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Green Climate Finance and Industrial Development in Africa (2017-2023)

Okwor, E. Emmanuel[1], Ebechidi Onuegbu, Eneoli[2], O. Calistus[3] and Ejinkonye, Remigius Chinwoke[4]
[1]*emmaokwor@evangeluniversity.edu.ng*
[2]*chidi.light@gmail.com*
[3]*obinnaeneoli1@gmail.com*
[4]*rejinkonye@evangeluniversity.edu.ng*

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Abstract: The investigation analyzed the impact of green climate finance on industrial development in Africa from 2017 to 2023. Green climate finance refers to funding acquired from various financial sources, to support climate change adaptation and mitigation efforts for the benefit of humanity. It was considered as the independent variable. The process of developing and expanding industries in an economy through the utilization of innovative technologies that enhance efficiency, speed, and quality of work, resulting in a rise in a company's production levels and profitability. Industry (including construction) value added represent Industrial development as the dependent variable. Inflation was utilized as the control variable in the analysis. Previous studies in this area often overlooked including all African countries benefiting from green climate finance in their sample, thus motivating this study. The sample comprised the African countries that received aid through green climate finance during the specified timeframe. Several preliminary tests were conducted, including panel unit root test, parameter stability test, co-integration test, and error correction model. Hypotheses were assessed using panel ARDL model. The coefficient of the explanatory variable is 6.5731 and its corresponding probability value is 0.5712 .There is evidence of positive and non-significant impact of green climate finance on industrial sector contribution to GDP in Africa. The study recommend that donors and host countries should jointly be engaged during the implementation stage for proper accountability.

Keywords: Green Climate Finance, Industrial Development, Panel ARDL, GDP. Inflation Rate

Introduction

Green industrialization is a critical metric of a nation's ability to effectively address environmental concerns, improve environmental performance, and promote industrial

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growth in a sustainable manner. The promotion of green industrial productivity has become a central issue in economic development, garnering significant attention from scholars and policymakers alike.

The transition of African economies towards industrialization has consistently lagged behind that of other emerging and developed nations. Various factors, internal and external, contribute to this sluggish pace of structural transformation, such as excessive government intervention in national economies, misguided investment strategies, and excessive protection of emerging industries. Externally, factors like declining export revenues and stagnant output, stemming from an unfavorable global context, also play a significant role.

Climate finance refers to financial support obtained from public, private, and alternative sources at local, national, or international levels to aid in climate change adaptation and mitigation efforts. International agreements like the Paris Agreement and the Kyoto Protocol require financially capable Parties to provide support to those less affluent and more susceptible to climate change. Given the varying contributions to and capacities for addressing climate change among countries, climate finance is crucial for both mitigation and adaptation efforts, as substantial investments are needed to reduce emissions and cope with the impacts of a changing climate.

Green industrialization serves as a crucial indicator of a nation's capacity to address environmental issues, enhance environmental performance, and promote sustainable industrialization concurrently. Thus, the stimulation of green industrial productivity has become a central concern in economic development, attracting considerable attention from scholars and policymakers (Lee and Lee, 2022). The provision of increased climate aid through climate finance is anticipated to redirect investment focus from non-green to green innovations, ultimately fostering green industrial progress. Green finance, through capital allocation, aims to provide market-driven financial assurances for green innovations, projects, and enterprises (Huang et al., 2022; Fang and Shao, 2022). Climate finance plays a role in diminishing investment risks, increasing return on investment, and drawing global investors towards green energy projects, thereby promoting sustainable industrialization (Tolliver et al., 2020).

The distinction between industrialization efforts in Africa and those in other developing nations is not only significant but also cumulative and reliant on the trajectory, as their industrialization journey deviates from historical industrial successes. Certain African policymakers advocate for the adoption of the Asian industrial approach due to the triumphs of rapidly growing emerging economies, notably China (Lall, 2004; Morris and Fessehaie, 2014). This strategy entails state intervention in the national economy

for structural transformation, outlining clear industrial pathways, transitioning from agriculture to industry, and from labor-intensive sectors to high value-added industries. To bridge the development gap and succeed in this endeavor, African economies must cultivate a competitive atmosphere to attract both domestic and foreign investments crucial for their structural evolution and unemployment reduction. Nonetheless, Africa faces a dilemma as it embarks on its industrialization journey amidst global efforts to combat environmental degradation through stringent environmental regulations, contrasting the industrialization histories of advanced economies.

It is imperative for all governments and stakeholders to comprehend, evaluate, and mobilize the necessary financial resources for developing nations. A balanced approach to providing resources that cater to both adaptation and mitigation is deemed appropriate. The principal objective of the Paris Agreement is to align financial flows with a trajectory towards reduced greenhouse gas emissions and climate-resilient growth. An evaluation of the current status of aid provision and mobilization is part of the global inventory mandated by the Agreement. The Paris Agreement also emphasizes the importance of enhanced predictability and transparency in financial assistance. The principle of "common but differentiated responsibility and respective capabilities" within the Convention stipulates that affluent country Parties are obligated to provide financial resources to assist developing country Parties in achieving the objectives of the UNFCCC. The Paris Agreement, although introducing the concept of voluntary contributions from other Parties for the first time, also underscores the obligation of wealthy nations. While recognizing the significance of public funds, affluent country Parties should also take the lead in mobilizing climate finance from diverse sources, mechanisms, and avenues. This endeavor should be guided by the needs and priorities of developing country Parties, while also supporting country-driven approaches. Such efforts in climate finance mobilization should represent a progression from previous endeavors.

Africa is confronted with the challenge of not yet achieving success in bridging its development gap. To address this, African economies must cultivate a conducive environment to attract both local and foreign investments, crucial for their economic restructuring and unemployment reduction. However, Africa is in a dilemma. While developed economies have advanced through industrialization, leading to substantial greenhouse gas emissions, African economies are commencing their industrialization journey amidst global efforts to combat environmental deterioration through stringent regulations. This situation places Africa in a difficult position as it pursues industrialization while adhering to new global environmental standards.

Due to its status as one of the poorest regions globally with underdeveloped human capital, Africa encounters obstacles in accessing and effectively implementing green technologies. Moreover, between 2020 and 2030, Africa's projected climate finance requirements totaled $2.5 trillion. Yet, by 2020, only 12% of this amount had been mobilized, with the continent receiving a mere 3% of the total global climate finance (Climate Policy Initiative, 2022). The African Development Bank (AfDB) maintains that Africa possesses substantial room for expansion in terms of climate financing.

Objective of the Study

The objective of the study is to examine the impact of green climate finance on industrial development in Africa from 2017 to 2023.

Statement of Hypothesis

H_1: Green climate finance does not impact industrial development in Africa from 2017 to 2023.

Scope of the Study

The research investigates the influence of green climate finance on the industrial progress in Africa within the period 2017 to 2023. The foundation year of the investigation is established upon the economic analysis of Africa in 2017, which explores strategies to exploit the benefits of swift urbanization for advancing industrialization and facilitating structural transformation. The African countries that benefited from the green climate funding were used out fi fty four countries in Africa .These countries are Algeria, Angola, Burkina Faso ,Cabo Verde, Cammeroon, Chad, Congo, Cote Ivoire, Egypt,Ghana/Mozambiq,Guinea,Kenya,Lesotho ,Liberia,Madagascar,Malawi/Lesotho,Mali,Maurituis,Morrocco,Mozambiq/ Zambia,Namibia,Niger,Nigeria,Rwanda,South Sudan,Tanzania,Togo,Tunisia,Uganda and Zambia.

Review of Related Literature

Concept of Green Finance

Green finance, as defined by the United Nations Environment Programme Finance Initiative (2007), pertains to financial instruments that prioritize environmental concerns, such as loans, credit cards, insurances, and bonds. The expansion of green

finance is credited to the general progress of the financial industry. Correspondingly, Noh (2010) and Hyomnyoktan (2012) propose that green finance plays a substantial role in the financial sector, mainly deriving from international public finance, private sector finance, and domestic public finance, thereby enhancing the financial landscape of all economies. Wang et al. (2019) elaborate on green finance as a form of financial innovation, serving as a new policy tool designed to tackle environmental challenges. They observe that green finance exhibits resemblances to conventional financial practices.

Concept of Industrialization

Industrialization is a term used to describe a series of economic and social processes associated with the discovery of more effective methods for generating value. These methods are collectively known as "industry" or "the secondary sector," with the primary sector encompassing agriculture, hunting, fishing, and resource extraction, and the tertiary sector encompassing services. The scope and scale of industrial activity expanded significantly starting from the late 17th Century, with machinofacture gradually replacing manufacture. While industrialization studies have traditionally focused on the Industrial Revolution, contemporary economic geographers have shown interest in the global economic landscape. Economic changes can be classified into two categories based on the speed of change: events (rapid singular changes) and processes (gradual cumulative changes). Unlike an event, industrialization is a process that emerges over time within a system, such as a country or region, through a series of similar events. For instance, the establishment of a single industrial plant in a predominantly agrarian area does not signify industrialization. However, if a series of such events significantly impacts the local economy, it can be recognized as a process of industrialization shaping the regional economy. Two key conceptual distinctions must be made in this context. Firstly, it is essential to differentiate between quantitative economic growth and qualitative economic transformation. Merely opening new industrial plants in an already industrialized region does not constitute industrialization but rather represents ongoing industrial or economic growth.

The term "industrialization" ought to be confined to the qualitative transformation in the economy that occurs when an agrarian-based economy is significantly impacted by the establishment of new industrial facilities to the point where it is no longer accurate to label it as agrarian. Essentially, industrialization represents an emergent characteristic of an economic framework, a qualitative advancement resulting from the spatially structured accumulation of various economic occurrences. It is essential to

consider the determination of the threshold at which it becomes suitable to identify the occurrence of industrialization. While a single industrial occurrence may not signify industrialization in itself, the question arises as to when it becomes meaningful to denote such a phenomenon. Scholars in the fields of geography, economics, history, and sociology related to industrialization have tended to approach this issue casually, relying on common sense as well as specific quantitative benchmarks. There exist three primary methods for determining whether a national or regional economy is engaged in industrialization. The initial approach involves comparing the secondary sector's (manufacturing industry) contribution to the gross domestic product with that of the primary sector (agriculture, fishing, hunting, and raw material extraction). The second method involves contrasting the proportion of the workforce employed in industry with that in agriculture. The third method is more subjective yet geographical in nature, as it evaluates industrialization by visually inspecting a region's landscape. Given that industrial operations entail substantial alterations to the physical environment (e.g., infrastructure development), they are more conspicuous than nuanced social phenomena like exploitation, racism, or social hierarchy.

Theoretical Framework

This section outlines various theories of sustainable finance. The theories discussed include the priority theory of sustainable finance, the resource theory of sustainable finance, the life span theory of sustainable finance, and the positive signaling theory of sustainable finance.

The Priority theory of Sustainable Finance

It posits that the level of commitment exhibited by economic agents towards attaining sustainable finance objectives in a country or region reflects the significance accorded to the sustainable finance agenda in that particular area (Wilson 2010). This commitment can be evaluated based on three criteria: (i) the extent of coordinated, individual, and cooperative endeavors undertaken by economic agents to achieve sustainable finance targets, (ii) the speed at which a consensus is reached, and (iii) the promptness of actions taken towards realizing sustainable finance goals. Generally, economic agents have diverse priorities which can be categorized from the least to the most important. The prioritization of sustainable finance objectives among a set of priorities by economic agents mirrors the importance attached to these goals. Nevertheless, these priorities may evolve over time in response to changing circumstances locally or globally. If the sustainable finance agenda features among the top priorities of economic agents at a

given moment, it signifies a high level of commitment and substantial efforts towards realizing sustainable finance goals (Kuhn 2020). Conversely, if the sustainable finance agenda is not prioritized by economic agents, it indicates a lack of seriousness and minimal efforts towards achieving sustainable finance goals during that period (Krauss, Krüger, and Meyer 2016).

The prioritization of sustainable finance objectives is not devoid of repercussions. Such a course of action may entail forsaking other crucial objectives until the sustainable finance targets are met, resulting in a trade-off scenario where one goal is sacrificed for the sake of another. These trade-offs can be quite costly, potentially leading to the dismissal of the notion of prioritizing sustainable finance goals above other essential objectives. For instance, developing nations with pressing economic development requirements, like elevating GDP per capita, might not perceive the necessity of giving precedence to sustainable finance goals, deeming them as less critical economic development needs. The underlying implication of the sustainable finance priority theory is that the emphasis placed on sustainable finance objectives is contingent on the importance assigned to other significant goals when contemplating prioritization. This theory harbors two key advantages. Firstly, it acknowledges that economic actors harbor multiple vital priorities, allowing for the inclusion of sustainable finance goals as an additional priority. Secondly, it offers economic agents a platform to elucidate the significance or priority accorded to sustainable finance goals. This priority declaration can be made through public declarations in the media or other communication channels.

The Life Cycle Theory of Sustainable Finance

Is a concept derived from Vernon's product cycle hypothesis. It posits that the interest in sustainable finance is influenced by the life cycle of sustainable finance products, encompassing products, services, instruments, schemes, policies, or activities within the sustainable finance realm. According to this theory, sophisticated economic entities are cognizant of the life span of sustainable finance products, commencing from their inception as a novel concept, progressing through growth, maturity, and eventual decline. This understanding enables economic agents to formulate individual forecasts regarding the projected longevity of specific sustainable finance products. Subsequently, based on these projections, economic actors can determine whether to commit to sustainable finance in the short term, long term, or abstain from commitment altogether. Therefore, the level of endorsement for sustainable finance and the support for the transition from conventional to sustainable financing by economic entities hinge on their perception of the life span of particular sustainable finance products.

The Concept of Resource Theory in Sustainable Finance

It postulates that the disparities in human-created resources that can facilitate the accomplishment of sustainable finance objectives serve as a rationale for the varying degrees of success seen among different nations in reaching their sustainable finance targets. It posits that certain nations possess superior human-generated resources, providing them with a competitive edge in realizing their sustainable finance objectives and transitioning towards sustainable finance, in contrast to other nations. For instance, some countries possess ample foreign reserves, fiscal surplus, minimal external debt, well-established financial sectors, sophisticated financial technology systems, stringent financial regulations and oversight, effective climate change monitoring mechanisms, comprehensive education on sustainability, a populace inclined towards sustainability, and a significant number of institutional investors willing to engage in sustainable finance instruments. Nations endowed with such abundant human-generated resources enjoy a comparative advantage, enabling them to accomplish their sustainable finance objectives with ease and at a faster pace compared to countries lacking these resources. Furthermore, countries with abundant human-generated resources can transition more rapidly from conventional/mainstream finance to sustainable finance in comparison to nations with meager foreign reserves, substantial budget deficits, high external debt, nascent financial sectors, inadequate financial technology systems, deficient financial regulations and oversight, and a scarcity of institutional investors willing to participate in sustainable finance instruments. The resource theory of sustainable finance implies that economic actors in nations possessing ample human-generated resources can swiftly achieve sustainable finance objectives than those in countries with limited human-generated resources. Consequently, each nation should be permitted to advance towards their sustainable finance targets at their own speed and in accordance with the resources at their disposal. Nations with scarce human-generated resources might encounter delays in reaching sustainable finance objectives, while others might struggle to achieve any of their sustainable finance goals due to constraints in human-generated resources.

The Theory of Positive Signaling

This theory posits that economic entities are motivated to reveal favorable details regarding their dedication to achieving one or more sustainable financial objectives as a means to communicate positive developments to external stakeholders who may aid in their pursuits (Quatrini 2021; Park 2018). Economic entities can divulge optimistic details about their intentions in sustainable finance by issuing public statements in the

media or by furnishing supplementary voluntary financial and non-financial data in their annual reports. For instance, organizations can publicize data concerning their most recent sustainable financial tools or eco-friendly bonds to allure investors seeking to allocate their resources to enterprises with a focus on sustainability. Such revelations facilitate the attraction of investors with an interest in eco-friendly bonds. Likewise, a government can declare its intention to introduce a nationwide sustainable finance strategy. This declaration not only enhances the nation's reputation for sustainability but also signifies the country's preparedness to receive external technical assistance in implementing a national sustainable finance policy, thereby drawing significant foreign direct investments targeted at green initiatives within the nation. The advantage of the positive signaling theory of sustainable finance lies in the ability of information disclosure to mitigate information imbalances between investors and entities. However, this theory also has drawbacks. Initially, the disclosure of details regarding sustainable finance does not guarantee that economic entities will act in accordance with the disclosed information. Moreover, the frequent release of positive data concerning sustainable financing by organizations could potentially be utilized as a strategy to conceal unfavorable information, such as when a company has recently incurred substantial losses in its investment portfolio related to fossil fuels and subsequently announces positive information regarding its sustainable investment plans.

Natural resources play a pivotal role in enhancing the process of industrialization, particularly within the African continent, corroborating the research findings of Nkemgha et al. (2022) pertaining to the economies of Africa. The ample availability of natural resources in Africa leads to the generation of supplementary capital for the economy through the income derived from the exploitation of these resources, which can then be channeled towards investments across diverse industrial sectors. As indicated by Nchofoung et al. (2022), the provision of foreign aid can prove to be detrimental to the advancement of industries, given the instances of misappropriation by public officials in Africa, where a significant portion designated for developmental purposes is predominantly assigned to non-productive domains.

Moreover, Gennaioli et al. (2012) contend that the overreliance on external sources of financial backing obstructs the functioning and progress of manufacturing industries, a predicament that holds particular relevance for regions such as Africa, encompassing numerous low-income nations dependent on foreign aid. The excessive reliance on these external funding channels carries the risk of instigating abrupt economic downturns, particularly evident during periods of global crises. This vulnerability was underscored during the onset of the COVID-19 pandemic, as international donors diminished their

contributions of aid, with certain entities even contemplating a complete cessation of financial assistance to Africa. These circumstances underscore the fragility of economies that heavily lean on foreign aid.

Empirical Review

A cohort of academics has directed their attention towards the significance of green finance in the sustainable progression of China. Li et al. (2021) utilized the wavelet power spectrum technique to scrutinize the involvement of green finance in China subsequent to the COVID-19 outbreak. The primary discoveries have authenticated the one-way causal connection between renewable energy and green finance in China. In a recent investigation, Zhou and Xu (2022) assessed the influence of green finance on regional ecological improvement in China. The outcomes from the computations using the generalized method of moments (GMM) framework disclosed a U-shaped correlation between the two factors.

Zhu et al. (2022) have deliberated on the function of green finance concerning the developmental aims in China. By examining yearly data from 1986 to 2019, they unveiled a favorable correlation between green finance and green advancement in China. Irfan et al. (2022) have delved into the correlation between green finance and green innovation at the local level in China. By employing the panel Vector Autoregression (VAR) methodology and annual data from 2010 to 2019, they demonstrated that green finance positively influences green innovation across all regions of China.

Lin et al. (2022) have investigated the repercussions of green finance on CO2 emissions reduction in China from 2007 to 2018. A dynamic spatial Durbin model has verified that green finance in China is effective and can diminish carbon dioxide emissions. Zhang et al. (2022) endeavored to ascertain how green finance boosted urban city-level green development in China from 2002 to 2019. The primary findings accentuated the function of green finance in lessening urban energy intensity.

Hou et al. (2022) zeroed in on five provinces in China in 2017 to scrutinize the role of green financial policies in advancing environmental quality. They utilized a difference-in-differences model and concluded that green finance has a diverse effect among the scrutinized provinces.

Abbasi et al. (2022) juxtaposed the effects of green and fossil fuel energy resources on climate change in China. By utilizing dynamic ARDL and annual data from 1980 to 2018, they have deduced that green energy implementation has immediate and lasting beneficial effects on CO2 mitigation. In a separate study, Lin and Qiao (2022) probed how green electricity can be assimilated into individuals' routines to aid China

in reducing its environmental contamination. The primary findings disclosed that competitively priced green electricity could motivate individuals to utilize it, thereby resulting in decreased carbon emissions in China.

Zhu et al. (2022) have elucidated the role of green energy sources in alleviating fossil-fuel-based CO2 emissions in rural China from 2007 to 2018. The discoveries have underscored the substantial enduring impact of green energy resource development on rural environmental preservation in the nation.

Wang et al. (2023) conducted an investigation into the carbon dioxide emissions related to net energy in China. The empirical results have validated the beneficial impact of the advancement of green energy on industrial output in the nation. Zhang et al. (2023) similarly affirmed the favorable influence of green energy reservoirs on the expansion of agricultural land in China. The augmentation of farmland through policy can be fortified by the utilization of renewable energy sources. Through a synthesis of recent studies, it is evident that numerous inquiries have been carried out concerning green finance in China; nevertheless, it appears that the outcomes of such inquiries do not offer practical insights for policymakers. Hou et al. (2022) have demonstrated that the influence of green financing on climate challenges in China varies significantly among different provinces.

In connection to the interplay among green finance, green innovation, and industrialization, with green innovation assuming a regulatory function, the existing literature seems to be limited. Despite examinations of the correlation between sustainable progression, green finance, and industrial composition (Wang and Wang, 2021), as well as the mechanisms that connect green finance and green innovation (Huang et al., 2022), the specific triadic relationship remains largely uncharted. Alternative studies have explored the intervening function of green supply chain amalgamation in the correlation between green manufacturing practices and sustainable effectiveness (Afum et al., 2020), the repercussions of environmental tax regulations on industrialization (Tchapchet Tchouto et al., 2022), and the influence of gender disparities on the moderating role of green financing in eco-innovations (Saha et al., 2022). Despite the dearth of literature explicitly addressing the relationship between green finance, green innovation, and industrialization, the studies delineated in this segment indicate a plausible association among these variables. Consequently, undertaking this inquiry could enrich the discourse concerning the intersection of green finance and industrialization.

Yu et al. (2021) executed a study to ascertain the ramifications of restricted access to financial resources on the progress of China's green sectors. The study also

aimed to assess whether policies on green finance could function as a remedy to this predicament, particularly by fostering innovations in the green sector and alleviating the repercussions of financial constraints. The findings divulged that policies on green finance notably mitigate the repercussions of financial constraints on innovation within green sectors. Nonetheless, this impact is more notable for state-owned enterprises and marginally noticeable for privately-owned enterprises seeking financial respite. Dong et al. (2022) ascertained that green finance markedly boosts green innovation across diverse Chinese enterprises from 2008 to 2020. Other studies concluded that access to green credit augments corporate research and development, facilitates eco-innovation, fosters upgrades in industrial structure, and technological advancements (Chen et al., 2019; Wu et al., 2019; He et al., 2018). An alternative viewpoint in the literature posits that direct financing (investment in green securities) is more efficacious than indirect financing (green credit) for the advancement and progression of green enterprises (Lin et al., 2018).

Wang and Wang (2021) carried out an investigation that delved into the influence of green finance on the enhancement of China's regional industrial framework from 2008 to 2020. The utilization of the gray correlation technique allowed them to empirically evaluate the interconnection between the variables. Subsequent to the gray correlation investigation, the GMM model was utilized to comprehend the orientation and magnitude of the impact of green finance on the enhancement of industrial structure. The discoveries were classified according to different industrial tiers. The association between green finance and production value was particularly conspicuous in the tertiary sector, signifying that green finance exerts the most significant impact in this domain within China, thereby stimulating swift advancement and enabling the enhancement of the industrial sector. Nonetheless, the outcomes varied across distinct regions in China, notwithstanding all indicating favorable impacts. The inquiry culminated in robust policy recommendations, encompassing the necessity to foster green technology advancement, educate green finance practitioners, establish green finance infrastructure, and bolster international exchange collaboration. A considerable portion of extant research has predominantly focused on developed nations, OECD member states, and the Asia-Pacific realm, with a scarcity of studies addressing the correlation between green finance and industrialization in Africa and its subregions. This scenario presents an avenue for the present scrutiny to bridge this void and provide policy insights for the region, particularly in economies with low incomes.

Huang et al. (2022) in their examination explore the mechanisms whereby green finance influences green innovation. They drew upon data from 30 Chinese provinces

spanning from 2009 to 2017 and formulated a green finance index. By employing spatial Durbin and panel threshold models, they scrutinized the interaction between these variables. Their findings unveiled a noteworthy positive autocorrelation between green finance and green innovation. Both the coefficients for direct effect and indirect effect illustrated that green finance was determined to yield a significant positive influence on green innovation. Ultimately, concerning the threshold outcomes, the impact of green finance on green innovation wanes with the reinforcement of environmental regulatory measures. Consequently, they advocate for governmental deployment of trickle-down strategies in handling green finance and contemplate the relaxation of environmental regulations.

Gap in Literature

Most of the empirical studies examined in this context appear to be limited based on our current understanding. Several of these studies focused on the intersection of green finance and energy, green finance and economic development, or the industrialization of one or more nations using metrics such as average GDP and population size. However, the research utilized African countries that had received funding for green climate initiatives in 2017 and 2018 as the sample size, with their industrial contribution to GDP as a performance indicator from 2017 to 2023. It was observed that the financing for industrialization projects is typically of a long-term nature, hence a seven-year period is deemed sufficient to anticipate returns.

Methodology

Research Design

The research design of this study, which primarily concentrates on the analysis of the causal relationship and influence of green climate finance on industrial development, is grounded in ex post facto and analytical research design. Commencing the examination post-occurrence allows for reliance on existing data. A key feature of ex-post facto research design is the researcher's incapacity to manipulate these variables, rendering it well-suited for this study.

Nature and Source of Data

The data were acquired from secondary sources, which are conveniently available as they have been processed and consolidated beforehand. These secondary data are easily found in the World Development Indicator and Green Climate Finance Portal.

Therefore, the data collection process depends on documentation methods to gather the essential information on all African nations that received green climate funds in 2017 and 2018.

Model Modification and Adoption

Wang and Wang (2021) carried out an investigation that analyzed the influence of green finance on the enhancement of China's regional industrial framework spanning from 2008 to 2020. The utilization of the gray correlation technique was employed in order to empirically examine the association between the various variables. Subsequently, the gray correlation technique was substituted with the ARDL model to evaluate the effects of green climate finance on industrial progress within specific African nations between 2017 and 2023.

ARDL Equation

$$IND/GDP_{t-1} = \beta_0 + \beta gcff_{t-1} + INFL_{t-1} + \mu$$

IND/GDP = Ratio of industrial contribution to GDP

β_0 = the intercept

$\beta gcff_{t-1}$ = The coefficient of explanatory variable (green climate finance fund) at a time t

INFL = Inflation rate.

t-1 = The lag of time

Unit Root Test

Statement of Hypothesis

$\mathbf{H_{0:}}$ Series has a unit root

$\mathbf{H_1}$**:** $\mathbf{H_{0\ is}}$ not true

Decision: Reject the null hypothesis if the augmented Dickey-fuller statistic (ADF) is more negative than the critical value at 5% level of significance, otherwise accept the null.

Table 1: Unit root Table

Variable	*ADF Start*	*5% critical value*	*Probability value*	*Order of Diff*
IND/GDP	-3.310140	-2.677544	0.0158	1(0)
GCFF	-5.088098	-2.878212	0.0000	1(0)
INFL	-7.917778	-2.909206	0.0000	1(0)

Researcher's computation

IND/GDP= Ratio of industrial contribution to GDP, GCFF= Green climate finance funds and INFL= Inflation rate.

Table one represents the unit table of all the variables used in the study. The variables are IND/GDP, GCFF and INFL. All the variables are stationary at levels since the probability values of ADF statistics are negative than the critical values at 5%.(-3.310140,-5.088098 and 7.917778).The corresponding 5% critical values are (-2.677544,-2.878212 and -2.909206) .The probability values are 0.0158, 0.0000 and 0.0000 respectively. Based on these outcome, the study therefore reject the null and state that series has no unit root.

Johansson co-integration Test

Statement of Hypothesis

H_0: Series is not co-integrated

$\mathbf{H_1}$: H_0 is not true

Decision Criteria: Reject the null hypothesis if the trace statistics is greater than the critical value at 5%, otherwise accept the null hypothesis.

Table 2

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		*Trace*	*0.05*	
No. of CE(s)	*Eigenvalue*	*Statistic*	*Critical Value*	*Prob.***
None *	0.391094	39.44311	29.79707	0.0029
At most 1	0.136012	11.66200	15.49471	0.1739
At most 2	0.060167	3.474987	3.841466	0.0623

Table 2 indicated evidence of one co-integration (at None*) since the trace statistic (39.44311) is greater than 5% critical value(29.79707) and their corresponding probability value is less than 5% level of significance, therefore the alternate hypothesis is not rejected. This implied that short run deviation can be corrected in the long run. The speed at which this adjustment is made can be determined through the error correction model in table 3.

Error correction model (ECM)

Table 3: Error Correction Model Table

Sample: 1 186 Included observations: 61 ECM Regression Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
CointEq(-1)*	-0.237599	0.078884	-3.011995	0.0039

Table 3 revealed the rate (24%) at which the short run deviation can be corrected and at a significant speed (0.0039) .This implied that it takes a significant speed of 24% to converge in the long run, when there is evidence of short run divergence .

Test of Hypothesis

Statement of Hypothesis

Statement of Hypothesis in null form

H_0: Green climate finance funds does not have positive impact on industrial development in Africa.

Decision Criteria: Accept the null hypothesis if the coefficient of the explanatory variable is not positively signed, otherwise reject the null hypothesis.

Table 4: ARDL Model Table

Variable	*Coefficients*	*P-Values*	*R- Squared*	*DW-Start*	*Prob(F-statistic)*
IND/GDP		0.5712	0.640353	1.98	0.000000
GCFF	6.57E+08	0.3316			
INFL	3.74E+08	0.3316			

We observed that all the variables were associated with positive coefficients, although they are all non-significant since their probability value are not less than 5% of significance. The 64% as shown by R- squared was explained variation caused by the explanatory variables on the explained variable leaving the 36 % unexplained as a result of omitted variables not accounted for during the estimation .Durbin-Watson stat of 1.98 indicated absence of correlation among the variables, since 2 means perfect absence of correlation .The probability value of F-statistic (0.0000) indicates that, the overall regression is statistically significant. There is evidence of positive coefficient and this implied that null hypothesis is not accepted, therefore, green climate finance funds positively impact industrial development in African.

Findings

Green climate finance funds positively impact industrial development in Africa from 2017 to 2023.

Conclusion and Recommendation

This research contributes to the existing literature on factors influencing industrialization by examining the roles of climate finance and green innovations in

industrial development. Particularly significant for Africa, this study comes at a time when the global financial landscape is evolving, and there is a growing recognition of the need to tailor financial mechanisms to meet Africa's specific needs, considering its disproportionate vulnerability to climate change impacts. Therefore, assessing how Africa navigates its industrialization journey amidst a growing emphasis on green financing becomes imperative.

To maximize the effects of green finance on industrialization in Africa, a multi-faceted approach is required. A key focus should be on education and capacity building, particularly within rural communities, to foster small-scale innovation and prepare for the introduction of large-scale renewable energy technologies. Leveraging green finance for industrial development is crucial, requiring robust regulatory frameworks and dedicated management entities.

The study recommend that donors and host countries should jointly be engaged during the implementation stage for proper accountability.

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