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Revisiting the Contention of the FD/GDP Nexus of the Northern Sudanese Economy: A New Startling Empirical Result

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Abstract

Sudan, the largest continent in Africa, has been experiencing a critical internal crisis for several decades. This led to the split of the country between the south and the north. As a result of this, it is pertinent to ask whether the existing economic prospects and prosperity of Northern Sudan could aid in fostering its economic growth after its split with Southern Sudan. Could the financial development of the country foster its GDP growth despite the country's massive investment in its decade-long war? If not, what are the possible explanations for the country's economic growth profile in the modern era? From empirical findings in this respect, what factors may impede on the overall growth prospects of the country's economy in both the long run and the short run? To answer such questions, we measure the short-run and long-run impact of financial development on the economic growth of Northern Sudan and also investigate whether the relationship between financial development and economic growth is monotonic or not. The study uses time series data from 1980 to 2011using the ARDL bounds-testing approach to cointegration and the U test of Mehlum and Sasbuchi. Surprisingly, this study reveals that, among the three selected indicators of financial development, it is only the ratio of credit issued to the private sector by the banks to GDP that has a significant contributory impact in fostering the economic growth of the country in the long-run, while in the short-run, fixed capital formation and financial development make a significant contribution. The study also discovered that the relationship between financial development and GDP growth in the country is non-monotonic, meaning that there is too much finance in the economy due largely to the presence of international sanctions that have triggered a high rate of inflation.

Keywords: U-test, Northern Sudan, ARDL bounds-test, Economic growth.
JEL classification: N27; O16; O47; G27

1. Introduction

Sudan is the largest country in African in terms of land mass. This has meant it possesses significant potential to expand, develop, explore, and exploit its natural resources and to attract high levels of foreign investment. That said, however, and in contrast to what might be expected given the country's size, the country has been seriously marred by an incessant internal crisis that has significantly crippled its ability to exploit its vast economic potential. The African Economic Outlook (2013) notes that in 2012there was a spilt in the country that saw the birth of Southern Sudan, which broke away from the former Northern Sudan. This split led to the loss by Northern Sudan to Southern Sudan of about 75% of its revenues from oil and other income-generating sources. The real GDP of Northern Sudan contracted by 0.6% in 2012, while inflation was 36.0% in 2012, up from 20.0% in 2011.This phenomenal increase in inflationary pressures, coupled with a high fiscal deficit (which is currently 4.4% of the national budget) in the face of continuing economic sanctions applied to Northern Sudan, have constricted the economy and have created a binding domestic and international borrowing constraint that has translated into economic and political instability and has reduced the potential for the country's social and financial development.

Another potential factor to reckon with is the dwindling natural resources (mainly oil and gold) of Northern Sudan, which will impact upon its medium-term economic growth. Further, the civil wars in Darfur, which cost the country extensive financial resources, and in the border states of South Kordofan and Blue Nile have, combined to impair the growth prospects of Northern Sudan. A pioneering study by Mohamed (2006) attempted to identify the nexus between financial development and economic performance of the Sudanese economy from 1970 to2004. He argued that:

> *There are an overwhelmingly strong indication of a weak relationship between financial development and economic growth in Sudan. Although the coefficient of M3/GDP is significant, it is negative, whilst the impact of credit to the private sector by banks to real GDP is also negative and insignificant. These 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.*

From the foregoing discussion, this study investigates whether, because of the country's split between the south and the north, the existing financial prospects of Northern Sudan could aid in fostering its economic growth. It also asks whether the financial development of the country could foster its GDP growth despite its massive investment in the decade-long war with the south. If it cannot, the question is then asked as to what are factors that will be able to enhance Northern Sudan's economic growth prospects. Following on from a consideration of empirical findings in respect of these questions, it is investigated what factors may impede or improve the overall growth prospects of the country's economy in both the long run and the short run.

The rest of the paper is organized as follows. Section 2 provides an overview of the recent theoretical and empirical literature linking financial development and economic growth. Section 3 provides the theoretical framework for this study. Section 4 is the methodology section, which

introduces the data, the model specification, and the model estimation procedure used in this research. Section 5 contains results and discussion. Finally, Section 6 presents conclusions and recommendations for policy.

2. Theoretical review

For decades, there has been a burgeoning literature regarding the causal link between financial development and economic growth. Early researchers like Bagehot (1873), Schumpeter (1911), and Goldsmith (1969) emphatically agreed that the financial sector is the fundamental pillar for stimulating economic growth insofar as it is free from problems that could impede its effective functioning. These pioneering authors argued that an effective and efficient financial system should allow for the voluntary mobilization of savings, resource allocation, pooling of risk, inducing liquidity, and reducing heavy transaction costs.

Similar to the assertions of these pioneering researchers, modern researchers like Goldsmith (1969), Hicks (1969), McKinnon-Shaw (1973), King and Levine (1993), Khan (2000), Pagano and Volpin (2001), Christodoulou and Tsionas (2004), Shan (2005), Khan et al. (2005), Ma and Jalil (2008),Shahbaz et al. (2008),Shahbaz, (2009a), and Shahbaz et al. (2010a) have found conclusively that there is extensive empirical evidence that, in the long run, an efficient banking and financial system will be an embodiment of capital accumulation, which will in turn promote economic efficiency and will support sustainable economic growth.

There are four leading hypotheses that explain the link between financial development and economic growth. The supply-leading hypothesis, commonly known as the 'finance-led growth hypothesis', and the demand-following hypothesis, commonly known as the 'growth-lead finance hypothesis', were among the early hypotheses developed in the literature linking financial development and economic growth. These were then followed by the feedback hypothesis or 'bidirectional causality hypothesis'. The fourth and final hypothesis was the 'independent hypothesis' (see, for example, Al-Yousif, 2002 and Majid, 2007).

The seminal work of Schumpeter (1911) remained valid until 1973 when McKinnon-Shaw (1973) transformed it into a strong hypothesis used as a key tool of policy analysis for developing countries. It is now widely accepted as a hypothesis explaining capital accumulation and diversified financial intermediation. McKinnon-Shaw (1973) clearly identified that resource wastage, impacts on interest rates, and unplanned and inefficient investment arise as a result of financial repression. Such repression was common in the 1960s and 1970s in most less developed countries (LDCs). McKinnon-Shaw asserted that the most viable and enduring alternative is the adoption of financial liberalization, which can stimulate savings and investment that will in turn lead to investment growth. Fry (1988), Greenwood, and Jovanovic (1990), and Pagano (1993) were key proponents of this hypothesis and popularized it in a slightly amended form using their endogenous growth model. These authors emphasized "the lack of explicit modeling of the link between financial and real sector variables"(Anderson and Tarp 2003, p. 192).

In contrast to all the views presented above, Robinson (1952) argued that finance does not have the ability to influence growth. Rather, he argued that financial development follows economic growth largely because of the consistent rise in the demand for financial services. This author continued to point out that, typically, financial institutions are a mere reflection of the growth in overall economic activity. That is economic and entrepreneurial activity spurs demand for financial services, and that is all. This line of argument is in line with the assertions of the fourth hypothesis mentioned above, the 'independent hypothesis', as it is commonly known. The independent hypotheses in its modern formation underscores the fact that financial development and economic growth are not causally related. According to its proponent, Robert Lucas (a 1988 Nobel Laureate winner in economics),"economists badly overstress the role of financial factors in economic growth"(Lucas, 1988, pp.9) A supporter of this argument was Nicholas Stern (1989), who did not consider the impacts of the financial system in the economic

growth process in his investigation of the factors leading to economic growth. Similar approaches were also taken by Meier and Seers (1984) and, more recently, by Ram (1999). Ram (1999, p. 172) argued that, "the predominant correlation between financial development and economic growth is negligible or weakly negative." He continued to point out that there was yet to be evidence of an unequivocal theoretical or empirical link between the two, and that there is far from being a consensus view within the literature about the matter.

2.1 Empirical review

Thangavelu and James (2004) examined the dynamic relationship between financial development and economic growth in Australia, using an approach studying bank- and financial market-based financial structures. They applied a time-series approach and used a vector auto regression (VAR) model to assess the effects of the dynamic relationship between financial development and GDP growth. The findings of the authors revealed that financial intermediaries and financial markets have different impacts on economic growth due largely to their heterogeneous impacts on the domestic economy. They concluded emphatically that there is evidence of causality from economic growth to the development of financial intermediaries; that developments in financial markets cause economic growth; and that there is no evidence of any causality from economic growth to financial markets. They further found that sensitivity tests carried out using different interest rates did not change their results.

Shrestha and Chowdhury (2005) tested the financial liberalization hypothesis using the Auto Regressive Distributed Lag (ARDL) methodology with Nepalese data to examine the effect of interest rates as a crude means of retarding the process of financial development. Their results showed that the real interest rate positively affects both savings and investment. The authors further argued that it is an undeniable fact that financial repression retards economic growth and that, because of this, financial liberalization is the most effective way to eliminate the menace of financial repression. They also pointed out that deregulation of interest rates would result in a higher real interest rate, which would lead to increased savings and increased investment and would achieve efficiency in financial resource allocation.

Mohamed (2006), in his study of the Sudanese economy, investigated the effect of financial development on economic performance of the country from 1970 to 2004. He applied the time series methodology of ARDL. The results of his study, surprisingly, showed a weak association between financial development and economic growth in Sudan. He found that the coefficient of M3/GDP was significant but negative, while the impact of credit provided to the private sector by banks on real GDP was negative and insignificant. The author concluded that this was attributable to significant resource misallocation common with the financial sector in Sudan, coupled with the absence of an appropriate investment climate that is essential in fostering and stimulating extensive private sector investment that can promote growth in the long run. The author further asserted that the poor quality of credit disbursal in Sudan's banking sector also constituted significantly to the result. His econometric analysis suggests that the speed of adjustment in the estimated models is relatively high and had the expected significant and negative sign.

Ang and McKibbin (2006) examined the direction of causality between financial development and economic growth using the open Malaysian economy as a case study. The authors used time series data from 1960 to 2001, and applied cointegration and causality tests to enable them assess the finance-growth link by taking the real interest rate and financial repression into account. The empirical findings of their study reveal that financial liberalization, or removal of repressive policies, stimulated financial sector development. The authors concluded that financial depth and economic development are positively related; in contrast to conventional findings, the results further support Robinson's view that output growth leads to higher financial depth in the long-run.

Bakwena and Bodman (2008) used two set of countries (oil and non-oil producing countries) and tried to assess the role played by financial development in enhancing the economic growth of these countries. The researchers used a dynamic panel data set of 44

countries from 1984 to 2003 and applied a novel two-step, variance corrected system Generalized Method of Moments (GMM) estimator proposed by Windmeijer (2005). The evidence from their research findings showed how financial development plays a crucial role in influencing the efficiency of investment, and thus the economic performance of these economies. They found, however, that the potency of financial institutions is highly dependent on whether the economy is an oil- or non-oil- (mining-) based economy.

Gondo (2009) examined the impact of financial development on economic growth using evidence from South Africa from 1970 to 1999. Using time series data and applying a standard instrumental variable methodology with robust standard errors, and introducing an additional variable that accounted for taxes and political and economic polarization, the author found that credit to institutional entities statistically significantly predicted South Africa's overall economic growth. He also found that liquid liabilities negatively influence economic growth. His paper concluded with the assertion that a strong stock market and an efficient banking sector significantly drove the country's growth. In another development, Kargbo and Adamu (2009) examined the effects of the relationship between financial development and economic growth in Sierra Leone from 1970 to 2008. They used the ARDL approach to cointegration and applied principal component analysis (PCA) to derive an index of financial development, which was used as a proxy for financial development. Surprisingly, the study established that financial development exerts a positive and statistically significant effect on economic growth. In furtherance of their analysis, they found that investment is the principal channel through which financial development feeds economic growth.

Similar to the findings of Kargbo and Adamu(2009), Mosesov and Sahawneh (2010), in their investigation of financial development and economic growth of the United Arab Emirates (UAE), established how, within three decades, both the country's financial sector and the UAE economy as a whole experienced remarkable growth. To analyze the evidence, the authors used time series data from 1973 to2003 and employed multiple regression analysis. Their findings indicated the absence of a significant relationship between financial development and GDP. Their study further showed how the UAE economy is significantly dependent upon oil market prices. They then concluded that the ongoing financial sector revitalization of the UAE economy was the prime reason for the negative association between financial development and GDP.

Shahbaz and Islam (2011), in a seminal paper, examined the relationship between financial development and income inequality in Pakistan. With the main objective of assessing the applicability of the Greenwood and Jovianvich (GJ) hypothesis to Pakistan, the authors used time series data from 1971 to 2005and used the ARDL bounds-testing approach to cointegration to examine the existence of long-run relationships and the error correction model (ECM) to examine short-run relationships. The results of their study showed how financial development in Pakistan became a potent weapon for reducing income inequality while financial instability aggravated the problem of income inequality. In contrast to modern conventional wisdom, the authors found that economic growth worsens income distribution and that inequality of income distribution is further worsened by trade openness. Their paper did not find support for the GJ relation.

Al-Malkawi et al (2012) was an empirical examination of the relationship between financial development and economic growth in the small, open economy of the UAE. Using time series data from 1974 to 2008, the study employed the ARDL approach to cointegration. The analysis was carried out using two indicators to measure the level of financial development. The first indicator was the financial depth or size of the financial intermediary sector as measured by the monetization ratio (M2/GDP). The second indicator was the ratio of the credit provided to the private sector by commercial banks as a percentage of GDP (the financial intermediation ratio). Their results showed a negative and statistically significant relationship between financial development, as measured by M2/GDP, and economic growth. The results also suggested a bi-directional causality between the two variables. Overall, the evidence supported neither the demand-following nor the supply-leading hypotheses for the UAE.

This study contributes to the extant literature on financial development and economic growth surveyed above by taking note of the shortcomings of earlier research. Specifically, it makes the following contributions:

1. It determines the monotonic and/or non-monotonic relationship between financial development and economic growth and the impacts of shocks on this relationship. The aim is to ascertain whether, as a result of economic shocks, long-run or short-run changes can affect the direction of causality to have mitigating effects on the dependent variables to deviate from the observed relationship of financial development/GDP growth as theoretically and empirically established. This is done in the case of Northern Sudan using the latest methodology in the form of the Sasabuchi-Lind-Mehlum (SLM) test. The test enables the researchers to explore whether the marginal impact of financial development is positive at a certain point and whether, after a point, financial development no longer contributes to boosting economic growth or may even have a negative outcome for economic growth because of shocks.
2. In this study, we use three indicators of financial development as against the two used in the study of Al-Malkawi et al (2012),which we believe is the most robust measure of determining the effects of financial development on the economic growth of Northern Sudan. Similarly, a major contribution of this research was to investigate what happens to the financial development (FD)/GDP nexus after a country is split in two, experiences a loss of significant revenue, and is exposed to economic sanctions, in contrast to the study of Shahbaz and Islam (2011), which studied FD and income inequality.
3. This study also applies the long-run structural modeling approach of Pesaran and Shin (2002), which uses the ARDL bounds-testing approach to cointegration, as against the approach of Mosesov and Sahawneh (2010),who used a multiple regression approach to examine the sluggish or fast readjustment position of the ECM after a shock and national split. This allows the researchers to use modern economic theories to investigate the long-run relationship between financial development, economic growth, and other determinants of growth. It will equally help to correct for Johansen (1988, 1992) and other conventional cointegration tests, which are *theoretical* in nature; they impose restrictions arbitrarily based on the scale of data rather than the use of feasible econometric tools and theory.
4. Finally, most previous studies have mainly used either the residual-based cointegration test associated with Engle and Granger (1987) or the maximum likelihood test based on Johansen (1988) and Johansen and Juselius (1990). It is now well known, however, that these cointegration techniques may not be appropriate when the sample size is too small (see Nerayan and Smyth, 2005; Odhiambo, 2009). Second, some of the previous studies relied excessively on cross-sectional data, which may not satisfactorily address country-specific issues. The problem of using a cross-sectional method is that, by grouping countries together, some vital elements of the variables may be lost.

3. Theoretical framework

Solow (1956) made an effort to present his version of the neoclassical growth model based on his assumptions about prices of the elements of production, labor, capital, and technology. The author explained that these factors are the main determinants of output, and they are the cardinal elements that are responsible for fostering the growth of GDP. The Solow growth model can be presented as $Y=F(K, AL)$,where $Y=$ *GDP*, $K=$ *capital* (this is where the

concept of financial development and fixed capital formation are regarded as the proxy for capital) *and L= Labour* (replaced by population). Following Romer (2006), it is assumed that the labor of African countries is referred to as effective labour (AL) since, due to trade liberalization, modern technologies become readily available. Note that the initial levels of capital, labor, and knowledge are taken as given. Romer (2006) further assumes that labor and knowledge grow at constant rates:

$$\dot{L}(t) = nL(t), and\ \dot{A}(t) = \dot{} gA(t)$$

Where$\dot{L}(t) = \frac{dL(t)}{d(t)}$ and $\dot{A}(t) = \frac{dA(t)}{d(t)}$

That means labor and technology grow at the rates *n* and *g* respectively. The author also continued to insist that output is divided between consumption and investment. The fraction of output devoted to investment, *s*, is exogenous and constant. One unit of output devoted to investment yields one unit of new capital. In addition, existing capital depreciates at the rate δ. Thus,$\dot{K}(t) = sY(t) - \delta K(t)$. With this, we can now derive output per unit of labor by dividing by AL:

$$\frac{Y}{AL} = F(\frac{K}{AL}, \frac{AL}{AL}) = F(\frac{K}{AL}, 1)$$

Here,
$\frac{Y}{AL} = Outputperunitofeffectivelabor, \frac{K}{AL} = capitalperunitofeffectivelabor$

$$\text{Define } k = \frac{K}{AL}, y = \frac{Y}{AL}, and f(k) = F(k, 1).$$

The whole equation can be rewritten as$y = f(k)$.This means that output per unit of effective labor is a function of capital per unit of effective labor. This function demonstrates that when a unit of labor consumes a zero amount of capital, then total production will be zero [f(0)=0]. Since $F(K, AL)$equals $ALf\left(\frac{K}{AL}\right)$,it follows that the marginal product of capital,$\frac{\partial F(K,AL)}{\partial K}$equals $ALf'\left(\frac{K}{AL}\right)\left(\frac{1}{AL}\right)$, which is just $f'(k)$. Thus, the model assumes that $f'(k) > 0$ and$f''(k) < 0$, which shows that the marginal product of capital is positive but declines as the capital-labor ratio passes a certain point. In contrast to the marginal product of capital, labor productivity rises with a rise in the K/L ratio. In the case of LDCs, labor consumes less capital and hence the marginal product of capital is higher than the marginal product of labor. Moreover, the problem is aggravated as K/AL decreases over time due to the inclusion of more labor and technology and depreciation of existing capital. From this theoretical analysis, it is possible to show the dynamics of k=K/AL as the economy grows over time. Hence, it will be easier to focus on the capital stock per unit of effective labor, *k*, than the unadjusted capital stock. Through the chain rule, it can be explained that:

$$\dot{k}(t) = \frac{\dot{K}(t)}{A(t)L(t)} - \frac{K(t)}{[A(t)L(t)]^2}[A(t)\dot{L}(t) + L(t)\dot{A}(t)]$$

$$= \frac{\dot{K}(t)}{A(t)L(t)} - \frac{K(t)}{A(t)L(t)}\frac{\dot{L}(t)}{L(t)} - \frac{K(t)}{A(t)L(t)}\frac{\dot{A}(t)}{A(t)}$$

$$\dot{k}(t) = \frac{sY(t) - \delta K(t)}{A(t)L(t)} - k(t)n - k(t)g$$

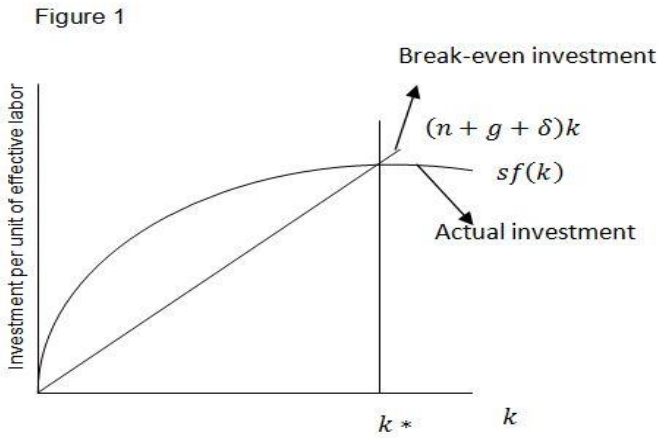
$$=s\frac{Y(t)}{A(t)L(t)} - \delta k(t) - nk(t) - gk(t)$$

Finally, the model will be

$$\dot{k}(t) = sf\big(k(t)\big) - (n + g + \delta)k(t)$$

Hence, for ensuring steady growth, (n+g+δ) amount of capital has to be invested. We believe that, in LDCs, if the capital-labor ratio is below the point k*, then the ratio will be falling due to depreciation of existing capital and inclusion of new effective labor. Diagrammatically, the above propositions can be explained as follows:

Figure-1. Actual and break-even investment



The vertical axis of the diagram represents total investment per unit of efficient labor needed to be committed in a country to produce a given steady state of output. The horizontal axis represents the total capital per unit of effective labour (K/AL) employed. *sf(k)* is the representation of total actual investment that accrues as a result of the unit of labor and capital employed – i.e., *f(k)*– while a fraction of that output that is invested is *s*. Then,$(n + g + \delta)k$ will yield a break-even point of the investment required. As a result of this, it represents the expected level of investment that must be committed in order to allow *k* to remain at a steady state. With respect to this analysis and in order to keep K from depreciating, consistent capital replacement must be ensured, particularly in Africa as this is in line with the theory of creative destruction. Similarly, where the quantity of labor is accelerating due to population growth, in this case sufficient investment must further be committed to keeping the capital stock (K) constant. This may not, however, be enough to keep the capital stock per unit of effective labor (k) constant.

4. Methodology, data, and model specification

This study employs annual time series data of South Africa from 1980 to 2011. The data are extracted from the World Development Indicators (WDI) dataset. The main variable of concern is GDP per capita (GDP constant at 2000 prices) as the main explanatory variable and the other explanatory variables are those associated with economic growth, fixed capital formation (FCF), trade openness (TRADE), the population growth rate (POP), and financial development (FD). Moreover, this study takes three measures of financial development:(1) the ratio of liquid liabilities to nominal GDP (M3);(2) the ratio of commercial bank assets to central bank assets(BASSET); and 3) the ratio of credit issued to the private sector by the banks to GDP (PRIVATE). All variables are in logarithms.

The study also follows Ang and McKibbin (2007) in using the PCA of the financial development variable. This method has two distinct advantages. First, it overcomes the multicollinearity issue that may be common with time series data, particularly in the PCA of the financial development variable. Second, it brings in the gross effect of financial development on GDP growth. The traditional approaches used are mainly aimed at exploring the cointegration relation among respective variables in most of the research using the Engle and Granger and Johansen approaches. These make these two approaches have some severe limitations. First of all, the Engle and Granger approach is only applicable to a bivariate test and as a result it does not consider more than two variables at a time. Secondly, the Johansen test is only applicable to variables of the same order of integration. Furthermore, the Johansen test is acutely sensitive to the selection of the optimal number of lags (Gnzalo, 1994). Considering these criticisms, this study applies the ARDL bounds-testing technique of Pesaran et al. (2001). This mechanism has the following key fundamental characteristics. First, after selecting the optimum lag, a cointegration relationship can be estimated using the OLS technique. Second, the test furnishes the long- and short-run relationship coefficient simultaneously. Third, in contrast to the Engle-Granger and Johansen methods, this test provides consistent result seven in an existing mix order of I(0) or I(1) or mutually integrated order of variables (this test procedure, however, will not be applicable if an I(2) series exists in the model). Fourth, notwithstanding the incidence of the endogeneity problem, the ARDL model provides unbiased coefficients of explanatory variables along with valid t statistics. In addition, the ARDL model sufficiently corrects omitted lag variable bias (Inder, 1993). Finally, this test is remarkably efficient and consistent in small and finite sample sizes.

4.1 Model specification

Following Ang and McKibbin (2005), Khan and Qayyum (2005), and Fosu and Magnus (2006), the ARDL version of the vector error correction model (VECM) can be specified as:

Model 1 (Equation 1a)

$$\Delta \ln GDP = \beta_0 + \beta_1 \ln GDP_{t-1} + \beta_2 \ln FCF_{t-1} + \beta_3 POP_{t-1} + \beta_4 TRADE_{t-1} + \beta_5 \ln FD_{t-1} + \Sigma_i^p \gamma_i \Delta \ln GDP_{t-1}$$
$$+\Sigma_1^q \varphi_1 \Delta \ln FCF_{t-1} + \Sigma_m^q \varphi_1 \Delta POP_{t-m} + \Sigma_r^q \psi_1 \Delta TRADE_{t-r} + \Sigma_n^q \eta_m \Delta FD_{t-n} + \varepsilon_t \text{.....(1}a\text{)}$$

Model 2 (Equation 1b)

$$\Delta \ln GDP = \beta_0 + \beta_1 \ln GDP_{t-1} + \beta_2 \ln FCF_{t-1} + \beta_3 \ln POP_{t-1} + \beta_4 \ln M3_{t-1} + \beta_5 \ln PRIVATE_{t-1} + \beta_6 \ln BASSET_{t-1}$$
$$+\Sigma_i^p \gamma_i \Delta \ln GDP_{t-1} + \Sigma_j^q \delta_j \Delta \ln FCF_{t-j} + \Sigma_1^q \varphi_1 \Delta POP_{t-1} + \Sigma_m^q \eta_m \Delta \ln M3_{t-m} + \Sigma_n^q \theta_n \Delta \ln PRIVATE_{t-1}$$
$$+\Sigma_p^q \vartheta_p \Delta \ln BASSET_{t-m} + \varepsilon_t \text{.....(1}b\text{)}$$

4.2 Model estimation procedure

We begin the estimation of equation (1a) using the OLS approach and then proceed to conduct the Wald test or F-test for joint significance of the coefficients of the lagged variables. This will enable us to examine the existence of the long-run relationship among the variables. The null hypothesis is (H_0): $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$, which means that there is no cointegration among the variables. The alternative hypothesis is (H_a): $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$. Then, the calculated F-statistic is evaluated with the critical value (upper and lower bound) given by Pesaran et al. (2001). If the F-statistic is above the upper critical value, the null hypothesis of no cointegration is rejected as this indicates that a long-run relationship exists among the variables. Conversely, if the F-statistic is smaller than the lower critical value, the null hypothesis cannot be rejected, implying no cointegration among the variables. If the F-statistic lies between lower and upper critical values, however, the test is

inconclusive. In the second step, after establishing the cointegration relationship among the variables, the long-run coefficient of the ARDL model can be estimated:

Equation 2a:

$$\ln GDP = \beta_0 + \Sigma_{j=1}^{q1}\gamma_i \ln GDP_{t-1} + \Sigma_{j=0}^{q2}\tau_j \ln FCF_{t-j} + \Sigma_{j=0}^{q3}\varphi_j \ln POP_{t-1} + \Sigma_{j=0}^{q4}\psi_j \ln TRADE_{t-j} + \Sigma_{j=0}^{q5}\eta_m \ln FD_{t-1} + \varepsilon_t .....(2a)$$

E

Equation 2a:

$$\ln GDP = \beta_0 + \Sigma_{i=1}^{p}\gamma_i \ln GDP_{t-1} + \Sigma_{j=0}^{q1}\psi_j \ln TRADE_{t-j} + \Sigma_{k=0}^{q2}\delta_j \ln FCF_{t-k} + \Sigma_{l=0}^{q3}\varphi_1 \ln POP_{t-1} + \Sigma_{m=0}^{q4}\eta_m \ln M3_{t-m} + \Sigma_{n=0}^{q5}\tau_n \Delta \ln PRIVATE_{t-1} + \Sigma_{s=0}^{q6}\omega_s \ln BASSET_{t-s} + \varepsilon_t .....(2b)$$

In this process, we use the Schwarz Information Criterion (SIC) for selecting the appropriate lag length of the ARDL model for all the variables under study. Finally, we use the error correction model (Equation 3a and Equation 3b) to estimate short-run dynamics:

Equation 3a:

$$\Delta \ln GDP = \beta_0 + +\Sigma_{i=1}^{p}\gamma_i \Delta \ln GDP_{t-1} + \Sigma_{j=0}^{q}\tau_j \Delta \ln FCF_{t-j} + \Sigma_{l=0}^{q}\varphi_l \Delta \ln POP_{t-l} + \Sigma_{n=0}^{q}\psi_j \Delta \ln TRADE_{t-J} + \Sigma_{m=0}^{q}\eta_m \Delta \ln FD_{t-m} + \vartheta emc_{t-1} + \varepsilon_t .....(3a)$$

Equation 3b:

$$\Delta \ln GDP = \beta_0 + +\Sigma_{i=1}^{q}\gamma_i \Delta \ln GDP_{t-1} + \Sigma_{j=0}^{q}\tau_j \Delta \ln TRADE_{t-j} + \Sigma_{k=0}^{q}\delta_k \Delta \ln FCF_{t-k} + \Sigma_{l=0}^{q}\varphi_l \Delta \ln POP_{t-l} + \Sigma_{m=0}^{q}\eta_m \Delta \ln M3_{t-m} + \Sigma_{n=0}^{q}\theta_n \Delta \ln PRIVATE_{t-1} + \Sigma_{p=0}^{q}\vartheta_s \Delta \ln BASSET_{t-m} + \vartheta emc_{t-1} + \varepsilon_t .....(3b)$$

Cusum and cusumsq (stability test)

We performed two tests of stability on the long-run coefficients together with the short-run dynamics, following the suggestion by Pesaran (1997),to check the stability of short- and long-run parameters of the selected ARDL model by using the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) tests.

5. Empirical results and discussion

Before proceeding to ARDL estimation, this study conducts a unit root test to see the status of stationarity of each of the variables. This is done in order to ensure that no variable is I(2) so as to avoid a spurious result as Ouattara (2004) argues that the ARDL model is based on the assumption of I(0) and I(1). Hence, the unit root test still would be beneficial to make sure no variable exceeds the integrated order I(1).This applied unit root test, however, considers both the constant and trend, and Table 1 shows that all the variables are stationary at I(1) where the logarithm of GDP (LGDP) and TRADE are stationary at I(0) at the 10% significance level. The presence of such a mixed order of integration suggests the appropriateness of applying an ARDL bounds-testing approach to cointegration other than the Johansen and Juslieus approach.

Table-1. Unit root test

Variables	**DF OLS**		**DF OLS**
	In level		First difference
	Intercept	Intercept & trend	Intercept
LGDP	-1.731*	-1.328	-4.647***
LFCF	-0.192	-1.576	-4.677***
LPOP	-1.116	-0.725	-5.574***
TRADE	-1.165*	-1.172	-5.925***
M3	-1.520	-1.961	-5.709***
PRIVATE	-1.011	-0.866	-5.797***
BASSET	-0.724	-0.639	-4.457***

Notes: All variables are in logs except TRD, M3, PRIVATE, and BASSET due to negative numbers in the series. The DF-GLS statistic is compared to the critical values from the simulated MacKinnon table in ERS (1996, Table 1, p. 825). *** (**) denotes the rejection of the null at the 1%(5%) significance level. Results are obtained from EViews 6.

Table-2. VAR model for lag order selection criteria

Endogenous variables: LGDPC LPOP LFCF TRADE PRIVATE M3 BASSET						
Lag	Log L	LR	FPE	AIC	SC	HQ
0	-82.68332	NA	0.000291	6.047125	6.282866	6.120956
1	81.03681	259.6940	2.10e-08	-3.519780	-2.105336	-3.076794
2	114.2404	41.21820*	1.41e-08	-4.085542	-1.492395	-3.273401
3	146.8224	29.21151	1.37e-08*	-4.608444*	-0.836593*	-3.427147*

Prior to estimating the ARDL bounds test, this study uses a standard VAR model for selecting the optimum lag. This study, however, follows the Schwarz Bayesian Criterion (SC), which reveals that the optimum lag is 3. After selecting the optimum lag order, we proceed to estimate Equations 1a and 1b using the OLS approach. We then proceed to conduct the Wald test for measuring the joint effect of all regressors. The calculated F-statistics for the cointegration test are displayed in Table 3a and Table 3b, where both of the tables confirm the existence of cointegration relations in both of the models. Through the normalization process, the study also found that there is cointegration at the 5% level of significance when FCF and FD are dependent variables. The same procedure has been applied to analyze model 2. The study found a cointegration relationship between GDP and all the other explanatory variables and this is shown in Table 3b.

Table-3a. Results from bounds test: model 1:
GDP=F(POP, TRD, FCF, FD)

Dep. Var.	SIC Lag	F-statistic	Probability	Outcome
F_{GDP}(GDP|POP, TRD, FCF, FD)	3	6.088***	0.005	Cointegration
F_{POP}(POP|GDPC, TRD, FCF, FD)	3	5.383***	0.005	Cointegration
F_{TRD}(TRD| GDP, POP, FCF, FD)	3	5.494***	0.005	Cointegration
F_{FCF}(FCF| GDP, POP, TRD, FD)	3	5.161***	0.009	Cointegration
F_{FD}(FD| GDP, POP, TRD, FCF)	3	4.888**	0.011	Cointegration

Notes: Asymptotic critical value bounds are obtained from Table F in Appendix C, Case II: intercept and no trend for k=5 (Pesaran and Pesaran, 1997, p. 478). Lower bound I(0) = 2.39 and upper bound I(1) = 3.38 at the 5% significance level.

Table 3a reports the results of the calculated F-statistics when each variable is considered as a dependent variable (normalized) in the ARDL-OLS regressions. The calculated F-statistic F_{GDP} (GDP| TO, POPG, GOV, FD)=6.088is higher than the upper bound critical value 4.15 at the 1% level of significance, which means cointegration exists in the model. Similarly, when population growth, trade openness, fixed capital formation, and financial development are normalized, the Wald test F-statistic falls within the upper bound of the critical value, which indicates cointegration exists among all of these variables.

Table-3b. Results from bounds test: model 2:
GDP=F (POP, TRD, FCF, M3, PRIVATE, BASSET)

Dep. Var.	SIC Lag	F-statistic	Probability	Outcome
F_{GDP}(GDPC|POP, TRD, FCF, M3, PRIVATE, BASSET)	3	9.300***	0.007	Cointegration
F_{POP}(POP|GDP, TRD, FCF, M3, PRIVATE, BASSET)	3	2.293	0.834	NoCointegration.
F_{TRD}(TRD| GDP, POP, FCF, M3, PRIVATE, BASSET)	3	4.409***	0.045	Cointegration
F_{FCF}(FCF| GDP, POP, TRD, M3, PRIVATE, BASSET)	3	6.223**	0.020	Cointegration
F_{M3}(M3| GDP, POP, TRD, FCF, PRIVATE, BASSET)	3	9.379***	0.007	Cointegration
F_{PRIV}(PRIVATE| GDP, POP, TRD, FCF, M3, BASSET)	3	5.512***	0.027	Cointegration
F_{BASS}(BASSET| GDP, POP, TRD, FCF, M3, PRIVATE)	3	4.117***	0.052	Cointegration

Notes: Asymptotic critical value bounds are obtained from Table F in Appendix C, Case II: intercept and no trend for k=5 (Pesaran and Pesaran, 1997, p.478). Lower bound I(0) = 2.73 and upper bound I(1) = 3.90 at the 1% significance level.

Table 4b reports the results of the calculated F-statistics when each variable is considered as a dependent variable (normalized) in the ARDL-OLS regressions. The calculated F-statisticF_{GDPC}(GDP| TO, POPG, GOV, FD)=9.300is higher than the upper bound critical value 3.90 at the 1% significance level, which means cointegration exists in the model. Likewise, when all the variable are considered as dependent variables one by one, the respective F-statistic falls within the upper bound of the Pesaran critical value, which reveals that they are cointegrated. In the case of population growth, however, cointegration does not hold.

Table-4a. Estimated long-run coefficients. ARDL (1,0,0,0,0) selected based on Schwarz Bayesian Criterion (SBC)

Regressor	Coefficient	Standard Error	T-ratio[Prob]
TRADE	0.001	0.002	0.791[.437]
FCF	0.120	0.047	2.554[.018]
LPOP	0.765	0.129	5.912[.000]
FD	0.041	0.007	5.363[.000]
C	-9.769	1.517	-6.437[.000]

Table 4a reports an inconclusive impact of trade openness on GDP per capita in the long run as its coefficient is insignificant. Fixed capital formation, population growth, and financial development, however, have positive and significant impacts on long-run GDP per capita.

Table-4b. Estimated long-run coefficients. ARDL (1, 0, 2, 0, 0, 0, and 0) selected based on Schwarz Bayesian Criterion (SBC)

Regressor	Coefficient	Standard error	T-ratio[Prob]
TRADE	0.005	0.003	1.432[.167]
FCF	-0.047	0.100	-0.477[.638]
LPOP	1.170	0.262	4.458[.000]
M3	-0.843	0.613	-1.376[.184]
BASSET	-0.031	0.157	-0.198[.844]
PRIVATE	3.716	1.588	2.340[.030]
C	-13.303	2.600	-5.116[.000]

Similarly, model1 and model 2 also found trade openness has an insignificant impact on GDP. Unlike model1, model 2 shows that FCF has no significant impact. Nevertheless, the impact of population growth is consistent with model 1 and means that the population grows faster than the long-run economic growth of Sudan. Among all three indicators of financial development, only PRIVATE has a positive and significant impact on GDP per capita.

Table-5a. Error correction representation for the selected ARDL model

Regressor	Coefficient	Standard error	T-ratio[Prob]
dTRADE	0.001	0.001	0.808[.427]
dFCF	0.079	0.039	2.012[.056]
dLPOP	0.504	0.108	4.637[.000]
dFD	0.027	0.008	3.279[.003]
dC	-6.430	1.333	-4.823[.000]
ecm(-1)	-0.658	0.145	-4.509[.000]

ecm = GDP -.0017360*TRADE -.12021*FCF -.76583*LPOP -.041092*FD + 9.7694*C

Table 5a reveals that, other than trade openness, LFCF, LPOP, and FD have positive and significant impacts on GDP in the short run. The error correction coefficient is negative and significant, which means that after any economic shock it adjusts 65% per year towards the long-run equilibrium.

Table-5b. Error correction representation for the selected ARDL model

Regressor	Coefficient	Standard error	T-ratio[Prob]
dTRADE	0.003	0.001	1.748[.095]
dFCF	0.068	0.053	1.262[.221]
dFCF1	0.068	0.039	1.738[.097]
dLPOP	0.660	0.159	4.141[.000]
dM3	-0.475	0.325	-1.462[.158]
dBASSET	-0.017	0.085	-0.206[.839]
dPRIVATE	2.096	0.716	2.926[.008]
dC	-7.502	1.647	-4.553[.000]
ecm(-1)	-0.563	0.167	-3.375[.003]

ecm = GDP -.0055124*TRADE + .047740*FCF -1.1708*LPOP + .84381*M3 + .031374*BASSET-3.7166*PRIVATE + 13.3030*C

Table 5b reports that TRADE and LPOP still have positive and significant impacts on GDP, whereas M3 and BASSET have negative but insignificant impacts on GDP in the short run. PRIVATE, however, has a strong positive association with short-run GDP. The error correction coefficient is negative and significant, which means that after any economic shock, it adjusts 56% per year towards the long-run equilibrium.

Sasabuchi-Lind-Mehlum (SLM) test

The seminal work of Arcnad et al (2012) found a non-monotonic relationship between financial development and economic growth. In view of this, we employ the same line of investigation to the case of Northern Sudan. The main purpose of this test is to explore whether the marginal impact of financial development is positive at a certain point and after the point where financial development no longer contributes to boosting economic growth or may have a negative outcome, particularly as a result of economic shocks from the recent global financial crisis. The conventional procedure is to capture the non-monotonic relation, which is done simply by taking a quadratic form of the variable of concern. According to Lind and Mehlum (2010), however, including the quadratic term does not guarantee the existence of a non-monotonic association between financial development and economic growth. Such a procedure is only confirmed by the necessary condition of the existence of an inverted U-shaped relationship, but is not a sufficient condition. Thus, in order to make sure of the presence of an inverted U-shaped relationship, Lind and Mehlum (2010) developed and modified Sasabuchi's (1980) likelihood ratio test, which is now known as the Sasabuchi-Lind-Mehlum (SLM) test. To conduct the test, we have to estimate the following model:

$$GDP_t = aFD + bFD_t^2 + Z_t C + \varepsilon_t$$

Next, it is necessary to conduct the following joint hypothesis test: $H_0: (a + b2FD_{min} \leq 0) \cup (a + b2FD_{max} \geq 0)$ against t. The alternative hypothesis is $H_1: (a + b2FD_{min} > 0) \cup (a + b2FD_{max} < 0)$ Where FD_{min} and FD_{max} represent t. Here, FD_{min} and FD_{max} represent the maximum and minimum value of financial development. If the null hypothesis is rejected, it confirms the existence of a U-shaped relationship.

The results of the U test are shown in Table 6and indicate that the lower bound slope of FD is negative (-0.35) and statistically significant while the upper bound slope of FD is positive (0.49) but insignificant. The SLM test in the bottom panel of Table 6 shows that the null hypothesis is rejected, which means that there is a non-linear relationship between FD and GDP but as long as the upper-bound slope is insignificant, we cannot make a conclusion of a non-monotonic relationship between FD and GDP in the case of Northern Sudan.

Table-6. U-test: The table reports the results of the Sasabuchi-Lind-Mehlum (SLM) test for an inverse U-shaped relationship

Northern Sudan	
Slope at FD_{min}	-0.350 (0.000)
Slope at FD_{Max}	0.497 (0.387)
SLM test for inverse U-shape	5.14
P value	0.00

Table-7a. ARDL-VECM model diagnostic tests for model 1

R^2=0.99, Adjusted R^2=0.98	
Serial correlation $\chi^2(1)$=0.100[0.752]	Normality $\chi^2(2)$=0.588[0.745]
Functional form $\chi^2(1)$= 1.889[0.169]	Heteroscedasticity$\chi^2(1)$=5.900[0.015]

Table-7b. ARDL-VECM model diagnostic tests for model 2

R^2=0.99, Adjusted R^2=0.98	
Serial correlation $\chi^2(1)$=0.130[0.718]	Normality $\chi^2(2)$=0.338[0.844]
Functional form $\chi^2(1)$= 0.705[0.401]	Heteroscedasticity$\chi^2(1)$=3.563[0.059]

The overall goodness of fit of the estimated models is shown in Tables 7a and 7b, and the R^2 values are quite high – i.e., 98% for model 1 and 99% for model 2. In order to ensure the accuracy of this, we applied a number of diagnostic tests to the ARDL model. The tests found no evidence of serial correlation, multicollinearity, or error in functional form, but did find a heteroscedasticity problem in both models (Tables 7a and 7b). According to Shrestha and Chowdhury (2005) and Fosu and Magnus (2006), however, it is quite natural to detect heteroscedasticity in the ADRL approach since the model uses time series data mixing the integrated order I(0) and I(1). Figures, 2, 3, 4, and 5show the stability test results of both the CUSUM and the CUSUMSQ: the CUSUM and CUSUMSQ remain within the critical boundaries of the 5% significance level. These statistics specify that the long-run coefficients and all the short-run coefficients in the error correction model are stable and affect economic growth in the case of Northern Sudan.

6. Conclusion and policy recommendations

In this paper, we examined the empirical relationship between financial development and economic growth in Northern Sudan from 1980 to 2011 using an ARDL bounds-testing approach to cointegration. The study found that the Northern Sudanese economy has not benefited significantly from the overall impacts of financial development in both the long run and the short run. The study found only fixed capital formation and financial development to be positive and significant in the short-run, while in the long-run it is only the ratio of credit issued to the private sector by the banks to GDP that is positive and makes a significant contribution to Northern Sudanese GDP. This startling finding is in contrast to that of Muhammed (2006), as a

result we found it surprising to see a country that is subject to economic sanctions, war-torn, and split into two parts yielding this robust result(see Table 4a, Table 4b,Table 5a, and Table 5b).

The study, however, consistently found that trade does not have significant impact on GDP in both the long run and the short-run. We believe that this finding is due largely to the economic sanctions facing the country, in this respect, the insignificant contribution of trade to the GDP has consistently impeded on the economic growth of Northern Sudan, coupled also with a less productive population that is expanding without a corresponding increase in productive effort, as the findings suggest. This result is found to be inconsistent with empirical research like Dollar (1992), Edwards (1998), Harrison (1996), Barro and Lee (1994), Easterly and Levine (2001), Dollar and Kraay (2003), Irwin and Tervio (2002), Islam (1995), and Sala-i-Martin (1997). This may be due to the international economic sanctions placed on the Northern Sudanese economy. The research also discovered that among the three indicators of financial development, only the ratio of credit issued to the private sector by the banks to GDP has a positive and significant impact on GDP per capita. In another startling finding, the research further discovered that the ratio of liquid liabilities to nominal GDP and the ratio of commercial bank assets to central bank assets have negative but insignificant impacts on GDP in the short run. The ratio of credit issued to the private sector by the banks to GDP has, however, a strong positive association with short-run GDP. The error correction coefficient is also negative and significant, which means that after any economic shock it adjusts 65% per year and 56% per year towards the long-run equilibrium in model 1 and model 2 respectively.

A recent study by Arcand *et al*/ (2011) confirmed that the relationship between financial development and economic growth is non-monotonic. Following from this finding, and considering the series of shocks witnessed in the recent global financial crisis and the economic sanction the country is facing, we investigated the assertion made by the author in the case of Northern Sudan. The result of the analysis can be seen from Table 7, where the lower-bound slope of financial development is negative (-0.35) and statistically significant, while the upper-bound slope of financial development is positive (0.49) but insignificant. The SLM test in the bottom panel of Table 7 shows that the null hypothesis is rejected, which indicates that there is a non-linear relationship between financial development and GDP, but as the upper-bound slope is insignificant, we cannot conclude the existence of a non-monotonic relationship between financial development and GDP in Northern Sudan. This surprising finding is in line with Arcand et al. (2011), which suggests that too much finance prevails in the Northern Sudanese economy. This fact can be supported by the high inflationary pressure (an inflation rate of 36%) facing the country.

From the above findings, we recommend that Northern Sudan needs to find a way in which it can free itself from international sanctions. If it cannot do this, its economy is bound to be further crippled, considering the series of variables that showed negative long-run association with its GDP and the resultant high level of inflation, large fiscal deficit etc. In the interim, we suggest that a formidable means for boosting productivity should be devised as this may be a short-run palliative measures. In essences massive investment in entrepreneurial activities might be something that takes advantage of the fact that the country has a vast land mass endowed with abundant natural resources, which different innovative and creative entrepreneurial means may exploit. It will equally be vital for the Northern Sudanese government to reshape its monetary policies towards battling inflation and creating synergies that will enable it to have a more resilient, effective, and efficient financial sector. However, this may be very difficult with the ongoing economic sanctions.

Schedule A present CUSUM and CUSUMSQ graph for model 1

Figure 2

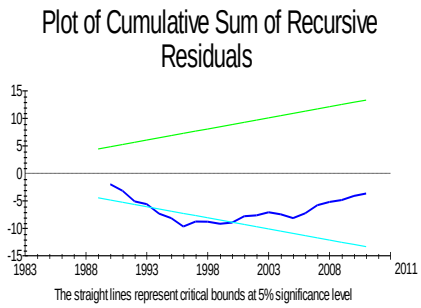
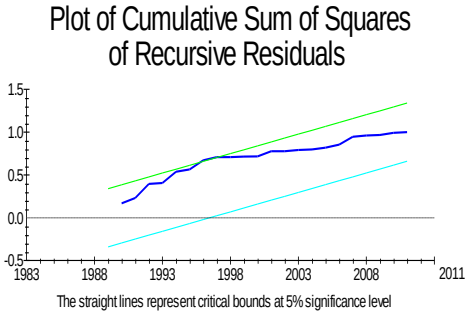


Figure 3



Schedule B present CUSUM and CUSUMSQ graph for model 2

Figure 4

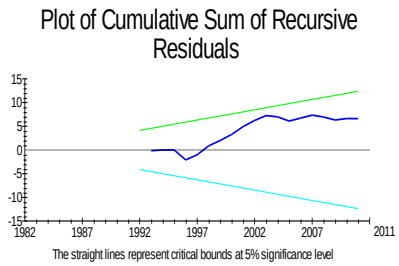
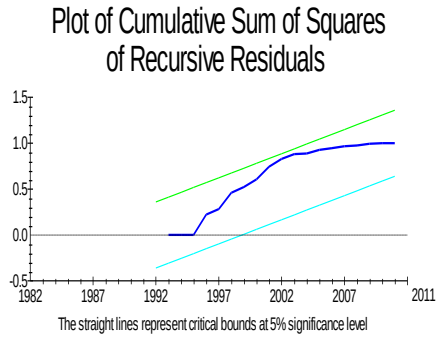


Figure 5



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