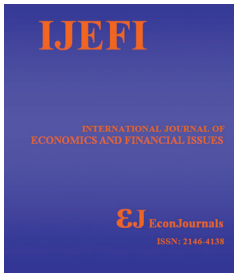

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The Impact of Foreign Direct Investment on Domestic Investment: Evidence from Sudan

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ABSTRACT

This study applies the autoregressive distributed-lag bounds test to cointegration and Granger causality to examine the impact of foreign direct investment (FDI) inflows on domestic investment of Sudan over the period 1976-2016. Empirical results show a crowd out effect of FDI on Sudan's domestic investment, and the results confirm the cointegration relationships. Economic growth, exchange rate, macroeconomic stability and natural resource rent have shown short and long-run significant association with domestic investment, whereas, FDI appears as a long-term determinant. Moreover, the error correction model reveals that system corrects previous period disequilibrium at an annual rate of 35%. The Granger Causality results conclude unidirectional causal flows from FDI, exchange rate, macroeconomic stability, natural resource rent, and trade openness to domestic investment. The study suggests some policy measures to design effective policies for macroeconomic stability; controlling inflation, flexible exchange rate spurring economic growth, and as well as developing effective strategies to encourage the mode of FDI that can create technological and market share spillover.

Keywords: Foreign Direct Investment, Domestic Investment, Crowd-in, Crowd-out
JEL Classifications: E22, F23, O55

1. INTRODUCTION

Empirical studies have shown that most of developing countries, mainly those were initially borrower from international lending intuitions, particularly after the 1980s where debt crises steamed up, those countries find themselves forced to adjust their investment policies to bridge the gap in national saving through their endeavours to attract more direct and indirect investment. To date, studies have established a correlation between the output allocated for investment and economic growth rate (Agiomirgianakis et al., 2003; Prasanna, 2010; UNCTAD, 1999a). Similarly, the authors confirm that the foreign direct investment (FDI) has become the most convenient alternative to capital loans, the source of capital inflow, and catalyst for economic growth without bearing risks associated to the debt, as were before. The effect of FDI has been studied extensively in recent years, as it has a lot of significant outcomes for the host country. The effect is ranged from physical to intangible assets; regarding technology; management practice; know how; market opportunities. Moreover, researchers have become increasingly concerned about the FDI effects on the efficiency of domestic productivity and economic growth (Agosin and Mayer, 2000;

Jan Mišun, 2002; Prasanna, 2010; Tadesse and Ryan, 2004; Wang, 2010).

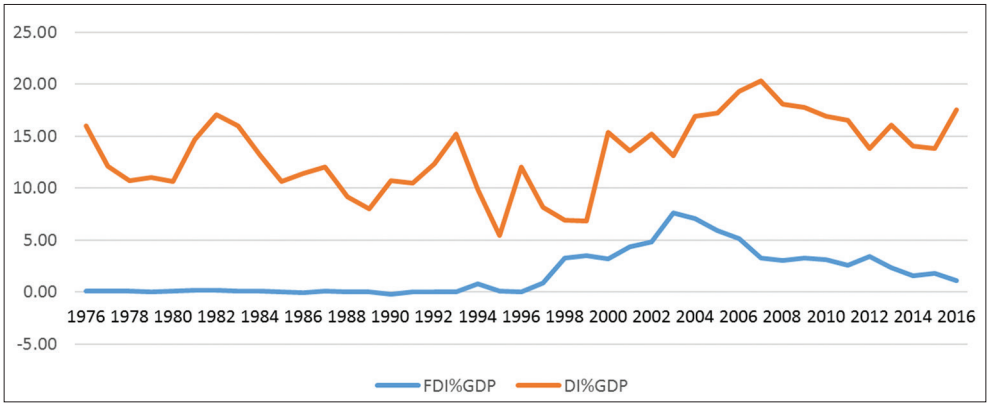
Researchers, increasingly have acknowledged the implications between attracting FDI, economic and political stability (Baniak et al., 2005; Dupasquier and Osakwe, 2006; Mwilima, 2003; Ok, 2004). Following the upsurge of FDI into developing countries in the 1990s, increasing debates and concerns have been raised regarding whether the FDI "crowds-in" or "crowds-out" private domestic investment[1] (Al-Sadig, 2013). Researchers confirm FDI crowd out occurs when multinational enterprises knocked out domestic firms from market competition, and this could happen either for MNEs efficiencies or when they tend to "finance their investment by borrowing, while crowd-in occurs in the case of Greenfield (Harrison and McMillan, 2003). Therefore, we find that the effect of FDI inflow is the bottom line of most studies (Blonigen and Wang, 2004; Chakraborty and Basu, 2002; Choi, 2004; Wang and Yu, 2007). Such studies prove the causality between the economic growth; domestic productivity and the effect of FDI inflow on the host countries' economies. Mottaleb and Kalirajan (2010) find a positive relationship between gross domestic product (GDP); international trade volume; doing business climate and attracting FDI. However, few studies have addressed the impact of inward FDI on domestic investment (Wang, 2010).

It worth noting that, the FDI flows has become the most important external source of finance compare to remittances, ODAs; portfolio investment and other investment (UNCTAD, 2017). Sudan is known as a rich country in natural resources, and even was coined as "breadbasket of the Arab World." (O'Neill, 2007). However, the path of the FDI development, in Sudan, was adversely affected by changing on the political regime, ideology adopted and natural disasters (Suliman and Badawi, 2010a). The foreign capital inflows shared three key objectives: Seeking for cheap raw materials for manufacturers (British colonialism); secure cheap food (Arab States) (O'Neill, 2007) or seeking for natural resources in the case of Chevron (USA) in the early 1960s (later some concession given to Shell) as well as in 1990s where some western and Asian oil giant companies entered into Sudan as first mover (Kobrin, 2005). O'Neill (2007) confirms the trends of FDI in Sudan witnessed huge co-finance source between Arab and Western capital as well as other international agencies (IDA), the World Bank, and the European Economic Community (EEC) likewise bilateral sources from Arab and Islamic institutions. Consequently, contractual arrangements established between the government of Sudan and some international tenderers targeted big infrastructure projects, i.e., Old Suakin Port (Italy); River Transport (Germany); Jonglei Canal and Juba Airport (France), agri-industries, etc. (O'Neill, 2007). Interestingly, last decade witnessed a significant oil-FDI inflow from China (about US$ 7.6), India, Malaysia accompanied by considerable non-oil FDI from Arab counties and China, too (Suliman and Badawi, 2010a). The rationale behind this huge investment was not only to serve the purpose of the foreign investors, but it was also necessary for Sudan to bridge the gap of domestic saving needed for economic development purposes. However, some results conclude that FDI has a negative impact on (Wang, 2010) domestic investment. On the other hand, other researchers prove accrued spillover providing that FDI provides appropriate technology inputs (Liang, 2017). While others assure a positive correlation between the FDI and host country "technological supply" and "public funding" as these later considered as enabling factor for FDI to have a positive spillover (Melane-Lavado et al., 2018) as well as the case for the "resource-rich countries" which can acquaint positive spillovers for their "extractive industries" (Alla et al., 2015).

With regard to the effect of the FDI on Sudan's domestic investment, we find the case of Sudan either was included amongst a multi-countries studies (Al-Sadig, 2013; Boly et al., 2015; Mottaleb and Kalirajan, 2010; Wang, 2010), or were being addressed from the point of economic determinants of FDI in Sudan (Alla et al., 2015; Ibrahim and Hassan, 2013; Lado, 2015). Moreover, some studies undertook some evaluation for bilateral inward FDI at sectoral level (Suliman and Badawi, 2010a). Sudan experiences successful records amongst developing countries in attracting FDI (Mottaleb and Kalirajan, 2010). Strategic location for the country, and substantial natural resources endowment; for example, 200 million acres of fertile lands along with water resources of 30 billion cubic meters, and 145 million heads of livestock (cattle, sheep and camel heads), name but a few that qualifying Sudan as a hub for FDI inflows. Economic and political factors contribute to such good investment performance. Since the early 1990s, the government has introduced series of significant economic reforms, culminated with national investment act 2013; as well as some political achievement namely the Comprehensive Peace Agreement in 2005 which ended the most protracted civil war in Africa and Doha Agreement for Darfur Peace 2011. Consequently, FDI inflows increased from the US $ 2.31 billion to the US $ 2.53 billion for 2005 and 2008 respectively, while FDI stock stands at the US $ 16.3 in 2008, representing 28.1% of the GDP (UNCTAD, 2009). Sudan is second leading recipient after South Africa for Chinese FDI inflow, for instance (UNCTAD, 2013). Sudan recorded 7% GDP growth rate as the highest economic growth in Africa during the period 2005 -2007 (World-Bank, 2008). That means the FDI has increasingly become important globally and for Sudan, however, the domestic investment remained highly unpredictable during the studied period, (Figure 1). Nevertheless, Sudan has paid attention to create conducive environment policies for attracting FDI. Under the framework of what so-called "the Comprehensive National Strategy (2007-2031), the Government of Sudan is implementing a 5-year economic program 2015-2019, to restore macroeconomic stability and promote inclusive growth. In line with the plan above Sudan's economy is diversified with the sectoral share distributed as agriculture (29.2%) industry (20.4% and service (50.4%) along with the exerted efforts towards enhancing the role of the private sector and accelerating the WTO accession process. However, there were some trigger factors induce these macroeconomic reforms. In 1997, the government engaged with the International Monetary Fund Economic Structural Adjustment Program to: (1) Implement fiscal and monetary policies to improve the current

1 Crowding-in refers to a situation when FDI leads to an increase in private investment while crowding out refers to a situation when FDI leads to a decrease in private investment (UNCTAD, 1999). Noting this study restrict the analysis to domestic investment, as it lacked to access a disaggregated data on private investment.

Figure 1: Patterns of DI and foreign direct investment for Sudan (1976-2016), Billon USD



Source: Author computation drown from the World Bank data (2017)

account (i.e., remove exchange rate distortion); (2) reduce cost-push inflation; (3) normalize relation with international organization; and (4) improve the inflow of external financial resources.

The objective of this study is to empirically examine the impact of FDI inflows on domestic investment in Sudan, whether there is crowding-in or crowding out effects and the causality effects between the dependent variable and explanatory variables. We used time series for the period 1976-2016, employing secondary data from the World Bank, and the Central Bank of Sudan (CBS).

This study differs from previous studies in four ways: (1) Though the survey faces lack of data on domestic private investment, to the best of our knowledge, this is the first study focusses on the relationship between FDI inflow and domestic investment (impact and causality analysis), while the earlier studies focus on the holistic relationship between FDI and investment at multi-countries level (Al-Sadig, 2013; Ashraf and Herzer, 2014) which does not give a country specific picture or at bilateral level (Suliman and Badawi, 2010b) (2) focus on domestic investment is beneficial for developing countries (Ndikumana and Verick, 2008); (3) long time series coverage; and (4) using autoregressive distributed-lag (ARDL) bonds and Granger Causality. The importance of this paper may rise from being coincided the outcomes of two recent significant developments on Sudan; the lifting sanction of the USA on Sudan[2] and recent government momentum on the WTO accession process along with effort exerted by the government to attract FDI[3].

The second part of this paper reviews the past literature review on the impact of FDI on the DI of the host country. The third part discusses the methodology; model and data used to interpret the FDI effects on the domestic investment of Sudan. The fourth part of the study elaborates the results, while the fifth part concludes the study.

2. LITERATURE REVIEW

Recent literature confirms that the FDI inflow varies significantly from a country or region to another and even in the same state overtimes (Dunning, 2000). Having concerned about the effect of FDI on domestic investment (DI), scholars do consider the importance of OLI[4] (Ownership, Location, Internalization) variables in their analysis, for instance, the ownership advantages may ascend firm's capability and willingness to share its value chain (i.e., manufacturing; distribution, etc.) across or within countries, while location advantages refer to difference in countries endowments; policies and regulations; macroeconomic stability, name but a few. On the other hand internalization advantages arise from "exploiting imperfections in external markets; including reduction of uncertainty and transaction costs to generate knowledge more efficiently as well as the reduction of state-generated imperfections such as tariffs, foreign exchange control, and subsidies" (Anyanwu, 2011; Stefanović, 2008). The MNEs' business effects, on the host countries can be channeled through endowment and productivity factors; "demonstration effect whereby domestic firms learn by imitation from foreign MNEs;" "forward and backward linkages with domestic firms;" "competitive pressure in host-country markets;" and "externalities" in certain "spillover effects" (Boly et al., 2015). It is worth noting that mind-setup of the policymakers, in most developing countries, has changed from "hostility" to "conscious encouragement" towards the inward FDI and that motivates scholars' interest; hence FDI no longer saw as "parasitic" and anti-infant industries (Imoudu, 2012). In this context, since early 1980s countries, mainly LDCs have exerted efforts to maximize FDI spillover benefits. Consequently, a significant increase in FDI inflow from the US $ 24 billion (24% of total foreign investment) to the US $ 178 billion (61% of total foreign investment) for 1990 and 2000, respectively recorded and reached to the US $ 578 billion in 2010 (UNCTAD, 2011). However, Working on developing countries is profoundly challenging for those MNEs, particularly for transferring profit retained from host countries, yet, MNEs mostly aware how to maneuver from such contractionary policies

2 October 12, 2017, the USA has lifted sanctions imposed on Sudan for more than 20 years, included a fairly comprehensive trade embargo, a freeze on government assets, and tight restrictions on financial institutions dealing with Sudan

3 For example the National Investment Encouragement Act 2013

4 For further details refer to Dunning (2000). The eclectic paradigm as an envelope for economic and business theories of MNE activity. *International business review,* 9(2), 163-190.

of host countries benefiting from their subsidiaries worldwide (Prasanna, 2010).

The recent empirical literature provides unclear evidence on inward FDI effect over domestic investment. We find some studies recommend two levels of analysis, to examine the impact of inward FDI on the DI; the "Macro-level studies" whereby the "absorptive capacity" of the host country can explain such relationship, and the micro-level to examine that effects on domestic firm's productivity, though such effects likely to be "heterogeneous" (Boly et al., 2015), and are vague, too (Driffield and Jindra, 2012). Prasanna (2010) Provides promising view, from his study on the effect of FDI inflow on DI in India, using multiple linear regression models. The author claims that amplifying DI through inward FDI "would greater than the amount of FDI inflows". Prasanna finds that the inward FDI has a positive direct effect on domestic investment in India while the indirect impact is "neutral" in the long run and the increase in DI accrued by FDI inflows is larger than the "amount of the FDI inflows in India." The study, also concludes that impact of FDI on the DI is greater than the real GDP. Moreover, Prasanna finds that FDI neither create crowding-in nor crowding-out to DI in India during the study period (1991-1992 and 2006-07). Chen et al. (2017) in their study about the effect of FDI on DI in China used quarterly (1994Q1-2014Q4) find that FDI has a neutral effect on DI, while they confirmed such effect when they disaggregated the FDI. Authors find the equity joint venture (EJV) crowds in DI, and the "wholly foreign-funded enterprise" (WFFE) crowds the DI out, these findings hold true based on entry mode chosen by foreign investors. In the same context, there was a "crowding-out effect in Poland (1990-2000) in Hungary (1990-2000), in Czech Republic (1993-2000)" was a crowding-in effect) (Jan Mišun, 2002). Nevertheless, (Jan Mišun, 2002) argues that it is hard to discriminate the effect of FDI on the host country by mode of entry after the elapse of the initial period. No matter how the effects of FDI or mode of entry, the crowding-in or crowding out is a country-specific, for instance in Latin America, the crowd-out was due to little investment compared with Asia (Jan Mišun, 2002). Wang (2010) uses a panel data for 50 countries for the period 1970-2004, finds that FDI has a neutral effect on DI, however, the "contemporaneous FDI" crowd-out DI in DCs. The author recommends that FDI can "increase LDCs' DI over time." We find that most empirical studies on the effect of FDI on host countries are mostly confined to multi-countries-level; as mentioned before. Mottaleb and Kalirajan (2010) use a panel data analysis to identify the determinant factors of the inward FDI for 68 developing countries in Asia, Africa, and Latin America. Their study's results reveal that countries with "larger GDPs; higher GDP growth rates; a higher proportion of international trade and a more business-friendly environment are more successful in attracting FDI."

However, this mixed grouping of countries is "prone to aggregate bias" that won't qualify to present clear interpretation of the FDI-DI relationship effect (Farla et al., 2016). Furthermore, such method (mixed grouping of countries) is a violation of homogeneity assumption "to estimate coefficients of the lagged dependent variables using GMM method," "when in fact the dynamics are heterogeneous across the panel" (Ndikumana and Verick, 2008). Therefore, to avoid such aggregate bias, some researchers they decide to avoid this aggregate bias by categorizing those countries based on their income levels (Al-Sadig, 2013; Wang, 2010).

In connection to Sudan case, some previous studies confined to the FDI determinants, for instance, Ibrahim and Hassan (2013) prove long-run FDI effects relationship using Granger casualty from each of the "exchange rate, investment incentive policy, and market size. The study considers the market size, inflation rate, exchange rate, indirect taxes, trade openness, and investment incentive policy as a factor influencing FDI, over the period (1970-2010). Sudan is not an exceptional case in the Sub-Saharan Africa, where most of FDI, in particular, resource-seeking investments, have negative impact on domestic economy due to lack or elimination of domestic firm into the "network chain of the such FDI firms as well as some violation in technology adaptability and transparency of profitability (Suliman and Badawi, 2010a).

General speaking, FDI effects might vary across countries and industries, however, for LDCs where capacities are lacking, FDI may have a direct impact in capital formation, likely causes crowding-out effects for those countries with "competitive domestic firms" functioning in the "same industries and market" (Prasanna, 2010). Also, the FDI-DI relationship on host country is apparently affected with "entry mode, period, and aggregation bias" and this highly supports "crowd-in hypothesis" especially in LDCs (Chen et al., 2017). However, it is highly recommended to examine the effectiveness of such FDI, which means that policymakers shouldn't presumably consider which FDI is beneficial for their economy (Van Loo, 1977). Ashraf and Herzer (2014) provide up to date study on the effect of FDI entry mode on DI in 100 LDCs over period 2003-2011 and conclude that M&As have no impact on DI, whereas WFFEs likely to crowd out DI.

It worth noting that, literature proves more positive perception towards FDI is a critical factor for economic growth and bring solutions for many developmental constraints, by providing direct benefits regarding capital-augmenting effects, or indirect through knowledge, management practices (Imoudu, 2012; Suliman and Badawi, 2010a). Agosin and Mayer (2000) conclude that the effects of FDI on DI are positive, though the policies are not conducive. Goh and Wong (2014), studied the long relationship FDI-DI effects, in Malaysia over period 1991Q1-2010Q3, by using ARDL test and find FDI crowd-in effect on DI. Authors recommend that Malaysian government should make use of the relative elasticity of "inward FDI-domestic investment" over "outward FDI-domestic investment" to "offset the crowding-out effect" incurred by outward FDI. Also, Gameli et al. (2014) prove a crowding-in effect on the agriculture sector in Ghana over period 1976 to 2007. However, this study examines the impact of FDI inflow on Sudan's domestic investment (Prasanna, 2010) and ARDL Bounds Test (Chen et al., 2017).

In conclusion, as we aforementioned, in the introduction section, most literature about the development of FDI in Sudan can be categorized under the competition hegemony policy of the US-Soviet bipolarism to the LDC (Suliman and Badawi, 2010a). Even though, as we indicated before, this study differs from the previous

studies in two ways; firstly it taken into account the Sudan as empirical sample because the previous efforts, to the best of our knowledge, are restricted to the sectoral (Nour, 2011), bilateral (Mills, 2010; Suliman and Badawi, 2010b) or multilateral focus (Al-Sadig, 2013; Bartels et al., 2009; Drogendijk and Blomkvist, 2013; Naudé and Krugell, 2007; O'Neill, 2007). Secondly, the study uses the most efficient methodology applicable to longitudinal nature of data along with Granger Causality, which is not the case for most respected previous studies.

3. EMPIRICAL METHODOLOGY

In the methodology part, as per the literature reviewed and considering the macroeconomic context of Sudan, we first show the primary relationship explained by equation (1) as follows;

$$DIt = \alpha_0+\beta_1 FDI_t+\delta Z+\mu \quad (1)$$

Where DIt (USD current) and FDI_t, represent domestic investment and FDI (USD current) respectively in year t, Z stands for a vector of control variables, α is the constant term, β_1 is coefficient (how FDI affects DI overtime, or elasticity) and μ is the stochastic error term. Our main independent variable is the FDI (Prasanna, 2010) and economic growth (EG) measured by GDP; LR as control variables (Chen et al., 2017) whereby we can control the direct and indirect effects of variables employed, we also find output (GDP) (Ashraf and Herzer, 2014; Mody and Murshid, 2005), macroeconomic stability (MES) measured by (CPI) (Ibrahim and Hassan, 2013; Yartey, 2010), rent of natural resources (NRR) (Mavrotas et al., 2011), exchange rate (ER) (Ibrahim and Hassan, 2013) and trade openness (TO) (Brueckner and Lederman, 2015; Ulaşan, 2015) as important control for DI. From equation (1) a positive and significant of β_1 interpret that FDI crowding-in DI, while negative and significant β_1 proves that leads crowding-out DI (Agosin and Machado, 2005; Farla et al., 2016; Morrissey and Udomkerdmongkol, 2012). Noting that-for our case- a positive and statistically significant β interprets a crowding-in effect of FDI_t on DI_t in Sudan, while a negative and statistically significant β proves a crowding-out effect (Agosin and Machado, 2005; Farla et al., 2016; Morrissey and Udomkerdmongkol, 2012). Therefore, in the next section, the estimation and testing, the study examines the potential impact and causality between the dependent variable (DI) and the explanatories (FDI, EG, TO, LR, MES, NRR and ER) due to interdependence among these variables (Sunde, 2017)[5] . To avoid spurious relationship in the model used, the study used the counteraction and causality analysis. Sudan is known as natural resource endowed, however, a symptom of a "Dutch Disease" were experienced which hamper a diversification of its economy where domestic investment could play a key role (Nour, 2011). Furthermore, recent studies prove interdependence relationship between economic growth and natural resources, therefore, we incorporate NRR within our model to control for this effect (Brunnschweiler, 2008; Mavrotas et al., 2011).

5 See the Foreign direct investment, exports and economic growth: ADRL and causality analysis for South Africa, Sunde, 2017

3.1. Variables and Data

This study was intended to examine the effect FDI inflows in Sudan during the period 1976-2016 and its impact on domestic investment. The primary data sources for this study are The World Bank (GDP (current US$); Export of goods and services (current US$), and FDI, net inflows (BoP, current US$) and the CBS (Lending Rate). There are likely difficulties in maintaining a good quality of data on private investment in developing countries that qualify researchers to efficiently interpret the relationship between FDI and public financing and domestic private investment (Morrissey and Udomkerdmongkol, 2016). Therefore, for this study, we construct the DI as outcome series of the GFCF subtracts FDI (Chen et al., 2017; Prasanna, 2010).

3.2. Unit Root Test

In this section, we used the ARDL bond test, for the reason that we will able to get proper estimation even there a potential of endogeneity amongst our independent variables (Alam and Quazi, 2003). Moreover, having considered that ARDL is free from residual correlation, the endogeneity is less problem. According to Pesaran et al. (1999) the advantages of ARDL model is not only proved appropriate lags which related to both residual correlation and endogeneity; it enables us to confirm consistent results for long-run parameters regardless the studied variables are I(0), I(1) or mutually integrated. Moreover, other analysis methods, such as Engle and Granger apt to endogeneity problems, ARDL can differentiate between dependent and independent variables. The starting point for the ARDL is to determine which variable is stationary at level and each at first difference. For this purpose, the study uses the Augmented Dickey-Fuller (ADF) unit root testing (Dickey and Fuller, 1979) and the Philips Peron test (PP). In the ADF test, the coefficients β in the equation (2) are going to be calculated:

$$\Delta DI_{t-1} = \alpha_0 + \beta_1 FDI_{t-1} + \beta_2 GDP_{t-1} + \beta_3 TO_{t-1} + \beta_4 LR_{t-1} + \beta_5 MES_{t-1} + \beta_6 NRR_{t-1} + \beta_7 ER_{t-1} + \sum_{j=1}^{q}\delta_8 DI_{t-j} + \sum_{j=1}^{q}\delta_9 FDI_{t-j} + \sum_{j=1}^{q}\delta_{10} GDP_{t-j} + \sum_{j=1}^{q}\delta_{11} TO_{t-j} + \sum_{j=1}^{q}\delta_{12} LR_{t-j} + \sum_{j=1}^{q}\delta_{11} MES_{t-j} + \sum_{j=1}^{q}\delta_{12} NRR_{t-j} + \sum_{j=1}^{q}\delta_{13} ER_{t-j} + \mu_1 \quad (2)$$

Where Δ indicates for first differences, coefficients β_1 to β_7 represent long-run association and δ_8 to δ_{13} show short-run association, q is the maximum lag length chosen by AIC and μ is the error term that adjust the autocorrelation. After establishing the long-run relationship, we reconfirm with error correction model (ECM) of using equation (3).

$$\Delta DI_{t-1} = \alpha_0 + \sum_{j=1}^{q}\gamma_1 DI_{t-j} + \sum_{j=1}^{q}\gamma_2 FDI_{t-j} + \sum_{j=1}^{q}\gamma_3 GDP_{t-j} + \sum_{j=1}^{q}\gamma_4 TO_{t-j} + \sum_{j=1}^{q}\gamma_5 LR_{t-j} + \sum_{j=1}^{q}\gamma_6 MES_{t-j} + \sum_{j=1}^{q}\gamma_7 NRR_{t-j} + \sum_{j=1}^{q}\gamma_8 ER_{t-j} + \eta ECT_{t-j} + \mu_t \quad (3)$$

Where ECT_{t-j} denotes the error correction term, means the speed with which system corrects pervious period disequilibrium and sign of coefficient (η) must be negative and statistically significant. The coefficients γ_1 to γ_8) represents the short-run speed of adjustments respectively for each variable on DI.

3.3.Test for Granger Causality

Once the ARDL bond test proves the long-run relationship, we run Granger Causality test to explore the direction of this potential causality. In this regard, we applied angle Granger ECM to confirm the co-integration captured by bounds test. The Following model is used to identify the causality purpose between the domestic investment (DI) as the dependent variable and the explanatory variables: FDI, EG, TO, LR, MES, NRR and ER, as follows:

$$(1-L)\begin{bmatrix} DI_t \\ FDI_t \\ GDP_t \\ TO_t \\ LR_t \\ MES_t \\ NRR_t \\ ER_t \end{bmatrix} = \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \\ \alpha_{31} \\ \alpha_{41} \\ \alpha_{51} \\ \alpha_{61} \\ \alpha_{71} \\ \alpha_{81} \end{bmatrix} + \sum_{i=1}^{q}(1-L)$$

$$\begin{bmatrix} \gamma_{1i} & \varnothing_{1i} & \beta_{1i} & \delta_{1i} & h_{1i} & \varnothing_{1i} & \measuredangle_{1i} & \partial_{1i} \\ \gamma_{2i} & \varnothing_{2i} & \beta_{2i} & \delta_{2i} & h_{2i} & \varnothing_{2i} & \measuredangle_{2i} & \partial_{2i} \\ \gamma_{3i} & \varnothing_{3i} & \beta_{3i} & \delta_{3i} & h_{3i} & \varnothing_{3i} & \measuredangle_{3i} & \partial_{3i} \\ \gamma_{4i} & \varnothing_{4i} & \beta_{4i} & \delta_{4i} & h_{4i} & \varnothing_{4i} & \measuredangle_{4i} & \partial_{4i} \\ \gamma_{5i} & \varnothing_{5i} & \beta_{5i} & \delta_{5i} & h_{5i} & \varnothing_{5i} & \measuredangle_{5i} & \partial_{5i} \\ \gamma_{6i} & \varnothing_{6i} & \beta_{6i} & \delta_{6i} & h_{6i} & \varnothing_{6i} & \measuredangle_{6i} & \partial_{6i} \\ \gamma_{7i} & \varnothing_{7i} & \beta_{7i} & \delta_{7i} & h_{7i} & \varnothing_{7i} & \measuredangle_{7i} & \partial_{7i} \\ \gamma_{8i} & \varnothing_{8i} & \beta_{8i} & \delta_{8i} & h_{8i} & \varnothing_{8i} & \measuredangle_{8i} & \partial_{8i} \end{bmatrix} + \begin{bmatrix} Ö \\ \varphi \\ \rho \\ \omega \\ Ù \\ \ni \\ \bigcup \\ \pi \end{bmatrix} ECM_{t-1} \begin{bmatrix} \eta_{1t} \\ \eta_{2t} \\ \eta_{3t} \\ \eta_{4t} \\ \eta_{5t} \\ \eta_{6t} \\ \eta_{7t} \\ \eta_{8t} \end{bmatrix} \quad (4)$$

Where (1-L) is the difference operator, ECM_{t-1} is the lagged error correction term, and η_{1t} to η_{8t}, are white noise serial random error terms for independent variables. Evidence on short-run and long run causality prove by confirmation of a significance in first difference and a significance of t-statistic of the ECM_{t-1} respectively.

4. EMPIRICAL RESULTS

The results of unit-root are presented in Table 1, concerning ADF test calculated the critical value at 5% level of significance. We found only ER and NRR variables are stationary at the level, while other variables become stationary at first difference under respected unit root test. This mixed results of integration order lead the application of ARDL Bounds test for co-integration, as Pesaran and Shin (1998) suggest that ARDL bounds test produce best estimates when underlying variables show mixed integration.

We present the outcome of ARDL Bounds test in Table 2. The F-statistics computed for ARDL bounds test is compared with critical upper and lower bounds [I(0) and I(1)]. Here our F-statistics is 3.6520, which is higher than upper bound value 3.50, helps us to reject the null hypothesis of no co-integration against the alternative that holds co-integration among underlying variables, over the period 1976-2016.

In this section, we applied angle Granger ECM for the co-integration captured by bounds test. The results of ECM are exhibited in Table 3. As ECM suggests all the variables should be converted into first difference during estimation and if coefficient of ECM is negative and statistically significant, this holds the long run equilibrium relationship of concerned variables, therefore, this is found valid in case of Sudan that FDI, economic growth, trade openness, lending rate, macroeconomic stability, natural resource rent, and exchange rate co-integrated with domestic investment. ECT coefficient signifies that system corrects the previous period disequilibrium at an annual rate of 35%. Similarly, economic growth, exchange rate, macroeconomic stability and natural resource rent have shown short-run and significant long-run association with domestic investment, whereas, FDI has only proved long-term determinant of domestic investment. Importantly ECT coefficient has a negative sign that holds crowd out effects which is consistent with the argument in past literature

Table 1: Unit-root testing with Augmented Dickey-Fuller test

Variable	ADF test statistic		
	Level	First difference	Decision
DI	0.288754(−0.526609)	−5.273376*(−3.529758)	I(1)
FDI	−1.015322(−3.526609)	−5.150793*(−3.529758)	I(1)
TO	−1.607604(−3.526609)	−6.144336*(−3.529758)	I(1)
GDP	−0.775681(−3.526609)	−5.071721*(−3.529758)	I(1)
LR	−1.593715(−3.526609)	−6.479842*(−3.529758)	I(1)
ER	−4.259497*(−3.529758)	−3.613980*(−3.533083)	I(0), I(1)
MES	1.133890(−3.536601)	−4.599490*(−3.536601)	I(1)
NRR	−4.655505*(−3.557759)	−6.556485*(−3.533083)	I(0), I(1)

*Indicates ADF t-stat significant at 5% level against the ADF critical value mentioned in parenthesis. Only ER, NRR is stationary at level

Table 2: ARDL bounds test to cointegration

Test statistics	F-statistic	10 bound	11 bound
ARDL bounds test	3.6520***	2.32	3.50
R^2	0.751694	F-statistic(P-value)	7.537443 (0.000018)
Adjusted R^2	0.738699	Durbin-Watson stat	1.951831

***Denote significance at 1, 5 and 10% respectively. Null hypothesis: No long-run relationships exist, (F-stat < upper bound 4.01). Alternative hypothesis: There exist long-run relationship (F-stat > upper bound). ARDL: Autoregressive distributed-lag

Table 3: ARDL co-integrating form and ECM

Short run form			Long run form		
Variable	Coefficient	t-Statistic (P-value)	Variable	Coefficient	t-Statistic (P-value)
Δ (FDI)	−0.167524	−1.731022 (0.5244)	FDI	0.404486	3.157136 (0.01147)
Δ (EG)	0.106985	2.391795 (0.0262)	EG	0.085744	2.315215 (0.0308)
Δ (ER)	−0.02987	−2.338527 (0.0293)	ER	−0.023939	−3.046449 (0.0061)
Δ (LR)	−0.058	−0.658343 (0.517)	MES	0.0564	2.389768 (0.0024)
Δ (MES)	0.0704	2.750000 (0.012)	NRR	0.04531	2.389768 (0.0263)
Δ (NRR(-1))	0.03232	2.305278 (0.0315)	CointEq(−1)	−1.24772	−4.482445 (0.0002)
Δ (TO(-1))	0.224925	2.043788 (0.0537)	ΔECT	−0.349001	−2.105144 (0.04257)

ARDL: Autoregressive distributed-lag. ECM: Error correction model

Table 4: Diagnostic and stability analysis

Nature	Test	t-stat (P-value)
Normality	Jarque-Bera	1.387148(0.9978)
Serial correlation	Breusch-Godfrey LM test	4.443670(0.1261)
Heteroskedasticity	Breusch-Pagan-Godfrey TEST	0.913271(0.5671)
Stability	Ramsey RESET: t-stat	1.388056(0.1804)
	Ramsey RESET: F-stat	1.926699(0.1804)
	CUSUM	Stable
	CUSUM squares	Stable

Table 5: Variance inflation factor

Variable	Variance	VIF
FDI	0.1497	4.0173
EG	0.0891	3.0115
ER	0.0106	3.5775
LR	0.0362	2.1979
MES	0.0375	3.6301
NRR	0.0214	2.2859
TO	0.0489	4.1590

If VIF >5, this indicates the presence of collinearity among variables estimated. If VIF <5, this shows the absence of interrelationship

Table 6: Granger causality tests

Null Hypothesis	F-statistic	P	Remarks
FDI → DI	3.14437	0.0391	Unidirectional
DI → FDI	1.20472	0.3244	No causality
ER → DI	3.87410	0.0184	Unidirectional
DI → ER	1.08763	0.3689	No causality
EG → DI	0.57713	0.6344	No causality
DI → EG	2.94974	0.0480	Unidirectional
LR → DI	1.56307	0.2181	No causality
DI → LR	1.30038	0.2918	No causality
MES → DI	3.84839	0.0189	Unidirectional
DI → MES	1.39529	0.2627	No Causality
NRR → DI	5.20521	0.0107	Unidirectional
DI → NRR	0.58539	1.77143	No causality
TO → DI	4.31144	0.0119	Unidirectional
DI → TO	0.80439	0.5010	No causality

Null hypothesis: Y does not Granger Cause X (Rejected if P value <5%). Otherwise, we will accept the alternative hypothesis (there was Granger Cause run from the first variable to the later. (→) Indicates the direction of causal flow

(Agosin and Machado, 2005; Farla et al., 2016; Morrissey and Udomkerdmongkol, 2012). The adjusted R_2 (Table 2) reveals that ARDL Bounds test explains around 75% variation in domestic investment jointly predicted by FDI, economic growth, trade openness, lending rate, exchange rate, macroeconomic stability and natural resource rent. Similarly, statistically significant F-statistics enables us to be confident on the inclusion of relevant variables and fitness of the research model.

Table 4 shows that Jarque-Bera, Breusch-Godfrey LM and Breusch-Pagan-Godfrey tests prove the stochastic term in equations (2and 3) are typically distributed, homoscedastic and not serially correlated. While Ramsey RESET: t-stat, Ramsey RESET: F-stat, CUSUM, and CUSUM squares conclude a stable co-integration relationship over the studied period (Appendices A and B), or in another word, they determine model specification function.

Multicollinearity is an essential issue in empirical research; often results are over/underestimation. In Table 5, we applied variance inflation factor tool to detect the collinearity among a set of variables explanatory and control variables, or another way around to see which explanatory variable is essential to the dependent variable. The result of this VIF test– among other things- does matter most in the study recommendation requirements. The rule of thumb is the VIF value if it is >5, it signals the presence of interrelationship among independent variables. Interestingly, all of the predictors reveals a tolerable interdependence and therefore permits a reliable estimation.

Though the ARDL proves the causality, the direction of causality between various pairs of variables has been estimated using Granger Causality framework. Table 6 shows the results for each pair of domestic investment (DI) as the dependent variable and the explanatory variables: FDI, EG, TO, LR, MES, NRR, and ER with F-statistics and corresponding p-value as a benchmark to identify the causality. For each pair we have a null hypothesis that suggests no causality towards next variable, the null is accepted when

P-value corresponding to F-statistics is insignificant. If F-statistics is significant, the null hypothesis is rejected, and the alternative is accepted which holds causal flow from earlier to later in each pair. We find unidirectional causal flows from FDI, ER, MES, NRR and TO to DI while there was unidirectional causal flow the dependent variable DI to economic growth, as well.

5. CONCLUSION AND POLICY IMPLICATIONS

The objective of this study was to empirically examine the impact of FDI inflows on domestic investment in Sudan, for the period 1976-2016. We find that FDI had a crowd-out effect on Sudan's domestic investment, and the results confirmed cointegration relationships between domestic investment, FDI, economic growth, trade openness, lending rate, exchange rate, macroeconomic stability and natural resource rent. Interestingly economic growth, exchange rate, macroeconomic stability and natural resource rent have shown short-run and significant long-run association with domestic investment, whereas, FDI has only proved long-term determinant of domestic investment. Moreover, the study suggests a disequilibrium correction at an annual rate of 35%. The Granger Causality results conclude unidirectional causal flows from FDI, ER, MES, NRR and TO to DI while there was unidirectional causal flow the dependent variable DI to economic growth, too. The results of the study demonstrate some policy trade-off between encouraging FDI that creates a positive impact on domestic investment and adopt, among other things, conducive economic reforms, to control inflation, flexible exchange rate and spurring economic growth, as well as to promote Sudan's OLI potentiality.

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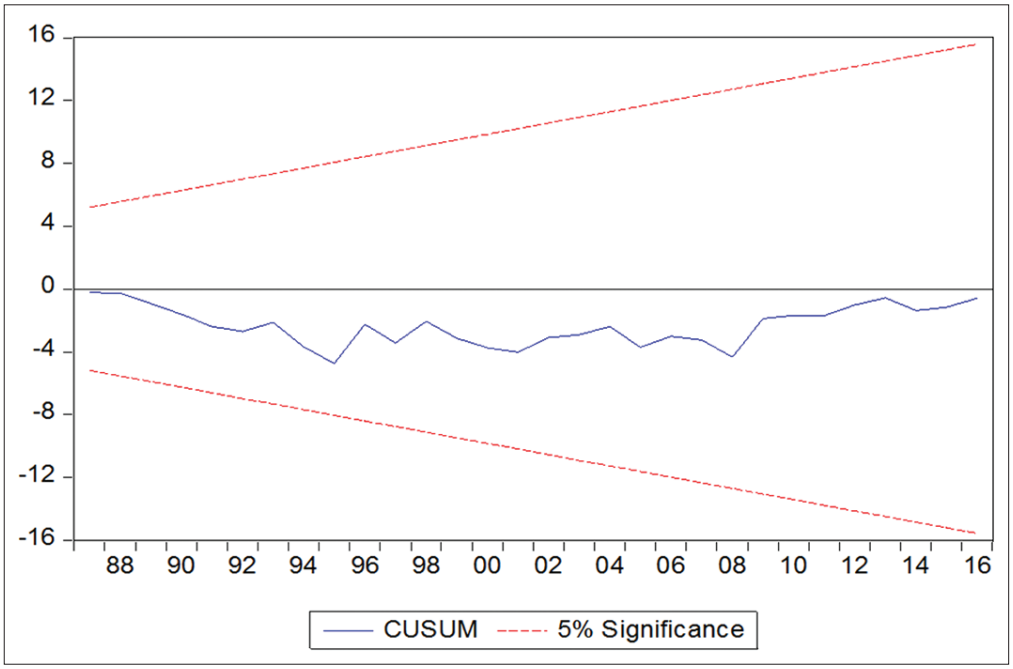
APPENDICES

Appendix 1: CUSUM



Appendix 2: CUSUM of squares