ISTANBUL COMMERCE UNIVERSITY

GRADUATE SCHOOL OF SOCIAL SCIENCES

DEPARTMENT OF ECONOMICS

ECONOMICS M.A. PROGRAM

REVISITING THE FDI-CO2 EMISSIONS NEXUS WITHIN THE N-EKC FRAMEWORK: EVIDENCE FROM EAST AFRICAN COUNTRIES.

M.A. THESIS

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ISTANBUL, 2024

DECLARATION

I hereby declare that the thesis titled "Revisiting the FDI-CO_2 emissions nexus within the N-EKC framework: evidence from east African countries" is my original work, conducted after enrollment for the M.A degree at Istanbul Commerce University. I have appropriately referenced the works of other researchers in accordance with university policies. All data used in this thesis are from legitimate sources.

OZET

İklim değişikliği, insanlığın karşı karşıya olduğu en acil sorunlardan biri olarak ortaya çıktı ve etkisini azaltmak için yoğun çabaları tetikledi. Bu araştırma, gayri safi yurt içi hasıla, gayri safi yurt içi hasılanın karesi, gayri safi yurt içi hasılanın kübik biçimi, yenilenebilir enerji ve ticaret gibi değişkenleri kontrol ederken, Doğu Afrika ülkelerindeki N-EKC çerçevesi içindeki DYY-CO2 emisyon bağını yeniden ele almaktadır. açıklık. Çalışma, değişkenler arasındaki bağlantıyı incelemek için momentler kantil regresyon (MMQR) yöntemini kullanan, 2012-2019 dönemini kapsayan yıllık bir panel veri seti kullanmaktadır. Sonuçlar, doğrudan yabancı yatırımların Doğu Afrika'daki çevreyi olumsuz etkilediğini, ancak bunun yalnızca nispeten yüksek oranlarda (0,7'den büyük) olduğunu ortaya koyuyor. Ayrıca, karbon emisyonlarının yüzdelik dilimleri arttıkça, doğrudan yabancı yatırımların olumlu etkisi daha belirgin hale geliyor; bu da, kirlilik seviyeleri zaten nispeten yüksek olduğunda, doğrudan yabancı yatırımların karbon emisyonları üzerinde daha büyük bir etkiye sahip olduğunu ortaya koyuyor. Araştırma aynı zamanda gayri safi yurtiçi hasıla ile CO2 emisyonları arasında ters N-EKC ilişkisini de ortaya koyuyor. Bu sonuç, kirlilik sığınağı hipotezine önemli bir destek sağlamaktadır. Bu belge yalnızca DYY'nin Doğu Afrika'da artan kirliliğe katkıda bulunduğunu doğrulamakla kalmıyor, aynı zamanda DYY'nin, özellikle kirliliğin zaten önemli bir sorun olduğu ve genellikle daha az katı çevre düzenlemeleriyle işaretlenmiş bölgelerde çevresel zararı büyüttüğünün altını çiziyor.

Anahtar Kelimeler: Doğu Afrika, Doğrudan Yabancı Yatırım, CO2, MMQR, N-EKC.

ABSTRACT

Climate change has begun as one of the most pressing problems confronting humanity, triggering extensive efforts to mitigate its impact. This research revisits the FDI-CO_2 emissions nexus within the N-EKC framework in East African countries, while controlling for variables such as gross domestic product, the square of gross domestic product, the cubic form of gross domestic product, renewable energy, and trade openness. The study employs an annual panel dataset covering the period 2012-2019, utilizing method of moments quantile regression (MMQR) to test the nexus with the variables. The findings reveal that foreign direct investment negatively affects the environment in East Africa, but only at relatively high quantiles (greater than 0.7). Furthermore, as the quantiles of CO_2 emissions increase, the positive impact of foreign direct investment becomes more pronounced, suggesting that FDI has a greater effect on carbon dioxide emissions when pollution levels are already relatively high. The research also reveals an inverted N-EKC association between GDP and CO_2 emissions. This outcome provides substantial support for the pollution haven hypothesis. It not only confirms that foreign direct investment contributes to heightened pollution in East Africa but also emphasizes that FDI magnifies environmental damage, especially in regions where pollution is already a substantial concern, often marked by less stringent environmental regulations.

Keywords: East Africa, FDI, CO_2, MMQR, N-EKC.

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ABBREVIATIONS

EKC: Environmental Kuznets Curve

N-EKC: Nonlinear Environmental Kuznets Curve

UNCTD: United Nations Conference on Trade and Development

MMQR: Moments of methods quantile regression

EAC: East African countries

FDI: Foreign Direct Investment

CO2: Carbon Dioxide Emissions

GDP: Gross domestic product

TO: Trade openness

RE: Renewable Energy

WBD: World Bank Data

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CHAPTER ONE

1.0 INTRODUCTION

This chapter serves as the exploratory segment of the thesis, encompassing key elements such as the research introduction, problem statement, research objectives, research questions, research scope, research significance, and the conceptual framework of the study.

1.1 Background of the study

Foreign Direct Investment is characterized by the ownership, either direct or indirect, of at least 10% of the voting power of an organization by an investor from another country (Griffin & Pustay, 2007). As described by Farrell (2008), Foreign direct investment represents a combination of investment, information, collaboration, and entrepreneurial initiative, enabling a business to manage and offer goods and services in a foreign market. In theoretical terms, foreign direct investment is broadly classified into two main types: horizontal and vertical. Horizontal FDI occurs when an enterprise initiates a similar business model abroad, whereas vertical FDI occurs when a multinational firm takes ownership of an operation that functions as either a distributor or a supplier (Maskus, 2002; Haile & Assefa, 2006).

FDI has been instrumental in boosting productivity and fostering economic development in underdeveloped countries, particularly those within the East African Community that have actively sought such investments. Playing a central role as the primary source of foreign funding for developing economies, Foreign Direct Investment serves as a critical mechanism for transferring technology from developed to underdeveloped countries. According to Pegkas (2015), Foreign Direct Investment expedites technological progress in the host nation by promoting the spreading of knowledge, often referred to as externalities or efficiency spillovers.

Concerns have been raised regarding Africa's growing economic openness to the global arena, which has facilitated increased foreign investment inflow. One important criticism of this increased economic openness is the likelihood that the rise in energy consumption and the consequential surge in pollution emissions could be potential outcomes. A contention has been made that the foreign investment policies adopted by a substantial number of African nations heavily favor extractive industries. This preference is rooted in the significant reliance of these industries on natural resources, as highlighted by the African Union in 2009. It is worth noting that

extractive industries are often associated with adverse environmental effects, as emphasized by Azapagic (2004). This has been attributed to the tendency of foreign firms to relocate dirty production processes to poor African countries so as to avoid the cost of inflexible ecological rules.

In theoretical terms, the examination observing the impact of Foreign direct investment on the environment, mostly concerning pollution reveals two conflicting sides. The first perspective is that corporations are bound by stringent environmental laws. Companies might opt to shift their operations to nations with less stringent ecological rules, a trend known as the Pollution Haven Hypothesis As per the hypothesis, multinational corporations, aiming to circumvent the financial constraints linked to complying with stringent ecological rules in their home countries, opt to move their pollutant-producing operations to countries with less rigorous regulations, as observed in East African nations (Tobey, 1990; Copeland et al., 2022). The PHVH posits that businesses with high contamination levels may be transferred to nations with weak ecological regulations through FDI, leading to increased pollution in the host countries (Stef & Jabeur, 2020).

The second perspective, known as the Pollution Halo Hypothesis (PHH), suggests that Foreign direct investment has a confirmed influence on ecological attribute in the recipient countries (see Sapkota & Bastola, 2017; Hanif et al., 2019; Salehnia et al., 2020). This viewpoint argues that the influx of FDI from more advanced economies reduces CO_2 emissions in less developed host nations by ensuring higher production standards and the transfer of clean technology (Zhu et al., 2016; Huang & Zhang, 2017; Feng et al., 2019). Through foreign direct investment, multinational corporations often transfer technologies related to pollution reduction, renewable energy, and energy conservation to host nations (Duan & Jiang, 2021). For example, Marques and Caetano (2020) investigate the benefits of Foreign direct investment for developing countries and observe a decline in CO_2 linked to a negative relationship between FDI and CO_2, potentially attributable to innovation. However, while Kisswani and Zaitouni (2023) confirm PHVH in the Philippines, they also confirm PHLH in Malaysia, Singapore, and Thailand. Notably, some studies have also suggested that there is no substantial association among FDI flows besides ecological filth (see Li et al., 2022).

In 2021, global carbon dioxide (CO2) emissions witnessed a significant surge, marking a substantial increase of almost 4%. This surge represents the highest growing rate since 2013 and is a staggering 70% greater than the ordinary growth observed since 2011. In EAC, CO2 emissions

rose from 66,300 kilotons in 2012 to 101,420 kilotons in 2019. Addressing the need for prompt solutions to mitigate its adverse environmental effects, this study influences on existing research in various circumstances. Firstly, it enhances the understanding of the environmental challenges faced by East African nations. Secondly, the study equips legislators in East African countries with essential knowledge to formulate principles, procedures, and other instruments aimed at reducing CO_2 emissions. Thirdly, this research provides valuable insights into how East African policymakers can effectively manage the tradeoff between FDI inflows and ecological pollution.

1.2 Problem statement

In recent years, East African countries have experienced a notable surge in investment inflows. This influx of capital, however, has brought about a concerning trend, as some investors are choosing to relocate their environmentally impactful operations to regions with weaker environmental regulations. This strategic move is driven by a desire to maximize profits by capitalizing on the less stringent oversight in these areas. As a result, the economic landscape in East Africa is witnessing a complex interplay between increased investment, potential economic growth, and the environmental challenges associated with the shifting of less eco-friendly business practices to regions with inadequate regulations Aybar & Joyce (2019).

While FDI undoubtedly offers the potential to invigorate the economies of emerging nations by bringing in foreign capital, technology, and expertise, this process not only stimulates growth, innovation, and job creation but also raises the overall skill level of the domestic workforce. Nevertheless, scholars in the past have drawn attention to a significant downside. They have highlighted that investment inflows from developing nations may inadvertently exacerbate environmental issues, specifically by contributing to a rise in pollution levels. Recognizing this nuanced perspective is crucial, as it emphasizes the need for a comprehensive examination of the consequences of FDI on environmental quality Shahbaz and Sinha (2019).

According to studies conducted by Fankhauser and McDermott (2014), it is asserted that economically disadvantaged nations, particularly those in East Africa, face greater Susceptibility to the consequences of environment revolution associated to wealthier industrialized nations. This underscores the pressing environmental challenges faced by less affluent regions. Africa has already experienced a heat rise of over 0.6°C involving 1990 and 2000. This increase has led to

adverse effects such as reduced food making, circumstances of droughts and floods, and a decline in biodiversity.

Many studies have discovered the connection between FDI with pollution, shedding light on the complex relationship between these variables. As specific findings suggest a positive correlation between increased FDI and ecological filth in developing nations, others propose an inverse pattern. The absence of a consensus regarding the nexus between FDI and CO_2 levels underscores a substantial knowledge gap. This study levels to discourse this break by offering precise empirical justifications for the effect of Foreign direct investment on Carbon dioxide emissions in East African countries.

The ongoing need for comprehensive insights into this relationship serves as the primary motivation behind this study, which extends its focus over a broader period, spanning from 2012 to 2019. Through this extended timeframe, the research aims to offer a more thorough examination of the changing aspects among FDI and Carbon dioxide emissions in the environment of East Africa.

1.3 Research questions

This study is showed by the subsequent research questions:

1. What is the effect of foreign direct investment on carbon dioxide emissions in East African countries?
2. Do the effects of the foreign direct investment on carbon dioxide emissions in East African countries vary across quantiles?
3. Is the N-EKC hypothesis valid for East African countries?

1.4 Hypothesis of the study

H_{01}:Forigin direct investment has no significant effect on carbon dioxide emissions in East African countries.

H_{11} Foreign direct investment has significant effect on carbon dioxide emissions in East African countries.

H_{02}: There are no variations in the impact of foreign direct investment on carbon dioxide emissions across quantiles in East African countries.

H_{12}: There are significant variations in the impact of foreign direct investment on Carbon dioxide emissions across quantiles in East African countries.

H_{03}: The N-EKC hypothesis is no valid in East African countries.

H_{13}: The N-EKC hypothesis is valid in East African countries.

1.5 Objective of the study

This study aims to assess the influence of foreign direct investment on CO_2 emissions in East African countries, with a specific focus on validating the (N-EKC) framework.

The study is specifically designed to accomplish the following goals:

1. To assess the impact of foreign direct investment on carbon dioxide emissions in East African nations.
2. To determine whether variations exist in the effect of foreign direct investment on carbon dioxide emissions across quantiles in East African nations.
3. To examine the existence of the N-EKC (N-shaped Environmental Kuznets curves) hypothesis in East African countries.

1.6 Scope of the study

This study explores the effect of FDI on CO_2 emissions nexus within N-EKC in East Africa nations. This analysis places a particular emphasis on empirical evidence sourced from a variety of resources, ensuring a comprehensive and multifaceted analysis. It's notable to highlight that the study will include data from 11 out of the 15 East African countries, providing a broad and representative perspective on the examined relationships. This consider agrees for a nuanced agreement of the dynamics at play within the specific context of these nations, contributing to the robustness and applicability of the study's findings.

While the economies of East Africa may not currently match the same economic scale as other regional economic communities, such as the Economic community of west African states (ECOWAS), the region exhibits unique characteristics and developmental pathways that merit distinct attention and consideration. Despite differences in economic size, East Africa holds significant potential for growth and collaboration, marked by a diverse range of industries, natural resources, and a growing population.

1.7 Significance of the study

The significance of this study is in its capacity to offer valuable insights into the intricate link among FDI and CO_2 emissions within the nations of East Africa. Considering the pivotal role of FDI in economic improvement and the substantial influence of CO_2 emissions on climate change, belief the dynamics concerning these two factors is critical for policymakers and stakeholders in the section. The empirical of the study is to furnish a thorough and evidence-based evaluation of the FDI-CO_2 emissions nexus, particularly focusing on the N-EKC in the context of East Africa.

Grasping the influence of FDI on CO_2 emissions in East Africa holds paramount importance for both policymakers and stakeholders in the region. As East Africa undergoes rapid economic development propelled by FDI inflows, comprehending the repercussions on environmental sustainability becomes essential. Moreover, the results of this study are poised to approach virtual suggestions to effective the management of FDI flows and the implementation of environment break mitigation strategies in East Africa.

The study not only seeks to offer policy recommendations for mitigating the opposing ecological effects of FDI while optimizing its economic benefits but also purposes to contribute to a deeper considerate of the tasks and opportunities in reaching maintainable development in East Africa.

By elucidating the intricate association relating FDI and CO_2 emissions, the research endeavors to inform future policy decisions and research initiatives in the region.

This investigation has the capacity to influence global policy discussions regarding the impact of FDI on climate change, particularly in the context of developing nations where FDI holds a pivotal role in economic advancement. The study performs as a foundational framework for coming study endeavors that delve into the association among foreign direct investment and climate change in growing nations, it aims to make a significant influence to the accumulation of policy-relevant awareness concerning the nexus of FDI and CO_2 emissions in this specific context. In conclusion, these findings have the potential to make a significant involvement to the offered area of sources on the association among FDI and climate change in developing countries. Furthermore, the research strives to provide beneficial perceptions that can shape strategy outcomes and steer investment strategies geared towards promoting sustainable development in these regions.

1.8 Organization of the study

The thesis follows a structured academic framework: **Chapter two** engages in a comprehensive exploration of theoretical underpinnings, delving into the intricacies of theories concerning the suggestion among Foreign direct investment and Carbon dioxide emissions in emerging nations, with particular consideration given to the East Africa region. **Chapter three** establishes the academic framework and introduces the study's model. **Chapter four** is dedicated to presenting the findings and conducting in-depth discussions. Lastly, **Chapter five** serves as a synthesis, offering a summary, concluding the study's findings, and elucidating their policy implications.

CHAPTER TWO

LITERATURE REVIEW

INTROUDUCTION

This study encompasses comprehensive examination of preceding academic and observed literature associated to the intersection of Foreign direct investment and Carbon dioxide emissions. A contentious debate exists regarding the nature of FDI's impact on CO_2 emissions, with some asserting a positive correlation, others positing a negative relationship, and yet others identifying a neutral effect. The discussion extends to both the theoretic and construction of the current study, alongside a thorough review of relevant theoretical and empirical literature exploring FDI's implications on CO2 emissions specifically within the context of East Africa.

2.1 Conceptual framework of the study

2.1.1 Foreign direct investment

The term of FDI is characterized as the amalgamation of financial resources, technological expertise, managerial proficiency, and entrepreneurial skills, collectively empowering a company to function, and delivering products and services in an international market. In a theoretical framework. Almfraji & Almsafir (2014). FDI is commonly regarded as a interpretation handler of societal and economic advancement, playing a fundamental position in the making of work chances and the dissemination of technology (Lessmann, 2013).

FDI holds substantial promise for fostering the economic progress of developing nations. Given that many of these countries face a shortfall in domestic savings to meet their investment requirements, FDI emerges as a viable solution to address this challenge Farrell (2022).

FDI assumes vital value as it involves the deployment of both tangible and intangible assets, positioning the firms utilizing it as significant contributors to the global economy. Robust evidence underscores the capacity of FDI to influence economic advance and advancement by supplementing local investments and nurturing the sharing of knowledge and technology (Ajayi, 2006).

The pursuit of FDI has evolved into a pivotal element within the development strategies adopted by developing nations. In the African context, FDI assumes a critical role as a capital source,

signifying its importance not only in bridging the savings-investment gap but also in furnishing essential resources to attain the Millennium Development Goals (MDGs). FDI has the potential to alleviate poverty not only through stimulating economic advance but also by generating employment opportunities. Multinational employment has been shown to elevate local salary, boost local employment rates, Facilitating the exchange of technology between international and domestic enterprises while improving the overall productivity of the workforce Asiedu, (2004).

2.1.2 Carbon dioxide (co2) emissions

Climate change is a significant issue in the context of global industrial growth. Based on existing scholarly material, the most effective approach for addressing global warming involves embracing low-carbon practices. CO_2 emissions is recognized as one of the greenhouse emissions and play a crucial role in maintaining a livable environment by contributing to global warming. Fossil fuels dominated as the primary energy source, comprising almost 80% of global energy consumption. Consequently, the central concern for society lies in regulating and mitigating CO_2 emissions. The influence of CO_2 emissions extends beyond climate change, including economic, social, and political aspects.

In recent years, UNFCCC has organized a series of conferences aimed at facilitating consensus among governments on the issue of CO2 emissions limitation. In 2009, the Copenhagen Accord was established to affirm the commitment to uphold the Kyoto Protocol (Nordhaus, 2010).

2.1.3 East Africa and foreign direct investment

The literature exploring the influences of FDI in developing nations highlights numerous potential advantages for the recipient nations. Moreover, it is widely thought that FDI exerts a substantial direct effect on domestic businesses by fostering opportunities for trading, outsourcing, and establishing robust supply and distribution networks (Blomström & Kokko, 1997; Markusen & Venables, 1997).

Since the 1990s, the East Africa Community experienced a relatively low level of FDI. Over the ensuing 14 years, the region witnessed a consistent increase in FDI. Notably, from 2000 to 2014, all member states of the East Africa Community reported a remarkable upswing in Foreign Direct Investment, as documented by Mehic et al. (2013).

Over a span of 14 years, Burundi witnessed a modest yet significant increase in FDI into the nation. In contrast, Tanzania achieved an impressive average annual growth rate exceeding 10 percent in

FDI attraction from 2009 to 2014. Concurrently, Uganda experienced a noteworthy surge in FDI, more than doubling roughly from $850 million to more than $1 billion between 2009 and 2014. Similarly, Rwanda observed a substantial increase in FDI during the period spanning from 2009 to 2014, escalating from $119 million to $268 million. Kenya, during the same timeframe, demonstrated remarkable growth in FDI, with an increase from $115 million to $989 million.

The substantial surge of inbound Foreign Direct Investments to GDP between 2000 and 2014 emerged as the principal catalyst for the heightened experience of FDI in the EAC nations, commencing in the year 2000. Notably, there is compelling evidence indicating an upward trend in foreign direct investment (FDI) within the EAC when compared to FDI trends across Africa. Specifically, an observed disparity is evident in the percentages of inbound FDI stock to GDP in the EAC, which stood roughly 20% in 2003. In contrast, the same ratio for the entire African continent was notably higher at 33.2 percent Penev & Marusic, (2014).

2.2 Theoretical literature review

2.2.1 Theories related in FDI ON EKC and N-EKC

The association among FDI and environmental quality has garnered increasing attention among environmental economists. Various concepts have been introduced as an outcome of this significant engagement. A pivotal theory that has significantly contributed to delineating the bond among environment and economic development is known as the Environmental Kuznets Curve hypothesis. The EKC hypothesis suggests that in the initial phases of the economy, the objective is usually to increase output as much as possible, with relatively minimal attention paid to environmental quality. This causes a continuous escalation in pollution until a critical threshold is reached (Dinda, 2004). Beyond this point, environmental quality starts to improve as nations progress in their development (Selden & Song, 1994; Dinda, 2004). Hence, the connection between greenhouse gasses and economic growth takes on an inverted U-shaped form. Empirical evidence from Shafik (1994), Lieb (2002), Stern (2004), Orubu and Omotor (2011), Kuo et al. (2014), and Chaouachi and Balsalobre-Lorente (2022) confirm this inverted U-shape of the EKC.

In addition to scrutinizing the conventional EKC hypothesis, which proposes a U-shaped curve, researchers have extended their inquiry to validate the presence of an N-EKC link among economic growth and ecological quality. The N-EKC suggests that the long-term validity of the original EKC concept is questionable. Instead, economic growth may once again exhibit a positive

correlation with environmental deterioration upon reaching a specific level (De Bruyn et al., 1998). Scholars such as Torras and Boyce (1998) suggest that the N-shaped relationship becomes noticeable when the influence of scale effects is greater than that of composition and technical effects. This may arise due to limited opportunities for further improvement in industry distribution or diminishing returns on technological advancements.

2.3 Empirical literature of the study

2.3.1 The impact of FDI on pollution

Jun et al, (2018) observed the effect of FDI on contamination in China. The study was inspected over the period spanning from 1982 to 2016. The outcome shows, in the short term, FDI exhibited a positive association with pollution, particularly during the 1980s and post-2000 periods. Conversely, over the entire time frame, FDI demonstrated a confirmed influence on pollution at the long-term frequency but did not demonstrate a comparable impact at the medium-term frequency.

Bulus et al, (2021) performed research to examine the effect of FDI and government spending on the environment in Korea. The observed scores reveal a distinctive N-shaped correlation Among GDP per person and CO2 emissions.

Kivyiro & Arminen (2014), investigate the study explores the links between Carbon dioxide emissions, and Foreign direct investment in six African countries. Notably, the research findings affirm the EKC theory in the cases of the Democratic Republic of Congo (DRC), Kenya, and Zimbabwe.

Tang & Tan (2015), investigate the interplay among CO2 emissions, FDI, and economic growth in Vietnam. Notably, the emissions in Vietnam from petroleum are directly affected by energy consumption and income, but negatively impacted by the square of income. These findings lend support to the EKC theory, suggesting a reversed U-shape relationship between GDP development and carbon dioxide emissions in Vietnam.

Voumik & Ridwan (2023), delves into the environmental ramifications of FDI in Argentina, employing the ARDL technique. Spanning from 1972 to 2021, the study utilizes (STIRPAT) technique. The empirical analysis indicates a cointegration relationship among CO2 emissions. The results suggest that, over the long term, population growth and industrialization negatively impact Argentina's ecology.

Zugravu-Soilita (2017), investigates the influence of FDI on industrial pollution. The research focuses on production FDIs from France, and other EU countries during the period from 1995 to 2008. This exploration is facilitated through the development of an empirical model incorporating interaction. The paper's primary findings can be summarized as follows: (1) Foreign Direct Investments (FDIs) are noted to contribute to increased pollution in specific instances, indicating the simultaneous presence of pollution haven.

Kim & Seok (2023), investigated the correlation among inflows of Foreign direct investment and CO_2 emissions in Korea, utilizing ARDL model for examination. The findings indicate a positive and favorable long-term impact of Foreign direct investment inflows on Carbon dioxide emissions. However, it is noteworthy that as income increases, the absolute magnitude of this beneficial effect diminishes. Over time, FDI inflows exhibit a positive impact that eventually turns negative, contributing to the rise in GDP per capita.

Chenran et al, (2019) examines the influences that affect CO2 emissions in Laos, taking into consideration the substantial impact that FDI had on CO2 emissions between 1990 and 2017. the empirical results reveal a robust short-term dynamic impact of FDI on the fluctuations in CO2 emissions, indicative of a relationship characterized by an inverted U-shaped curve. This pattern aligns with the (EKC) theory.

Duodu et al (2002), analysis the emphasis is placed on evaluating the impact of the CWA initiative on both (FDI) and pollution. The study explores the causal influence of the Clean Water

Aliyu & Ismail (2015), explores the connection FDI, and pollution in 19 African nations spanning the years 1990 to 2010. The study, employing the PMG estimation approach, reveals that the energy intensity linked to FDI inflows exerts a notable and increasing impact on greenhouse gas emissions across the sampled nations. As indicated by the results, the energy intensity linked to FDI inflows exerts a meaningful and strengthening impact on greenhouse gas emissions within the nations surveyed. Furthermore, the data substantiates the presence of a pollution refuge theory concerning carbon dioxide emissions.

Bouzahzah (2022), investigating the impact of Foreign Direct Investment (FDI) inflows on CO2 emissions across 40 African nations, with a specific emphasis on testing the Pollution Haven Hypothesis. Utilizing yearly data covering from 1988-2016, the findings suggest that the characteristics of (FDI) received by African nations is contingent upon the quality of institutions. In countries characterized by high levels of corruption, Incoming Foreign direct investment directs to a substantial reduction in Carbon dioxide emissions.

Arogundade et al (2022), explores the repercussions of FDI on the environmental path of 31 African nations from 1990 to 2017. the study reveals a nonlinear impact of FDI on Africa's ecological footprint. Initially, FDI directs a reduction in the environmental footprint until reaching threshold range of $404.75-$669.96 million, beyond which it contributes to an escalation in ecological deterioration.

Singhania & Saini (2021), investigates the link among FDI, influential variables, and sustainability, while reevaluating the pollution haven hypothesis. The results, FDI demonstrate a substantial helpful impact on environmental degradation. The findings substantiate the concept of pollution havens, particularly in the situation of developing countries.

Halliru et al (2020), examines concerning CO2 emissions and environmental footprint in six ECOWAS countries. The findings reveal a discernible pattern in which Carbon dioxide emissions reveal an inverted U-shaped trajectory, thereby substantiating the authority of the EKC theory. However, it's noteworthy that we observed a U-shaped relationship for ecological footprint, signifying a concerning indication of environmental deterioration.

Keho (2015), assessing the persistent influence of Foreign direct investment inflows on the release of carbon dioxide (CO2) within ECOWAS. The investigation uncovered evidence suggesting that (FDI) contributes to an increase in (CO2) emissions in specific nations, whereas it leads to a decrease in emissions in others.

In 2016, Riti and colleagues embarked on a research endeavor exploring the nexus among FDI inflows, industrial exports, and environmental conditions in Nigeria. The findings discovered a noteworthy effect of FDI on the undulations in carbon dioxide (CO2) levels. Nonetheless, the parameter linked to manufacturing exports exhibited a positive trend but lacked statistical significance.

Assa, (2018) explores the influence of FDI In investigating alterations in forest cover within Sub-Saharan Africa (SSA), the focus shifts to the influence of governance. The aim is to recognize the impact of governing structures on changes in forest areas. The research employs a panel dataset encompassing 38 SSA nations from 1996 to 2011. The outcomes expose a substantial and negative impact of FDI on the extent of forest area.

2.3.2 GDP and pollution

Magazzino (2016), delved into an exploration of the correlation between real Gross Domestic Product, and CO_2 emissions, within the six Gulf nations. The study incorporates stationarity tests, structural breakdown analyses, and cointegration tests using yearly data spanning from 1960 to 2013. The empirical data overwhelmingly Provides evidence for the existence of unit roots. Cointegration experiments highlight a distinct long-term connection observed exclusively in Oman. Granger causality research unveils that, in the context of Kuwait, Oman, and Qatar, the

"growth hypothesis" is predominant, as it demonstrates a significant impact of energy consumption on real GDP.

Cialani (2017), examining the interplay among CO_2 emissions, GDP, and trade. The outcomes from this model unveil enduring correlations among the variables in the overall sample countries.

Ameyaw and Yao's (2018), focuses on the correlation linking GDP and CO2 emissions in five West African nations from 2007 to 2014, employing a panel data model. The causal analysis performed suggests a direct relationship, indicating that GDP influences CO2 emissions in the examined context.

Saidi and Hammami (2015), investigate the influence of economic development and CO_2 emissions on energy consumption in 58 nations globally. The analysis employs a dynamic panel data model estimated through GMM method, covering the period 1990 to 2012. The outcome highlights a definite relationship concerning Carbon dioxide emissions and resources expenditure across four global panels.

Mikayilov et al (2018), examining the link involving economic growth and CO_2 emissions in Azerbaijan. The findings from multiple co-integration techniques are consistent and indicate that long-term economic expansion exerts a positive and substantial influence on emissions. This suggests that the EKC hypothesis is not applicable to Azerbaijan.

Mitić et al (2017), investigated the correlation between actual GDP and CO_2 emissions within 17 transitional economies. They utilized annual data involving the period from 1997 to 2014. The results indicated a 1% rise in GDP was linked to an approximate 0.35% elevation in CO2 emissions for the specified of nations.

Odhiambo (2012), examines the instrumental link among CO_2 emissions and economic increase in South Africa. The data indicates causal relationship, where economic development influences carbon emissions in South Africa. Furthermore, the study suggests that there is a pivotal connection between energy use and both carbon emissions and economic development.

Muftau and Ademola's (2014), explores the link between CO2 emissions and economic growth in West African nations. The empirical results uncover a non-linear correlation between wealth and CO2 emissions over time, characterized by an N-shaped pattern. This implies that the association among profitable increase and Carbon dioxide emissions is not linear and undergoes distinct phases.

Al-Mulali et al (2012), investigation, the emphasis is on assessing the impact of carbon dioxide emissions on GDP and economic growth in 30 Sub-Saharan African countries. The study's results indicate that energy consumption has a notable definite influence on both economic growth and economic increase within the examined economies. Nevertheless, it is highlighted that this positive effect is accompanied by a downside, as it is correlated with increased pollution, manifested by higher levels of CO2 emissions.

Kais and Ben (2017), examine the interactions linking carbon CO_2 emissions and economic growth in three distinct North African nations. Employing panel co-integration analysis with data covering the time from 1980 to 2012, the study shows a relationship, demonstrating that economic growth influences energy consumption in these North African countries. Additionally, a one-way association is identified, wherein economic expansion directly affects CO2 emissions.

2.3.3 Renewables energy and pollution

Bulut (2017), investigating the influence of both non-renewable and renewable energy sources on carbon dioxide emissions in Turkey over the period from 1970 to 2013. The study utilizes time-varying parameter estimate techniques to evaluate the relationships. The findings of the study suggest a confirmed correlation among CO2 emissions and both non-renewable and renewable energy sources in Turkey. This implies that, during the specified time frame, the utilization of both types of energy sources was associated with rise in CO2 in the country. The study sheds light on the environmental implications of energy choices and patterns in Turkey, contributing to the broader discourse on sustainable energy and emissions management.

Boontome et al (2017), investigate the main aim is to analyze the causal connections between CO_2 emissions and economic growth in Thailand over the period from 1971 to 2013. The study's findings affirm the existence of cointegration among the variables, indicating the presence of a long-term relationship.

Mahmoodi (2017), analyze the relationship among economic growth and CO_2 emissions in a sample of 11 developing nations spanning the years 2000 to 2014. The panel causality results unveil various relationships, including a link among renewable energy (RE) and CO2 emissions, as well as a reciprocal association among gross domestic product and Carbon dioxide emissions.

Salahodjaev et al (2022), exploring the association among tourism, renewable energy, and carbon dioxide emissions in Europe and Central Asia nations during the period from 1990 to 2015. The

study's results disclose a positive relationship linking tourism and CO2 emissions, suggesting that an augmentation in tourism is linked to an increase in carbon emissions.

Madaleno and Nogueira (2023), investigate the link between renewable energy and CO_2 emissions in prominent nations heavily dependent on natural resources, covering the period from 2000 to 2015. The realistic effects of the study demonstrate a significant mitigating impact of renewable energy on per capita CO2 emissions. More precisely, the estimates indicate that a one percentage point improve in renewable energy consumption is associated with a 1.25% decrease in per capita CO2 emissions.

Khoshnevis and Shakouri (2018), explore the long-term equilibrium and causal dealings between urbanization, renewable energy utilization, and carbon dioxide emissions, considering implications for the future sustainable growth of EU nations. The study's results uncover a link from carbon dioxide emissions to urbanization, indicating that alterations in carbon emissions impact urbanization. However, the study does not identify a causal association between the use of energy and Carbon dioxide emissions.

Batool et al (2022), the emphasis lies in investigating the impacts of Information and Communication Technology (ICT), renewable energy consumption, and economic growth on CO_2 emissions in certain developing nations in East and South Asia. The findings indicate that the advancement of ICT and financial development positively contributes to environmental degradation over an extended period.

Leitão (2021), examining the interrelationships among economic growth, corruption, renewable energies, international trade, and carbon dioxide emissions is conducted. The findings reveal that both the vice index and economic growth exert a statistically substantial positive influence on CO_2 emissions. This suggests that a surge in corruption and financial increase to a simultaneous rise in CO_2 emissions. However, the study underscores the importance of adopting renewable energies and facilitating international commerce as essential factors in mitigating climate change and promoting environmental improvement.

Ponce & Khan (2021), the focus is on exploring the enduring relationship among CO_2 emissions and various factors, including GDP. The study spans the years 1995 to 2019 and covers nine industrialized nations. Utilizing the (FMOLS) and (VECM), the research uncovers a stable and well-balanced connection in European nations that have attained advanced development levels over an extended period. However, this correlation is notably absent in non-European countries

with similar development levels. The key findings highlight a negative association between renewable energy, energy efficiency, and CO2 emissions. Specifically, in industrialized European nations, a marginal 1% increase in the adoption of renewable energy corresponds to a reduction of approximately 0.03% in carbon dioxide (CO2) emissions.

Asongu et al (2019), focuses the correlation between renewable energy and environmental quality within a sample of 40 African nations. The results from each estimation consistently demonstrate that renewable energy has a diminishing effect on carbon dioxide (CO2) emissions. Notably, this negative impact is inversely proportional to CO2 emissions, suggesting that the adverse influence of renewable energy on CO2 emissions declines as the levels of CO2 emissions increase.

2.3.4 Trade openness and pollution

Tachie et al (2020), investigate the impact of trade openness on environmental pollution, specifically focusing on the economies of the EU-18 from 1990 to 2015. The study's findings direct that heightened trade openness is correlated with an increase in CO_2 emissions within the EU-18. Additionally, the study highlights that the start in energy consumption and urbanization further contributes to a subsequent increase in emissions.

Cetin et al (2015), investigate the influence of trade openness on environmental pollution within newly industrialized nations involved in trade from 1971 to 2010. The study's results unveiled a cointegration relationship among the variables under consideration. This advocates that, over the examined period, an augmentation in trade openness was linked to a subsequent rise in CO_2 emissions in the newly industrialized nations, offering insights into the environmental implications of trade activities in the second texts.

Van Tran (2020), investigate the dynamic relationship between the degree of trade openness and the occurrence of environmental pollutants, taking into account various factors influencing environmental quality. The empirical results revealed that trade openness might have detrimental effects on the environment. This implies that as trade becomes more open, there could be an upsurge in environmental pollutants in the studied emerging economies.

Le et al (2016), exploring the connection between trade openness and environmental quality, measured through particulate matter (PM10) emissions, across a diverse set of countries. The sample comprised 98 nations, and the analysis spanned from 1990 to 2013. Employing a panel cointegration test, the study aimed to uncover sustained relationships among particulate matter emissions, trade openness, and economic development. The findings of the study indicated

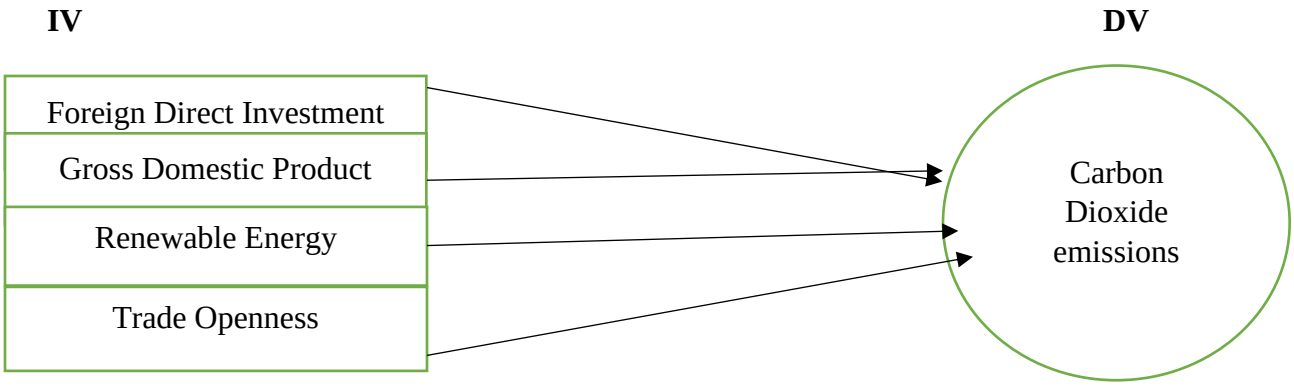
variability based on the economic status of nations. Specifically, trade openness was found to exert a confirmed influence on the environment in high-income countries.

Fang et al. (2020), exploring the impact of economic growth and trade openness on the environment in 261 Chinese cities. The results of the study indicated that the Environmental Kuznets Curve theory is applicable not only to China but also to specific regions within the country. This finding provides valuable insights into the complex interactions between economic growth, trade openness, and environmental outcomes in the context of Chinese cities.

Dauda et al (2021), exploring the interplay among innovation, trade openness, and carbon dioxide (CO2) emissions in nine African nations. The study's findings confirmed the existence of a curvilinear relationship between innovation and CO2 emissions across multiple panels, with this pattern particularly evident in countries such as Mauritius, Egypt, and South Africa.

In Lv and Xu's (2011) analysis, the analysis is centered on examining the influence of trade openness and urbanization on carbon dioxide emissions. The study's findings specify that trade openness has a positive influence on the environment in the short term, but this effect becomes negative in the long term. This implies that, initially, heightened trade openness is linked to increased carbon dioxide emissions, but over time, it becomes a factor contributing to reduced emissions. Conversely, urbanization is consistently identified as having an adverse and significant effect on CO2 emissions, both in the short and long term.

Figure 2.4.1 Framework of the study



CHAPTER THREE

RESEARCH METHODOLOGY & DATA

3.0 Introduction

This chapter is the third chapter of the research that studies the outcome of FDI on CO_2 emissions within nexus EKC in East African countries. In this chapter the investigator gives explanations of the research data, theoretical model of the research, and estimation technique of the study and definitions of variable under study. This study is an empirical study by using production process to find the effect of FDI on CO_2 emissions in East African countries.

3.1 Theoretical framework and econometric model

The inverted-U shaped Environmental Kuznets Curve (EKC) hypothesis was primarily intended by Grossman and Krueger, Shafik and Bandyopadhya, and Panayotou. Following these studies, other theoretical models such as the green Solow model, macroeconomic production, and utility functions on the EKC association have been offered. The framework proposed by the EKC indicates that the decline in environmental quality intensifies with the expansion of economic activity until reaching a certain threshold. Beyond this point, an increase in income levels is associated with the recovery of environmental quality (Selden and Song, 1994). Our work implies that Foreign direct investment may affect carbon emissions through scale, technique, and structure effects, even if there doesn't seem conclusive proof of this link in the body of existing literature. According to Bilgili et al. (2016), the value of vestige fossil fuel worsens ecological property and raises carbon emissions. This argument prompts us to build an observed model employing an inverted-U shaped EKC framework. Using logarithmic transformations and such theoretical and observed premises, we made the basic (standard) EKC model can be defined as follows:

$$INCO_2 = \gamma_0 + \gamma_1 INFDI_{it} + \gamma_2 INCGDP_{it} + \gamma_3 INCGDP_{it}^2 + \gamma_4 INCGDP_{it}^3 + \gamma_5 INRE_{it} + \gamma_6 INTO_{it} + \varepsilon_{it} \quad (3.1)$$

Where $INCO_2$ stands for the logarithmic form of carbon dioxide emissions metric per ton, and $INFDI_{it}$ represents the logarithmic form of foreign direct investment. Also, $INCGDP_{it}$, $INCGDP_{it}^2$, $INCGDP_{it}^2$, $INRE_{it}$, and $INTO_{it}$ denote the logarithmic forms of GDP, square of GDP, cubic form of GDP, renewable energy use and trade openness, respectively. γ_0- γ_6 are the constraint estimates, and ε_{it} is the error term.

The Environmental Kuznets Curve is just one of several hypothetical curves that have been proposed to depict how economic expansion affects the environment. Another perspective on the connection between GDP and environmental harm is provided in the 1978 "Our future" WCED study (World Commission on Environment and Development, it is known as the Brundtland report. According to the Brundtland theory, poor countries firstly contribute significantly to environmental deterioration, which subsequently declines as countries develop till a point of no return arrives, after which environmental degradation grows. The Brundtland curve is a U-shaped curve in contrast to the EKC. The Brundtland Curve hypothesis posits that due to their inability to prioritize environmental protection, impoverished nations significantly contribute to environmental harm. To survive, people staying in severe need must be involved in general disforestation and abuse of sensitive countries (Larsson, et al., 2011).

Environmental harm declines as the economy expands, primarily because the factors that kept environmental harm at a high level are reduced. When the turning point is achieved, pollution is believed to rise along with economic expansion until it reaches its initial level. According to the Brundtland Curve hypothesis, growing production because of rising consumption is the source of the trend in environmental deterioration. According to the theory, increased output harms the environment just as much as issues brought on by poverty (Holden et al., 2014). Cederborg and Snöbohm (2016) examined 45 developing nations and 69 industrialized nations. Researchers have discovered a correlation involving CO_2 emissions and Gross domestic product for the industrialized nations, resulting in a polynomial curve resembling the EKC's inverted U form. The authors discovered a definite association among CO_2 emissions and Gross domestic product for the group of developing nations, which runs counter to the BCH but is supported by the EKC and EDC.

3.2 Research Data

This study will focus on a sample 11 of 15 in East Africa countries, including: Somalia, Kenya, Ethiopia, Djibouti, Tanzania, Uganda, Burundi, Rwanda, Comoros, Seychelles, Zambia, and Sudan. The study employs time series panel data from 2012-2019. In this research, Secondary data of FDI, CO_2, GDP, GDP^2, GDP^3, RE, and TO, are used. The data apply to the variables being examined in this study are found from the World Development Indicators database. This database serves as the primary repository from which the relevant information for our research is extracted

and analyzed. The utilization of this comprehensive database ensures the reliability and breadth of the data, enabling a thorough exploration of the relationships and patterns between the chosen variables.

3.3 Description of variables

3.3.1 Carbon Dioxide emissions

Carbon dioxide emissions (CO_2) is produced into the surroundings through the boiling of waste materials, coal, oil, and natural gas for energy production. Furthermore, various industrialized developments, such as cement manufacturing, provide to the release of CO_2 emissions. The principal driver of global environment transformation is widely attributed to these carbon dioxide emissions.

The East Africa region has experienced substantial economic growth, resulting in heightened economic activity and a rapid rise in resources use and CO_2 emissions. It's worth noting, however, that these emission levels, while on the rise, remain relatively low on a global scale. At the onset of industrialization, East African nations were primarily agrarian, actively seeking innovative approaches to enhance their economies. Industrialization stands as a pivotal objective in the pursuit of national prosperity for major economies. Kenya Tanzania, two of the biggest nations within the East African Community (EAC), are significant contributors to carbon dioxide emissions. Leading the EAC in this regard, Kenya emitted 20 million metric tons of carbon dioxide in 2021, closely followed by Tanzania with 14 million metric tons.

3.3.2 Foreign Direct Investment

FDI characterizes a form of international investing wherein a saver originating from one nation confirms a permanent interest, often accompanied by a substantial level of control, in a business situated in another country or economic region. FDI stands as a pivotal element in the process of global commercial combination, as it establishes robust and enduring ties between economies. Beyond this, FDI can exert a substantial effect on economic increase and functions as a crucial channel for the exchange of knowledge between nations. Moreover, it serves to streamline international trade by offering a mechanism for accessing foreign markets.

However, despite facing economic challenges, foreign investments in East Africa exhibited resilience, surging from $4.9 billion in 2021 to $5.8 billion in the previous year.

South Sudan experienced the most substantial growth in foreign direct investment inflows, with an impressive 80% increase to $121 million, nearly double the amount it received in 2021 ($67.5 million). Kenya witnessed the second-highest surge in inflows, registering a remarkable 64% increase to $759 million from $463 million in 2021. Following closely, Uganda and Burundi experienced respective increases of 39% and 30%. On the flip side, the only nation recording a dip in investment inflows was the DR Congo. In the challenging year of 2022, it attracted $1.85 billion, reflecting a 1% decrease from the $1.87 billion reported in 2021.

3.3.3 Gross Domestic Product

GDP serves as a frequently employed metric to gauge the estimate added among the production of goods and services within a nation during a defined timeframe. It assesses both the income derived from these expenditures and the funds allocated to finished goods and services. While GDP stands out as the foremost indicator for evaluating the overall economy, alternative measures may be better suited for appraising the material well-being of individuals (OECD 2022).

The analysis contends that in 2022, the genuine GDP expansion in East Africa was chiefly driven by the services sector, constituting roughly half of the overall growth in the region. The industry's contribution to GDP growth amounted to 2.0 percentage points, falling short of the 2015–2021 average of 2.5 percentage points. The region's allure, stemming from its natural and cultural attractions, attracts global travelers, thereby intensifying the demand for accommodation, dining, and entertainment services.

3.3.4 Trade openness

Trade openness is characterized by the summation of total exports of goods and services plus total imports of goods and services, all normalized by the GDP. Trade openness empowers nations to broaden their market presence by venturing into new markets, fostering competitiveness, and more. Several studies suggest that heightened trade integration diminishes a country's susceptibility to financial instability and the risk of a currency crisis. This, in turn, enhances a nation's capacity and willingness to meet its obligations related to foreign debt (IMF, 2002b).A larger export ratio lessens the chance of sudden reversals in capital flows since the country is better prepared to shell out of its financial obligations in foreign currencies.

Africa's trade in goods and services experienced substantial growth, escalating from over US $4.4 billion in 1994 to approximately US $36.78 billion in 2012. This suggests a growing rank of 88.1%.

An assessment of progress rates indicates that the EAC nations' trade growth rate is higher than that of world commerce. This demonstrates that, compared to worldwide trade, EAC commerce flourished far more quickly during that time.

3.3.5 Renewable energy

Renewable energy is sourced from natural resources that renew at a rate equal to or faster than their utilization. Examples of such continuously replenished sources include sunlight and wind. Our surroundings are rich with a wealth of renewable energy incomes. In contrast, non-renewable resources such as coal, oil, and gas take 100 million of years to construct. Utilization leads to the emission of harmful greenhouse gases, such as carbon dioxide, into the atmosphere.

Despite the instant progress of the renewable energy market in East Africa, the energy produced since stellar and storm power remains relatively minimal. The region's ability to generate power from renewables reached 11.5 GW in 2021, more than quadrupling from 2000 (2.7 GW), and nearly doubling since 2010 (5.8 GW). As of 2021, 65 percent of East Africa's overall electrical capacity is sourced from renewable energy. The surge is primarily attributed to the development of hydropower in the early 2000s, with contributions from geothermal, biofuels, wind, and solar power. Solar and wind power, despite their significant potential, still constitute a small fraction of the region's total capacity, accounting for only 3.5% and 4.5%, respectively. Their considerable potential has only recently begun to be fully realized.

3.4 Estimation techniques: Method of Moments Quantile Regression (MMQR)

This study utilizes the innovative of MMQR, a recently developed estimation technique attributed to the contributions of Machado and Silva (2019). The objective is to delve into the nuanced and distributional association among FDI and CO_2 emissions. By employing MMQR, this study aims to precisely capture the tail dynamics of the influence of Foreign direct investment on carbon dioxide emissions within East African countries. The MMQR model mitigates several limitations inherent in standard regression models. It excels in providing precise and robust findings, particularly in scenarios where the dataset distribution is non-parametric, includes outliers, exhibits minimal or no correlation, and departs from normality.

Moreover, this approach excels in discerning the distributional and distinctive characteristics across various quantile values, effectively addressing concerns related to uneven distribution. Additionally, MMQR accommodates individual fixed effects across the conditional distribution,

enabling predictors to incorporate both location and scale functions, as highlighted by Alhassan et al. (2020). Furthermore, MMQR demonstrates resilience in identifying the provisional diverse covariance influences of variables such as Foreign direct investment, gross domestic product, renewable energy, and trade openness on carbon dioxide. This capability effectively addresses and overcomes challenges associated with unobserved heterogeneity, contributing to a more accurate and nuanced understanding of the complex relationships among these factors.

MMQR exhibits the ability to manage endogeneity and heterogeneity through moment limitations, rendering it well-suited for generating estimates in scenarios involving asymmetry and nonlinearity. Characterized as a practice-based technique, MMQR not only accommodates the complexities of real-world situations but also enhances the reliability of results by addressing issues related to endogeneity and heterogeneity. In accordance with the work of Machado and Silva (2019), the provisional quantile of the random variable within the panel data, accounting for both the location and scale parameters, is described as follows:

$$Y_{it} = \alpha_i + X_{it}'\beta + (\delta_i + Z_{it}'\gamma)U_{it} \quad (3.2)$$

Where Y_{it} is the dependent variable, X_{it}' is the endogenous variable, $(\alpha_i, \beta, \delta, Z)$ are the parameters to be calculated. The probability, P{ $\delta_i + Z_{it}'\gamma > 0$} = 1, and U_{it} is the unobservable error term which is truly separate of X_{it}' , and (α_i, δ_i) $i = 1, \dots, n$ takes the different i the fixed effects. Z' reveals a k vector of recognized transformation of the factors of X_{it} with factor I defined as Z'=$Z(X_{it}')$ where $I = 1, \dots K$.

Agreeing to Machado and Silva (2009), the intensity act $F_u(.)$ is restricted absent from 0, and therefore regulated to fulfill the second condition provided as $E(U_{it})$ = 0 and $E(/U_{it})$ = 1. Equation (1) so converts:

$$Q_Y(\tau|X_{it}) = \big(\alpha_i + \delta_i q(\tau)\big) + X_{it}\beta + Z_{it}'\gamma q(\tau) \quad (3.3)$$

Where $q(\tau)$=$F_U^{-1}(\tau)$ and $P\big(U < q(\tau)\big) = \tau$. The scalar parameter implies that $\alpha_i(\tau) = \alpha_i + \delta_i q(\tau)$ is revealing of the quantile -τ fixed effect for single i. In contrast to OLS-fixed effects, the distributional impact of MMQR is permitted to vary across all quantiles of the conditional distribution of the dependent variable.

CHAPTER FOUR

RESEARCH RESULTS AND ANALYSIS

4.0 Introduction

This segment reports the results obtained from the application of statistical methods to the collected data, aiming to fulfill the established objectives, building upon the groundwork laid out in the previous chapter. Furthermore, it compares the outcomes of the empirical analysis employed in the study with previous research findings, emphasizing both the similarities and disparities between the current research and earlier investigations.

4.1 Summary statistics of the variables used for empirical analysis.

Table 4.1 provides a comprehensive overview of the numerical info associated with the variables outlined in eq. (1). CO_2 ranges from 0.035 to 6.267, with a mean value of 0.670. The distribution displays a moderate level of variability (Std. Dev. = 1.498) and is characterized by a positively skewed pattern (Skewness = 3.032) and a heavy-tailed distribution (Kurtosis = 10.476). FDI has a mean of 4.284, ranging from 0.002 to 57.877. Demonstrating notable variability (Std. Dev. = 6.414), FDI's distribution is right skewed (Skewness = 6.357) and exhibits a heavy tail (Kurtosis = 52.321). The average value of GDP is 2.93 billion, with a range spanning from 8.95 million to 8.96 billion. The distribution is characterized by substantial variability (Std. Dev. = 3.05 billion) and shows mild rightward skewness (Skewness = 0.713) with less pronounced tails (Kurtosis = 1.984). The mean value of RNE is 70.593, with a minimum of 0.780 and a maximum of 95.030. The distribution displays moderate variability (Std. Dev. = 27.786) and is left-skewed (Skewness = -1.429) with moderately heavy tails (Kurtosis = 3.891). TO exhibits a mean of 79.906, ranging from 1.218 to 347.99. With substantial variability (Std. Dev. = 82.963), the distribution of TO is right skewed (Skewness = 1.810) and has heavy tails (Kurtosis = 5.235). Additionally, the Jarque-Bera test results indicate that these variables significantly deviate from a normal distribution.

Table 4.1 Descriptive statistics

	CO2	FDI	GDP	RNE	TRO
Mean	0.670	4.284	2.93B	70.593	79.906
Maximum	6.267	57.877	8.96B	95.030	347.99
Minimum	0.035	0.002	8.95M	0.780	1.218
Std. Dev.	1.498	6.414	3.05B	27.786	82.963
Skewness	3.032	6.357	0.713	-1.429	1.810
Kurtosis	10.476	52.321	1.984	3.891	5.235
Jarque-Bera	370.78[a]	10377.31[a]	12.28[a]	35.87[a]	72.466[a]

Note: [a] represents statistical significance at 1%

4.2 Correlation matrix

Following the descriptive statistics, tests for correlation amongst the variables are also carried out. The purpose of this is twofold. The first reason is to influence the nature, intensity, and significance of the associations among the variables of interest. The second reason is to determine whether multicollinearity is a problem in the specified econometric model. Multicollinearity is assumed to be present between two regressors if the correlation value is greater than 0.8. The correlation matrix generated is presented in Figure 4.2.

The result shows there is a statistically significant positive correlation between FDI and CO_2. This is the first confirmation by this study that FDI inflow into East Africa has adverse effects on the environment. Moreover, the results show that multicollinearity is not a challenge in this study as none of the coefficients is greater than 0.8.

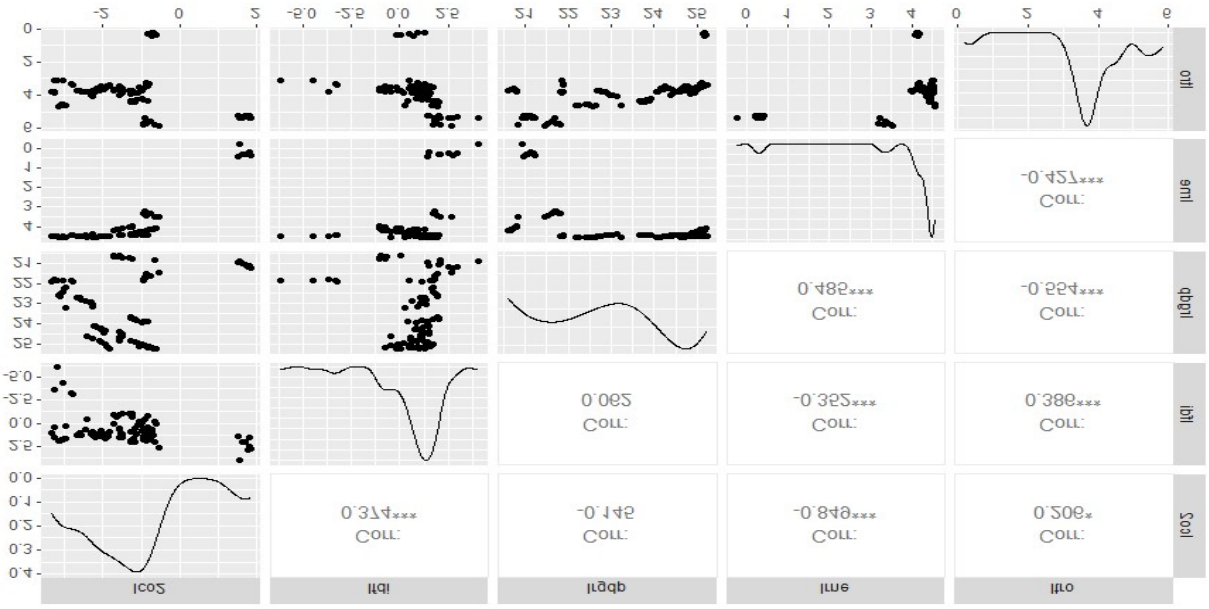


Figure 4.2 Correlation matrix

4.3 Quantile regression results

Finally, the regression results generated through MMQR are reported in Table 4.2. The associated graphical representations of the quantile constants are also presented in Table 4.2. Coefficients under location parameters reveal that the FDI has no statistically significant effect on carbon emissions in East Africa. An inverted N-EKC relationship is detected among GDP and carbon emissions. Statistically significant negative, positive, and negative relationships are detected respectively among gross domestic product and carbon emissions. Below location parameters, the result also shows that renewable energy consumption has a statistically significant negative influence on carbon emissions in East Africa, while the effect of trade openness is statistically insignificant. It is however significant to state that results reported under location parameters are simply mean values generated by standard fixed-effects regressions. The statistical significance of the FDI variable reported under scale parameters is indicative of the fact that the data is heterogeneous in nature. This supports the reexamination of the relationship between carbon emissions and the regressors via the MMQR method.

When the results generated across quantiles by MMQR are considered, it can be observed that FDI only has a statistically significant positive impact on CO_2 emissions at higher quantiles (values greater than 0.7) in East Africa. This positive effect also increases from lower to higher quantiles of carbon emissions, showing that FDI has a bigger effect on carbon emissions when pollution is

already relatively high. This is an important confirmation of the pollution haven hypothesis, as this study does not only show that FDI is causing more pollution in East Africa, but also that FDI is causing more environmental damage in places where pollution is already a major problem (places with relatively lax environmental laws).

The inverted N-EKC revealed under the location parameters is also confirmed across quantiles. The coefficients of GDP are negative and statistically significant across all quantiles, whereas the coefficients of the quadratic form of GDP are positive and statistically significant across all quantiles. The cubic form of GDP again has statistically significant negative coefficients, though only from low to mid quantiles. The statistically significant negative effect of renewable energy consumption is also maintained across all quantiles when the MMQR results are considered. The size of the coefficients however shows gradual decline from low to high quantiles. This suggests that renewable energy use is more effective in lowering pollution when carbon emissions are already relatively low (places with more effective environmental laws).

Table 4.2 MMQR with fixed-effects results

	Method of Moments Quantile Regression									
	Location	Scale	Grid of quantiles							
			0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
Variables											
LFDI	0.0397	0.054[b]	-0.042	-0.0178	-0.008	0.024	0.036	0.056	0.0763[c]	0.1088[c]	0.131[c]
LGDP	-124.48[a]	13.702	-144.94[a]	-138.846[a]	-136.41[a]	-128.21[a]	-125.41[a]	120.27[b]	-115.34[b]	-107.22[c]	-101.5[a]
$LGDP^2$	5.268[***]	-0.598	6.161[a]	5.895[a]	5.788[a]	5.430[a]	5.308[a]	5.084[b]	4.868[b]	4.514	4.265
$LGDP^3$	-0.0739[a]	0.0086	-0.086[a]	-0.0830[a]	-0.0815[a]	-0.076[a]	-0.0745[a]	-0.071[b]	-0.0681[c]	-0.062	-0.059
LRNE	-0.963[a]	0.047	-1.034[a]	-1.013[a]	-1.0046[a]	-0.976[a]	-0.966[a]	-0.948[a]	-0.931[a]	-0.902[a]	-0.88[a]
LTRO	0.0307	0.033	-0.0193	-0.0043	0.0015	0.021	0.0285	0.041	0.0531	0.073	0.087
CONST	977.63[a]	-104.43	1133.63[a]	1087.13[a]	1068.5[a]	1006.08[a]	984.74[a]	945.57[c]	907.97[c]	846.10[c]	802.63

Note: [a,b,c] represent statistical significance at 1%, 5%, 10% respectively.

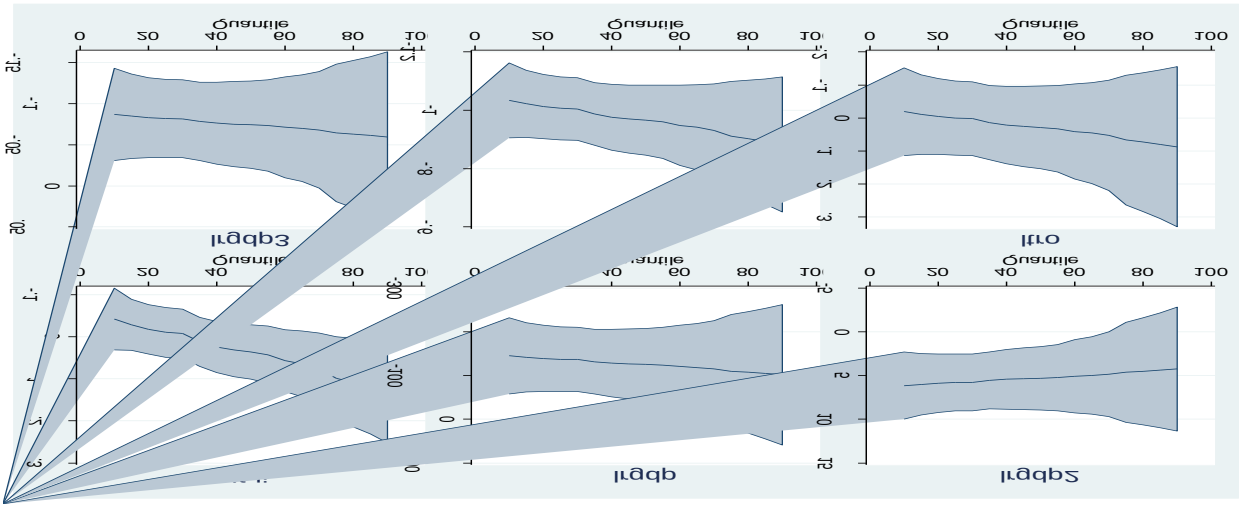


Figure 4.2 Graphs showing the trends of the coefficients of regressors across quantiles.

CHAPTER FIVE

CONCLUSSION AND RECOMMENDATIONS

5.0 Conclusion

This chapter studies the effect of FDI on CO_2 emissions in East African countries within the N-EKC framework, while controlling for the effects of the level, quadratic and cubic forms of gross domestic product, as well as renewable energy and trade openness. Panel data from 2012 to 2019 is analyzed using MMQR. This statistical method is utilized to robustly examine and derive insights from the data, ensuring a comprehensive examination of the relationships under investigation. MMQR is particularly advantageous in capturing the nuances of the data distribution, enabling a more nuanced understanding of the effect of various factors, such as FDI, on CO_2 emissions through different quantiles.

Our findings underscore that the impact of FDI on CO_2 emissions becomes more significant when pollution levels are already elevated. Moreover, the findings deliver empirical confirmation for the strength of the PHH within the region. The empirical outcomes revealed the presence of an inverted N-EKC association among GDP and CO_2 emissions. The statistical analysis shows successive, significant negative, positive, and negative relationships between gross domestic product and Carbon dioxide emissions.

The MMQR results consistently indicate a statistically significant negative effect of renewable energy consumption across all quantiles. This finding underscores the robustness and uniformity of the observed relationship, suggesting that the influence of renewable energy consumption on the variables under consideration remains consistently negative throughout various levels of the distribution. This implication indicates that the efficacy of renewable energy use in reducing pollution is more pronounced in regions where carbon emissions are already relatively low, indicative of areas with more stringent and effective environmental regulations.

5.1 Policy Implications

The outcomes of this study underscore the importance of deliberate planning when it comes to attracting FDI, particularly in East Africa states, where FDI inflows appear to be correlated with an increase in CO2 emissions. In response to these findings, policymakers should craft well-thought-out policies aimed at drawing FDI from regions where environmental regulations are not only present but also rigorously enforced. This strategic approach is crucial to ensuring that incoming investments align with established environmental standards and contribute positively to sustainable development. This deliberate direction not only safeguards the region against potential environmental degradation but also steers investments toward sectors that contribute positively to ecological sustainability and overall development goals.

Another crucial aspect involves the enactment of laws designed to facilitate the transfer of knowledge and the development of local capacity. This would empower local firms to adopt production techniques that align with environmentally friendly practices. Such initiatives could be effectively implemented through strategic alliances with international businesses committed to environmental preservation. Furthermore, actively promoting investments in energy efficiency and renewable energy sources emerges as a dual strategy: it helps mitigate CO_2 emissions and, simultaneously, enhances the attractiveness of the region for Foreign Direct Investment (FDI).

Thirdly, East African nations must arrange the enhancement of their institutional capacities and regulatory frameworks. This strategic focus aims to strengthen the implementation of environmental legislation and robustly monitor compliance. Such measures are crucial in ensuring that foreign direct investment projects align with stringent environmental requirements, thereby contributing substantively to the overarching goal of sustainable development in the region.

In conclusion, the nexus between FDI and CO_2 emissions within the context (E-EKC) in East African nations underscores the importance of adopting a balanced strategy regarding FDI inflows. The nations of East Africa possess the potential to leverage FDI as a catalyst for sustainable improvement, climate change mitigation, and preservation.

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