INTERNATIONAL JOURNAL OF ACADEMIC RESEARCH IN BUSINESS & SOCIAL SCIENCES

Vol 13, Issue 12, (2023) E-ISSN: 2222-6990

Environmental Pollution and Economic Growth Determinants in Foreign Direct Investment Inflows: The Case for Sub-Saharan Sierra Leone

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To Link this Article: http://dx.doi.org/10.6007/IJARBSS/v13-i12/19883 DOI:10.6007/IJARBSS/v13-i12/19883

Published Date: 11 December 2023

Abstract

The primary objective of the present research was the examination of environmental pollution, economic growth, and supplementary selected macroeconomic elements as determinants of foreign direct investment inflows into Sub-Saharan Sierra Leone for the post-conflict period, 2002-2020, and whether the association between the determinants and foreign direct investment is long-term and short-term. The research methodology was quantitative, and the dataset was time series with 76 observations and 10 variables. Using the *AR*(2) model, the findings indicated the lags of foreign direct investment, gross fixed capital formation, carbon dioxide, trade, and population growth were significant determinants of foreign direct investment inflows. Furthermore, applying the Phillips-Ouliaris cointegration model, the results indicated a statistically significant long-run association between foreign direct investment and, at least, one determinant (*Rho* = -39.458, *Tau* = -5.024, $p < .05$). Additionally, the error correction model (errorECM1) applied to explore the short-run deviation from the long-run had the expected sign, and was statistically significant ($\beta_{errorECM1}$ = -.524, *SE* = .158, *t* = -3.31, *p* = .002), representing a speedy conversion movement to long-run equilibrium of about 52.4% annually. Nonetheless, the research restricted itself to 19 post-conflict years (2002-2020), which may be inadequate to recognize the comprehensive determinant of foreign direct investment inflows. Succeeding studies must embrace additional years, including pre-conflict periods, to recognize the comprehensive determinants of foreign direct investment inflows into Sub-Saharan Sierra Leone.

Keywords: Carbon Dioxide Emissions, Foreign Direct Investment Inflows, Gross Domestic Product, Autoregressive Model, Cointegration, Error Correction Mode.

Introduction

For the last forty years and beyond, Sub-Saharan Africa has realized an augmented movement of foreign direct investment (FDI) from international companies, notwithstanding

the argument whether FDI engenders economic growth (Chia & Ogbaji, 2013; Kemeny, 2010; Okafor, 2015; Okurut et al., 2012). Lipsey and Chrystal (2011), for example, acknowledged FDI as a non-residential speculation through the purchase or principal venture in a local division, factory, or secondary organization where the stakeholder had voting power. Similarly, Todaro and Smith (2015) noted FDI was the speculation completed by outsized international organizations external to the nation of their head office. Meanwhile, Adejumo (2013), referencing the World Bank, said FDI was the net inflows of outlay to acquire a robust regulating interest (10 percent or more of voting stock) in a commerce executing in an economy exclusive of that of the investor.

Given all this, it is desirable to recognize the sustained importance of FDI as a key foundation of capital outlay in Sub-Saharan Africa, despite the persistent doubt relating to its factual relationship with the economic growth of a nation. Obute et al (2019) even argued an important worth of FDI at the micro level was the allowance of capitals to flow easily to any commercial with the unsurpassed projections for development anyplace globally, since stockholders unceasingly pursued the finest return for their investment with the minimum peril. Lo et al (2013) equally recognized the role of FDI as a crucial element of economic growth. The authors argued FDI was an imitative of the neoclassical growth theoretical model and, consequently, it was plausible that FDI can augment growth by way of transference of external speculation, leading-edge technology, and enhanced management in establishments in the host homeland. Indeed, Owusu-Antwi et al (2013) amplified this concept by perceiving FDI inflows transported urgently required capital to finance local actions, producing the phase for repositioning technology and technical knowledge for the host country.

Despite its significance, sceptic scholars have argued FDI holds an adverse or inconsequential effect on the economic growth of Sub-Saharan Africa (Acheampong & Osei, 2014; Eregha, 2015; Fiodendji & Evlo, 2015; Okurut et al., 2012). Acheampong and Osei (2014), for instance, realized FDI demonstrated long-run and short-run positive associations with the gross domestic product (GDP) macroeconomic element, although these relationships were unimportant, in their examination on FDI inflows into Ghana. Alternatively, Okurut et al. (2012) noted economic growth and inflation had adverse and substantial influences on FDI inflows into the Economic Community of West African States (ECOWAS), in their research on the determining factors of FDI inflows into ECOWAS. In continuity, while a few academics have recognized that market size and growth Bekana (2016); Gwenhamo (2011); Okafor (2015); Wafure & Nurudeen (2010) hold positive and substantial impacts on FDI inflows, others, including Acheampong and Osei (2014); Eregha (2015), acknowledged that these variables hold insignificant influences on FDI inflows into a nation.

The augmented movement of FDI from international corporations to African nations is also true of a country-specific Sub-Saharan Sierra Leone. This is factual with the realization that, Sub-Saharan Sierra Leone has experienced an enhanced flow of FDI (stocks) from international corporations of about 756.8% between 2000 and 2020 (United Nations Conference on Trade and Development, 2022). Notwithstanding this augmented FDI inflows, information on the determinants and effect of FDI on the economic growth of Sub-Saharan Sierra Leone is inadequate in the literature. Even the available imperfect information on FDI and economic growth in Sub-Saharan Sierra Leone have disparate reviews. For some academics, FDI inflows have had a significant effect on the economic growth of Sub-Saharan Sierra Leone (Brima, 2015; Mansaray 2017a, 2017b), even where this effect was speciously negative, non-existent, or even weak during its ten years' internal conflict (1991 – 2002) (Duramany-Lakkoh, 2021; Duramany-Lakkoh, Jalloh, et al., 2021; Kargbo, 2012).

In addition, even where the academics have applied similar macroeconomic elements in determining FDI inflows, including inflation and exchange rates, for example, the outcomes received were distinct altogether. Undeniably, Brima (2015), in his research on macroeconomic determinants of FDI inflows into Sub-Saharan Sierra Leone, realized exchange rate, for instance, had positive and significant long-run and short-run effects on FDI inflows. Conversely, Brima realized inflation had negative but significant long-run and short-run impacts on FDI inflows. An equivalent study on FDI determinants in Sub-Saharan Sierra Leone by Mansaray (2017b), however, found that, exchange rate, for example, had positive but insignificant long-run and short-run impacts on FDI inflows. Mansaray also realized inflation, for instance, had a negative but insignificant long-run effect on FDI inflows, and a positive but insignificant short-run effect on FDI inflows.

Now, other academics have argued foreign investment programs in certain Sub-Saharan African nations, which are principally resource-reliant, desire the extractive sectors and these are characteristically pollution concentrated (African Union, 2010; Boutabba, 2014; Ren et al., 2014). Consequently, these sectors are frequently connected with adverse environmental values (Aliyu & Ismail, 2015). Obviously, because several industries in Sub-Saharan Africa are extractive in nature, and that substantial FDI inflows into Sub-Saharan Africa relate to the extractive industries, we should anticipate the element of environmental pollution as a determining factor in FDI inflows. Given this, it is commendable to explore the conceivable relationship between FDI inflows and tangible selective macroeconomic elements in the post-civil conflict cycle of Sub-Saharan Sierra Leone. The analysis is for the period encompassing 2002 to 2020, since a complete information beyond the year 2020 was unavailable at the time of the research exploration. Consequently, the 2002 to 2020 period is substantial in determining the enhanced foreign direct investments and its association with environmental pollution and economic growth in Sub-Saharan Sierra Leone in the after-effects of its civil engagement in the early 2002. The 2002-2020 era witnessed the rapid augmentation of economic growth in Sierra Leone after the conclusion of its internal strife. Therefore, the principal design of the present research is two-fold

- The examination of a conceivable relationship between FDI inflows and tangible selective macroeconomic elements, including the environmental pollution element (CO_2), in post conflict Sub-Saharan Sierra Leone.
- The determination of whether the conceivable association between FDI inflows and the environmental pollution element (CO_2) shadows the Pollution Heaven Hypothesis or the Pollution Halo Hypothesis, following similar submissions in the literature (Acharyya, 2009; Aliyu & Ismail, 2015; Boutabba, 2014; Grimes & Kentor, 2003; Kılıçarslan & Dumrul, 2017; Sapkota & Bastola, 2017).

The objective is expressly substantial because even with the prevailing inadequate information on FDI inflows and economic growth in Sub-Saharan Sierra Leone, there is hardly any information on the environmental pollution element and its impact on FDI inflows. Therefore, this research offers the underpinning for a theoretical and practical examination on the association between FDI inflows and environmental pollution as a determinant in the post-internal dissonance of Sub-Saharan Sierra Leone, for government policy approach. Additionally, a portion of the incomplete resources on FDI inflows and economic growth in Sub-Saharan Sierra Leone had suggested procedures that would endure selective macroeconomic determinants of FDI inflows, including domestic investment, by utilizing development configuration and workable policies to inspire growth. Arguably, the macroeconomic element of gross fixed capital formation, which is a key constituent of

domestic investment, appears as a noteworthy method that could accelerate economic growth, and policy planners should stimulate procedures (e.g., corporate tax breaks, etc.) to supplement the freedom of investment in Sub-Saharan Sierra Leone, which may upsurge production because of its run-off impact on economic realization. Hence, this research is substantial because it offers an exploration of the continued role of private investments concerning FDI inflows in the post-conflict years of Sub-Saharan Sierra Leone and its applied insinuations for governments, policy designers, and investors. The research is also reasonably significant for the Sub-Saharan African region because of its similar emerging and unbalanced macroeconomic setting. Now, concerning the context and specificity of the research organization, the paper embraces seven sections altogether. After the introduction, section two is the literature review, which covers, among other things, the conceptual framework of the theories of FDI and the planned theoretical model for the current research. Section three is the methodology, which defines the applicable econometric procedures and model estimation. Section four defines the relevant data and the overall observations in the dataset. Section five outlines the result of the research, while section six evaluates the empirical results. Section seven offers a summary of the comprehensive research with proposals and confirmations.

Literature Review

***Conceptual Framework*.** The design of the current research is the exploration of macroeconomic determinants of FDI inflows into post-conflict Sub-Saharan Sierra Leone (2002-2020). Thus, the applicable theoretical framework in the present research embraces features of the international trade theory, the internalization theory, and the eclectic paradigm theory of FDI owing to their characteristic positions on FDI, market growth, and trade openness, among others, which are important in examining the macroeconomic determinants of FDI inflows into post-conflict Sub-Saharan Sierra Leone. Instinctively, there are countless journals on FDI with some endorsements on the recognition that, FDI in Sub-Saharan Africa, for example, was feasible by international trade and international speculation (Bartels et al., 2014; Fehér & Poór, 2013; Okafor, 2015; Saibu & Akinbobola, 2014; Seyoum et al., 2015). Mundell (1957) was a prominent advocate of the neoclassical international trade theory in determining FDI inflows into a nation. Clearly, Mundell (1957) incorporated FDI into the neoclassical structure as the concern of complications to trade in goods. Mundell contended that, even if there were the respite of trade hurdles, this would not concurrently lead to the rearrangement of capital flights, because FDI was now a portion of the dynamic appearances of the host-country, which encompassed sunk and fixed outlays. Mundell bolstered that, trade hurdles buoyed FDI, and trade openness neither narrowed FDI nor augmented trade. In all, Mundell surmised that FDI and trade were substitution elements. It is obvious in the neoclassical international trade framework that countries cannot be outflow and inflow investors concurrently because across-movements of FDI are nonexistent. The neoclassical international trade theory was among the theoretical models utilized by Aliber (1970), in his research on the concept of direct foreign investment. Despite that, Denisia (2010) argued the neoclassical international trade theory was challenging because of its misstep to delineate the existence of multinational companies, since delineations concerning distinctions in rates of return between countries could define portfolio assets, but not FDI.

Augmenting the neoclassical trade theory is the internalization theory of FDI. Buckley and Casson (2009, 2011) were the frontal pioneers of the internalization of FDI into foreign countries, founded on their postulation that, market restrictions produced the existence of

internalizing commerce in an institution. FDI slashed a company's expenditures and supplemented the production efficiency of the multinational corporation (Buckley & Casson, 2009, 2011). Buckley and Casson perceptibly seemed the leaders advancing the macroeconomic notions of trade openness and market efficacy determinants of FDI inflows into a country. Ogasavara and Maseru (2013) applied Buckley and Casson's (2009, 2011) theory of the internalization of FDI to investigate the subtleties and impulses considered by Asian transnational commerce for gaining access to the Brazilian market. Using a quantitative approach, Ogasavara and Maseru recognized that, market edifices, especially regarding the level and growth of the host's market, were the reasons for the entering decisions of Asian companies into the Brazilian market. Buckley and Caisson's (2009, 2011) concept of internalization of FDI had met with reproach though, because it was based on its mixture of industry-delimited characteristics as the principal import concerning the internalization choosing (Kurtishi-Kastrati, 2013). Despite this reproof, the theory is significant since it helped detail the cost effectiveness as an FDI determinant.

Equally, Dunning (1988, 2001) was prominent in investigating the determining factors of FDI by offering the eclectic paradigm (OLI) theory of FDI. Dunning (1988, 2001) argued investors selected FDI due to its three clusters of leverages embracing ownership, locational, and internalization specific advantages. Dunning (1988, 2001) argued, for example, that the location specific advantage was the realization the commerce accumulated because it located its commercial activities in a specific area. The locational advantage equally encompassed the effortlessness of entree of minor business costs, expert staff, regular substructure, and local stratagems, inter alia, in the host nation that may decoy FDI inflows (Dunning, 1988, 2001). It is apparent locational affluences would progress on the condition the host economy can sanction big markets or the impulse of creating them by trade openness, small business expenses, or excellent substructure. This specific of Dunning's concept thus appears to encompass macroeconomic determinants (e.g., market size, and trade openness) of FDI inflows into a country. Okafor (2015) identically utilized the OLI method in panel data models, to investigate the locational determining elements of the United States (US) FDI inflows into 23 Sub-Saharan Africa nations, from 1996 to 2010. Applying quantitative models on panel data, Okafor recognized that US external FDI into Sub-Saharan Africa rose to reliability due to the presence of crude oil and natural gas, infrastructural expansion, market outlook, and primary education achievement rates. Notwithstanding the all-approving application of the OLI model, it faces reproachment for its crowded extrapolative aptitude for the combination of elements (Fofana, 2014). However, Dunning (2001) responded that the advancement of the OLI paradigm was not to embrace all natures of industrial varieties which the international groups anticipated.

***The Theoretical Model*.** Following the conceptual frameworks of the international trade theory, internalization theory, and the eclectic paradigm theory of the determinants of FDI inflows (Aliber, 1970; Bartels et al., 2014; Buckley & Casson, 2009, 2011; Denisia, 2010; Dunning 1988, 2001; Mundell, 1957; Okafor, 2015), a level of conjunction on the truly applicable practical specification has ensued. Given this, the assumption of the research exploration is that the effect realized in the FDI inflows element in the current period depends on its values from the prior period and complementary elements, following similar suppositions by Noorbakhsh et al. (2001), Quazi (2014), and Quazi, Vemuri, et al. (2014). This relationship is preliminary represented by the following FDI model:

$$FDI = f(FDI_{t-p}, GDP, GFCF, CO_2, Infl, Trade, Energ, Intr, Extr, POP) \quad (1)$$

Where

FDI is a function of its values from the prior period/s; GDP = real gross domestic product as a proxy for economic growth; GFCF = gross fixed capital formation; CO_2 = carbon dioxide emission; Infl = inflation; Trade = trade openness; Energ = renewable energy; Intr = interest rate; Extr = exchange rate; and POP = population growth rate.

***Macroeconomic Determinants of FDI*.** There are countless research scholarships in the current journals on macroeconomic determining factors of FDI inflows into countries, including Sub-Saharan Africa. A few of the connected determining dynamics embrace market growth and market size, gross fixed capital formation, carbon dioxide, renewable energy, inflation, trade openness, interest rate, and exchange rate (Acheampong et al., 2021; Akin, 2009; Aziz & Makkawi, 2012; Babatunde, 2011; Bekana, 2016; Billington, 1999; Ezeoha & Cattaneo, 2012; Faroh & Shen, 2015; Fiodendji & Evlo, 2015; Gonzalez-Perezet al., 2011; Oladipo, 2013; Okurut et al., 2012; Owusu-Antwi, 2012; Ren et al., 2014; Wafure & Nurudeen, 2010; Zhang et al., 2010).

The utilization of market growth and market size as essential determinants of FDI inflows, for example, is striking in numerous empirical research studies on FDI (Acheampong & Osei, 2014; Akin, 2009; Aziz & Makkawi, 2012; Bekana, 2016; Dinda, 2014; Eregha, 2015; Ezeoha & Cattaneo, 2012; Fiodendji & Evlo, 2015; Gwenhamo, 2011; Okafor, 2015; Suliman et al., 2015; Owusu-Antwi et al., 2013; Wafure & Nurudeen, 2010). Countless empirical studies in the current journals, for instance, have frequently applied the real GDP growth (a proxy for market growth), in investigating the significance of market growth in determining the inflow of FDI into a host nation. Javed et al (2014); Musonera et al (2010), for instance, had distinctly argued the significance of the application of the GDP growth in conjectural and empirical scholarships in pulling in actual economic growth. Gwenhamo (2011) similarly applied the real GDP as an assessment of the market magnitude of the host nation, and inferred the macroeconomic component was a significant decisive influence of horizontal FDI and, was steadily prominent in empirical scholarships. Applying the Johansen cointegration model, to investigate the long-run decisive factors of the inflows of FDI into Zimbabwe, Gwenhamo (2011) recognized that real GDP had a positive and substantial influence on FDI inflow with essential elasticity of 1.01. In closing, Gwenhamo argued the result affirmed the market size hypothesis, which advanced that superior markets were the reinforcement of the economies of scale that enhanced revenues from corporate investments and, hence, stimulated the inflows of FDI.

Bekana (2016) realized a corresponding investigation on the determinants of FDI inflows into Ethiopia. Primarily, Bekana (2016) had argued the essential reason behind FDI inflows into developing nations was to access the national market and, accordingly, market size was imperative, for host nation's local market enthused FDI. Consequently, utilizing the Engle-Granger cointegration techniques on selected time series data for the period, 1991 to 2013, Bekana recognized that, GDP growth rate and GDP *per capita* had positive long-run and short-run impacts on FDI inflows. Bekana eventually recognized that market-rising competences were the striking determinants of FDI inflows into Ethiopia. Other academics have similarly examined the significance of market growth and market size in determining FDI inflows into a nation, especially into Sub-Saharan Africa (Fiodendji & Evlo, 2015; Hasnet, 2013; Okurut et al., 2012; Suliman et al., 2015; Wafure & Nurudeen, 2010). Similar authors have applied the population growth of a nation as a proxy for market size in determining FDI inflows into a

nation (Akin, 2009; Aziz & Makkawi, 2012; Billiington, 1999). Akin (2009), for example, applied population growth as a proxy for market size in determining FDI inflows into selective developing countries. Applying regression analysis with a consistent heteroscedasticity, Akin realized population growth had a positive and significant association with FDI inflows, an indication multinational companies considered the size of the market in these nations to generate a meaningful investment. In all, these varied reviews advance the existence of market growth and market size as significant determinants of FDI inflows into nations, including Sub-Saharan Africa.

Similarly, economic scholars have examined the likely importance of gross domestic features in determining FDI inflows into a country (Bayar & Ozel, 2014; Chakraborty & Mukherjee, 2012; Danish & Akram, 2014; Gupta & Singh, 2016; Kok & Ersoy, 2009; Ojong et al., 2015; Oladipo, 2010; Vijayakumar et al., 2010). Kok and Ersoy (2009), for example, argued the domestic gross fixed capital formation as a percentage of GDP was the speculation stock in the host country and the accessibility of substructure. Vijayakumar et al (2010), all together had contended that, in a conversion economy, augmentations in the investment setting enabled the desirability of innovative FDI inflows. The forefront FDI inflows became transformed into innovative gross capital formation, which sequentially advanced into greater economic growth (Vijayakumar et al., 2010). Ojong et al (2015) separately researched the determining features of FDI inflows into Nigeria for the period, 1983 to 2013. Applying the ordinary least square model, Ojong et al. recognized gross fixed capital formation, inter alia, had an angle but significantly influenced FDI inflows into Nigeria. Awan et al (2011) similarly acknowledged a positive and significant association between gross fixed capital formation and FDI inflows, in their research on the economic determining features of FDI inflows into Pakistan. Danish and Akram (2014) recognized a comparable result when they acknowledged that domestic gross fixed capital formation, among others, had a positive and significant impact on FDI inflows into Pakistan, in their research exploration on FDI inflows. In total, the domestic element of gross fixed capital formation is an important macroeconomic cause of FDI inflows.

Arguably also is the realization that, myriad preceding studies have explored the unswerving effects of FDI inflows on carbon emissions and postulated the Pollution Haven Hypothesis (PHH), suggesting a connection between FDI inflows and an advanced level of carbon emissions. Accordingly, to maximize profits, industrialized nations tend to finance in emerging nations with fewer inflexible environmental procedures or lesser environmental levies, which advances to transferring polluting industries to these states (Aller et al., 2021). Consequently, carbon emissions in host nations upsurge with the growth of FDI-directed economic undertakings (Ren et al., 2014; Grimes & Kentor, 2003; Mahadevan & Sun, 2020). Applying data from 66 emerging nations, Grimes and Kentor (2003) realized FDI inflows expressively enhanced the development of carbon emissions in emerging nations. Additionally, the motivation of emerging nations was to espouse sloppy rules, to entice foreign capitals for the purpose of attaining economic expansion (Bommer, 1995). Cole et al (2006) applied data from 33 nations in exploring the nexus between FDI inflows and the rigidity of environmental procedures. The outcomes indicated that, in nations with extraordinary levels of dishonesty, national carbon emissions upsurge as transnationals may canvass national administrations for lenient environmental rules.

Nevertheless, innumerable previous studies have postulated an opposing hypothesis (*pollution halo hypothesis*) stipulating that, FDI inflows can transport pure and added effectual equipment to the host nation which are progressive and significantly aid to alleviate carbon

emissions (Melane-Lavado et al., 2018; Wang et al., 2021). Zhu et al (2016) equally recognized the effects of FDI inflows on emissions were negative and became substantial at upper quantiles in Indonesia, Malaysia, Philippines, Singapore, and Thailand. Additionally, Acharyya (2009) had argued FDI inflows had an outsized valuable influence on carbon emissions by snowballing production in the long-run with reference to India.

The interest on renewable energy as an FDI determinant entrant may possibly be a derivate of the pollution halo hypothesis (PH), which argued, among others, that FDI inflows with a singular emphasis on energy helped condense pollution and guaranteed the manufacturing progression with none or reduced adverse impacts on the environment, which eventually led to a constructive outcome on human wellbeing and impermanence (Acheampong et al., 2021). Belloumi (2014) equivalently argued FDI may augment development, hearten the espousal of novel technologies, and galvanize knowledge transmission regarding skills acquisition and labor training. Even Dean (1999) had hitherto contended FDI may completely affect the environment in the long-run because of the demand for cleaner products. In addition, other academics have argued that myriad studies on renewable energy and FDI inflows equally acknowledged that FDI defined by renewable energy would have a decisive effect on economic growth (Ankrah & Lin, 2020; Doytch & Narayan, 2016; Kutan et al., 2018; Mielnik & Goldemberg, 2002; Shah et al., 2022). Doytch and Narayan (2016), for example, in exploring the association between sectoral FDI and energy consumption in a panel data of 74 countries for the period, 1985–2012, realized that FDI indorsed energy savings by snowballing renewable energy consumption. However, other academics, including Lee (2013); Murshed (2020), realized inconclusive or statistically insignificant connection between FDI inflows and renewable energy consumption in similar research explorations.

Another determining factor of FDI inflows is inflation, which is considered by academic scholars as a macroeconomic risk element (Acheampong & Osei, 2014; Babatunde, 2011; Bekena, 2016; Dinda, 2014; Hua, 2014; Kahai, 2004; Leshoro, 2014; Omankhanlen, 2011; Reenu & Kumar, 2015; Shahmoradi & Baghbanyan, 2011). Kahai (2004), for instance, had previously argued monetary and fiscal policies influenced economic permanency by impacting inflation rate, in addition to external and monetary balances. This compelling, Kahai argued it has sequentially influenced all types of investment, as well as FDI. Therefore, applying the linear regression technique on a panel data of 55 developing countries, Kahai recognized that inflation, among others, was a significant determining factor of FDI inflows. Similarly, Asiedu (2002); Koojaroenprasit (2013) recognized the concept that the inflation rate was appropriate as an assessment of the comprehensive macroeconomic stability of a country. Given this, Dinda (2014) noted that soaring inflation might behave as inhibition to the inflows of FDI into a country because it would expand the cost of investment to the consumer cost of capital. Likewise, Hua (2014), in his examination on the decisive effect of China's exterior direct outlay in Africa, recognized that the inflation of African nations exercised a negative effect on China's ventures. Additional academics have also recognized that soaring inflation obstructs FDI inflows into a nation (Bibi et al., 2014; Fauzel et al., 2015; Kaur & Sharma, 2013; Okurut et al., 2012). Given this evaluation, it is concrete to speculate soaring inflation presages economic unpredictability, and this would hold a negative impact on FDI inflows.

Even when it can be argued that soaring inflation is a preventive factor to FDI inflows into a nation, there are alternative reports which indicated inflation had negligible impact on FDI inflows, notwithstanding the predictable signal (Koojaroenprasit, 2013; Niazi et al., 2011;

Omankhanlen, 2011; Shahmoradi & Baghbanyan, 2011). Koojaroenprasit (2013), for example, examined the determining elements of FDI inflows into Autralia, applying three FDI outsource nations comprising USA, United Kingdom (UK), and Japan, and recognized that inflation had a negative but negligible effect on FDI inflows into Australia from the UK. Koojaroenprasit inferred that inflation was not a determinant of Australian FDI from the three outsource nations, because the research methodology also embraced the real interest rate which, equally acknowledged the inflation rate. Shahmoradi and Baghbanyan (2011) also realized inflation had a negative but negligible impact on FDI inflows into emerging nations, in their panel data research on the determining factors of FDI inflows into emerging countries. Therefore, the importance of inflation as a macroeconomic determining factor of FDI inflows has a diverse analysis.

The recognition of trade openness as a determining factor in FDI inflows is acknowledgeable in a myriad of research publications (Babatunde, 2011; Bekana, 2016; Gwenhamo, 2011; Kaur & Sharma, 2013; Owusu-Antwi, 2012; Quazi, Vemuri, et al., 2014; Wafure & Nurudeen, 2010; Vijayakumar et al., 2010). Naanwaab and Diarrassouba (2016), for example, had argued the openness of the host country to trade was a striking characteristic in global selections in moving into a definite country. Babatunde (2011) had also postulated that FDI inflows were subtle to the level of trade openness, including the investment situation in host nations. In addition, Babatunde noted the decisive impact of trade on FDI was forceful to the kind of econometric practice applied and examined by the nations. Owusu-Antwi (2012) postulated a similar notion in their argument that a host country's trade openness seemed a primary determinant in FDI inflows and had distinct effects on FDI. Thus, applying the regression model on time series data for the sampled period, 1988 to 2011, Owusu-Antwi acknowledged the coefficient approximation of trade openness, among others, was substantial and had a positive effect on FDI. Successively, Owusu-Antwi surmised that an effectual situation which had auxiliary openness to trade was feasible to encourage transnational companies and, those nations that incorporated trade generalization received additional FDI. Owusu-Antwi's results were compatible with the findings of Babatunde (2011) who, in the same way, realized that the coefficient approximation of trade openness was significant at the 1% level of significance, and had a positive association with FDI, in his research on trade openness, infrastructure, FDI and growth in Sub-Saharan African countries.

Additionally, Naanwaab and Diarrassouba (2016) argued openness of the host nation to trade was a uniformly considerable feature in international determinations to station in a precise nation, which was crucial to export-enthralled multinationals. Exploiting the Generalized Method of Moments (GMM) procedure on a panel data of 137 countries (encompassing low, middle, and high wages), Naanwaab and Diarrassouba realized that trade openness, inter alia, had a positive and considerable impact on FDI inflows, in total. Additionally, Vemuri, et al (2014) examined the impact of corruption on FDI in Africa and realized that economic openness had a positive impact on FDI, but that this impact was weak. In all, there appears a relationship between trade openness and FDI inflows into a host country. Notwithstanding this, academics, including Vijayakumar et al (2010), had also acknowledged that trade openness was not a significant FDI determinant. Consequently, the review that trade openness is a significant macroeconomics determining factor of FDI inflows into a nation appears mixed.

Expanding this is the recognition that, macroeconomic academics have also examined the importance of interest rate as a determining factor in the inflow of FDI into a country (Anna et al., 2012; Awan et al., 2011; Dua & Garg, 2015; Jepkurui & Olweny, 2015; Kok &

Ersoy, 2009; Koojaroenprasit, 2013; Oladipo, 2013; Siddiqui & Aumeboonsuke 2014; Singhania & Gupta, 2011; Victor, 2013). Anna et al (2012), as an example, contended that interest rate was the rate imposed or rewarded for expending money or the value of funding. Koojaroenprasit (2013) had also argued progressive interest rate may resonate with leading market liability and, hence, reduced FDI inflows. Nevertheless, Gross and Trevino (1996) had previously noted an outsized interest rate in a host country had a positive impact on FDI inflows, but the path of the impact may be inverse if the foreign investors depended on the host countries' money market in floating FDI bookkeeping. Therefore, the import of interest rate as a determining factor of FDI inflows seems motley, following these reviews. Dua and Garg (2015) further debated the importance of interest rate as a determining factor in FDI inflows in connection with the income and substitution effect. Regarding the income effect, Dua and Garg argued an increase in production/interest rates in the FDI homebased countries (industrialized countries) specified higher revenues of companies in these countries and, hence, greater availability of capitals for speculation at home and abroad. Jepkurui and Olweny (2015) similarly realized that interest rate was a major determinant of FDI inflows into Kenya, in their research on the macroeconomic features of FDI inflows into Kenya.

Expanding the argument of macroeconomic determinants is the supposition that, the official exchange rate of a nation is an important element in determining FDI inflows, which is applicable in some research studies (Ang, 2008; Baby & Sharma, 2017; Bekana, 2016; Dua & Garg, 2015; Ezeoha & Cattaneo, 2012; Naanwaab & Diarrassouba, 2015; Oladipo, 2013; Omodero & Ekwe, 2017; Wafure & Nurudeen, 2010). Dua and Garg (2015), for instance, had previously commented on the host nation's currency depreciation regarding its exchange rates. The authors noted that, a depreciation of the host nation's currency improved the relative price of the capital controlled by the companies in the host nation, which stimulated the conglomerates to invest a superior sum through FDI in the host inherent nation. Vijayakumar, et al (2010) as well, considered the exchange rate as the wealth of a country's currency, and feasibly representative as an auxiliary for the level of inflation and the procuring supremacy of the investment business. Furthermore, Vijayakumar et al. postulated that, the devaluing of a country's currency initiated a reduction in the exchange rate weakness, and currency devaluation enhanced the procuring power of investors in foreign currency equivalents (FDI). Clearly, Dua and Garg (2015); Vijayakumar et al (2010) en masse appeared parallel regarding currency devaluation, and its expansion of FDI inflows into a host nation. Oladipo (2013) also researched the association between exchange rate and FDI inflows into Nigeria for the period, 1985 to 2010, and ralized exchange rate meaningfully determined FDI inflows into the country. Surely, Bekana (2016) equally recognized that the official exchange rate, among others, expressively engendered FDI inflows into Ethiopia, in his research on FDI. Overall, the analysis on the host country's exchange rate seems to be a determining factor in FDI inflows into a nation.

Methodology

The applicable methodology is quantitative procedure with the use of secondary time series data and the incorporation of selective econometric model specifications, and estimation.

***Econometric Specifications of the Model*.** The preceding Equation (1) is the delineation of the theoretical model for the current research. Transforming the previous Equation (1) results in a preliminary detailed regression model, as in Equation (2)

$$FDI_t = \delta_0 + \delta_1 FDI_{t-1} + \delta_2 FDI_{t-2} + \delta_3 GDP_t + \delta_4 GFCF_t + \delta_5 CO_{2t} + \delta_6 Infl_t + \delta_7 Trade_t + \delta_8 Energ_t + \delta_9 Intr_t + \delta_{10} Extr_t + \delta_{11} POP_t \quad (2)$$

Where

t is time, and $t\text{-}_1$ and $t\text{-}_2$ are two lags of the values of FDI.

The relationship between FDI and its supplementary subtleties is further instructive with the application of the Autoregressive of order p [$AR(p)$] models because of their inherent computational efficiency (Palaniappan, 2007; SAS, 2020; Stephanie, 2015) in forecasting upcoming performance, grounded on previous performance. Thus, following similar submissions by Palaniappan (2007), SAS (2020), and Stephanie (2015), Equation (3) exemplifies the description of the $AR(p)$ model

$$x_t = \phi + \psi_1 x_{t-1} + \psi_2 x_{t-2} + \ldots + \psi_p x_{t-p} + e_t \quad (3)$$

Where:

- $x_{t-1}, x_{t-2}, \ldots, x_{t-p}$ symbolizes previous series' values (lag values),
- e_t is a white noise (that is, randomness).

Intuitively, the following Equation (4) is applicable in clarifying the constant ϕ in Equation (3):

$$\phi = \left(1 = \sum_{i=1}^{k} \delta i\right)\mu, \quad (4)$$

where μ is the procedure mean.

Taking precisely, Shumway and Stoffer (2017) alternatively defined the $AR(p)$ model as:

$$X_t = c + \sum_{i=1}^{p} \varphi i \, X_{t-1} + \varepsilon_t \quad (5)$$

Shumway and Stoffer (2017) argued $\phi_i, \ldots, \phi_p$ were the parameters of the model and the symbol c was a constant, while ε_t was a white noise. Shumway and Stoffer transformed Equation (5) using the backshift operator $\boldsymbol{B}$ to a novel $AR(p)$ model representing Equation (6):

$$\boldsymbol{X}_t = c + \sum_{i=1}^{p} \varphi i \boldsymbol{B}^i \boldsymbol{X}_t + \varepsilon_t \quad (6)$$

Consequently, Shumway and Stoffer argued shifting the aggregate term leftward and applying multinomial representation results in Equation (7):

$$\Phi[B]\boldsymbol{X}_t = c + \varepsilon_t \quad (7)$$

In total, Shumway and Stoffer perceived the AR model as the outcome of an all-shaft endless impulse response shift whose process was white noise.

Alternatively, Stralkowski et al. (1970) described the autoregressive of order two [$AR(2)$] model as:

$$(1 - \varphi_1 \boldsymbol{B} - \varphi_2 \boldsymbol{B}^2) z_t = \alpha_t \quad (8)$$

Where:

$\boldsymbol{B}$ is a backward shift operator,

That is, $\boldsymbol{B}^i z_t = z_{t-i}$, and $\alpha_i \sim NID(0, \sigma^2)$

Stralkowski et al. argued that it was possible to transform Equation (8) in terms of its roots, α_1, and α_2 into Equation (9):

$$(1 - \alpha_1 \boldsymbol{B})(1 - \alpha_2 \boldsymbol{B}^2) z_t = \alpha_t \quad (9)$$

In addition, Stralkowski et al. noted φ_1 and φ_2 in Equation (8) had a relationship with the analogous roots α_1 and α_2.

There are myriad applicable techniques in estimation $AR(p)$, including the Yule-Walker, unconditional least square, and maximum likelihood methods. However, the Yule-Walker method has applicability disadvantage due to its massive computational time usage Palaniappan (2007), and the unconditional least square is believed to hold fewer attractive optimality settings than maximum likelihood. Thus, the maximum likelihood in estimating AR(p) is the appropriate approach selected in evaluating Equation (1). Therefore, following similar postulations by Anderson and Mentz (1980); Harvey (1981); Judge et al (1985); Spitzer

(1978), it is fair to postulate the maximum likelihood (*ML*) function for the autoregressive error model as indicated in Equation (10):

$$I = -\frac{G}{2}\mathrm{In}(2\pi) - \frac{G}{2}\mathrm{In}(\sigma^2) - \frac{1}{2}\mathrm{In}(|\mathbf{W}|) - \frac{N}{2\sigma 2} \quad (10)$$

Where

$|\mathbf{W}|$ indicates the determining factor of **W**. Considering the *ML* method, the likelihood action appears augmented by diminishing a comparable sum-of-squares action.

Certainly, augmenting *I* in relation to σ^2 (and engaged σ^2 out of the likelihood) and depressing term $-\frac{G}{2}\mathrm{In}(2\pi) + 1 - \mathrm{In}\,(G)$ realizes the focused log likelihood operation:

$$I_e = -\frac{G}{2}\mathrm{In}\left(\boldsymbol{N}|\mathbf{W}|^{1/G}\right) \quad (11)$$

Subsequently, modifying the variable term in the logarithm results in Equation (12):

$$N_{ml} = |\mathbf{L}|^{1/G} h' h |\mathbf{L}|^{1/G} \quad (12)$$

Taking all this into consideration, Equation (1) is subsequently transformed into the leading log-log (Guga et al., 2015; Wooldridge, 2016) autoregressive econometric model, to determine the relationship between FDI and selective macroeconomics variables. The log stochastic autoregression model is Equation (13):

$$LFDI_t = \delta_0 + \delta_1 LFDI_{t-1} + \delta_2 LFDI_{t-2} + \delta_3 LGDP_t + \ldots + \delta_p y_{t-p} + e_t \quad (13)$$

Where:

L = natural logarithm; δ_0 = a constant; $\delta_1 LFDI_{t-1}$ *and* $\delta_2 LFDI_{t-2}$ = two lag values of log FDI; $\delta_2 LGDP_t$ = the log of GDP; $\delta_p y_{t-p}$ = the remainder of the predictors and their lag values; e_t = the error term, predicted as unbiased and identically distributed.

The model is a multiple regression but with lagged values of *LFDI* as predictors. The adding of the subscript *t* to the elements is to specify that they are time series data. Moreover, the addition of two lagged values of *LFDI* as predictors is to indicate the impact realized in the FDI inflows element in the current period depends on its values from the prior periods, including complementary elements. Transforming all the applicable elements in the present research into natural logarithm is significant because it weakened the series of its values, thus permitting the regression estimates to be less exposed to outliers (Wooldridge, 2016). Given this primary autoregression model, the *a priori* expectation of the coefficient estimate for the distinct elements in the model is:

$$\delta_{FDIt-p} > 0,\ \delta_{GDP} > 0,\ \delta_{GFCF} > 0,\ \delta_{CO2} > 0,\ \delta_{Infl} < 0,\ \delta_{Trade} > 0,\ \delta_{Energ} > 0,\ \delta_{Intr} < 0,$$
$$\delta_{Extr} > 0,\ \delta_{POP} > 0$$

Where

The projections of the two lags of the values of foreign direct investment (FDI_{t-p}) hold positive effects on FDI inflows, as in Quazi (2014), and Quazi, Vemuri, et al. (2014); gross domestic product (*GDP*) is projected to realize a positive effect on FDI inflows, similar to Gwenhamo's (2011) postulation; gross fixed capital formation (*GFCF*) is expected to have a practical effect on FDI inflows, following corresponding suppositions by Awan et al (2011); Ojong et al (2015); carbon dioxide emission (CO_2) is projected to hold a positive association with FDI inflows, as in Boutabba (2014), and Ren et al (2014); inflation (*Infl*) is predicted to hold a negative impact on FDI inflows, after a similar recognition by Okurut et al (2012); trade openness (*Trade*) is expected to hold a positive effect on FDI inflows, subsequent to a comparable submission by Owusu-Antwi et al (2013); renewable energy (*Energ*) is projected to hold a positive impact on FDI inflows, following similar realization by Doytch and Narayan (2016); interest rate (*Intr*) is anticipated

to realize a negative response on FDI inflows, as in Koojaroenprasit (2013); exchange rate (*Extr*) is anticipated to hold a positive effect on FDI inflows, after similar postulations by Bekana (2016); Dua and Garg (2015); and, population growth (*POP*) is expected to have a positive impact on FDI inflows, as in (Al-Sadig, 2009).

In addition to the application of the log stochastic autoregression model is the determination of a possible long-run relationship between FDI and the selected macroeconomic elements under examination. Therefore, the model specification for determining the long-run association among the selected elements of interest is the Phillips-Ouliaris cointegration model (Larbi, 2013; Shin, 1994), which is comparable to the Engle-Granger cointegration model (Ahmed & Pulok, 2013; Wooldridge, 2016). The co-integration examination specifies assessing the econometric equation:

$$\Delta LFDI_t = \delta_0 + \delta_1 \Delta LFDI_{t-1} + \delta_2 \Delta LFDI_{t-2} + \delta_3 \Delta LGDP_t + \cdots + \delta_p \Delta y_{t-p} + et \quad (14)$$

Where

δ_0 = a constant; $\Delta LFDI_{t-1}$ and $\Delta LFDI_{t-1}$ = changes in the log of *FDI* growth at times t_{-1} and t_{-2}; $\Delta LGDP_t$ = changes in the log of real *GDP* growth at time *t*; $\delta_p \Delta y_{t-p}$ = changes in the remaining predictors in logarithms at *t* times; *et* = error term. The *a priori* anticipation of the cointegration assessment reveals a long-term connection between FDI inflows and the elected macroeconomic determinants.

Additionally, consistent with the Phillips-Ouliaris, and the Engle-Granger cointegration models, when elements are cointegrated, there should be an error correction model (ECM) that summarizes the short-run obscured impulses or modifications of the cointegrated elements in the direction of their equilibrium values (Akhtar et al., 2013). Consequently, drawing from Wooldridge (2016), the model specification is the transparent error correction model, and is appropriate in determining the short-run relationship between FDI inflows and the selected macroeconomic elements:

$$\Delta k_t = \beta_0 + \beta_1 \Delta k_{t-1} + \delta_0 \Delta g_t + \delta_1 \Delta g_{t-1} + \vartheta j_{t-1} + \varepsilon_t \quad (15)$$
$$= \beta_0 + \beta_1 \Delta k_{t-1} + \delta_0 \Delta g_t + \delta_1 \Delta g_{t-1} + \vartheta(k_{t-1} - \beta g_{t-1}) + \varepsilon_t$$

Where

$E(\varepsilon_t | P_{t-1}) = 0$, and P_{t-1} have values in Δg_t and all previous statistics of *g* and *k*. Moreover, $\vartheta(k_{t-1} - \beta g_{t-1})$ is the error correction term and is an instance of an error correction model.

Embedding Equation (1) in Equation (15) and exchanging the elements within the two equations to embrace ECM will mirror the short-run dynamic, as detailed in Equation (16):

$$\Delta LFDI_t = \delta_0 + \sum_{i-1}^{g} \delta_1 \Delta LFDI_{t-1} + \sum_{i-1}^{g} \delta_2 \Delta LFDI_{t-2} + \sum_{i-1}^{g} \delta_3 \Delta LGDP_t + \sum_{i-1}^{g} \delta_4 \Delta LGFCG_t + \sum_{i-1}^{g} \delta_5 \Delta LCO_{2_t} + \sum_{i-1}^{g} \delta_6 \Delta LInfl_t + \sum_{i-1}^{g} \delta_7 \Delta LTrade_t + \sum_{i-1}^{g} \delta_8 \Delta LEnerg_t + \sum_{i-1}^{g} \delta_9 \Delta LIntr_t + \sum_{i-1}^{g} \delta_{10} \Delta LExtr_t + \sum_{i-1}^{g} \delta_{11} \Delta LPOP_t + \theta(k_{t-1} - \beta g_{t-1}) + \varepsilon_t \quad (16)$$

Certainly, the *a priori* anticipation of the error correction model reveals a short-run relationship between FDI inflows and the selected macroeconomic elements.

***Model Estimation*.** The relevant model applied in the current research is the autoregression model. The application of the autoregression model is significant because of the characteristics of time series data, which often channel the presence of serial correlation in the series. The autoregression model seems to correct the serial correlation dilemma by complementing the regression model with an autoregressive formation for the random error, thus clarifying for the autocorrelation of the errors (Peiris, 2014; SAS, 2020). Additionally, because of the characteristics of time series, it is central to evaluate the stationarity of the data by utilizing the Augmented Dickey Fuller (ADF), the Phillips-Perron (PP), and the Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) tests for unit root (Eita, 2012; Kwiatkowski et al., 1992; Phillips & Perron, 1988; Silvia et al., 2014; Woolridge, 2016) on individual elements before the exploration of Equation (14). It is likely the regression output will be inaccurate in the practicable occurrence the time series are non-stationary (Akhtar et al., 2013). Against this backdrop, differencing the data will correct this dilemma. Subsequently, Equation (17) is the ADF procedure for estimating unit root following similar submissions by (Brima, 2015; Glynn et al., 2007):

$$\Delta x_t = u + \theta_t + \delta x_{t-1} + \sum_{i=1}^{k} \vartheta_i \Delta x_{t-1} + \varepsilon_t \quad (17)$$

Where:

Δ = is first difference; x_t = time series; t = time trend; k = number of lags in the model to the residuals $\mathcal{E}_t$ are white noise (that is, $\mathcal{E}_t$ has a zero mean and a constant variance that is not correlated with $\mathcal{E}_p$ for $t \neq p$. In Equation (17), following this structure, the null hypothesis, H_0: $_\delta = 0$, $\{\Delta x_t\}$ suggests a stable $AR(1)$ model, while the alternate hypothesis, H_1: $_\delta < 0$, postulates $\{x_t\}$ as a stable $AR(2)$ model.

Complementary to the ADF model are the Phillips and Perron [PP] (1988), and the Kwiatkowski et al [KPSS] (1992) tests for stationarity. The ADF and PP examinations share parallel null-and-alternative hypotheses for unit root. The inclusion of the KPSS test was to supplement the ADF and PP unit root tests because both tests, on occasion, exhibit diverse stationarity outcomes. The KPSS test distinguishes itself from the ADF and PP tests because of a disparate null hypothesis emphasizing non-unit root (stationary), while its alternate hypothesis emphasizes a unit root (nonstationary).

Data

The relevant data applied in the current research are annual time series on the preferred elements. The data include the inward flow of foreign direct investment stock (FDI), gross domestic product growth rate, gross fixed capital formation, carbon dioxide emissions, renewable energy, inflation, trade openness, interest rate, exchange rate, and population growth rate. The sources for the preferred data in the current research comprise the World Development Indicators (WDI) of the World Bank, the United Nations Conference on Trade and Development (UNCTAD), Our World in Data (OWD), and the Global Carbon Project (GCP), a supplemental data of Global Carbon Budget. The WDI of the World Bank is the principal source for the gross domestic product, gross fixed capital formation, trade openness, exchange rate, and interest rate elements. The gross domestic product (GDP) is the real annual gross domestic product growth rate and considered a proxy for market growth in the present research. Employing the GDP element is essential, to procure real growth (Javed et al., 2014; Musonera et al., 2010). The gross fixed capital formation (GFCF) utilized in the present research is the gross fixed capital formation as a percentage of GDP, following a

comparable submission by Danish and Akram (2014), and Kok and Ersoy (2009). The trade openness (Trade) element is the measure of the addition of export of goods and services and the import of goods and services as a percentage of GDP at market prices, following similar postulations by (Gwenhamo, 2011; Kaur and Sharma, 2013). The exchange rate (Extr) element is the country's real effective exchange rate, with the usage of the 2010 CPI based index. The real interest rate (Intr) macroeconomic element applied in the current research follows a related submission by (Dua and Garg, 2015). The real interest rate (Intr) refers to the nominal interest rate adjusted for inflation.

The UNCTAD is the principal source for the FDI, inflation, and population elements. The crucial operationalized element in the FDI component is the net inward FDI stock assessed in millions of current US dollars, transformed into real FDI inflow through dividing FDI by the host nation's consumer price index (CPI, 2010 = 100), adapting a similar methodology by Li et al. (2015). The inward FDI stock data progressively protects the actualization of flows in the host country-state, and are slightly unsteady than flows (Gwenhamo, 2011; Júlio et al., 2013; Kerner & Lawrence, 2014). FDI is the dependent variable in the present research. The applicable inflation (Infl) determinant is the country's mean annual consumer price index (2010 index based), following an analogous postulation by Adeleke (2014). The population (POP) component in the dataset is the average annual population growth rate, which is a proxy for market size, following a similar application by Akin (2009). OWD is the primary source of the applicable renewable energy (Energ) data. The renewable energy element is the percentage of electricity generated, and embraces electricity production from hydropower, solar, wind, biomass & waste, geothermal, wave, and tidal sources. GCP is the principal source for the carbon dioxide (CO_2) emissions element, following similar applications by (Grimes and Kentor (2003); Mahadevan and Sun, 2020). CO_2 are the annual production-based emissions of carbon dioxide, measured in tones. This is contingent on regional emissions, which excludes emissions based on traded products.

FDI is the predicted variable in the present research. Because the primary elements used in the present research are low frequency annual time series, transforming them into high frequency quarterly time series elements is crucial, to institute restricted and supplementary all-incorporating short range analyses (Pavia-Miralles, 2010), and policy assessment in the prevailing study. The transformed quarterly time series data ensued in 76 observations altogether. Moreover, transforming all the applicable elements in the current research into natural logarithm is crucial since it reduced the series of its values, thus letting the regression estimations to be less defenseless to heteroskedasticity and outliers (Özokcu & Özdemir, 2017; Wooldridge 2016). Additionally, since the selective elements, including GDP, Energ, and Intr, may embrace a slight number of negative or below 0 values, any log transformation is impractical for negative, 0 or below 0 values (Cowpertwait & Metcalfe, 2009; Osborne, 2011; Wooldridge, 2016). For that reason, a mutual application for negative values is the addition of a constant to the values, to demonstrate all values are positive prior to the employment of the log conversion, which is similar to the position Cowpertwait and Metcalfe (2009) upheld.

Results

The resulting Equation (13) was the designated model, to explore a conceivable association between FDI inflows and the selective macroeconomic elements, including the environmental pollution segment (CO_2), in post conflict Sub-Saharan Sierra Leone. The autoregression maximum likelihood *(ML*) with two lags *AR*(2) was the appropriate

econometric technique for Equation (13), since it rectified the problem of autocorrelation Larbi (2013), which may be contemporaneous in time series data

$$LFDI_t = \delta_0 + \delta_1 LFDI_{t-1} + \delta_2 LFDI_{t-2} + \delta_3 LGDP_t + ... + \delta_p y_{t-p} + e_t \quad (13)$$

Table 1 is the results of the *AR*(2) model. The lower section of the table was the autoregression procedure, following the exactness of autocorrelation, and had *ML* estimates (*SSE* = .015, *MSE* = .000, *AIC* = -389.734, *Reg.* R^2 = .995, *Tot.* R^2 = .999, *DW* = 1.55), which were important in defining the goodness-of-fit of the model. The Durbin-Watson (*DW* = 1.55) autocorrelation result, for instance, detailed the absence of autocorrelation, which agreed with the postulation of Prusty (2010) concerning autocorrelation. Therefore, the *AR*(2) econometric model was the appropriate technique to estimate Equation (13) in the present study. The upper section of Table 1 holds the coefficient approximations of the *AR*(2) regression model with FDI as the response variable. In the table, the predictors, excluding the logs of gross domestic product (*LGDP*), inflation (*LInfl*), renewable energy (*LEnerg*), interest rate (*LIntr*), and exchange rate (*LExtr*) had statistically significant associations with FDI at $p < .05$ and, in total, can determine FDI inflows into Sub-Saharan Sierra Leone. Hence, lag one of foreign direct investment ($LFDI_{-1}$), for instance, had a positive and statistically significant association with the response FDI element (*LFDI*) ($ß_{LFDI-1}$ = 1.622, *df* =1, *se* = .070, *t* = 23.26, *p* = .000), an indication of a significant positive impetus of robust state necessity of FDI. However, lag two of foreign direct investment ($LFDI_{-2}$), for example, had a negative but statistically significant relationship with the response FDI element (*LFDI*) ($ß_{LFDI-2}$ = -.756, *df* =1, *se* = .069, *t* = -10.95, *p* = .000), a signal of a weighty negative push of ineffective state need of FDI. Equally, the gross fixed capital formation (*LGFCF*) element, for example, had a positive and statistically significant relationship with FDI inflows ($ß_{LGFCF}$ = .105, *df* =1, *se* = .027, *t* = 3.95, *p* = .000). This revealed that a 1% upsurge in gross fixed capital formation triggered an increase of approximately 10.5% FDI inflows. Correspondingly, the pollution element (LCO_2), for example, displayed a positive and statistically significant relationship with FDI inflows ($ß_{LCO2}$ = .223, *df* =1, *se* = .067, *t* = 3.38, *p* = .001). By inference, a 1% upsurge in carbon dioxide pollution triggered a surge of approximately 22.3% FDI inflows. The trade (*LTrade*) and population (*LPOP*) segments in Table 1 were equally significant and had responsibilities in the *AR*(2) model as determinants of FDI inflows into Sub-Saharan Sierra Leone. However, in Table 1, the outputs of gross domestic product (*LGDP*), inflation (*LInfl*), renewable energy (*LEnerg*), interest rate (*LIntr*), and exchange rate (*LExtr*) elements, for example, were altogether statistically insignificant at $p < .05$ and, in all, failed to determine FDI inflows into Sub-Saharan Sierra Leone for the review period under review. Now, consistent with the autoregressive model applied in Equation (13) is the successive segment on cointegration econometric technique, to examine a conceivable long-run association between FDI inflows and the selected elements of economic growth, displayed in Equation (14):

$$\Delta LFDI_t = \delta_0 + \delta_1 \Delta LFDI_{t-1} + \delta_2 \Delta LFDI_{t-2} + \delta_3 \Delta LGDP_t + \cdots + \delta_p \Delta y_{t-p} + et \quad (14)$$

Nevertheless, preceding the long-run cointegration model was the ascertainment of the stationarity of the elected elements in the present research, following the postulation of Silvia et al. (2014), who recognized the utilization of cointegration models with elements in the level *I*(1) arrangement. Consequently, the application of the ADF, PP, and KPSS techniques, to study for the existence of unit roots in the elected variables appeared significant after prior differencing, to solve conceivable concerns of unit root, following Wooldridge (2016), as

unveiled in Equation (14). Table 2 is the outputs of the ADF, PP, and KPSS unit root tests for the
selected elements in the present research, following first differencing. In Table 2, the ADF and PP outputs encompassed the *Rho* and *Tau* columns (≈ Ordinary Least Square *t*-values and the *null hypothesis* dismissal level of a unit root at $p < .05$ (Silvia et al., 2014)). The KPSS had the Eta
column with the *null hypothesis* dismissal level of a unit root at $p > .05$. Altogether, the comprehensive elements in Table 2 seemed stationary following first differencing and,

Table 1
The Results of The Autoregression Maximum Likelihood (Ar2) Model (DEPENDENT VARIABLE: LFDI)

Explanatory Variables	***DF***	***Coefficient***	***Standard Error***	***t-Statistic***	***p-value***
Constant	1	-2.539***	.434	-5.85	.000
$LFDI_{-1}$	1	1.622***	.070	23.26	.000
$LFDI_{-2}$	1	-.756***	.069	-10.95	.000
LGDP	1	.017	.016	1.07	.288
LGFCF	1	.105***	.027	3.95	.000
LCO_2	1	.223**	.067	3.38	.001
LInfl	1	-.008	.029	-.28	.780
LTrade	1	-.131**	.047	-2.80	.007
LEnerg	1	-.012	.007	-1.80	.078
LIntr	1	.022	.015	1.50	.139
LExtr	1	-.011	.091	-.12	.906
LPOP	1	.077**	.036	2.17	.034
*AR*1	1	-1.172***	.080	-14.58	.000
*AR*2	1	.811***	.078	10.41	.000
ML Approx.					
SSE		.015			
MSE		.000			
Root MSE		.000			
AIC		-389.734			
Reg. R-square		.995			
Tot. R-square		.999			
Durbin-Watson		1.55			
No. of Observ.		74			

Source: Author's computations grounded on the current research data.
*Note: ***, and ** specify significance at 1% and 5% levels, correspondingly* accordingly, it endorsed the postulation of the absence of a unit root in the designated elements, which were now at the level *I*(1), hence permitting the application of the cointegration model a likelihood.

The succeeding segment examines the long-run association (Equation (14)) among the selected elements with the utilization of the Phillips-Ouliaris (PO) cointegration assessment. The long-run exploration comprised two lags maximum on the autoregression procedure, which appeared uniform with the Akaike Information Criterion (AIC) endorsing two lags model (Goh & Wong, 2011). Tables 3 and 4 reveal the PO cointegration statistical test results. Based on Table

TABLE 2
Augmented Dickey Fuller, Phillips-peron, and Kwiatkowski, Phillips, Schmidt, and Shin Unit Root Test Results

Variables in:	***ADF Test***		***PP Test***		***KPSS***
First Difference	***Rho***	***Tau***	***Rho***	***Tau***	***ETA***
$\Delta LFDI_{-1}$	-168.402***	-4.932***	-20.418**	-3.353**	.540**
$\Delta LFDI_{-2}$	-162.420***	-4.901***	-20.112**	-3.332**	.519**
$\Delta LGDP$	-66.438***	-4.621***	-34.307***	-4.469***	.674**
$\Delta LGFCF$	-84.249***	-6.091***	-17.087**	-2.907	.600**
ΔLCO_2	-209.338***	-9.910***	-21.891**	-3.317**	.480**
$\Delta LInfl$	-50.988***	-6.682***	-34.471***	-5.323***	.239**
$\Delta LTrade$	-61.065***	-3.808**	-17.838**	-3.094**	.141**
$\Delta LEnerg$	-156.319***	-10.926***	-20.660**	-3.149**	.366**
$\Delta LIntr$	-68.049***	-4.615***	-30.639***	-4.050**	.532**
$\Delta LExrt$	-83.869***	-6.453***	-9.827**	-2.469**	.382**
$\Delta LPOP$	-15.011**	-3.096**	-7.011	-3.361**	.304**

Source: Author's computations grounded on the current research data.
*Note: Standard errors in parenthesis. ***, and ** specify significance at 1% and 5% levels, correspondingly.*

Table 3
Results of the phillips-ouliaris cointegration test

Dependent Variable: ΔLFDI		
Lags	***Rho***	***Tau***
2	*-39.458***	*-5.024***

Source: Author's computations based on the contemporary research data.
*Note: ** indicates significance at 5% level.*

3, the *Rho p*-value for the PO cointegration test was -39.458, and the *Tau p*-value was -5.024. The results in Table (3), when paralleled with the PO cointegration critical value for the *null hypothesis* described in Falk et al (2012), rejected the *null hypothesis* of no cointegration, suggesting that, at the least possible, one component had a long-run relationship with FDI inflows.

Table 4 is the output of the parameter estimations and the *t*-values of the discrete elements in the PO cointegration model. In the table, gross fixed capital formation ($\Delta LGFCF$), for instance, had a positive long-run relationship with foreign direct investment, which was statistically significant ($\beta\Delta_{LGFCF} = .119$, $SE = .036$, $t = 3.27$, $p = .002$). Principally, holding the supplementary components in the model constant, a one-unit increase in gross fixed capital formation resulted in approximately 11.9% surge in foreign direct investment inflows in the long-run, for the period in review. This is also true of carbon dioxide (ΔLCO_2), which had a

positive and statistically significant relationship with foreign direct investment inflows ($ßΔ_{LCO2}$ = 3.193e-7, *SE* = 1.400e-7, *t* = 2.28, *p* = .026). In truth, holding the other components in the model constant, a one-unit increase in carbon dioxide resulted in less than 1% surge in foreign direct investment inflows in the long-run, for the period in review. In addition, the two lags of foreign direct investment had statistically significant long-run relationships with the response element (Δ*LFDI*). Although the relationship with lag one was positive ($ßΔ_{LFDI-1}$ = 1.541, *SE* = .071, *t* = 21.73, *p* = .000), lag two had a negative relationship with the response element ($ßΔ_{LFDI-2}$ =

Table 4
The Phillips-ouliaris Cointegration Result Estimations (dependent variable: δlfdi)

Explanatory Variables	***DF***	***Coefficient***	***Standard Error***	***t-Statistic***	***p-value***
Constant	1	-.003	.005	-.58	.566
$ΔLFDI_{-1}$	1	1.541***	.071	21.73	.000
$ΔLFDI_{-2}$	1	-.756***	.068	-11.22	.000
Δ*LGDP*	1	-.027	.024	-1.16	.253
Δ*LGFCF*	1	.119**	.036	3.27	.002
$ΔLCO_2$	1	3.193e-7**	1.400e-7	2.28	.026
Δ*LInfl*	1	.075	.145	.52	.606
Δ*LTrade*	1	-.003	.084	-.03	.975
Δ*LEnerg*	1	-.000	.000	-.44	.662
Δ*LIntr*	1	.017	.020	.87	.390
Δ*LExtr*	1	-.040	.160	-.25	.803
Δ*LPOP*	1	.047	.204	.23	.817

Source: Author's computations grounded on the current research data.
*Note: ***, and ** specify significance at 1% and 5% levels, correspondingly*.

-.756, *SE* = .068, *t* = -11.22, *p* = .000). However, the remaining elements in Table 4, including gross domestic product (Δ*LGDP*), and inflation (Δ*LInfl*), among others, individually had insignificant long-run relationships with foreign direct investment inflows.

Time series sometimes deviate from this long-long relationship to short-term subtleties. Hence, the ensuing objective is the exploration of whether the deviation from the long-term association is statistically significant. Considering this, the Error Correction Model (ECM) (Equation (16)) was the appropriate procedure in determining the expected short-term subtleties, with a specified *p*-value of .05 for the rejection of the *null hypothesis* of no short-term association. Table 5 is the results of the ECM test. The errorECM1 element in the table, for instance, is the lag of the residual ECM predictor variable embraced in the regression model, to examine the short-term subtleties. The coefficient approximation of errorECM1 was negative, as anticipated, and established the presence of a cointegrating association between the predictive element and the predictor features in reflection. Moreover, the negative errorECM1 merely exposed how swiftly the return of the equilibrium was after the ECM model had lingered outside equilibrium. The errorECM1 calculated coefficient of -.524 specified a quick adjustment evolution to long-run equilibrium of about 52.4% annually. Furthermore, in Table 5, the discrete carbon dioxide macroeconomic element ($ΔLCO_2$), for instance, had a positive short-run association with foreign direct investment inflows, which was statistically significant ($ßΔ_{LCO2}$ = 2.698e-7, *SE* = 1.307e-7, *t* = 2.06, *p* = .043). Effectively,

holding the other elements in the model constant, a one-unit expansion in carbon dioxide resulted in less than 1% growth in foreign direct investment inflows in the short-run, for the period under review. Like the long-run model, the two lags of foreign direct investment had statistically significant short-run

Table 5
The results of the autoregression error correction model (dependent variable: δlfdi)

Explanatory Variables	***DF***	***Coefficient***	***Standard Error***	***t-Statistic***	***p-value***
Constant	1	.001	.005	.25	.805
Δ*LFDI*$_{-1}$	1	1.755***	.092	19.04	.000
Δ*LFDI*$_{-2}$	1	-.959***	.087	-11.04	.000
Δ*LGDP*	1	-.000	.023	-.01	.995
Δ*LGFCF*	1	.060	.038	1.56	.123
Δ*LCO*$_2$	1	2.698e-7**	1.307e-7	2.06	.043
Δ*LInfl*	1	-.105	.145	-.73	.469
Δ*LTrade*	1	-.092	.082	-1.12	.267
Δ*LEnerg*	1	.001	.000	.93	.356
Δ*LIntr*	1	.009	.019	.46	.648
Δ*LExtr*	1	.285	.178	1.60	.114
Δ*LPOP*	1	.046	.189	.24	.809
errorECMl	1	-.524***	.158	-3.31	.002

Source: Author's computations grounded on the current research data.
*Note: ***, and ** specify significance at 1% and 5% levels, correspondingly*.

associations with the response element (Δ*LFDI*). Although the association with lag one was positive ($ßΔ_{LFDI-1}$ = 1.755, *SE* = .092, *t* = 19.04, *p* = .000), lag two had a negative association with the response element ($ßΔ_{LFDI-2}$ = -.959, *SE* = .087, *t* = -11.04, *p* = .000). Nevertheless, the residual elements in Table 5, including gross domestic product (Δ*LGDP*), and gross fixed capital formation (Δ*LGFCF*), among others, individually had insignificant short-run associations with foreign direct investment inflows.

Analyzing the Results

The primary application of the existing research is the exploration of a conceivable association between FDI inflows and the selective macroeconomic elements, including the environmental pollution element (CO_2), in post conflict Sub-Saharan Sierra Leone, for the research period. The primary econometric model is the autoregressive maximum likelihood *AR* (2) model, whose results in Table 1 stipulate the FDI's two lags (*LFDI*$_{-1}$, and *LFDI*$_{-2}$), gross fixed capital formation (*LGFCF*), carbon dioxide (LCO_2), trade (*LTRADE*), and population growth (*LPOP*) elements altogether hold significant relationships with foreign direct investment inflows into Sub-Saharan Sierra Leone. This is analogous to the econometric model specifications. Thus, in Table 1, the contemporaneous *LFDI*$_{-1}$ element, for example, has a positive and significant effect on FDI inflows at the 5% level of significance. This is consistent with the estimated *a priori* in the econometric model specifications that, multinationals, among others, are characteristically risk antipathetic and incline to evade unacquainted regions, which makes it significant for host nations to establish a reputation of enticing FDI, as that can engender a push for enticing extra FDI inflows (Quazi, 2014; Quazi, Vemuri, et al.,

2014). However, lag two of foreign direct investment (*LFDI*$_{-2}$) has a negative but statistically significant association with the response FDI element, an indication of a weighty negative push of ineffective state need of FDI inflows.

In Table 1 also, the contemporaneous gross fixed capital formation (*LGFCF*) element, for instance, has a positive and significant effect on FDI inflows at the 5% level of significance. This is in alliance with the projected *a priori* in the econometric model specifications that, an expansion in gross fixed capital formation, a crucial essential of domestic investment, fast-tracks production and economic growth, which may indorse foreign direct investment in post-conflict Sub-Saharan Sierra Leone, because of its apparent run-off impact on economic attainment. This positive and significant impact of *LGFCF* on FDI inflows is also consistent with related outcomes in the literature (Awan et al., 2011; Danish & Aram, 2014; Jong et al., 2015; Vijayakumar et al., 2010). Moreover, the results in Table 1 similarly specify the contemporaneous carbon dioxide emission element (*LCO*$_2$) holds positive and significant effect on FDI inflows at the 5% level of significance. The findings support the Pollution Heaven Hypothesis (PHH), which postulates that, to exploit revenues, developed nations tend to invest in emerging countries with less uncompromising environmental rules or reduced environmental taxes, which progresses to relocating polluting industries to these countries (Aller et al., 2021). Therefore, carbon emissions in host countries increase with the growth of FDI-engaged economic activities (Grimes & Kentor, 2003; Mahadevan & Sun, 2020). The results are consistent with the model's *a priori* anticipation on CO_2 in the *AR*(2) model. Additionally, the results in Table 1 also stipulate the contemporaneous population growth element (*LPOP*) has a positive and significant effect on FDI inflows at the 5% level of significance, which is consistent with the *a priori* expectancy. These findings underpin the argument that, population growth hold a positive and important relationship with FDI inflows, a suggestion that international corporations consider the scope of the market in these countries to engender a significant investment. The results are consistent with comparable results in the literature (Akin, 2009; Aziz & Makkawi, 2012; Billiington, 1999) on population growth. From Table 1 also, the outputs of the real gross domestic product (*LGDP*), inflation (LInfl), renewable energy (*LEnerg*), interest rate (LIntr), and exchange rate (*LExtr*) elements, for instance, are, in total, statistically insignificant at the 5% level of significance and, altogether, fail to determine FDI inflows into Sub-Saharan Sierra Leone for the research period. The results are consistent with related outcomes in the literature Acheampong & Osei (2014); Ang (2008); Ezeoha & Cattaneo (2012); Faroh & Shen (2015); Lee (2013); Murshed (2020); Omankhalen (2011); Singhania & Gupt (2011); Vijayakumar et al (2010) regarding the determinants of FDI inflows.

Now, Table 3 is the results regarding the possible long-run relationship between FDI inflows and the selected elements, following the stationarity of the elements after first differencing, as indicated in Table 2. In Table 3, the appropriate Phillips-Ouliaris (PO) cointegration procedure, to examine the long-run relationship, sanctions that, there is, at least, one cointegration association between FDI inflows and the selected elements. The suggestion is that the elements in the cointegration model shared a collective stochastic drift and will advance evenly. The findings are consistent with the cointegration *a priori* anticipation in the model specification. The discoveries are also consistent with comparable cointegration estimations in the literature (Bekana, 2016; Dinda, 2014; Gwenhamo, 2011; Okurut et al., 2012). Furthermore, in Table 4, like in Table 1, the contemporaneous *ΔLFDI*$_{-1}$ element has a positive and significant long-run impact on FDI inflows at the 5% level of significance. Again, the result is consistent with the estimated *a priori* in the econometric

model specifications that, transnationals, inter alia, are symptomatically risk averse and prone to avoid unfamiliar nations, which makes it noteworthy for host countries to establish a status of alluring FDI, as that can stimulate a push for attracting additional FDI inflows (Quazi, 2014; Quazi, Vemuri, et al., 2014). Nevertheless, lag two of foreign direct investment ($\Delta LFDI_{-2}$) has a negative but statistically significant long-run relationship with the dependent FDI element, a signal of a substantial opposing push of unproductive state necessity of FDI inflows. Following this, the contemporaneous gross fixed capital formation ($\Delta LGFCF$) has a positive and significant long-run association with foreign direct investment inflows. The result suggests Sub-Saharan Sierra Leone is a transformative economy and, hence, expansions in the venture setting will expedite the appeal of novel FDI inflows. Obviously, the novel FDI inflows transfigures into innovative gross fixed capital formation, which successively accelerates greater economic growth. The argument is consistent with the submissions of (Awan et al., 2011; Danish and Akim, 2014; Vijayakumar et al., 2010).

Similarly, the carbon dioxide element (ΔLCO_2) in Table 4 holds a positive and significant long-run impact on FDI inflows at the 5% level of significance, which is consistent with the *a priori* expectancy. The results support the Pollution Haven Hypothesis (PHH) (Aliyu & Ismail 2015; Kılıçarslan & Dumrul, 2017). Previously, Ren et al (2014) had submitted that, unhindered developing economies with fewer buoyant environmental measures engendered the expansion of PHH in developing nations as pollution-exhaustive organizations relocated from developed nations with robust environmental measures to developing nations and, consequently, developing nations with trade openness and FDI inflows became further polluted. In Table 4 also, the outputs of the real gross domestic product ($\Delta LGDP$), inflation ($\Delta LInfl$), trade openness ($\Delta LTrade$), renewable energy ($\Delta LEnerg$), interest rate ($\Delta LIntr$), exchange rate ($\Delta LExtr$), and population growth (ΔLPOP) elements hold statistically insignificant relationships with FDI inflows and, in all, fail as long-run determinants of FDI inflows into Sub-Saharan Sierra Leone at least, for the research period under consideration. The results are consistent with related results in the literature Acheampong & Osei (2014); Ang (2008); Ezeoha & Cattaneo (2012); Faroh & Shen (2015); Lee (2013); Murshed (2020); Omankhalen (2011); Singhania & Gupta (2011); Vijayakumar et al (2010), regarding the determinants of FDI inflows.

Following the existence of a cointegration relationship, it is evident time series occasionally deviate from this long-run relationship to short-run nuances. Table 5 is the findings of the short-run nuances of the relationship between the coefficient approximations of FDI inflows and the selected elements, applying the error correction model (errorECM1). The results in Table 5 disclose the coefficient estimation of the lagged error term; that is, the errorECM1 element is negative, as projected (Bari, 2013; Gwenhamo, 2011; Oladipo, 2010; Victor, 2013), and recognized the presence of a cointegration association between the predictive element and the predictor components in review (Bari, 2013; Gwenhamo, 2011; Ismaila & Imoughele, 2015). What is more, the negative errorECM1 merely stipulates how promptly is the return to equilibrium as soon as the errorECM1 model has undergone disequilibrium (Ahmed & Pulok, 2013). The errorECM1 coefficient estimation of -.524 indicates a speedy correction advancement to long-run equilibrium of approximately 52.4% annually. The findings are consistent with the short-run *a priori* anticipation in the model specification. Moreover, in Table 5, the individual contemporaneous $\Delta LFDI_{-1}$ element has a positive and significant short-run impact on FDI inflows at the 5% level of significance, like the *AR*(2) model outputs in Table 1, and the cointegration model outputs in Table 4. Again, this is consistent with the projected *a priori* in the econometric model specification, with

explanations for its occurrence similar to the *AR*(2) and cointegration models in Tables 1 and 4. However, lag two of foreign direct investment ($\Delta LFDI_{-2}$) has a negative but statistically significant short-run association with the dependent FDI element, an indication of a considerable disparate push of uncreative state requirement of FDI inflows. Concurrently, the carbon dioxide element (ΔLCO_2) in Table 5 holds a positive and significant short-run effect on FDI inflows at the 5% level of significance, which is consistent with the *a priori* expectancy. The result supports the Pollution Haven Hypothesis (PHH) in Sub-Saharan Sierra Leone, even in the short-run as well. In addition, in Table 5, the outputs of the real gross domestic product ($\Delta LGDP$), inflation ($\Delta LInfl$), trade openness ($\Delta LTrade$), renewable energy ($\Delta LEnerg$), interest rate ($\Delta LIntr$), exchange rate ($\Delta LExtr$), and population growth ($\Delta LPOP$) elements are discretely statistically insignificant at the 5% level of significance and, in total, fail to determine FDI inflows into Sub-Saharan Sierra Leone in the short-run, for this research period. The outputs are consistent with related results in the literature (Acheampong & Osei, 2014; Ang, 2008; Ezeoha & Cattaneo, 2012; Faroh & Shen, 2015; Lee, 2013; Murshed, 2020; Omankhalen, 2011; Singhania & Gupta, 2011; Vijayakumar et al., 2010). In addition, the relationship between gross fixed capital formation ($\Delta LGFCF$) and FDI inflows is positive but insignificant in the short-run model, unlike the discoveries in the *AR*(2) and cointegration models. In the short-run, even when the novel FDI inflows may have transfigured into advanced gross fixed capital formation, it did not accelerate leading economic growth in Sub-Saharan Sierra Leone.

Conclusion

Notwithstanding the countless articles in the current journals on the relationship between FDI inflows and economic growth in emerging countries, insufficient knowledge exists on FDI inflows and economic growth in Sub-Saharan Sierra Leone. In addition, insufficient knowledge exists on the impact of environmental pollution on FDI inflows into Sub-Saharan Sierra Leone. Therefore, the principal objective of the present research was the determination of a relationship between FDI inflows and the selective macroeconomic elements in post-conflict Sierra Leone for the period, 2002 to 2020. In assessing the FDI inflows and economic growth relationship, including the impact of the environmental pollution element on FDI inflows, three models encompassing the *AR*(2), long-run, and short-run models were applied.

The major findings in the *AR*(2) (autoregressive) model indicated that FDI lag one, gross fixed capital formation, carbon dioxide emissions, and population growth individually had positive and significant effects on FDI inflows into post-conflict Sub-Saharan Sierra Leone, suggesting a one percent increase in any of these macroeconomic elements upsurge FDI inflows into the nation in review. Conversely, the findings in the *AR*(2) model similarly realized FDI lag two, and trade separately had negative and significant impacts on FDI inflows into Sub-Saharan Sierra Leone, suggesting that free trade, for example, decreased FDI inflows into Sub-Saharan Sierra Leone for the period under review. The remaining elements in the *AR*(2) model, including the real gross domestic product, inflation, and interest rate, among others, altogether had insignificant relationships with FDI inflows. In addition, the findings realized from the long-run (cointegration) model indicated that FDI lag one, gross fixed capital formation, and carbon dioxide emissions exclusively had positive and significant effects on FDI inflows into post-conflict Sub-Saharan Sierra Leone, suggesting the gross domestic features and carbon dioxide emissions elements, for example, were constructive and crucial determinants of FDI inflows into Sub-Saharan Sierra Leone, for the research period under review. The negative but significant impact of FDI lag two on FDI inflows in the long-run model

is merely the substantial undesirable impulse of unproductive state desire of FDI inflows. The remaining elements in the long-run model, including the real gross domestic product, inflation, and trade openness, among others, in all had insignificant associations with FDI inflows. Lastly, in the short-run (error correction) model, after it was disconnected from its long-run equilibrium, it accomplished a speedy correction sequence to long-run equilibrium of about 52.4% annually. Additionally, the findings from the short-run model revealed that FDI lag one, and carbon dioxide emissions independently had positive and significant impacts on FDI inflows into post-conflict Sub-Saharan Sierra Leone, indicating a one percent increase in any of these macroeconomic elements upsurge FDI inflows into the nation under review. The negative but significant impact of FDI lag two on FDI inflows in the short-run model is again simply the substantial adverse impulse of unproductive state desire of FDI inflows. The remaining elements in the short-run model, including the real gross domestic product, inflation, and trade openness, among others, in all had insignificant relationships with FDI inflows.

Given all this, the following are selective, allowing policy proposals for unceasing economic growth and environmental extension in Sub-Saharan Sierra Leone

- The gross fixed capital formation was positive and a significant macroeconomic determinant of FDI inflows into Sub-Saharan Sierra Leone in the *AR*(2) and long-run models, but not in the short-run model. Hence, it is apparent that the macroeconomic element of gross fixed capital formation, which is a significant component of domestic investment, seems to be a striking approach that could fast-track economic growth. Therefore, policy developers should stimulate measures (e.g., corporate tax breaks, etc.) to complement the freedom of investment in Sub-Saharan Sierra Leone, which may increase production because of its overspill effect on economic accomplishment.
- In addition, Sierra Leone policy makers should create policies to lure complementary transnationals into the nation, to ensnare practical labor at economical rate, to enlarge the nation's employment rate.
- FDI inflows increased carbon dioxide emissions in the *AR*(2), long-run, and short-run models. These outcomes support the Pollution Haven Hypothesis (Aliyu & Ismail, 2015; Kılıçarslana & Dumrulb, 2017). Therefore, policy developers should generate policies to include environmental qualms in the nation's FDI and energy strategies.
- Aliyu and Ismail (2015) had argued the positive effect of FDI inflows on carbon dioxide emissions was the probable result of foreign investment approaches of the African countries that recurrently decidedly favored mining activities. Consequently, policy designers should stimulate processes to navigate foreign investment in the path of economic deviation and inspire the augmentation of ecologically approachable technologies (i.e., clean technologies) that emphasizes on developing energy effectiveness.
- Policy planners should trigger procedures that prominently challenge international organization environmental polluters, to lessen the destructive effect of FDI on carbon dioxide emissions.

A censure of the research is conceivable because the research restricted itself to merely 19 post-conflict years (2002-2020), which may be insufficient to recognize the inclusive determinant of foreign direct investment inflows. However, a comprehensive information beyond the year 2020 was unattainable at the time of the research examination. Even with

only nineteen post-conflict years, including the application of selective macroeconomic elements, the transfiguration of the yearly data into quarterly time series, and the utilization of discrete economic techniques ensured a robust decisive conclusion. Moreover, the research did not offer consideration to the possibility of a COVID-19 impulse response shock on FDI inflows in Sub-Saharan Sierra Leone, as it did in other macroeconomic research studies. Nevertheless, subsequent succeeding research considerations should consider supplementary years to include the COVID-19 shock on FDI inflows into the nation in review. Notwithstanding these inadequacies, the research outcomes will supplement an innovative knowledge of a country-select research on FDI inflows and economic growth.

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