Financial Intermediation and Economic Growth in Sudan: An Empirical Investigation, 1970-2011

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Author's contribution

Author SASA carried out the whole work without the help of any one.

ABSTRACT

This paper investigates empirically the long-run relationship and short-run dynamic linkages between financial development and economic growth in Sudan during the period 1970- 2011. The study employs the autoregressive distributed lag (ARDL) approach to co-integration. The analysis is carried out using three indicators to measure the level of financial developments which are the ratio of the credit provided to private sector by commercial banks as a percentage of GDP, the ratio of liquid liabilities of commercial banks to nominal GDP and the broad money supply as a percentage of GDP. We also include four control variables in our analysis. These variables are inflation rate, trade openness, gross investment and government expenditures. As financial development indicators concerned, the result of the long run analysis indicates that credit to the private sector and the liquid liabilities exert positive effect while money supply affect real per capita GDP negatively. The credit to the private sector and the liquid liabilities coefficients have expected signs. Although the relation between financial development indicators and real per capita GDP is low and insignificant especially in the case of liquid liabilities and money supply, credit to the private sector is the only indicator that affects the economy in Sudan in the long-run. Although we could not find any short-run relationship between the explanatory variables and real per capita GDP in Sudan, these variables are found to be related in the long-run. The results indicate that government expenditure, inflation, money supply and trade openness exert negative effects, while investment, private credit and liquidity have positive effect on real per capita GDP. These findings may be attributed to the weak capital base of Sudanese banks, the high cost of borrowing due to insufficient inter-bank competition, the risk of extending credit to sectors other than trade, which is considered by banks as unjustifiably high and the absence of an appropriate investment

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climate required to foster significant private investment and promote growth in the long run.

1. INTRODUCTION

Financial markets play a significant role in the growth of the real economy by channeling funds from savers to borrowers in an efficient way to facilitate investment in physical capital and spur innovation and the creative destruction process. Also, the effectiveness of economic policy is positively associated with how well financial markets work. Through their actions, financial intermediaries increase efficiency in many ways for example by decreasing leakages in savings, by allowing the development of longer term projects with higher returns or by allowing risk sharing. All these effects have been shown to have a positive impact on growth at the macroeconomic level. There are many empirical findings that support the argument that development in financial markets has a positive impact on economic performance in any economy.

However, despite the major role that the financial sector plays in the process of growth and development, its role remains quite limited in many developing countries, especially in Sub-Saharan African countries (SSA). This is due to the fact that, the financial sector in most countries remains highly fragmented and inefficient, protected from competition or is highly segmented and regulated. Moreover, financial systems in most SSA countries are dominated by a small number of banks that command heavy markets power, which undermine the efficient allocation of resources [1].

Historically, Sudan's financial system has been characterized by heavy government interventions and regulations, centralized lending by the central bank to public enterprises, absence of indirect monetary policy instruments, lax bank supervision and an inadequate accounting system. According to [2], the Sudanese banks still remain very small even by the modest international standard as compared with Islamic banks in other countries.

Like many developing countries, the Sudanese financial sector is still young and underdeveloped following years of repression, political and economic instability upheld by long chronic civil war. The government embarked upon policies to reform the sector. As part of its economic and structural adjustment program, the government has adopted a comprehensive package of financial policy reforms in the early 1990s. The claimed objective is to create better business environment through relaxing some of the financial sector restrictions, modernize the financial sector to cope with the new achievements in the banking industry and to build more efficient financial market to promote economic growth through a more efficient allocation of credit. Therefore, it becomes imperative to examine the impact of the improvements in financial intermediation on economic growth in Sudan.

Although the size of the banking sector is important for growth, its efficiency in resource allocation is even more important in that respect. As such, the small size of the banking sector in Sudan does not preclude an examination of its intermediary role in growth. This is particularly the case in a small economy where resource mobilization through non-banking institutions becomes a formidable task.

Given the very small number of studies that test the relationship between financial intermediation and economic growth in Sudan compared to the voluminous literature in US, Europe and other emerging economies the major objective of this study is to partially fill this knowledge gap. More specifically, this paper investigates empirically the long-run relationship and short-run dynamic linkages between financial development and economic growth in Sudan during the period 1970- 2011. The study employs the autoregressive distributed lag (ARDL) approach to co-integration. The analysis is carried out using three indicators to measure the level of financial developments. The first indicator is the ratio of the credit provided to private sector by commercial banks as a percentage of GDP. The second indicator of financial intermediation is the ratio of liquid liabilities of commercial banks to nominal GDP. Broad money supply as a percentage of GDP is the third indicator which is a standard measure of financial depth and an indicator of the overall size of financial intermediary activity. We included four control variables in our analysis. These variables are inflation rate, trade openness, gross investment and government expenditures. This work is different from previous study of [1] Sudan in two things; first, this study uses the most up-to-date data (1970-2011) to empirically examine the relationship between financial intermediation and the growth of the economy. Second, this study uses three financial development indicators, as mentioned above, while [1] uses only two indicators, credit provided to private sector by commercial banks as a percentage of GDP and broad money supply as a percentage of GDP. Other objective of the present study is to investigate the impact of the formal financial sector reform on economic issues in Sudan. Different economic and financial indicators are separately discussed to measure how far Sudan has benefited from the reform policy. In this study we are going to question whether financial development, in the sense of deregulated environment can be expected to act as "engine of growth" in the development process.

We find that among financial development indicators, credit to the private sector is the only indicator that affects the economy in the long run. Although we could not find any short-run relationship between the explanatory variables and real per capita GDP in Sudan, they are related in the long-run.

The rest of the paper is organized as follows: Section (2) discusses the issues of finance and growth addressed in the literature. Section (3) provides some background about the Sudanese economy and its banking sector. Section (4) discusses the research methodology, including model specification and methods of analysis. The main results of the paper are contained in section (5). Finally, section (6) contains our concluding remarks.

2. LITERATURE REVIEW

Theoretical disagreements do exist about the role of financial systems in economic growth. Some economists see the role as significant while others see it as minor. At the theoretical level.

There are four channels in which financial intermediaries promote economic growth through efficient allocation of resources. First, the financial intermediaries act as fund-transferring mechanisms to channel the excess fund from surplus units to deficit units. Second, financial intermediaries will offer more attractive and innovative instruments and incentives to encourage the mobilization of savings, which in turn may promote higher saving rates. Third, financial institutions lower their costs of project evaluation and origination through economies of scale, and facilitate the monitoring of projects via corporate governance. Finally, as institutions which operating at economies of scale and obtain symmetry information, financial

intermediaries provide opportunities to reduce risk management and promote liquidity level by promoting the development of markets and instruments with attractive characteristics that enable risk-sharing [3].

The significant role of financial development, however, has begun to receive considerable attention in the growth process. In his work, [4] concluded that the well-functioning financial system will spur technological innovations through the efficiency of resource allocation from unproductive sector to productive sector. This idea was viewed as the first framework in analyzing the finance-led growth hypothesis. In contrast, [5] argued that the relationship should be started from growth to finance. According to this thought, a high rate of economic growth leads to a high demand for particular financial arrangement, and the well-developed financial sector will automatically respond to these types of demand. This view was defined recently as growth-led finance hypothesis.

Several empirical studies have attempted to test the relationship between financial intermediation and economic growth since the work of [6]. Using data from 35 countries between 1860 and 1963 he examined the correlation between financial intermediation and economic growth and argued that a rough parallelism can be observed between economic and financial development if periods of several decades are considered. Similarly, [7,8,9] reported close association between financial development and economic growth in a number of countries. Moreover, the evidence presented by [10,11] has also given support to [6,7,8]. In an earlier work, [12] have proved the effect of financial repression on economic growth taking a sample of 21 developing countries. They have found a significant positive relationship between real GDP growth rate and the interest rate dummy variable for the1971-1980 period. Confirming previous results, [13] used cross-sectional and pooled data for 74 countries and found robust evidence that financial development and depth lead to an improved growth performance. [14] analyzed a larger number of countries (one hundred and nine countries from 1960 to 1994) and on pooled data employed the Geweke decomposition test. They reached the same result that financial development generally leads to economic growth. In contrast to [14], but on a sample of ten developing countries from 1970 to 2000, [15] found that long-run causality runs from financial development to economic growth they do not found any short-run causality between financial deepening and output. [16] obtained the opposite result in terms of the time perspective. The most skeptical view of the importance of finance and growth can be found in papers written by [17,18]. The first revealed that there is little evidence that financial development leads to economic growth in the eleven countries in his sample (from 1985 to 1998, quarterly data) and the others found that there is no evidence of any positive unidirectional causal link from financial development indicators to economic growth.

With regards to time series analysis [19,20,21,22] found that financial development promotes economic growth. In the same line, [23] examined the relationship between financial intermediation and economic performance in Canada for the periods 1870-1926 and 1948-2002 using time series econometrics. Using Granger causality tests, he found evidence that financial development led to economic growth for the 1948- 2002 sample and no evidence of the reverse. The same results found by [24] for Turkey during 1986-2006. Also [25,26,27] found that there was a long-run equilibrium relationship among financial development and economic growth. However, the effect of financial development on economic growth is unstable in the short-run.

[20] showed that high income tax evasion induces policymakers to repress the financial system and set a high inflation rate in an attempt to generate higher revenues from the

inflation tax. Since financial repression reduces the productivity of capital and lowers savings, it hampers growth. From a different perspective [28] analyzed the effects of financial market developments on the savings rate. They suggested that financial deepening on the side of consumer credit was unlikely to increase savings. [29] in a more original study, have tested the finance-growth nexus and they found evidence for a channel through which finance theoretically influences growth. In contrast, [30] provides neither the demand following nor the supply-leading hypothesis for Mainland China over the period 1987:Q1 to 1999:Q4.

The existing evidence suggested that financial development has a positive effect on economic growth in Africa. [31] found that a developed financial sector spurs overall high but sustainable growth in Sub-Saharan African countries. Using various indicators of financial development, [32] investigated the role of financial intermediation in stimulating economic growth for members of the Southern African Development Community (SADC). The results landed some support to the hypothesis that financial development is positively correlated with the growth rate of real per capita GDP. In contrast, [33], found a weak causal relationship between finance and economic development in the West African countries members of the Economic Community of West African States (ECOWAS). For the same countries, [34] examined the cointegrating and causal relationship between financial development and economic growth. He found that there was a positive long-run relationship between financial development and economic growth in four countries, namely, Cote d'Ivoire, Guinea, Niger and Togo, and a negative one in Cape Verde and Sierra Leone.

Concerning time series analysis for Africa [35] examined the empirical relationship between the level of development by financial intermediaries and growth in Nigeria. He concluded that the development of financial intermediary institutions in Nigeria is fundamental for overall economic growth. In another study for Nigeria, [36] examined the long-run relationship between financial development and economic growth using annual time series for the period 1960-2005 and found unidirectional causality from financial development to economic growth when bank credit to the private sector is used as a measure of financial development. However, the other two measures of financial development, domestic credit to the private sector and bank deposit liabilities, indicate bidirectional relationship between financial development and economic growth. The same result was obtained by [37] who examined the causal relationship between financial development and economic growth in Egypt during the period 1960-2001. Their results significantly supported the view that financial development Granger causes economic growth either through increasing investment efficiency or through increasing resources for investment. Also, [38] examined the dynamic causal relationship between financial depth and economic growth in Kenya by including savings as an intermitting variable and concluded that economic growth Granger causes savings, while savings drive the development of the financial sector in Kenya.

[39] tested the validity of Schumpeter's prediction that finance promotes growth using annual time series data from South Africa from 1965 to 2010 and found that financial development does not promote economic growth both in the short run and in the long run. His paper concluded that Schumpeter may not be right in theorizing that finance promotes economic growth.

Meanwhile, as far as Sudan is concerned, [1] examined the short and long run relationship between financial development and economic growth in Sudan, one of the Middle East and North Africa (MENA) countries. Covering the period from 1970 to 2004, the result showed that financial development variables negatively affect real GDP.

With regards to Arab countries and in his very recent paper [40] examined the empirical relationship between economic growth and financial intermediation for Saudi Arabia during the last four decades (1968-2010). He argued that despite the minimal restrictions imposed on the functioning of the domestic financial system with a view to "fighting terrorism", the results overwhelmingly indicate that financial intermediation has impacted negatively on long-run real GDP. Also, [41] empirically examined the relationship between financial development and economic growth in a small open economy of United Arab Emirates (UAE). Using time series data from 1974 to 2008, the study showed a negative and statistically significant relationship between financial development.

[42] investigated the direction of causality between financial development and economic growth in the Middle East and North African (MENA) countries. Their results showed that there was no clear consensus on the direction of causality between financial development and economic growth.

3. THE ECONOMY AND THE BANKING SECTOR IN SUDAN

3.1 Economic Growth in Sudan

Over the years, Sudan's growth rates have shown fluctuating trends reflecting the effect of fluctuating weather conditions on agricultural production. The performance of the country in many ways typifies the severe economic decline that has affected many countries in the region since 1970s. In the late 1990s, oil and natural gas has also emerged as major sources of economic growth and revenue for the government as reflected in the balance of payments and investment flows.

Since independence in 1956, the economy has registered positive growth during two periods, namely the 1971-1983 and the 1990s onward periods. Since 1989 when the present government has taken office, the economy has witnessed dramatic changes following the adoption of economic and institutional reforms as well as privatization and liberalization policies. However, the inflationary pressure has increased tremendously, registering its first three digit rate of 122.5 in 1991 while reaching a highest rate of 130.4 percent in 1996 with an average annual inflation rate of 104 percent during 1990-1997. Efforts were made to suppress inflation. As a result, macroeconomic and price stabilization has become the focus of a strengthened reform program during 1997-2001. This program was boosted by the production and export of oil in 1998, which constituted a major source of economic growth and revenue for the government [43]. For this reason inflation rate was declined to reach 4.9 percent in 2001 but again started to increase to reach 14.9 percent in 2008, due to increase in world food prices and the global economic crisis, and 18.1 percent in 2011 due to the secession of Southern Sudan.

In summary, it may be argued that the period 1992-2008 witnessed strong performance of the economy with considerable improvement in the most important economic fundamentals. The strong economic performance may be attributed to a number of factors, including the efforts made toward economic reforms, the favorable weather conditions for agriculture, the high investment in the oil sector, the resulting relaxation of the tight foreign exchange resource constraint and the increase in FDI.

3.2 The Banking Sector in Sudan

Like many developing countries, the Sudanese financial sector was dominated by commercial banks rather than by bonds and equity markets, which require a mature system of accounting and financial information. The financial system in the Sudan has undergone significant developments since the establishment of the Bank of Sudan on February 22, 1960. The performance of the banking sector as measured by a number of conventional financial indicators was examined in this section. To begin with, we may note that the banking sector is the backbone of the Sudanese financial sector. Despite this, the size of the sector is very small by regional and international standards. Table 1 reveals that the ratio of assets to GDP is estimated at an annual average of 20.8% during 1995-2011. These low assets to GDP ratios underscore the sector's inability to play a larger and more important role in the development process.

Two financial ratios could be used as indicators of the ability of banks to make loans for investment purposes. The first of these ratios is the finance-assets ratio. From Table 1 we observe that banking finance in Sudan represents a small proportion of banks total assets. This ratio is estimated at an average value of 33.6% for the period 1995-2011. Thus, banking finance to economic sectors constitutes only a small fraction of total assets. This may be attributed to a number of factors, important among which is that banks maintain a large proportion of their resources in the form of liquid assets since short-term deposits dominate the liabilities side of the banking balance sheet.

Table 1. Ratios of banking finance to total banks assets and GDP, 1995-2011 (In million SD)

Year	Total Finance	Total Assets	GDP	Assets-GDP ratio (%)	Finance assets ratio (%)
1995	14,140	103,511	413,366	25.0	13.7
1996	33,950	161,445	1,021,750	15.8	21.0
1997	41,556	237,508	1,592,931	14.9	17.5
1998	47,383	328,176	1,991,613	16.5	14.4
1999	48,732	424,848	2,448,885	17.3	11.5
2000	79,224	357,068	2,969,452	12.0	22.2
2001	140,068	455,348	3,258,715	14.0	30.8
2002	193,201	611,238	3,923,817	15.6	31.6
2003	281,928	789,597	4,549,449	17.4	35.7
2004	429,071	1,044,506	5,245,245	19.9	41.1
2005	695,368	1,530,310	6,150,174	24.9	45.4
2006	1,113,960	2,314,430	8,001,578	28.2	48.1
2007	1,299,850	2,619,740	9,329,965	28.1	49.6
2008	1,496,110	3,065,000	12,073,400	25.4	48.8
2009	1,498,470	3,666,690	13,565,900	27.0	40.9
2010	2,099,280	4,310,770	16,220,390	26.6	48.7
2011	2,332,920	4,650,410	18,655,630	24.9	50.2

Source: Bank of Sudan Annual Reports (various issues) and own calculations.

Similar observations could be made on the basis of other financial indicators. Thus, from Table 2 we observe that the ratio of deposits to GDP is very low by any standard. Similarly, the ratio of finance to GDP amounted to 13.9% which is also far below the estimated averages of 40% and 88% for the Arab and emerging countries, respectively. These low

ratios indicate that the banking sector has ample room to further consolidate its efforts in resource mobilization as well as in efficiently allocating these resources for investment purposes.

Table 2. The Ratio of total deposits and total bank finance to GDP (%), 1995-2011 (In million SD)

Year	Total finance	Total deposits	GDP	Finance - GDP ratio (%)	Deposit-GDP ratio (%)	Finance-deposit ratio (%)
1995	14,140	41,642	413,366	3.4	10.1	33.9
1996	33,950	67,793	1,021,750	3.3	6.6	50.1
1997	41,556	96,754	1,592,931	2.6	6.1	43.0
1998	47,383	102,113	1,991,613	2.4	5.1	46.4
1999	48,732	145,519	2,448,885	2.0	5.9	33.5
2000	79,224	197,200	2,969,452	2.7	6.6	40.2
2001	140,068	274,188	3,258,715	4.3	8.4	51.1
2002	193,201	363.075	3,923,817	4.9	9.3	53.2
2003	281,928	472,952	4,549,449	6.2	10.4	59.6
2004	429,071	646,649	5,245,245	8.2	12.3	66.4
2005	695,368	977,595	6,150,174	11.3	15.9	71.1
2006	1,113,960	1,230,860	8,001,578	13.9	15.4	90.5
2007	1,299,850	1,394,240	9,329,965	13.9	14.9	93.2
2008	1,496,110	1,650,850	12,073,400	12.4	13.7	90.6
2009	1,498,470	2,084,800	13,565,900	11.0	15.4	87.1
2010	2,099,280	2,587,440	16,220,390	12.9	16.0	79.6
2011	2,332,920	2,777,560	18,655,630	12.5	14.9	82.3

Source: Bank of Sudan Annual Report (various Issues) and own calculations..

Since the early 1990s, banks were instructed to direct 50% of their credit to finance agriculture. As a result, the share of agriculture in total bank lending rose to 32% by 1993. However, following the financial liberalization and reform program, coupled with the high risk and relatively low or even negative real rate of return on agricultural finance, the share of agricultural loans declined to 22% in 2000 and further to 6.5% in 2005 (Table 3). Increased lending to the agricultural sector during the 1990s was accompanied by a sharp fall in lending to the industrial and export sectors.

Table 3. Banking finance by sector (%), 1995 -2011

Year	Agriculture	Industry	Exports	Imports	Domestic trade	Other sectors
1995	25.0	18.5	27.2	8.5	2.9	17.9
1996	27.0	18.8	19.6	5.0	3.6	26.0
1997	30.0	17.5	20.2	2.1	4.2	26.0
1998	33.0	18.8	17.1	0.7	4.3	26.1
1999	30.4	14.7	17.2	3.1	5.8	28.8
2000	22.0	10.5	21.0	1.0	10.0	35.5
2001	14.0	15.9	21.6	9.0	15.7	23.8
2002	12.3	13.2	12.0	13.5	20.4	28.6
2003	15.3	10.6	12.1	1.1	23.1	37.8
2004	9.5	11.5	10.2	1.2	36.3	31.3
2005	6.5	14.8	6.4	2.6	31.8	37.9
2006	11.9	9.3	4.0	2.5	22.5	49.8
2007	9.3	9.9	2.4	14.9	19.9	43.6
2008	10.7	9.3	2.2	12.3	18.6	46.9
2009	13.0	8.1	2.5	11.0	17.8	47.6
2010	14.9	9.0	2.6	6.3	16.0	51.2
2011	13.2	10.2	3.3	6.7	15.5	51.1

Source: Bank of Sudan Annual Reports: various issues.

In what follows, we examine the allocation of credit according to the Islamic modes of finance. For this purpose, we note that there are many Islamic modes of finance, the most important of which include; a) Musharaka (Partnership) under which the entrepreneur and the bank jointly supply the capital and manage the project. The losses are borne in proportion to the contribution of capital; while profit positions are negotiated freely. b) Mudaraba, which is a special type of Musharaka. In a Mudaraba contract, one partner contributes the capital and the other partner provides labour and expertise. c) Murabaha, under which the bank purchases the asset on behalf of an entrepreneur; the bank resells the asset to the entrepreneur at an agreed price that covers the original cost and added negotiated profit margin. Payment is made in the future in Lump sum or in installments. Ownership resides with the bank until all payments are made. d) Salam, which is a special type of sale contract, which is valid for both agricultural and industrial products. It is exactly the reverse of the deferred sale. In this contract, the price has to be paid immediately, whereas, the delivery of the commodity agreed on with specifications has to take place at a specific future period [44].

Table 4. Banking finance by mode of finance (%), 1995 -2011

Years	Murabaha	Musharaka	Mudaraba	Salam	Other	Total
1995	54.4	35.1	2.7	3.9	3.9	100
1996	53.0	32.0	2.0	4.0	9.0	100
1997	52.0	22.6	5.4	8.4	11.6	100
1998	54.3	21.1	6.1	6.5	12.0	100
1999	49.1	30.8	4.1	5.0	11.0	100
2000	33.7	42.9	3.5	3.4	16.5	100
2001	39.5	31.0	6.2	5.0	18.3	100
2002	35.9	27.9	4.6	3.3	28.2	100
2003	44.7	23.2	5.7	4.8	21.6	100
2004	38.5	32.0	5.7	3.0	20.8	100
2005	43.3	30.8	4.2	2.1	19.6	100
2006	53.4	20.4	5.2	1.3	19.7	100
2007	58.1	13.0	4.0	0.6	24.3	100
2008	46.9	12.1	6.0	2.0	33.0	100
2009	55.5	11.1	6.5	2.4	24.5	100
2010	54.7	9.4	7.1	1.2	27.6	100
2011	61.4	6.6	6.1	0.7	25.2	100

Source: Bank of Sudan Annual Report: various issues.

It is clear from Table 4 that Sudanese banks prefer Murabaha over other types of Islamic modes of finance. In the 1990s, almost half of the banking finance was in the form of Murabaha contracts. On the other hand Mudaraba, which is more suitable for entrepreneurs with no capital of their own, is the least mode of financing practiced by Islamic banks.

Extending credit by banks to the private sector is one of the major components of the IMF reform program. Between 1996 and 1998 commercial banks claims on the private sector fell markedly in real terms, and even dropped in nominal terms between 1998 and 1999. During these years credit to the private sector as a percentage of GDP equal 1.96 and 1.62 percent, respectively. To compact this, the central bank introduced a series of reforms in 2000 aimed at strengthening the (mainly state-owned) banks and increasing their commercial independence, while tightening supervision. Accordingly, credit to the private sector as a percentage of GDP started to increase to reach 15 percent in 2011. The liquid liabilities have decreased from around 6 percent of GDP in 1996 to 1.6 percent in 1999. In 2000 after the introduction of a series of reforms it started to increase to reach 7.3 percent in 2011. The ratio of broad money supply to GDP rose from 9 percent in 1997 to 11, 12, 14 and 22 percent in 2000, 2001, 2002 and 2011, respectively.

4. RESEARCH METHODOLOGY

4.1 The Theoretical Model

Economic performance is estimated using the natural logarithm of real GDP obtained by deflating nominal GDP by the CPI (or by the GDP deflator) at the January 1990 prices. Alternatively, we use the change in the natural logarithm of real per capita GDP (LPGDP) as a measure of economic growth.

Following common practice, two sets of explanatory variables that impact economic growth are employed in this study. The first includes variables that capture the impact of financial development, while the second captures the impact of factors other than financial development. Construction of financial development indicators is an extremely difficult task due to the diversity of financial services catered for in the financial system. What represent an appropriate measure of financial development (FD) seems to be controversial in the literature. Several measures (proxies) representing the liquid liabilities of the financial system, such as M1/GDP, M2/GDP, or M3/GDP have been widely used in econometric models (see, for example, [6,10,11]).These measures are not good proxies of financial development since they are likely to measure the extent to which transactions are monetized rather than the ability of the financial system to channel funds from depositors to investment opportunities As an alternative measure, bank credit to the private sector is often argued to be a more superior measure of functioning financial development because it is a measure of the quality and quantity of investment [1].

In light of the above, and following [40], this study uses three indicators of financial intermediation. The first indicator is the ratio of private credit to nominal GDP (CPS), where private credit is the credit extended to the private sector by commercial banks. This ratio indicates the importance of the role played by the financial sector, especially commercial banks, in financing the private economy. It isolates credit issued to the privates sector from credit issued to governments, government agencies, and public enterprises. Also, it excludes credits issued by the Central Bank [13]. The underlying assumption is that credit provided to the private sector increases investment and productivity to a much larger extent than do credits to the public sector. It is also argued that loans to the private sector are given under more stringent conditions and that the improved quality of investment emanating from financial intermediaries' evaluation of project viability is more significant for private sector credits [13]. The second indicator of financial intermediation is the ratio of liquid liabilities (currency plus demand and interest-bearing liabilities of banks) of commercial banks to nominal GDP (LIQ). This is a typical measure of the overall size of the financial intermediary sector. Broad money supply as a percentage of GDP (MS) is the third standard indicator of financial depth and of the overall size of financial intermediary activity. Broad money supply comprise the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. An increase in MS may be interpreted as an improvement of financial deepening in the economy.

Other variables were added to control for the possible effects of other growth determinants such as inflation rate (INF), gross investment as percent of GDP (INV), size of government also as percent of GDP (GOV), and openness to trade (OPEN). The inflation rate and size of government expenditure are commonly used as indicators of macroeconomic stability [32,13]. High inflation distorts economic activity and reduces investment in productive enterprises, thus reducing economic growth. Government expenditure could reduce economic growth because of the crowding out effect on private investment and the inflationary pressures it can lead to [32]. Inflation is measured in the analysis as the percentage change in CPI (at 1990 base year). The size of government is measured as the percentage share of government expenditure in GDP. The share of investment in GDP is one of the few economic variables that have robust effect on growth. The effect of international trade on growth is captured by the openness variable, which is measured as the sum of imports and exports as a percentage of nominal GDP [13]. Theoretically, the effects of trade can be negative or positive; as such the net effects can only be determined empirically. Exports may positively affect growth if it increases the market for domestic

products and generates foreign exchange reserves necessary to import capital goods. Imports can positively affect growth if increases in imports are associated with capital goods. Theoretically, there seems to be little doubt that long-run economic growth should be positively influenced by openness. Most theoretical models generate this relationship through transfers in technology and innovation which are facilitated by openness and trade. The more open the economy is, the easier it becomes to import and adopt technological innovations from higher-productivity trading partners, and thus the higher the growth rate. The empirical literature shows that trade openness affects output growth. Most of the studies have concluded that the openness of the trade regime has positive relation with GDP growth [45,46,47]. However, openness also can adversely affect growth, if the imports of consumer goods dominate the trade. In addition to these variables, we introduce a dummy variable (D) which takes the value of one for the peace years (from 1971 to 1983 and also from 2005 to 2011), and the value of zero for the other (war) years, to account for the effect of civil war in Sudan.

Following the literature [10,11,32] we estimate three versions of the model of the impact of financial development on growth in Sudan. The three versions are different in that the dependent variable (the natural logarithm of real per capita GDP) will be regressed on each of the three indicators of financial development, namely bank credit to the private sector (CPS), Broad money supply (MS), and the size of the financial intermediary sector (LIQ). The rest of explanatory variables included in the regressions are the same. Thus, after taking the natural logarithm of the variables, the three estimable versions of the model are:

$$\text{Ln } PGDP_t = \alpha_0 + \alpha_1 t + \alpha_2 \ln GOV_t + \alpha_3 \ln INF_t + \alpha_4 \ln INV_t + \alpha_5 \ln OPEN_t + \alpha_6 \ln FD_t + \alpha_7 D_t + U_{1t} \tag{1}$$

where FD represent the financial development variable, which is either LIQ, or MS, or CPS; lnGOV is the log of government spending/GDP ratio; lnINF is the log of inflation rate; lnINV is the log of current investment/GDP ratio; lnOPEN is the log of trade openness; t is time trend; D is dummy variable, and u is a white noise error term. Each of the equations in (1) represents only the long-run equilibrium relationship and may form a cointegration set provided that all variables included in each equation are integrated of order one, i.e. I(1).

4.2 Analytical Methods

To examine the effect of financial intermediary development on economic growth in Sudan, we collect annual time series data from various issues of the Bank of Sudan Annual Reports for the period 1970-2011. In this study we examine the empirical long-run relationships and dynamic interactions among the variables, using the autoregressive distributed lag (ARDL) bounds testing approach to cointegration, as developed by [48,49]. An ARDL model is a general dynamic specification, which uses the lags of the dependent variable and the lagged and contemporaneous values of the independent variables, through which the short-run effects can be directly estimated, and the long-run equilibrium relationship can be indirectly estimated. [50] introduce the bounds test for cointegration that can be employed within an ARDL specification. This method has definite advantages in comparison to other cointegration procedures since it can be employed regardless of whether the underlying variables are I(0), I(1) or fractionally integrated. Thus, the bounds test eliminates the uncertainty associated with pre-testing the order of integration. Secondly, it can be used in small sample sizes, whereas the Engle–Granger and the Johansen procedures are not reliable for relatively small samples. Given that our sample size is limited with a total of 42 observations only, conducting bounds test will be appropriate.

In an attempt to estimate the relationship between economic growth and financial intermediation in Sudan, the first task is to test for the presence of unit root. This is necessary in order to ensure that the parameters are estimated using stationary time series data. Thus, this study seeks to avert the occurrence of spurious results. To do this, the Augmented Dikky-Fuller (ADF) test is used. The null hypothesis is that the variable in question has a unit root (i.e. it is non-stationary), which is tested against the alternative hypothesis that the variable has no unit root (i.e. it is stationary). To reject the null hypothesis, the ADF statistics must be more negative than the critical values and significant. Along the lines of [49] if all variables involved are stationary, the next step is to apply the bounds testing approach to examine cointegration between the variables.

The ARDL approach involves two steps for estimating the long-run relationship. The first step is to examine the existence of a long-run relationship among all variables in the equation under examination. Conditional upon cointegration is confirmed, in the second stage, the long-run coefficients and the short-run coefficients are estimated using the associated ARDL and ECMs. To test for cointegration in Equation (1) by the bounds test, the following conditional Unrestricted Error Correction Model (ECM), is constructed assuming maximum lag lengths of q and k for the dependent and explanatory variables, respectively:

$$\Delta \text{Ln } PGDP_t = \alpha + \beta\, t + \rho\, D + \lambda_1 \text{Ln } PGDP_{t-1} + \lambda_2 \ln GOV_{t-1} + \lambda_3 \ln INF_{t-1}$$

$$+ \lambda_4 \ln INV_{t-1} + \lambda_5 \ln OPEN_{t-1} + \lambda_6 \ln FD_{t-1} + \sum_{i=1}^{q} \emptyset i\, \Delta \text{Ln} PGDP_{t-i}$$

$$+ \sum_{i=1}^{k} \varepsilon i\, \Delta \ln GOV_{t-i} + \sum_{i=1}^{k} \varphi i\, \Delta \ln INF_{t-i} + \sum_{i=1}^{k} \xi_i \Delta \ln INV_{t-i}$$

$$+ \sum_{i=1}^{k} \gamma_i\, \Delta \ln OPEN_{t-i} + \sum_{i=1}^{k} \delta_i \Delta \ln FD_{t-i} + U_{1t} \tag{2}$$

where FD is as defined above; the parameters λ_1, λ_2, λ_3, λ_4, λ_5 and λ_6 are the long-run parameters (elasticities), while $\emptyset i$, εi, φi, ξ_i, γ_i and δ_i are the short-run dynamic coefficients of the underlying ARDL model, and U_{it} are white noise errors. To examine the existence of a long-run relationship between the system variables, the OLS methods were applied to each of the three versions of the (unrestricted) ECMs given in Equation (2). Since the coefficients λ's of the lagged variables represent the long-run parameters of the underlying ARDL model, the existence of a long-run relationship among the variables is examined by conducting an F-test for the joint significance of these coefficients. Thus, for each of the three versions in Equation (2), the null hypothesis of "non-existence of the long-run relationship" defined by:

$$H_0 : \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$$

and it is tested against the alternative hypothesis

$$H_1: \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq \lambda_5 \neq \lambda_6 \neq 0$$

These hypotheses are examined using the standard Wald or F-statistics. The F-test statistic has distribution which depends upon (*i*) whether variables included in the ARDL model are I(0) or I(1), (*ii*) the number of regressors, (*iii*) whether the ARDL model contains an intercept and/or a trend, and (*iv*) the sample size. The F-test has a nonstandard distribution. Thus, [49] has provided two sets of critical values for the cointegration test. The lower critical bound assumes that all the variables are I(0), meaning that there is no cointegration among the variables, while the upper bound assumes that all the variables are I(1). If the computed F-statistic is greater than the upper critical bound, then the null hypothesis will be rejected

suggesting that there exists a cointegrating relationship among the variables. If the F-statistic falls below the lower critical bounds value, it implies that there is no cointegration relationship. However, when the F-statistic lies within the lower and upper bounds, then the test is inconclusive. In this context, the unit root tests should be conducted to ascertain the order of integration of the variables. If all the variables are found to be I(1), then the decision is taken on the basis of the upper critical value. On the other hand, if all the variables are I(0), then the decision is based on the lower critical bound value.

The ARDL model requires prior knowledge of the lag orders of variables, which is also sufficient to correct for autocorrelated residuals and the problem of endogenous regressors simultaneously [38]. Thus, if there is evidence for the existence of cointegration (long-run relationship) between variables, the next step involves selecting the appropriate lag orders of the dependent variable and regressors involved to obtain what is known as the conditional (restricted) ARDL model. This is normally accomplished by applying OLS methods to estimate the general ARDL model of the form:

$$\text{Ln } PGDP_t = \alpha + \beta t + \rho D + \sum_{i=1}^{q} \lambda_{1i} \text{ Ln } PGDP_{t-i} + \sum_{i=0}^{k1} \lambda_{2i} \ln GOV_{t-i}$$

$$+ \sum_{i=0}^{k2} \lambda_{3i} \ln INF_{t-i} + \sum_{i=0}^{k3} \lambda_{4i} \ln INV_{t-i}$$

$$+ \sum_{i=0}^{k4} \lambda_{5i} \ln OPEN_{t-i} + \sum_{i=0}^{k5} \lambda_{6i} \ln FD_{t-i} + U_t \tag{3}$$

Following [38], because of the small size of annual data a maximum lag length of two is used, so that ($q = 2$, $k_i = 2$) in Equation (3). By applying OLS method to the conditional ARDL long-run models in Equation (3) to obtain estimates of the long-run parameters $\lambda_1, \lambda_2, \lambda_3, \lambda_4, \lambda_5$ and λ_6. The estimated equation is also used to obtain an estimate of the error correction term (EC_{t-1}), which is obtained from Equation (3) as:

$$EC_{t-1} = \text{Ln } PGDP_t - \alpha - \beta t - \rho D - \sum_{i=1}^{q} \lambda_{1i} \text{ Ln } PGDP_{t-i}$$

$$- \sum_{i=0}^{k1} \lambda_{2i} \ln GOV_{t-i} - \sum_{i=0}^{k2} \lambda_{3i} \ln INF_{t-i}$$

$$- \sum_{i=0}^{k3} \lambda_{4i} \ln INV_{t-i} - \sum_{i=0}^{k4} \lambda_{5i} \ln OPEN_{t-i}$$

$$- \sum_{i=0}^{k5} \lambda_{6i} \ln FD_{t-i} \tag{4}$$

In this step, the resulting underlying ARDL equation (3) is also verified with all its statistical diagnostic properties in order to get unbiased and consistent/efficient estimates. The test for serial correlation (Breusch-Godfrey test), functional form (regression specification error test (RESET), normality (Jarque-Bera normality test) and heteroscedasticity (White's general heteroscedasticity test,) are carried out to ensure that the models are well specified and congruent with data. The stability of the estimated coefficients over the sample period will also be examined by adopting the recursive residual test for structural stability. The Cumulative Sum of Recursive Residuals (CUSUM) and the Cumulative Sum of Square of Recursive Residuals (CUSUMQ) obtained from a recursive estimation of the models will be plotted against the time horizon of the sample. These are compared with the bound critical values at specified significance level. If the plot of the CUSUM and CUSUMSQ remains within the boundaries of the 5 percent critical bound the null hypothesis that all coefficients are stable cannot be rejected.

After the long-run parameters and the error correction term are estimated, the final step involves estimating the short-run dynamic parameters by applying OLS to the error correction representation of the conditional ARDL model in Equation (3). The ECM model is given by:

$$\Delta \text{Ln } PGDP_t = \alpha + \beta\, t + \rho\, D + \sum_{i=1}^{q} \emptyset i\, \Delta \text{Ln } PGDP_{t\text{-}i}$$

$$+ \sum_{i=1}^{k1} \varepsilon i\, \Delta \ln GOV_{t\text{-}i} + \sum_{i=1}^{k2} \varphi i\, \Delta \ln INF_{t\text{-}i}$$

$$+ \sum_{i=1}^{k3} \xi_i \Delta \ln INV_{t\text{-}i} + \sum_{i=1}^{k4} \gamma_i\, \Delta \ln OPEN_{t\text{-}i}$$

$$+ \sum_{i=1}^{k5} \delta_i \Delta \ln FD_{t\text{-}i} + \mu\, EC_{t\text{-}1} + U_{1t} \tag{5}$$

where EC_{t-1} is the error correction term in (4) obtained from Equation (3). The parameters $\emptyset i$, εi, φi, ξ_i, γ_i and δ_i in Equation (5) are the short-run dynamic coefficients which measure the model's convergence to equilibrium, while the coefficient of the error correction term μ is the adjustment parameter, which gives the proportion of the deviations (errors) of the dependent variable from its long-run equilibrium value that has been adjusted (corrected). The coefficient must be negative and statistically significant. The negative sign of the coefficient means that the dependent variable adjusts back to its equilibrium value (or the dynamic model converges to equilibrium) following a disturbance; the magnitude of the coefficient measures the speed of adjustment.

5. EMPIRICAL RESULTS

5.1 Unit Root Test Results

ARDL framework depends on time series characteristics of the data sets. So, initially we have to investigate the order of integration. This is to ensure that the variables are not 1(2) stationary to avoid spurious results. In the presence of 1(2) variables the computed F-statistics provided by [49] are not valid. Because the bound test is based on the assumption that the variables are 1(0) or 1(1), therefore, the implementation of unit root tests in the ARDL procedure might still be necessary in order to ensure that none of the variables is 1(2) or beyond. The results of the ADF test are reported in Table 5. The results suggest that all the variables are integrated of order one i.e. stationary after first difference. This result gives support to the use of ARDL bounds approach to determine the long-run relationships among the variables.

Table 5. ADF unit root tests for stationarity of variables

| Variable | Calculated *ADF* statistic | | | | | Order of Integration I(d) |
| | Levels | | Ist differenced | | | |
	With intercept	With Intercept and trend	With intercept	With intercept and trend	Without intercept and trend	
ln*PGDP*	-1.612922	-1.565826	-3.979996**	-4.025534*	-4.024296**	1(1)
lnCPS	-1.396029	-1.214033	-2.380996	-2.498455	-2.413873*	1(1)
lnMS	-1.274461	-1.145045	-4.042218**	-4.031531*	-4.094587**	1(1)
lnLIQ	-1.333035	-1.940286	-4.609452**	-4.543903**	-4.660453**	1(1)
lnGOV	-1.936874	-2.020637	-4.779986**	-4.735750**	-4.830296**	1(1)
lnINF	-1.590161	-1.840765	-4.295784**	-4.230920**	-4.354367**	1(1)
LnINV	-2.460584	-3.095191	-6.746778**	-6.649705**	-6.801842**	1(1)
LnOPEN	-1.537737	-1.710687	-4.284918**	-4.222987**	-4.347577**	1(1)

*Source: Author's calculations. **, and * mean significant at 1% and 5%, respectively*

5.2 Cointegration Analysis

Since all used variables in the study become integrated by one differentiation (I(1)), we may use [49] test for long term relation. As seen in Table 6 below, the calculated F-statistic for all equations exceeds the corresponding upper critical bound values at the 1% significance level. Therefore, we reject the null hypothesis of no cointegration and conclude that there is a long-run level relationship between the regressors and the dependent variable in each model.

Table 6. Cointegration Test: Dependent Variable ΔlnPGDP

Financial Variable Included	*F*-Statistica	Critical value bounds of the F-statistics			
		1% Level		**5% Level**	
		1(0)	**1(1)**	**1(0)**	**1(1)**
lnCPS	7.468				
lnMS	9.200	3.34	4.63	2.69	3.83
lnLIQ	6.501				

Source: Author's calculations. Critical Values are from Pesaran et al. (2001), Table CI(iv)
Case IV: Unrestricted intercept and trend.

5.3 Estimation of the Long-Run Relationship

Having found a long run relationship, we applied the ARDL method to estimate the long run coefficients for the different versions of Equation (3). Table 7 reports the regressions of the long-run relationship. The overall goodness of fit of the estimated equations, as shown in Table 7, are high; the F-statistic measuring the joint significance of all regressors are statistically significant. It is obvious from Table 7 that in the long run government expenditure, inflation, money supply and trade openness exert negative effects, while investment, private credit and liquidity have positive effect on real per capita GDP. As expected the coefficients of government expenditure are negative but statistically insignificant in all versions of the model. An increase in government expenditure by 1% leads to a reduction in real per capita GDP over time by 0.13, 0.01, 0.09 percentage points in first, second, third version of the model, respectively. This is because government expenditure reduce economic growth through the crowding out effect on private investment and the inflationary pressure it may create [32].

Table 7. Estimation of long-run coefficients using the selected ARDL model for lnPGDP

Model version	Regressor	Coefficient	t-Ratio	R^2	Calculated-F	Significance level
	Constant	4.1511	9.6378**			
	trend	-0.0006	-0.2593			
	D	0.1332	1.7540	0.786	17.335	0.000
1	*LnGOV₋₁*	-0.1327	-1.4527			
	LnINF₋₁	-0.1075	-4.0856**			
	LnINV₋₁	0.1212	3.1840**			
	LnOPEN₋₁	-0.0938	-1.7883			
	Ln CPS₋₁	0.1243	2.0483*			
	Constant	4.4987	9.6576**			
	trend	0.0001	0.0495			
	D	0.2 903	4.2975**			
2	*LnGOV₋₁*	-0.0114	-0.1100	0.769	15.678	0.000
	LnINF₋₁	-0.1038	-3.6196**			
	LnINV₋₁	0.1142	2.7771**			
	LnOPEN₋₁	-0.1558	-3.0412**			
	In MS₋₁	-0.1114	-1.1834			
	Constant	4.2759	9.2171**			
	trend	0.0004	0.1622			
	D	0.2395	4.1230**			
3	*LnGOV₋₁*	-0.0892	-0.8653			
	LnINF₋₁	-0.1186	-3.9845**	0.760	14.919	0.000
	LnINV₋₁	0.1321	3.1620**			
	LnOPEN₋₁	-0.1325	-2.4402*			
	LnLIQ₋₁	0.0263	0.3459			

*Source: Authors' calculations. . **, and * mean significant at 1% and 5%, respectively.*

Also long run equations state a significant positive effect of investment on real per capita GDP in Sudan. In all versions of the model, this coefficient indicates that, other things being equal, a 1% rise in investment leads to an increase in real per capita GDP over time by 0.11 - 0.13 percentage points. This low response of real per capita GDP to investment indicates that investment in Sudan does not have an important effect on real per capita GDP. This weak relationship between investment and real GDP is attributed usually to the prevailing situations of political instability, prolonged civil wars, and other factors such as uncertainty over agricultural leases which resulted in declining investment, particularly in major agricultural projects. In all versions of the model, the coefficient of inflation is highly significant and negative as expected. A 1% rise in inflation leads to a reduction in real per capita GDP over time by 0.10 - 0.11 percentage points in the long run. In late 1980s and in 1990s Sudan witnessed very high inflation rates which distorted economic activity and reduced investment in productive enterprises, which in turn reduced economic growth. The coefficient of trade openness is negative and significant in all versions of the model. Accordingly, an increase in trade openness by 1% leads to a decrease in real per capita GDP by 0.09 - 0.15 percentage points. A possible explanation of the negative relation

between trade openness and real per capita GDP is that since imports dominate the trade in Sudan, and apparently most imports are consumer goods, this may tend to crowd out domestic production.

With regard to financial development indicators, the result of the long run analysis indicates that credit to the private sector and the liquid liabilities exert positive effect while money supply affects real per capita GDP negatively. Coefficients of credit to the private sector and liquid liabilities have expected signs and this finding is consistent with the results of [32] and inconsistent with the results of [40]. Although the result of the negative relationship between money supply and real per capita GDP reported in this study is inconsistent with general evidence in the empirical literature, it is not surprising in the case of Sudan. A possible explanation for that over our study period is that money supply increased to finance deficit in Sudan. And this is because the deficit in Sudan is used to pay off foreign debt obligation and not spent on goods and services and also it was used to finance the civil war in the south and the armed conflicts in Darfur. It could also be due to corrupt practices by the elite who take money outside the country to foreign accounts. Furthermore, the result of the negative relationship between money supply and real per capita GDP is consistent with [51] who reported negative relationship between financial development as measured by M2/GDP and economic growth in the UAE. In an earlier study, [52] did not support the view that financial development promotes economic growth. Using data for 95 individual countries including UAE, [52] found negligible or weakly negative correlation between financial development and economic growth. The coefficient of correlation between M2/GDP and GDP is found to be negative for UAE, but insignificant. Also, [53] obtained negative and significant coefficient on M2/GDP for 13 transition countries. More recently, [1] reported similar result for Sudan. Also [40] reached the same conclusion that money supply with other financial development indicators had negative impact on economic growth in Saudi Arabia. The coefficient of the credit to the private sector is statistically significant at 5% level while the other coefficients are insignificant. Despite the fact that, the credit to the private sector exerts a positive and statistically significant impact on real per capita GDP in the long run, the relationship between them in term of elasticities remains very weak i.e. 1% increase in the credit to the private sector leads to a respective real per capita GDP increase of 0.12% only. Although the relation between financial development indicators and real per capita GDP is low and insignificant specially in the case of liquid liabilities and money supply, credit to the private sector is the only indicator that affect economy in Sudan. The dummy variable is positive and significant in the all version of the model indicating that during the peace period the real per capita GDP increased.

Table 8 below reports the results of the diagnostic tests for the estimated long-run versions of the ARDL model. All versions pass all diagnostic tests of normality, serial correlation, functional form, and heteroscedasticity. For the first version of the model, Jarque-Bera, $\chi2(2)$ test statistic has a very high p-value, suggesting normality of the residuals, but it is small for the second and middle for the third version. Ramsey RESET F-statistic is highly significant, meaning that the model is correctly specified. White heteroscedasticity $\chi2(2)$ test statistic with cross terms is also insignificant, suggesting that there is no heteroscedasticity in the models. Breusch-Godfrey $\chi2(2)$ test statistic for serial correlation is insignificant for the all version of the model.

Table 8. Diagnostic tests of the estimated long-run ARDL models for lnPGDP (P-values)

Version	Normality (Jarque-Bera)	Functional form		Autocorrelation		White heteroscedasticity
		AIC	Ramsey RESET	DW	Breusch-godfrey	
1	0.160 (0.923)	-1.220	14.396 (0.000)	1.484	1.776 (0.183)	37.843 (0.298)
2	2.490 (0.289)	-1.142	7.584 (0.010)	1.465	1.930 (0.165)	39.236 (0.247)
3	1.510 (0.474)	-1.104	10.149 (0.003)	1.521	1.645 (0.200)	40.510 (0.205)

Source: Authors' calculations.

It is important to investigate whether the above long run relationships are stable for the entire period of study. For this purpose, we have examined the stability of the model parameters using the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) test procedures. CUSUM and CUSUMSQ are plotted against the break points. Parameter stability is indicated when the CUSUM and CUSUMSQ plots against time remain within the 5 percent significance level over the sample period, while parameters and hence the variance are unstable if these plots move outside the 5 percent critical lines. The plots of the CUSUM and CUSUMSQ in Figs. 1 - 6 below are obtained from a recursive estimation of the three versions of the model. These plots indicate stability in the coefficients of the first and the third versions of the model and instability in the coefficients of the second version of the model.
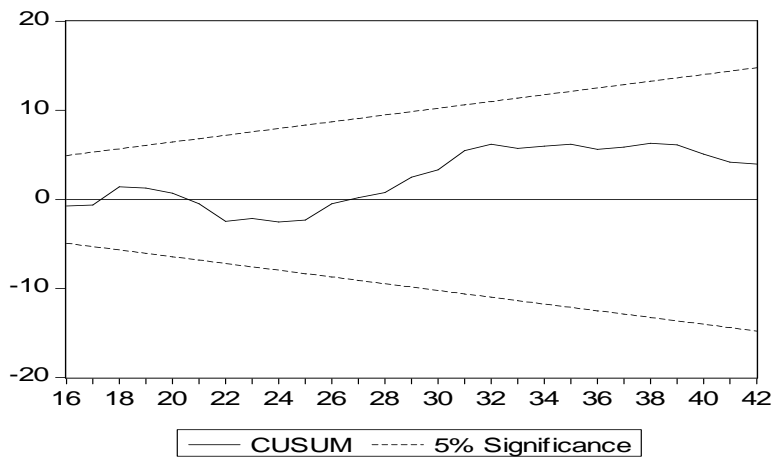

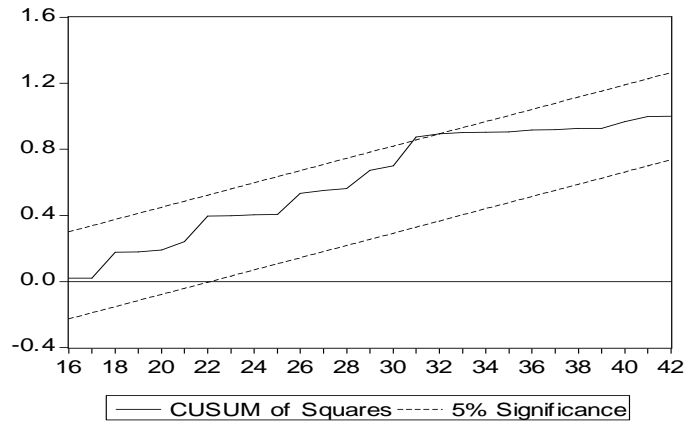**Fig. 1. Cumulative sum of recursive of residuals: model with CPS**

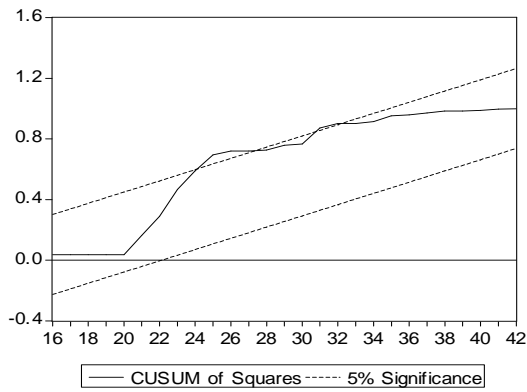**Fig. 2. Cumulative sum of squares recursive residuals: model with CPS**

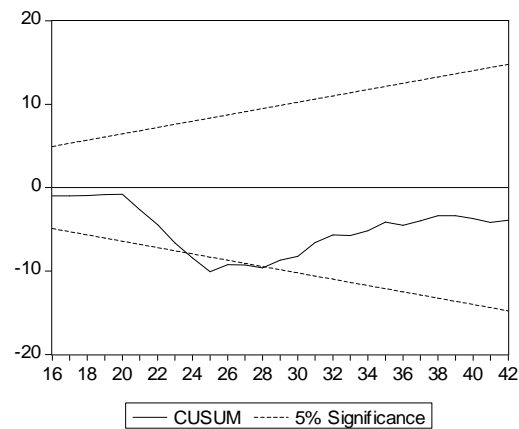**Fig. 3. Cumulative sum of recursive of residuals: model with MS**

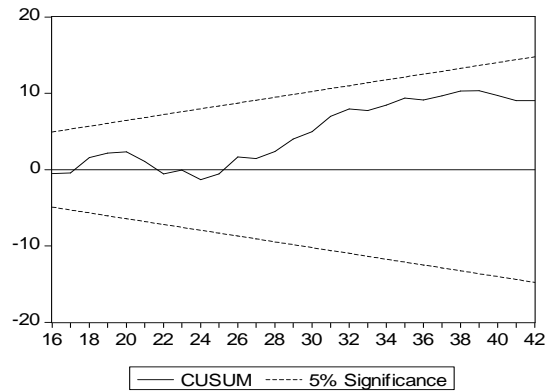**Fig. 4. Cumulative sum of squares recursive residuals: model with MS**

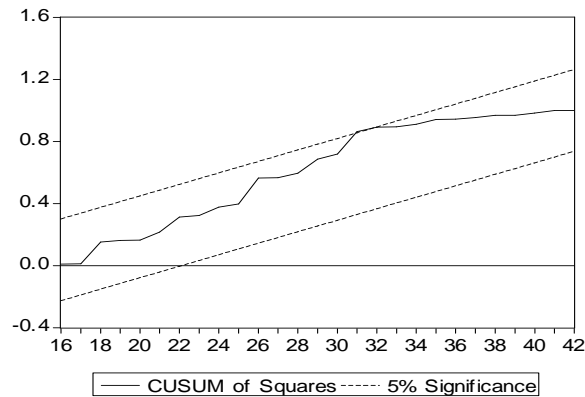**Fig. 5. Cumulative sum of recursive squares Residuals: model with LIQ**

Fig. 6. Cumulative sum of of recursive residuals: model with LIQ

5.4 Estimation of Short-Run Parameters

Finally, we estimate the short-run dynamic coefficients by using OLS method to estimate the ECM equations associated with the ARDL long-run relationships. Table 9 below reports the results of the error correction representation of the estimated versions of the ARDL model. It is obvious from Table 9 that the overall models are insignificant and the goodness of fit are very low.

Table 9. Estimation of the short-run dynamic coefficients of the error correction representations of the ARDL models: dependent variable Δ lnPGDP

Regressor	Coefficient	t-Ratio	R^2	AIC	F-Statistic
Constant	0.029	0.822			
Δ LnGOV$_{-1}$	0.020	0.215			
Δ LnINF$_{-1}$	-0.032	-0.801			
			0.152	-1.169	0.697
Δ LnINV$_{-1}$	0.074	1.824*			
ΔLnOPEN$_{-1}$	0.004	0.066			
Δ Ln CPS$_{-1}$	-0.027	-0.180			
D	-0.044	-0.728			
EC$_{-1}$	-0.018	-1.189*			
Constant	-0.009	-0.312			
Δ LnGOV$_{-1}$	0.107	1.252			
Δ LnINF$_{-1}$	-0.027	-0.734			
Δ LnINV$_{-1}$	0.022	0.609			
ΔLnOPEN$_{-1}$	0.031	0.597	0.302	-1.363	1.676
Δ Ln MS-1	-0.353	-2.795			
D	0.039	0.788			
EC$_{-1}$	0.030	0.432			
Constant	-0.004	-0.135			
Δ LnGOV$_{-1}$	0.045	0.458			
Δ LnINF$_{-1}$	-0.031	-0.731			
Δ LnINV$_{-1}$	0.046	1.236	0.110	0.479	-1.12
ΔLnOPEN$_{-1}$	0.020	0.310			
Δ LnLIQ-1	-0.034	-0.407			
D	0.024	0.555			
EC$_{-1}$	-0.056	-0.572			

*Source: Author's Calculations. **, and * mean significant at 1% and 5%, respectively.*

Although we could not find any short-run relationship between the explanatory variables and real per capita GDP in Sudan, they are related in the long-run. In the short run most variables are statistically insignificant and have the wrong signs. In contrast to the long - run analysis, all financial development seems to have insignificant negative impact on real per capita GDP in the short- run as well. This finding is supported by the study of [40] who find negative but significant relationship between financial development indicators and real per capita GDP in the short- run in Saudi Arabia. The coefficient of the lagged residual (EC$_{-1}$) in the ECM model shows the speed of adjustment towards the equilibrium following a shock to the system. The coefficient has the correct signs in the first and the third versions of the model and has the wrong sign in the second version of the model and only significant in the first version of the model. The coefficients of EC$_{-1}$ are very low and equal to (-0.018) and (-0.056) for first and third versions of the model respectively and imply that deviations from the long-term real per capita GDP are corrected by only 1.8 percent in the first version and 5.6 percent in the third version of the model between two successive time periods.

6. CONCLUSION

The purpose of this study is to examine the long and short run relationship between financial intermediation and real per capita GDP in Sudan using annual time series data during 1970-2011 by employing the ARDL bounds testing approach to cointegration and the associated error correction model (ECM). As financial development indicators concerned, the result of the long run analysis indicates that credit to the private sector and the liquid liabilities exert positive effect while money supply affect real per capita GDP negatively. The credit to the private sector and the liquid liabilities coefficients have an expected signs. Although the relation between financial development indicators and real per capita GDP is low and insignificant specially in the case of liquid liabilities and money supply, credit to the private sector is the only indicator that affect economy in Sudan in the long-run. A possible explanation for the negative relation between money supply and real per capita GDP over our study period is that money supply increased to finance deficit and corruption in Sudan. Other reasons are that, the deficit in Sudan is used to pay off foreign debt obligation and not spent on goods and services and also it was used to finance the civil war in the south and the armed conflicts in Darfur. This result is consistent with the study of [1] for Sudan. As [1] argued, the weak findings may be attributed to the inefficient allocation of resources by banks, along with the absence of an appropriate investment climate required to foster significant private investment and promote growth in the long run, and to the poor quality of credit disbursal of the banking sector in Sudan. Also, the weak capital base, the high cost of borrowing due to insufficient inter-bank competition and the risk of extending credit to sectors other than trade, which is considered by banks as unjustifiably high lead to this weak findings. With regard to the factors other than financial development, we found that the size of government as percent of GDP, inflation rate, gross investment as percent of GDP, and openness to trade affect real per capita GDP in the long-run. Although we find long-run relationship between the explanatory variables and real per capita GDP in Sudan, they are not related in the short-run. One of the most obvious implications of our results is that if Sudan is to realize its target growth rate it needs to reform the financial sector well, create a stable political and economic climate conducive to investment and to finance its budget deficit from real resources. The government should realize effective macro-economic policies along with momentous improvements in the structure and functioning systems of governance for stabilizing economic growth along with trade and financial liberalization reforms. The government should adopt policies that reduce inflation and also the diversification of exports is necessary.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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