Determining Factors in the Influx of Foreign Direct Investment to Sudan: Implementing Autoregressive Distributed Lag (ARDL)

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Abstract

The purpose of this study was to examine foreign direct investment (FDI) in the context of Sudan between the years 1990 and 2020 by using the bounds testing method of cointegration and the error-correction model. As per the results, it can be understood that the variables considered for the study are combined on a long-term basis if FDI remains a dependent variable. Further, a significant equilibrium correction was found, which supports the existence of a long-term relationship. A number of internal and external factors (especially gross domestic product (GDP), trade openness, inflation, exchange rate, and growth rate, as well as additional macroeconomic indicators such as investment/GDP) were found to impact the state of FDI in Sudan. The variables showed no causalities as per the outcomes of the Granger causality test. Moreover, as per the variance decomposition results, the forecast error variance of FDI, in addition to that of GDP, investment/GDP, and inflation, was found to be self-explanatory. Additionally, as per the impulse response functions, the results demonstrated a short-term negative association between GDP and FDI, suggesting that Sudan possesses inadequate absorptive capacity for promoting its economy using FDI. The results of this research emphasized how selective public policies can be utilized to promote FDI and consequently facilitate short- and long-term economic growth. Therefore, it is useful to recommend some policy implications to promote the application of FDI in Sudan.

Keywords: *ARDL, FDI, exchange rate, economic growth, trade openness.*

JEL Classification Codes: *C22, F13, F21.*

1. Introduction

Although it is a small and open economy, the agricultural sector contributes approximately 40% of Sudan's gross domestic product (GDP). Agriculture and mining are the prominent drivers of supply, whereas investment and private consumption are the primary drivers of demand (African Development Bank, 2021). The performance of the Sudanese economy over the last four decades is characterized by the following:

a) Low production and fluctuations in growth have been recorded in the agricultural and manufacturing sectors, primarily due to the impact of weather on dominant agricultural crops. In comparison with the population, the whole agricultural production of the country registered a minimal growth, whereas the food production per capita has declined drastically. This phenomenon has increased the import of food materials.
b) Total exports have almost stagnated as a result of poor production performance and export-inhibiting policies.
c) The growth of agricultural output and consequently that of GDP have both been negatively impacted by natural disasters such as flooding, desertification, and drought. Rather than the slow development of supply, the most noticeable characteristic of the Sudanese economy has been the large and expanding financial imbalances.

Instead of leveraging self-savings, Sudan is mostly dependent upon foreign financing and domestic borrowing to ensure financial inflow in order to budget and balance its payment deficits. This phenomenon, i.e., dependence upon foreign financing as well as domestic borrowing rather than taxation and savings, provoked a decline in the availability of goods for exports, rapid inflation, high imports, and debt service. Even a series of devaluation decisions have been taken, as recommended by the International Monterey Fund (IMF), but there has been no sign of recovery (Ibrahim & Bashir, 2021; Bashir & Ibrahim, 2023). The income facilitated by international exchange via export is primarily used to repay foreign debts, including payments arrears and government deficits, which have increased sharply. The amounting arrears on foreign debts have reduced Sudan's access to foreign finance, and the monetization of the government deficits has contributed to high and rising domestic inflation. As a result of the foregoing factors, savings and investments have been very low, and lack of maintenance have led to the deterioration of

supportive infrastructure, which threatens to erode the ability of the country to even maintain its poor production and export performance (Ali et al., 2022; Bashir & Ibrahim, 2022).

1.1 Comparison Between Foreign Direct Investment (FDI) in Sudan and That in Sub-Saharan Africa

The development indicators presented by the World Bank demonstrate that in 2020, the net inflow (percentage of a country's GDP) of foreign direct investment (FDI) in Sudan was 2.65%. As Figure (1) shows the FDI to comprise 1.74% of GDP on average between 1970 and 2020 (with lowest and highest values of -0.09% and 6.32% in 1990 and 2003, respectively) (World Bank, 2022a). The ratio of FDI to GDP in Sudan was higher than that in sub-Saharan Africa in 1998–2007 and 2018–2020, while in 1970–1997 and 2013–2017, it was lower. This indicates the influence exerted by internal as well as external factors on the investment climate in Sudan, particularly political stability, growth rate, the level of economic growth and openness, as well as other macroeconomic indicators related to FDI.

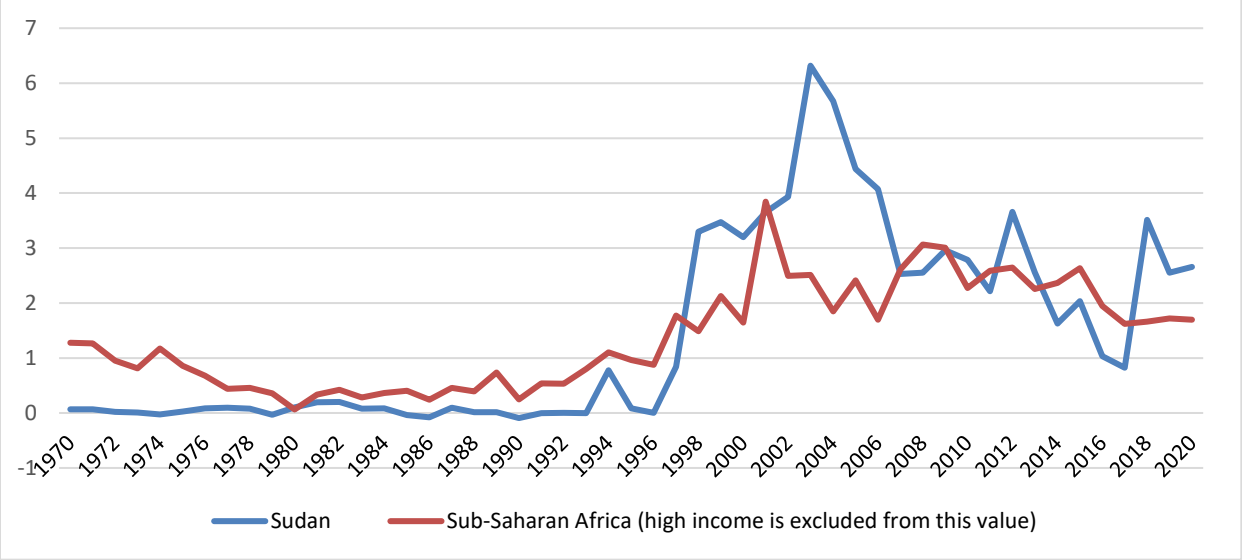

Figure 1: Sudan and Sub-Saharan Foreign Direct Investment (% of GDP), 1970-2020

Source: *Authors' own creation based on data from World Bank (2022b).*

In previous studies, the importance of FDI inflow in developing as well as developed countries has been well documented. In recent years, the growth of FDI has been twice as rapid as that of trade.

The prevalent unavailability of capital in developing countries, which they require for development activities, increases the capital's productivity in their trade (Meyer, 2003).

Sudan, as one of many developing countries, has increasingly addressed FDI as a means of economic development as well as for the stimulation of income growth and employment opportunities. This is reflected by the reform of some economic policies to improve conditions by attracting more FDI and maximizing its benefits to the domestic economy. Though there has been a number of studies published in this domain, i.e., determinants of inward FDI with specific reference to developing countries, no or little relevant research has been published in the Sudanese context. The comparison of the roles played by FDI inflows can facilitate development of crucial guidelines and takeaway points for policymakers to formulate an efficient scheme for boosting the growth of a country's economy. This is especially important in countries like Sudan that suffer from high unemployment and inflation rate. The current study is an important and informative contribution to this domain in the context of Sudan. Unlike the current study, no previous study has considered the timespan of three decades. Further, the current study is an important research work that highlights the value of FDI determinants in the Sudanese context.

The current research aims to investigate FDI determinants in Sudan supported by the bounds testing cointegration approach. This empirical investigation analyzes the association of Sudan's economic growth with its FDI in order to analyze the determinants of FDI inflow within the Sudanese between 1990 and 2020. The authors have organized the current research paper as presented below. In the following part, a review of the relevant literature is provided; in the third part, an explanation of the economic methodology and the estimated model are provided; in the fourth part, the results are presented and discussed; and in the fifth part, the conclusion is presented, including some concluding remarks and policy implications.

2. Theoretical Considerations

In-depth study has long been dedicated to identifying the determinants of FDI in the home country. As per the data-backed studies, various types of economic policies impact the quantum of FDI flow, whereas the literature establishes an association between FDI and GDP (Sengupta & Puri, 2020; Iweze et al., 2020; Morshed & Hossain, 2022).

2.1 Benefits of FDI

FDI is arguably crucial for economic growth in developing countries. Besides the application of FDI as a private source of external funding, there are some major benefits associated with FDI including transfer of information sources and technological and financial resources, increased employment opportunities, and mitigation of the burden upon host countries, caused by imports via the substitution of imports and catalysts to enhance investment and domestic savings (Seabra & Flach, 2005; Mowlaei, 2018; Madhavan et al., 2020; Sengupta & Puri, 2020). FDI is associated with economic growth because it provides technological and managerial competence. This leads to an increase in aggregate demand, investment reserves, employment, income, GDP, and exports (Adhikary, 2017). Specifically, inward FDI is the most crucial platform to increase the flow of funds for local investment, which in turn promotes the home country's capital growth. Further, this can promote local investment by enhancing production chain links in case of procurement of indigenous goods by overseas firms; it may also occur when overseas companies either provide or purchase intermediary products on the behalf of companies in the host company. FDI can also potentially increase the export capacity of host country, resulting in increased earnings from the foreign currency exchange. FDI has a relationship with novel job creation and technological exchange, thereby stimulating the entire national economy (Fosu & Magnus, 2006; Cieślik & Hien Tran, 2019).

2.2 Factors that Attract FDI

In comparison with previous times, FDI has gradually emerged as an important component in national economic growth. FDI inflows are heavily impacted by varying policies on the micro and macro levels, while some other market forces also contribute to this phenomenon. The policies framed and implemented by the government in terms of entry rules, subsidy, regulations, taxation, trade, and foreign exchange are important determining factors regarding FDI flow (Contractor et al., 2021; Alnafissa et al., 2022). Besides government policies, market characteristics, size of external debt, growth rate of GDP, profitability in manufacturing, domestic savings, and public attitude are also important determinants of FDI. Wage rate structure and the quality and quantity of labor or human capital, skilled local labor, economic, and political and social stability also attract FDI. Although domestic investment is essential for strengthening economic development

and expansion in most developing countries, it remains insufficient for their growth and development needs (Kyaw, 2003; Froot & Stein, 1991; Mahbub et al., 2022).

2.3 Factors that Discourage FDI

Various major aspects inhibiting FDI can also be identified, including structural modifications in being a less open economy (e.g., closure to entry or nationalization, etc.). These factors reduce the inflow of FDI (UNCTAD, 1999). FDI inflow is also further reduced by regulatory restrictions such as tariffs and quotas (Kyaw, 2003). A country experiencing rampant corruption is unlikely to acquire FDI (Cieslik & Goczek, 2018). Political instability in Sudan also plays a negative role for attracting FDI. Sudan has consistently experienced political instability since its independence in 1956, including four successful military coups, three democratic governments, and three provisional governments. Poor civilian democratic regimes usually paved the way for military coup. In almost 65 years of independence, Sudan has known only 12 years of peace. Several civilian and tribal conflicts are ongoing in many parts of the country.

2.4 Economic Determinants

The economic determinants of inward FDI are classified into three categories: market-seeking, resource-seeking, and efficiency-seeking. Among these categories, resource-seeking FDI determinants are associated with innovation, technology, and created assets; telecommunication and energy; roads and other physical infrastructure such as ports; raw materials; cheap and illiterate labor; and skilled labor. Market-seeking FDI inflow is associated with country-specific consumer preferences, market size and growth, individual income, access to global markets, competition policies, structure of FDI liberalization, and other such reforms intending to enhance the business environment to boost foreign and domestic investors (Nguyen & Cieslik, 2020; Kumari & Sharma, 2017). According to Emako et al. (2022), the primary reason behind the decreased ability of a developing economy to acquire FDI inflow is the institutional quality of that country. In the context of a developing economy, political stability and regulatory quality are crucial for promoting FDI. According to Muzurura (2019), FDI inflow is negatively influenced by political instability, formation of gross fixed capital, uneven government policies, poor governance and weak export competition, absence of trade openness, and economic stability and corruption. As per O'Meara (2015), the major FDI determinants vary between countries. In the current research, the author

considered both developed and developing economies with a specific timespan, and confirmed that the size and extent of economic activity are the major FDI determinants. The author further confirmed that FDI cannot be attracted by merely changing the policies regarding economic freedom, human capital, and tax incentives and asserted that FDI has become a common global factor that converges countries across the globe. Developing countries design their policies to favor the flow of FDI, assuming that a significant volume of FDI inflow creates a positive impact on the host countries (Ibhagui, 2020). The influx of FDI is a driver for growth, technological transfer, and income derived from overseas economies of various sizes (Mowlaei, 2018).

3. Methodology

3.1 Information Sources

Annual data from 1990 to 2020 on six macroeconomic indicators (e.g., real GDP, exchange and inflation rates, domestic investment, openness of trade, and FDI) were utilized in this research, including time series data obtained from Central Bank of Sudan, the Ministry of Investment, and Central Bureau of Statistics. The values of the variables are expressed in USD. Ratios were used to remove the effect of differences in absolute size. The dependent variable was FDI inflow, while five explanatory variables, namely, GDP, IGDP, exchange rate, trade openness, and inflation, were also included.

3.2 Design of the Model

This research applied a model that assesses how various types of selective variables impacted the attraction of FDI to Sudan between 1990 and 2020.The model's specification, as adopted by UNCTAD (1993), can be written as follows:

$$FDI_t = \beta_0 + \beta_1 GDP_t + \beta_2 (I/GDP)_t + \beta_3 ER_t + \beta_4 OP_t + \beta_5 IF_t + \mu_t \qquad (1)$$

In which *FDI* represents real gross FDI; *GDP* represents economic growth rate; I/GDP represents the proportion of domestic investment to GDP; ER represents the exchange rate; OP represents the degree of trade openness; IF represents the inflation rate; β_0 represents the intercept; $\beta_1, \beta_2, \beta_3, \beta_4, and\ \beta_5$ represent the elasticity coefficients; and μ represents error. All data collected were changed

into their logarithmic values so as to consider the cascading impact of the time series. The sign of the constant elasticity coefficients such as $\beta_1, \beta_2, \ and \ \beta_4$ were assumed to be positive. However, β_3 tends to remain either positive or negative, whereas β_5 may remain negative. Equation (1) demonstrates the equilibrium relation in the long-term context, while it may create a cointegration in the case of the combination of the whole set of variables into an order of one (in other words, I(1)).

3.3 The Cointegration Process

This study evaluated the long-term associations and interplay between the target variables, using autoregressive distributed lag (ARDL) as well as the testing and estimation procedures advanced in Pesaran et al. (2001), and Pesaran & Shin (1995). Additionally, FDI determinants were evaluated using vector autoregression (VAR) upon time series analysis, which specifically involved the error-correction model, variance decomposition, cointegration analysis, and impulse response functions. The VAR approach is helpful in predicting the inter-related time series systems and in the evaluation of how various random disruptions can affect the variables.

A normal error-correction model (ECM) is denoted as follows:

$$\Delta FDI_t = \alpha_0 + \sum_{i=1}^{n} \beta_1 \Delta GDP_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta I/GDP_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta OP_{t-1} + \sum_{i=1}^{n} \beta_4 \ \Delta ER_{t-1} + \sum_{i=1}^{n} \beta_5 \Delta IF_{t-1} + \theta_1 EC_{t-1} + \mu_t \qquad (2)$$

Here, EC_{t-1} denotes that the error-correction term is lagging behind one period.

To identify the FDI determinants, an ECM was executed following the cointegration and Granger causality tests. For the purpose of analyzing the FDI determinations, the short-run dynamics should be executed using an ECM, i.e., a long-run model (Pesaran et al., 2001). With annual observations taken into consideration, the authors analyzed the maximum order of lags in ARDL between 1990 and 2020. The error-correction ARDL (2,2,2,2,2) with regards to variables in equation (1) can be defined as follows:

$$\Delta \ln FDI_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta \ln FDI_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta \ln GDP_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta \ln I/GDP_{t-i} + \sum_{i=1}^{n} \beta_4 \Delta \ln OP_{t-i} + \sum_{i=1}^{n} \beta_5 \Delta \ln ER_{t-i} + \sum_{i=1}^{n} \beta_6 \Delta \ln IF_{t-i} + \delta_1 \ln FDI_{t-1} + \delta_2 \ln GDP_{t-1} + \delta_3 \ln I/GDP_{t-1} + \delta_4 \ln OP_{t-1} + \delta_5 \ln ER_{t-1} + \delta_6 \ln IF_{t-1} + \mu_t \quad (3)$$

If $(\delta_1 - \delta_6)$ are jointly significant, the cointegration of variables can be confirmed. The estimates of δ_i infer how the determinants of FDI are affected in the short term.

4. Results and Discussion

4.1 The Unit Root Test

This study investigated the variables' time series characteristics, primarily by evaluating how stationary the series were as lack of stationarity may increase the spuriousness of the results; this analysis was conducted using unit root tests. Unit root tests were conducted prior to performing the ARDL bounds test, which revolves around the assumption of variables of I(0) or I(1), to evaluate the order of integration.

Table 1: The Augmented Dickey–Fuller (ADF) Test

Variable	**Level**		**First difference**		
	Intercept	Trend and intercept	Intercept	Trend and intercept	Order of integration
lnFDI	-2.13 (-2.97)	-1.82 (-3.58)	-6.47 (-2.98)	-8.20 (-3.59)	I(1)
lnGDP	-1.79 (-2.96)	-0.68 (-3.57)	-4.51 (-2.97)	-5.10 (-3.55)	I(1)
lnI/GDP	-2.17 (-2.96)	-2.08 (-3.57)	-5.38 (-2.97)	-5.37 (-3.57)	I(1)
lnOP	-1.67 (-2.96)	-0.94 (-3.57)	-5.99 (-2.97)	-6.31 (-3.57)	I(1)
lnER	-3.41 (-2.96)	-3.76 (-3.57)	-4.55 (-2.97)	-4.58 (-3.57)	I(0)
lnIF	-0.95 (-2.96)	-0.43 (-3.57)	-4.55 (-2.97)	-5.18 (-3.57)	I(1)

Note: Figures in parentheses represent critical values at 5%.

Source: Authors' calculations based on EViews output.

This study incorporated both the ADF and Phillips–Perron (PP) tests into the data at multiple levels with first differences. Table 1 shows the results of ADF, while Table 2 shows those of PP. Overall, these analysis outcomes support the unit root hypothesis. Thus, aside from the exchange rate, whose stationarity was confirmed, the majority of the variables fall under I(1).

Table 2: The Phillips–Perron (PP) Test

Variable	Level		First difference		
	Intercept	Trend and intercept	Intercept	Trend and intercept	Order of integration
lnFDI	-1.32 (-2.96)	-3.36 (-3.57)	-8.18 (-2.97)	-16.95 (-3.57)	I(1)
lnGDP	-2.32 (-2.96)	-0.29 (-3.57)	-4.77 (-2.97)	-5.66 (-3.57)	I(1)
lnI/GDP	-2.26 (-2.96)	-2.18 (-3.57)	-5.64 (-2.97)	-7.66 (-3.57)	I(1)
lnOP	-1.69 (-2.96)	-1.08 (-3.57)	-6.01 (-2.97)	-6.23 (-3.57)	I(1)
lnER	-3.27 (-2.96)	-3.68 (-3.57)	-4.55 (-2.97)	-4.54 (-3.57)	I(0)
lnIF	-1.17 (-2.96)	-0.43 (-3.57)	-4.61 (-2.97))	-5.18 (-3.57)	I(1)

Note: Figures in parentheses represent critical values at 5%.

Source: Authors' calculations based on EViews output.

4.2 Criteria for Lag Length

As outlined in Table 3, five lag criteria were analyzed. Lag length stayed at two in the AIC criteria. This forms the crux of selecting two lags length, specifically, identifying the most suitable lag for the current model to ensure a small sample size, thereby achieving a compact result. At second lag, there is a lack of evidence for the autocorrelation problem, as revealed by the Lagrange Multiplier test, i.e., *p*-value (0.4640) is more than 5%.

Table 3: The Optimal Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-106.8638	NA	0.000128	8.061697	8.347170*	8.148969
1	-48.93719	86.88986*	2.85e-05*	6.495514	8.493820	7.106416*
2	-11.12119	40.51714	3.72e-05	6.365799*	10.07694	7.500332

Notes: * Lag order chosen using the relevant criterion.

LR: sequential modified LR test statistic (each test at 5%), FPE: Final Prediction Error, AIC: Akaike Information Criterion, SC: Schwarz information Criterion, HQ: Hannan-Quinn information criterion.

Source: Calculations made by the authors based on output from EViews.

4.3 ARDL Bounds for Cointegration

This research evaluated the long- and short-term associations and interplay between relevant variables, including FDI, GDP, ratio of domestic investment to GDP, trade openness, inflation, and exchange rate, using the ARDL cointegration approach. This research also conducted the Wald statistical analysis alike *F*-test. When the *F*-statistic value remains significant, i.e., higher than the upper bound, then the H_0 is rejected in favor of H_1. This finding indicates a long-term balanced association among variables.

Table 4: Results of the Bounds Test

Test Statistic	**Value**	**Sig.**	**I(0)**	**I(1)**
F-statistic	10.28762	10%	2.08	3
K	5	5%	2.39	3.38
		2.5%	2.70	3.73
		1%	3.06	4.15

Source: Authors' calculations based on EViews output.

As shown in Table 4, the result that *F* (10.29) was found to be high compared with the upper bound of the critical value band at 5% in both the lower (2.39) and upper (3.38) bonds rejects the hypothesis that cointegration is absent. Thus, the presence of long-term associations among FDI, GDP, I/GDP, ER, OP, and IF can be inferred, as can the possibility of treating GDP, I/GDP, ER, OP, and IF can be treated as 'long-term forcing' variables regarding FDI. Furthermore, this infers that, in the long term, variables change together. This outcome aligns with previous studies (Olabisi, 2018; Mansour et al., 2017; Adusah-Poku, 2016; Nwosa & Akinbobola, 2016) that were conducted in developing African countries.

4.4 Error-correction Model (ECM)

Following the establishment of a cointegration relationship, it is easy to determine the ECM so as to identify the dynamic behavior of FDI determinants.

Table 5: Error-correction Regression of ARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LONFDI(-1))	0.473002	0.118818	3.980892	0.0011
D(LONIGDP)	0.299150	0.129618	2.307941	0.0347
D(LNER)	1.060458	0.419887	2.525581	0.0225
D(LNER(-1))	-1.232463	0.341460	-3.609397	0.0024
D(LONIF)	-1.507505	0.312629	-4.822031	0.0002
CointEq(-1)*	-1.972062	0.198181	-9.950795	0.0000

Source: Authors' calculations based on EViews output.

As shown in Table 5, the coefficient of error-correction term representing the extent to which long-term imbalance in FDI can be amended per year, estimated as -1.972062, was found to be significant at the 5% level and was rightly negatively signed. The estimated value of the (EC_{t-1}) coefficient indicates that the adjustment rate in the system alters the disequilibrium level of its earlier period by about 197% per year, indicating a rapid adjustment to equilibrium in the long term. GDP, IGDP, exchange rate, and inflation were also found to be key determinant factors of FDI in Sudan. These findings are similar to previous studies conducted by Alnafissa et al. (2022) and Abel et al. (2021).

4.5 Diagnostic Tests

To evaluate model robustness, this study performed several diagnostic assessments, specifically regarding residual normality, heteroscedasticity, and serial autocorrelation. In particular, the author conducted the Ramsey RESET, Breusch-Pagan-Godfrey correlation, Jacque-Bera normality, and Breusch-Pagan-Godfrey heteroskedasticity tests. As per the results, the outcomes accept the null hypothesis of normal distribution, homoscedasticity, and no autocorrelation.

4.6 Granger Causality Test

Since the variables FDI and GDP are fixed, we assumed that their residuals were not correlated, which is the condition of Granger causality test, and optimal lag is 2, which is the lowest AIC. To evaluate this study's null hypothesis, we used the *F*-test, whose guideline was the 5% value and significance level. As the results of the Granger causality test demonstrate, this hypothesis, i.e., there is no relationship of causality between FDI and GDP, and vice versa, is supported since the *p*-value of *F* is higher than 5% (0.6848 and 0.8297, respectively). Therefore, the Granger causality tests confirm the absence of any evidence to establish any significant association of FDI with GDP. In general, foreign investors are deterred by foreign loan dependency, political instability, and insufficient GDP growth. A previous study conducted by Attari et al. (2011) documented a similar finding, while this result contradicts with that of Yahia et al. (2018), who confirmed that the Granger causality outcomes infer the unidirectional causal flows from FDI, exchange rate, and trade openness to domestic investment.

4.7 Impulse Response Functions (IRFs)

Impulse Response Functions (IRFs) evaluate how shock to an endogenous variable impacts all other variables in the system. It remains a shock to the VAR system. IRFs can be used as a tool for evaluating how FDI movements impact each variable. In this research, ordering was determined based on Cholesky as set by the EViews package. The period has been divided into the long term and the short term. The latter is fixed as quarter 3, whereas the former is quarter 10. Figure 2 shows the estimated orthogonalized impulse response functions for GDP, I/GDP, ER, OP, and IF regarding one standard deviation innovation in FDI. The effect of each variable on FDI is shown in the figure below, from FDI itself to other variables, namely, GDP, I/GDP, ER, OP, and IF. This finding resembles those of Asiamah et al. (2019).

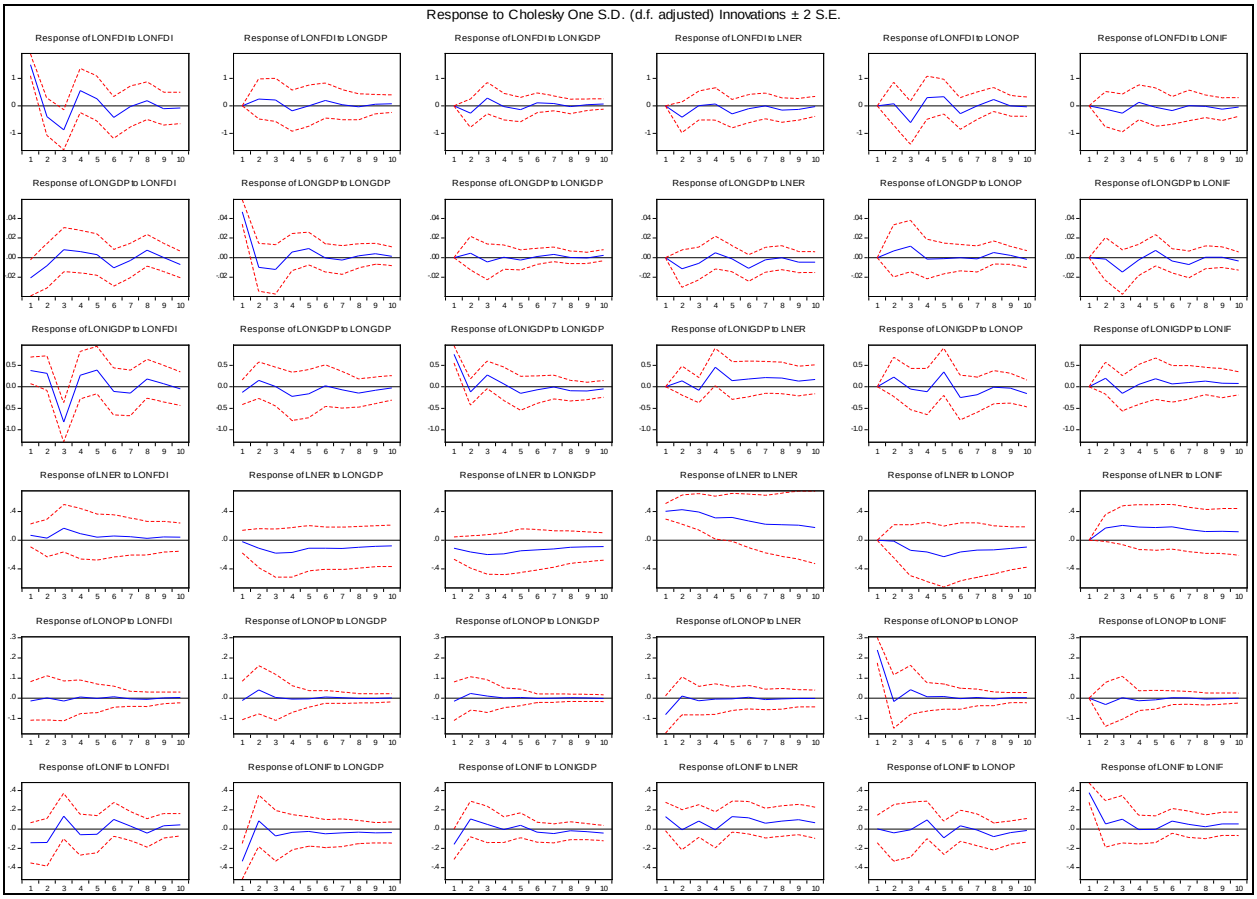

Figure 2: Impulse Response Functions

4.8 Variance Decompositions

Table 8 shows the Variance Decompositions (VDC) outcomes that are calculated across long- and short-term predictions to determine the extent of forecast error variance for model variables, which can be briefed through innovations to each explanatory variable. As per the results, the FDI inflow was impacted due to self-shock by 78.10% in the third quarter; however, this decreased to 70.76% in the tenth quarter. Thus, in the long term, a reduction of FDI inflow occurs due to self-shock; meanwhile, in the short term, GDP, I/GDP, trade openness, inflation, and exchange rate can explain 2.65%, 3.65%, 9.29%, 2.07%, and 4.23% of variation in FDI, respectively. Variations in the inflow of FDI may be detailed based on exchange rate and trade openness in the short term; however, in the long term, the effect of trade openness (13.8%) is more accurate than that of exchange rate (5.9%). As a result, it can be inferred that trade openness holds the highest possible explanatory power to manage FDI inflow in the Sudanese context in both the short term and the

long term. Further, the findings of this research also demonstrate that exchange range holds a better explanatory power than other factors such as inflation, I/GDP, and GDP in both the short and long term. This study's findings align partially with those of Ibhagui (2020), Asiamah et al. (2019), Mourao (2018), Ali & Mingque (2018), and Asamoah et al. (2016,2019).

Table 8: Variance Decompositions

VD of	Period	LONFDI	LONGDP	LONIGDP	LNER	LONOP	LONIF
LONFDI	Q3	78.10	2.65	3.65	4.23	9.29	2.07
	Q10	70.76	3.55	3.69	5.90	13.28	2.82
LONGDP	Q 3	15.57	67.48	1.07	4.52	5.22	6.15
	Q10	18.84	58.40	1.44	8.07	5.17	8.08
LONIGDP	Q3	51.84	2.23	37.82	1.48	3.07	3.55
	Q10	40.94	5.04	24.22	14.37	10.46	4.96
LNER	Q3	4.51	6.06	10.53	66.66	2.60	9.64
	Q10	3.13	7.70	11.10	53.93	10.49	13.65
LONOP	Q3	0.53	2.69	1.28	9.77	84.38	1.36
	Q10	0.76	2.78	1.30	9.81	83.68	1.68
LONIF	Q3	14.35	30.64	9.51	6.02	0.38	39.10
	Q10	14.77	24.62	8.49	14.81	5.13	32.16

Source*:* Authors' calculations based on EViews output.

Regarding the variance decomposition of GDP, as shown in Q3, the impact on GDP in the short term comprised 15.57% of variation of the fluctuation in FDI and 67.48% of that in GDP itself. A shock to GDP could contribute 1.07%, 4.52%, 5.22% and 6.15% of variation of the fluctuation in the proportion of domestic investment in comparison with GDP, ER, OP, and IF. Meanwhile, as shown in Q10, shock to GDP in the long term could account for 18.84%, 58.40%, 1.44%, 8.07%, 5.17% and 8.08% of variation of the fluctuation in FDI, GDP, IGDP, ER, OP, and IF, respectively. Regarding the variance decomposition of IGDP, as shown in Q3, shock to IGDP in the short term accounted for 51.84%, 2.23%, 37.82%, 1.48%, 3.07%, and 3.55% of variation in FDI, GDP, IGDP, ER, OP, and IF, respectively. Meanwhile, as shown in Q10, shock to IGDP in the long term could contribute 40.94%, 5.04%, 24.22%, 14.37%, 10.46%, and 4.96% of variation of the fluctuation in FDI, GDP, IGDP, ER, OP, and IF, respectively.

Regarding the variance decomposition of exchange rate, as shown in Q3, impact on exchange rate in the short term accounted for 4.51%, 6.06%, 10.53%, 66.66, 2.60% and 9.64% of variation of the fluctuation in FDI, GDP, IGDP, ER, OP, and IF, respectively. Meanwhile, as shown in Q10, shock to exchange rate in the long term can contribute 3.13%, 7.70%, 11.10%, 53.93%, 10.49%, and 13.65% of variation of the fluctuation in FDI, GDP, IGDP, ER, OP, and IF, respectively.

Regarding the variance decomposition of trade openness, as shown in Q3, shock to trade openness in the short term accounted for 0.53%, 2.69%, 1.28%, 9.77%, 84.38%, and 1.36% of variation of the fluctuation in FDI, GDP, IGDP, ER, OP, and IF, respectively. Meanwhile, as shown in Q10, shock to OP in the long term could contribute 0.76%, 2.78%, 1.30%, 9.81%, 83.68%, and 1.68% of variation of the fluctuation in FDI, GDP, IGDP, ER, OP, and IF, respectively.

Regarding the variance decomposition of inflation, as shown in Q3, impact on inflation in the short term accounted for 14.35%, 30.64%, 9.51%, 6.02%, 0.38%, and 39.10% of variation of the fluctuation in FDI, GDP, IGDP, ER, OP, and IF, respectively. Meanwhile, as shown in Q10, shock to IF in the long term could contribute 14.77%, 24.62%, 8.49%, 14.81%, 5.13%, and 32.16% of variation of the fluctuation in FDI, GDP, IGDP, ER, OP, and IF, respectively.

We can conclude that OP contributed a significant 9.28% to FDI in Q3, while ER contributed 4.23%. As the horizon extended in the tenth quarter, the contributions of OP and ER to FDI increased to 13.28% and 5.90%, respectively. Some empirical studies documented similar findings (e.g., Mansour et al., 2017; Ali & Mingue, 2018; Mourao, 2018; Olabisi, 2018; and Asiamah et al., 2019; Abel et al., 2021).

4.9 Stability Tests

Figure 3 shows the statistical outputs of CUSUM and CUSUMQ. If the coefficients can generally be considered stable, then the plots of these statistics should remain within 5% significance levels. In Figure 3, the blue line remains between the two red lines; therefore, the model can be considered stable.

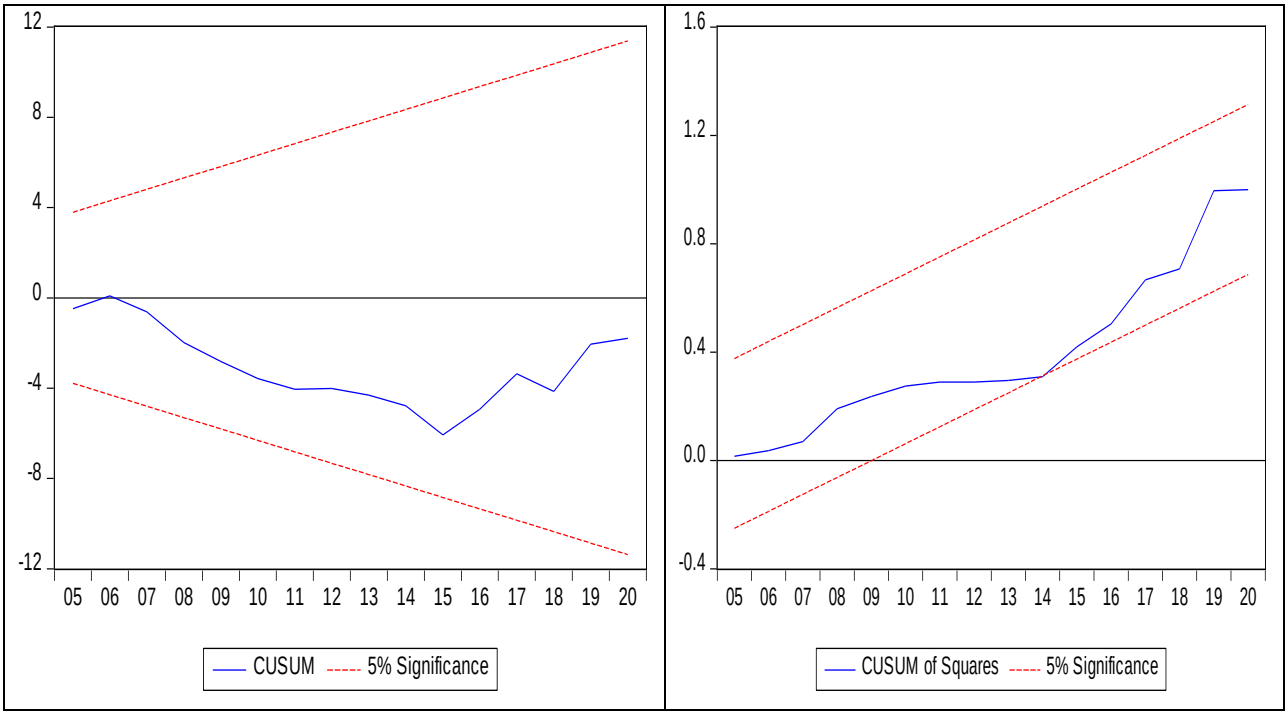

Figure 3: Plots of CUSUM and CUSUMSQ

5. Concluding Remarks and Policy Recommendations

The primary aim of this study was to identify determinants of FDI in Sudan for the period between 1990 and 2020. The ARDL model to cointegration approach was implemented to analyze the long-term equilibrium between the selected variables. The presence of causality between FDI and FDI was evaluated using the Granger causality test, which confirms the absence of any evidence to establish any significant association of FDI with GDP. Additionally, a significant equilibrium correction was found that supports the existence of a long-term relationship. Several factors at both the external and internal levels were found to influence FDI in Sudan, particularly GDP, growth and exchange rates, inflation, and trade openness, as well as other indicators such as investment/GDP. The outcomes conclude a significant, positive coefficient regarding GDP. This phenomenon assures that the market size hypothesis, in terms of heavy host countries, has a relationship with high GDI since market opportunities are high for the investor. Further, the variable trade openness was found to be a significant positive factor for economic growth. Thus, the study findings firmly establish the role played by policy variables regarding FDI and the short-

term and long-term prospects for growth within the Sudanese context. These results further support some policy recommendations to the Sudanese government for optimizing the positive effect of FDI inflow on Sudan's economic development. In short, this study demonstrated that FDI is affected by IGDP, GDP, and IF in both the short term and the long term.

First, the abundance of natural resources in Sudan is not fully utilized. A prominent and crucial policy implication of the current study findings is that increased export facilitates national economic growth, and that the latter also facilitates the former. As a policy implication, it should be emphasized that, in addition to the previously mentioned factors, human capital is considered a crucial FDI inflow determinant. This factor establishes that a large proportion of FDI in Sudan is directed toward knowledge-intensive activities. Further, policies should also be developed to improve the quality of manpower through various initiatives such as training, education activities, skill improvement, etc., since these measures promote investments. Further, the government must expand science, technology and business-based educational activities throughout the country via higher educational institutions such as universities and polytechnics; to prepare people for employment, intensive technical and vocational education courses should also be introduced nationwide.

The empirical evidence demonstrates the necessity for countries that expect high FDI inflow, like Sudan and other such developing countries, to optimize the investment climate for this purpose via the introduction of dedicated initiatives. These initiatives also enhance a country's capability to attract multinational investors who engage in FDI. A dynamic, attractive domestic environment should be created through the implementation of relevant policies, and FDI must be supported in recipient countries by hospitable regulatory frameworks, the large market, and a favorable economic environment. Indeed, experience demonstrates that lowering their capital movement barriers enables developing economies to increase FDI. Governments in Sudan should therefore ensure that the economy is stable, and that the investment climate is attractive. These factors promote investments, fixed capital formation, and export competitiveness.

From a wider research perspective, FDI is used as a more general term, but each FDI provides different economic benefits to different sectors. More detailed research is needed on the comparative advantage of different types of FDI in different sectors and how FDI can impact overall economic growth. While the present article did not cover this aspect, it is an interesting and valuable topic for future study. This study also contains some further limitations, particularly

regarding the specific data chosen for evaluation. Primarily, the data collection period was short as Sudan hasn't been publishing monthly data since 1990. Another main limitation was the inability to collect data regarding primary determinants including cost of labor, political risk and corruption, natural resources, and efficacy of rule of law. Therefore, inclusion of these variables could be a significant area for future research.

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Conflicts of Interest

The authors do not have conflict of interest.

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