Financial liberalization and the development of stock markets in Sub-Saharan Africa

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December 2017

FINANCIAL LIBERALIZATION AND THE DEVELOPMENT OF STOCK MARKETS IN SUB-SAHARAN AFRICA

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Abstract

This study sought to investigate the relationship between financial liberalization and stock market development in four Sub-Saharan African stock markets using quarterly data for the period 1975 - 2014. The analysis focused on three dimensions of liberalization in isolation, which are capital account liberalization, stock market liberalization and financial sector liberalization. Hence, the empirical analysis uses three Bayesian VAR models for each market studied. The results from the investigation show a positive correlation between stock market development and the liberalization of stock markets and the financial sector in all four countries, which advocates for the opening of financial markets to international investors, as well as the deepening of the sector. Additionally, a positive long-run response of stock market development to all three forms of liberalization in all the markets considered suggested that greater focus should therefore be put on increasing financial openness by removing the restrictions in the financial sectors of the respective economies, as this will promote the effectiveness of the deliverance of credit to the private sector, efficient credit evaluation and public sector surveillance, which is provided through the stock market. Finally, the analysis uncovered negative correlation between stock market development and inflation in all four

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markets, suggesting that policy makers in these countries should pay special attention to inflation targeting policies in order to positively contribute to enhancing these markets.

Keywords: Financial liberalization, capital account liberalization, stock market liberalization, stock market development, Bayesian Vector Autoregressive model.

JEL Classification: G18, G28, G38.

1 Introduction

After the financial crises of the 1980s, major reforms were implemented as part of broader programs of financial sector reforms funded by loans from the World Bank or other multilateral agencies. Reforms regarding the bank regulations and supervision were high on the list of conditions of the World Bank financial sector adjustment loans, bearing higher probability of inclusion than interest rate deregulation, bank privatization or directed credit reforms (Brownbridge and Kirkpatrick, 2000). However, a number of developing economies faced banking crises during the mid to late 1990s, many years after the prudential reforms started to be implemented (Brownbridge and Kirkpatrick, 2000). These crises were attributed to an incorrect sequencing of financial sector reforms, with liberalization preceding prudential reforms. In effect, it is of convention that emerging economies should only liberalize their financial sectors after sound prudential systems have been put in place, or at least gradually, while systems are being strengthened (Brownbridge and Kirkpatrick, 2000). Nevertheless, multilateral organizations such as the IMF and the World Bank, still support the traditional free market neoclassical view arguing that financial repression is the cause of the slow growth and the alarming rate of persistent poverty in Africa. Actually, the proponents of this view maintain that restrictions such as interest rate control or considerable reserve requirements constitute the main sources of the low growth and poor driven allocation of financial resources on the continent (Yusuf, Malarvizhi and Jayashree, 2014).

In spite of the banking crises plaguing the financial markets worldwide in the 1980s -

1990s, that period saw a mushrooming of stock markets in Sub-Saharan Africa. Besides a few early risers such as the Egypt Exchange, the Johannesburg Stock Exchange, the Casablanca Stock Exchange and the Zimbabwe Stock Exchange, established in 1883, 1887, 1929 and 1948, respectively; 13 of the 29 exchanges housed on the continent were established between 1988 and 1999. Before the 2008 financial crisis, the equity market sector improved and expanded rapidly. In fact, market capitalization in most African exchanges doubled between 1992 and 2002, increasing from US$113.4 billion to US$244.6 billion (Yartey and Adjasi, 2007). Although these markets remain small in size and relatively illiquid, many have yielded high returns to investors over time. Since 1995, at least one African stock market has been ranked in the world's top-10 best performing markets every year. However, the global financial crisis, creating gloomy growth prospects worldwide, tighter credit conditions as well as an increase in risk aversion, affected foreign investors' interest in African markets' investment opportunities. Thus, in 2008 there was a fall in foreign direct investment and portfolio equity flows, as well as a sharp fall in equity prices. Moreover, the decrease in private sector credit growth in some countries and the stiffening of domestic banking lending conditions in others impacted negatively the development of the banking sector which is considered as playing a complementary role for stock market development in Africa.

In light of the preceding discussion, it is relevant to pose the following research questions: Does the liberalization of the financial sector impact the performance of stock markets in Sub-Saharan Africa? Could financial liberalization induce the development of stock markets? Hence, the objectives of this paper are to evaluate the degree of financial liberalization in selected Sub-Saharan Africa countries; and to examine the effects of liberalization on the stock markets' performance.

Analyzing the impact of liberalization in the financial sector on the stock markets could contribute to form policy makers' understanding of the right instruments to employ in order to promote the development of security exchanges. Despite, the considerable number of already available studies on the effect of financial liberalization on the development of financial markets in general, there is limited existing literature on the effect of liberalization on the stock market development specifically. Therefore, this paper aims

at contributing to the existing literature by focusing on the development of securities exchanges in the Sub-Saharan African region. More precisely, this analysis will focus on four stock markets in the region, namely, the Nigerian stock exchange, the Nairobi stock market, the Johannesburg stock exchange and the West African stock market [1] (i.e the Bourse Regionale des Valeurs Mobilieres). These four markets, with a total market capitalization of US$ 1174 trillion constitute more than 80 percent of the total market capitalization in the Sub-Saharan African region.

Financial liberalization was not a uniform process across the Sub-Saharan African region. In fact, countries such as South Africa, Mauritius and Senegal were quite early in their embrace of the reforms (as early as 1980), while others such as Sierra Leone, Uganda, Zambia and Zimbabwe were quite late in joining the movement, with liberalization starting in 1991 in Zambia and Zimbabwe, and in 1992 in Sierra Leone and Uganda (Fowowe, 2008). While some undertook many reforms in the same year, others adopted a gradual method to liberalization by implementing only a couple of measures per year. Although most countries took considerable steps towards liberalization since 1980, a great number of them are still found with a low liberalization index in 2014. Additionally, one can argue that the reforms initially adopted have been reversed after they had adverse effects on economic growth and development than what was initially expected, as it was the case in South Africa between 1970 and 1972.

The financial liberalization theory advanced by McKinnon (1973) and Shaw (1973) encourages the removal of interest rate and credit controls, the free mobility of capital in and out of the economy and the opening of domestic capital markets to foreign investors. The argument maintains that this will lead to a rise in savings and investment, and ultimately boost economic growth and financial development. However, the arguments against liberalization stress the importance of policy complementarity, suggesting that liberalization cannot induce development as long as it is not coupled with other macroeconomic policies.

Empirically, a number of studies have been conducted to analyze the effect of financial

[1]The BRVM is a regional stock market serving the eight West African countries comprising the West African Monetary Union and the BCEAO. These countries are: Benin, Burkina Faso, Guinea Bissau, Cote d'Ivoire, Mali, Niger, Senegal and Togo.

liberalization on economic growth and financial development. Although some of the studies uncovered a positive relationship between liberalization and growth, others proved that liberalization measures on their own do not have significant effect on growth and development. In fact, only when these reforms are associated with other macroeconomic variables such as governance and institutional quality, they were found to positively affect growth.

Although the literature on the relationship between financial liberalization and economic growth or financial development in Sub-Saharan Africa is quite rich, there is a lack of studies on the effect of liberalization measures on stock market development. Hence, this study aims at bridging this gap by focusing on the effect of each of the three forms of liberalization (i.e. capital control liberalization, stock market liberalization and financial sector liberalization) on the development of stock markets in Sub-Saharan Africa. Additionally, the majority of the existing studies used cointegration tests and VECM models. In an attempt to explore better tools for this type of analysis, this study will rather make use of the Bayesian VAR, which is a more elaborate than the unrestricted VAR, and especially more appropriate when modelling large datasets. In effect, during the choice of variables, lag length selection, and specification of identification restrictions, the unrestricted VAR scantily makes use of a-priori information. This may lead to overfitting, when there is a large number of parameters, weak sample information or a short data set. Typically, in-sample overfitting leads to poor quality unconditional and conditional (Canova, 2007: 351). These shortcomings can be addressed when using the Bayesian methods, as less dramatic in-sample fitting can be made and out-of-sample performance is improved (Canova, 2007: 351).

The rest of the paper is organized as follows. Section two will describe the evolution of financial liberalization in the region up to date. Section three provides a brief review of the theoretical and empirical literature. Section four discusses the methodology used to conduct the analysis and provides a detailed description of the data. Section five presents the empirical analysis and findings; while the last section provides a conclusion to the paper.

2 Methodology and Data

This study employs the Bayesian VAR (BVAR) that addresses the shortcomings of the unrestricted VAR. The BVAR which was initially developed to improve forecasting in the macroeconomics field, has evolved substantially over the years and is now applied for divers purposes.

The Vector Autoregressive (VAR) models are atheoretical models used to capture and evaluate linear interdependence between time series (Woźniak, 2016). Introduced by Sims (1972), they successfully capture stylized facts about time series such as dynamic linear interdependence, robust autocorrelations at annual frequencies, and the deteriorating pattern in the values of autocorrelations when the lag order increases (Woźniak, 2016). According to Woźniak (2016), the dynamic interdependence between series which is analyzed through the Granger causality hypothesis, is efficiently captured by the VAR, making it a crucial tool for empirical macroeconomic research. With the introduction of an econometric technique named parameter shrinkage, the Bayesian VAR was developed.

Pioneered by Thomas Bayes, the Bayes' theorem was presented as an answer to the inverse probability problem. A simple representation of Bayes' rule is written as:

$$p(\theta|Y) = \frac{p(Y|\theta)p(\theta)}{p(Y)}, \tag{1}$$

where θ is a collection of all the parameters included in the model; Y is the data used for the estimation of the parameters; and p is some probability distribution.

The left-hand side of equation 1 gives the posterior distribution; that is, a conditional distribution of the collection of parameters θ given the data Y. This distribution is a full designation of the information gathered about the parameters of the model after observation of the data (Woźniak, 2016). The first element of the numerator on the right-hand side of equation 1 presents the likelihood function. This is the conditional distribution of the data given the parameters of the model. The second element of the numerator on the right-hand side represents the prior distribution of the parameters θ. This symbolizes the uncertainty about θ before the data is observed; and is outlined as a marginal distribution of θ. The specification of this distribution by an investigator is required, as it is the information about the parameters that is being included in the

statistical inference. When both the prior and the likelihood functions are known for all hypothesis, the exact posterior can be computed using Bayes' formula. However, in most cases the prior probabilities are unknown and they have to be made up as subjective beliefs about the parameters.

In equation 1, the computation of the posterior distribution involves the division of the joint distribution of the data and the parameters by a denominator called the marginal data density (or marginal likelihood in statistics). This is the total probability of the data considering all possible hypotheses, and substantiate the model embodied in the data. The marginal density can be obtained from an integral of the joint distribution of the data and the parameters, with respect to the parameters.

The likelihood function of an m variable VAR(q)

The VAR can be written in two formats:

$$\mathbf{Y} = \mathbf{XA} + \mathbf{E} \tag{2}$$

$$y = (I_m \otimes X)\alpha + ee \sim (0, \sigma_e \otimes I_T) \tag{3}$$

where $\mathbf{Y}$ and $\mathbf{E}$ are Txm matrices; $\mathbf{X}$ is a Txk matrix; $\mathbf{X}_t = [y'_{t-1}, ..., y'_{t-q}, \bar{y}'_t]$; y and e are $mTx1$ vectors; I_m is the identity matrix of dimension m, and $\alpha = vec(\mathbf{A})$ is a $mkx1$ vector.

Based on equation 2, the likelihood function is:

$$L(\alpha, \Sigma_e) \propto |\Sigma_e \otimes I_T|^{-0.5} exp - 0.5(y - (I_m \otimes X)\alpha)'(\Sigma_e^{-1} \otimes I_T)(y - (I_m \otimes X)\alpha) \tag{4}$$

After careful decomposition, equation 4 becomes:

$$\begin{aligned} L(\alpha, \Sigma_e) &\propto |\Sigma_e \otimes I_T|^{-0.5} exp\{-0.5(\alpha - \alpha_{ols})'(\Sigma_e^{-1} \otimes X'X)(\alpha - \alpha_{ols}) \\ &- 0.5[(\Sigma_e^{-0.5} \otimes I_T)y - ((\Sigma_e^{-0.5} \otimes X)\alpha_{ols})'][(\Sigma_e^{-0.5} \otimes I_T)y - ((\Sigma_e^{-0.5} \otimes X)\alpha_{ols})]\} \\ &= |\Sigma_e|^{-0.5k} exp{-0.5}(\alpha - \alpha_{ols})'(\Sigma_e^{-1} \otimes X'X)(\alpha - \alpha_{ols}) \\ &\times |\Sigma_e|^{-0.5(T-k)} exp\{-0.5tr[(\Sigma_e^{-0.5} \otimes I_T)y - ((\Sigma_e^{-0.5} \otimes X)\alpha_{ols})'(\Sigma_e^{-0.5} \otimes I_T)y \\ &- (\Sigma_e^{-0.5} \otimes X)\alpha_{ols}]\} \\ &\propto \mathbb{N}(\alpha|\alpha_o ls, \Sigma_e, X, y) \times \mathbb{W}(\Sigma_e^{-1}|y, X, \alpha_{ols}, T - k - m - 1) \end{aligned} \tag{5}$$

where tr is the trace of a matrix.

From equation 5, it is observed the possibility to decompose the likelihood function of a VAR(q) into the product of a Normal density for α, conditional on its OLS estimate α_{ols} and on Σ_e, and a Whishart density for Σ_e^{-1}, also conditional on α_{ols}, with (T–k–m–1) degrees of freedom and $[(y - (I_m \otimes X)\alpha_{ols})'(y - (I_m \otimes X)\alpha_{ols})]^{-1}$ as a scale matrix.

Consequently, with a combination of the appropriate prior restrictions, the conditional posterior distribution for the VAR coefficients and the covariance matrix of the reduced form shocks can be analytical derived. Under the assumptions of the Normal-Wishart prior, which combines the two blocks of the likelihood, the conditional posterior of Σ_e^{-1} will be Wishart, while the conditional posterior of α will be Normal (Canova, 2007). There also exist other prior assumptions that permit analytical computation of conditional posteriors.

In this analysis, the Minnesota prior was specified. This is a commonly used class of prior distribution. In this case, α and Σ_α are functions of a small number of hyper-parameters (Canova, 2007). Particularly, the assumption of the Minnesota prior is that $\bar{\alpha} = 0$ except for $\bar{\alpha}_{i1} = 1, i = 1, ..., m$; that Σ_a is diagonal, and it also assumes that the $\sigma_{ij,l}$ element that corresponds to lag l of variable j in equation i is of the form:

$$\begin{aligned} \sigma_{ij,l} &= \frac{\phi_0}{h(l)} \text{ if } i = j, \forall l \\ &= \phi_0 \times \frac{\phi_1}{h(l)} \times (\frac{\sigma_j}{\sigma_i})^2 \text{ otherwise when } i \neq j, j \text{ endogenous, } \forall l \\ &= \phi_0 \times \phi_2 \text{ for } j \text{ endogenous.} \end{aligned} \tag{6}$$

In this case, the hyperparameters are ϕ_i, $i = 0, 1, 2$; the scaling factor is $\frac{\sigma_j}{\sigma_i})^2$; and $h(l)$

represents a deterministic function of l. The features of interest are captured in the prior (i.e. equation 6). These are, the tightness of the variance of the first lag as represented by ϕ_0; the relative tightness of the exogenous variables as represented by ϕ_2; and the relative tightness of the variance of lags other than the first one as represented by $h(l)$. Generally, either a harmonic decay $h(l) = l^{\phi 3}$ or a geometric decay $h(l) = \phi_3^{-l+1}, \phi_3 > 0$, is assumed. With $\sigma_i, i = 1, ..., m$ being unknown, equation 6 makes use of consistent estimates of standard errors of the variables i, j.

Canova (2007) explains that the logic of a prior can be understood by noting the fact that the m time series are a-priori characterized as random walks. This is due to the typical appropriateness of univariate random walk models, when forecasting macroeconomic time series. However, while the imposition of the random walk hypothesis is done a-priori, each time series may represent a more complex process a posteriori, if the data contains sufficient information to require it (Canova, 2007).

In dealing with the "curse of dimensionality", restrictions are introduced by the Minnesota prior in a versatile manner, by imposing probability distributions on the coefficients of the VAR, effectively reducing the dimensionality of the issue while simultaneously reasonably accounting for the uncertainty faced by the researcher (Canova, 2007).

2.1 Model Specification

The three measures of financial liberalization that are considered in this model are the capital account liberalization index (CAPLIB), stock market liberalization index (STOCKLIB) and the financial sector liberalization index (FINLIB). The effect of these measures of financial liberalization on stock market development are examined including a stock market development index (DEVINDEX) and two control variables, namely inflation (INF) and investment (INV). When examining the effect of each of these forms of liberalization in isolation for the four selected markets, the BVARs estimated can be written as three systems of four equations of the form:

$$y_{i,t} = A(L)y_{i,t-1} + C\bar{y}_{i,t} + e_{i,t},\ e_{i,t} \sim (0, \Sigma_e) \tag{7}$$

where

$$y_{i,t} = \begin{bmatrix} DEVINDEX_{i,t} \\ CAPLIB_{i,t} \\ INF_{i,t} \\ INV_{i,t} \end{bmatrix}, \text{ for country } i \text{ in Model 1;}$$

$$y_{i,t} = \begin{bmatrix} DEVINDEX_{i,t} \\ STOCKLIB_{i,t} \\ INF_{i,t} \\ INV_{i,t} \end{bmatrix}, \text{ for country } i \text{ in Model 2;}$$

and

$$y_{i,t} = \begin{bmatrix} DEVINDEX_{i,t} \\ FINLIB_{i,t} \\ INF_{i,t} \\ INV_{i,t} \end{bmatrix}, \text{ for country } i \text{ in Model 3.}$$

After the stationarity tests have been run and the models estimated, the impulse-response functions and variance decompositions are estimated.

2.2 Data and descriptive statistics

The data sample consist of quarterly values of the variables included in the model for different time periods specific to each country considered. The difference in the period covered by the data samples stems from the unavailability of data in some of the countries. The sample period for each country is given in Table 1. Moreover, the study focuses on four Sub-Saharan African stock markets namely the Nigeria Stock Exchange, the Nairobi Stock Exchange, the Johannesburg Stock Exchange and la Bourse Regionale des Valeurs Mobilieres (BRVM).

To examine the relationship between financial liberalization and the development of stock markets, the study employs three indicators of stock market development, as defined in Levine and Zervos (1998) These are size, liquidity and volatility. The market size (SIZE) is measured by the market capitalization ratio, and is calculated by dividing the value of listed shares by the GDP. Market liquidity is measured using both the value

traded ratio (VTR) and the market turnover ratio (MTR). Volatility in the market is measured as a 12-month rolling standard deviation estimate based on the daily returns of the All share index. The data for these variables was collected from the Federal Reserve of St Louis database and the World Bank's World Development Indicators (WDI) database. A simple average of the values of the four indicators of financial liberalization are used to construct an overall index of stock market development (DEVINDEX).

The rate of inflation is measured by the percentage change in the consumer price index; and the level of investment is measured by the ratio of gross fixed capital formation to GDP. Quarterly values of the CPI were collected from the IMF International Financial Statistics database, while annual values of the gross fixed capital formation/GDP were collected from the World Bank's WDI database.

The Chinn-Ito index is used to represent capital account openness and is used in this study as a measure of capital account liberalization (CAPLIB). This index introduced by Chinn and Ito (2006) measures a country's degree of capital account openness and is based on the binary dummy variables that codify the tabulation of restrictions on cross-border financial transactions reported in the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions (Chinn and Ito, 2006). The financial sector liberalization index (FINLIB) is extracted from the New Database of Financial Reforms constructed by Abiad, Detragiache and Tressel (2009). The index takes into account seven different dimensions of financial sector policy, namely credit controls and excessively high reserve requirements, interest rate controls, barriers to entry into the financial system of new domestic banks or other potential competitors, state ownership in the banking sector, financial account restrictions, prudential regulations and supervision of the banking sector, and securities market policy. For each dimension included, a final score on a graded scale from zero to three is given, where 0=fully repressed, 1=partially repressed, 2=partially liberalized, 3=fully liberalized. After equal weight is assigned to each dimension, the final scores for all dimensions are added to get the aggregate index for each country for every year. The index then takes values between 0 and 21.

These two indexes that are presented in annual frequency have been transformed into quarterly frequency using information on the specific reforms dates provided by the IMF

Annual Report on Exchange Arrangements and Exchange Restrictions. Moreover, the Abiad, *et al.* (2009) database only provides data up to 2005. Thus, information from the IMF AEAER and central bank reports was used to extend the dataset until 2014.

Furthermore, the stock market liberalization index (STOCKLIB) was built following the same methodology as Abiad, *et al.* (2009). Four dimensions of stock market liberalization were included in the index. These are: local purchase of equity by non-residents, equity sales or issue locally by non-residents, purchase of equity abroad by residents and equity sale or issue abroad by residents. A final score on a graded scale from 0 to 3 is given to each dimension; and the final scores for all dimensions are added to get the aggregate index for each country for every year. Because the index includes only four dimensions, it then takes values between 0 and 12.

Additionally, due to the unavailability of the required stock market development data in higher frequency than annual, an interpolation method had to be used to transform the datasets from annual to quarterly frequency. This was done to avoid the issues that the study could encounter when using a sample that is too small. The method used for the interpolation is Newton's method with divided differences. Since interpolating high degree polynomials with such volatile data as financial data is usually difficult, each interpolated point was constrained to the bounds of known values (i.e. the annual values).

Table 1 gives a summary of the descriptive statistics of the six variables included in the models for every country. The table shows statistics such as the mean, maximum, minimum, standard deviation for the six datasets for each market.

While Nigeria is seen to rank among the top 2 markets in terms of stock market development (DEVINDEX), financial sector liberalization (FINLIB) and Stock market liberalization (STOCKLIB), it has the lowest average level of real investment and the highest level of inflation for the sample period. Moreover, the six variables exhibit substantial variability both across indicators within the same country and across countries, with high standard deviations reported for all indicators during the sample periods. The highest standard deviation was seen in the stock market development index for South Africa.

Table 2 presents the correlations and the corresponding p-values of the six variables

Table 1: Descriptive statistics

Panel A: WAEMU

	DEVINDEX	INF	INV	FINLIB	CAPLIB	STOCKLIB
Mean	7.750	0.946	11.473	13.269	-1.066	4.923
Maximum	15.517	4.899	19.277	14.000	-0.126	8.000
Minimum	1.442	-2.339	8.253	7.750	-1.189	0.000
Std Deviation	4.290	2.159	2.857	1.689	0.341	3.633
Period covered	1989Q1 - 2014Q4					

Panel B: SOUTH AFRICA

	DEVINDEX	INF	INV	FINLIB	CAPLIB	STOCKLIB
Mean	51.265	2.328	21.131	13.744	-1.294	5.675
Maximum	116.342	6.137	32.103	19.250	-0.126	10.000
Minimum	19.594	-1.196	15.150	3.000	-1.895	0.000
Std Deviation	23.864	1.274	4.796	5.268	0.484	3.463
Period covered	1975Q1 - 2014Q4					

Panel C: NIGERIA

	DEVINDEX	INF	INV	FINLIB	CAPLIB	STOCKLIB
Mean	9.894	4.582	10.557	14.731	-1.094	8.346
Maximum	22.151	22.296	16.555	18.000	-0.597	11.000
Minimum	1.589	-4.682	5.459	8.750	-1.895	1.000
Std Deviation	5.327	5.473	3.258	3.237	0.581	3.780
Period covered	1989Q1 - 2014Q4					

Panel D: KENYA

	DEVINDEX	INF	INV	FINLIB	CAPLIB	STOCKLIB
Mean	8.982	3.146	18.184	12.583	0.308	7.146
Maximum	19.522	17.401	21.386	15.500	1.091	9.000
Minimum	2.627	-3.287	15.388	6.750	-1.895	4.000
Std Deviation	4.384	3.691	1.852	3.073	1.241	1.914
Period covered	1989Q1 - 2012Q4					

Source: Author's estimations

for each market considered. As can be observed from Table 2, stock market development is negatively related to inflation and positively related to STOCKLIB and FINLIB in all four markets. While in the WAEMU and Kenya, DEVINDEX is also positively related to investment, it is the opposite in South Africa and Nigeria where it is negatively related. In almost all the markets, inflation is negatively related to all three forms of liberalization, except in the WAEMU, where there is a significantly positive correlation between inflation and CAPLIB. Investment is also negatively related to all three forms of liberalization in all markets except in the WAEMU where there is significantly positive relationship between investment and CAPLIB. The next section will present the empirical analysis conducted and will give the interpretation of the findings.

Table 2: Correlations and p-values

Panel A: WAEMU

VARIABLES	DEVINDEX	INF	INV	CAPLIB	FINLIB	STOCKLIB
DEVINDEX	1.000					
INFLATION	-0.083	1.000				
	(0.399)					
INVESTMENT	0.520	0.008	1.000			
	(0.000)	(0.939)				
CAPLIB	-0.076	0.411	0.140	1.000		
	(0.446)	(0.000)	(0.157)			
FINLIB	0.552	0.146	0.374	0.050	1.000	
	(0.000)	(0.138)	(0.000)	(0.6173)		
STOCKLIB	0.583	-0.179	0.095	-0.492	0.592	1.000
	(0.000)	(0.069)	(0.339)	(0.000)	(0.000)	

Panel B: SOUTH AFRICA

VARIABLES	DEVINDEX	INF	INV	FINLIB	CAPLIB	STOCKLIB
DEVINDEX	1.000					
INFLATION	-0.556	1.000				
	(0.000)					
INVESTMENT	-0.511	0.407	1.000			
	(0.0000)	(0.0000)				
FINLIB	0.855	-0.568	-0.777	1.000		
	(0.000)	(0.000)	(0.000)			
CAPLIB	0.205	-0.408	-0.102	0.251	1.000	
	(0.009)	(0.000)	(0.201)	(0.001)		
STOCKLIB	0.879	-0.568	-0.707	0.973	0.217	1.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	

Panel C: NIGERIA

VARIABLES	DEVINDEX	INF	INV	FINLIB	CAPLIB	STOCKLIB
DEVINDEX	1.000					
INFLATION	-0.312	1.000				
	(0.001)					
INVESTMENT	-0.313	-0.028	1.000			
	(0.001)	(0.779)				
FINLIB	0.638	-0.482	-0.127	1.000		
	(0.000)	(0.000)	(0.199)			
CAPLIB	0.590	-0.475	-0.017	0.930	1.000	
	(0.000)	(0.000)	(0.865)	(0.000)		
STOCKLIB	0.620	-0.440	-0.219	0.939	0.922	1.000
	(0.000)	(0.000)	(0.025)	(0.000)	(0.000)	

Panel D: KENYA

VARIABLES	DEVINDEX	INF	INV	FINLIB	CAPLIB	STOCKLIB
DEVINDEX	1.000					
INFLATION	-0.043	1.000				
	(0.679)					
INVESTMENT	0.425	-0.001	1.000			
	(0.000)	(0.996)				
CAPLIB	0.317	-0.330	-0.104	1.000		
	(0.002)	(0.001)	(0.313)			
FINLIB	0.482	-0.336	-0.068	0.929	1.000	
	(0.000)	(0.001)	(0.507)	(0.000)		
STOCKLIB	0.468	-0.346	-0.158	0.889	0.952	1.000
	(0.000)	(0.001)	(0.125)	(0.000)	(0.000)	

Note: p-values in parenthesis

Source: Author's estimations

3 Empirical Analysis and Findings

The unit root test disclosed that almost all the variables are $I(1)$ at the 1 percent level of significance, for all four markets. Only FINLIB for the WAEMU, as well as INF in the WAEMU, South Africa and Kenya, were found to be $I(0)$ at the 1 percent level of significance. Based on the arguments by Sims (1980) and Sims, Stock and Watson (1990), the study made use of the variables in levels as the analysis aimed to capture the dynamic responses of non-policy variables as a result of unexpected shocks in the policy variables. They argued that, if the end-purpose of the analysis is to capture the dynamic responses of non-policy variables as a result of unexpected shocks in the policy variables, there is no issue in incorporating the non-stationary variables in levels (Sims, 1980; Sims, Stock and Watson, 1990). In that case, when estimating the impulse response functions, the shocks can be identified by using the Cholesky decomposition method where a recursive structure is imposed on the model. An alternative option would be to identify the policy shocks through the imposition of theory-backed restrictions on the contemporaneous relationships between the variables under consideration in the model. Hence, the crucial dynamic relationships between variables are well captured when using non-stationary variables in level form in the VAR model, thus providing valuable insights on policy analysis. Therefore, the non-stationary variables was used in level form throughout this study.

3.1 Model 1: Capital account liberalization and stock market development

The model used to examine the effect of capital account liberalization on stock market development for each market considered is referred to as Model 1 and will include four variables, namely DEVINDEX, INF, INV and CAPLIB, for each market. Finally, the impulse functions and variance decompositions are estimated. For all four markets the optimal lag order was found to be 1. Thus in the four cases, BVAR(1) models were estimated. A Minnesota/Litterman prior is specified in all cases, with univariate AR as the initial residual covariance matrix, degrees of freedom correction, and hyper-parameters

$\mu = 0$, $\lambda_1 = 0.1$, $\lambda_2 = 0.99$ and $\lambda_3 = 1$.

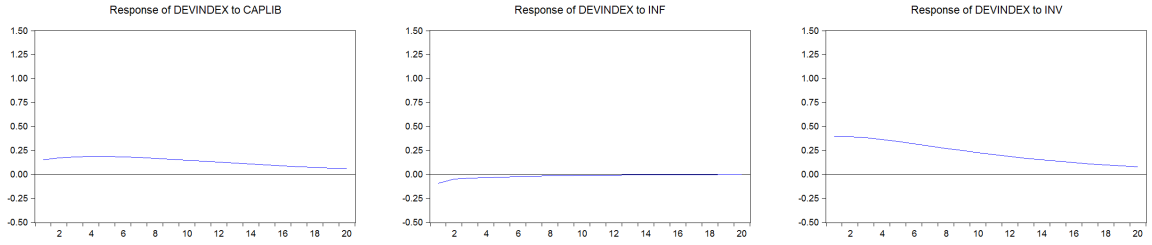
The impulse response functions reveal the responsiveness of the non-policy variable (i.e. the dependent variable) to a shock (i.e. a one-unit increase) to a policy variable (i.e. the independent variable). Since the objective of Model 1 is to identify the effect of capital account liberalization on stock market development, only the functions of the response of DEVINDEX to a shock to each of the other three variables (i.e. CAPLIB, INF and INV) will be presented. Moreover, the impulse definition included a Cholesky decomposition with the ordering set as $\begin{bmatrix} CAPLIB \\ INF \\ INV \\ DEVINDEX \end{bmatrix}$. This Cholesky ordering assumes that CAPLIB has a contemporaneous effect on INF, INV, and DEVINDEX but the reverse does not apply. Similarly, INF has a contemporaneous effect on INV and DEVINDEX but the reverse does not apply; and INV has a contemporaneous effect on DEVINDEX but the reverse does not apply.

Figure 1 presents the impulse response functions for Model 1 for the four stock markets considered. From the figure, it can be seen that a unit shock to CAPLIB produces similar responses of DEVINDEX in Nigeria and Kenya. In effect, there is a negative response of DEVINDEX in the first quarter after the shock occurred. Although the response was considerably small, it increases in subsequent periods and become positive by the third quarter. Up to the 20th quarter, the response stays positive but gets closer to zero. In the WAEMU, although the immediate response of DEVINDEX to a shock to CAPLIB is positive, has similar trend to the one observed in Nigeria and Kenya, as the response remains positive and approaching zero by the 20th quarter. In that market, the positive response of the development index is also considerably small, being less than 0.25 percent.

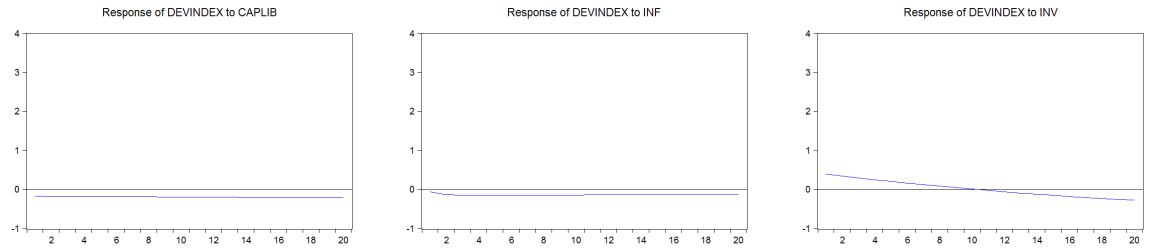
Conversely, DEVINDEX in South Africa has an opposite response to a one-unit increase in CAPLIB. The response in the first quarter is considerably small (less than 1 percent) and negative. It remains constant and negative even after the 20th quarter. In all four markets, the response of DEVINDEX to a unit shock to INF is considerably small, hence insignificant. Interestingly, a unit shock to investment in Nigeria produces an initial negative response of the stock market development index, which progressively becomes more negative until the 9th quarter, and subsequently approaches zero. While

Figure 1: Impulse-response functions for Model 1

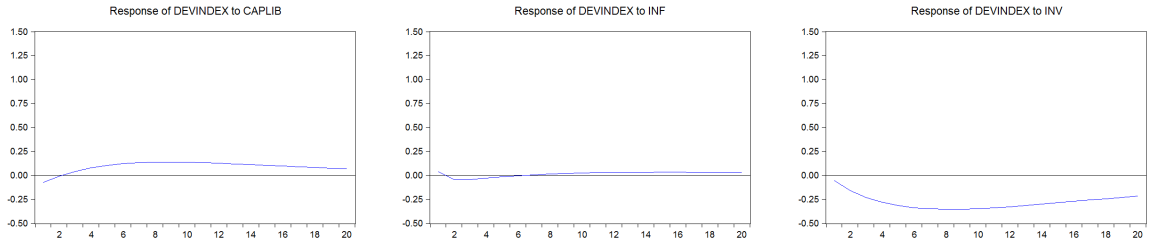
A- WAEMU



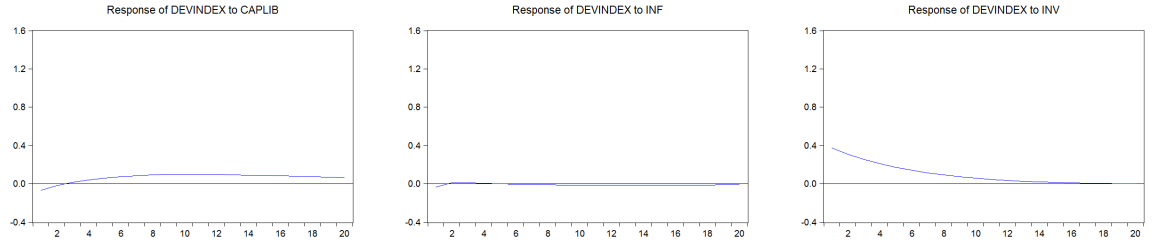
B- SOUTH AFRICA



C- NIGERIA



D- KENYA



Source: Author's estimations

in the other three markets, the initial response of DEVINDEX to a unit shock to INV is positive, it subsequently decreases, reaching a negative value in South Africa by the 20th quarter; reaching the value of zero in Kenya by the 15th quarter; and closely approaching zero in the WAEMU by the 20th quarter.

The variance decomposition was estimated from Model 1 for each of the markets to get more insight about the actual value of each policy variable in explaining stock market development. Table 3 summarizes the results. There is some evidence that innovations in INV are relatively important in explaining the variations in the DEVINDEX in the WAEMU, Nigeria and Kenya. In the WAEMU, it represents 7.3 percent of the variance decomposition of DEVINDEX in the first quarter, 13.6 percent in the 10th quarter and 14.9 percent in the 20th quarter; in Nigeria, 0.16 percent in the first quarter and 17.73 percent in the 20th quarter; and in Kenya, 7.66 percent in the first quarter, 6.29 percent in the 10th quarter and 5.94 percent in the 20th quarter. However, innovations in INF are relatively insignificant in explaining the variations in DEVINDEX at less than 0.5 percent between the 1st and 20th quarter for all four markets; while innovations to CAPLIB have a small, yet increasing, part in explaining variations in DEVINDEX, at lessthan 5 percent for the WAEMU, Nigeria and Kenya; and less than 0.5 percent in the case of South Africa.

3.2 Model 2: Stock Market liberalization and stock market development

In this case, the model is referred to as Model 2 and will also include DEVINDEX, INF, INV, as in Model 1, and the liberalization index considered here which is STOCKLIB, for each market. Then, the impulse functions and variance decompositions are estimated.

For three of the markets, i.e. WAEMU, South Africa and Nigeria, the optimal lag order was found to be 1. In the case of Kenya, the AIC, SC and HQ chose different lag orders. However, because the SC is known to be more parsimonious when estimating the coefficients, one lag order selected by the SC will be used for Kenya. Thus, in all four cases, BVAR(1) models with the same Minnesota prior and hyperparameters specification as Model 1 were estimated in Model 2.

Again, only the impulse response functions of the response of DEVINDEX to a shock

Table 3: Variance Decomposition for Model 1

Panel A: WAEMU

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	CAPLIB
1	1.470	91.207	0.399	7.329	1.070
10	2.818	82.543	0.210	13.580	3.667
20	2.919	80.333	0.201	14.941	4.525

Panel B: SOUTH AFRICA

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	CAPLIB
1	3.504	98.420	0.025	1.300	0.255
10	10.384	99.019	0.173	0.491	0.317
20	13.765	98.960	0.192	0.446	0.401

Panel C: NIGERIA

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	CAPLIB
1	1.440	99.523	0.064	0.158	0.262
10	2.845	87.715	0.099	10.821	1.365
20	3.076	79.839	0.176	17.731	2.254

Panel D: KENYA

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	CAPLIB
1	1.343	92.030	0.063	7.660	0.247
10	2.608	92.932	0.027	6.289	0.752
20	2.698	92.322	0.048	5.944	1.686

Source: Author's estimations

to each of the other three variables (i.e. STOCKLIB, INF and INV) are presented. Moreover, the impulse definition in this model also included a Cholesky decomposition with the ordering set as $\begin{bmatrix} STOCKLIB \\ INF \\ INV \\ DEVINDEX \end{bmatrix}$.This Cholesky ordering assumes that STOCKLIB has a contemporaneous effect on INF, INV, and DEVINDEX but the reverse does not apply. Similarly, INF has a contemporaneous effect on INV and DEVINDEX but the reverse does not apply; and INV has a contemporaneous effect on DEVINDEX but the reverse does not apply.

Figure 2 depicts the impulse response functions for Model 2 for the four markets considered in the study. From the figure, it is interesting to see that the response of DEVINDEX to a unit shock to STOCKLIB generally follows the same trend in all four stock markets. The initial response is negative, although it immediately increases and stays positive and high (i.e. around 1 percent) in the case of South Africa, even after the

Table 4: Variance Decomposition for Model 2

Panel A: WAEMU

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	STOCKLIB
1	1.474	90.084	0.000	9.860	0.055
10	2.612	71.533	0.198	22.105	6.164
20	2.823	64.549	0.178	24.527	10.747

Panel B: SOUTH AFRICA

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	STOCKLIB
1	3.543	98.894	0.009	1.021	0.076
10	9.254	94.471	0.106	1.164	4.259
20	11.777	89.866	0.180	0.791	9.163

Panel C: NIGERIA

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	STOCKLIB
1	1.438	99.717	0.049	0.198	0.036
10	2.834	88.883	0.153	9.759	1.204
20	3.047	80.804	0.231	16.564	2.401

Panel D: KENYA

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	STOCKLIB
1	1.354	92.987	0.086	6.527	0.400
10	2.573	91.893	0.047	6.320	1.740
20	2.681	90.268	0.066	5.871	3.794

Source: Author's estimations

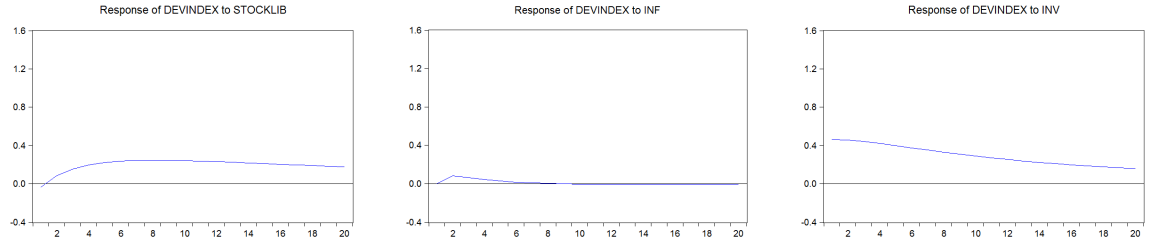
20th quarter where it is still persistent. In the case of the WAEMU, Nigeria and Kenya, the response is not as persistent, and approaches zero by the 20th quarter. Noticeably, the response of DEVINDEX to a unit shock to STOCKLIB in the WAEMU is considerably higher than the response of the development index to CAPLIB in Model 1.

Similar to Model 1, the response of DEVINDEX to a unit shock to INF is insignificant, for all markets; while there is an initial negative response of DEVINDEX to a unit shock to investment in Nigeria. The progressively becomes more negative until the 9th quarter, and subsequently approaches zero. In Kenya, the WAEMU and South Africa, the initial response of DEVINDEX to a unit shock to INV is positive, but subsequently decreases. It reaches a negative value in South Africa by the 20th quarter; the value of zero in Kenya by the 15th quarter; and closely approaches zero in the WAEMU by the 20th quarter.

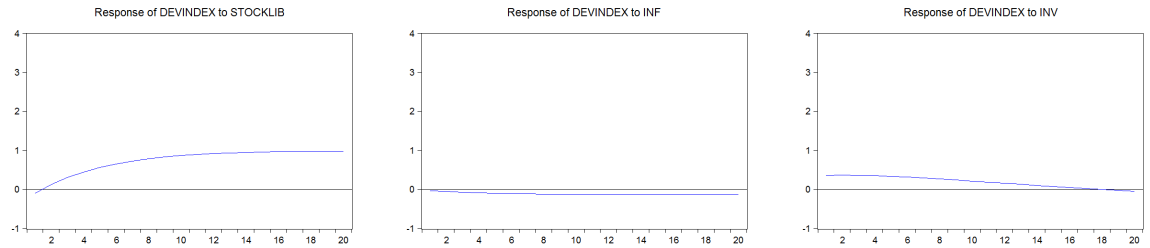
In this model, innovations to INF are still insignificant in explaining the variations in

Figure 2: Impulse-response functions for Model 2

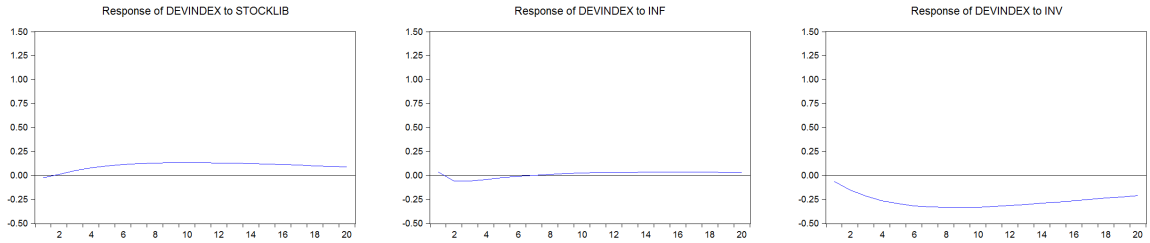
A- WAEMU



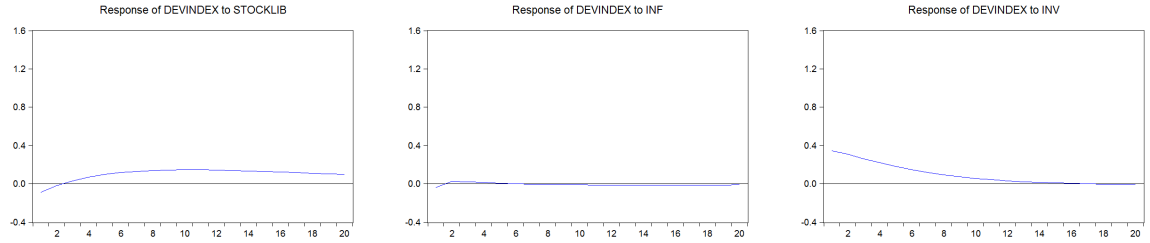
B- SOUTH AFRICA



C- NIGERIA



D- KENYA



Source: Author's estimations

DEVINDEX, for all four markets. In all four cases, however, innovations to STOCKLIB get relatively more important in the variance decomposition of DEVINDEX over time. Although in all cases, it is less than 0.5 percent in the 1st quarter , it increases over time reaching 10.7 percent, 9.2 percent, 3.8 percent and 2.4 percent in WAEMU, South Africa, Kenya and Nigeria, respectively, in the 20th quarter. Interestingly, in this model, innovations to INV are more significant in the variance decomposition of DEVINDEX in the WAEMU, at 24.5 percent in the 20th quarter.

3.3 Model 3: Financial sector liberalization and stock market development

The analysis of the effect of financial liberalization on stock market development using the Bayesian VAR method is referred to as Model 3 and will include four variables, that are the same three included in the Model 1 and 2 (i.e. DEVINDEX, INF, INV) and the liberalization index FINLIB, for each market. The optimal lag order selection criteria for Model 3 for the four countries selected one as the optimal lag order for South Africa and Nigeria. For Kenya, both the SC and the HQ also selected lag order 1, while the AIC selected lag order 2. In the case of the WAEMU, the AIC, SC and HQ chose different lag orders. However, because the SC is known to be more parsimonious when estimating the coefficients, lag order 1 selected by the SC will be used for the WAEMU. Thus, in all four cases, BVAR(1) models were estimated as Model 3, specifying a similar Minnesota/Litterman prior to the first two models.

Similar to the first two model, the impulse definition in this model also included a Cholesky decomposition with the ordering set as $\begin{bmatrix} FINLIB \\ INF \\ INV \\ DEVINDEX \end{bmatrix}$. The assumption of this Cholesky ordering is that FINLIB has a contemporaneous effect on INF, INV, and DEVINDEX but the reverse does not apply; INF has a contemporaneous effect on INV and DEVINDEX but the reverse does not apply; and INV has a contemporaneous effect on DEVINDEX but the reverse does not apply.

The impulse response functions for Model 3 for the four markets considered in the study are depicted in Figure 3. From the figure, it can be seen that while in both South Africa and Kenya, the initial response of DEVINDEX to a one unit increase in FINLIB

Table 5: Variance Decomposition for Model 3

Panel A: WAEMU

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	FINLIB
1	1.472	90.866	0.137	8.995	0.001
10	2.511	82.388	0.144	13.008	4.460
20	2.589	78.717	0.146	13.358	7.778

Panel B: SOUTH AFRICA

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	FINLIB
1	3.542	98.512	0.013	0.995	0.479
10	9.211	95.990	0.074	1.860	2.076
20	11.593	92.998	0.112	1.485	5.405

Panel C: NIGERIA

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	FINLIB
1	1.444	98.934	0.126	0.146	0.795
10	2.782	84.684	0.061	10.817	4.437
20	3.002	75.517	0.118	18.449	5.916

Panel D: KENYA

Variance Decomposition of DEVINDEX:					
Period	S.E.	DEVINDEX	INF	INV	FINLIB
1	1.352	91.829	0.002	6.291	1.877
10	2.484	91.732	0.162	6.589	1.516
20	2.572	89.622	0.179	6.266	3.933

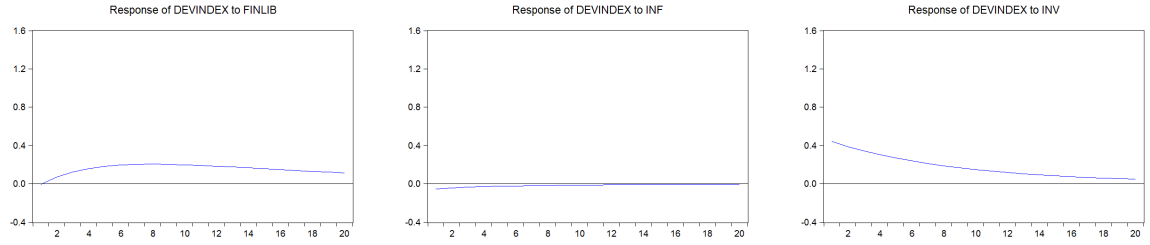
Source: Author's estimations

is negative; the initial response of DEVNDEX was null in the WAEMU and positive in Nigeria. In subsequent periods, the response in all markets increased and stayed positive after the 20th period. Noticeably, the response of DEVINDEX to FINLIB in Kenya only becomes positive after the 4th quarter and stays constant even after the 20th quarter. The same persistence is also seen in South Africa; while in the WAEMU and Nigeria, the response gets closer to zero by the 20th quarter. The response of DEVINDEX to INF and INV is similar to Model 2, for all four markets.

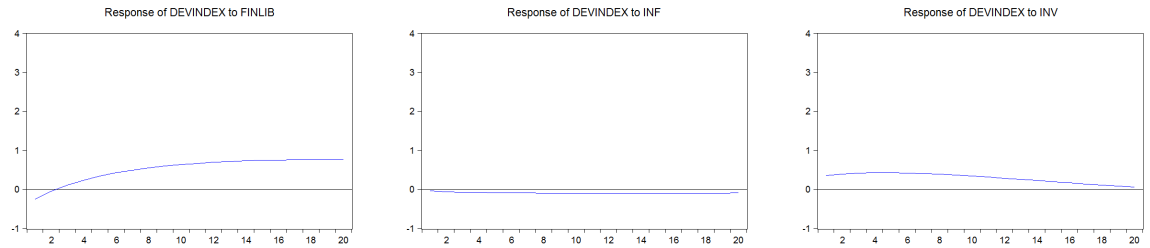
This model also confirms the insignificance of innovations in INF in explaining variations in DEVINDEX for all four markets. Innovations in FINLIB are more significant than innovations in CAPLIB in explaining variations in DEVINDEX for all the stock markets considered. Like in Model 2, the proportion of FINLIB in the variance decomposition of DEVINDEX increases over time, but it is still lower than the proportion of

Figure 3: Impulse-response functions for Model 3

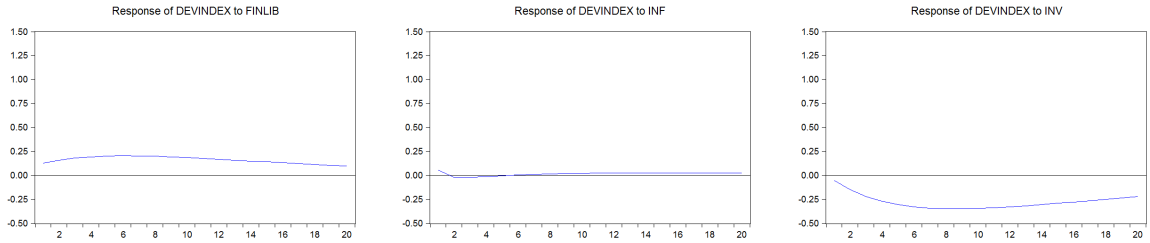
A- WAEMU



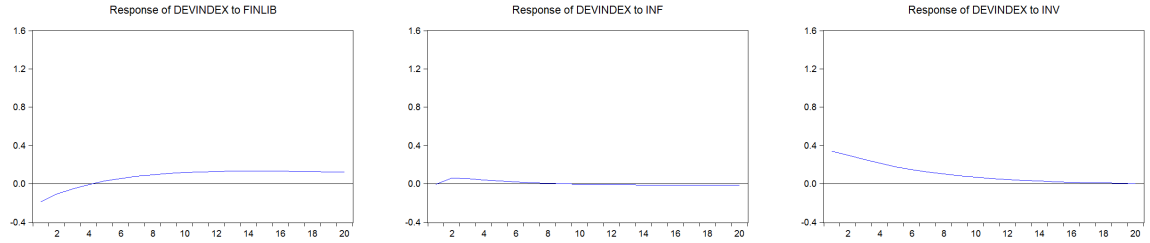
B- SOUTH AFRICA



C- NIGERIA



D- KENYA



Source: Author's estimations

STOCKLIB in Model 2. Innovations in INV are, in this case, still the most important of the three variables, in explaining variations in DEVINDEX, in all markets, except South Africa where the proportion of FINLIB exceeds INV in the 20th quarter.

The initial response of the stock market to capital account liberalization is found to be small and negative in Nigeria and Kenya. This could be explained by the initial adverse reaction from domestic investors in these countries who may be encouraged to move their domestic investments to other markets perceived as more profitable. In effect, the integration of segmented markets through liberalization and the elimination of differential risk across markets would immediately entice local investors to redirect their interest to other markets, as can be observed in South Africa where a shock to capital account liberalization lead to a constant and negative response of stock market development . However, due to the low participation rate of domestic investors in these markets, the adverse effects of the initial capital outflow from these stock markets will be offset in the long-run by the stronger participation from foreign investors who would create capital inflow in the market. This could be the case in the BRVM from the initial shock as the market may be mainly dominated by foreign investors.

Stock market liberalization has a more direct impact on stock markets by opening them to foreign participation. In all of the markets under consideration the liberalization of the stock market improved their market capitalization and turnover ratios, hence their positive response to stock market liberalization. The persistence of the positive response of the markets, especially in South Africa speaks to the potential long lasting effect of stock market liberalization policies. With the continuous interest of global investors in Sub-Saharan African equities for both their high returns and their portfolio risk diversification opportunities, increased stock market liberalization should lead to a continuously greater stock market development.

Lastly, financial sector liberalization has an indirect effect on stock market development by improving the mobilization of savings, the channeling of capital into the most appropriate sectors of the economy and the amount of investment. By removing direct

credit controls, liberalizing interest rate, denationalizing banks, and strengthening prudential regulations, investors are encouraged by the availability of cheaper credit into investing more on the stock markets. This seems to be the case in to happen in the long run in all four markets as their response to a shock to financial liberalization becomes and stays persistently positive in the long run. However, similarly to the case of a shock to capital account liberalization, there is a varying trend in the initial response of the markets. In both South Africa and Kenya, the initial response of stock market development to a shock to financial sector liberalization is negative. This is a puzzling result especially in the case of South Africa whose financial sector is considered as more developed and sophisticated by international standards, compared to the other three markets. However, coupled with the high level of integration between the market and more developed ones, a shock to financial sector liberalization, such as relaxation of credit controls and interest rate deregulation that increase the real rate of interest, may have an adverse initial impact on stock market development due to an increase in the pre-disposition to save and a loss of risk adverse investors' confidence in the domestic banking sector and financial stability of the country. In the WAEMU, the delayed response of stock market development to a shock to financial liberalization may be attributed to its relatively small size and relative isolation from other more developed markets. It may take global investors, who have the higher rate of participation in this market, a little delay to redirect their funds to the market.

4 Conclusion and Recommendations

The main objective of this study was to investigate the relationship between liberalization in the financial sector and the development of stock markets in Sub-Saharan Africa. This study focused on four stock markets, which together constitute more than 80 percent of the total market capitalization in the Sub-Saharan African region. These are the Nigerian stock exchange, the Nairobi stock market, the Johannesburg stock exchange and the West African stock market (i.e. the Bourse Regionale des Valeurs Mobilieres). Moreover, the study looked at three separate dimensions of financial liberalization: capital

account liberalization, stock market liberalization and financial sector liberalization. Due to unavailability of data, different sample periods were used for each of the stock markets considered.

The data sample consisted of quarterly values of the variables included in the model for different time periods specific to each country considered. The variables used in the models were the stock market development index, the capital account liberalization index, stock market liberalization index, financial liberalization index, as well as two control variables (i.e. Inflation and Investment). A preliminary analysis of correlation among the variables showed that stock market development is negatively related to inflation and positively related to stock market liberalization and financial liberalization in all four markets. While in the WAEMU and Kenya, stock market development is also positively related to investment, it is the opposite in South Africa and Nigeria where they are negatively related. In almost all the markets, inflation is negatively related to all three forms of liberalization, except in the WAEMU, where there is a significantly positive correlation between inflation and capital account liberalization. Investment is also negatively related to all three forms of liberalization in all markets except in the WAEMU where there is a significant positive relationship between investment and capital account liberalization.

Moreover, in both Nigeria and Kenya, stock market development initially responded negatively to an increase in capital account liberalization. Although the response quickly becomes and stays positive, it starts dying out by the fifth year. Besides a positive yet considerably small initial response of stock market development to capital account liberalization in the WAEMU, the subsequent trend is similar to Nigeria and Kenya. An opposite response was observed in South Africa, with a small negative initial response of stock market development, which remains constant and negative. Innovations in investment are relatively more important in explaining the variations in stock market development in most markets than innovations to capital account liberalization that have a small, yet increasing, part in explaining variations in stock market development.

Additionally, stock market development was found to respond positively to a shock to stock market liberalization, in the long run, in all four stock markets. While in

South Africa, this effect was relatively high and persistent. In the case of the WAEMU, Nigeria and Kenya, the response was not as persistent, and started dying out by the fifth year. In the WAEMU particularly, stock market development responded more strongly to stock market liberalization than it did to capital liberalization. This is confirmed by the variance decomposition which showed that, in all four cases, innovations to stock market liberalization become relatively more important in explaining the variations in stock market development over time.

Furthermore, although the initial responses of stock market development to an increase in financial sector liberalization varied across markets, it subsequently becomes positive and persistent in most cases. Innovations in financial sector liberalization are more significant than innovations in capital account liberalization in explaining variations in stock market development for all the stock markets considered.

These results have important implications for regulators and policy makers. Firstly, the existence of negative correlation between stock market development inflation in all four markets suggests that policy makers in these countries should pay special attention to inflation targeting policies in order to positively contribute to enhancing the markets. Secondly, the positive correlation found between stock market development and the liberalization of stock markets and the financial sector in all four countries also advocate for the opening of financial markets to international investors, as well as the deepening of the sector. Additionally, this is confirmed by the positive long-run response of stock market development to all three forms of liberalization in all the markets considered. More emphasis should therefore be put on improving financial openness process and removing of the restrictions in the financial sectors of the respective economies, as this will contribute to boosting the effectiveness of the deliverance of credit to the private sector, efficient credit evaluation and public sector surveillance, which is provided through the stock market.

Due to the unavailability of high frequency data for most of the variables selected and in most of the countries considered, annual values of the data had to be used with Newton's method of interpolation to create a dataset in quarterly frequencies. This could have affected the robustness of the results, and has increased the risk of data mining.

Thus, the results of these analyses should be interpreted with caution.

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