaluation are less important to determining divestment in a medium stock portfolio, as the

coefficients are not significant. In small stocks, overvaluation causes divestment but the mispricing effect is not clear. These results indicate that investors should take long on a medium and small size stocks to increase trading returns on the Exchange. It is also critical to frequently trade the big size portfolio stocks to reducing mispricing and overvaluation effects. Panel D contains the South African results. The results show that irrespective of the portfolio size, the transient mispricing does not cause divestments but overvaluation significantly does. The positive relationships between overvaluation and divestment for all portfolio-sizes show that as stocks are overvalued during crises, investors tend to drop the stocks for either undervalued stocks (internal divestment) or otherwise.

Essentially, the impact of mispricing on divestment (underinvestment) shows mixed results. Divestment in big stocks can be caused by transient mispricing, particularly in Morocco and Nigeria. Meanwhile, divestments in medium and small stock portfolios are caused by mispricing in Egypt. This effect does not hold for stocks on Moroccan, Nigerian and South African Stock Exchanges. Therefore, the mispricing-divestment relation is more prominent in big size portfolios.

Table 2a: Mispricing of Portfolios of Equities using the Variance Ratio

Panel A: Results of Mispricing of Equity Portfolios sorted by Size (Egypt and Morocco)

Ratios	EGYPT						MOROCCO					
	Big-Size Portf.		Med-Size Portf.		Small-Size Portf.		Big-Size Portf.		Med-Size Portf.		Small-Size Portf.	
	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility
VR (20)	0.173	0.128	0.089	0.184	0.405	0.133	0.389	0.311	0.546	0.305	0.235	0.258
VR (15)	0.425	0.063	0.406	0.025	0.369	0.087	0.438	0.188	0.772	0.214	0.365	0.154
VR (10)	0.684	0.081	0.365	0.032	0.415	0.079	0.825	0.089	0.866	0.207	0.687	0.108
VR (5)	**0.925**	0.044	0.551	0.008	0.782	0.025	**1.058**	0.199	**0.904**	0.185	0.725	0.074
Adj R-SQRD	17.20%		10.10%		9.80%		13.40%		10.70%		5.20%	

Panel B: Results of Mispricing of Equity Portfolios sorted by Size (Nigeria and South Africa)

Ratios	NIGERIA						SOUTH AFRICA					
	Big-Size Portf.		Med-Size Portf.		Small-Size Portf.		Big-Size Portf.		Med-Size Portf.		Small-Size Portf.	
	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility
VR (20)	0.085	0.166	0.685	0.198	0.524	0.187	0.542	0.354	0.875	0.294	0.154	0.359
VR (15)	0.118	0.153	0.607	0.113	0.591	0.164	0.705	0.201	**0.909**	0.258	0.584	0.211
VR (10)	0.652	0.144	0.762	0.105	0.611	0.133	**1.058**	0.178	0.858	0.203	0.623	0.204
VR(5)	0.698	0.127	**0.904**	0.089	0.873	0.115	**0.964**	0.157	**0.993**	0.165	0.733	0.187
Adj R-SQRD	8.92%		7.04%		9.40%		6.55%		8.80%		10.09%	

Source: Research findings.

Notes: underlying data are derived from two main sources such as official websites of Exchanges and Author's calculations. Volatility is the volatility of residual returns which is computed by taking the standard deviation of the portfolio residuals at different periodic intervals of 5, 10, 15, and 20 days. The variance ratio is also computed along with these intervals. The adjusted R-squared shows that for each of the models, the explanatory variables are quite significant even after controlling for degrees of freedom. The estimates are outcomes of several regressions and authors' calculations. The model used for the regressions is the risk-augmented CAPM (the risks considered are liquidity and volatility making the CAPM a three-factor model). The big, medium, and small size portfolios consist of equal stocks (20) making sixty (60) listed equities in each Exchange. The selection of these equities is based on price continuity.

Table 2b: Mispricing of Portfolios of Equities using the Variance Ratio

Panel A: Results of Mispricing of Equity Portfolios through Systematic Volatility (Egypt and Morocco)

Ratios	EGYPT						MOROCCO					
	High Vol. Portf.		Med. Vol. Portf.		Low Vol. Portf.		High Vol. Portf.		Med. Vol. Portf.		Low Vol. Portf.	
	coef	volatility	coef	volatility	coef	volatility	coef	volatility	coef	volatility	coef	volatility
VR (20)	0.152	0.101	0.078	0.164	0.54	0.134	0.306	0.733	0.178	0.531	0.510	0.657
VR (15)	0.385	0.085	0.416	0.133	0.639	0.107	0.384	0.674	0.602	0.255	0.403	0.336
VR (10)	0.486	0.074	0.281	0.158	0.627	0.114	0.669	0.384	0.819	0.173	0.873	0.115
VR (5)	0.885	0.019	0.627	0.089	0.682	0.098	0.851	0.203	0.904	0.147	0.882	0.102
Adj R-SQRD	10.73%		11.02%		8.49%		10.15%		9.96%		6.33%	

Panel B: Results of Mispricing of Equity Portfolio through Systematic Volatility (Nigeria and South Africa)

Ratios	NIGERIA						SOUTH AFRICA					
	High Vol. Portf.		Med. Vol. Portf.		Low Vol. Portf.		High Vol. Portf.		Med. Vol. Portf.		Low Vol. Portf.	
	coef	volatility	coef	volatility	coef	volatility	coef	volatility	coef	volatility	coef	volatility
VR (20)	0.105	0.147	0.439	0.092	0.544	0.122	0.601	0.426	0.744	0.291	0.483	0.393
VR (15)	0.237	0.118	0.782	0.074	0.619	0.108	0.788	0.374	0.909	0.128	0.619	0.217
VR (10)	0.775	0.063	0.811	0.068	0.764	0.083	0.942	0.118	0.755	0.255	0.74	0.206
VR (5)	0.987	0.042	0.904	0.049	0.79	0.061	0.872	0.174	0.832	0.186	0.899	0.105
Adj R-SQRD	9.05%		7.61%		8.54%		8.48%		9.13%		10.90%	

Source: Research findings.

Notes: underlying data are derived from two main sources such as official websites of Exchanges and Author's calculations. The table contains the estimates, where portfolios are sorted by the volatility of individual stocks.

Table 3: Impact of Mispricing on Under-Investment in Selected African Exchanges

Panel A: Egypt	**Classes of Stock Portfolios**					
Dependent Variable	**Big**		**Medium**		**Small**	
$\left(^{-}\Delta I/I_{t-1}\right)$	$P_{(Mis)}$	V^{+}	$P_{(Mis)}$	V^{+}	$P_{(Mis)}$	V^{+}
Coefficients	-0.0286**	0.0859*	0.3436*	-0.0432	0.8035*	0.0323
t-statistics	-2.8005	4.6023	3.7988	-1.0091	4.9023	0.2863
R-Squared	14.77		9.29		19.28	
Adjusted R-Squared	11.57		8.06		16.11	
No of Observation	1549		1549		1549	
Panel B: Morocco						
Coefficients	0.3544*	0.3275*	-0.0238*	0.1269*	-0.0067***	0.1103*
t-statistics	23.7395	4.532	-3.1862	5.1564	-1.9492	7.2949
R-Squared	28.04		20.93		24.54	
Adjusted R-Squared	27.81		17.76		21.74	
No of Observation	1549		1549		1541	
Panel C: Nigeria						
Coefficients	0.1896*	0.1365**	-0.0551	-0.0281	-0.3009*	0.1864*
t-statistics	21.8034	2.7207	-1.0467	-0.7601	-16.4447	6.2585
R-Squared	23.79		19.4		15.43	
Adjusted R-Squared	23.54		18.22		15.16	
No of Observation	1549		1549		1549	
Panel D: South Africa						
Coefficients	-0.0819*	0.0093*	-0.0491***	0.0481**	-0.0309**	0.0018**
t-statistics	-15.0447	3.3994	-1.8754	2.0258	-3.612	2.4009
R-Squared	13.17		8.49		17.49	
Adjusted R-Squared	12.88		7.64		14.32	
No of Observation	1549		1549		1549	

Source: Research findings.

Notes: The dependent variable is under-investment $\left(^{-}\Delta I/I_{t-1}\right)$ which is the negative difference between the average volume of transactions at time t and t-1 divided by the total volume of the transaction at time t-1. The explanatory factors include aggregate mispricing and over-valuation. The over-valuation was considered in the model because previous studies have recognized that over-valuation increases the effect of the financial crises on the performances of African Stock Exchanges. The

underlying data contains African equities falling between 4th January 2010 and 30th December 2015. The t-statistics are reported for the significance of variables and coefficients with asterisks one, two, and three because they are statistically significant at the one, five, and ten percent, respectively.

4.4 Presentation and Analysis of the Safe-Haven Results

The results of the safe-haven analysis are shown in Table 4. The coefficients are the average effects of the explanatory factors on the dependent variables. The results of the GARCH (1,1) model for each of the countries are also depicted in this table and are all significant at varying levels. The choice of the lag length of the GARCH model is arbitrarily informed (see Baur et al., 2010; and Ciner et al., 2012). The independent variables of the safe-haven model consist of contemporaneous commodity returns and extreme declining moments in the markets of selected commodities, proxies by varying dummies.

For the Egyptian Stock Market, values for the intercepts show that the market seems to be a remarkable hedge for gold, but a weak hedge for cocoa during market tranquillity. On average, it remains a strong diversifier for oil and a weak one for platinum in the absence of market turbulence. This type of behavior holds for Moroccan and South African markets, except that the South African market is stronger as a diversifier for platinum traders as given by 0.107% compared to Egypt and Morocco. The Nigerian Stock Market is not resilient to diversifying. The results show that in the absence of market uproar, the market cannot be used as a diversification strategy for investors that have positions in gold, oil, cocoa, and platinum markets. However, the market is a good hedge for all these commodities. This is justified by the negative signs of the intercept across the board.

The safe-haven results indicate that the Egyptian Stock Market is a strong safe-haven for investors holding positions in the platinum market. Thus, on the average, it shows that returns from the Egyptian equities react differently to shocks and events in the platinum market compared to other commodity markets. The significant uncorrelated strands were highly pronounced when returns decline by 1% and 5%, respectively. Although the results also show that the market can serve as a safe-haven for dealers in the cocoa market when market return crashes by 1% and 5%, this relationship is not significant. More so, the total effect (sum of quantiles) refutes this claim, with a positive

sign. The Casablanca Stock Market remains receptive. The result shows that there are prospects of using the CSE as a safe-haven for oil and platinum markets. These can be seen by the negative values of the total effects in two commodity markets, -0.249 (for oil market) and -0.299 (for platinum market). While the CSE shows a weak safe-haven for the platinum market compared to the Egyptian market with -0.842, the safe-haven for oil investors exhibited by the market shows the high possibility of cross-market correlations. This will boost the performance of the market if properly harnessed.

Unfortunately, the Nigerian Stock Market cannot serve as a safe-haven to any of these commodities. Despite being a major exporter of crude oil in the continent, the NSE cannot even be a safe-haven to oil market investors during market crises. Although 'strong' safe-havens for oil and cocoa markets was observed in the period of light market turbulence (say 1% declining moments in returns) and 'strong' safe-havens for returns of investors that hold positions in oil and platinum markets during an extreme market crisis (say 10% declining moments in returns), these coefficients are not significant. The JSE remains the only equity market among those sampled that can be used as a safe-haven for investors' returns in the cocoa market. The total effect shows that the South African Market has 'strong' safe-havens behavior for returns in cocoa and platinum markets with -0.236% and -0.117%. Returns in the platinum market are highly uncorrelated with returns in the South African market during low, declining moments (say 1%) while the returns are highly uncorrelated during extreme market turbulence (say 5%) in the cocoa market. The results imply that the equity returns on the JSE market rise during increasing market crises in cocoa and platinum.

Therefore, investors (both domestic and international) that hold stakes in these commodities may find JSE, a safe-haven during the global market crashes. The results indicate that African equities possess relatively considerable safe-havens features. These findings were not surprising, as Alagidede (2008) found that African Stock Markets are not well integrated and have a weak stochastic trend with the rest of the world. The anatomy of the findings established the existence of the safe-haven hypothesis in the following market pairs: Egypt and Platinum (strong uncorrelated markets on the average);

Morocco and Platinum (weak uncorrelated markets on the average); Morocco and Oil (strong uncorrelated markets on the average); South Africa and Cocoa (strong uncorrelated markets on the average) and South Africa and Platinum (weak uncorrelated market on the average). These illustrations reveal that three (3) markets (Egypt, Morocco, and South Africa) offer safe-haven properties for Platinum, while one (1) market offers safe-haven for Oil. Of all the markets sampled, only the South Africa market proffers a safe-haven for Cocoa. The implication of the safe-haven properties observed in African Equity Markets is that investors holding African equities during periods of crises in the global commodity markets are compensated for losses from their global investments through positive returns from their stakes in Africa.

The GARCH (1,1) models show that there is a high significance for the ARCH and GARCH parameters in all the equity-commodity market models. The results of Egypt and Morocco show less volatility persistence in the long run compared to Nigeria and South Africa. The analyses of the ARCH-LM tests for lag 12 in all the markets suggest that the presence of ARCH effects in all the models is highly minimized. For the robustness of results, the study restricted the number of factors in the safe-haven equation by focusing more on the pair relatives for these markets. It further considers the peculiarity of oil, for Nigeria. The findings were presented in Appendix 3. The results were quite similar to earlier findings except for a slight change in magnitude and for Nigeria, that now has a strong safe-haven for oil, the result is not significant.

Table 4: Results of Safe-haven Hypothesis Using African Equities

African Equity Markets	**Selected Commodities**			
	Oil	**Gold**	**Cocoa**	**Platinum**
EGYPT				
Intercept	1.032**	**-1.779**	-0.061	0.012
Sum of quantiles	0.175	0.96	0.017	***-0.842***
quant. 1%	-0.265	0.683*	-0.105	***-0.747*** **
quant. 5%	0.338**	0.121	-0.387	-0.203**
quant. 10%	0.102	0.156	0.509	0.108
alpha	0.142**	0.102**	0.087***	0.216**
beta	0.781***	0.649**	0.864***	0.618***

African Equity Markets	**Selected Commodities**			
	Oil	**Gold**	**Cocoa**	**Platinum**
ARCH-LM (12)	1.166[0.307]	1.206[0.197]	1.107[0.184]	1.981[0.027]
MOROCCO				
Intercept	0.073	**-0.806**	-0.182	0.104
Sum of quantiles	***-0.249***	0.237	0.442	***-0.299***
quant. 1%	***-0.205****	-0.203	0.519**	***-0.559****
quant. 5%	-0.087***	0.322	-0.036	0.201
quant. 10%	0.043	0.118	-0.041	0.059
alpha	0.117**	0.173***	0.118***	0.127***
beta	0.698***	0.594***	0.711***	0.698**
ARCH-LM (12)	1.28[0.317]	1.114[0.283]		1.214[0.283]
NIGERIA				
Intercept	**-1.384**	**-1.107**	**-1.153**	**-1.409**
Sum of quantiles	0.072	0.2	0.454	1.084
quant. 1%	-0.204	0.112	-0.059	0.962**
quant. 5%	**0.388****	-0.108	**0.411****	0.327
quant. 10%	-0.112	0.196	0.102	-0.205
alpha	0.255**	0.271*	0.296***	0.322**
beta	0.714**	0.649**	0.707***	0.734**
ARCH-LM (12)	1.706[0.033]	1.963[0.057]	1.354[0.121]	1.935[0.093]
SOUTH AFRICA				
Intercept	0.429	**-1.125**	0.291	0.107
Sum of quantiles	0.107	0.996	***-0.236***	***-0.117***
quant. 1%	-0.446	0.885**	0.203	***-0.719****
quant. 5%	0.592**	-0.301	***-0.875****	0.213
quant. 10%	-0.039	0.412	0.436	0.389
alpha	0.093**	0.107*	0.093**	0.105**
beta	0.904**	0.812**	0.901*	0.859*
ARCH-LM (12)	0.685[0.612]	0.918[0.562]	0.983[0.608]	0.769[0.544]

Notes:

*The underlying data is from the Bloomberg trading terminal.

** The table shows the estimates of the safe-haven hypothesis. Each of the markets is dependent variables in the specification in equation (4). The interpretations of the safe-haven are as follows. Zero intercept suggests a weak hedge and negative values indicate a strong hedge. Zero or negative coefficients of quantiles series (1%, 5%, and 10%) show that the equity market is a weak or strong safe-haven for associated commodities. The GARCH (1,1) is used to present the presence of volatility persistence in the residual of the mean equation in (2). The ARCH-LM effect is tested using the Engel (1982) test for the presence of ARCH effects and the results provide mixed levels of not significant, except in few cases. The asterisks represent the level of significance (*, **, *** for 0.01, 0.05, and 0.10 respectively) and values in italics are safe-havens.

5. Conclusion: Highlights and Policy Recommendations

This paper affirms the presence and extent of mispricing in portfolios of equities. The mispricing-divestment relation and establish that African equities can act as diversifiers and safe havens to commodities during market crises. A safe-haven asset is differentiated from a hedge and a diversifier asset which on average provides diversification benefits for investors. The empirical findings show some instructive and interesting highlights:

1. Mispricing of portfolio returns in Africa's equities is caused by the low trading frequency of stocks. This is due to the 'buy' and 'hold' strategy used by speculative investors and increased ignorance to trade inequities among individual investors which constitute a large proportion of total investors' inequities.
2. Infrequently traded stock portfolios, it was seen that mispricing is short-lived. Therefore, it has been concluded that mispricing in Africa's equity portfolios regardless of the size and volatility effects remains a 'low trading frequency phenomenon'.
3. The transient mispricing observed in stock portfolios can cause divestment in stock portfolios, especially the big size portfolios.
4. African equities can be used as safe-havens during global commodity market turmoil. South Africa, Egypt, and Morocco Stock Exchanges can serve as safe havens for investors/traders in cocoa, platinum, and oil markets, respectively.

5.1 Recommendations

In line with the findings, the study recommends the following:

a. Speculative investors should desist from 'buy' and 'hold' strategy as it is quite unhealthy to portfolio returns of equities.
b. Portfolio traders that intend to lessen the mispricing in a portfolio of equity returns should form the portfolio with equities that are frequently traded.
c. African countries should fast track the development of their commodity exchanges to improve performance inequities. They should encourage the establishment of regional and African commodity exchanges to achieve the desired inclusive growth.

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Appendixes and Annexures

Appendix 1: Summary Statistics of Returns and Risks

Returns/Risks / *Countries*	Mean (%)	Std. Dev (%)	Skewness	Kurtosis	JB Test	Stationary Test ADF-Stats	Stationary Test I(d)
Egypt	0.0789	1.6682	-0.5991	9.9633	6712.322*	-20.204	I(0)
Morocco	0.0148	1.2559	-0.0514	7.3822	2177.068*	-22.467	I(0)
Nigeria	0.0205	1.1392	-0.2009	8.1479	3411.219*	-15.055	I(0)
South Africa	0.0386	1.5804	-0.2419	8.0611	4011.073*	-20.473	I(0)
Portfolios							
Egypt Big-size	0.0411	1.237	-0.3966	5.1472	3877.205*	-10.844	I(0)
Egypt Med-size	0.0287	1.1994	-0.3572	6.5877	4021.662*	-12.896	I(0)
Egypt Small-size	0.0398	1.3303	-0.4258	8.2214	4172.008*	-11.337	I(0)
Morocco Big-size	0.0113	1.4472	-0.3809	6.2058	2933.586**	-6.892	I(0)
Morocco Med-size	0.0274	1.9825	-0.3114	5.8941	3058.771*	-8.561	I(0)
Morocco Small-size	0.0308	1.6166	-0.3578	6.0927	3024.336*	-8.732	I(0)
Nigeria Big-size	0.0299	1.2475	-0.3124	7.6785	3722.86*	-10.358	I(0)
Nigeria Med-size	0.0435	1.2046	-0.2754	8.0558	4052.335**	-9.641	I(0)
Nigeria Small-size	0.0301	1.1935	-0.2589	8.2234	3922.784*	-9.558	I(0)
South Africa Big-size	0.0421	1.3733	-0.2025	8.3622	3977.112*	-12.558	I(0)
South Africa Med-size	0.0358	1.2886	-0.2861	9.0571	4287.009*	-14.286	I(0)
South Africa Small-size	0.0325	1.3052	-0.3114	7.9925	3857.448*	-10.471	I(0)
Commodities							

Appendix 1: Summary Statistics of Returns and Risks

Returns/Risks	Mean (%)	Std. Dev (%)	Skewness	Kurtosis	JB Test	Stationary Test	
Countries						ADF-Stats	I(d)
Oil	0.0175	2.3089	0.0351	13.2851	12347.33*	-18.209	I(0)
Gold	0.0039	2.3581	0.0925	9.0908	6049.212*	-21.637	I(0)
Cocoa	0.0146	1.9957	-0.3854	15.5675	28773.422*	-38.917	I(0)
Platinum	0.0326	1.5472	-0.8741	8.9624	4088.328*	-21.664	I(0)
				Risks			
Egypt Liquidity	2.9615	5.8743	-3.1425	21.4336	11138.374**	-12.336	I(0)
Morocco Liquidity	1.6584	4.3691	1.8592	16.8795	9365.245*	-10.587	I(0)
Nigeria Liquidity	3.4521	6.3251	-5.2456	12.1147	10568.68**	-8.025	I(0)
South Africa Liquidity	5.0782	6.8974	-2.3687	18.0046	7025.207**	-23.664	I(0)
Egypt Volatility	0.3061	3.5452	-4.2258	18.5476	9362.485	-8.115	I(0)
Morocco Volatility	0.2827	1.5586	-3.8755	13.5899	8369.117*	-14.284	I(0)
Nigeria Volatility	0.9325	3.2854	-5.2116	10.0478	9065.154**	-13.452	I(0)
South Africa Volatility	0.6211	2.6654	-3.8472	19.2544	7258.32**	-15.008	I(0)

Source: National Stock Exchange websites, the Bloomberg Terminal and the Author's Computation.

Notes: data on African equity indices and commodity prices are gotten from Bloomberg trading terminal. Stocks are sorted into three different portfolios – Big, medium and small sizes. This is done based on firm's volume traded and volatility. The liquidity risk is computed using the standard deviation of the change in firms' volume traded $liq_{risk,t} = \left[L_t - \bar{L} \right]^{1/2}$ this is consistent with Brennan et al. (2006). Volatility is the market systematic volatility which is obtained from the standard deviation of the daily stock prices. The J-B test is significant at 99% confidence level for almost all the variables. Hence, there are rich evidences to reject the null hypothesis.

Annexure 1 (cont'd): Results of Autocorrelation and Heteroscedasticity Tests (African Equity and Commodity Markets)

Diagnostic Tests	Egypt	Morocco	Nigeria	South Africa	Gold	Oil	Cocoa	Platinum
Ljung-Box Q (12 lags)	0.001	0	0.0005	0.0013	0.003	0.00042	0.00001	0.00008
ARCH (12 lags)	0.0002	0.00001	0.003	0.002	0	0	0.00035	

Source: Research findings.

Notes: Underlying data is from Bloomberg Terminal. The probabilities of the chi-square statistics of the Ljung-Box Q and the ARCH tests are reported. The results show the presence of autocorrelation and partial autocorrelation in the returns of equities and commodities selected. Again, at 12 lags, there is absence of ARCH effect in the return series.

Annexure 2: Mispricing of Portfolios of Equities using Alternative Specification

Panel A: Results of Mispricing of Equity Portfolios sorted by Size (Egypt and Morocco)

Ratios	EGYPT						MOROCCO					
	Big-Size Portf.		Med-Size Portf.		Small-Size Portf.		Big-Size Portf.		Med-Size Portf.		Small-Size Portf.	
	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility
VR (20)	0.002	0.108	0.019	0.084	0.032	0.103	0.014	0.091	0.035	0.015	0.025	0.058
VR (15)	0.165	0.058	0.144	0.027	0.096	0.094	0.138	0.086	0.072	0.136	0.087	0.094
VR (10)	0.313	0.061	0.289	0.015	0.204	0.07	0.482	0.109	0.294	0.097	0.117	0.119
VR (5)	0.562	0.037	0.401	0.011	0.355	0.053	0.672	0.252	0.509	0.185	0.372	0.056
Adj R-SQRD	6.71%		7.01%		6.18%		8.14%		8.27%		3.99%	

Panel B: Results of Mispricing of Equity Portfolios sorted by Size (Nigeria and South Africa)

Ratios	NIGERIA						SOUTH AFRICA					
	Big-Size Portf.		Med-Size Portf.		Small-Size Portf.		Big-Size Portf.		Med-Size Portf.		Small-Size Portf.	
	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility	coef.	volatility
VR (20)	0.007	0.103	0.081	0.088	0.024	0.055	0.391	0.174	0.586	0.109	0.079	0.19
VR (15)	0.103	0.099	0.206	0.063	0.095	0.064	0.552	0.199	0.609	0.158	0.324	0.232
VR (10)	0.413	0.053	0.402	0.105	0.311	0.073	0.733	0.207	0.638	0.231	0.569	0.194
VR (5)	0.609	0.027	0.617	0.098	0.437	0.095	0.785	0.117	0.746	0.151	0.706	0.173
Adj R-SQRD	5.82%		6.18%		4.49%		5.70%		6.73%		6.24%	

Notes: Estimates are obtained from the 'Black CAPM' specification. The Black CAPM was developed by Fischer Black in 1972 after the novel work of Sharpe (1964), Lintner (1965), and Mossin (1966). The Black CAPM does not consider the riskless asset and therefore, did not adjust the returns (both market and firms' returns) for risk-free rate. The portfolios are sorted based on firms' liquidity into 'Big-size', 'Medium-size' and Small-size'. The variance ratios for various numbers of days and their respective volatilities are reported. The Adjusted R-Squared was also presented. The models estimated for each of the countries where the residuals used to generate the variance ratio and volatilities are extracted are available based

on request. We flout it for clarity of presentation. Underlying data has been sourced from the website of each of the select Stock Exchange and Reuters and it ranges from 5th January 2010 to 30th December 2015.

Appendix 3: Robustness Test for the Safe Haven Assessments

African Equity Markets	Select Commodities		
EGYPT	**Platinum**	**Cocoa**	**Oil**
Intercept	0.025**		
Sum of quantiles	**-0.651**		
quant. 1%	**-0.802**		
quant. 5%	-0.161		
quant. 10%	0.352		
SOUTH AFRICA			
Intercept		0.308	
Sum of quantiles		**-0.127**	
quant. 1%		0.292	
quant. 5%		**-1.007**	
quant. 10%		0.588	
NIGERIA			
Intercept			**-0.759**
Sum of quantiles			**-0.056**
quant. 1%			-0.421
quant. 5%			0.573***
quant. 10%			-0.208

Source: National Stock Exchange websites, the Bloomberg Terminal and Research findings.

Notes: Estimates are from the peculiar regression model.