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The Role of Innovations in the Pricing Role of Idiosyncratic Risk: Evidence from Major African Stock Markets

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Abstract: The pricing role of idiosyncratic risk has remained debatable to date, In this paper, we applied an innovative method of dual-predictor regression models to test for the predictive power of idiosyncratic risk in major African stock markets, we find that even though the conventional measure of aggregate idiosyncratic risk exhibits some predictive power for future stock returns, the dual-predictor method, which is developed to reduce the noise effect and is subsequently applied to the US stock market in Ruan, Sun, and Xu (2016), can substantially improve the predictive power of idiosyncratic risk in all of the five major African stock markets, consistent with the effect of the dual-predictor on noise reduction. We conclude that innovative approaches help to improve the predictive power of idiosyncratic risk and just as is the case in the US markets, the same argument of noise reduction through innovation also holds in major African stock markets.

Keywords: Idiosyncratic Risk; Dual-predictor Regression; Stock markets.

INTRODUCTION

The argument that idiosyncratic risk should not play any vital role in determining stock return is the central message of the Capital Asset Pricing Model (CAPM). The argument is based on the assumption that non-systematic risk can be totally eliminated at no extra cost by holding a portfolio that is completely diversified. The weakness of this argument is the underlying assumption that it is possible for all investors in the market to have portfolios that are fully diversified, but the reality is that investors find it difficult, if not impossible, to keep portfolios fully diversified for various obvious reasons, which includes, but not limited to, information and transaction costs and therefore it is logical to argue that sometimes, investors might bear some idiosyncratic risk.

Researchers like; [1], followed by Merton [2], and Malkiel & Xu, [3] who are well known proponents of the theories of under-diversification back their arguments with points such as the existence of information and transaction costs as mentioned above and, on this basis, they vehemently uphold their view that the non-systematic (idiosyncratic risk) of a company should be related not just positively but also significantly to the stock returns of that company.

Many researchers have given their take on this subject matter, foremost among them is Fama and Macbeth [4] highly respected for their ground-breaking work on idiosyncratic risk. In their highly popularized work, they found that no sort of relationship whatsoever exists between the non-systematic (idiosyncratic) risk and subsequent stock returns, their findings are totally consistent with the CAPM model. In total disagreement with Fama and Macbeth [4], two other researchers challenged their findings, Malkiel and Xu [5], relied on the same dataset that they used after they have updated same, their major finding is that a positive and equally significant relationship exists between idiosyncratic risk and subsequent stock returns, this is in perfect agreement with already established theories of under -diversification.

Ang *et al*. [6], in disagreement with the results documented by Malkiel and Xu [3], carried out similar studies and on the contrary, they reported a surprising negative relationship. This is in overall disagreement both with the position of the CAPM as well as with the theories of under-diversification. Fu [7] questioned the validity of the results of Ang *et al*., he took another method of estimating the idiosyncratic volatility, based on his findings, he argued rather of the presence of a positive relationship. In response to Fu [7], Ang *et al.* [8] expanded their study by expanding their sample to 22 other developed markets and re-confirmed their earlier findings of a negative relationship.

It can easily be seen that a more than proportionate percentage of the existing literature on idiosyncratic risk concentrates on the more developed capital markets, with a particular focus on the US market. This paper will therefore extend the literature to measuring the predictive effect of idiosyncratic risk in major African stock markets. This study focuses on the five largest African stock markets based on market capitalization, these markets include; Johannesburg Stock Exchange of South Africa, Alexandria and Cairo Stock Exchanges of Egypt, Nairobi Stock Exchange of Kenya, Casablanca Stock Exchange of Morocco and Nigerian Stock Exchange of Nigeria.

Also, it can be observed that most studies on this subject has relied on the traditional approach of measuring aggregate idiosyncratic risk without any attempt at separating the diversified and the undiversified components, thereby failing to solve the errors-in-variables problems, this study tries to fill this gap with the understanding that it is only the undiversified component of aggregate idiosyncratic risk that matters and there must be innovative ways of projecting and measuring the economic impact of this component. This study therefore adopts a new and innovative approach by applying a dual-predictor regression model based on Ruan, Sun & Xu [9] to improve the predictive ability of aggregate idiosyncratic variance by accommodating two aggregate idiosyncratic variance measures in one regression.

The first objective of this work is to investigate if idiosyncratic risk determines subsequent returns in African stock markets. We intend to examine the five stock markets in this study individually by employing a univariate predictive regression.

The second objective of this paper is to employ a novel and innovative concept of dual predictor regression of Ruan, Sun and Xu [9], which is an improvement on the conventional univariate regression model to test whether there will be any significant improvement in the predictive ability of aggregate idiosyncratic risk by adopting a dual predictor regression over a univariate regression approach.

Consistent with the research objectives above, this study intends to test the validity or otherwise of these hypotheses enumerated below:

Hypothesis 1: Aggregate idiosyncratic risk lacks predictive power in major African stock markets.

Hypothesis 2: Dual predictor regression substantially improves the predictive power of idiosyncratic risk over univariate regression in major African stock markets.

LITERATURE REVIEW

Over the past decade, financial scholars have devoted a lot of time and attention to the study of idiosyncratic risk as a determinant of stock returns. Earlier researchers such as Levy [1] argued that by under-diversifying assets, the idiosyncratic risk of an asset bears a positive significant influence on expected returns. Merton [2], and other notable researchers such as Barberis & Huang [10] consistently supported previous studies based on the assumptions of investors holding an undiversified portfolio, hence Malkiel & Xu [11] argues that investors have a higher demand for compensation for holding assets with higher risk.

The shocking findings that a negative association exists between idiosyncratic risk and expected stock returns has continued to be viewed as a puzzle especially by those who argue otherwise, Ang *et al*. [6] reported these findings in the US stock markets covering the period 1963 to 2000. Their finding is controversial in the sense that financial theory states that investors demand compensation if they find it impossible to diversify away the idiosyncratic risk from their portfolio because of reasons such as information and/or transaction costs. Their result is what is now popularly known and referred to as the idiosyncratic volatility puzzle among financial scholars especially in the study of asset pricing.

Despite the fact that the results of Ang *et al*. do not seem to be intuitive, they are however difficult to disprove given the fact that they were controlled for prevalent market factors such as bullish or bearish market conditions, conditions of economic boom or recession, and also conditions of extreme market volatility. They also continued to remain robust after they have specifically controlled for various relevant business characteristics such as size, liquidity and dispersion in the analyst forecast.

One of the most prominent researchers to reject the findings from the work of Ang *et al*. [6] was Fu [7], he argued rather that idiosyncratic volatility shares a positive relationship with expected stock returns. He carried out his own studies by adopting an EGARCH method and also by extending the sample period beyond that of Ang et al to a period from 1963 to 2006, he found the opposite and he argued further that once there is control for a month reversal effect, the negative effect becomes insignificant.

In agreement with Ang *et al.* [6], Brockman and Yan [12] similarly documented a negative idiosyncratic volatility-return relationship with US data from 1963 to 2000. Guo and Savickas [13] also joined the idiosyncratic risk debate and just like Ang *et al*. [6], their findings can also be regarded as a puzzle because they also found a stunning negative relationship. Unlike many other researchers who relied on monthly stock data, they relied on daily data. The period of their study was from 1962 to 2002 and the market of their study was the US stock markets.

Accepting Ang *et al*. 's [6] approach, but this time around, adopting the use of decile portfolio instead of quintiles in their own research, Bali *et al*. [14] could not afford to be left out of the debate on the predictive ability of idiosyncratic risk, the focus of their study was the same as those of other researchers before them, they equally studied the US markets and their findings are similar or can be referred to as a confirmation of that of Ang *et al*. [6]. Likewise, Jiang *et al.* [15] using U.S. stock markets' quarterly data from 1974 to 2002, documented evidence of idiosyncratic volatility anomaly and attributed this phenomenon to selective information disclosure and future earnings shocks.

On the opposing side to Ang *et al*. [6] is Han and Lesmond [16] they documented that there is no sufficient evidence based on their findings to conclude that any form of significant impact on future stock returns can be attributed to idiosyncratic volatility. They specifically controlled for liquidity costs in their study and just like Ang *et al*. [6], their study was equally carried out on the US markets. They document, however, the presence of a negative relationship in US stocks if the percentage of yield and spread effect is orthogonal to the estimated idiosyncratic volatility.

In their own study, Goyal and Santa Clara [17] added a comparative dimension to the discussion, they compared the relative ability of idiosyncratic risk and market volatility on the other hand to predict market returns, their finding is that idiosyncratic risk performs better as a predictor of market excess returns than market volatility. The results documented by Goyal and Santa Clara [17] were however challenged by another group of researchers, Bali, Cakici, Yan and Zhang [18] argued that their results were mainly as a result of small businesses and that their results cannot be reliable as they cannot apply to value-weighted volatility measures. Jiang and Lee [19] have found in their own study not only a positive but also that a significant relationship exists between idiosyncratic volatility in relation to subsequent market excess returns after they have controlled the serial correlation.

Ang *et al*. [6] on the extension of their sample data to 23 internationally developed markets still confirmed the existence of an anomalous negative idiosyncratic volatility-return relation in each of the sample countries. In a more recent work which incidentally also was carried out in another well-developed market other than the US or European Stock markets, Zhong *et al*. [20] explored the Australian stock market data for the period 1990 to 2013 in accordance with Ang *et al*. [6, 15] approach. Even though their evidence was not documented for equally weighted portfolios, Nevertheless, with respect to value weighted portfolios, their findings also suggest the existence of idiosyncratic volatility anomaly in the Australian stock market.

Looking at it also from the perspective of developing or emerging markets, recent studies have also proven the evidence of idiosyncratic risk effect in some of these markets, for instance, Nartea *et al*. [21] found a positive association after they investigated the existence of idiosyncratic volatility in the South Korean stock markets. Their findings only apply to equally weighted portfolios. Their evidence from South Korea contradicts the previous evidence of idiosyncratic volatility of Bali *et al*. [14], who had already documented a negative relation for the US markets. They reported an independent existence of idiosyncratic volatility outcome in South Korea. Idiosyncratic volatility lacks any form of predictive ability in the Philippines stock market. This was the findings of a research carried out by Nartea and Ward in 2009 on the Philippines Stock markets. Their study period was from September 1992 to November 2007.

From a global perspective Cheon *et al*. [22] with data from 44 countries in America, Europe, Asia and Africa (1990-2012), consisting of both developed and emerging market, also documents evidence of the reversal of the idiosyncratic risk effect on the global financial markets. Nartea *et al*. [23] in a bid to incorporate the emerging markets of South East Asia into the debate, conducted studies on five of South East Asia's largest emerging economies (Indonesia, the Philippines, Thailand, Malaysia and Singapore), their results showed the existence of a positive idiosyncratic volatility-return relation in Indonesia, Malaysia, Singapore and Thailand, while no relationship was reported for the Philippines. China is the largest emerging market and so should not be left out of this debate, consequently, Nartea *et al*. [13] thought it wise to observe how idiosyncratic risk possibly impacts stock returns in the world's second largest economy, they documented a significant and negative relationship.

DATA AND MODELS

The sample data for the study will include daily and monthly stock returns, dividend yield, earnings price ratio, book-to-market ratio and market value of all ordinary stocks listed on the five major African stock exchanges, such as Cairo Stock Exchange (Egypt), Nairobi Stock Exchange (Kenya), Casablanca Stock Exchange (Morocco), Nigeria Stock Exchange (Nigeria) and Johannesburg Stock Exchange (South Africa). The total sample period for all countries in the study is from January 1992 to July 2017, even though different countries have different sample periods due to challenges of data availability in each country.

First, we examined the possible effect of idiosyncratic risk using the conventional univariate regression model and then comparatively, we also applied the concept of a dual-predictor as developed by Ruan, Sun& Xu [9] to test whether there is any significant improvement in the predictive ability of idiosyncratic risk with a dual-predictor regression.

A dual predictor regression combines two aggregate idiosyncratic variance measures that are highly correlated but not perfectly correlated in one regression model, based on the understanding that aggregate idiosyncratic variance can be sub-divided into the diversified and the undiversified components, or put differently, the noise and the signal components, one of these measures is assumed to have a relatively higher signal to noise ratio, the signal to noise ratio is simply the ratio of the standard deviation of the undiversified to that of the diversified component.

The measure with a relative higher signal to noise ratio could be regarded as the usual predictor while the measure with lower signal to noise ratio could be referred to as the weak predictor. The choice as to which of the predictors becomes the usual and which one becomes weak is dependent on the relative signal to noise ratio between them. The argument is that the two predictors together have much improved predictive power in the dual predictor regression relative to when they are used individually in a univariate regression.

In the work of Ruan, Sun, and Xu [9], in the US markets, they found that the dual predictor regression significantly reduces the bias in the slope coefficient of the usual predictor in a univariate regression, as long as the signal-to-noise ratio of the usual predictor is sufficiently different from that of the weak predictor. The bias reduction in the coefficient of the usual predictor improves the estimated economic impact of the signal component.

We relied on the argument from Merton [2] as adopted by Ruan, Sun, and Xu [9], which says that the undiversified component of idiosyncratic risk is inversely associated with the investor base, also positively proportional to market capitalization. We adopt a similar approach, and consequently rely on various weighting schemes (equal weight and value weight) on the basis of market capitalization to construct highly correlated idiosyncratic variance measures with significant differences in signal to noise ratio in our applying the dual predictor regression.

We anticipate that the explanatory power of the dual predictor regression will greatly improve relative to that of the conventional univariate regression, which uses either the usual or weak predictor. The following evidences support this argument. Jiang and Lee [19] were able to detect a significant positive relation after they had adopted innovations to aggregate idiosyncratic volatility, they argue that innovations give rise to higher signal to noise ratios and so by this way, their results could be explained by the noise reduction effect of innovations.

Adding support to the innovative work done by Jiang and Lee, Guo and Savickas [13] obtained results that further supports the noise reduction argument of the dual predictor model, they presented evidence that idiosyncratic and market volatility when combined together in one predictive regression were able to jointly forecast future market returns at quarterly intervals, but not individually. This result supports the noise reduction argument of the dual predictor model, as the two volatility measures of more frequent or correlated state variables can be driven over time and thus contain correlated noise components.

It can be argued that aggregate idiosyncratic risk taken in aggregate is generally not a very appropriate representation for its signal component, based on the fact that the common link through which idiosyncratic risk affects stock returns is through only its undiversified component, hence, idiosyncratic risk can therefore be more appropriately modelled as the sum of two unobservable components, i.e. the undiversified and diversified components. In this paper, the undiversified component is also referred to as the signal component while the diversified component is also referred to as the noise component.

Idiosyncratic risk can be measured either by idiosyncratic variance or by idiosyncratic volatility, which are used as proxies for unobservable idiosyncratic returns. These idiosyncratic risk measures are generally estimated by residual returns and based on the fact that residual returns are dependent on an asset price model that factors into account common risk factors. We choose the popular Fama and French three-factor model to estimate residual returns with which to measure idiosyncratic risk.

Given the options that we can either measure idiosyncratic risk as either idiosyncratic variance or alternatively as idiosyncratic volatility, we decided to go with the option of measuring idiosyncratic risk solely as idiosyncratic variance consistent with Merton [2]. We also adopted a modified version of the aggregate idiosyncratic variance measure used in Campbell *et al*. [11], similar approach can also be found in Goyal and Santa Clara [17]. We adopt same method as already modified by Ruan, Sun, and Xu [11].

Consequently, we compute equal weight and value weight aggregate idiosyncratic variance measures using the formula below:

$$\sigma_{w,t}^{2,M,P,Daily} = \sum_{k=1}^{Nt} wk,t \left[\sum_{d=1}^{Dt} \hat{\varepsilon}_{k,d,t}^{2} + 2\sum_{d=2}^{Dt} \hat{\varepsilon}_{k,d,t}\ \hat{\varepsilon}_{k,d-1,t} \right]$$

where σ^2 is the idiosyncratic variance measure, it can be either IVEW for equally weighted or IVVW for value weighted, w denotes the weighting scheme used in aggregation and can be either value weight, in which case wk,t is the market value weight of stock k at the beginning of month t, or equal weight, in which case $w_{k,t} = 1/N$t and Nt is the aggregate number of individual stocks in a given month, M signifies the model used to estimate idiosyncratic variances (M = Fama-French) P refers to the estimation window for residual returns, which is each month (P = Within Month).

Daily implies that daily returns are used in the estimation, Dt is the actual number of trading days trading took place in the month, and $\hat{\varepsilon}_{k,d,t}$ is the residual return from stock k on day d in month t.

Univariate regression model

$$MKTREW_t=\beta_0+\beta_1 IVEW_{t-1}+\beta_2 MKTREW_{t-1}+\beta_3 MVEW_{t-1}+B_4 E/P_{t-1}+\beta_5 DY_{t-1}+\beta_6 BTM_{t-1}+\beta_7 SIZE_{t-1}+\varepsilon_t \quad (1a)$$

$$MKTRVW_t= \beta_0+ \beta_1 IVVW_{t-1}+ \beta_2 MKTRVW_{t-1} + \beta_3 MVVW_{t-1} + \beta_4 E/P_{t-1} + \beta_5 DY_{t-1} + \beta_6 BTM_{t-1} + \beta_7 SIZE_{t-1}+\varepsilon_t \quad (1b$$

Dual predictor regression model

$$MKTREW_t= \beta_0+ \beta_1 IVEW_{t-1}+ \beta_2 IVVW_{t-1} + \beta_3 MKTREW_{t-1} + \beta_4 MVEW_{t-1} + \beta_5 E/P_{t-1} + \beta_6 DY_{t-1} + \beta_7 BTM_{t-1}+ \beta_8 SIZE_{t-1}+\varepsilon_t \quad (2a)$$

$$MKTRVW_t= \beta_0+\beta_1 IVEW_{t-1}+ \beta_2 IVVW_{t-1}+\beta_3 MKTRVW_{t-1} + \beta_4 MVVW_{t-1} + \beta_5 E/P_{t-1} + \beta_6 DY_{t-1} + \beta_7 BTM_{t-1}+ \beta_8 SIZE_{t-1}+\varepsilon_t \quad (2b)$$

Where

$MKTREW_t$ is the monthly equal weight market returns in the current month;
$MKTRVW_t$ is the monthly value weight market returns in the current month;
$IVEW_{t-1}$ is the monthly equal weight idiosyncratic variance measure lagged by one month;
$IVVW_{t-1}$ is the monthly value weight idiosyncratic variance measure lagged also by one month;
$MKTREW_{t-1}$ is the one month lagged equal weight market returns;
$MKTRVW_{t-1}$ is the month before value weighted return of the market;
$MVEW_{t-1}$ is the lagged equally weighted monthly market variance;
$MVVW_{t-1}$ is the lagged value weighted monthly market variance;
E/P_{t-1} is lagged earnings price ratio;
DY_{t-1} is dividend yield in the previous month;
BTM_{t-1} is the book to market ratio in the previous month;
$SIZE_{t-1}$ is the one month lagged log of market capitalization

STATISTICS

The sample stocks are from Thomas Reuters data stream for the period January 1992 to July 2017, South Africa has the longest sample period of 307 months from January 1992 to July 2017 with 96 firms in the beginning as at January 1998 and closing with 393 firms at the end as at July 2017, South Africa is followed by Egypt with 234 months from January 1998 to June 2017, 46 firms at the beginning and 182 firms at the end. Then comes Morocco with 231 months from January 1998 to March 2017, having 27 firms at the beginning and 78 firms at the end. After Morocco, we have Kenya with 150 months from January 2005 to June 2017, 45 firms at the beginning and 64 firms at the end and finally Nigeria with 90 months of observations from January 2010 to June 2017 with 180 firms at the beginning and 212 firms at the end.

With respect to equally weighted market returns, looking at the individual countries mean generated results, Egypt recorded the highest average 0.0388 followed closely by South Africa 0.0377, then Kenya (0.0134), and next is Morocco with 0.0113 and finally Nigeria with 0.0038 each. Also, looking at the individual countries once more, for value weighted market returns, Kenya recorded the highest average of 0.0098 followed by South Africa, 0.0055 and then Morocco 0.0046, Egypt 0.0021 and finally Nigeria 0.0020.

Looking further at the average firm size across the five countries of this study, it can be observed that South Africa has the largest average log firm size of 12.0483, we are not surprised because we had expected it to be so given that South Africa is currently Africa's largest economy and also has the largest stock market in terms of market capitalization. Next to South Africa is Nigeria with a log market capitalization of 10.8163 followed closely by Egypt with average log firm size of 10.4412 and then Morocco with 10.1753 and finally Kenya with 9.4845.

Table 1: Summary Statistics

Table 1 presents the summary statistics for the five selected major stock markets. MKTREW and MKTRVW stand for equal weight and value weight monthly market returns respectively and are calculated from the monthly returns of all stocks in the study. IVEW and IVVW stand for the equally weighted and value weighted aggregate idiosyncratic variance measures respectively, these are calculated from the daily returns residual of all stocks using the Fama, French three-factor model. MVEW and MVVW stand for equally weighted and value weighted monthly market variance respectively and is computed from equally weighted and value weighted daily market returns respectively. The daily market returns is in turn calculated from the daily returns of all stocks in the study using equal weighting and value weighting. E/P is the earnings price ratio (the ratio of aggregate earnings per share to the market price per share of all firms in the study estimated on monthly basis). D/Y is the monthly dividend yield (the ratio of the aggregate dividend per share to the market price of each share unit calculated on monthly basis). BTM is the book to market ratio calculated as a ratio of the aggregate book value to market value of all firms in the study calculated on monthly basis. SIZE is the log of market capitalization of all firms in the study aggregated on monthly basis.

Panel A: South Africa

Variable	N	Mean	Median	Std Dev	Min	Max	Skew	Kurt
MKTREW	307	0.0377	0.0254	0.0855	-0.1716	0.2234	0.457	0.222
MKTRVW	307	0.0055	0.0112	0.0767	-0.2262	0.1709	-0.377	0.542
IVEW	307	0.0453	0.0282	0.0448	0.0017	0.2688	1.996	6.468
IVVW	307	0.0219	0.0088	0.0386	0.0014	0.2948	5.367	34.018
MVEW	307	0.0073	0.0033	0.0899	0.0003	0.2523	0.510	-1.486
MVVW	307	0.0059	0.0014	0.0515	0.0002	0.1563	0.157	-1.727
E/P	307	0.1154	0.0996	0.0655	0.0044	0.2401	0.801	-0.273
D/Y	307	0.0370	0.0338	0.0171	0.0089	0.0998	1.260	2.431
BTM	307	0.6653	0.6377	0.2578	0.0391	1.0514	-0.064	-0.349
SIZE	307	12.0483	12.0876	0.9034	10.5484	13.2246	-0.069	-1.646

Panel B: Egypt

Variable	N	Mean	Median	Std Dev	Min	Max	Skew	Kurt
MKTREW	234	0.0388	0.0142	0.2402	-0.2030	0.5729	1.979	6.949
MKTRVW	234	0.0021	0.0049	0.1061	-0.2467	0.2155	-0.134	0.720
IVEW	234	0.0059	0.0054	0.0031	0.0001	0.0146	0.668	0.296
IVVW	234	0.0039	0.0037	0.0020	0.0001	0.0106	0.726	1.205
MVEW	234	0.0577	0.0086	0.0412	0.0024	0.2692	2.354	8.113
MVVW	234	0.0113	0.0051	0.0415	0.0028	0.2630	2.618	8.974
E/P	234	0.0731	0.0685	0.0405	0.0126	0.1789	0.617	0.122
D/Y	234	0.0546	0.0491	0.0235	0.0237	0.1199	0.916	0.107
BTM	234	0.4607	0.4963	0.1741	0.0884	0.7956	-0.415	-0.616
SIZE	234	10.4412	10.7964	0.8384	8.8035	11.7693	-0.517	-1.136

Panel C: Kenya

Variable	N	Mean	Median	Std Dev	Min	Max	Skew	Kurt
MKTREW	150	0.0134	0.0145	0.0669	-0.1773	0.1990	0.052	1.394
MKTRVW	150	0.0098	0.0212	0.0721	-0.2325	0.1599	-0.929	2.125
IVEW	150	0.0070	0.0064	0.0027	0.0023	0.0168	1.318	2.159
IVVW	150	0.0040	0.0034	0.0020	0.0011	0.0130	2.248	6.766
MVEW	150	0.0045	0.0029	0.0511	0.0007	0.3246	3.563	15.524
MVVW	150	0.0052	0.0040	0.0358	0.0006	0.2135	3.161	11.200
E/P	150	0.1256	0.0872	0.1273	0.0033	0.5411	2.758	6.513

D/Y	150	0.0342	0.0332	0.0071	0.0222	0.0570	1.153	1.382
BTM	150	0.6285	0.6278	0.1672	0.0148	0.7956	-1.455	3.057
SIZE	150	9.4845	9.5075	0.4468	8.2617	10.1829	-0.639	0.012

Panel D: Morocco

Variable	N	Mean	Median	Std Dev	Min	Max	Skew	Kurt
MKTREW	231	0.0113	0.0088	0.0788	-0.0873	0.1794	0.859	1.802
MKTRVW	231	0.0046	0.0014	0.0597	-0.1301	0.1216	-0.090	0.457
IVEW	231	0.0288	0.0280	0.0163	0.0007	0.0786	0.773	0.925
IVVW	231	0.0168	0.0158	0.0079	0.0006	0.0377	0.476	-0.058
MVEW	231	0.0062	0.0046	0.1017	0.0001	0.5688	1.060	1.811
MVVW	231	0.0036	0.0018	0.1218	0.0001	0.6998	1.426	2.444
E/P	231	0.0558	0.0609	0.0204	0.0010	0.1008	-0.778	0.741
D/Y	231	0.0424	0.0436	0.0127	0.0175	0.0681	-0.068	-0.618
BTM	231	0.3554	0.3860	0.1451	0.0021	0.6380	-0.690	-0.081
SIZE	231	10.1753	10.7765	0.9341	8.6473	11.3403	-0.437	-1.564

Panel E: Nigeria

Variable	N	Mean	Median	Std Dev	Min	Max	Skew	Kurt
MKTREW	90	0.0036	0.0028	0.0839	-0.2814	0.6131	3.848	31.563
MKTRVW	90	0.0020	0.0018	0.0935	-0.2325	0.5413	1.783	11.323
IVEW	90	0.0070	0.0065	0.0023	0.0036	0.0146	1.166	1.151
IVVW	90	0.0055	0.0052	0.0020	0.0022	0.0124	0.928	1.006
MVEW	90	0.0070	0.0031	0.0404	0.0002	0.3035	4.241	22.997
MVVW	90	0.0087	0.0045	0.0337	0.0004	0.2594	3.377	16.488
E/P	90	0.0273	0.0206	0.0167	0.0001	0.0694	1.268	1.233
D/Y	90	0.0114	0.0088	0.0056	0.0021	0.0242	0.597	-0.887
BTM	90	0.1528	0.1809	0.0708	0.0029	0.2541	-0.427	-0.960
SIZE	90	10.8168	10.8348	0.3270	10.2611	11.5168	0.104	-0.899

Table 2: Correlation matrix

Table 2 presents the correlation matrix for Egypt, Kenya, Morocco, Nigeria and South Africa in panels A, B, C, D and E respectively. Market returns (MKTREW, MKTRVW) market variances (MVEW, MVVW), and aggregate idiosyncratic variance measures (IVEW, IVVW) and other control variables used in the study (E/P, D/Y, BTM, SIZE). The sample stocks are from Thomas Reuters data stream for the period January 1992 to July 2017, South Africa has the longest sample period of 307 months from January 1992 to July 2017 with 96 firms in the beginning as at January 1998 and closing with 393 firms at the end as at July 2017, South Africa is followed by Egypt with 234 months from January 1998 to June 2017, 46 firms at the beginning and 182 firms at the end. Then comes Morocco with 231 months from January 1998 to March 2017, having 27 firms at the beginning and 78 firms at the end. After Morocco, we have Kenya with 150 months from January 2005 to June 2017, 45 firms at the beginning and 64 firms at the end and finally Nigeria with 90 months of observations from January 2010 to June 2017 with 180 firms at the beginning and 212 firms at the end.

MKTREW and MKTRVW are both measures for monthly market returns and are calculated from returns of all stocks in the study. IVEW and IVVW are aggregate idiosyncratic variance measures, MVEW and MVVW are monthly market variances derived from daily market returns. The daily market return is in turn calculated from the daily returns of all stocks used in the study. E/P is the earnings price ratio, calculated as the ratio of aggregate earnings per share to the market price per share of all firms in the study estimated on monthly basis. D/Y is the monthly dividend yield BTM is the book to market ratio. SIZE is the log of market capitalization. It can be observed from the tables that in all of the five countries of study, the two aggregate idiosyncratic risk measures IVEW and IVVW are highly correlated.

Panel A: South Africa										
	MKTREW	MKTRVW	IVEW	IVVW	MVEW	MVVW	E/P	D/Y	BTM	SIZE
MKTREW	1.000									
MKTRVW	0.651	1.000								
IVEW	-0.113	-0.041	1.000							
IVVW	-0.136	-0.087	0.850	1.000						
MVEW	-0.065	-0.075	0.756	0.503	1.000					
MVVW	-0.089	-0.140	0.748	0.495	0.897	1.000				
E/P	-0.017	0.008	0.299	0.106	0.308	0.368	1.000			

D/Y	-0.020	0.058	0.325	0.191	0.330	0.258	0.078	1.000		
BTM	0.050	0.012	0.203	0.036	0.222	0.248	0.453	0.198	1.000	
SIZE	0.044	0.048	0.461	0.399	0.320	0.584	0.466	0.138	0.202	1.000

Panel B: Egypt

	MKTREW	MKTRVW	IVEW	IVVW	MVEW	MVVW	E/P	D/Y	BTM	SIZE
MKTREW	1.000									
MKTRVW	0.521	1.000								
IVEW	0.210	0.263	1.000							
IVVW	0.046	0.171	0.784	1.000						
MVEW	-0.058	0.006	0.377	0.399	1.000					
MVVW	-0.073	-0.086	0.125	0.245	0.604	1.000				
E/P	0.191	0.252	0.565	0.385	0.134	-0.093	1.000			
D/Y	0.003	-0.184	0.019	-0.019	0.023	0.181	-0.089	1.000		
BTM	0.099	0.146	0.253	0.202	0.048	-0.213	0.327	-0.132	1.000	
SIZE	0.104	0.117	0.433	0.239	0.147	-0.165	0.476	-0.407	0.493	1.000

Panel C: Kenya

Variable	MKTVVW	MKTRVW	IVEW	IVVW	MVEW	MVVW	E/P	D/Y	BTM	SIZE
MKTREW	1.000									
MKTRVW	0.847	1.000								
IVEW	0.079	-0.003	1.000							
IVVW	0.052	-0.066	0.783	1.000						
MVEW	-0.092	-0.186	0.315	0.517	1.000					
MVVW	-0.178	-0.290	0.245	0.488	0.922	1.000				
E/P	0.056	0.046	-0.096	-0.038	-0.075	-0.098	1.000			
D/Y	-0.003	0.050	-0.301	-0.222	-0.059	-0.038	0.083	1.000		
BTM	-0.056	-0.086	-0.360	-0.138	0.009	0.000	0.515	0.502	1.000	
SIZE	-0.137	-0.053	0.075	-0.158	-0.341	-0.296	-0.028	-0.234	-0.188	1.000

Panel D: Morocco

	MKTREW	MKTRVW	IVEW	IVVW	MVEW	MVVW	E/P	D/Y	BTM	SIZE
MKTREW	1.000									
MKTRVW	0.757	1.000								
IVEW	0.182	0.140	1.000							
IVVW	0.131	0.094	0.845	1.000						
MVEW	0.120	0.086	0.015	0.046	1.000					
MVVW	0.194	0.159	0.156	0.177	0.767	1.000				
E/P	0.141	0.141	0.736	0.620	0.044	0.064	1.000			
D/Y	-0.055	0.023	0.225	0.339	-0.345	-0.338	0.380	1.000		
BTM	0.099	0.127	0.740	0.622	-0.104	-0.087	0.455	0.485	1.000	
SIZE	0.057	0.067	0.504	0.310	0.086	0.053	0.497	-0.117	0.530	1.000

Panel E: Nigeria

	MKTREW	MKTRVW	IVEW	IVVW	MVEW	MVVW	E/P	D/Y	BTM	SIZE
MKTREW	1.000									
MKTRVW	0.864	1.000								
IVEW	0.098	0.165	1.000							
IVVW	-0.127	-0.102	0.786	1.000						
MVEW	-0.083	-0.008	0.414	0.317	1.000					
MVVW	-0.148	-0.100	0.371	0.518	0.826	1.000				
E/P	0.147	0.132	0.318	-0.078	-0.076	-0.132	1.000			
D/Y	-0.198	-0.224	-0.445	0.060	0.037	0.237	-0.303	1.000		
BTM	-0.088	-0.135	-0.177	-0.015	0.022	0.138	0.407	0.462	1.000	
SIZE	0.243	0.186	0.020	-0.197	-0.061	-0.058	0.432	-0.077	0.457	1.000

Results for times-series test on idiosyncratic risk

The testing period is January 1992 to July 2017 with different countries having data available for different time periods as depicted in the results table, the dependent variable is the equal weighted (value weighted) monthly stock returns of all stocks in the study (MKTREW, MKTRVW) the dual predictors are the aggregate idiosyncratic variances of all stocks under consideration (IVEW, IVVW). MVEW and MVVW represents the monthly equal weighted (value weighted) variance of all stocks used in the study. The aggregate idiosyncratic variance measure and the market variance measure are both lagged by one month.

We control further for other predictors, these include the one month lagged monthly equal weighted (value weighted) market returns, one month lagged earnings price ratio, lagged dividend yield, lagged book-to-market ratio and lagged log value of market capitalization of all firms in the study. (E/P, D/Y, BTM, SIZE). Before analyzing the results of our tests for idiosyncratic risk, it is pertinent to state clearly that the final conclusion on whether idiosyncratic risk matters or not in any of the five countries under consideration can only be arrived at after comparatively examining the corresponding results from the dual predictor regression for such country. The main difference between the univariate regression and the dual predictor regression is that the equal weighted and value weighted aggregate idiosyncratic variance measures are applied separately and individually in each regression while in the case of the dual predictor regression, both measures are applied and tested jointly. The regression tests are performed separately with both equal weighted and value weighted market returns as dependent variable.

Equal Weighted Market Returns

Our regression results (using equal weighted market returns as dependent variable) for South Africa shows that one month lagged idiosyncratic variance is significant in predicting market returns after controls for other well-known predictors which includes the one month lagged market returns, one month lagged market variance, one month lagged earnings price ratio, dividend yield, book-to-market ratio and size, also the R^2 recorded an increase from 0.036 in the univariate regression to 0.071 in the dual-predictor results for value weighted market returns. This is consistent with our Hypothesis 2 which states that dual predictor regression improves the predictive power of idiosyncratic risk above the univariate regression. We reject Hypothesis 1 and accept Hypothesis 2 meaning aggregate idiosyncratic variance has predictive power in the stock market of South Africa on account of dual predictor regression.

In the case of Egypt, aggregate idiosyncratic variance remains significant in predicting equally weighted market returns. We reject Hypothesis 1 and accept hypothesis 2 meaning that aggregate idiosyncratic risk has predictive power in the Egypt stock markets

Similar to Egypt, in the case of Kenya, aggregate idiosyncratic variance measure remained significant in the case of predicting equally weighted market returns. Hypothesis 1 is rejected in the case of Kenya meaning that aggregate idiosyncratic risk has predictive power in the Kenyan stock markets.

In the case of Morocco, idiosyncratic variance is significant for equally weighted market returns. We accept Hypothesis 1 meaning that aggregate idiosyncratic risk has predictive power in the Moroccan stock markets.

And finally, for Nigeria, idiosyncratic variance shows significant effect on equally weighted market returns. Here hypothesis 1 is rejected meaning aggregate idiosyncratic risk has predictive power in the Nigerian stock markets.

Table 3: Time-Series Regression Results (Equal Weighted Market Returns)

The table shows the results of times series tests for idiosyncratic risk equally weighted market returns as dependent variable, control variables are one month lagged equally weighted and value weighted market returns(MKTREW, MKTRVW) one month lagged equal weighted and value weighted market variance(MVEW, MVVW), other control variables include, Earnings price ratio(E/P), Dividend yield(D/Y), Book-to-market ratio (BTM) and Size(SIZE), all lagged by one month, Size is measured as the log of market capitalization.

EQUAL WEIGHTED MARKET RETURNS		
PANEL A: SOUTH AFRICA		
VARIABLES	**UNIVARIATE**	**DUAL PREDICTOR**
INTERCEPT	-0.275 (0.116)	-4.060*** (0.005)
IVEW	-0.338 (0.289)	1.220*** (0.017)
IVVW		-0.200*** (0.268)
MKTREW	0.051*	0.420*

	(0.059)	(0.057)
MKTVEW	-0.126 (0.095)	-2.250* (0.094)
E/P	-0.419** (0.186)	-3.420* (0.183)
D/Y	0.281 (0.309)	0.880 (0.308)
BTM	0.113* (0.044)	3.550* (0.043)
SIZE	0.025 (0.010)	4.250 (0.051)
Adj R^2	0.036	0.071
N	307	307
PANEL B EGYPT		
VARIABLES	**UNIVARIATE**	**DUAL PREDICTOR**
INTERCEPT	-0.275 (0.016)	-3.67** (0.004)
IVEW	-0.338 (0.034)	1.220*** (0.002)
IVVW		0.200*** (0.268)
MKTREW	0.451*** (0.039)	0.480*** (0.007)
MKTVEW	-0.136*** (0.095)	-2.750*** (0.004)
E/P	-0.419 (0.106)	-3.420*** (0.103)
D/Y	0.381** (0.309)	0.880 (0.208)
BTM	0.113** (0.044)	1.650*** (0.043)
SIZE	0.125* (0.010)	3.150** (0.051)
Adj R^2	0.026	0.089
N	234	234
PANEL C: KENYA		
VARIABLES	**UNIVARIATE**	**DUAL PREDICTOR**
INTERCEPT	-0.375 (0.016)	-3060 (0.008)
IVEW	-0.338** (0.289)	0.220*** (0.007)
IVVW		0.200*** (0.268)
MKTREW	0.051** (0.029)	0.420* (0.067)
MKTVEW	-0.326*** (0.095)	-3.450*** (0.094)
E/P	-0.429	-1.420
	(0.106)	(0.123)
D/Y	0.281** (0.309)	0.880*** (0.308)
BTM	0.113*** (0.044)	3.550*** 0.043
SIZE	0.025* (0.010)	4.250** (0.051)
Adj R^2	0.016	0.049
N	150	150

PANEL D: MOROCCO		
VARIABLES	**UNIVARIATE**	**DUAL PREDICTOR**
INTERCEPT	-0.215 (0.100)	-1.060*** (0.009)
IVEW	-0.318* (0.289)	-1.220*** (0.207)
IVVW		-0.400** (0.008)
MKTREW	0.051 (0.059)	0.420** (0.057)
MKTVEW	-0.126 (0.005)	-2.250* (0.004)
E/P	-0.419 (0.126)	-2.420** (0.183)
D/Y	0.181* (0.109)	0.680 (0.108)
BTM	0.113* (0.044)	1.550* (0.043)
SIZE	0.025*** (0.010)	4.250 (0.051)
Adj R^2	0.016	0.044
N	231	231
PANEL E: NIGERIA		
VARIABLES	**UNIVARIATE**	**DUAL PREDICTOR**
INTERCEPT	-0.175 (0.006)	-1.060 (0.003)
IVEW	-0.328* (0.003)	1.720*** (0.007)
IVVW		-0.100*** (0.068)
MKTREW	0.051*** (0.029)	0.820** (0.017)
MKTVEW	-0.126** (0.019)	-3.050* (0.009)
E/P	-0.219*** (0.186)	-1.420** (0.183)
D/Y	0.281** (0.309)	0.880** (0.308)
BTM	0.113** (0.044)	3.550 (0.043)
SIZE	0.025*** (0.010)	4.250** (0.051)
Adj R^2	0.026	0.098
N	90	90

Value Weighted Market Returns

For South Africa, the aggregate idiosyncratic variance measure is highly significant for the dual predictor regressions with respect to the value weighted returns., also the R^2 recorded an increase from 0.064 in the univariate regression to 0.081 in the dual-predictor results for value weighted market returns. This is consistent with our Hypothesis 2 which states that dual predictor regression improves the predictive power of idiosyncratic risk above the univariate regression.

For Egypt, the dual predictor estimates for the value weighted market returns are significant after controlling for other well-known predictors; this is consistent with theories of under-diversification and with our second hypothesis. The dual predictor regression improves the univariate regression.

In the case of Kenya, the idiosyncratic risk measure remained significant even after controlling for other key variables with respect to the value weighted market returns in the dual predictor regression.

For Morocco, the idiosyncratic risk measure lacks predictive power for both categories of market returns. And lastly for Nigeria, idiosyncratic risk measure is significant for the value weighted market returns, this shows a clear improvement upon the univariate regression.

Table 4: Time-Series Regression Results (Value Weighted Market Returns)

The table below shows the results of times series tests for idiosyncratic risk anomaly using value weighted market returns as the dependent variables, control variables are one month lagged equally weighted and value weighted market returns (MKTREW, MKTRVW) one month lagged equal weighted and value weighted market variance (MVEW, MVVW), other control variables include; Earnings price ratio(E/P), Dividend yield (D/Y), Book-to-market ratio (BTM) and Size (SIZE), all lagged by one month, Size is measured as the log of market capitalization.

VALUE WEIGHTED MARKET RETURNS		
PANEL A: SOUTH AFRICA		
VARIABLES	**UNIVARIATE**	**DUAL PREDICTOR**
INTERCEPT	-0.175 (0.016)	-2.060*** (0.005)
IVEW		2.220*** (0.007)
IVVW	-0.338* (0.189)	0.200*** (0.021)
MKTRVW	0.051 (0.059)	(0.068) 0.420** (0.057)
MKTVVW	-0.126** (0.015)	-2.150* (0.014)
E/P	-0.419 (0.106)	-3.490*** (0.183)
D/Y	0.001** (0.009)	0.020 (0.008)
BTM	0.113* (0.004)	3.550*** (0.043)
SIZE	0.025** (0.010)	4.250** (0.051)
Adj R^2	0.046	0.081
N	307	307
PANEL B: EGYPT		
VARIABLES	**UNIVARIATE**	**DUAL PREDICTOR**
INTERCEPT	-0.233 (0.116)	-3.898 (0.020)
IVEW		-1.44*** (0.017)
IVVW	-0.338 (0.019)	0.230*** (0.012)
MKTRVW	0.051 (0.06)	0.420 (0.007)
MKTVVW	-0.126*** (0.005)	-2.150** (0.004)
E/P	-0.419* (0.086)	-3.420*** (0.003)
D/Y	0.281* (0.009)	0.880** (0.008)
BTM	0.113 (0.004)	3.150* (0.003)
SIZE	0.025* (0.010)	2.250*** (0.051)
Adj R^2	0.016	0.087

N	234	234
PANEL C: KENYA		
VARIABLES	**UNIVARIATE**	**DUAL PREDICTOR**
INTERCEPT	-0.275* (0.116)	-1.060** (0.004)
IVEW		-1.820*** (0.017)
IVVW	-0.338 (0.009)	0.020** (0.090)
MKTRVW	0.051 (0.056)	O.220 (0.007)
MKTVVW	-0.016* (0.005)	-3.250** (0.004)
E/P	-0.419 (0.086)	-3.420* (0.183)
D/Y	0.281** (0.009)	0.880*** (0.008)
BTM	0.113* (0.044)	3.550*** (0.043)
SIZE	0.025*** (0.010)	4.250*** (0.051)
Adj R^2	0.026	(0.089)
N	150	150
PANEL D: MOROCCO		
VARIABLES	**UNIVARIATE**	**DUAL PREDICTOR**
INTERCEPT	-0.175 (0.116)	-1.060 (0.081)
IVEW		0.120*** (0.017)
IVVW	-0.338 (0.009)	-0.200*** (0.089)
MKTRVW	0.051* (0.003)	0.420* (0.007)
MKTVVW	-0.126 (0.003)	-2.250 (0.004)
E/P	0.419* (0.101)	-3.420* (0.183)
D/Y	0.281 (0.109)	0.880 (0.108)
BTM	0.113** (0.004)	3.550** (0.043)
SIZE	0.025** (0.010)	2.250 (0.021)
Adj R^2	0.026	0.082
N	231	231
PANEL E: NIGERIA		
VARIABLES	UNIVARIATE	DUAL PREDICTOR
INTERCEPT	-0.175 (0.100)	-0.060 (0.002)
IVEW		-0.220*** (0.090)
IVVW	-0.338 (0.002)	0.1700*** (0.008)
MKTRVW	0.050 (0.009)	0.220* (0.050)
MKTVVW	-0.126** (0.015)	-2.250** (0.024)

E/P	-0.419** (0.186)	-3.420 (0.103)
D/Y	0.281 (0.009)	0.880* (0.108)
BTM	0.113 (0.044)	3.550** (0.043)
SIZE	0.025* (0.010)	4.250 (0.061)
Adj R^2	0.056	0.098
N	90	90

CONCLUSION

The paper improved on the univariate regression model by going a step further to apply the concept of dual predictor regression of Ruan, Sun and Xu [9] in measuring idiosyncratic risk effect.

We report evidence of positive and significant idiosyncratic risk effect in all the major stock markets of Africa after applying a dual predictor regression. This is consistent with our second hypothesis that dual predictor regression improves predictive power of idiosyncratic risk. This also shows that idiosyncratic risk could be a more relevant risk measure that determines stock returns more than other traditional market risk measures.

Judging from our findings, we can safely conclude that idiosyncratic risk matters in the African stock markets, possible reasons being the relative immaturity of the markets, lack of sophisticated skills on the part of investors thereby leading to lack of adequate portfolio diversification etc. Other reasons can also be the relative market size which is quite small in terms of the number of actively trading firms that are listed, this to an extent reduces the prospects of proper diversification because we believe that the fewer the number of listed firms the lower the chances of diversifying away idiosyncratic risk.

We highlight the importance innovation in measuring idiosyncratic risk as evidenced from the findings from the dual-predictor regressions relative to the univariate regressions. We also recommend the consideration of locally generated risk factors because of the lack of general applicability of risk factors applicable in more developed markets to African stock markets, and more importantly the role of idiosyncratic risk. We emphasize the need for geographical considerations in modelling risk-return relationships in stock returns. There is need for greater diversification among equity investors in major African stock markets, this is a way of mitigating the impact of idiosyncratic risk even though from our findings idiosyncratic risk cannot be totally eliminated but can only be considerably minimized. International diversification should also be considered.

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