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IN SUDAN? EVIDENCE FROM ARDL BOUNDS TESTING
ANALYSIS**

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Abstract

This study examines the relationship between foreign aid and economic growth in Sudan using autoregressive distributed lag (ARDL) bounds tests. Relying on time series data spanned over the period 1980 to 2015, the findings reveal that there is a long run relationship between variables under consideration. Specifically, the findings show that foreign aid in the form of official development assistance (ODA) has a positive and significant long run impact on economic growth in Sudan. However, the interaction between aid and corruption in public institutions imposes a negative and significant long run impact on economic growth. Interestingly, the findings indicate that aid deters economic growth in the short run. This outcome may stand as indication that aid spurs economic growth via its contributions to human capital and improving infrastructural facilities both of which become rewarding in the long run. The paper concludes with the importance of utilizing aid in enhancing human capital capacities in order to boost economic growth.

Keywords: GDP, Growth, Foreign Aid, ARDL, Sudan

JEL Classifications: F14, F15

ملخص

تهدف هذه الدراسة إلى إختبار العلاقة بين تدفق العون الأجنبي والنمو الاقتصادي في السودان وذلك باستخدام منهجية الإنحدار الذاتي للفجوات الزمنية الموزعة. ولتحقيق هذا الهدف إعتمدت الدراسة على بيانات سلاسل زمنية تمتد خلال الفترة من 1980 إلى 2015. وقد أوضحت نتائج الدراسة أن هناك علاقة طويلة المدى بين المتغيرات قيد الدراسة. وبصورة أكثر تحديداً، أثبتت نتائج التحليل أن المعونات الأجنبية التي عادة ما تُمنح في شكل مساعدات إنمائية رسمية لها أثر إيجابي ومعنوي على النمو الاقتصادي في المدى الطويل. وعلى النقيض من ذلك، توصلت الدراسة إلى نتيجة مفادها أن التفاعل بين المعونات الخارجية وتفشي الفساد في المؤسسات العامة له أثر سلبي ومعنوي على النمو الاقتصادي في المدى الطويل. ومن المُثير للاهتمام أن النتائج قد أشارت إلى أن المعونات الأجنبية تُثبط النمو الاقتصادي في المدى القصير. ولعل مثل هذه النتيجة تُدلُّ على أن المعونات الأجنبية تحفز النمو الاقتصادي من خلال مساهماتها في تطوير رأس المال البشري وتحسين مرافق البنى التحتية التي عادة ما تصبح داعمة للنمو في المدى الطويل فقط. وقد خلصت الدراسة إلى ضرورة الإستفادة من المعونات الأجنبية في تطوير إمكانيات رأس المال البشري من أجل تعزيز النمو الاقتصادي.

1. Introduction

It has been widely acknowledged that the key target of the official development assistance (ODA) is to help developing countries exist the prolonged poverty and economic backwardness. Specifically, the ultimate goal of sending these resources is to provide these countries with financial and technical assistances in order to put their economies on the track of sustainable economic development. Theoretically, the contribution of aid in achieving these targets also has been strongly emphasized. Many of the leading development scholars (e.g. Harod-Domar, Rosenstein-Rodan and Rostow), claim that aid, whatever the form it takes, establishes a great deal in filling the capital gap experienced by developing economies. Furthermore, those scholars argue that apart from its contributions in capitalizing undercapitalized economies, aid can boost economic growth through the opportunities it offers for building the capacities of local cadres, elevating healthiness of human capital and establishing enhanced infrastructures.

Owing to these claims, huge amounts of aid have been transferred regularly to developing nations. During a one decade, for instance, the amounts of aid disbursed to developing countries increased 2.27 times, from US\$ 33.7132 billion in the 1960 to US\$ 76.5664 billion in the 1970, to US\$ 83.7002 billion in the 1980 (twice that of the 1970) and to US\$ 74.8361 billion in the 2000. According to OECD's reports, real ODA inflows to these countries rose by 6.1% to 134.8 billion in 2013, reaching its ever recorded peak (OECD, 2013). However, although the disbursed aid is less than those amounts hoped and called for by development scholars and leading international organizations, aid resources seem to be not performing effectively in achieving the desirable targets. The high illiteracy rates, breakouts of diseases, severe poverty and extremely low standards of livings are still dominant in the majority of aid's recipient countries. The obvious ineffectiveness of aid is manifested in the failure to realize sustainable and reasonable levels of economic growth in these countries. This argument finds support in the paradoxical findings on aid-led growth hypothesis which represents one of the hotly debated issues in the contemporary literature on aid (Papanek, 1972; Bauer, 1976; Bauer, 1982; World Bank, 1985; Mosley et al. 1987 and Newlyn, 1990). These controversies were not restricted to whether aid does or doesn't have a positive effect on economic growth, but it surpasses that to question the contexts in which aid being allocated. Some scholars argued that the effectiveness of aid is likely to depend on the suitability of policies and institutional settings in recipient countries (Bauer, 1991; Collier and Dollar, 2002 and Burnside and Dollar, 2000).

Sudan, like other developing countries, has received and continues to receive considerable ODA from different donors. The stylized facts show that the real net ODA inflows into Sudan, although fluctuate and appear to be conditioned by political and humanitarian developments, keep on growing during last decades. According to Nour (2011) Sudan occupies a position among the top ODA's recipient countries. Aid as a percentage of gross national income (GNI) grew dramatically from representing 2.44% in the 1960 to 6.16% in the 1975 to 8.88% in the 1980 and to 7.44% in the 1990. During the last five decades (i.e. 1960 and 2014) ODA grew by an annual average of, approximately, 22%, demonstrating the generous assistance from donors to Sudan. These aid inflows, if utilized effectively, are supposed to contribute greatly in upgrading country's economic performance to the level that could possibly free it from poverty trap. Specifically, the effectiveness of aid in all fronts can be better materialized through its direct contributions in boosting GDP growth to the levels

that allow the country to graduate from its current unfavorable positions development ranking. In fact, the country's economy remains stagnant, GDP rotates around moderate rates of growth and labor market fails to absorb the army of unemployed. Arguably, since its independence in 1956, the country has suffered severe economic, political and social obstacles that have worked collectively in confining its economy in a vicious circle of lowest economic growth rates. These obstacles, however, wouldn't justify the negligible contributions of aid to economic growth. In view of that, the question may arise here is that: does aid contribute in promoting economic growth in Sudan during last three decades?

No doubt, this question is also motivated by the deep controversies in the existing literature on the contribution of aid to economic growth. Given these concerns, this paper represents an empirical endeavor to investigate the contribution of aid in promoting economic growth in Sudan. Towards this aim, the paper applies the autoregressive distributed lag (ARDL) bounds tests for co-integration and utilizes a time series data extended over the period 1980 to 2015 to carry out the intended empirical investigation.

The rest of this paper is organized as follows: Section 2 presents a detailed picture about the evolution of aid inflows into Sudan with the emphasis on its interactions with the key economic parameters. Section 3 introduces the related literature. Section 4 sets the method on which the analysis is performed, while Section 5 discusses and introduces empirical results. Finally, Section 6 concludes and sketches some policy implications.

2. Patterns of Aid Inflows into Sudan Economy

Like the case of other countries, the patterns of ODA received by Sudan reflect, to a large extent, the economic, political and social circumstances that the country had undergone. Specifically, the amounts of aid received rise when the country exposes to instability and shrink when the reverse is hold. For instance, during the period followed independence in which the country had enjoyed a relatively good economic performance, ODA inflows were at minimum. During the 1970s, the net ODA inflows decreased and, as Figure 1 indicates, troughed in the 1970. Undoubtedly, the reason behind the decline of ODA inflows was the dominance of the socialist believes branded the first two years of May regime. However, after the abortion of cough arranged by communists in the 1971 and the elimination of communists from government, ODA began to increase.

Driven by donors' humanitarian concerns, the country's ODA record has improved significantly with the incidence of natural disasters. The period of the 1980s, in which the country was hit by one of the toughest waves of drought, has witnessed one of the historical peaks of ODA inflows. Similarly, and as Figure 1 shows, ODA inflows has been affected by the political developments prevailing in the country. For example, at the beginning of the 1990s when Sudan became vulnerable in its international relations, the ODA registered its lowest records. In contrast, in 2000s, when the country conducted national conciliations and attempted to pacify its connections with the rest of the world, ODA has increased considerably. Agreeing with this argument, the signature of the General Peace Agreement between government of Sudan and Sudan People Liberation Movement (SPLM) in 2005 qualified the country to be one of the notable destinations for the ODA in SSA region. As can be read from Figure 1, these changes in political atmosphere led the country to register its second peak in terms of ODA reception.

Whatever the forms it takes, aid inflows are argued to elevate economic performance in recipient countries. In the context of a country lagging behind in terms of physical capital like

Sudan, aid inflows are anticipated to do a lot in mitigating these shortcomings. However, the stylized facts on the country's macroeconomic indicators may don't support such assertion. Table 1 exhibits the interactions between some of key macroeconomic indicators in Sudan economy and ODA during the period 1960 to 2014. Over these five decades, as the table shows, the overall correlations between aid presence and these indicators were not strong. Picking one, the reported figures indicate great divergences between ODA inflows and GDP growth rates. The exceptions were the 1960s and the 1970s, the periods in which there was a considerable conformity between aid presence and GDP growth. Specifically, during this period, aid growth rose from an annual average of 10.9% during 1960 -1964 to an annual average of 11.80% during the period from 1965 to 1969. In the same time period, GDP growth rates rose from an annual average of 0.59% during 1960 -1964 to an annual average of 1.60% in the next five years, proving a considerable consistency with aid performance. The decade of the 1970s also saw the same positive co-movements between ODA inflows and GDP growth. This consistency in the patterns of ODA inflows and GDP growth may, in part, arose due to the relative political stability that the country had perceived after the signature of Addis Ababa Agreement between the government and Sudan People' Liberation Army (SPLA) in 1972.

As mentioned earlier, during the second half of the 1980s, the country has exposed to hard waves of drought that hit a large portion of population's livelihoods. Stirred by that event, donors surged a huge amounts of humanitarian assistance leading ODA growth rates to jump by 77% in a one year (i.e. from 1984 to 1985). However, these increases in ODA were not in a complete match with the GDP growth rates. Specifically, while GDP grew by 4.39% during 1985 -1989, ODA grew at an annual average of only 2.02%. Furthermore, the inconsistency between aid flows and GDP growth can be proven by the positive economic growth rates had been achieved in the 1990s, the decade in which ODA inflows declined sharply.

Summing up, many interpretations can be proposed to justify aid's ineffectiveness in stimulating economic progresses in Sudan. First, the positive impact of aid on indicators such as, economic growth and capital accumulation is likely to depend on the type of ODA received. In this regard, considerable portions of ODA received by Sudan were in the form of food and other humanitarian assistance. Second, the poor absorptive capacities characterized Sudan economy, particularly the aspects related to human capital, may slow the digestion of benefits arising from aid presence. Third, the actual amounts of ODA inflows received by Sudan may turn out to be negligible compared to the capital gap experienced by the country. Fourth, the perception of corruption may also hinder the contribution of aid to economic growth. Yet, concluding that aid is ineffective in spurring economic enhancements in Sudan based on the above mentioned stylized facts, is largely subject to the doubts. Therefore, a sophisticated analysis performed via an advanced econometric technique can be called up to challenge this conclusion.

3. Literature review

The relationship between foreign aid and economic growth has been extensively analyzed by researchers. Theoretically, the spectrum of the debate extends from viewing aid as a mask hiding the exploitation by former colonizers for their past colonies (Frank, 1963; Taylor and Frank, 1971; Hayter, 1971; Stevenso, 1972; Hayter and Watson, 1985 and Hayter 2013), to advocating it as a kind assistance intends to assist developing nations to exist the miserable economic realities (Papanek, 1972 and World Bank, 1985). This theoretical disagreement

found its ways to the empirical evidence. On the one hand, several studies have reached to an outcome that aid encourages economic growth (Levy, 1988; Murthy et al., 1994; Fayissa and El-Kaissy, 1999; Gounder, 2001; Karras, 2006; Fasanya and Onakoya, 2012; Mekasha et al., 2013 and Adams and Atsu, 2014). On the other hand, many researchers have found that aid is inversely related to economic growth in targeted countries (Griffin and Enos, 1970; Cassen, 1994; Dhakal et al., 1996; Nyoni, 1998; Burke and Ahmadi-Esfahani, 2006; Mallik, 2008 and Kimura et al., 2012).

In the midst of this conflicting empirical evidence, several explanations have been picked up to justify the failure of aid in producing the desirable outcome on economic growth. First, numerous works have repeatedly reported that the contribution of aid to economic growth is conditioned by political, institutional and economic settings prevailing in recipient countries (Burnside and Dollar, 2000; Collier and Dollar, 2002; Collier and Hoeffler, 2004; Guillaumont and Chauvet, 2001; Svensson, 1999; Islam, 2003; Dalgaard et al., 2004 and Elbadawi et al., 2012). However, although some studies confirm the effectiveness of aid in spurring economic growth, they fail to detect the contribution of institutions and policies in deciding the exact thresholds of this effectiveness. Of these studies, Islam (2003) found that aid has a negative effect on economic growth in tinpot countries and a robust positive in totalitarian countries. Agreeing with Islam's study, Boone (1996) analyzed the effectiveness of aid in 96 recipient countries. His findings showed no significant differences between democratic and totalitarian regimes in managing aid ineffectively. In the same way, some studies have argued that aid accelerates economic growth in countries with bad institutional environment and that the good policies have no effects on aid effectiveness (Guillaumont and Chauvet, 2001). Second, some authors linked aid effectiveness to a certain period of time. Agreeing with this line of argument, Mosely (1980) claimed that the positive association between aid and economic growth has occurred and disappeared in the decades followed 1970s. Third, another strand of research contends that aid turns out to be ineffective in promoting economic growth when aggregated data has been used. Supporting this point of view, some authors argued that it is difficult to quantify the effect of aid on recipient economies at macro levels due to the incidence of fungibility (Mosley, 1987; Boone, 1994; 1996 and Devarajan et al., 1999).

Summing up, the disagreement among previous studies indicates that the empirical evidence on the nexus between aid and economic growth is largely inconclusive. This indecisive relationship calls the attention to the falseness of drawing one conclusion for all countries particularly when the case of a single country is considered. Taking the aim of this paper into account, studying the case of Sudan is of a great importance for both policymakers and donors. To the best of authors' knowledge, the only cited empirical study on aid effectiveness in Sudan has been done by Nour (2011). Depending on data collected at micro level, the author investigated the contribution of Chinese resources (i.e. loans, grants and aid) to improve the performance of Sudan economy. Her results showed that these resources exercise both a negative and a positive impact on Sudan economy. Specifically, the positive impact results from the fact that the Chinese resources crowds in domestic capital and offer funds for developmental projects. In contrast, the negative effects emerge from the fact that these financial resources accumulate Sudanese foreign debts. However, the conclusions established by Nour (2011) face many limitations. First, her study limits its scope to one type of aid (i.e. project aid) and, thus, doesn't allow to induct a concise conclusion on the full impact of aid

on economic growth in Sudan. Second, Nour's study used project level data and restricted the analysis to one donor, while Sudan used to receive ODA from different donors. Finally, analyzing the impact of aid on economic growth using descriptive statistics without resorting to sophisticated econometric methods may undermine the ability of the analysis to capture the marginal effects among the variables studied and, hence, raises doubt on the accuracy of the outcomes obtained.

4. Methodological Procedures

4.1 Model Specification

Both Lucas (1988) and Romer (1989) argue that the neoclassical growth model developed by Solow (1956) fails to explain a large portion of growth in the output because it treats technological innovation and population growth as exogenous variables. This criticism, combined with other empirical drawbacks experienced by the model, gave birth to the endogenous growth model in which output growth has been set as a function of physical capital, labor and human capital. According to Rana (1987) and Tallman and Wang (1994), the basic neoclassical growth model of Solow (1956) and Swan (1956) can be expressed in an augmented aggregate production function as follows:

$$Y_t = A_t K_t^\alpha (H C_t L_t)^\beta \dots (1)$$

Where Y_t represents real aggregate output; L and K denote, respectively, labor and physical capital inputs; H represents human capital; A is a measure of technology and exogenous knowledge; α is the share of capital; β is the share of labor and the subscript t represents time. Taking the natural logarithm for the underlying variables, the estimated form of equation 1 can be derived as:

$$\ln Y_t = \alpha \ln(K_t) + \beta \ln(L_t) + \delta \ln(H_t) + \ln(A_t) \dots (2)$$

Taking the aim of investigating the effect of aid on the economic growth into account, the aggregate capital (K_t) can be disaggregated into domestic and foreign capital in the form of aid. In addition, the variables that conventionally appear in economic growth model such as export, availability of banking credit can be also added. Moreover, we see that the model we intend to investigate must take into consideration the changes that occurred in economic policies during the period being investigated as well as the level of institutional quality. Accordingly, a dummy variable is included to represent the adoption of privatization policy, while the institutional quality is measured by interacting public corruption index and ODA. Applying these changes to equation 2, the final model can be rewritten as follows:

$$\ln GDP_t = \beta_0 + \beta_1 \ln LAB_t + \beta_2 \ln HC_t + \beta_3 \ln K_t + \beta_4 \ln ODA_t + \beta_5 \ln (ODA_t * PUBCORR_t) + \beta_6 \ln REXP_t + \beta_7 CRD_t + \beta_8 PRIV_t + \varepsilon_t \dots (3)$$

Where $\ln GDP$, $\ln LAB$, $\ln HC$, $\ln ODA$, $\ln (ODA * PUBCORR)$, $\ln REXP$, CRD and $PRIV$ are respectively, real GDP, labor measured by total labor force, human capital (measured by average years of schooling), real gross domestic capital formation, real ODA, real exports, financial credit provided to the private sector by banks as a percentage of GDP, and the interaction term between public corruption index and real ODA all in natural logarithms. $PRIV$ is a dummy variable used to capture the effect of implementing privatization policy on economic growth and ε_t is disturbance term which is assumed to be normally distributed. The β coefficients of the explanatory variables, excluding the dummy variable, reflect the elasticity of the real GDP with respect to each of these variables. Therefore, the generated coefficients of the log explanatory variables represent the percentage change in the dependent

variable resulting from a one percent change in the corresponding regressor. The financial credit provided to private sector by banks (CRD) which is expressed in ratios can be interpreted as semi-elasticity where its generated coefficient is multiplied by 100 to give the percentage change in the regressed variable (Wooldridge, 2006).

Based on economic theory, a priory expectation is that *InLAB* is likely to be associated with a positive sign ($\beta_1 > 0$) because increases in labor force lead to increases in economic activities and thus boost GDP growth. Similarly, the growth can be also influenced by the level of education (Barro and Lee, 1993; Barro, 1991 and Benhabib and Spiegel, 1994). Accordingly, the coefficient of human capital variable (*HC*) is expected to carry a positive sign ($\beta_2 > 0$). Similarly, the amount of physical capital (*lnK*) would have a major impact on GDP growth as increases in capital create a substantial rise in total factor productivity. Therefore, the estimated value of domestic capital coefficient is expected to be positive ($\beta_3 > 0$).

In the context of this study, aid represents the variable of interest. It has been included in the above equation so that its role in augmenting GDP growth can be captured. As an input in the production function, aid is expected to exercise a positive impact on total output thus the coefficient of the variable is expected to be positive. However, as stressed in the reviewed literature, the empirical evidence points out that aid could have a positive or negative effect on economic growth depending on the existence of some conditions. Therefore, the sign of its coefficient is anticipated to be undecided and waiting for empirical investigation ($\beta_4 > ?$). Moreover, the effect of ODA on GDP is likely to be affected by the level of institutional quality. As shown in the literature section, several studies have emphasized that the full utilization of aid resources requires a minimum level of institutional development in recipient countries. To include this complementary relationship between aid and institutional quality, the model has extended by including an interactive regressor *In(ODA * PUBCORR)*. The *PUBCORR* represents the public corruption index which used to proxy the institutional quality in Sudan. The coefficient β_5 represents the elasticity of GDP with respect to *ODA * PUBCORR* interactive term. The sign of β_5 's coefficient would depend on the level of corruption prevailing in the country and, therefore, remain undecided ($\beta_5 > ?$).

The previous researches have concluded that exports play an important role in advancing economic growth (Balassa 1985; Ram, 1985; Balassa, 1978 and Bhagwati, 1988). Thus, the coefficient of the real exports variable is expected to be accompanied by a positive sign ($\beta_6 > 0$). Furthermore, there is a large body of empirical literature on the role of the financial development in escalating economic growth. The availability of credit may determine the extent to which domestic firms are able to borrow in order to extend innovative activities. Besides, the capable banks would attract and mobilize public saving and offer it to other sectors at lower interest rates. Accordingly, the coefficient of banking credit variable is supposed to be associated with a positive sign ($\beta_7 > 0$).

Finally, the model also takes the adoption of the privatization policy that initiated in 1992 into account. Its impact has been delivered by the coefficient of the dummy variable (β_8). We see that it is feasible to include an exogenous variable to deliver the impact of privatization policy on economic growth. First, the privatization increases the level of accountability in business environment, decreases corruption and, therefore, expands domestic businesses. Second, the presence of a successful private sector is likely to motivate the managers of publicly owned projects to adopt the same managerial and technical methods adopted by private sector to

achieve business success. Adopting such efficient managerial techniques can boost productivity and accelerates GDP growth.

4.2 Estimation Method

We employ the autoregressive distributed lag (ARDL) cointegration procedures, as proposed by Pesaran and Shin (1999) and Pesaran et al. (2001), to investigate the effect of aid on economic growth in Sudan. We have chosen the ARDL co-integration technique because it possesses several superior merits compared to other cointegrating techniques. First, the ARDL bounds test facilitates obtaining consistent estimates even in small samples. Second, ARDL permits dealing with both stationary and non-stationary variables, as long as their order of integration doesn't exceed one I(1). Third, ARDL approach overcomes both serial correlation and endogeneity problem among variables, allowing the estimation of both the short-run and long run coefficients simultaneously and with lagged dependent and predictors variables. Fourth, according to Marques et al. (2016), the asymptotic theory built in the ARDL bounds test will not be affected even when one-zero dummy variables are included in the model being estimated. Fifth, the main concern of this analysis is to examine aid effectiveness on economic growth in Sudan economy. As foreign aid doesn't materialize as a spot effect on GDP growth but also leads to long run effects, some studies, when modeling aid effectiveness, apply lagged forms of both dependent and independent variables as additional predictors. In the ARDL sense, this matter can be handled automatically since the approach is dynamic in nature and openly considers the behavior of the variable over measurable period of time.

To investigate the long relationship among the variables pertaining to equation 3, the ARDL bounds test for the cointegration can be specified as follows:

$$\begin{aligned}
\Delta \ln GDP_t = & \alpha_0 + \sum_{i=1}^{n-1} \alpha_{1i} \Delta \ln GDP_{t-1} \\
& + \sum_{i=1}^{n-1} \alpha_{2i} \Delta \ln LAB_{t-1} + \sum_{i=1}^{n-1} \alpha_{3i} \Delta \ln HC_{t-1} + \sum_{i=1}^{n-1} \alpha_{4i} \Delta K_{t-1} + \sum_{i=1}^{n-1} \alpha_{5i} \Delta \ln ODA_{t-1} \\
& + \sum_{i=1}^{n-1} \alpha_{5i} \Delta \ln (ODA_t * PUBCORR_t)_{t-1} + \sum_{i=1}^{n-1} \alpha_{7i} \Delta \ln REXP_{t-1} \\
& + \sum_{i=1}^{n-1} \alpha_{8i} \Delta CRD_{t-1} + \sum_{i=1}^{n-1} \alpha_{9i} \Delta PRIV_{t-1} + \beta_1 \ln GDP_{t-1} + \beta_2 \ln LAB_{t-1} \\
& + \beta_3 \ln HC_{t-1} + \beta_4 \ln K_{t-1} + \beta_5 \ln ODA_{t-1} + \beta_6 \ln (ODA_t * PUBCORR_t) \\
& + \beta_7 \ln REXP_{t-1} + \beta_8 CRD_{t-1} + \beta_9 PRIV_{t-1} + \varepsilon_t \dots (4)
\end{aligned}$$

Where Δ denotes the first difference operator of the respective variable; a_0 represents the drift component and ε_t is the error term. The dynamics for the error correction in the short run are denoted by the terms with summation symbols while the long-run relationship is represented by β_s . The ARDL approach to cointegration involves two phases. In the first phase, the hypothesis of no cointegration is tested. Specifically, to detect the presence of cointegration relationship among the variables, we test the null hypothesis that $H_0: \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = \beta_7 = \beta_8 = 0$ against the alternative hypothesis $H_a: \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq \beta_6 \neq \beta_7 \neq \beta_8 \neq 0$ by implementing the join F-statistic suggested by Pesaran et al. (2001) and Narayan (2005). Then, the calculated F can be compared with critical values given by Pesaran et al. (2001) for cointegration test. Accordingly, when the computed F-statistic exceeds their upper bounds

critical values, then null hypothesis is rejected. In contrast, the null hypothesis cannot be rejected if the F-statistic is below the lower bound critical value. The test will be inconclusive if the F-statistic lies between the lower and upper bound critical values.

After confirming the existence of co-integrating relationship among the variables under examination, the second phase in the ARDL approach encompasses estimating the long run coefficients. Thus, the vector error correction model will be estimated to identify the causality direction between economic growth and aid presence. However, before proceeding with the ARDL bounds test, it is necessary to determine the order of integration of the variables. This step is undertaken to ensure that the variables are not $I(2)$ stationary so as to avoid spurious results and, thus, allows the analysis to produce the optimal inference. Both Augmented Dickey-Fuller (ADF) and Phillip and Perron (PP) tests are used for this purpose.

4.3 The data

To investigate the impact of aid on economic growth in Sudan, a time series data set containing annual observations for the period 1980-2015 has been used. The majority of the data used is obtained from the World Bank Development Indicators (WDI) published by World Bank. Specifically, data on real gross domestic product, real exports, domestic banking credit to the private sector, and gross domestic capital formation are sourced from World Bank. The data on ODA is obtained from OECD database. The basic source of data on labor force is the statistics on population and labor force issued by United Nation Conference on Trade and development (UNCTAD). The data on human capital, which is measured by average years of schooling, has been obtained from Barro and Lee educational database. All monetary variables are in real values.

5. Empirical results and discussion

Before proceed with estimating the ARDL bounds test, we start the analysis by examining the stationarity characteristics of the variables used. The results of ADF and PP unit roots tests are summarized in Table 2. As the tests statistics indicate, except human capital variable ($\ln HC$) which seems to be of order $I(0)$ at level, the rest of the variables are found to have unit roots at levels when these two tests are conducted⁴. However, after differencing the series once, all variables become stationary.

Having confirmed that the variables satisfy the stationarity conditions, the next step is to run the bounds test to determine the levels of cointegration. The results reported in Table 3 show that the calculated value of F-statistic is 7.09 which is greater than the upper level of bounds critical values of 3.13, 3.50, 3.84 and 4.26 at the 1%, 5%, and 10% levels of significance. Obviously, this outcome implies that the null hypothesis of no cointegration cannot be accepted and there exists a cointegration relationship among the set of variables concerned. However, these results represent a preliminary evidence for the existence of cointegration. Thus, the ARDL model can be further expanded by estimating the long and the short run in order to ratify this result.

The results of estimated long-run ARDL cointegration model (1, 1, 0, 2, 2, 0, 1, 0), which selected automatically from 20 models based on Akaike Information Criterion (see Appendix

⁴ Since the computed F-statistics provided by Pesaran et al. (2001) is based on the assumption that the variables are $I(0)$ or $I(1)$, finding that education variable is purely $I(0)$ at level and not at first difference wouldn't lead to spurious results. Instead, these dissimilarities in the order of integration of variables support the usage of ARDL as an appropriate cointegration technique to execute the empirical investigation.

B), are presented in Table 4. As the reported results indicate, the long run coefficient of ODA variable (*lnAID*) is positive and statistically significant indicating that foreign aid boosts GDP growth. Specifically, the findings indicate that a one percent increase in ODA disbursement pushes GDP to grow by, approximately, 0.38 percent. In light of this finding, some theoretical aspects on the relationship between aid and economic growth need to be acknowledged. As argued by many scholars, aid has a potentiality to contribute directly and indirectly to economic growth. Directly, aid probably expands the existing physical capital pushing GDP to grow beyond the levels that could otherwise be achieved without aid inflows. Indirectly, aid improves human capital and, hence, boosts the absorption of new knowledge and modern business practices that are likely to spillovers from sources such as foreign investment and other know-how sources. It is worth to note that the contributions of foreign aid to human capital development in Sudan cannot be overlooked. The schools, universities, health care centers (i.e. hospitals, dressing points and diagnostic units) and other social overhead capital facilities are extensively spread throughout the regions constituting the country.

However, regardless of the contribution gained from aid, there may be many hidden explanations behind its significant effect on economic growth in Sudan. First, this significant contribution may reflect the weakness in domestic capital formation. In other words, the negligible contribution of domestic capital to the total output may boom the contribution of aid to economic growth. Second, the high dependency on aid may increase the fragility of the country's economy by making it subject to changes and fluctuations in the international relations.

Interestingly, the coefficient associated with the interaction between ODA and public corruption variable is negative and statistically significant. This indicates that the spread of corruption in Sudanese public institutions undermines the contributions of aid in promoting economic growth. It is worth noting that in the last four decades, Sudan has experienced a severe deterioration in the quality of its public institutions. The nepotism, embezzlements, abuses against public properties, and bad institutional practices became strongly institutionalized. Accordingly, in the midst of such corrupt environment, aid wouldn't be used effectively and, consequently, fail to enhance economic capabilities in a manner that sustain economic growth. Moreover, the lack of accountability is likely to make aid resources act as a substitute for public spending leading to significant deterioration in economic growth. Many researchers have frequently confirmed the existence of fungibility of aid particularly in institutionally less developed countries (Bauer, 1976; Khilji and Zampelli, 1991; Farag et al. 2009 and Ke et al, 2011).

Turning to the rest of the variables, the findings show that the coefficients associated with human capital (*InHC*), real export (*InREXP*), banking credit (*CRD*) and privatization (*PRIV*) variables are all correctly signed and statistically significant. Specifically, the coefficient of human capital variable is positive and statistically significant indicating that the enhancements in the capabilities of human cadres via increasing years of schooling lead to progressive increases in economic growth. Likewise, in tune with the well-established proposition that economic liberalization increases economic growth, we find that implementing privatization policy generates significant increases in GDP.

As expected, the coefficient of the real exports variable is positive and statistically significant indicating that the returns from exports have a significant contribution to economic growth.

Similarly, and in line with prior expectations, the coefficient of banking credit variable is positive and statistically significant. It demonstrates that the provision of borrowing facilities via banking system contributes positively to economic growth. This outcome is expected since the country suffers from a prolonged gap between national savings and the actual demand for capital. Conversely, the results indicate that GDP has a negative elasticity with respect to the expansion in labor force. As the coefficient in front of labor force variable (*InLAB*) indicates, an increase in labor force by a one percent, decreases GDP growth rates by 0.37 percent. This may endorse that aggregate production function in Sudan economy exhibits decreasing returns to scale with respect to labor input. This outcome can be justified by the fact that the capital input is proportionally smaller than the labor force. Accordingly, regardless of the proportions of other inputs, increases in labor force add less to the GDP giving birth to decreasing returns to scale in the long run.

The results on the estimates of the error correction representation don't diverge significantly from those obtained for the long run. As Table 5 shows, the short run coefficients of human capital variable (*InΔHC*), real exports (*InΔREXP*), banking credit (*ΔCRD*) and privatization (*PRIV*) variables preserve their positive and statistically significant signs. In contrast, the short run coefficient appears in front of aid variable turns out to be negative and statistically significant.

The coefficient of the lagged error correction term (ecm_{t-1}) is negative and statistically significant lending further support to the existence of cointegration between variables under consideration. Its coefficient is -0.39 demonstrating that in each year, about 39% of shocks in the equilibrium can be adjusted to restore the long run equilibrium.

Finally, and as suggested by Brown et al. (1975), we investigate the stability of the model by using Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ) tests. As can be read from Appendices A.3 and A.4, the straight lines plots of both CUSUM and CUSUMSQ are situated between the two dashed lines. Since these two lines signify that both test stay within 5% levels of significance it can be inferred that the relationship between the variables concerned is stable and the model is correctly specified.

6. Conclusion and Policy Implications

Driven by the current debates on the effectiveness of foreign aid in mitigating economic illnesses in recipient countries, this study aims at investigating the impact of aid on economic growth in Sudan. To make this aim reachable, the intended study applies the ARDL cointegration technique to a time series data set pertain to Sudan and spans over the period from 1980 to 2015.

The result of ARDL F-statistic bounds tests conclusively reveals the existence of cointegrating relationship between variables used. Accordingly, the study proceeds to estimate the error correction model to verify the short and the long run relationships. Expectedly, the results show that aid in the form of ODA has a positive and significant long run influence on GDP growth. This result is consistent with the voluminous number of previous studies arguing that aid presence spurs economic growth in recipient countries. In the same vein, it challenges the findings brought by a strand of well-established studies rejecting the contribution of aid to economic growth. Interestingly, the results also show that the interaction between aid and corruption in public institutions debilitates economic growth. As predicted, improvement in human capital, the expansion in exports, making banking credit

available to private sector, implementing privatization policy are all found to be positively and significantly related to economic growth. In addition, the results show that domestic capital formation has no long run significant impact on GDP. This finding agrees with the new classical growth theory which argues that the contribution of capital to economic growth can be only hold in the short run.

The results obtained by this study have many policy implications. First, Sudan as one of the highly aided countries needs to lighten its reliance on aid as a key promoter for economic growth. This is because the dependence on such unguaranteed resources has negative consequences on the future economic performance of the country. For instance, aid, particularly when it turns out to be conditioned or fluctuated, would draw government to take some measures that may oppose nation's higher economic goals. Second, policymakers should use aid resources to develop soft infrastructures such as educational facilities, health care services and rebuilding the capacities of cadres. Third, the above findings may be indicative for the severity of corruption in public institutions on the country's economic performance. Yet, there is much evidence that high institutional quality increases the desirable impact of foreign aid on the national economy. Accordingly, policymakers should work on establishing a transparent public environment. Specifically, the levels of accountability in the public institutions must be enforced and sustained. This would help maximize the contributions of aid in accelerating and sustaining economic growth in the long run.

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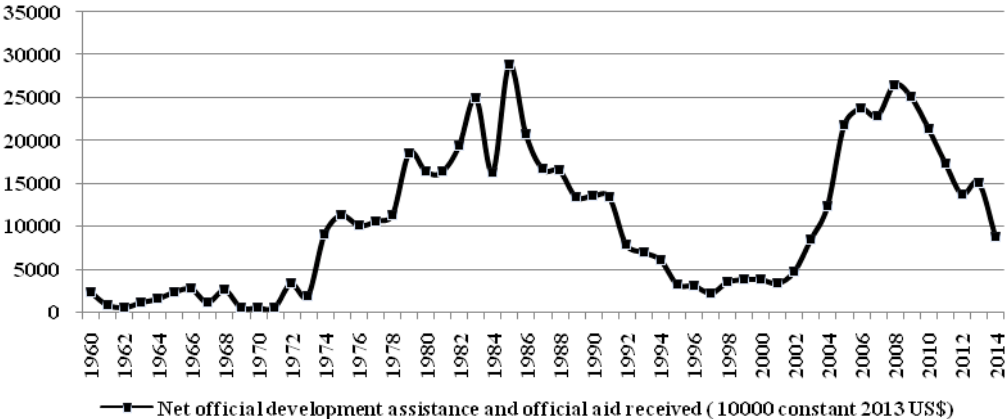
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Figure 1. Real net official development assistance and official aid received by Sudan (1960-2014)



Source: World Bank Indicators (2015), World Bank (2015)

Table 1. GDP growth, domestic capital formation and ODA inflows into Sudan (1960-2014)

(1) Period	(2) GDP Growth	(3) ODA (%GDK)	(4) ODA (%GNI)	(5) ODA (% imports)	(6) ODA Growth (%)	(6) ODA per capita (current US\$)	(7) GDK/ (%GDP)
1960-1964	0.59	11.03	1.39	-	10.9	1.58	13.40
1965-1969	1.60	-	1.58	-	11.8	1.96	-
1970-1974	3.04	-	1.98	-	192	4.26	-
1975-1979	5.53	34.98 ^a	5.53	36.8 ^b	18.0	22.0	15.8 ^c
1980-1984	2.39	57.15	8.39	53.8	0.10	35.1	15.2
1985-1989	4.39	79.30	6.24	85.7	2.02	39.1	9.7
1990-1994	2.83	37.99	6.79	61.2	-13.3	22.9	17.1
1995-1999	5.98	12.63	1.98	16.9	-2.37	6.58	15.4
2000-2004	6.18	10.02	2.91	10.7	31.2	12.40	26.4
2005-2009	8.02	19.64	5.66	16.7	18.5	51.25	26.7
2010-2014	1.14	10.60	2.39	12.6	-17.5	37.70	20.9

Source: World Bank Indicators (2016), World Bank (2016)

^a calculated for the period 1976-1979

^b calculated for the period 1978-1979

^c calculated for the period 1976-1979

Table 2. Summary of ADF and PP unit roots tests

Variable	Augmented Dickey-Fuller (ADF)		Phillips-Perron (PP)	
	Level		Level	
	With intercept but without trend	With intercept and trend	With intercept/no trend	With intercept and trend
LnGDP _t	0.356(0)	-3.133(7)	0.355(5)	-1.990(6)
LnLAB _t	1.691(0)	-1.261(0)	1.741(1)	-1.261(0)
LnHC _t	-2.177(1)	-1.734(1)	-14.03(3) ^a	-3.195(3)
LnODA _t	-1.983(2)	-1.938(2)	-1.326(4)	-1.593(4)
LnREXP _t	-0.023(0)	-1.784(1)	-0.327(3)	-1.945(3)
LnK _t	-0.674(0)	-1.344(0)	-0.743(2)	-1.539(1)
CRD _t	-1.334(0)	-1.636(1)	-1.534(3)	-1.431(2)
PUBCORR _t	-1.409(0)	-1.246(0)	-1.409(0)	-1.537(1)
The first difference				
ΔLnGDP _t	-4.928(0) ^a	-4.957(0) ^a	-4.883(5) ^a	-4.911(6) ^a
ΔLnLAB _t	-5.857(0) ^a	-6.055(0) ^a	-5.857(1) ^a	-6.125(4) ^a
ΔLnODA _t	-5.178(0) ^a	-5.110(0) ^a	-5.372(4) ^a	-5.301(4) ^a
ΔLnREXP _t	-4.305(0) ^a	-4.279(0) ^a	-4.289(2) ^a	-4.266(2) ^b
ΔLnK _t	-4.587(0) ^a	-4.516(0) ^a	-4.586(4) ^a	-4.517(4) ^a
ΔCRD _t	-3.456(0) ^b	-3.716(0) ^b	-3.456(0) ^b	-3.781(1) ^b
ΔPUBCORR _t	-3.733(0) ^a	-3.753(0) ^b	-3.673(3) ^a	-3.674(3) ^b

Lag order is shown in parenthesis based on SIC. ^{a, b and c} represents 1%, 5% and 10% level of significance, respectively.

Table 3. Results of bounds test

Null hypothesis :No co-integration

Significance	Critical value	
	Lower bound	Upper bound
<i>10% significance level</i>	2.03	3.13
<i>5% significance level</i>	2.32	3.50
<i>1% significance level</i>	2.96	4.26

Computed F-statistic: 7.09, k = 7

Decision: *Reject the null hypothesis at 1% significance level.*

Note: the critical values are obtained from Pesaran et al. (2001). Table CI case III based on unrestricted intercept and no trend, p. 300.

Table 4. Estimates of the Error Correction Representation, ARDL (1, 1, 0, 2, 2, 0, 1,0)

Dependent variable	Log GDP			
Variable	Coefficient	Standard Error	t-ratio	P-value
ΔLnLAB_t	-0.066**	0.026	-2.509	0.021
ΔLnHC_t	0.283***	0.078	3.623	0.002
ΔLnK_t	0.054**	0.024	2.255	0.036
ΔLnK_{t-1}	0.093***	0.029	3.205	0.005
ΔLnODA_t	-0.216***	0.052	-4.126	0.001
$\Delta \text{LnODA}_{t-1}$	-0.053***	0.017	-3.199	0.005
ΔLnREXP_t	0.083**	0.034	2.452	0.024
$\Delta \text{Ln ODA}^* \text{BUCOR}$	0.210**	0.052	4.069	0.001
ΔCRD_t	0.007*	0.004	1.908	0.072
ΔPRIV_t	0.238***	0.043	5.533	0.000
ect_{t-1}	-0.388***	0.068	-5.691	0.000

Note: ***, **, and * indicate significance at the 1, 5 and 10 percent levels, respectively.

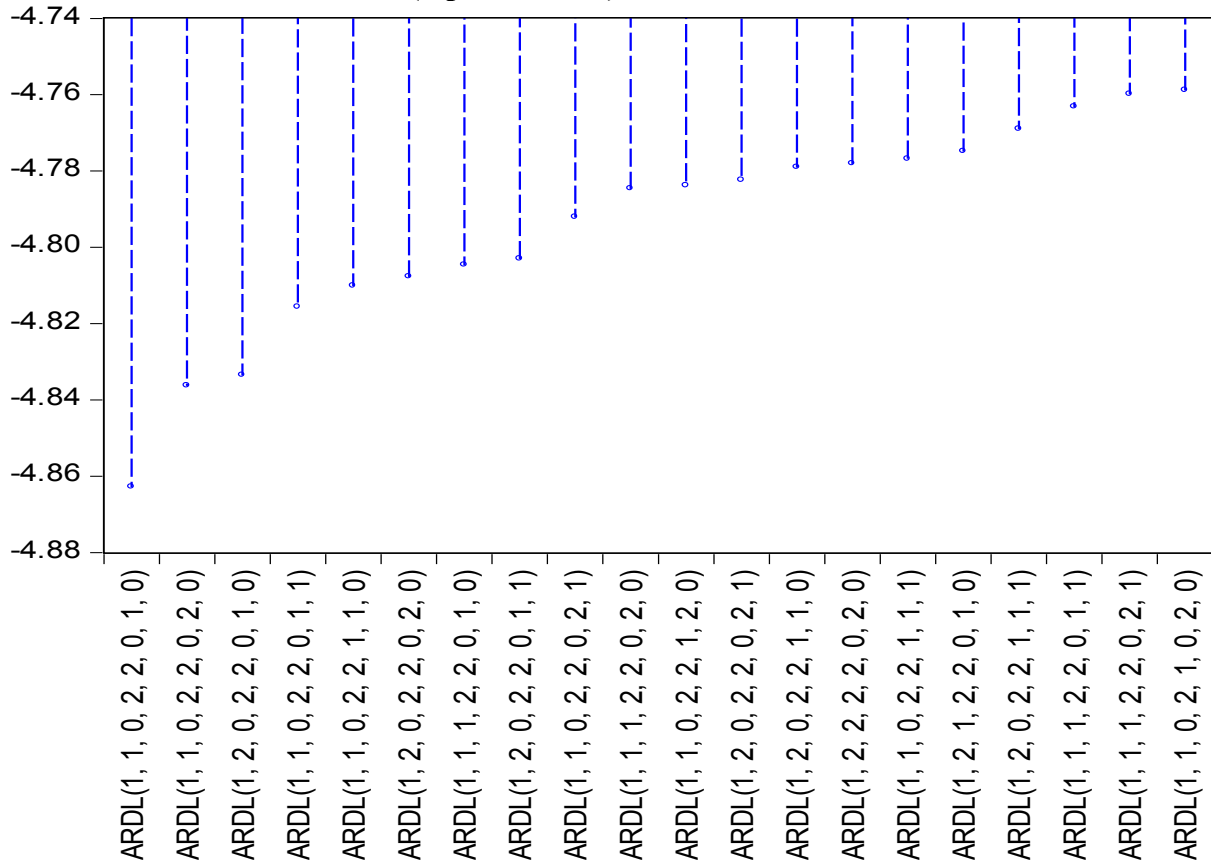
Table 5. Estimates of the long run coefficients, ARDL (1, 1, 0, 2, 2, 0, 1,0)

Dependent variable	Log(GDP)			
Variable	Coefficient	Standard Error	t-ratio	P-value
LnLAB _t	-0.366***	0.054	-6.698	0.000
LnHC _t	0.729***	0.163	4.467	0.000
LnKt-1	0.075	0.101	0.741	0.468
LnODA _t	0.376**	0.158	2.381	0.027
LnREXP _t	0.214**	0.084	2.553	0.019
Ln ODA _t *BUCOR _t	-0.327**	0.156	-2.102	0.049
CRD	0.019*	0.0106	1.814	0.085
PRIV	0.613***	0.161	3.799	0.001
Constant	18.851***	1.562	12.07	0.000

Note: ***, **, and * indicate significance at the 1, 5 and 10 percent levels, respectively.

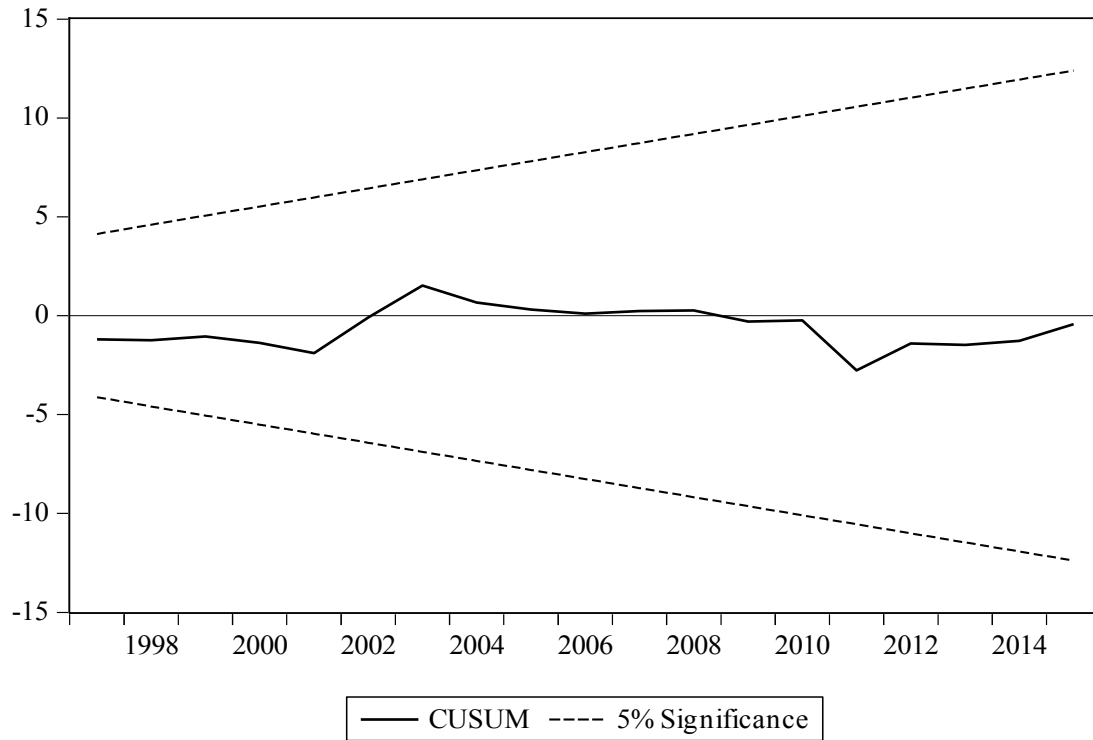
Appendix A.2

Akaike Information Criteria (top 20 models)



Appendix A.3

Plot of Cumulative Sum of Recursive Residuals



Appendix A.4

Plot of Cumulative Sum of Squares of Recursive Residuals

