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Macroeconomic variables and their association to stock market returns in sub-Saharan Africa

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Abstract

The thesis examines the relationship between stock market returns and macroeconomic variables in seventeen countries that are included in the IMF's definition of Sub-Saharan Africa. The study is conducted using a multivariate OLS regression and a Granger Causality test. The results suggest that macroeconomic variables do affect stock market returns in the given region, but that the relationship between the two is not necessarily what economic theory suggests. Even so, as Gross Domestic Product per Capita, inflation, net inflows in the form of Foreign Direct Investment and Real Interest Rates are significantly explaining returns of stock market indices, they should be considered for investment decisions and further studies.

I. Introduction

Is there an association to be found between macroeconomic variables and stock market returns in Sub-Saharan Africa (SSA)? Could these associations be of any help to investors, institutional and private, when making investment decisions with respect to diversifying their portfolios in such markets? In modern portfolio theory, the practice of diversification has been essential to investors. In light of this, African stock markets have gained traction, and for that reason it becomes all the more important to understand them. The effects of volatility on the returns of emerging markets has already been researched extensively, whereas the macroeconomic aspects that could be linked to returns in these types of economies have been less thoroughly examined.

Regardless of the risk involved in emerging markets across the globe, they have shown extraordinary performance over the past two decades and seem to steadily continue doing so. Thus, the objective of our thesis is to select a demographic area characterized as an emerging market and study the relationship between the macroeconomic variables and stock market returns. The SSA region, an area that is scarcely researched, qualifies as an emerging market (a term that will be defined later on). Consequently, we have chosen to explore the dynamics between their macroeconomic indicators and stock markets returns. In terms of this relationship, the conclusions drawn in the literature are split. Some find a relationship that falls in line with economic theory, while others attest to bidirectional relationships between them that are not as straightforward as

***Figure* 1**. Return comparisons between SSA vs MXEU and SSA vs SPX

NOTE. y-axis represents the price changes in percentages, and the x-axis represents the years. MXEU: MSCI Europe Index (Performance of large and mid-cap equities across 15 developed countries in Europe), SPX: S&P 500 Index (Standard & Poor's 500 large-cap US equities), SSA returns (Panel average

economic theory would have it. Therefore, through our research we try to unveil a relationship that will enlighten investors with respect to SSA.

To address the matter, we construct a model that helps us investigate the link between stock market returns and macroeconomic variables. First, we select economic variables that are relevant to SSA. Secondly, to avoid any statistical issues and to determine initial dynamics between the variables; we look at the correlations between them. Finally, we run a multivariate OLS regression and a Granger Causality (GC) test on the proper variables to establish statistical significance and the direction of the relationships.

Our research suggest that macroeconomic variables do affect stock markets returns in SSA countries. The observations disclose four highly significant economic indicators; Foreign Direct Investment net Inflows (FDI_I), Gross Domestic Product per Capita (GDP_PC_US), Inflation (INF) and Real Interest Rates (RIR). However, the GC test highlights the fact that these implicit unidirectional relationships, where macroeconomic indicators explain market returns, are more complex than what our OLS regression would suggest. Except for the proxy for money supply, broad money (BM_GA), there are no other results in the test indicating that a macroeconomic variable causes returns.

We begin by presenting the background and literature in section II. In section III, we talk about the economic model for valuation of assets and the theory supporting our chosen macroeconomic determinants. Further, section IV and V describes the data and methodology process before we move on to empirical results in section VI. The discussion and limitations of our results are summarized in section VII. Finally, we reach our conclusion in section VIII.

II. Background and Literature review

African stock markets have been growing at a considerable rate over the past few years and investors are taking notice. There are now 29 stock exchanges on the African continent, giving market participants wider possibilities in terms portfolio diversification and investment opportunities. Accordingly, there is an increasing interest in return on investments from these markets. Research shows that tried and tested asset pricing models used in developed markets seem to either fail in explaining returns, or are incompatible for emerging markets. Thus, our hope is that

through the use of macroeconomic drivers we will be able to observe an association between the variables that will shed light onto neglected stock returns determinants.

Emerging and developing markets tend to be characterized by high volatility in asset returns and illiquidity when compared to developed markets. As such, an important part of the literature is focused on volatility and liquidity to explain the expected returns.

The study by De Santis and Imrohoroğlu (1997) looks mainly at the dynamics of market volatility. Their findings indicate that emerging markets are unconditionally more volatile than developed markets, and also that they are more susceptible to surprises with respect to publicly available information. Moreover, the authors observe through two different models capturing degrees of market integration, that the relationship between expected return and market volatility is often negative. These findings are rather peculiar because the Capital Asset Pricing Model (CAPM), for instance, anticipates a positive relationship between volatility (a measure of risk) and return.

Building on this, other papers such as the one written by Aggarwal, Inclan, and Leal (1999) analyse the changes in volatility through what could be described as an event study. They discover that volatility in emerging markets is mainly explained by local political, social and economic variables.

Another paper that looks at the behaviour of stock returns in African markets, Alagidede and Panagiotidis (2009), arrives at conclusions that are contrary to that predicted by widely used asset pricing models. They find that the Efficient Market Hypothesis (EMH) does not hold in Africa's largest markets. They argue that since the random walk is rejected (i.e. consecutive price changes are not independent), markets are more predictable. Furthermore, there is evidence showing that conditional asset pricing models fail to accurately predict returns in emerging markets (Harvey, 1995). Considering this, they offer a possible explanation for excess returns other than volatility, which they relate to the low liquidity of African markets. The evidence found in the literature seems to point towards the failure of asset pricing models and their ability to price assets correctly; returns in emerging and developing markets behave differently from what the existing models and theories predict.

Given these observations, macroeconomic factors in Sub-Saharan economies will be tested in our paper to highlight their possible relevance with regards to stock

market returns. The relationship between economic indicators and stock market returns has been researched and findings suggest that they are significant to market performance, particularly in developed markets. For the purpose of this Masters' thesis such indicators will be tested as to uncover the type of relationship that exist between them and the SSA markets. In the IMF paper Mlachila, Jidoud, Newiak, Radzewicz-Bak and Takebe (2016) provide an outline of financial development and how it promotes economic growth within the Sub-Saharan region. The part of the paper that is of value to our research is the analysis that focuses on the impact that macroeconomics has on financial development. To illustrate this, four drivers of financial development present in previous literature such as Boyd, Levine, and Smith's, were selected by the authors. The four drivers are the following; Inflation, International Trade Integration, International Financial Integration and Country Risk. Inflation, for instance, is the most commonly used proxy for macroeconomic stability. It is viewed by the authors as a fundamental driver of financial development in the SSA region. High inflation usually translates to macroeconomic instability and hence a negative relationship between the driver and financial development. The second driver, International Trade Integration, represented by export and import of goods and services should theoretically have positive contributions to financial development. Mlachila et al. (2016) find that this relationship is waning in the SSA region. International Financial Integration, a driver that speaks to the degree of capital account openness, is not going to be of main concern to this paper, as there is a severe lack of data in the SSA countries. Country risk is a driver that is self-explanatory and of importance in the IMF paper, but again we will not concern ourselves with it due to problems relating to availability of data. Based on this information, investigations will be conducted to help us define the relevant drivers' ability to influence the financial markets, and more specifically stock market returns. However, it is important to note that even though there is an apparent relationship between the two, Schwert (1989) argues through his findings that there is strong evidence in support of financial asset volatility being a predictor of future macroeconomic volatility. This means that the interpretation of causality between the two needs to be done cautiously when drawing conclusions from our analysis. Supporting the findings of Schwert (1989) is Credit Suisse's Yearbook from 2010 where economic growth, proxied by GDP, and its relation to stock returns reveal puzzling results. After reviewing the Yearbook (2010), we learn how the GDP has performed as a macroeconomic

explanatory variable for stock returns in different markets around the world. Dimson, Marsh, Staunton, and Wilmot (2010) find that historic GDP per capita tends to have a negative correlation with stock returns, while using stock market performance as an indicator positively describes the expected future GDP in economies. In the same Yearbook (2010), the authors observe that when applying GDP per capita as a macroeconomic determinant for stock returns, growth in the economy itself does not necessarily correspond to a growth in stock returns from investments in emerging markets. Further, they note that there are several observations that weaken the belief of the association between GDP and stock-market returns. One of which is that; growth in the real economy is not the same as growth in the stock-market for that same economy. An economy can grow in terms of wealth because of the growth in real activity. Enterprises contribute partially to growth in real GDP in emerging market economies by increasing for example the labour activity, import and export levels and thus consumption. However, this does not imply growth in stock market returns. Another observation reveals that the link between economic growth and stock-market performance has shown to be statistically weak and that there is no clear relationship between these variables in the long run. Consequently, the difficulty lies in choosing the correct indicators of return so that our research is found relevance.

III. Theory

Theoretically speaking, the relationship between market returns and macroeconomic factors of economies can hardly be described as unidirectional, but given the purpose of our paper we will mostly focus on how stock prices react to macroeconomic factors. Moving forward, variables need to be identified, their theoretical premise needs to be established and their formal structure for our model need to be outlined.

All securities present on the market have a value, a price, on which their return is dependent. Based on Arrow's (1953) notion of "state prices", Duffie (2003) defines a security's implied value as the weighted sum of its future cash flows. Going further, we know that practitioners and academics alike favour the enterprise discounted cash flow (DCF) model for valuing companies. This model requires discounting the free cash flow of a company's operations at the weighted average

cost of capital (WACC) (Koller, Goedhart, Wessels, Schwimmer, & Manoury, 2015).

DCF model

$$V_0 = \frac{FCF_1}{WACC} \quad [\mathbf{1}]$$

Where

V_0 = value of the firm at time t=0
FCF_1 = future cash flows at time t=1
WACC = weighted average cost of capital

$$WACC = \frac{D}{V} k_d (1 - T_m) + \frac{E}{V} k_e \quad [\mathbf{2}]$$

Where

D = debt
E = equity
D/V = target level of debt to enterprise value using market based values
E/V = target level of equity to enterprise value using market based values
k_d = cost of debt
k_e = cost of equity
T_m = company's marginal income tax rate

Both these elements, cash flows and WACC, can be influenced by fluctuations in economic variables, which in turn would affect enterprise value and thereby security returns defined in our paper as:

$$Annual\ returns, \boldsymbol{R} = \log P_{(t)} - \log P_{(t-1)} \quad [\mathbf{3}]$$

Intuitively, we believe that stock markets returns are subject to changes in economic factors of development, growth and performance. There is evidence showing that certain drivers of financial development cause economic growth. McKinnon's (1974) work reviewed in the International Journal looked at this particular relationship and concluded that pursuing financial development encourages economic growth, an idea also shared by others such as Shaw (1973). Additionally, academics such as Fry (1978) did empirical tests on "models of finance in economic development", a theory introduced by the previously mentioned authors McKinnon and Shaw. Applying his analysis to seven less developed Asian countries (Burma, India, Malaysia, Philippines, Singapore, Taiwan and Korea), Fry finds evidence supporting the theory that financial development has an impact on economic

growth. In more recent work by Enisan and Olufisayo (2009), an investigation is conducted on the long run relationship between stock markets and economic growth in seven African countries (Côte D'Ivoire, Egypt, Kenya, Morocco, Nigeria, South Africa, and Zimbabwe). Their findings indicate that there is a link between cause and effect for stock markets and economic growth. The question remains as to whether this linkage can be found in SSA.

Literature such as the paper by Chen, Roll, and Ross (1986) proposes a few economic variables that are relevant to our research, and from those we ought to identify those that can be used for our region. Other than identifying variables we should be able to uncover correct measures for the time series being used in our research. Knowing that macroeconomic variables are signalling tools used to show trends in the economy, they are often non-stationary time series. Consequently, these series should be manipulated as a pre-emptive measure to possible stationarity issues. More importantly, however, we must transform the series such that we can address the question at hand, which relates to economic factors and how they associate with stock market returns.

Following the above reasoning, we will be using a combination of first difference in natural logs and percentage changes from one period to the other, and the typical period is one year.

Inflation

Inflation is a macroeconomic variable, most notably used as a proxy for price stability, that can be decomposed in two components of an anticipated and unanticipated nature with relation to changes in price levels. All anticipated price level movements will shape the prevailing inflation rate and be accounted for in price expectations. Unanticipated changes, on the other hand, will lead to a positive or negative adjustment of the anticipated inflation rate (Meltzer, 1977). Concerning this thesis, the cost of capital (more specifically the risk-free interest rate + risk premium) will respond to changes in general inflation or any of its components, and hence the value of an asset on the market will change.

Broad money

Broad money is defined as the sum of currency outside banks. For example: demand deposits other than those of the central government, savings and foreign currency deposits of resident sectors other than the central government.

The Quantity theory of Money

The Fischer equation in economic theory states that there is positive relationship between money supply and the long-term price of goods:

$$MV = PY \qquad [\mathbf{4}]$$

We know that monetary policy decisions are partially determined by broad money (M) movements. Thus, we believe that there could exist an indirect coherence with equity returns, when applying GDP [Price (P) * Output (Y)] as a proxy for economic growth in our research (Mishkin, 2014). In our case we will investigate broad money in annual percentage growth, BM_GA.

Trade

Trade levels, exports and imports of goods and services, allow us to measure a country's degree of openness (openness indicator). Trade opening has a positive effect on stock markets and an open country is one that has access, through imports, to a greater array of intermediate inputs (in-between good or service used for production purposes). The availability of global technology to local producers exemplifies the advantages of removing trade barriers. As cutting-edge imported intermediate inputs are made available, production processes will be made more efficient (Basu & Morey, 2005). Efficiency in production promotes growth which in turn triggers returns at a firm level. In our case we would imagine that any improvement in efficiency would result in an increase in the cash flow component of firm value, and thereby the relationship between trade and stock returns.

The basic series for imports and exports, which represent trade, are given in absolute values. For the purpose of our investigation, we transform these values into growth rates where exports and imports of goods and services are denoted in year *t*:

$$Annual\ growth, Ex_{US(t)} = \log Ex_{US(t)} - \log Ex_{US(t-1)} \qquad [\mathbf{5.1}]$$

$$Annual\ growth,\ Imp_{US(t)} = \log Imp_{US(t)} - \log Imp_{US(t-1)} \qquad [\mathbf{5.2}]$$

Industry, value added

We use industry value added data, which is defined as net output of all sectors less intermediate inputs of the same sectors. Aligned with the method employed by the World Bank, we do not make any deductions of fabricated assets or depletion and degradation of natural resources. Industry value added could reflect incremental

value creation or deterioration over time. It encompasses value added in manufacturing, construction, electricity, mining, water and gas, which affects the estimation of expected free cash flow, hence the net present value using the DCF valuation method (Mard, Dunne, Osborne, & Rigby Jr, 2005).

This performance measure uses the market value added model (MVA) as it only captures the market value creation based on the net change. Like broad money, we will apply the percentage annual changes, IVA_GA.

Final consumption expenditure

Final consumption expenditure comprises the sum of household and governmental spending. Typically standing for the major part of Gross Domestic Product, consumption spending is crucial as it functions as a key catalyst for economic growth. Our data consists of average annual growth, based on local currencies denoted as FCEX.

GDP per capita growth

GDP is defined as gross value added by all resident producers plus product taxes, less any subsidies not included in the value of product. These calculations are excluded deduction for fabricated assets or for depletion and degradation of natural resources.

Gross Domestic Product is probably one of the most important economic indicators, it functions as an aggregate measure of total economic production for a country. GDP behaviour discloses an economy's consumption, housing activity, input prices, net import and so on (Piros & Pinto, 2013). Additionally, it is a common parameter for other economic performance measures; amongst them, the one we use is the GDP per capita. Again, as we believe market returns could respond to the annual growth variable of the GDP per capita, GDP_PC_US, we will transform this variable and include it our model.

$$Annual\ growth, GDP_{per\ capita\ US(t)} = \log GDP_{per\ capita\ US(t)} - \log GDP_{per\ capita\ US(t-1)} \quad [6]$$

Real Interest Rate

The Real Interest Rate (RIR) is the yield of capital to the investor, or in other words, the cost of borrowing funds after adjusting for inflation. To see this factor's influence on market returns, we will look at the levels in the variable, RIR. From a

macroeconomic perspective, it reflects the purchasing power for a specific period and is an essential determinant in our research for two reasons.

Firstly, the real rate of return determines investors' valuation of an asset when applying the DCF model, in other words the pricing of assets (Chen et al., 1986). Secondly, based on that approach investors assess whether domestic, as opposed to cross-border projects, seem attractive or not. This means that it can have significant implications on the level of inflows and outflows for Foreign Direct Investments (Akuffo, 2014).

Foreign Direct Investment

A Foreign Direct Investment (FDI) occurs if a company decides to make a cross-border investment acquiring a minimum of 10% of the foreign company's shares (Bekaert & Hodrick, 2013).

Our sample data contains the net in- and outflow of equity as ratio of GDP, comprising the sum of equity capital, reinvestment of earnings, other long-term capital and short-term capital stated in the balance of payments.

This variable is considered relevant based on the potential influence shareholders may have on the management, seeing as ownership and control could reflect performance (Goergen, 2012). More specifically, "*FDI is an important vehicle for the transfer of technology, contributing relatively more to growth than domestic investment*" (Borensztein, De Gregorio, & Lee, 1998). FDI is given in inflows (FDI_I) and outflows (FDI_O) allowing us to better assess which direction contributes to the stock returns. We believe that the two components are influenced by the Real Interest Rates and inflation, and that they indicate the flow of investments in a country (Akuffo, 2014). Investments, at a firm level, is an element that influences the present value and ultimately the market returns of a given firm.

$$Annual\ growth, FDI\_I_t = \frac{FDI\_I_t - FDI\_I_{t-1}}{FDI\_I_{t-1}} \qquad [\mathbf{7.1}]$$

$$Annual\ growth, FDI\_O_t = \frac{FDI\_O_t - FDI\_O_{t-1}}{FDI\_O_{t-1}} \qquad [\mathbf{7.2}]$$

To uncover any effect that FDI might have on returns we transform the FDI net inflow into a percentage change variable, FDI_I, defined as above.

IV. Model and Method

To arrive at a proper conclusion in our research, we had to apply two central econometric models. First, the ordinary least square (OLS) between the exogenous variables, mentioned in the preceding section, and the endogenous variable; namely stock market returns in SSA. Secondly, the Granger Causality test to study the individual relationships between exogenous and endogenous variables. The latter, is conducted to examine the interaction (bidirectional or unidirectional causality) in our regression.

Definition of model

If we apply the macroeconomic variables described in our theory section to a model in which we try to explain returns in SSA, our multivariate regression analysis should be defined in the following way:

$$\mathbf{R} = \alpha + \beta_2\Delta(BM)_t + \beta_3\Delta(FCEX)_t + \beta_4\Delta(EXP)_t + \beta_5\Delta(IMP)_t + \beta_6\Delta(FDI\_I)_t + \beta_7\Delta(FDI\_O)_t + \beta_8\Delta(GDP\_PC)_t + \beta_9\Delta(IVA)_t + \beta_{10}\Delta(INF)_t + \beta_{11}\Delta(RIR)_t + \varepsilon_{it} \quad [\mathbf{8}]$$

Where **R** is the market log return, $\propto$ is the constant, the betas are the coefficient on the regressors, Δ is the difference operator for the economic variables and ε is unsystematic error term.

Model specification

Before we decided to work with the determinants in our multivariate regression, we pooled all the exogenous time series data and ran a multicollinearity test, ***table (4)***. Further, knowing that the time series could be non-stationary, we have conducted an Augmented Dickey- Fuller Panel unit root-test to avoid any spurious regressions. If non-stationarity occurs, we will have to transform our variables before estimating the econometric models.

Unit root tests

When putting together a regression model, a prominent issue to disclose is the existence of unit root in the data series. If our time series contains a unit root, our regression could achieve abnormally high covariance (R^2). The regression would be spurious and create an unreliable relationship between the dependent and independent variables. To discover such anomalies in data sets, one of the most

applied methods is the Augmented Dickey-Fuller test (ADF). For this test, the null and alternative hypotheses are stated as following:

H_0: $\rho = 1$, *Unit root (non-stationary variable)*
H_1: $\rho < 1$, *No Unit root (stationary variable)*

As shown below in table 1, all our variables reject the null hypotheses with great certainty. In this case, the times series in question are stationary and up to this point the variables in our OLS regression are meaningful.

***Table (1)**:* Augmented Dickey-Fuller stationary process test results

Variable	t-Statistic	P-value	H_0	H_1	Result
BM_GA	107.724	0.0000	Unit root	No unit root	Stationary
EXP_US	92.866	0.0000	Unit root	No unit root	Stationary
FCEX	91.748	0.0000	Unit root	No unit root	Stationary
FDI_I	130.480	0.0000	Unit root	No unit root	Stationary
FDI_O	95.565	0.0000	Unit root	No unit root	Stationary
GDP_PC_US	92.431	0.0000	Unit root	No unit root	Stationary
IMP_US	85.109	0.0000	Unit root	No unit root	Stationary
INF	133.074	0.0000	Unit root	No unit root	Stationary
IVA_GA	83.615	0.0000	Unit root	No unit root	Stationary
RIR	120.545	0.0000	Unit root	No unit root	Stationary

Cross-section dependence test

A usual problem when working with panel data is cross-section dependency, and we confirm this in our dataset when running the Breusch-Pagan LM for interdependence (see Appendix, table I). Nevertheless, our data is still usable after adjusting for random effects. The rationale behind random effects is that the existence of variations across entities are uncorrelated with their exogenous variables. However, believing that cross-sectional differences impact the dependent variable, one should apply random variables. The advantage of using random effects is that one could include time invariant variables in a regression.

Hausman Test

Given the fact that we are dealing with countries of different sizes, financial standing and so on, we have reason to believe that there are differences we have not

been able to measure; differences that might influence the dependent variable. To confirm that the random effect model is indeed best suited to our model, we had to run the Hausman test for model misspecification.

> H_0: errors (ε_i) not correlated with exogeneous variables (Random effects model is preferred)
> H_1: errors (ε_i) correlated with exogenous variables (Fixed effects model is preferred)

Table (2): *Hausman test summary*

Test summary	Chi-squared statistic	Prob.
Cross-section random	4.934608	0.8955

We cannot reject the null in our case, and so we proceed with the random effects rather than fixed effects. Moving forward with the random effects model, we no longer need to worry about any omitted time invariant variables.
In summary, we discovered that there is high cross-sectional dependency among our explanatory variables, meaning that our variables contain heteroskedasticity. However, due to the absence of unit roots in our time series, this also means that we have stationary linear combinations in our variables. Also, cointegration between our variables was confirmed through testing and this allows us to conclude that there exists a long-term relationship between them, making it possible to work with our panel data.

V. Data

We are investigating the influence of economic factors on stock market returns in SSA during the period 1997-2015. Based on the IMF list of countries that constitutes SSA (*Sub-Saharan Africa: Time for a Policy Reset*, 2016), and with respect to availability, continuity and reliability of the data, we focus our research around seventeen of those countries:

> Benin, Botswana, Burkina Faso, Côte d'Ivoire, Ghana, Guinea-Bissau, Kenya, Malawi, Mali, Mauritius, Niger, Nigeria, Senegal, South Africa, Tanzania, Togo, Uganda.

The macroeconomic data, shown in ***table (3)***, was retrieved from the World Bank and International Monetary Fund databases. If not transformed to percentage changes (annual percentage growth), the macroeconomic series are used as defined by the databases. Before proceeding with our battery of statistical tests, we graph the panel averages of our individual macroeconomic variables; this to get a depiction of their characteristics (Appendix: *Figure* I). As for the data on stock market returns, the paper relies on closing prices of stock market indices all from the seventeen SSA nations selected (see Appendix: *table* II***)***. Additionally, due to the characteristics of stock prices, the series was transformed into log returns. We chose to use data given in U.S Dollars for simplicity and comparability reasons. All data collected is in annual terms. Every local currency was converted to USD using a single exchange rate applicable across all year (Appendix: *Figure* II).

Table (3). Economic Development Factors: Data Sources and Description

Economic factor	Variable	Abbreviation	Description & Source
Money supply	Broad money growth (annual %)	BM_GA	IMF
Trade openness	Exports of goods and services (US$)	EXP_US	WDI, World Bank
	Imports of goods and services (US$)	IMP_US	WDI, World Bank
Economic performance	GDP per capita (US$)	GDP_PC_US	WDI, World Bank
	Industry, value added (annual % growth)	IVA_GA	WDI, World Bank
Economic stability	Inflation, consumer prices (annual %)	INF	WDI, World Bank
Foreign Direct Investment	Foreign Direct Investment, net inflows (% of GDP)	FDI_I	IMF
	Foreign Direct Investment, net outflows (% of GDP)	FDI_O	IMF
Interest rates	Real Interest Rate (%)	RIR	WDI, IMF
Final consumption expenditure	Final consumption expenditure (annual % growth)	FCEX	WDI, World Bank

Our analysis drove us to generate a correlation matrix of the variables in our model. The matrix represented in ***table (4)*** considers observations from 1999 to 2015 and excludes the first two years of our time horizon for the sake of a balanced sample.

As expected, the strongest correlation is between a component of economic performance, GDP_PC_US, and trade, EXP_US. The economic performance series is in part defined by the World Bank as the value added by resident producers, and one could imagine that the value added by a producer is increased or decreased by how much they manage to export.

Table (4). Correlation matrices for market return and macro variables

Symbol	BM_GA	EXP_US	FCEX	FDI_I	FDI_O	GDP_PC_US	IMP_US	INF	IVA_GA	RET_US
Period: 1999-2015 (226 observations)										
EXP_US	.183									
	(0.006)									
FCEX	.133	-.101								
	(0.047)	(0.129)								
FDI_I	-.038	-.072	.021							
	(0.573)	(0.279)	(0.758)							
FDI_O	.075	.057	.005	.000						
	(0.261)	(0.396)	(0.939)	(0.995)						
GDP_PC_US	.106	.635	-.008	-.069	.017					
	(0.112)	(0.000)	(0.910)	(0.299)	(0.799)					
IMP_US	.111	.538	.134	-.020	.094	.507				
	(0.097)	(0.000)	(0.044)	(0.761)	(0.161)	(0.000)				
INF	.162	.032	.063	-.203	-.104	.074	.047			
	(0.015)	(0.632)	(0.344)	(0.002)	(0.118)	(0.267)	(0.481)			
IVA_GA	.105	.156	.049	.071	-.037	.074	.049	-.012		
	(0.115)	(0.019)	(0.466)	(0.286)	(0.582)	(0.267)	(0.465)	(0.854)		
RET_US	.032	.189	.071	-.160	.022	.325	.235	-.148	-.040	
	(0.631)	(0.004)	(0.289)	(0.016)	(0.746)	(0.000)	(0.000)	(0.026)	(0.552)	
RIR	.069	-.388	.201	-.081	-.054	-.371	-.146	.260	.034	.011
	(0.304)	(0.000)	(0.002)	(0.228)	(0.416)	(0.000)	(0.028)	(0.000)	(0.002)	(0.228)

NOTE: The values in parentheses correspond to the probability |t|=0.

GDP_PC_US has also a relatively strong correlation to IMP_US, another component of trade. Referring to our previous definition of trade, imports would allow a producer to widen and improve his production process, and ultimately add value.

Even more predictable is the strong correlation between the two components of trade openness, EXP_US and IMP_US. With both being elements of the same economy factor, it is inevitable. The strongest negative correlation that exists

between our economic factors is that of export variable, EXP_US, and the Real Interest Rate, RIR. Economic theory suggests that higher interest rates render an economy more attractive, and that as the interest rate levels increase a currency appreciates. Another negative and noteworthy relationship that manifests itself in our matrix is the one between GDP_PC_US and RIR, which can be explained by theory. An increase in Real Interest Rate might dissuade new investments from taking place, and a slowdown in new investments would inhibit value brought by production of goods and services from being added at a national level. In other words, GDP would decrease.

Despite the probable linear combination of the mentioned explanatory variables, dropping any of them is not in accord with economic theory, or with the considerations made in the previous section. Of the remaining variables, there are some noticeable correlations, but none of which are near strong enough to be problematic. This absence of high pairwise correlation between the variables tells us that the possibility of multicollinearity is low, and the statistical inference that can be drawn from this sample is that all the variables in our model have merit.

Additionally, we have computed correlation matrices with one and two-year lagged variables, trying to observe patterns in our determinants. In the matrices, there does not seem to be any irregularities. The highest cross-correlation is found between inflation and its first lagged variable with 0.702. This finding is expected as present inflation rates are heavily influenced by previous price levels and consumers' expectation of inflation. Unsurprisingly, the second lagged variable of inflation correlated with its contemporaneous variable, and is the most notable in ***table (5)***. However, the proportion in which it correlates decreases with the number lags. Carrying forward, we are aware of some inertia in our macroeconomic variables and the fact that certain lagged variables correlate slightly with our contemporaneous variables. This might be an indication that the statistical significance of our estimators will prove less reliable. However, this will be a nonissue in terms of the biasness of the estimators.

Table (5.1)	BM_GA(-1)	EXP _US(-1)	FCEX(-1)	FDI_I(-1)	FDI_O(-1)	GDP_PC_US(-1)	IMP_US(-1)	INF(-1)	IVA_GA(-1)	RIR(-1)
BM_GA	.116	.120	-.069	.079	-.006	.056	.109	.229	-.040	.082
	(0,061)	(0,052)	(0,265)	(0,201)	(0,926)	(0,362)	(0,080)	(0,000)	(0,515)	(0,187)
EXP_US	.013	-.123	.009	.032	.051	.041	-.005	-.039	.020	-.044
	(0,835)	(0,047)	(0,889)	(0,604)	(0,408)	(0,511)	(0,942)	(0,531)	(0,751)	(0,476)
FCEX	.028	.182	-.179	-.024	-.014	.040	.029	-.046	.041	-.006
	(0,646)	(0,003)	(0,004)	(0,696)	(0,817)	(0,517)	(0,646)	(0,463)	(0,507)	(0,920)
FDI_I	-.014	-.002	-.049	-.007	.005	.133	-.032	-.146	-.003	-.091
	(0,824)	(0,970)	(0,432)	(0,914)	(0,930)	(0,032)	(0,602)	(0,018)	(0,963)	(0,141)
FDI_O	.056	.087	-.091	.006	-.011	.032	.018	-.080	-.015	.009
	(0,363)	(0,158)	(0,141)	(0,926)	(0,862)	(0,601)	(0,774)	(0,194)	(0,807)	(0,890)
GDP_PC_US	.024	.025	.076	-.010	-.019	.033	.093	.079	.007	.146
	(0,705)	(0,684)	(0,219)	(0,870)	(0,756)	(0,597)	(0,135)	(0,204)	(0,912)	(0,018)
IMP_US	.106	.204	-.073	.042	.035	.189	-.022	-.061	-.019	-.113
	(0,088)	(0,001)	(0,241)	(0,501)	(0,578)	(0,002)	(0,722)	(0,326)	(0,764)	(0,068)
INF	.377	-.021	-.008	-.072	.000	-.098	-.047	.702	-.050	.302
	(0,000)	(0,729)	(0,893)	(0,244)	(0,994)	(0,115)	(0,452)	(0,000)	(0,425)	(0,000)
IVA_GA	.068	.115	.005	.030	-.037	.092	-.005	-.064	.101	-.093
	(0,271)	(0,064)	(0,941)	(0,631)	(0,552)	(0,139)	(0,942)	(0,300)	(0,101)	(0,132)
RIR	.153	.081	-.085	-.075	-.056	.108	-.029	.284	.032	.238
	(0,013)	(0,190)	(0,169)	(0,227)	(0,365)	(0,081)	(0,639)	(0,000)	(0,610)	(0,000)

Table (5.2)	BM_GA(-2)	EXP_US(-2)	FCEX(-2)	FDI_I(-2)	FDI_O(-2)	GDP_PC_US(-2)	IMP_US(-2)	INF(-2)	IVA_GA(-2)	RIR(-2)
BM_GA	.126	-.002	-.002	-.038	-.022	.043	-.022	.252	.062	.041
	(0,050)	(0,974)	(0,726)	(0,557)	(0,971)	(0,504)	(0,731)	(0,000)	(0,335)	(0,522)
EXP_US	-.001	-.018	-.066	.053	.009	-.008	-.048	.020	-.059	.050
	(0,982)	(0,778)	(0,886)	(0,407)	(0,305)	(0,901)	(0,459)	(0,754)	(0,361)	(0,440)
FCEX	.012	.050	.078	-.009	-.018	.097	.034	-.012	.062	-.063
	(0,855)	(0,433)	(0,776)	(0,887)	(0,225)	(0,130)	(0,592)	(0,852)	(0,338)	(0,329)
FDI_I	-.158	.022	-.012	-.055	-.013	.014	.070	-.009	-.008	-.006
	(0,013)	(0,737)	(0,839)	(0,392)	(0,852)	(0,822)	(0,273)	(0,890)	(0,900)	(0,927)
FDI_O	-.165	-.186	-.045	-.016	-.010	-.055	-.061	-.038	-.031	.007
	(0,010)	(0,004)	(0,877)	(0,807)	(0,486)	(0,389)	(0,342)	(0,558)	(0,626)	(0,911)
GDP_PC_US	.141	-.029	-.103	.026	-.004	-.022	-.115	.121	.009	.030
	(0,027)	(0,651)	(0,944)	(0,684)	(0,106)	(0,735)	(0,073)	(0,058)	(0,891)	(0,641)
IMP_US	.024	-.048	.018	.054	-.007	-.016	-.046	.020	-.024	.060
	(0,709)	(0,452)	(0,911)	(0,396)	(0,777)	(0,806)	(0,473)	(0,760)	(0,704)	(0,352)
INF	.337	-.002	.018	-.095	-.035	-.016	-.022	.558	-.046	.267
	(0,000)	(0,979)	(0,590)	(0,138)	(0,777)	(0,808)	(0,734)	(0,000)	(0,471)	(0,000)
IVA_GA	.008	-.032	.072	-.001	-.041	-.002	.017	-.056	.064	.039
	(0,904)	(0,619)	(0,528)	(0,992)	(0,262)	(0,980)	(0,795)	(0,387)	(0,315)	(0,542)
RIR	.064	-.012	.027	-.074	.008	.008	.046	.311	-.018	.315
	(0,315)	(0,851)	(0,899)	(0,246)	(0,679)	(0,900)	(0,478)	(0,000)	(0,776)	(0,000)

NOTE: The values in parentheses correspond to the probability |t|=0.

VI. Empirical results

Regression Output, OLS

Table (6) reports the results of the multivariate regression on our panel data with random effects. In this regression where market returns in SSA were regressed on macroeconomic factors, four out of ten variables are significantly able to explain returns. However, given the that fact that we cannot reject the F-Statistic for this model, the estimated regression line is significant. In other words, the coefficients are collectively significant. On an individual basis, the proxy for money supply, BM_GA is not significant. The trade variables EXP_US and IMP_US, and final consumption expenditure, FCEX, are not statistically significant either. The economic stability variable**,** INF, has a negative sign and is significant at 1% level. Our results are consistent with previous research by Fama and Schwert (1977), there is in fact a negative relationship between stock market returns and inflation.

Table (6): *Random effects regression*

Variable	Coefficient		Std. Error	t-Statistic	Prob.	R^2
C	0.0528	*	0.0298	1.7741	0.0775	
BM_GA	0.0189		0.1210	0.1560	0.8762	
EXP_US	-0.0011		0.1317	-0.0087	0.9931	
FCEX	0.1113		0.1703	0.6535	0.5142	
FDI_I	-0.0070	***	0.0027	-2.6038	0.0099	
FDI_O	-2.33E-05		0.0001	-0.2144	0.8304	**0.2172**
GDP_PC_US	0.8440	***	0.1918	4.4009	0.0000	
IMP_US	0.1420		0.1338	1.0618	0.2895	
INF	-1.4840	***	0.3609	-4.1114	0.0000	
IVA_GA	-0.2746		0.2355	-1.1662	0.2448	
RIR	0.8143	***	0.2833	2.8743	0.0045	
F-statistic	5.9659					
Prob(F-statistic)	0.0000					

*, ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively.

The Foreign Direct Investment variables, FDI_I and FDI_O, are highly significant and not significant, respectively. The FDI_I variable has a slightly negative coefficient. This seem to be consistent with previous research done in Sub-Saharan Africa and could be explained by governmental issues and political frictions

(Odenthal, 2001). However, the coefficient of our GDP_PC_US, significant at the 1 % level, contradicts Credit Suisse's Yearbook findings in 2010. Lastly, our results show that the RIR is positively correlated to our dependent variable and significant at 1% level.

The Granger Causality test

To support our results we conduct a Granger Causality test for which the hypothesis of a current or lagged time series helps predict future changes of another variable (Stock & Watson, 2015). ***Table (7)*** reports the results of the given test, and in summation; there exists no bidirectional relationship between any of the variables and returns in our dataset. However, in terms of unidirectional causality, we observe that GDP_PC_US is Granger caused by market returns, which is consistent with Credit Suisse's research from their 2010 Yearbook. Broad money, BM_GA, unidirectionally Granger cause stock market returns, RETURNS_US, at 5% significance level. Furthermore, neither of RIR, IVA_GA or any of the FDI variables Granger cause stock market returns. With that, looking at opposite directional relationships, we find that stock market returns do Granger cause EXP_US, FCEX, IMP_US and INF at 1%, 10%, 1% and 5% significance levels, respectively.

Table (7): *Granger Causality test*

H_0: Independent/dependent variable does not Granger cause Independent/dependent variable

H_1: Independent/dependent variable does Granger cause Independent/dependent variable

Variable	# Obs.	F-Statistic		Rejecting H_0
BM_GA does not Granger Cause RETURN_US	227	4.3464	**	✓
RETURN_US does not Granger Cause BM_GA		0.8831		
EXP_US does not Granger Cause RETURN_US	227	0.0488		
RETURN_US does not Granger Cause EXP_US		13.2010	***	✓
FCEX does not Granger Cause RETURN_US	227	2.0473		
RETURN_US does not Granger Cause FCEX		3.3300	*	✓
FDI_I does not Granger Cause RETURN_US	227	0.4081		
RETURN_US does not Granger Cause FDI_I		0.1347		
FDI_O does not Granger Cause RETURN_US	227	0.0138		
RETURN_US does not Granger Cause FDI_O		1.2313		
GDP_PC_US does not Granger Cause RETURN_US	227	1.0259		
RETURN_US does not Granger Cause GDP_PC_US		26.8241	***	✓
IMP_US does not Granger Cause RETURN_US	227	1.0957		
RETURN_US does not Granger Cause IMPORT_US		42.1273	***	✓
INF does not Granger Cause RETURN_US	227	0.0024		
RETURN_US does not Granger Cause INF		5.6929	**	✓
IVA_GA does not Granger Cause RETURN_US	227	0.0037		
RETURN_US does not Granger Cause IVA_GA		0.0550		
RIR does not Granger Cause RETURN_US	227	0.9743		
RETURN_US does not Granger Cause RIR		1.4322		

*, ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively.

VII. Discussion and Limitations

Discussion

The tests in ***table (6)*** and ***table (7)*** are designed to show that macroeconomic factors can explain market indices in the SSA region. The regression looked at the simultaneous significance of each individual economic factor and the results in ***table (6)*** show four significant explanatory variables, all of which are theoretically conceivable.

By its nature, FDI_I's significance is founded in the capital support it brings to industries in an economy. The latter should boost investments and growth at a firm level and ultimately translate into upward movements in prices. However, although significant, the mentioned coefficient has a slightly negative relation to market returns. The results indicate that a unit increase in the FDI inflows would lead to a 0.007 % decrease in returns. This is unwarranted given the paper's theoretical premise for FDI.

In this context, we could argue that our time series data on the economic factor is not a true representation of the population; hence the coefficient on the regressor becomes unreliable. Or, we could argue, following Hausmann and Fernandez-Arias (2000) and Claessens, Klingebiel, and Schmukler (2001), that FDI replaces the role of stock markets. Consequently, as capital is raised through FDI rather than stock markets, the relationship between the two should be negative. This is due to the fact that in a region such as SSA, most countries are less financially developed, and the risks associated with capital market investing is higher due to the frailty of shareholder rights. In terms of causality, the results in ***table (7)*** show there is not any unidirectional or bidirectional relationship between the FDI inflow and market log returns.

Another variable which is significant in the model we tested is annual growth in GDP per capita. Not only is the coefficient significant, the positive direction of the relationship is as expected. As discussed in our theory section, market returns respond to this proxy for economic performance; the results from ***table (6)*** tell us that a unit increase in the GDP_PC_US causes a 0.844 % rise in log returns, holding all other variables constant. However, the results from the Granger Causality test, in ***table (7)***, tell us that the causal relationship is from GDP per capita to market

returns, and not vice versa. This demonstrates that although the coefficient of GDP_PC_US is significant and as expected, any interpretation of the results from our model could be misleading.

Inflation, the indicator for economic stability chosen for our model is statistically significant and negatively correlated to the log returns. It is also the macroeconomic factor that contributes the most to returns in our model, with a negative coefficient of 1.484.

Holding all other variable constant, a unit increase in inflation affects log returns at a rate that is approximately 76 % higher than that of the GDP factor. Sufficient to say that the SSA stock markets are susceptible to changes in inflation, and that our findings here are reasonable. Without economic stability, and all that it implies in terms of price levels, it is unconceivable to sustain long term growth at a financial or economic level. With that said, similar to the causality relationship found for the previous indicator, the results in ***table (7)*** only attest to a unidirectional relationship where inflation causes returns.

The Real Interest Rate, whose coefficient is positive, is the final significant macroeconomic indicator in our results. The positive relation between RIR and returns contradicts the DCF model on which our paper bases prices, and it also challenges the idea that lower interest rates in an economy incentivises investments across the board. Both of which imply a negative relationship between interest rates and prices, ergo returns and prices.

However, if one opts away from these two explanations and focuses on the relationship between interest rates and economic growth, it could be argued that this positive coefficient is sensible. Previous studies find that a rise in Real Interest Rates encourages economic growth, supporting the fact that the two are positively related. Be that as it may, the results in ***table (7)*** show there is not any unidirectional or bidirectional relationship between the RIR and market log returns.

Limitations

The research in this thesis helped us show that there exists an association between macroeconomic variables and stock market indices. Having said that, our investigation is conditioned by the data we chose, the statistical model we employed and the region we selected.

On the one hand, due to non-existing or lack of accessible data, our sample could not be a true representation of the SSA region. A region defined by 45 countries had to be cut down to seventeen countries, and we were dealing with relatively young stock market indices. Consequently, our findings were limited to the select group of countries remaining, and the sample period was restricted to the number of years where market data was available. With the passing of time, and African data becoming more available, we imagine that the estimates of further research will become increasingly accurate for the region.

On the other hand, we know that the sample period could be a source of bias with respect to the levels in our variables. Country risk and political risk in the form of civil wars, political uprisings and riots disrupt the ordinary development of our macroeconomic factors and stock market indices. Specifically, the Kenya crisis (2007-2008), the civil wars in Côte d'Ivoire (2002-2007 and 2010-2011) and the Boko Haram insurgency in Nigeria (2009-present) are a few examples. Moreover, due to a relatively significant level of corruption in SSA, some factors could be misrepresented.

Despite these considerations, we found an association within the select few SSA countries, and further research in this field should be able to uncover more objective results. Finding a way to include a more representative group of SSA countries and accounting for instabilities in the region should give more unbiased estimates.

VIII. Conclusion

The thesis sets out to show that macroeconomic factors can be associated with stock market returns in SSA countries. OLS regression exposes four significant macroeconomic factors of market return, while only two of those show causality in the GC test.

From an economic and financial point of view, in section III, we attempted to lay the groundwork that would support our array of candidates for economic variables. Going forward, the results have revealed that economic performance in the form of GDP per capita and economic stability proxied by inflation; are both significant with regards to stock market returns. However, the GC test shows no evidence of the economic indicators causing returns in SSA markets, but in the meantime, it shows causality in the opposite direction. Moreover, FDI and RIR are also significant, but in this case there is no causal relationship to be found between economic indicators and returns.

Our results imply that for our set sample, and during the period we have chosen, there is an association between macroeconomic variables and stock market returns in SSA countries. Nonetheless, we are not bold enough to contend that our evidence is undisputable, or that it has revealed the true relationship between economic indicators and SSA stock markets. We are simply trying to shed light onto the fact that when investing in SSA stock markets, the game might be similar but the rules are different.

For research purposes, the results of the thesis suggest that macroeconomic factors should be considered as viable candidates for any model attempting to explain stock market returns in SSA countries. Furthermore, market participants looking to invest in the stock markets of this specific region should take into consideration the effects of economic performance, economic stability, Foreign Direct Investments and interest rates. As mentioned in our background and theory section EMH does not hold in African markets; they are more predictable. As such, these aforementioned effects could help capitalize on returns in SSA, where the level of these macroeconomic indicators can be used for gauging the market climate in the selected countries.

We conclude that there is an association between stock market returns and macroeconomic variables. That is, regardless of the degree of causality between them, prices in the financial market respond to changes in economic factors of SSA countries.

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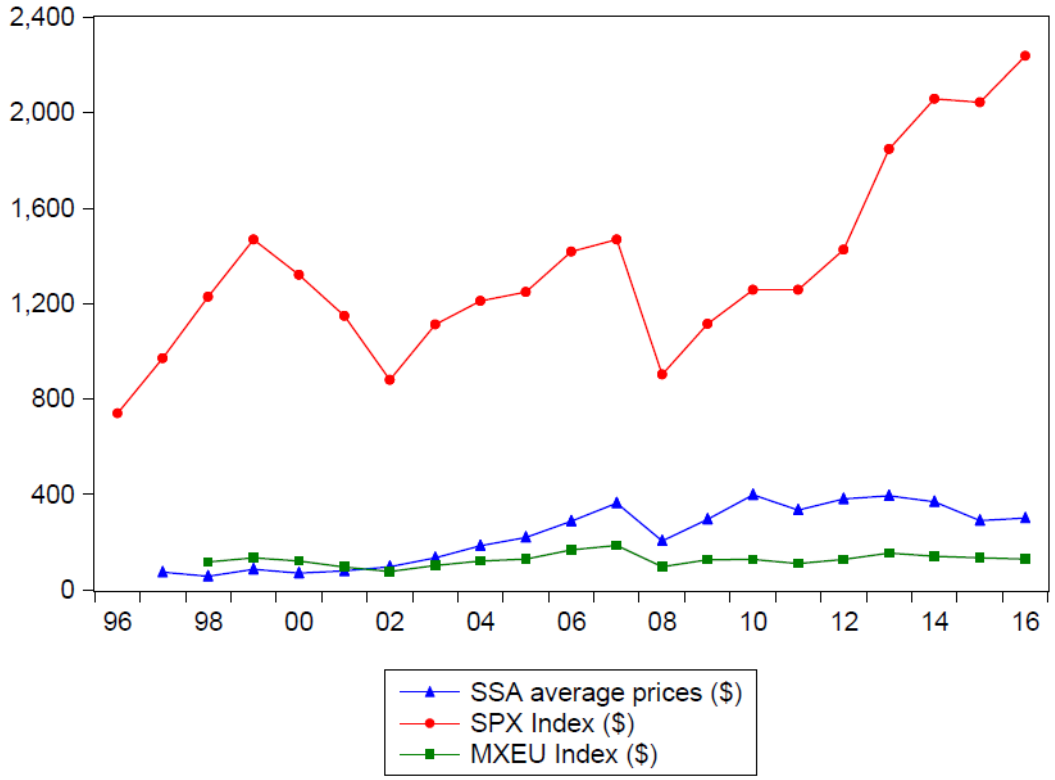
Appendix

Introduction

***Figure* I.** Index prices for Europe and US indices vs SSA panel average prices



Model specification

Cross-section dependency

Test hypothesis

H_0: No cross-section dependence (no correlation)

H_1: Cross-section dependence

***Table* I.** *Breusch- Pagan LM*

Test	***Statistic***	***Prob.***
Breusch-Pagan LM	589.7373	0.0000***

*, ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively.

Data

***Figure* II.** Graphical representation of macroeconomic variables

***Table* II**. Stock market indices

Country	Index
Benin	BRVM COMPOSITE - PRICE INDEX
Botswana	BOTSWANA SE DMS COS. IDX. - PRICE INDEX
Burkina Faso	BRVM COMPOSITE - PRICE INDEX
Cote d'Ivoire	BRVM COMPOSITE - PRICE INDEX
Ghana	GHANA COMPOSITE GSE-CI - PRICE INDEX
Guinea-Bissau	BRVM COMPOSITE - PRICE INDEX
Kenya	KENYA NAIROBI SE ALL SHARE - PRICE INDEX
Malawi	MALAWI ALL SHR
Mali	BRVM COMPOSITE - PRICE INDEX
Mauritius	SEMDEX INDEX
Niger	BRVM COMPOSITE - PRICE INDEX
Nigeria	NIGERIAN STOCK EXCHANGE ALL SHARE INDEX
Senegal	BRVM COMPOSITE - PRICE INDEX
South Africa	JOHANNESBURG STOCK EXCHANGE ALL SHARE INDEX
Tanzania	TN DSE ALL SHARE INDEX NADJ
Togo	BRVM COMPOSITE - PRICE INDEX
Uganda	UGANDA SE ALL SHARE (ALSI) - PRICE INDEX

Empirical results

Regression output, OLS

***Table* III:** *Normal regression*

Variable	Coefficient		Std. Error	t-Statistic	Prob.	R^2
C	0.0528	*	0.0291	1.8149	0.0709	
BM_GA	0.0189		0.1182	0.1596	0.8734	
EXP_US	-0.0011		0.1288	-0.0089	0.9929	
FCEX	0.1113		0.1665	0.6685	0.5045	
FDI_I	-0.0070	***	0.0026	-2.6638	0.0083	
FDI_O	-2.33E-05		0.0001	-0.2194	0.8266	**0.2172**
GDP_PC_US	0.8441	***	0.1875	4.5022	0.0000	
IMP_US	0.1420		0.1307	1.0862	0.2786	
INF	-1.4840	***	0.3528	-4.2061	0.0000	
IVA_GA	-0.2746		0.2302	-1.1931	0.2342	
RIR	0.8143	***	0.2769	2.9405	0.0036	
F-statistic	5.9659					
Prob(F-statistic)	0.0000					

*, ** and *** indicate statistical significance at the 10%, 5% and 1% levels respectively.