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Stock Market Development and Economic Growth in Sudan (1995-2009): Evidence from Granger Causality Test

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Abstract

This study examines the causal relationship between stock market development and economic growth for the Sudanese economy based on time series data for the period 1995-2009. The study uses the Granger causality approach based on the classical unit root tests. It provides a theoretical basis for establishing the channel through which stock markets affect economic growth in the long run. The empirical results of the study show that the causal relationship between stock market development and economic growth is sensitive to the proxy used for describing the stock market development. When the stock market capitalization is used, the results indicate a bidirectional causal relationship between stock market development and economic growth. However, when the stock market liquidity is used, the results show unidirectional causal relationship from economic growth to stock market development. The overall conclusion is that, Granger causality test results suggest that stock market development in Sudan leads to economic growth at least for the period under study, which is in line with the 'supply leading' hypotheses.

***Keywords*:** Stock Market Development, Economic Growth, Unit Root, Causality Test, Sudan

Introduction

Over the last few decades, economists have devoted considerable attention to the study of the relationship between financial markets development and economic growth[1], at both theoretical and empirical levels, the focus is mainly on stock market development and economic growth. Levine and Zarkos (1998) argued that various measures of stock market development have explained part of the variation of economic growth. The idea that financial markets may be related with economic growth is not new, but the view of this relationship has changed over time. Gurley and Shaw (1955) were the first to study the relationship between financial markets and economic growth. They argued that one of the differences between developed and a developing country is that the financial system is more developed in the former. The argument was that

[1] Financial markets provide a vital link between saving and investment. Their effectiveness and efficiency can positively influence the volume and quality of investment, an important determinant of economic growth.

financial markets could extend a borrower's financial capacity and improve the efficiency of trade. With well-developed financial markets investors can be provided with the necessary funds for their projects. They concluded that financial markets contribute to economic development through enhancing physical capital accumulation.

Empirical investigations of the link between financial development in general and stock markets in particular and growth have been relatively limited in the case of Sudan. For example, saef (2008) investigates the relationship between financial sector development and economic growth in Sudan for the period 1970-2005; based on Granger causality test he finds evidence of causality between finance and growth in the long run. In this paper, we explore the relationship between stock market development and economic growth in Sudan for the period 1995 - 2009. More specifically, the study will explore the following questions: First, does the stock market lead the real economy, in the sense that variation in its past values explains some of the variation in the real economy? Second, does the stock market "Granger-cause" the real economy, in which case past values of stock prices improve the prediction of future economic activity? And third, does the real economy "Granger-cause" the stock market, in that past values of economic activity improve the prediction of the stock market?

Sudan has experienced sustained and consistent growth over the years. The Stock Market of Sudan is fairly new, established in 1995. We use two measures of stock market development namely SIZE and LIQUIDITY. SIZE is denoted as market capitalization as a percentage of GDP. The assumption behind this measure is that overall market size is positively correlated with the ability to mobilize capital and diversify risk on an economy-wide basis. LIQUIDITY is calculated as value of shares traded on the stock market exchange divided by GDP. The total value traded ratio measures the organized trading of firm equity as a share of national output and therefore should positively reflect liquidity on an economy-wide basis. The total value traded ratio complements the market capitalization ratio: although a market may be large, there may be little trading. In an attempt to explore the existence of a causal relationship between stock market development and economic growth, the study hypotheses that there is a significant relationship between stock market development and economic growth in Sudan economy over the period 1995 - 2009.

The remainder of this paper is organized as follows. Section 2 presents a brief overview of the literature. Theoretical issues about financial development and economic growth will be displayed in section 3, and we present a brief overview of the structure of Sudan Economy and outlining main features of financial sector in Sudan in sections 4 and 5 respectively. The data and methodology issues are described in section 6. Section 7 depicts the estimation results and we conclude in section 8.

Literature Review

The growing importance of stock market around the world has reinforced the belief that finance is an important ingredient for growth. The focus is mainly on stock market development and economic growth. There have been a lot of empirical studies dealing with this relationship; in this section we will briefly mention some of these empirical works.

The idea that finance matters for growth in the early stages of economic development goes back to Patrick (1966), Cameron (1967) and Goldsmith (1969). In his study, Goldsmith (1969) establishes the important stylized fact that periods of above average rates of economic growth tend to be accompanied by faster financial development. King and Levine (1993) document a robust relationship between initial levels of financial development and subsequent economic growth across 80 countries, after controlling for other growth-inducing factors. Their measures

of financial development are based on the degree of monetization and bank development. Rousseau and Sylla (2001) also employ a cross-country regression framework to make the case for finance-led growth. They use a long data set (1850-1997) for the US, the UK, Japan, France, Germany, and the Netherlands. Atje and Jovanovic (1993) test the hypothesis that the stock markets have a positive impact on growth performance. They find significant correlations between economic growth and the value of stock market trading divided by GDP for 40 countries over the period 1980-1988. Similarly, Levine and Zervos (1996, 1998) and Singh (1997) show that stock market development is positively and robustly associated with long-run economic growth. Levine and Zervos (1998) conduct a similar analysis for 48 countries and for the period 1976- 1993, but focus on the role played by the stock market. They measure stock market development along various dimensions: size, liquidity, international integration and volatility. More precisely their measures are aggregate stock market capitalization to GDP and the number of listed firms (size), domestic turnover and value traded (liquidity), integration with world capital markets, and the standard deviation of monthly stock returns (volatility). The results suggest a strong and statistically significant relationship between initial stock market development and subsequent economic growth. Including stock market liquidity, stock market capitalization and bank intermediation jointly as regressors yields a separate and significant influence on the rate of economic growth for each of them. This suggests that banks and stock markets play somewhat different roles in the process of economic development. Furthermore, using data from 44 industrial and developing countries from 1976 to 1993, Demirguc-Kunt and Levine (1996a) investigate the relationships between stock market development and financial intermediary development. They find that countries with better-developed stock markets also have better-developed financial intermediaries. Thus, they conclude that stock market development goes hand-in-hand with financial intermediary development. Hansson and Jonung (1997) investigate the case of Sweden from 1830 to 1991. In a bivaraite system, they find that bank development is cointegrated with per capita GDP for the entire period 1834-1991, but the relationship is unstable over time. Banking has the strongest influence on the real economy in the interval 1890-1939 and to a lesser extent in the period 1834-1890. Rousseau and Wachtel (1998) compare the US, the UK, Canada, Norway and Sweden for the period 1870-1929. This comparative 5 country study uses the same methodology to study tri-variate systems of GDP, the monetary base and financial intensity, measured by the value of the financial sector's assets. The authors find a single cointegration relationship between the three variables under examination, suggesting persistent co-movements between finance and growth. Demetriades and Hussein (1996) and Van Nieuwerburgh (1998) apply cointegration analysis to a mixed sample of developing and developed countries for the postwar era. Financial development variables, which are bank-based, are cointegrated with economic development. In both studies, the direction of causality varies across countries and depends on the measure of financial development used.

Financial Development and Economic growth: Theoretical Issues

The Role of the Financial Sector in an Economy

The main reason why an efficient financial system is essential to an economy is that there are substantial information and transactions costs. Asymmetric information creates adverse selection and moral hazard, and high transactions costs impose inefficiencies (Valeriano and Lin, 1999). By specializing in collecting information, evaluating projects, sharing risks, and providing liquidity, an efficient financial system increases financial savings, and improves their allocations across investments. Consequently, financial intermediation increases capital productivity, and promotes economic growth. There are three main channels through which financial

intermediaries and markets may affect economic growth. First, a developing financial sector makes room for increasing saving rates. By using economies of scale and expertise, financial intermediaries and markets are able to provide savers with a relatively higher yield, and therefore stimulate savings. A lot of literature has shown the role played by financial intermediaries and markets in increasing savings. For example, McKinnon (1973) and Shaw (1973) emphasize the role played by financial liberalization in increasing savings and, hence, investment. They claim that financial deepening improves not only productivity of capital but also the saving rate and, therefore, investment and growth. Second, by reducing information and transactions costs, the financial intermediaries and markets perform the essential economic function of increasing the funneling of funds from lenders to borrowers. For example, Gurley and Shaw (1955, 1960 and 1967) stress the importance of financial intermediation in channeling savings to investment. Third, the financial sector improves the allocation of resources. A recent line of research argues forcefully that financial development enhances growth by promoting an efficient allocation of investment through various mechanisms: (1) fund pooling, that is, making large investment projects possible and lending cheaper; (2) risk diversification, that is, reducing productivity and default risks by holding diversified portfolios; (3) liquidity management, that is, providing liquidity to investment projects; (4) screening, that is, gathering and evaluating information on projects to channel funds to the most profitable ones; (5) monitoring, that is, disciplining borrowers' performance to make sure they fulfill their commitments. A well functioning financial system improves resource allocation through these mechanisms.

Stock Market and Economic Growth

In principle, the stock market is expected to accelerate economic growth by providing a boost to domestic savings and increasing the quantity and the quality of investment (Singh, 1997).The stock market is expected to encourage savings by providing individuals with an additional financial instrument that may better meet their risk preferences and liquidity needs. Better savings mobilization may increase the savings rate (Levine and Zervos, 1998). Stock markets also provide an avenue for growing companies to raise capital at lower cost. In addition, companies in countries with developed stock markets are less dependent on bank financing, which can reduce the risk of a credit crunch. Stock markets therefore are able to positively influence economic growth through encouraging savings amongst individuals and providing avenues for firm financing. The stock market is supposed to ensure through the takeover mechanism that past investments are also most efficiently used. Theoretically, the threat of takeover is expected to provide management with an incentive to maximize firm value. The presumption is that, if management does not maximize firm value, another economic agent may take control of the firm, replace management and reap the gains from the more efficient firm. Thus, a free market in corporate control, by providing financial discipline, is expected to provide the best guarantee of efficiency in the use of assets. Similarly, the ability to effect changes in the management of listed companies is expected to ensure that managerial resources are used efficiently (Kumar, 1984). Efficient stock markets may also reduce the costs of information. They may do so through the generation and dissemination of firm specific information that efficient stock prices reveal. Stock markets are efficient if prices incorporate all available information. Reducing the costs of acquiring information is expected to facilitate and improve the acquisition of information about investment opportunities and thereby improves resource allocation. Stock prices determined in exchanges and other publicly available information may help investor make better investment decisions and thereby ensure better allocation of funds among corporations and as a result a higher rate of economic growth. Stock market liquidity is

expected to reduce the downside risk and costs of investing in projects that do not pay off for a long time. With a liquid market, the initial investors do not lose access to their savings for the duration of the investment project because they can easily, quickly, and cheaply, sell their stake in the company (Bencivenga and Smith, 1991). Thus, more liquid stock markets could ease investment in long term, potentially more profitable projects, thereby improving the allocation of capital and enhancing prospects for long-term growth. It is important to point out, however, that, theory is ambiguous about the exact impacts of greater stock market liquidity on economic growth. By reducing the need for precautionary savings, increased stock market liquidity may have an adverse effect on the rate of economic growth (Charles and Charles, 2007).

The Direction of Causality between Financial Development and Economic Growth

It is now well recognized that financial development is crucial for economic growth. However, the relationship can go the other direction. In other words, economic growth can also promote financial development. Recent literature on growth deals with this causal relationship along three lines: (1) financial development stimulates economic growth; (2) economic growth promotes the development of the financial sector; and (3) a circular relationship that financial development and economic growth simultaneously affect each other. Below we briefly discuss these three types of causal relationships. First, *financial development causes economic growth.* Some analyses suggest that financial development has a causal influence on economic growth. That is, deliberate creation of financial institutions and markets increases the supply of financial services. The financial sector increases savings, and allocates them to more productive investments. Thereby financial development can stimulate economic growth. For example, findings in McKinnon (1973), Shaw (1973), and King and Levine (1993a, b, c) support this hypothesis. Second, *economic growth causes financial development.* Some analyses postulate a causal relationship from economic growth to financial development. This hypothesis stresses the passive role of the financial system. In this view, financial development appears as a consequence of the overall economic development. Continual economic expansion requires more financial services and new instruments. The financial system adapts itself to the financing needs of the real sector and fits in with its autonomous development. Therefore, this type of financial development plays a rather passive role in the growth process. For example, Gurley and Shaw (1967) and Goldsmith (1969) show that, economic growth propels financial development. Third, *the reciprocal relationships.* This third view stresses the reciprocal relationship between financial development and economic growth. Economic growth makes the development of financial intermediation system profitable, and the establishment of an efficient financial system permits faster economic growth. By specializing in fund pooling, risk diversification, liquidity management, project evaluation and monitoring, the financial system improves the efficiency of capital allocation and increases the productive capacity of the real sector. At the same time, the technological efficiency of the financial sector increases with its size, because economies of scale and learning-by-doing effects are present in financial intermediation activities. As a result, the real sector can exert a positive externality on the financial sector through the volume of savings. Therefore, financial development and economic growth positively influence each other in the process of development. In reality, the financial and real sectors interact during all stages of development. In other words, there is, at no stage, only a one-way relationship between financial development and economic growth. Thus, more and more authors prefer describing the relationship as a two-way causation now. So far, many empirical studies have demonstrated the existence of a positive correlation between financial development and economic growth. However, these studies do not always establish the direction of the causality between these two

variables, and those that do seek to identify the direction of the causality often lead to ambiguous conclusions (Charles and Charles, 2007).

Can the Stock Market Predict Economic Activity?

The question of whether the stock market can predict the economy has been widely debated. Those who support the market's predictive ability argue that the stock market is forward-looking, and current prices reflect the future earnings potential, or profitability, of corporations. Since stock prices reflect expectations about profitability, and profitability is directly linked to economic activity, fluctuations in stock prices are thought to lead the direction of the economy. If the economy is expected to enter into a recession, for example, the stock market will anticipate this by bidding down the prices of stocks. The "wealth effect" is also regarded as support for the stock market's predictive ability. Pearce (1983) argues that since fluctuations in stock prices have a direct effect on aggregate spending, the economy can be predicted from the stock market. When the stock market is rising, investors are wealthier and spend more. As a result, the economy expands. On the other hand, if stock prices are declining, investors are less wealthy and spend less. This results in slower economic growth.

The Structure of Sudan Economy

Agriculture is the main economic activity in Sudan where different types of crops are grown like cotton, and cereals like wheat, sorghum and durra, oil seeds such as groundnuts, sesame, and sunflower beside gum Arabic. In addition to that there is a large grazing land over which cattle, sheep, camels and goats breeding activities took place. Industries like sugar, chemical and food manufactories, and textile are also found in some parts of the country. The structure of Sudan economy moreover consists of a service sector; education, health and other government services and other activities can be found like construction and transport. In the late 1990s oil was discovered in some parts of the country, and it is now accounted for a significant share of national output. Table 1 gives the contribution of each sector in Sudan's GDP during 1970 to 2005:

Table 1: Shares of Economic Sectors in Sudan's GDP (%).

Period	1970/75	1975/80	1980/85	1985/90	1990/95	1995/00	2000/05	2005/09
Agriculture	36.3	35.7	32.6	35	39.2	36.8	36.0	31.1
Petroleum	-	-	-	-	-	1.1	6.9	7.2
Electricity and Water	2.7	1.4	1.2	1.5	1.1	2.2	2.2	2.4
Construction	7.2	9.4	10.5	9.6	7	3.0	2.7	3.2
Government Services	14.3	9.3	9	5.9	4.1	9.6	9.4	13.7
Other Mining and Manufacturing	9.7	8.5	8.2	7.5	5.8	9.5	10.1	11.0
Other Services	29.8	35.7	38.6	40.6	42.8	37.8	32.7	31.4
Total	100	100	100	100	100	100	100	100

Source: Central Bureau of Statistics

In the late 1990s petroleum has emerged and changed the structure of Sudan economy, it contributed by about 1.1 % of the total GDP in the period of 1995/00 and by about 7.2% of the GDP during the period 2005/09. Sudan is a low income country with a volatile growth. Throughout the period 1970 -2009 the country's GDP was growing at low rates, GDP growth rate was negative in many years and positive and low in some other years.

Overview of the Financial Sector in Sudan

Financial Institutions in Sudan

The financial sector in Sudan operates based on Islamic banking and financing principles[2]. The four principles governing this system are the absence of interest-based transactions *(riba)*; the avoidance of economic activities involving speculation *(ghirar)*; the introduction of an Islamic tax, (*zakat*); and the discouragement of the production of goods and services that are inconsistent with Islamic values *(haram)*. The financial sector is a collection of various institutions, markets, individuals, laws and regulations. According to Subrata 1983, the financial sectors in LDCs are divided into organized sector and unorganised sector. The co-existence of organized and unorganized sector is termed "the financial dualism." Sudan as one of these countries has the same experience of financial dualism.

The Organized Financial Sector

The financial institutions forming the organised sector are the central bank, commercial and specialised banks, finance companies, security firms, pension funds and insurance companies. The first institution in Sudan's organised financial sector is the central bank.

The Unorganized Financial Sector

Sudan has an unorganised financial sector which consists of money lenders, merchants and land lords as well as friends and relatives and several smaller microfinance institutions. This unorganized sector is flexible in loan transactions with personal and informal dealings among customers and simple system of maintaining accounts and joining together money lending with other economic activities.

The activities of the financial sector in Sudan since its nationalisation in 1969 were subject to many government regulations. In 1984 Sudan started to introduce elements of Islamic banking (interest rate free banking system). By the year 1992, Sudan's financial sector was completely built on Islamic principles.

Khartoum Stock Exchange

Established of Khartoum Stock Exchange

The idea of establishing a securities market in the Sudan was first mooted in 1962; an Act for a securities market was passed in 1982, and in 1990 serious step was taken to bring the idea to fruition within the framework of the required liberalization policies of the time. In November 1992 the Council of Ministers approved an amendment of the Securities Market Act of 1982. A new Act was prepared to establish the Khartoum Stock Exchange and was passed by the Transitional National Assembly in June 1994, after which the Khartoum Stock Exchange finally became an independent legal entity. Work on the Primary Market (or Issue Market) started on 10 October 1994; and at the beginning of 1995 the Secondary Market (where shares are traded) was started.

[2] For a detailed discussion of the Islamic banking and financing principles and its practices see for example: El-Gamal (2006) and Ayub (2007).

Objectives of Khartoum Stock Exchange

The Exchange operates on the basis of the directives of Islamic *Sharia*. Its objectives include:

- The organization and supervision of the issue of securities.
- Encouraging saving by ordinary citizens and raising capital for public companies.
- Promoting and encouraging investment in securities.
- Creating the necessary investment environment.
- Establishing a code of conduct and fairness among the various investors.
- Guaranteeing equal opportunities for those dealing in securities in order to protect small investors.

Data and Methodology

Data Measurement

The study focuses on Sudanese economy spanning over a period of fifteen years (1995-2009). Any study on stock market development should preferably be based on daily (or monthly) frequency, given the dynamic nature of the market. But given the fact that monthly GDP figures in Sudan are not available, the study will therefore based on annual observations. The variables which will be included in our estimation are as follows:

- Economic development is measured by the growth rate of real GDP at constant prices (base year: 1990 = 100).
- Stock market development is measured by two proxies: real market capitalization ratio (*size proxy*) defined by the ratio of market capitalization to real GDP, and real value traded ratio (*liquidity proxy*) defined by the ratio of trading volume to real GDP.

The data set on stock market was obtained from Khartoum Stock Exchange (KSE) primary publications, and the data on growth rate of real GDP obtained from Bank of Sudan annual reports.

Unit Root Test

There are several reasons why the concept of non-stationarity is important. A stationary series have a constant mean, constant variance and constant auto covariance for each given lag. Many factors can make the series non- stationary. In particular, seasonal affects, trend, shocks and so on can cause a non- stationary series. Time series should be separated from all these effects to make a correct evaluation with correct models. Stationarity could be achieved by appropriate differencing and this appropriate number of differencing is called order of integration. If some series are non- stationary, differences should be taken until series will be stationary at some level. If a non-stationary series, Y_t must be differenced one times before it becomes stationary, then it is said to be integrated of order (1).This would be written as Y_t ~ I(1). So if Y_t ~ I(1) ,then $\Delta^d Y_t$ ~ I(0). This latter piece of terminology states that applying the difference operator Δ, 1 times, leads to I (0) process, a process with no unit roots. One of the methods to test whether series is stationary or not is Dickey-Fuller (DF) (1979), DF test is very important in terms of measuring which degree stationary series have, but it does not consider an autocorrelation in disturbance term. If disturbance term contains autocorrelation, DF test is invalid. In this situation, by adding lagged terms of dependent variable to explanatory variable, Generalized Dickey Fuller (Augmented Dickey-Fuller) is used. The Augmented Dickey-Fuller (ADF) unit root test is used for this purpose. The ADF regression equations are:

$$\Delta Y_t = \delta Y_{t-1} + \sum_{j=1}^{P} \gamma_j \Delta Y_{t-j} + \varepsilon_t \quad \ldots\ldots(1)$$

$$\Delta Y_t = \alpha_0 + \delta Y_{t-1} + \sum_{j=1}^{P} \gamma_j \Delta Y_{t-j} + \varepsilon_t \quad \ldots\ldots(2)$$

$$\Delta Y_t = \alpha_0 + \alpha_1 t + \delta Y_{t-1} + \sum_{j=1}^{P} \gamma_j \Delta Y_{t-j} + \varepsilon_t \quad \ldots\ldots(3)$$

Where Y_t is our variable of interest, Δ is the differencing operator, *t* is the time trend and ε is the white noise residual of zero mean and constant variance. $\{\alpha_0, \alpha_1, \delta, \gamma_1, ..., \gamma_p\}$ is a set of parameters to be estimated. Both of the null and alternative hypotheses in unit root tests are:

$H_0 : \delta = 0$ (Y_t is non-stationary)

$H_1 : \delta \neq 0$ (Y_t is stationary)

The unit root hypothesis of the Dickey-Fuller can be rejected if the t-test statistic from these tests is negatively less than the critical value tabulated. In other words, by the Augmented Dickey Fuller (ADF) test, a unit root exists in the series Y_t (implies nonstationarity); the null hypothesis of δ equals zero is not rejected (Gujarati 1995).

Granger Causality Test

Granger causality is used for testing the long-run relationship between stock market development and economic growth. The Granger procedure is selected because it consists the more powerful and simpler way of testing causal relationship (Granger, 1986). Granger's operational causality definition depends on two hypotheses. First, next cannot be reason of past. Certain causality is possible only with past causes present time or future time. Cause is always to be come true before the result. In addition, this makes time lagged between causes and results. Second, causality can be determined only stochastic process. It is not possible to determine the causality between two deterministic processes. Granger test states that, if past values of a variable Y significantly contribute to forecast the value of another variable X then Y is said to Granger cause X and vice versa. The test is based on the following regressions:

$$y_t = \beta_0 + \sum_{k=1}^{M} \beta_k y_{t-k} + \sum_{l=1}^{N} \alpha_l x_{t-l} + \mu_t \quad \ldots\ldots(4)$$

$$x_t = \gamma_0 + \sum_{k=1}^{M} \delta_k y_{t-k} + \sum_{l=1}^{N} \gamma_l x_{t-l} + \nu_t \quad \ldots\ldots(5)$$

Where y_t and x_t are the two variables, μ_t and ν_t are mutually uncorrelated error terms, *t* denotes the time period and *'k'* and *'l'* are the number of lags. The null hypothesis is $\alpha_l = 0$ for all *l*'s and $\delta_k = 0$ for all *k*'s versus the alternative hypothesis that $\alpha_l \neq 0$ and $\delta_k \neq 0$ for at least some *l*'s and *k*'s. If the coefficients α_l's are statistically significant but δ_k's are not, then *x* causes *y*. In the reverse case, *y* causes *x*. But if both α_l and δ_k are significant, then causality runs both ways. In our case, we have to bivaraite models to be estimated, these are:

Model 1: Stock Market Capitalization (Size) and Economic Growth

$$growth_t = \beta_0 + \sum_{k=1}^{M} \beta_k growth_{t-k} + \sum_{l=1}^{N} \alpha_l CAP_{t-l} + \mu_t \quad \ldots\ldots(6)$$

$$CAP_t = \beta_0 + \sum_{k=1}^{M} \beta_k CAP_{t-k} + \sum_{l=1}^{N} \alpha_l growth_{t-l} + \mu_t \quad \ldots\ldots(7)$$

Model 2: Stock Market Liquidity and Economic Growth

$$growth_t = \beta_0 + \sum_{k=1}^{M} \beta_k growth_{t-k} + \sum_{l=1}^{N} \alpha_l LIQ_{t-l} + \mu_t \quad \ldots\ldots(8)$$

$$LIQ_t = \beta_0 + \sum_{k=1}^{M} \beta_k CAP_{t-k} + \sum_{l=1}^{N} \alpha_l growth_{t-l} + \mu_t \quad \ldots\ldots(9)$$

Empirical Results

Tests of Stationarity (Unit Root Tests)

The tests for unit roots are closely related to the investigation of stationarity (or nonstationarity) in a time series. As mentioned earlier, unit root test like Augmented Dickey-Fuller (ADF) is employed to check the stationarity of the selected variables. The test is applied to both the original series and to the first differences. Further, both the models with and without trend are tried. The truncation lag parameters are determined following Schwartz's (1987). The results are reported in Table 2.

Table 2. Unit Root Tests of Stationarity of selected variables

	In levels		In first differences	
Variables	ADF_{τ_C}	ADF_{τ_T}	ADF_{τ_C}	ADF_{τ_T}
GROWTH	-2.21 (0)	-1.82 (1)	-3.37***(2)	-4.70**(0)
CAPITALIZATION	4.85*(0)	3.63***(0)	-	-
LIQIDITY	-0.64(2)	-2.78(0)	-4.23**(0)	-3.88***(0)

Notes:

1- τ_c and τ_t are the test statistics for the ADF tests with allowance for only constant and constant & trend terms in the unit root tests, respectively.
2-* ,** ,*** denotes the rejection of the unit root null hypothesis for the 1%, 5%10 ,% respectively.
3- The numbers in parentheses are the lags used for the ADF test, which are augmented up to a maximum of 3 lags.
4- The choice of optimum lag for the ADF test was decided on the basis of minimizing the Schwarz information criterion.

The results in Table 2 suggest that the capitalization variable is stationary, that is, I(0). On the other hand, each of the remaining two variables has a unit root, but the first difference of each is stationary, so that they can be characterized as I (1), i.e. integrated of order 1.

Granger Causality Results

Based on the results of the integration order determination, we proceed with testing for Granger causality. The results of Granger causality for Equations 6, 7, 8 and 9 are represented in Table 3.

Table 3. Pairwise Granger Causality Test Results:

Null Hypothesis	Wald F-Statistic	Probability	Lag
Economic Growth does not Granger Cause Stock Market Capitalization	5.3419	0.0278	3
Cause Stock Market Capitalization does not Granger Cause Economic Growth	4.6413	0.0431	2
Economic Growth does not Granger Cause Stock Market Liquidity	4.9471	0.0025	2
Stock Market Liquidity does not Granger Cause Economic Growth	1.3124	0.9621	5

The empirical results reported in Table 3 show that there is a long run bidirectional causal relationship from stock market capitalization to economic growth and vice versa. On the other hand, there is a unidirectional causal relationship from economic growth to stock market liquidity.

Conclusion

The present paper makes an attempt to explore the causal relationship between stock market development and economic growth in the Sudan economy for the period 1995 – 2009. The study primarily revolved around two major questions: *first* whether at all any relationship exists between stock market development and economic growth and *secondly*, what could be the nature and direction of the causal relationship, if any i.e. does development of stock market promote economic growth or vice versa? To test this hypothesis, we employ the methodology of *Granger –causality.* The two important indicators for stock market development variables included in the study are market capitalization ratio (*size proxy*), and real value traded ratio (*liquidity proxy*). Real GDP growth rate is used as a proxy for economic development. The main findings of the paper are that the causal relationship between stock market development and economic growth is sensitive to the proxy used for describing the stock market development. When the stock market capitalization is used, the results indicate a bivaraite causal relationship between stock market development and economic growth. However, when the stock market liquidity is used, the results show unidirectional causal relationship from economic growth to stock market development. The overall conclusion is that, Granger causality test results suggest that stock market development in Sudan leads to economic growth at least for the period under study, which is in line with the 'supply leading' hypotheses.

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