UNIVERSITY OF CAPE COAST

EXCHANGE RATE AND PERFORMANCE OF THE MANUFACTURING SECTOR IN GHANA: EVIDENCE FROM NONLINEAR ARDL ANALYSIS

ASIEDU EBENEZER

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BY

ASIEDU EBENEZER

Thesis Submitted to Department of Economic Studies of the School of Economics of the College of Humanities and Legal Studies, University of Cape Coast, in Partial Fulfilment of the Requirements for the Award of Master of Philosophy Degree in Economics.

2023

DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my original research and that no part of it has been presented for another degree at this university or anywhere else.

Candidate's Signature…… Date……

Name: Ebenezer Asiedu

Supervisors' Declaration

We hereby declare that the thesis preparation and presentation were supervised in accordance with the thesis supervision guidelines of the University of Cape Coast.

Principal Supervisor's Signature……. Date…….

Name: Dr. Isaac Bentum-Ennin

Co-Supervisor's Signature……. Date……....

Name: Dr. Eric Amoo Bondzie

ABSTRACT

Stabilizing the exchange rate in Ghana has been a major concern. This study examined the effect of exchange rate appreciation and depreciation on the performance of the manufacturing sector in Ghana. Again, it investigated whether there exists an asymmetric relation between the exchange rate and manufacturing performance in Ghana. This study employed non-linear autoregressive distributed lags to examine the purpose of the study. The results from the NARDL models indicate that, on average, both appreciation and depreciation of the exchange rate and Gross Fixed Capital Formation (investment) are significant determinants of the performance of the manufacturing sector in Ghana in the long run. From the short-run estimates, the linear and nonlinear ARDL models revealed that the real effective exchange rate, inflation rate, gross fixed capital formation, and labor force participation influence the manufacturing sector. The results confirm the presence of asymmetric relationships between the exchange rate and manufacturing output in Ghana. The effect of appreciation of the currency is more than that of depreciation. In view of this, it is recommended that the central bank and the government, through the Ministry of Finance should ensure stabilization of the currency by abolishing the of use of foreign currency to trade in Ghana. Again, some more restrictive measures such as increases in import duties and tariffs should be put in place for goods and services that could be locally produced so as to reduce the pressure on the demand for foreign currency.

KEYWORDS

Appreciation

Depreciation

Exchange rate

Ghana

Manufacturing sector

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DEDICATION

To my family

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LIST OF ABBREVIATIONS

AfDB	Africa Development Bank
ARDL	Autoregressive Distributed Lags
CPI	Consumer Price Index
CUSUMQ	Cumulative Sum of Squares of Recursive Residuals
CUSUM	Cumulative Sum of Recursive Residuals
ERP	Economic Recovery Program
FLFP	Female Labour Force Participation
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
NARDL	Non-Linear Autoregressive Distributed Lags
NEPAD	New Partnership for Africa Development
IMF	International Monetary Fund
ISIC	International Standard Industrial Classification
OLS	Ordinary Least Square
REER	Real Effective Exchange Rate
UN	United Nations
SDGs	Sustainable Development Goals
VAR	Vector Auto Regression
VECM	Vector Error Correction Model

CHAPTER ONE

INTRODUCTION

This chapter consists of the background, the problem statement, the research objectives and hypotheses, the significance of the study, the definition of terms, delimitation of the study and the organizational structure of the study.

Background to the Study

Recent studies by Mlambo, (2020); Ududechinyere & Mbam, (2018); Wonyra, (2018) have proved that industrialization may serve as an engine of economic growth if industries are prioritized in developing countries. In addition, Bhorat (2017) comes to the same conclusion and states that very few nations have achieved sustained and sustainable economic development without the manufacturing sector as the primary driver of that growth.

Figure 1 shows a detailed description of the industrial sector and the GDP shares of its sub-sectors. Overall, the industrial sector contributed the most to GDP in 2014 with a share of 37.29%, three years after commercial exploration of Ghana's oil resources. The sector has four main sub-sectors: mining and quarrying, manufacturing, utilities, and construction. A heedful look at these sub-sectors shows that the manufacturing sub-sector has exhibited an invariantly high contribution of the industry sectors' share to GDP. This was closely and consistently followed by an unpredictably high contribution from the mining sub-sectors the sector's contribution to GDP. The construction and utility sub-sectors contributed the least. Judging from the contribution of this industrial sub-sector to

GDP, one can hardly confirm that the manufacturing sector or the mining and quarry sector should be prioritised.

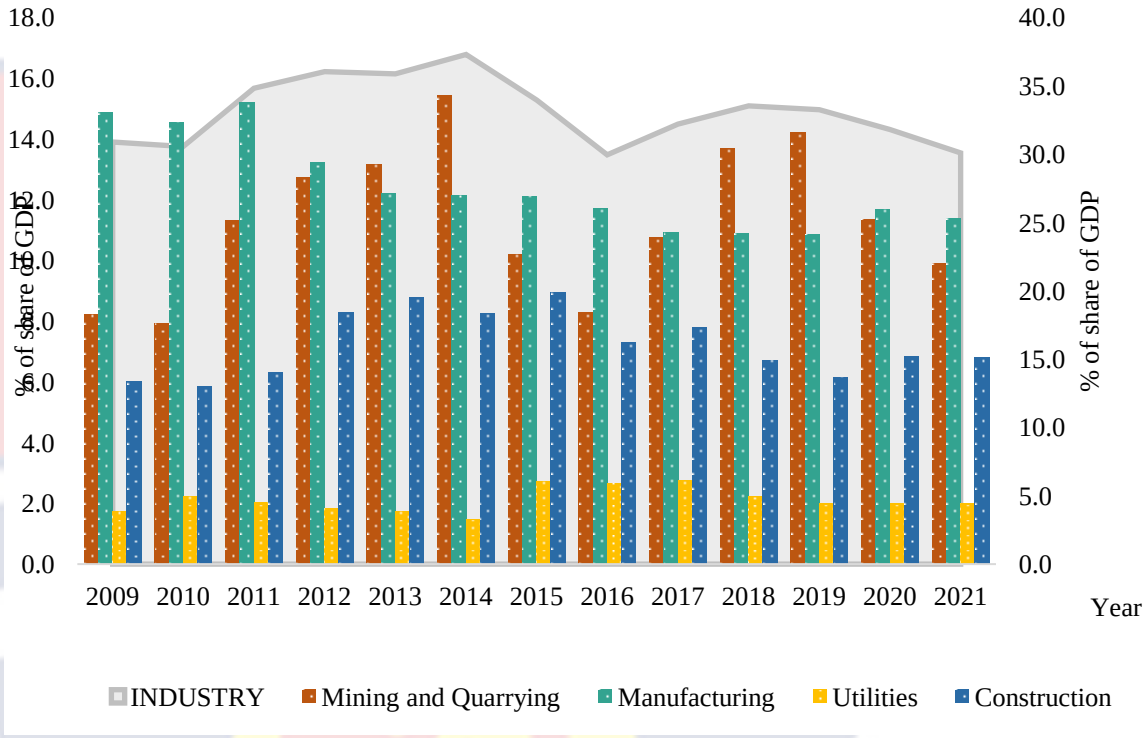


Figure 1: Industry sub-sector share of GDP

Source: Author's construct (2023)

To prioritise a sub-sector as key to propelling economic development, it is prudent to take into account its growth prospects. Figure 2 depicts the expansion of the manufacturing, utilities, building, and mining and quarrying industries. The manufacturing sector is the only industrial sub-sector to have recorded a negative growth rate once, which occurred in 2016. Though the mining and quarrying sub-sectors experienced nearly 80% growth in 2011, the growth rate in recent years, especially after 2019, has been deteriorating. Over the past half-decade, the manufacturing sector has experienced positive development. The utilities industry, like the manufacturing industry, has had positive development during

the past seven years. Although the manufacturing sector vigorously fought the mining and quarrying sub-sector's contribution to the industrial sector's share of GDP, overall, the sub-sector's growth rate has not been excellent since COVID-19 (see Figure 2). From the perspective of growth rate, the manufacturing sector can be said to be promising in terms of the positive increase in the size of its growth. In addition to being an important driver of innovation and competitiveness, the manufacturing sector is a key contributor to the increase of exports as well as the growth of productivity.

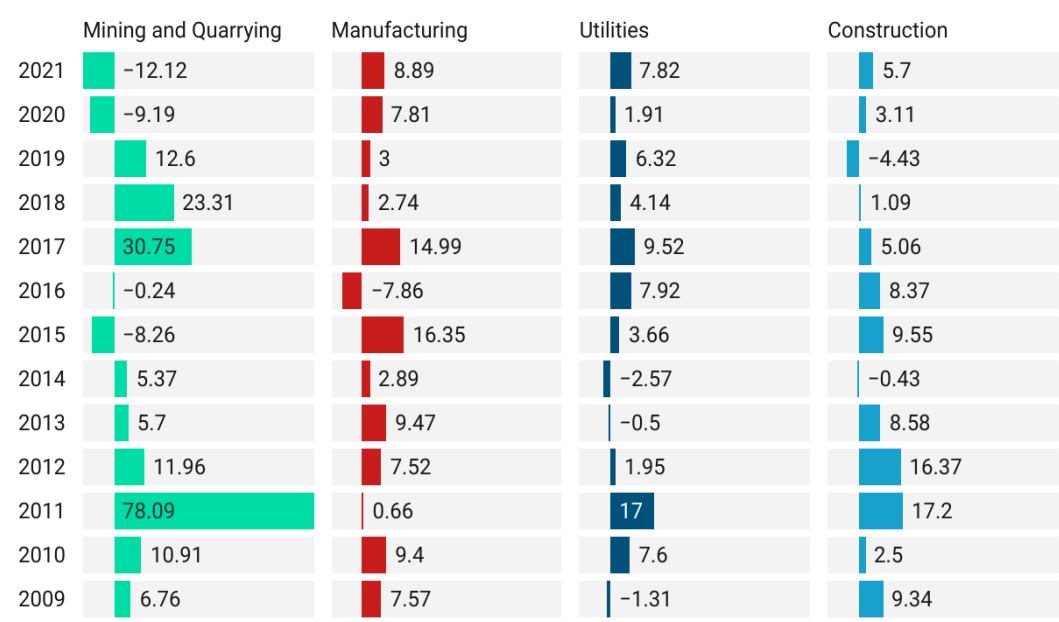


Figure 2: Industry sub-sector growth rate

Source: Author's construct (2023)

The manufacturing sector reported an average contribution of 1.4 percent to GDP at the end of 2020, down from an average of 6.3 percent the year before (Ghana Statistical Service, 2021). This is despite the fact that the sector currently dominates how it relates to the GDP contribution and the creation of jobs in the service sector. This contraction is due to the COVID-19 epidemic spreading more

widely as well as fluctuations in the ongoing exchange rate. Figure 3 displays the manufacturing sector of Ghana has witnessed a decline in its value-added contribution to GDP from 11.098 in 2015 to an average value of 10.473 in 2020. "What factor(s) is (are) accounting for the decline in manufacturing sector performance?" is a natural question being asked. Existing literature (Menzel et al., 2010; Dinh et al., 2012; Ududechinyere & Mbam, 2018; Moyo & Jeke, 2019; Mlambo,2020) attributes the decline in value-added of the manufacturing sector to factors like the comparatively limited supply of inputs, including raw materials, the low patronage of locally produced "made in Ghana" goods and services, and others. Based on Figure 1's depiction of the manufacturing industry's most recent performance the natural question that we ask is, to what extent does Ghana's industrial sector (commonly known as the manufacturing sector) serve as the country's primary driver of economic growth? Historically, many developing economies, including Ghana, faced numerous challenges in developing their manufacturing sector. These challenges have resulted in frequent changes in strategy and direction, along with corresponding changes in political power and broader trends in industrial policy.

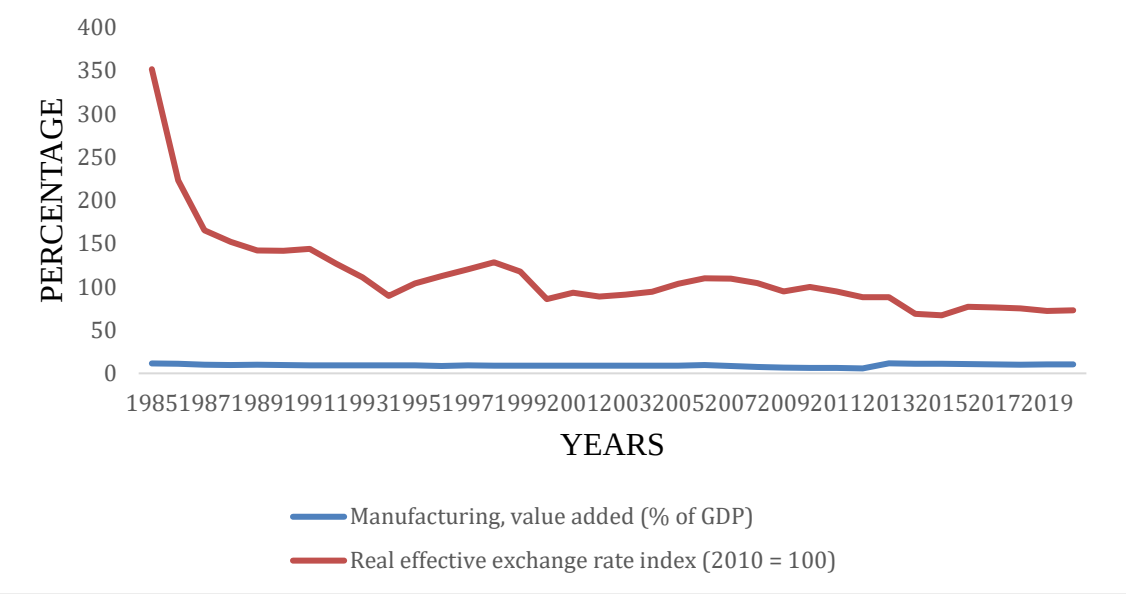


Figure 3: **Trend of the manufacturing sector value added (% of GDP) and real exchange rate.**

Source: Author's construct (2023)

After the initial devaluation of the cedi in April 1983, which marked the beginning of Ghana's Economic Recovery Programme (ERP), the country worked toward establishing an exchange rate that was more realistic and flexible? The policy was to promote economic development, reform and restore productive incentives, currency rates, interest rates, and productive incentives should all be adjusted. The Ghana cedi exchange rate continues to fluctuate often despite the measures stated. As a result, the expansion and improvement of the manufacturing industry are negatively impacted. The employment situation, the balance of payments, the price of domestic products and services, and the rate of economic expansion of a nation are all significantly impacted by changes in the exchange rate. Exchange rate control is therefore one of the most crucial

macroeconomic management instruments. Consequently, the existence and growth of the manufacturing industry in any nation is significantly influenced by a competitive currency. (Mlambo, 2020). However, the current pace of local currency depreciation has prompted economists, policymakers, and corporate organisations to examine how exchange rates affect the development of different economic sectors, particularly the manufacturing sector, which mostly relies on imported goods for input.

The growth of the manufacturing sector may be impacted by currency depreciation via aggregate supply, aggregate demand, or both. The volume of products and services made in the nation is reduced as a result of rising export costs brought on by an increase in exchange rates. The industry of manufacturing, what is recognized to be an input-dependent industry, may experience weaker development as a result. A depreciating exchange rate, on the other hand, would minimize market inefficiencies and correct price misalignment, increasing global pricing competitiveness. Furthermore, exchange rate fluctuations have an effect on industry production levels via trade channels and adjustments to input and output prices. Due to the unfavourable effects of exchange rate fluctuations, Ghana's industrial sectors underperformed generally and advanced slowly. By focusing on the non-linear currency rate has an impact on industrial performance in underdeveloped nations like Ghana, according to the research seeks to fill a significant vacuum in the literature.

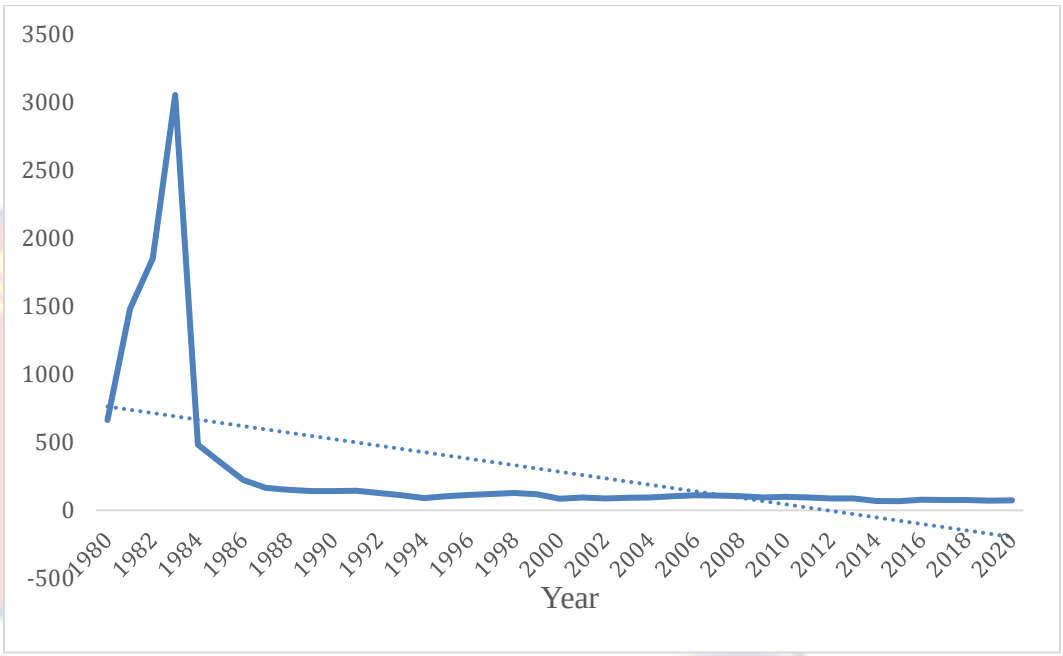


Figure 4: **Trend of Ghana's Real effective exchange rate**

Source: Author's construct (2023)

As shown Figure 4, sharp currency depreciation will increase the cost of intermediate and capital products, hence increasing the cost of production in the sector. Producers will pass on the increased cost of production to consumers and this increase the price of products and services and later cascade the impact on the economy as a whole. Consequently, general price levels will rise (inflation) and domestic output will decline.

The negative consequences of exchange rate fluctuation are magnified when exports are invoiced in the importer's currency (Qian and Varangis, 1994). After the Nkrumahist period, Ghana's industrial sectors had slow development, low profitability, and overall underperformance. As a result, the study hopes to address an essential gap in the literature by concentrating on the non-linear effect

of exchange rate volatility on manufacturing performance in developing countries like Ghana.

According to Dornbusch (1987), when the exchange rate rises, it will be reflected in the domestic price level as a whole. As the native currency depreciates, the overall level of prices is anticipated to increase. Therefore, it is feasible to draw the conclusion that exchange rates and inflation are closely related. Research currently conducted presupposes a linear link between changes in output (the industrial sector's performance) and exchange rate swings. In other words, appreciation is contractionary and depreciation is expansionary. However, it's likely that changes in the currency rate will have hazy impacts on production. There may be nonlinear impacts of currency rates on the manufacturing industry's performance as a result of the exports' import composition. Imports with a higher price tag and imports with a lower price tag might be argued to be the reverse. The purpose of this study is to identify the nonlinear effects of actual exchange rate changes on the performance of the manufacturing sector. Thus, the research must take into account the unfavourable link between the exchange rate and the growth of Ghana's manufacturing sector.

Problem Statement

Sustainable Development Goal (SDG) 9 emphasizes the need for nations to achieve sustainable industrial and infrastructure development (United Nations (UN), 2015). Following this concept, the African Union created Agenda 2030, which specifies that industrial growth would be the primary sector or driving force for African nations to achieve their developmental objectives (African

Union (AU), 2015). With regard to these policies, the President of Ghana launched the "One-District, One-Factory" policy in 2018 to boost and support the performance of the Ghanaian manufacturing sector.

Despite the afore-mentioned policy, the Ghanaian cedi continues to be volatile, regularly affecting the performance of the manufacturing sector and some macroeconomic variables like economic growth, employment, inflation, imports, exports, and many more.

Studies on Ghana's manufacturing sector have used the cointegration technique to assess the effect of exchange rate variations on the performance of the industry, using autoregressive distribution lags (ARDL) and ordinary least squares (Buabeng, Ayesu, & Adabor, 2019; Addo, 2017; Abdul-Mumuni, 2016; Mensah, Awunyo-Vitor, & Asare-Menako, 2013). Scholars have challenged the use of autoregressive distribution lags (ARDL) and ordinary least squares methods for estimation because macroeconomic variables such as economic growth, investment, prices, and trade may be nonlinear and that any estimations of these time series variables must take the nonlinearity into account (Cuestas & Mourelle, 2011; Habibi, 2019). According to Cuestas and Mourelle (2011) and Habibi (2019), using linear models such as ARDL to estimate a non-linear relationship can lead to wrong estimates and spurious regression analyses. Researchers from Ghana examined how exchange rate changes affected the industrial sector's performance and revealed a significant and unfavourable correlation between the two and their performance using the autoregressive distribution lags (ARDL), and ordinary least squares (Buabeng, Ayesu, & Adabor,

2019; Addo, 2017). It is therefore, unclear whether their findings underestimated or overestimated. Part of the argument is that using the nonlinear ARDL decomposes how the exchange rate affects the manufacturing industry when the currencies appreciate or depreciate.

Despite the above empirical findings (see, for example, Boateng, 2019; Abdul-Mumuni, 2019; Alagidede & Ibrahim, 2017; Ofori et al., 2018; Salifu et al., 2007; Mensah et al., 2013; Insah & Chiaraah, 2013; Nyarko et al., 2011), Most people are not aware of how exchange rate variations affect the functioning of industrial enterprises in Ghana. However, empirical studies have shown how changes in exchange rates impact the nation's overall development, including job possibilities, trade balance, capital inflows, and economic growth. (Kenneth et al., 2016; Elbadawi et al., 2008; Alagidede & Ibrahim, 2017; Mensah et al., 2013; Umaru et al., 2018; Nyarko et al., 2011). Despite the abundance of literature in this domain, there is a notable scarcity of research investigating the correlation between nonlinear rates of change the effectiveness of Ghana's industrial sector. To date, limited research has specifically explored the correlation between nonlinear currency rates affect Ghana's industrial sector's successes. Boateng's 2019 study assessed the manufacturing sector's financial success as determined by return on assets and equity.

Despite the fact that the aforementioned aspects may be potential obstacles to the expansion of the industry in Ghana, there are a number of macroeconomic factors that might influence how effectively the manufacturing sector operates. The exchange rate is one of these elements. Why should we pay attention to the

industrial sector's success and the exchange rate is a logical question that we questioned. It is widely accepted that creating a competitive manufacturing sector is crucial for achieving exporting requirements to maintain self-sustaining growth (Schneider, 2000). Therefore, it is vital to provide a favourable atmosphere for manufacturing enterprises for them to achieve a local and worldwide competitive position (Prause, 2015).

Similarly, Abdul-Mumuni's research in 2019 employed the GDP contribution to the industrial sector as a performance indicator. However, a more recent study conducted by Mesagan, Alimi, and Vo in 2022 delved into the outcomes of trade and output imbalances owing to changes in currency in eight significant African nations, including Ghana. They analyzed data from 1970 to 2019 using a non-linear autoregressive distributed lag (NARDL) architecture. The findings of this study provided empirical evidence supporting a long-term connection between exchange rates, trade, and economic output. The research suggested that currency depreciation generally leads to short-term improvements in production performance for most African countries, while currency appreciation often has the opposite effect.The impact of exchange rate shocks on pricing throughout whole supply chain were analysed by Rincon and Rodrguez-Nio (2018), and forecasts for both the short and long term were provided. It uses monthly data from a small, open economy and a Bayesian-estimated auto-regressive vector model with a smooth transition. The most important discovery is the nonlinearity, shock, and state dependence on exchange rate pass-through.

First, the nonlinear and endogenous properties of the pass-through should be reflected in the models used by central banks to design policy.

Moreover, it is important to evaluate the connection between the exchange rate and the industrial sector because exchange rate affects major macroeconomic indicators such as income inequality, economic conditions, unemployment, tax revenue, budget deficits, private sector investment, human capital, balance-of-payment deficits, and growth. Understanding the impact of currency fluctuations on Ghana's manufacturing industry efficacy is crucial as it provides valuable insights into the sector's effectiveness, efficiency, and implications for overall economic growth. Given this, the goal of the study was to ascertain how much the performance of Ghana's manufacturing sector is impacted by exchange rate volatility.

In addition, changes in exchange rates have an influence on the production levels of industries through trade channels and changes in input and output prices. As a result of the negative consequences of exchange rate changes, Ghana's industrial sectors had slow development, low profitability, and overall underperformance. As a result, the study hopes to address an essential gap in the literature by concentrating on the non-linear effect of exchange rate on manufacturing performance in developing countries like Ghana.

According to Dornbusch (1987), when the exchange rate rises, it will be reflected in the domestic price level as a whole. As the native currency depreciates, the overall level of prices is anticipated to increase. Therefore, it is feasible to conclude that exchange rates and inflation have a very tight connection

Based on the research foundation provided above, this study aims to revisit the nexus between the exchange rate and the manufacturing sector in Ghana using the nonlinear ARDL estimation.

Purpose of the Study

The study aimed at examining the non-linear effect of exchange rate on the performance of the manufacturing sector in Ghana. Specifically, to:

1. examine the effect of exchange rate on the performance of the manufacturing sector in Ghana;
2. examine the asymmetric relation between exchange rate and manufacturing performance in Ghana.

Research hypotheses

Based on the specific objectives of the study, these hypotheses were formulated;

1. H_0: Exchange rate does not significantly affect the performance of the manufacturing sector

H_1: Exchange rate does significantly affect the performance of the manufacturing sector

2. H_0: There is no asymmetric relationship between exchange rate and the performance of the manufacturing sector

H_1: There is an asymmetric relationship between exchange rate and the performance of the manufacturing sector

Significance of the study

It is crucial to conduct this research since the exchange rate not only restrains the expansion of the manufacturing industry but also hinders it, but it

also affects major macroeconomic indicators such as income inequality, economic conditions, unemployment, tax revenue, budget deficits, private sector investment, human capital, balance-of-payment deficits, and growth. Again, understanding the effect of exchange rate and how much it impedes the expansion of the industrial sector's performance is important is very important because it sheds light on the efficiency and efficacy of the sector and also has implications for the development of the economy. The NARDL method, a novel estimating technique, is to perform this study to expand our understanding of the subject, to estimate exchange rate and connection volatility and manufacturing performance in the Ghanaian context. By employing this innovative approach, the study provides a unique perspective on understanding the association between changes in the currency rate and Ghana's industrial sector's performance.

The findings of this study will improve our understanding of how the industrial sector and the exchange rate are related. Policymakers will be able to use this information to develop measures to stabilize currency rate volatility and choose the areas on which they should focus. The Ghana Statistical Service (GSS) and the Ministry of Trade and Industry will determine the degree to which the exchange rate affects the development of the manufacturing sector. This research will also inform policymakers on the kind of exchange rate policies that would boost the development of Ghana's manufacturing sector. This study will also contribute to helping institutions such as the Bank of Ghana and the government decides what exchange rate is optimal for promoting the manufacturing sector's development and contributing to SDG 9. It will also serve as a resource for

individuals who need to undertake more research in this sector and fill the gap indicated in this study.

Delimitation of the study

The study focuses specifically on the manufacturing sector in Ghana. The findings and conclusions may not be directly applicable to other countries or regions. In addition, the study primarily focuses on the impact of exchange rate appreciation and depreciation on the performance of the manufacturing sector in Ghana. Other factors or variables that may influence manufacturing performance, such as government policies, technological advancements, and global market dynamics, are not explicitly addressed in the document.

Organization of the study

The study consists of five chapters. The first chapter dealed with the introduction of the study which includes the background to the study, statement of the problem, objectives, research hypothesis and question, and significance of the study. Chapter two deal with the literature review which will be divided into the theoretical and empirical review. Chapter three cover the research methods comprising the research design, the study area, study population, measurement of variables, sample size, and data processing and analysis method. Chapter four deal with the presentation and discussion of the findings of the study. Finally, chapter five cover the conclusion, recommendations and area for further studies.

CHAPTER TWO

LITERATURE REVIEW

Introduction

This section, in particular, examined the performance of Ghana's industrial sector, alongside a comprehensive review of relevant literature pertaining to the exchange rate. The chapter aims to provide a theoretical framework that encompasses the connection between the manufacturing industry and the exchange rate. Additionally, it explores existing empirical research on this subject, identifying various approaches employed to examine how the manufacturing sector and the currency rate are related. By examining these sources, the chapter aims to identify any gaps in the current literature, thereby paving the way for further research and contributing to a more comprehensive understanding of the topic. The content in this chapter is organised into three parts. An overview of Ghana's manufacturing sector's performance is provided in the first portion of this paragraph. The theoretical underpinnings of the exchange rate are covered in the part that follows in this chapter. The final section contains empirical analyses of manufacturing and exchange rate volatility.

Theoretical Review

This portion of Chapter two explains the determination of exchange rates and its impact on the performance of the manufacturing sector using many economic theories. According to the Marshall-Lerner condition, which was named after the English economist Alfred Marshall (1842-1924) and the Romanian-born economist Abba Lerner (1905), an increase in output would result

from a depreciation of the currency if the sum of the price elasticity of demand for imports and exports is greater than one. They maintained that when the currency depreciates, import prices increase, which is likely to reduce import demand in the local economy. This is because currency depreciation directly leads to increased import prices. It is projected that the external trade balance would improve as a consequence of higher exports and decreased imports. According to the Marshall-Lerner condition, if the total price elasticity of demand for imports and exports is greater than one, a decline in the value of a country's currency would increase the number of commodities produced. Fundamentally, it is believed that the depreciation of the local currency helps to enhance external competitiveness, which in turn boosts export sector production. However, this will depend on whether or not the nation in issue has satisfied the Marshall-Lerner requirement.

Gustav Cassel's Purching Power Parity (PPP) theory from 1996 says that the exchange rate is in balance when the purchasing power of two paper currencies is the same. It means that the exchange rate between two paper currencies that can't be changed is based on the prices in the two countries. There are two ways to look at the purchasing power parity hypothesis: the absolute version and the relative version. The absolute form of the purchasing power parity theory says that the exchange rate is equal to the ratio between the amount of money needed at home and in a foreign country to buy a certain set of goods. In the relative form, changes in the equilibrium exchange rate are linked to how much the prices of two countries have changed since a base period. The relative

changes in prices between the base period and the present have a huge effect on the relative changes in exchange rates between the base period and the present.

To explain how the exchange rate affects the performance of the industrial sector, we adopted Kandil and Dincer's theory of exchange rate volatility (2008). This theory posits that exchange rate volatility may be separated into two categories: predictable and unpredictable exchange rate shocks. The former refers to the flawless foresight with which rational producers and consumers can anticipate future swings in the exchange rate and adjust their investment and consumption patterns accordingly. The unexpected exchange shocks, on the other hand, must cope with the unanticipated uncertainty caused by exchange rate swings. According to these writers, demand and supply are the routes via which variations in exchange rates may be seen in the output. Furthermore, they believed that the production of an economy is often dependent on unanticipated swings in the exchange rate.

The theory predicts that an unexpected appreciation of the local currency relative to the foreign currency would lead imports to become less expensive and exports of home commodities to become more expensive on the international market, as the domestic country becomes less competitive internationally. This will result in a decline in international demand for local goods and services, prompting producers to reduce output and prices, and vice versa. On the other hand, the unexpected appreciation of the local currency reduces the cost of importing capital and intermediate products, which contributes to a rise in the manufacturing output of the home economy. The rise in industrial output or

production will result in decreased pricing for products and services. Production, growth, and inflation rate are influenced by the net impact of currency appreciations, according to Kandil and Dincer (2008).

Overview of the Manufacturing sector in Ghana

Ghana is a huge and highly active consumer and industrial products and services sector that supplies goods and services to the Ghanaian economy and Africa. The government has implemented new policies to create an enabling climate, with a concentration on manufacturing and exports, for this sector to see considerable development over the next several years. The export push led to the establishment of free zone zones, which has resulted in the establishment of businesses in the nation that export goods to the subregion and the rest of the globe. The industrial sector is dominated by subsidiaries of international corporations and medium-sized local firms, such as Unilever, Coca-Cola, Toyota, and Accra Brewery. Due to the institutionalization of democracy in Ghana since 1992 and the generally stable macroeconomic climate, economic investment has increased. The existing economic climate and economic stability have made Ghana an attractive location for international investors in the sub-region (MoF, 2021).

The industrial sector in Ghana currently consists of five subsectors: manufacturing, construction, mining and quarrying, power, water, and sewage. This is because the national account figures were rebased in November 2010. The power, water, and sewage sub-sectors were all combined prior to the rebasing (MoF, 2021). The industrial sector contracted on average by 1.3% in the first half

of 2021, compared to a 3.2% decrease for the same time period in 2020. The industry saw expansion in the first and second quarters of 1.3% and -4.3%, respectively. The Mining and Quarrying subsectors had declines of 11.2% and 18.9%, respectively, in the first and second quarters of 2021, as opposed to 8.8% and 11.6% in the corresponding period of 2020. The shrinkage indicates that the output of gold, natural gas, and crude oil will all decline over time. 2019's first two quarters had a -13.4 percent growth rate on average for the oil and gas industry. Increase in oil and gas at the same period in 2020 was -4.2 percent. According to Table 1, among industrial subsectors, Water Supply, Sewerage, and Waste Management & Remediation Activities had the greatest average growth rate at 13.6%. Construction (8.1%), manufacturing (7%), and electricity (7%), in that order, came in second (4.8 percent).

Table 1: GDP Growth in Industry sector and sub-sectors

Sector/ Sub-sectors	2014	2015	2016	2017	2018	2019	2020
Industry	1.1	1.2	4.3	15.6	10.5	6.4	-3.6
Manufacturing	-2.6	3.7	7.9	9.5	4.1	6.3	1.4
Mining and Quarrying	5.4	-8.3	-0.2	30.8	23.3	12.6	-11
Electricity	1.3	17.7-	-5.8	19.4	5.5	6	7.9
Water and Sewerage	5.9	13.9	-11.8	6.1	-3.6	-4.4	2.2
Construction	-0.4	9.5	8.4	5.1	1.1	-4.4	2.9

Source: Ghana Statistical Service, (2021).

Empirical Literature

This part presents the empirical investigation of the link between the rate of exchange and industrial sector. According to the previous studies, the rate at which the industrial sector expands is significantly influenced by changes in exchange rates. For instance, between 2000 and 2012, Dhasmana (2016) studied how the currency rate impacts the Indian industrial sector.

The results of this study, which used the Vector Autoregressive Model (VAR) approach to evaluate the elasticity of exchange rate to industrial sector performance, shows that the real exchange rate has a significant impact on the efficiency of Indian enterprises, though the impact varies depending on the firm and industry conditions. Additionally, it was discovered that industrial concentration, foreign ownership, market supremacy, trade orientation, and market dominance are the main factors influencing impact.

In a study conducted by Luckstead (2018), the asymmetry of cocoa import exchange rate pass-through was examined using dual estimation techniques: nonlinear ARDL and ARDL frameworks. Findings from ARDL analysis align with trade theory, indicating that increased imports of cocoa are a result of the US dollar's strengthening against other currencies. However, the trade elasticities over the long run, which measure the responsiveness of trade volumes to exchange rate changes, were found to be statistically insignificant across all three locations studied. In terms of long-run income elasticities, which measure the sensitivity of trade volumes to changes in income, the theoretical expectation proposes that income rise would result in higher trade volumes. Nevertheless, the outcomes

from the NARDL model reveal significant disparities in cocoa trade volumes in response to instability of the exchange rate. This suggests that even if the value of the US dollar decreases in Côte d'Ivoire, imports from the US do not necessarily increase when the dollar appreciates.

Similar to this, Hassan et al. (2020) investigated how changes in currency rates affected Pakistan's manufacturing industry between 1999 and 2015. Static panel data analysis methods, including fixed effects, random effects, and pooled OLS, were used in this investigation. The results of the study show that exchange rates and industrial production do not correlate well. Therefore, to reduce the risk of currency rate swings and improve performance, it is proposed that businesses with a degree of currency agreement implement certain advanced hedging strategies.

Mlambo (2020) examined how the exchange rate impacted the output of the industrial sector from 1995 to 2016 in SACU states. Ordinary least square (FMOL) as well as pooled-mean group (PMG) methods were used to quantify the effect of the rate of exchange on the output of the industrial sector. The outcomes show that the manufacturing sector's performance is negatively impacted by the currency rate, imports, and foreign direct investment. Additionally, a link was established between exports, inflation, and industrial performance.

Dube (2013) also examines how South Africa, China, and the United States' various industrial sectors' trade between 1990 and 2009 in relation to exchange rate swings. To calculate exchange rate volatility on a given day in the research, the GARCH model local scale while the Structured Vector

Autoregressive (SVAR) model was utilized to estimate exchange rate volatility globally. According to the study's findings, some subsectors were found to have a bad impact while others were found to have a positive one. Further research by Azeez et al. (2012) revealed that, in contrast to the manufacturing sector, where oil revenues and the balance of payments have a long-term negative impact on GDP, exchange rate turbulence also has a beneficial impact. Ehinomen and Olodipo (2012) similarly come to the conclusion that an increase in the worth of the national currency of Nigeria has an important effect on the nation's total production, which would assist the expansion of the manufacturing sector.

Ayirikame (2021) evaluated trade exchange rate, openness and industrial production in Sub-Saharan Africa (SSA) using fixed and random effect estimate methodologies. The study discovered that SSA's industrial production was positively impacted by changes in exchange rates. Ehinomen and Oladipo (2012) analyzed the manufacturing industry's performance and the currency exchange rate using time-series data in the Nigerian economy between 1986 and 2010. To evaluate the estimated results, multiple Ordinary Least Square (OLS) regression was utilized. Despite being a crucial component of Nigeria's economic reforms in 1986, devaluation had little to no effect on the industrial sector's level of productivity throughout the time period under study. Then again, Nigeria's manufacturing production was significantly impacted by exchange rate appreciation. Between 1980 and 2015, Akinlo (2018) looked at how Sub-Saharan Africa's manufacturing industry was affected by the exchange rate. Panel pooling OLS, dynamic generalized method of moment models and fixed effect were

applied to estimate the study's objective. The results showed that the manufacturing sector was negatively impacted by interest rates, exchange rate volatility, and trade openness.

Zhang (2019) examined the breakdown of Vietnam's industrial exports and the unpredictability of developing country currency rates between 2000 and 2015. Zhang (2019) employed the GARCH estimating method to assess the effects of exchange rate volatility on the industrial sector in various emerging nations. In order to determine the long-term effect and fluctuations in the export determinants, the Error Correction Model (ECM) and Dynamic Ordinary Least Square (DOLS) were also employed. According to the analysis, there is strong evidence that Vietnam's currency devaluation has positive short-term effects on exports but negative long-term ones.

The impact of currency rate instability on Nigeria's industrial sector between 1986 and 2005 was assessed in research by Opaluwa, Umeh, and Ameh (2018). Using the Augmented Dickey-Fuller (ADF) approach, the first differential MGDP (output) was evaluated, and the results were promising. The study's findings show that Nigeria's heavy reliance on imports from abroad has made exchange rate depreciation worse for the country overall, especially in the manufacturing sector. This is because the country's ability to import was constrained by the weakening currency, which led to a corresponding decline in output.

The Causality test, GARCH model, Ordinary Least Square, and Pairwise Granger were used by Kurotamunobaraomi, Rumuola, Akani, and Nwosi (2020)

to examine the connection between Nigeria's industrial sector and currency rate volatility. Production between 1982 and 2019.The study discovered that while the official exchange rate varies negatively in connection to Nigeria's industrial production, the market exchange rate fluctuates favourably. It was also shown that these qualities were negligible on their own but significant when combined.

Omotola (2016) investigated how changes in currency rates affect industrial sector output in the Nigerian economy throughout the period of 1986 to 2014. The link was investigated by means of the ARDL estimation approach. The findings indicate that the industrial sector's production is affected by both long- and short-term fluctuations in exchange rates. Further, the industrial sector's output was positively but marginally impacted by changes in exchange rates. In order to attain a positive balance of payments, the research suggests that the government take steps to increase exports and decrease imports. According to the research, manufacturing investments should be made in order to boost domestic competitiveness, increase national production, and promote economic growth. Investments in manufacturing also promote the use of locally sourced resources in production.

Between 1986 and 2017, Onuora, Obiamaka and Dominic (2019) investigated the impact of currency rate swings on Nigeria's industrial industry. The modified Dicker Fuller and Philip Perron tests, ordinary least squares (OLS), and OLS were used to assess the study's purpose. The outcomes showed that whereas inflation rates and fluctuations in exchange rates had a negative and less substantial influence on asset return over the course of the research period,

interest rates had a positive and substantial impact. The study comes to the conclusion that the exchange rate has a detrimental influence on the performance of Nigeria's manufacturing sector and hasn't helped increase investment levels there throughout the course of the study period. In studies published in 2018, Orji, Ogbuabor, Okeke and Anthony-Orji examined how changes in currency rates between 1981 and 2016 influenced the Nigerian manufacturing sector. Exports, government capital expansion (GCEX), imports, and foreign direct investment (FDI) all have favourable correlations with the manufacturing sector, according to the study's findings. The estimate method was OLS. The causes of exchange rate volatility in Nigeria were also examined by Mayowa and Olushola (2013) using the ADF and ECM. The study discovered that factors like economic openness, government spending, changes in interest rates, and currency exchange rate lag contributed to exchange rate volatility. Using the same Autoregressive Distributed Lag methodology, Oseni, Adekunle and Alabi (2019) investigated the variation in the exchange rate impacted the industrial performance. The results demonstrated that actual exchange rate instability had an effect on industrial production. Ayobami (2019) evaluated the performance of Nigeria's industrial sector and exchange rate instability between 1981 and 2016 using the ARDL estimation method. According to the study, both long- and short-term gains accrue to the industrial sector from exchange rate volatility.

Adedokum (2012) researched the currency rate volatility in Nigeria's industrial sector between 1970 and 2008 using GARCH models. According to empirical study using the import penetration channel, volatility of the exchange

rates has little impact on employment in the industrial sector. Exchange rate instability is thought to have had a significant beneficial influence on employment in the industrial sector, even if it did so via an export-focused manner. In 2018, currency rate fluctuations' effects were assessed by Adu Boahen and Oteng on foreign direct investment in Ghana. The research' findings revealed that while interest rate fluctuations and foreign direct investment (FDI) tend to move together over time, exchange rate instability and FDI do not have an empirically meaningful relationship. As a method of estimation, the autoregressive (VAR) model was utilized.

Abdul-Mumuni (2016) used the ARDL estimating technique to investigate changes in currency rates and the performance of Ghana's industrial sector between 1986 and 2013. The performance of the study's industrial sector was examined, and the researcher assessed the probable effects of exchange rate fluctuations. Empirical evidence suggested that the industrial sector's level of performance and the exchange rate had an unfavourable connection over both the long and short terms. Ghana's industrial sector performs better when the exchange rate is greater, whereas the industry suffers losses when it is lower.

Exchange rate and other macroeconomic variables

Between 1986 and 2006, Akpokodje and Omojimite (2010) examined the changes in exchange rates affected by exports from countries that are members of the Communauté Finance Africaine (CFA) and non-members. The researchers used the GARCH model to generate a series of exchange rate volatility. A number of estimating techniques, including fixed effect, OLS, first difference Generised

Method of Moment (GMM), and systems GMM, were used to produce regressions after the created series were entered into an export equation. The author's claim that compared to previous estimate methodologies, the system GMM method performed much better. The results demonstrated that exchange rate fluctuations have an effect on the exports of the countries represented in the panels. Exchange rate swings, however, have a much greater influence on the panel of non-CFA member nations than they do on all CFA members. The study's conclusions suggest that in order to stop exchange rates from becoming more volatile, appropriate fiscal and monetary policy measures are needed.

The research of Oluwaseyi Adelowokan (2020), An Asymetric Non-Linear Approach to Macroeconomic Determinants of Nigeria's Manufacturing Sector Performance examined the years 1981 to 2018. NARDL models were employed in the study to observe unequal effects in both the long and short runs. Even though they served diverse objectives at various points in time, the study's findings demonstrate the significance of each macroeconomic component. With the exception of GDP per capita, the manufacturing sector has achieved remarkable success over the long period. However, together with the exchange rate and delays in manufacturing value addition, it has a substantial impact on the industrial sector's performance in the short term. Asymmetrical shocks are also supported by the evidence.

A sampling of 40 nations in sub-Saharan Africa, Olayungbo, Yinusa, and Akinlo (2011) looked at how changes in exchange rates impacted business. Between 1986 and 2005, the inquiry was conducted. In this work, a panel

Generalized Method of Moments (GMM) method and pooled ordinary least squares (POLS) techniques were used in conjunction with a gravity model that contains fixed effects. Both of the methods employed made it clear that exchange rate volatility had a net beneficial impact on all commerce. The study also revealed that ECOWAS member states and non-ECOWAS nations largely achieved the same results in terms of how exchange rate volatility affects both primary and manufactured trade. The study also showed that the outcomes of ECOWAS member states and non-ECOWAS nations are substantially equal in terms of how changes in exchange rates have an effect on both primary and manufactured commerce. The study's conclusions state that because the history of fluctuating exchange rates is still rather recent to those of industrialized countries, significant caution must always be applied when interpreting the data.

The effects of exchange rate fluctuation on Sub-Saharan Africa's tax revenue performance were also studied by Ofori, Obeng, and Yeltulme (2021) using macrodata covering the years 1984 to 2017. They show in their analysis that openness to trade has an impact on revenue from taxes performance both directly and indirectly through exchange rate volatility using a panel autoregressive distributed lag approach.

Enu & Havi (2014) used yearly time series data from 1990 to 2014 to investigate macroeconomic disruptions in Ghana's manufacturing sector. Using the vector autoregressive (VAR) multivariate time series technique, it is possible to determine how the labour force, infrastructure, nominal exchange rate and nominal gross domestic output per person, and fixed capital formation in the

macroeconomic environment impact the production of manufacturing value added as a proportion of GDP. Real GDP per person was found to be incompatible with manufacturing output. The manufacturing industry was negatively impacted by macroeconomic issues such as the consumer price index and the actual exchange rate from the prior year, which are both long and short periods. Private sector credit, employment, and the real exchange rate were long-term macroeconomic determinants. To investigate the relationship between macroeconomic variables and exchange rate volatility.

Danmola (2013) used the Ordinary Least Square (OLS) and Granger Causality Test. According to the study's findings, while changes in exchange rates are beneficial for a country's GDP, foreign direct investment, and trade openness, they are harmful for inflation rates. The author recommended that the government increase the number of commodities intended for export, decrease its dependance on the petroleum sector, and reduce imports of unimportant things in order to expand the nation's income base and improve trade conditions. They went on to suggest that steps be done to increase local productivity because doing so will reduce

Determinants of manufacturing sector performance

This part presents the empirical research on the extra performance elements for the manufacturing industry. For instance, Bekele (2020) estimates the value supplied to the manufacturing sector using autoregressive-distributed lag and investigates how various macroeconomic variables affect this value using yearly time series data from 1982 and 2018. The study's data covers the years

1982 through 2018. The results of the Bound test demonstrate a long-term relationship between the model's macroeconomic elements and the value contributed to the manufacturing sector. The degree of trade opening, the currency's value, and the overall rate of inflation are all major and adverse factors that affect the long-term value that the manufacturing sector provides. As an alternative, the government's overall expenditure primarily has a favourable impact. The Error Correction model also demonstrates that modifications are being made to bring the industrial sector and value-added closer to its long-term equilibrium.

Kayamo (2021) used a non-linear ARDL technique to analyse the impact of the real exchange rate on inflation over the years 1982 to 2019 in order to identify the asymmetric impact of the real exchange rate on inflation in Ethiopia. To search for long-run co-integrations, a non-linear technique called the ARDL bounds test is utilized. The long-run and short-run estimates were finished by the ARDL error-correcting non-linear approach. The study's findings showed that inflation was impacted by the actual exchange rate in an asymmetrical manner both in the long and short term. Longer-term inflation results from real exchange rates that are out of equilibrium (depreciation and appreciation). Additionally, the Error Correction model shows that value added in the manufacturing industry is gradually approaching the long-run equilibrium.

Kayamo (2021) analyzed how the real exchange rate is related to inflation in Ethiopia from 1982 to 2019 using a non-linear ARDL technique to look at the asymmetric influence of the real exchange rate on inflation. The ARDL bounds

test, a non-linear analysis, is used to look at long-run co-integrations. Estimates were generated using the non-linear ARDL error correcting method for both the long and short timeframes. The results of the research revealed that both the short- and long-term effects of the real exchange rate on inflation varied. The mismatch in the real exchange rate (depreciation and appreciation) raises long-term inflation. The VECM, however, demonstrates that there is no connection between the manufacturing sector's productivity and recent inflation. A substantial negative association between industrial productivity and inflation is revealed by the OLS test's findings. The findings show that inflation has reduced manufacturing sector productivity, which means that policymakers must successfully control inflation to raise manufacturing sector productivity.

Research by Uche and Nwamiri (2021) using new evidence from Nigeria based on NARDL examined the dynamic impact of exchange rate changes on output levels. The goal of the study was to find any potential unequal pass-through of the exchange rate to production growth in Nigeria using non-linear autoregressive distributed lag (NARDL). The study's empirical results show an asymetric transfer of output and exchange rate. The depreciation of the currency rate caused a delay in short-term output, but had no effect on long-term output or the appreciation or depreciation of the exchange rate. The findings demonstrate once more that there is a gap and mismatch between Nigerian exchange rates and national productivity, with local currency depreciation failing to increase production. The findings demand a proper dollar-to-naira exchange rate alignment in order to boost economic output.

Musa (2021) looked at the variations in how the currency rate affected the performance of Nigeria's industrial sector between 1981 and 2016. The research made use of the non-linear ARDL developed by Shin et al. (2013). As a result, it is feasible to evaluate the independent effects encompasses both favourable and unfavourable developments in exchange rates on industrial performance. The study's results revealed that because Nigeria is a significant importer and imports the bulk of its industrial inputs, sustained lower exchange rates of the naira to major foreign currencies are required in that nation. Manufacturing has been proven to be positively correlated with increases in currency rates, or appreciation in exchange rates, throughout time. Depreciation of the currency rate, often known as a drop in the exchange rate, has a variety of effects.

Mohammed, David, Abu, and Alabi (2012) look at how Nigeria's industrial sector has been influenced by FDI. The expansion of the manufacturing sector and foreign direct investment (FDI) were linked using vector auto regression (VAR), co-integration, and error correction techniques. The results of the study show that FDI significantly lowers industrial productivity on a statistically meaningful basis. The findings have prompted some recommendations to be made to the government, with a focus on NEPAD and NEEDS through the MDGs. For example, creating an environment that is favourable for FDI and keeping an eye on its benefits will create the capacity for sustained expansion in the industrial industry.

Critique of the Literature

In spite of the empirical findings mentioned above (see, for example, Boateng, 2019; Abdul-Mumuni, 2019; Alagidede & Ibrahim, 2017; Salifu et al., 2007; Nyarko et al., 2011; Mensah et al., 2013; Ofori et al., 2018; Insah & Chiaraah, 2013), little is known about how the exchange rate influences the performance of manufacturing enterprises in Ghana. Ofori et al. However empirical studies (Umaru et al., 2018; Alagidede & Ibrahlim, 2017; Kenneth et al., 2016; Mensah et al., 2013; Elbadawi et al., 2008; Nyarko et al., 2011) show that exchange rate variations have an impact on economic growth, capital inflows, trade balance, employment, and growth.

According to the extensive body of literature on the issue, relatively few empirical studies, if any, have looked at the nonlinear link between exchange rates and the performance of Ghana's manufacturing industrial sector Boateng (2019) focused on the manufacturing sector's financial performance and used return on assets and equity as a statistic, whereas Abdul-Mumuni (2019) used the manufacturing sector's share of GDP as a measure of its performance. The existing research in Ghana and throughout Africa, using the ARDL and OLS estimate techniques, indicates a linear link between the manufacturing sector and currency rates. These computations have the potential to produce unreliable estimates and conclusions when used to investigate the nonlinear interplay between these significant components. By using threshold regression analysis and non-linear ARDL estimation, this work aims to close the gaps. The study aims to

ascertain how much exchange rate instability impacts Ghana's industrial sector's performance.

Chapter Summary

This chapter includes studies on exchange rates and the level of performance of the industrial sector in order to highlight pertinent findings, methodology, and benefits and drawbacks of the exchange rate. Numerous statistical techniques, including VAR, GARCH, ECM, and OLS, were applied in earlier research to analyze the connection between the success of the manufacturing sector and currency rates.

CHAPTER THREE

RESEARCH METHODS

Introduction

The subject of this chapter is various research methods that were utilized to investigate the nonlinear relationship between Ghana's industrial sector's performance and the exchange rate. The study area, estimating method, data source, variable definition and measurement, and a chapter summary are all included in this section.

Research Design

Positivist researchers operationalize concepts to measure them in an effort to get a deeper understanding of reality. They then use these measures to create hypotheses that would help them draw conclusions from their results.

The causal design and quantitative research approach were adopted because causal studies are used to comprehend a phenomenon in terms of conditional statements. By proving a causal connection between variables and excluding alternative explanations for the findings, a causal research strategy will also aid researchers in understanding why the universe functions the way it does. This is due to the study's aim of determining how exchange rate affects the manufacturing sector's performance.

Estimation Technique

The non-linear link between Ghana's industrial production and the country's exchange rate was taken into consideration using the Non-Linear Autoregressive Distributed Lags (NARDL) model, which is the precursor of the Autoregressive Distributed Lags model (Shin, Yu, & Greenwood-Nimmo, 2014). The NARDL model was used because it is capable of simulating both patterns of dynamic adjustment and asymmetries in the long-run relationship. For this experiment, the NARDL was employed because it enables the researcher to recognize the unequal adjustment patterns that cling to both delighted and unpleasant shocks to the exchange rate.

Data Description and Sources

The secondary-sourced data was used, and it spans the years 1985 through 2020. These years were chosen because there was data available for them. The databases of the World Bank, the International Monetary Fund, and the International Labour Organization provided the data on the variables that were utilized. The real effective exchange rate (REER), manufacturing output, gross fixed capital formation (K), the labour force participation rate (LFP), which served as a stand-in for measuring labour, and the Consumer Price Index (CPI), which measures inflation, were all variables used in the study. The value added (output) of the manufacturing sector in Ghana was used to assess its performance. It measures the sector's net production as a percentage of GDP after adding up all outputs and subtracting any necessary intermediate inputs. The deterioration and exhaustion of natural resources, as well as the depreciation of manufactured

assets, are not taken into consideration in the estimation. The International Standard Industrial Classification (ISIC) version 3 is used to determine the source of value addition. The extra value is measured in local currency in this study. The criteria used to choose the variables were based on the literature study.

Empirical Model Specification

To address the non-linear connection between currency rates and manufacturing performance (output) in Ghana's economy, a regression model was developed using the widely used Solow (1956) production function. This production function is a descriptive model made particularly for a closed economy, represented by equation 1. It defines the manufacturing sector's output (Y) as a result of various inputs such as labor, capital, and productivity.

$$Y_t = f\left(L_{t,} K_t A_t\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

However, the Ghanaian economy is far from a closed economy and the study considers adding other variables, such as Real Effective Exchange Rate (REER) and inflation. In order to take into consideration changes in the buying power of Ghana and its trading partners, which might lead to an increase or drop in industrial production in Ghana through exports of finished goods and imports of input materials for exports, the variable REER was included. Additionally, the variable REER was used instead of the nominal exchange rate based on research by Lal and Lowinger from 2002, which showed a short- and long-term association between real effective exchange rates (REER) and trade balances. In a similar manner to Bahmani-Oskooee and Mohammadian (2017), inflation (CPI) was employed as a further control variable to research how the exchange rate affects

the manufacturing sector's output. Since changes in prices have an impact on interest rates in Ghana's economy, inflation is regarded as a very reliable predictor of investment and monetary policy in that country. The production function would then be enhanced and written as follows:

$$Y_t = f\left(L_t, K_t A_t, REER_t, CPI_t\right) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 2$$

Empirical Model

To linearize the variables and ascertain their elasticity and estimate the production function shown in equation 2, the natural logarithm of the production function was employed. The ARDL model was therefore created in order to take into consideration influence of the independent variables on the dependent variable throughout the long and short terms (manufacturing output). Habibi (2019) determined that the regression was:

$$lnY_t = \alpha_0 + \sum_{K=1}^{n1} \alpha_1 \, \Delta Y_{t-k} + \sum_{K=0}^{n2} \alpha_2 \, \Delta K_{t-k} + \sum_{K=0}^{n3} \alpha_3 \, \Delta L_{t-k} + \sum_{K=0}^{n4} \alpha_4 \, \Delta REER_{t-k} + \sum_{K=0}^{n5} \alpha_5 \, \Delta CPI_{t-k} + \beta_1 Y_{t-1} + \beta_2 K_{t-1} + \beta_3 L_{t-1} + \beta_4 REER_{t-1} + \beta_5 CPI_{t-5} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

To investigate the non-linear exchange rate's impact on the manufacturing sector's production output, both positive and negative, the NARDL model was used in place of the ARDL model in equation 3. The NARDL's two newly constructed variables, $REER_x^+$ and $REER_x^-$,were utilized in place of REER to investigate both long- and short-run REER. In light of Habibi's (2019) research, the NARDL equations of number three will now be defined as:

$$\Delta lnY_t = \emptyset_0 + \sum_{K=1}^{n1} \emptyset_1 \ \Delta nY_{t-k} + \sum_{K=0}^{n2} \emptyset_2 \ \Delta nK_{t-k} + \emptyset \sum_{K=0}^{n3} \emptyset_3 \ \Delta L_{t-k}$$

$$+ \sum_{K=0}^{n4} \emptyset_4 \ \Delta REER^{+}_{t-k} + \sum_{K=0}^{n5} \emptyset_5 \ \Delta REER^{-}_{t-k}$$

$$+ \sum_{K=0}^{n6} \emptyset_6 \ \Delta CPI_{t-k} + \varphi_1 n\, Y_{t-1} + \varphi_2 n\, K_{t-1} + \varphi_3\, L_{t-1}$$

$$+ \varphi_4 REER^{+}_{t-1} + \varphi_5 REER^{-}_{t-1} + \varphi_6 CPI_{t-1}$$

$$+ \mu_t \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Y_t is the value added or output from the manufacturing sector in time t, Y_{t-1} is the lagged dependent variable of the dependent variable, K_t represents the Capital, L_t is Labour, $REER_t$ is the real effective exchange rate, $REER^{+}_{t-1}$ is exchange rate appreciation and $REER^{-}_{t-1}$ is exchange rate depreciation, CPI_trepresents inflation.

From equation 3, $\alpha_1\, \alpha_{2,}\alpha_{3,}\alpha_4,\ \alpha_5, \alpha_6,\ are\ the\ short\ run\ estimates$ while $\beta_1,\ \beta_2, \beta_3,\ \beta_4\, \beta_5$ and β_6 are the long run estimates of ARDL. Similarly, in equation 4, $\emptyset_1, \emptyset_2\ , \emptyset_3, \emptyset_4, \emptyset_{5,} \emptyset_6\ , \emptyset_6$ will be the short run estimates of NARDL while φ_1, φ_2, φ_3, φ_4, φ_5, φ_6 and φ_7 are also long run estimates. The short-run coefficients were generated to reflect the effect of exchange rate volatility on the value added of the manufacturing sector, whereas the long-run coefficients were produced to study when the exchange rate will revert to its original condition following a short-run shock.

Justification of variables and the Expected Signs

Real Effective Exchange Rate

In order to compute the real effective exchange rate, the cost of the index or price deflator must be divided. Exchange rates refer to the cost of converting one currency into another (Colander, 1994). Every time the value of one of the two components changes so does the market-based exchange rate. When demand for a currency outpaces supply, the value of that currency usually increases. If the supply is more than the demand, it depreciates. The increase in output may be impacted by the home currency's depreciation through aggregate supply, aggregate demand, or both. A rise in REER will result in a decrease in the cost of imports via aggregate demand channel. The amount of goods and services imported into the country will increase as demand for imports rises.

More products and services will be produced domestically as a result of the rising export demand. This will ultimately lead to increased productivity. It is a prevalent belief that the supply-side effects of REER depreciation will slow down an economy's rate of expansion. The cost of importing intermediate and capital goods will rise as a result of a sharp currency depreciation, which will raise manufacturing expenses. Consumers will be charged more for products as a result of the higher manufacturing costs. The economy as a whole will be impacted by price rises for goods and services. Price hikes and a decline in domestic output are the results. In light of the aforementioned, we anticipate that the actual effectiveness of the industrial sector will be positively impacted by the exchange rate.

The increase in one currency's value in comparison to another is known as currency appreciation. Several factors, including governmental initiatives, interest rates, trade balances, and business cycles, cause currency exchange rates to rise. In a floating rate exchange system, a currency's value varies continually depending on the foreign exchange market's supply and demand. Traders and companies can profit from value shifts by expanding or contracting their holdings. The process through which a currency decreases in value when compared to other currencies is known as currency depreciation. A few factors that contribute to currency depreciation are political unrest, interest rate variations, weak economic fundamentals, and investor aversion to risk. A country's currency may depreciate if it has bad economic fundamentals, such as a persistent current account deficit and excessive inflation. Currency depreciation, if done correctly and gradually, may improve an exporting nation's competitiveness and eventually lower its trade deficit. Foreign investors may elect to withdraw their portfolio assets from the nation if the currency suddenly and significantly depreciates out of concern that it would do so further. These actions will cause the currency to fall sharply. Easy monetary policy and high inflation are two of the key causes of currency depreciation.

Inflation

Inflation is also represented by the yearly percentage change in the price a basket of goods and services will cost the typical consumer, which may be set or altered at specific periods, such as yearly, as determined by the consumer price index. Most often, the Laspeyres formula is used. The implicit GDP deflator, a

measure of inflation, displays the yearly rate of change in prices throughout the economy. The GDP implicit deflator is the variation between the current GDP in local currency and the constant GDP in local currency. Both Judith and Chijindu (2016) and Bans-Akutey, Yaw Deh, and Mohammed (2016) forecast is little relationship between inflation and manufacturing sector performance.

Labour Force Participation Rate

The percentage of the population between the ages of 15 and 64 who are economically active, or provide labour over a specific time period to the development of goods and services, is known as the labour force participation rate. We consequently forecast that the labour force participation rate positively increases industrial production based on the aforementioned empirical findings.

Gross Fixed Capital Formation

The term "gross domestic fixed investment" (GDFI) refers to the creation of roads, railroads, and comparable structures including workplaces, hospitals, private homes, schools, and commercial and industrial facilities. Fences, ditches, drainage, and other land improvements are also included. As a stand-in for investment measurement, this variable. We predict an optimistic correlation between gross fixed capital creation (Investment) and the state of the manufacturing industry, in accordance with another research like David, Abu, Alabi, and Mohammed (2012).

Chapter Summary

This chapter provided details on the research design, data source, estimation techniques, empirical model specification and measurement of variables that were used for this study. The chapter also provides information on how the variables were measured and their expected sign.

CHAPTER FOUR

RESULTS AND DISCUSSION

Introduction

This section presents an empirical examination of Ghana's exchange rate and the performance of the manufacturing sector. By presenting the findings, this study can provide evidence to support the claims and contribute to the existing body of knowledge. Additionally, discussing the findings allows for a deeper understanding of the implications and significance of the results. The chapter begins by reviewing the descriptive information on Ghana's industrial output and the explanatory variables used throughout the study's sample period in order to make this happen. The parameters needed to calculate the time series features of the estimate are then examined. The cointegration test findings are then provided after looking at the time series properties of the study's variables. Estimates for the short run and the long run are given and carefully reviewed when cointegration is confirmed. Then, diagnostic tests are made accessible.

Descriptive Statistics of Variables

The dependent and independent variables' summary statistics, which were used to evaluate the study's goals, are shown in Table 2. The values indicate an acceptable match, while the average represents the central tendency. The kurtosis coefficient assesses the peaking of the probability distribution of the random variables. The coefficients of variation are used to gauge how volatile the data is. How far a data collection deviates from its mean is measured by its standard deviation. With data dispersion, the disparity widens. The results show that all

other included variables, apart from the labor force participation rate, are extremely volatile due to their high standard deviation values. The Jarque-Bera test shows that all other variables, with the exception of the labor force participation rate, are not regularly distributed. the kurtosis and skewness.

The information on kurtosis and skewness lends credence to this hypothesis. The log data were acquired before the ARDL and NARDL models were estimated since the variables (manufacturing output, real effective exchange rate, inflation, and gross fixed capital formation) were not normally distributed.

Table 2: Summary statistics

Variable	Manufacturing Output	REER	Inflation	GFCF	Labour Force
Mean	6.50E+09	113.486	20.6139	4.63E+09	73.043
Median	5.17E+08	101.800	16.8000	1.71E+09	73.351
Maximum	4.02E+10	351.600	59.5000	1.51E+10	75.800
Minimum	3956200	67.1000	4.90000	4.29E+08	69.200
Std. Dev.	1.15E+10	51.6125	12.9073	5.01E+09	2.513
Skewness	1.736544	3.05109	1.17168	1.118391	-0.290
Kurtosis	4.641588	14.0504	3.76891	2.609596	1.548
Jarque-Bera	22.13572	239.023	9.12389	7.733417	3.664
P-value	0.000016	0.00000	0.01044	0.020927	0.160
Observations	36	36	36	36	36

Source: Author's construct (2023).

Manufacturing value added (output) is 6.50E + 09 Ghana cedis on average, with a maximum value of 4.02E + 10 Ghana cedis and a minimum of 3956200 Ghana cedis. The actual exchange rate for the sample period has an average value of 11.4861, with a maximum value of 351.6 and a lowest value of 67.1. This rate is determined by dividing a cost index or price deflator by the value of a currency in relation to the weighted average of many different foreign currencies. Additionally, inflation has a value of 20.6139 percent on average and 59.5 percent and 4.9 percent for its maximum and minimum values, respectively. Inflation measures the rate of price growth over a certain time. This suggests that during the research period, the annual rate of rise in prices for goods and services is around 21%. Again, the findings show that Ghana's inflation over the sample period is positively skewed and not normally distributed.

Gross fixed capital formation (Investment) recorded an average value of 4.63E+09 with a standard deviation of 5.01E+09, indicating outliers in gross fixed capital formation data. In addition, the minimum, maximum, and standard deviation values indicate that the individual observations are widely dispersed from the average value of gross capital formation. Contrary to the summary statistics of the investment, the average labour force participation rate in Ghana over the sample period is 73.0417 with a corresponding standard deviation of 2.5134. The findings imply that the Ghanaian population is youthful, and this confirms the report by the Ghana Statistical Service on the 2021 population census. Additionally, it shows that, on average, the majority of the Ghanaian

population is economically active. The population appears to be centred around the mean value, as evidenced by the lower standard deviation (2,5134).

The study used a correlation matrix to compare all the variables and performed the multicollinearity test among the regressors to prevent erroneous regressions (results are shown in Table 3). The correlation matrix demonstrates that the correlation coefficient between the Real Effective Exchange Rate (REER) and manufacturing output (MO) is statistically significant. This provides a solid foundation for further investigation using multivariate techniques.

Table 3: Pairwise correlation matrix

Variable	MO	REER	INF	LF	GFGF
MO	1.000				
REER	-0.415**	1.000			
INF	-0.395**	0.069*	1.000		
LF	−0.388***	0.391**	0.548***	1.000	
GFGF	0.685***	-0.499***	-0.444***	-0.679***	1.000

Source: Author's construct (2023).

The study paid careful attention to the base unit characteristics of the variables in addition to conducting a multicollinearity test. Although some researchers have suggested that a unit root or stationarity test may not be necessary when using an ARDL estimation approach (as referenced in Duasa, 2007, quoted in Abu, Kadandani, Obi, and Modibbo, 2019, and Akinlo, 2006), it was important in this case to avoid including I(2) series. This is because such series can lead to spurious regression results (according to Abu, 2017, 2019, Sakanko & David, 2018,

Sakanko, Obilikwu & David, 2019, Sakanko, Abu & David, 2019, and David, 2018). Therefore, the researchers employed the Augmented Dickey-Fuller (ADF) technique to assess the stationarity properties of the series. The results of this analysis are presented in Table 4.

Table 4: Augmented Dicker Fuller Unit Root Test

Variable	LEVELS			FIRST DIFFERENCE		
	Coefficient	Std Error	P-value	Coefficient	Std Error	P-value
Manu Output	0.0037	0.0228	0.9643	-12.7353	3.2554	0.0065
REER	-0.2516	0.0527	0.0005	-0.7409	0.1417	0.0001
Inflation	-0.1278	0.3165	0.8958	-5.1592	0.8764	0.0000
GFCF	-0.0341	0.0385	0.7810	-1.5758	0.3787	0.0001
Labour Force	0.0406	0.0404	0.9957	-1.6741	0.1021	0.0000

Source: Author's construct (2023).

It is clear from Table 4's findings that the variables are composed of up of both I (0) and I (1) series. The ARDL (Autoregressive Distributed Lag) and NARDL (Nonlinear Autoregressive Distributed Lag) estimate approaches, which are based on the ARDL assumptions, were shown to be effective. The Akaike Information Criterion (AIC) was used to determine the proper lag lengths to estimate the linear and nonlinear ARDL models, yielding lag lengths of (4, 4, 4, 2, 4) for the linear model and (3, 3, 3, 3, 3) for the nonlinear model. After determining that there exists a long-term relationship between the variables, these lag times were selected. Since the dependent and explanatory variables had been found to be

cointegrated, the use of estimating methodologies was justified. The cointegration between these variables indicates a long-term connection among them. The study then proceeds to compare the real exchange rate over a long period of time and the success of Ghana's manufacturing industry of time using both linear and nonlinear ARDL relationships. The collective outcomes of this comparison are presented in Table 5.

Long Run Results of Linear and Non-Linear ARDL

From the long run results presented in Table 5, the non-linear ARDL (NARDL) model revealed that appreciation of the exchange rate, depreciation of the exchange rate and Gross Fixed Capital Formation (investment) are the significant determinants of the performance of the manufacturing sector in Ghana whilst the linear model (ARDL) revealed that exchange rate and labour force participation significantly influence manufacturing output in the long run. The estimated coefficient of appreciation in the Ghanaian currency indicates that a one percent positive change (or increase) in the appreciation of the currency would yield a 0.6924 percent increase in the output of the manufacturing sector in the long run, holding other factors constant. This implies that appreciation of the currency makes it competitive for domestic firms in the international market and further makes the importation of machines, raw materials, etc. relatively cheaper for them. In addition, appreciation in the local currency makes inputs that are being imported for production by the manufacturing sector become cheaper and they can purchase more of these inputs to increase production.

Similarly, the estimated coefficient of depreciation in the Ghanaian currency indicates that a one percent increase in depreciation brings about 0.32 percent decrease in the output of the manufacturing sector in the long run, holding other factors constant. This suggests that an increased depreciation does not increase domestic enterprises' ability to compete on the global market and instead causes them to import machinery, raw materials, etc. at a substantially higher rate.

Price increases for imported items, particularly raw materials and machinery needed in manufacturing, may result from the local currency's depreciation.

The result is consistent with that of the OECD (2012) and Abdul-Mumuni (2016), which indicated that appreciation of the real local currency led to an increase in manufacturing sector performance. Also in Nigeria, Olufisayo and Adebayo (2015) and Omotola (2016) discovered a positive but insignificant effect of exchange rate fluctuations on manufacturing output whereas, in Romania, Orhunbilge and Tas (2014) discovered a complex relationship between real exchange and the manufacturing sector over the long term. Similarly, in the same model, it was also revealed that, with a percentage point increase, investment would increase manufacturing output by 0.88 percent in the long run, holding other things constant.

Table 5: Long-Run Results of Linear and Nonlinear ARDL models

Explanatory Variables	NARDL	ARDL
In (Real Effective Exchange rate)		-0.2047***
		(0.8674)

Ln (Appreciation)	0.6924***	
	(0.1505)	
Ln (Depreciation)	-0.3176***	-0.0371
	(0.1244)	(0.0238)
Inflation Rate	-0.0026	-0.0371
	(0.0019)	(0.0238)
Ln (Gross Fixed Capital Formation)	0.8779***	0.5996
	(0.0503)	(0.5053)
Labour Force	0.0002	0.8130***
	(0.0215)	(0.1761)

NB: Significant level: ***=1%, **=5%, *=10 % standard errors in parenthesis ()

Source: Author's construct (2023).

Alternatively, the linear ARDL model also reveals that a one percent increase in the real exchange rate would reduce manufacturing output by 0.2017 percent in the long run, all other things being equal in Ghana. In contrast, as the average labour force participation rate increases by one percent, manufacturing output would increase by 0.08 13 percent in the long run, all other things being equal in the ARDL model but not significant in the NARDL model.

Short-Run Results of Linear and Non-Linear ARDL

The section presents and discusses the findings of the short-run analysis. As shown in Table 6, there are several variables that influence manufacturing performance in Ghana. These variables include the labour force participation rate, the real effective exchange rate, the inflation rate, and the output of gross fixed

capital. The lagged Error Correction (ECM-1) has a value smaller than 1 in both models and statistically significant. This suggests that approximately 70% and 43% of the deviations from equilibrium will be fixed within a year for the NARDL and ARDL models, respectively. For lags 1 and 2, respectively, in the nonlinear ARDL model, a percentage point increase in manufacturing production from prior years would boost manufacturing output, everything else being equal, by 2.0 and 0.67 percent, respectively. This is in accordance with the nonlinear ARDL model's coefficient of manufacturing production from prior years.

Furthermore, a one percent increase in currency appreciation would, on average, result in 0.5873 percent higher manufacturing production in the current year and 0.8394 percent more in the prior year. These estimates align with the long-term estimates.

In addition, industrial production in Ghana has seen an increase of 0.109 percent this year and 0.597 percent since last year. Similarly, with all other variables kept constant, manufacturing production grows by 0.109 percent in the present year, 0.597 percent in the previous year, and 0.3662 percent in the previous two years for every one percent drop in depreciation in the short term.

Table 6: Estimation of short run ARDL AND NARDL results

	ARDL	**NARDL**
	Coefficient	Coefficient
Error Correction Model	-0.4257***	-0.6966***
	(0.0610)	(0.0563)
D [Ln (Manufacturing output)] (-1)	-1.1304 ***	2.0428***

	(0.2177)	(0.337)
D [LnManufacturing output)] (-2)	-0.7455	0.6745 ***
	(0.1876)	(0.200)
D [LnManufacturing output] (-3)	-0.8428	
	(0.2031)	
D [Ln (Real exchange rate)]	0.4692***	
	(0.1265)	
D [Ln (Real exchange rate] (-1)	-0.5793 ***	
	(0.1667)	
D [LnReal exchange rate] (-2)	-0.6085 ***	
	(0.2394)	
D [LnReal exchange rate] (-3)	-0.0611	
	(0.2895)	
D [Ln (Appreciation)]		0.5873 **
		(0.2332)
D [Ln (Appreciation)] (-1)		0.8394 ***
		(0.2237)
D [Ln (Appreciation)] (-2)		-0.2490
		(0.1681)
D [Ln (Appreciation)] (-3)		-0.5465
		(0.4641)

D [Ln (Depreciation)]		-0.109 ***
		(0.0420)
D [Ln (Depreciation)] (-1)		-0.5971 *
		(0.3000)
D [Ln (Depreciation)](-2)		0.3662 **
		(0.1650)
D [Ln (Depreciation)] (-3)		0.0977
		(0.3282)
D (Inflation Rate)	0.0973	-0.0460***
		(0.0020)
D (Inflation Rate] (-1)	-0.21881 ***	-0.0326 ***
		(0.0020)
D [Ln (Gross Fixed Capital Formation)]	0.4024 ***	0.6208 ***
		(0.2581)
D [Ln (Gross Fixed Capital Formation)] (-1)	0.3462 ***	0.3058**
		(0.1403)
D [Ln (Gross Fixed Capital Formation)] (-2)	0.4220***	0.0057 *
		(0. 0031)
D [Ln (Gross Fixed Capital Formation)] (-3)	0.3937 *	
D [Labour Force]	0.2686***	0.3260 **

		(0.0556)	
D [Labour Force] (-1)		0.1400***	
		(0.0260)	
Constant	-10.1345	147.6787*	
	(7.3881)	(80.2298)	
Observation	32	Durbin-Watson Statistic	1.9852
R-square	0.9742	Akaike Info Criterion	-1.1217
Adjusted R-square	0.9355	Schwarz Criterion	-0.4346
F-statistic (1198.680)	P-value 0.0000	Hannan-Quinn Criterion	-0.8939

NB: significant level: ***=1%, **=5%, *=10 % standard errors in parenthesis ()

Source: Author's construct (2023).

However, as presented in the ARDL model, the short run, a percentage point increase in the actual effective exchange rate will increase output levels in the manufacturing sector by 0.4692 percent in the current year but decrease them by 0.5793 percent in the year prior, 0.6085 percent in the years prior, and 0.0611 percent in the years prior.

A percentage point increase in inflation during the last year and the current year would also reduce the production of the manufacturing sector by 0.0326 percentage points and 0.046%, respectively. This indicates that the performance of the manufacturing sector is adversely affected by an increase in the cost of

products and services in general. The aforementioned findings support earlier studies conducted by Chaudhry et al. (2013), Siyakiya (2014), and Osinowo (2015). These findings, however, are at odds with those from Loto (2012) and Adaora (2013).

Furthermore, the relationship between investment and manufacturing sector production is substantial and statistically significant. Investment from the current, preceding, and previous two years would, in the short term, increase the production of the manufacturing sector by 0.628 percent, 0.3058 percent, and 0.057 percent, respectively, assuming nothing else changed.

Both the NARDL and the linear ARDL short-run models show that making investments in Ghana is profitable and statistically significant. The output of the manufacturing sector would grow by 0.4024 percent, 0.3462 percent, 0.4220 percent, and 0.3937 percent, respectively, for a one percent increase in investment in the current, past two, and previous three years, according to the ARDL model results shown in Table 6. This implies that as the sector receives more investment, the sector will, on average, grow rapidly and its manufacturing output will also increase, all other things held constant.

From to the NARDL model, a 1% increase in the country's current and prior year's labour force participation rates will, in the short run, increase manufacturing output by 0.3260% and 0.1400%, respectively. A rise in the economy's labor force participation rate, however, will result in an increase in manufacturing production of 0.2686 percent, according to ARDL's short-term projections, which keep all other variables constant. The means result that as

more people participate in the labour force, the sector will be able to expand employment and increase production since labour force participation rate depicts the proportion of labour resources that are available for the production of products and services.

Post-Estimation Test

The dynamic parameters of the model have undergone a number of diagnostic tests to make sure the estimates were reliable. These tests included the Breusch-Godfrey autocorrelation diagnostics, the Jarque-Bera normalcy test, the Durbin-Watson test, and the Breusch-Pagan-Godfrey tests for heteroscedasticity. (Similar to Verheyen, 2013), in addition to the analysis of the Durbin-Watson, Cumulative Sum of Recursive Residuals (CUSUM), and Cumulative Sum of Squares of Recursive Residuals (CUSUMQ) plots. The purpose of these diagnostic tests was to evaluate the stability and dependability of the model estimations. These diagnostic tests examine model specification, model normalcy, and constant variance (Homoscedasticity), autocorrelation and parameter and variance stability respectively. The insignificant p-value (0.4477) of the Ramsey Reset test indicates that the model is correctly specified. The model's residuals are uncorrelated and it is free of the serial correlation issue if the probability chi-square for the LM test is statistically insignificant. In addition, the p-value of 0.6427 for Jarque-Bera implies that the errors have a normal distribution. In addition, the statistically insignificant p-value (0.8636) of the Heteroscedasticity test indicates that the model is devoid of the heteroscedasticity issue.

Table 7: NARDL and ARDL model post-diagnostic tests

Test statistics	*Non-Linear ARDL*		*Linear ARDL*	
	F-statistic	P-value	F-Statistic	P-Value
Functional Form: Ramsey Reset	0.6783	0.4477	0.4714	0.5066
Normality: Jaque-Bera	0.8841	0.6427	2.0892	0.3518
Breusch-Pagan Heteroscedasticity	0.5479	0.8636	0.8014	0.6773
Breusch-Godfrey Serial Correlation LM Test	4.6059	0.0917	2.9368	0.0992

Source: Author's construct (2023).

Additionally, the linear and nonlinear ARDL models' Wald F-statistics, which are 5.7406 and 7.3633, respectively, exceed the 90%, 95%, and 98% upper critical limits based on the results of the ARDL bound testing provided in Table 7. This demonstrates that both models have a long-term link (co-integration).

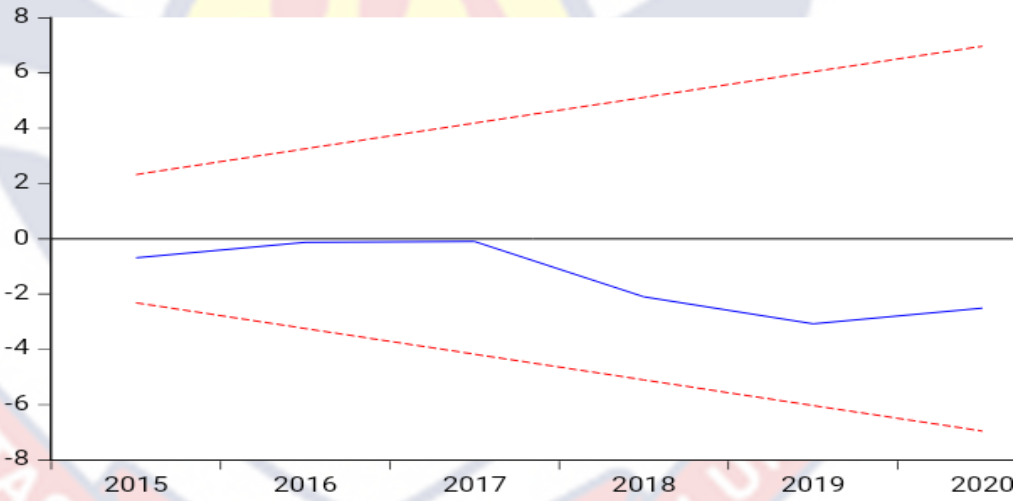
Table 8: Results of Bound Test

Model	K	F-statistics			Decision
ARDL	4	5.7406			Cointegration
NARDL	5	7.3633			Cointegration
			Critical Values		

	1%		5%		10%	
	I (0)	***I (1)***	***I (0)***	***I (1)***	***I (0)***	***I (1)***
ARDL	3.29	4.37	2.56	3.49	2.2	3.09
NARDL	3.06	4.15	2.39	3.38	2.08	33.38

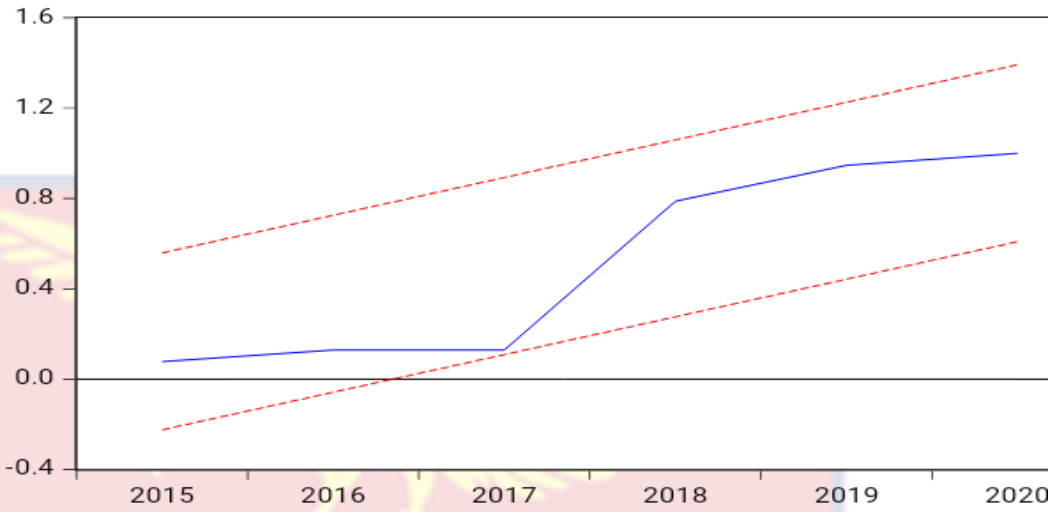
Source: Author's construct (2023).

Additionally, as the blue line lies within the confidence interval, the findings of the CUSUM and CUSUMQ plots shown in Figures 3a and 3b support the stability of the models and estimated parameters.



Source: Author's construct (2023).

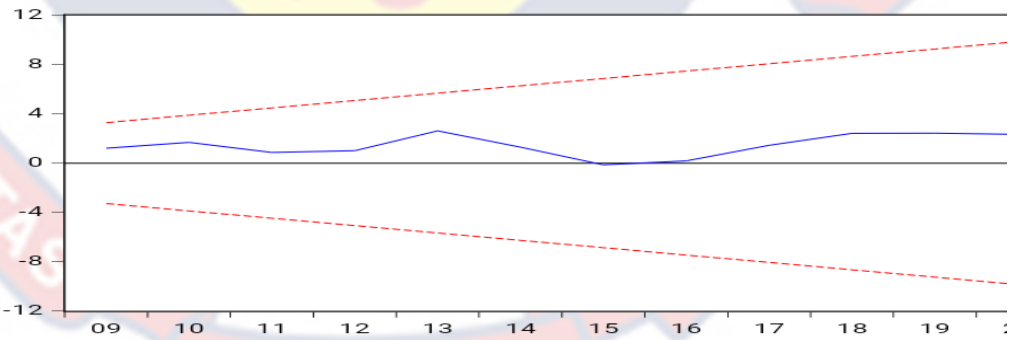
Figure 5: **Cumulative Sum of Recursive Residuals (CUSUM) of NARDL**



Source: Author's construct (2023).

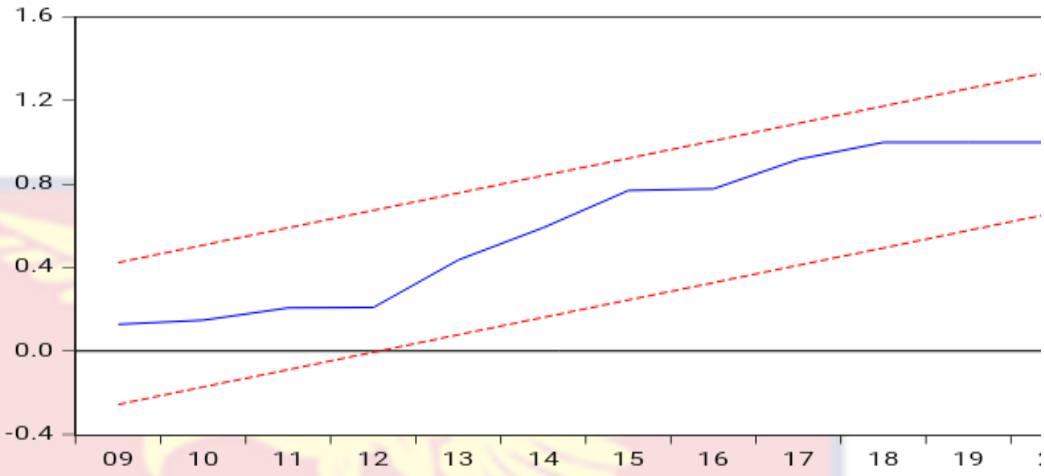
Figure 6: **Cumulative Sum of Squares of Recursive Residuals (CUSUMQ) of NARDL.**

The long-run and short-run findings of the linear ARDL model reported in Tables 6 and 7 respectively are stable and reliable for future inferences, according to the ARDL model stability test results, which are similar to the NARDL results on the model stability.



Source: Author's construct (2023).

Figure 7: **ARDL Cumulative Sum of Recursive Residuals (CUSUM)**



Source: Author's construct (2023).

Figure 8: **ARDL Cumulative Sum of Squares of Recursive Residuals (CUSUMQ)**

Testing the presence of long run asymmetries

Examining the asymmetric link between Ghana's exchange rate and industrial performance was the second objective. The Wald test was used to assess whether any asymmetric associations existed. The Wald test's findings, which are displayed in Table 8, indicate that there are asymmetries between industrial output and the real effective exchange rate. As a result, there is a statistical difference between the effects of real effective exchange rate appreciation and depreciation on Ghana's industrial output.

Table 9: Testing the presence of long-run asymmetries

Variable	F-statistic	P-value	Decision
Real Effective exchange rate	5.673652	0.0444	Long-run asymmetric relationships exist

Author's construct (2023).

Chapter Summary

This chapter addressed the study's empirical findings. The criteria considered in this inquiry are briefly described and evaluated in this section. Tests following the estimate were run one more. The ARDL models, both linear and nonlinear, are related over the long term. According to the NARDL model, there would be an asymmetry relationship between changes in Ghana's real effective exchange rate and changes in the performance of the manufacturing sector. The non-linear ARDL (NARDL) model demonstrates that exchange rate appreciation and depreciation as well as Gross Fixed Capital Formation (investment) are significant long-term determinants of the success of Ghana's manufacturing sector. These findings are displayed in Table 6. The most significant short-term determinants of manufacturing performance in Ghana are past-year manufacturing production values, real effective exchange rate, inflation rate, gross fixed capital formation, and labour force participation rate. These variables are also consistent with short-run estimates from the linear and nonlinear ARDL model.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Introduction

This chapter provides an overview of the study findings on Ghana's manufacturing sector's performance and the exchange rate. Additionally, it provides significant study conclusions and beneficial recommendations derived from the data analysis. These suggestions were developed to complement the policy direction being followed helps in improving Ghana's manufacturing sector's performance.

Summary

Understanding of the link between exchange rate and manufacturing sector has motivated the study of "Exchange Rate and The Performance of The Manufacturing Sector in Ghana: Evidence from Nonlinear ARDL Analysis". To accomplish the goals of the study, secondary data from several sources, including the WDI and IMF, spanning the years 1985 to 2020, were employed. The study's primary objective was to determine the impacts of appreciation and depreciation on the manufacturing sector's efficacy. The final goal is to investigate whether there exists an asymmetric relation between the exchange rate and manufacturing performance in Ghana.

Contrary to earlier research, this one employed both the linear and nonlinear models to examine the relationship between industrial production and exchange rates employed in both linear ARDL and NARDL to examine the first and second objectives. Both models have a statistically significant and correctly

significant lagged error correction component (ECM-1). The outcomes of both calculations point to a long-term correlation between the variables. The study's findings also show that, generally speaking, currency rate appreciation and depreciation, as well as gross fixed capital creation (investment), are important long-term predictors of the performance of Ghana's manufacturing sector.

Further, the linear and nonlinear ARDL model's short-run estimates show that the key factors affecting Ghana's manufacturing performance in the short term are past-year manufacturing output values, the labour force participation rate, the inflation rate, the gross fixed capital creation and the real effective exchange rate. Finally, this study examined if an asymmetric relationship is indeed present. The outcome suggests and supports the existence of asymmetries between Ghana's industrial output and the exchange rate.

Conclusion

The study concludes that, based on the evidence presented in the preceding sections, although the impact is dependent on the movement of the real effective exchange rate, the manufacturing sector's performance is impacted by the real effective exchange rate. This research also comes to the conclusion that there is an asymmetric link between Ghana's manufacturing sector performance and the actual effective exchange rate. The impact of currency appreciation is more significant than that of currency depreciation. Therefore, it is not advised to use the linear estimation approach to investigate the link between the exchange rate and the performance of Ghana's manufacturing sector.

Recommendations

The findings of the research proved that the manufacturing sector's performance is impacted by both currency rate appreciation and depreciation. It is advised that the government focus on enhancing the business environment by pursuing policies to stabilize the real exchange rate and pro-business reform for the manufacturing sector through the Monetary Authorities, the Ministry of Finance, the Ministry of Trade and Industry, and private partnerships. Particularly, these economic agents (the Ministries of Finance, Trade and Industry, Monetary Authorities, and Private Partnerships) ought to; Enhance manufacturing companies to continue using locally made capital goods despite the declining currency.

1. It is recommended that the central bank and the government, should create a conducive business environment by given the local manufacturing industries credit facilities to expand their production capacities.
2. The government, through the Ministry of Trade and Industries, can encourage import substitution industries by providing subsidies. These subsidies aim to make these industries more competitive and enable them to produce goods at lower prices compared to imported goods.
3. It is recommended that the central bank and the government, through the Ministry of Finance should ensure stabilization of the currency by abolishing the of use of foreign currency to trade in Ghana.

4. The report also suggests that interest rates be lowered by the monetary authorities to encourage business investment. This will improve the efficiency of manufacturing companies.

Suggestions for future research

The nonlinear ARDL technique should be used in a future research study to include more economic sectors. This study has established asymmetric relation between exchange rate and the manufacturing sector. However, future should use the nonlinear ARDL technique investigate whether there is asymmetric relation between exchange rate and other sectors of the economy.

REFERENCES

Abdul-Mumuni, A. (2016). Exchange Rate Variability and Manufacturing Sector Performance in Ghana: Evidence from Cointegration Analysis. *Issues in Economics and Business.* 2(1). 512-572

Adebanjo, J. F., Oluwasegun, E., Adegbola, O., Asamu, F., Peter, O., Ben-Caleb, E. & Eluyela, F. D. (2019). Impact of exchange rate on the manufacturing sector in Nigeria. *International Journal of Mechanical Engineering and Technology*, *10*(2), 1568-1583.

Adedokum, A.J. (2012). Employment effect of exchange rate volatility in Nigeria's manufacturing sector. *Journal of Economic Theory 6(1), 14-25.*

Adelowokan .O (2020). Macroeconomic Determinants of Manufacturing Sector Performance in Nigeria: An Asymmetric Non-Linear Approach. *International Journal of Social Sciences (IJSS).*10(3), 1-15.

Adu Boahen . E & Oteng E. The effect of exchange rate volatility on foreign direct investment in Ghana. *International Journal of Economic Behavior and Organization.* 2(2), 20-28.

Agénor, P. R., Haque, N. U., & Montiel, P. J. (1993). Macroeconomic effects of anticipated devaluations with informal financial markets. *Journal of Development Economics*, *42*(1), 133-153.

Akinlo, T. (2018). The impact of exchange rate volatility on manufacturing sector in sub-Saharan Africa (1980-2015). *Jurnal Perspektif Pembiayaan dan Pembangunan Daerah*, 6(1), 113-119

Alagidede, P., & Ibrahim, M. (2017). On the causes and effects of exchange rate volatility on economic growth: Evidence from Ghana. *Journal of African Business*, *18*(2), 169-193.

Aloulou, R., Kalai, M., & Helali, K. (2023). The symmetric and asymmetric impacts of external debt on economic growth in Tunisia: evidence from linear and nonlinear ARDL models. *SN Business & Economics*, *3*(7), 112.

Amoah, L. and Aziakpono, M.J. (2018), Exchange rate pass-through to consumer prices in Ghana: is there asymmetry?. *International Journal of Emerging Markets*, 13(1), 162-184.

Ayiah-Mensah, F., Arthur-Nunoo, P., Acquah, J., & Addor, J. A. (2023). Trend Analysis of Exchange Rate of the Ghana Cedi against the US Dollar Using Time Series. *Open Journal of Statistics*, *13*(5), 734-745.

Ayobami, O.T. (2019). Exchange rate volatility and the performance of manufacturing sector in Nigeria (1981-2016). *African Journal of Economic Review*, (2), 316-334.

Aysan, A. F., & Y. S. Hacıhasanoğlu. (2007). Investigation into the Determinants of Turkish Export-Boom in 2000s. Retrieved from https://econpapers.repec.org/paper/pram \sprapa/5493.htm

Bekele, D. T. (2020). The impact of macroeconomic factors on manufacturing sector value added in Ethiopia: An application of bounds testing approach to cointegration. *Journal of Economics, Business, and Accountancy Ventura*, *23*, 96-107.

Boateng, J. O. (2019). *The Impact of Exchange Rate Fluctuations on Firms Financial Performance: A Case Study of Some Selected Manufacturing Firms in Ghana* (Doctoral dissertation, University of Ghana).

Buabeng, E., Ayesu, E. K., & Adabor, O. (2019). The effect of exchange rate fluctuation on the performance of manufacturing firms: Empirical evidence from Ghana. *Economics Literature*, *1*(2), 133-147.

Courage M. (2020) Exchange rate and manufacturing sector performance in SACU states, *Cogent Business & Management*, 7(1), 178-187.

Dada, J. T., & Abanikanda, E. O. (2019). How important is oil revenue in Nigerian growth process? Evidence from a threshold regression. *International Journal of Sustainable Economy*, *11*(4), 364-377

Danlami I. A, Hassan S & Hidthiir M. H. B (2020). Assessing the asymmetry of the exchange rate pass-through to inflation in west African commonwealth countries. *Academic Journal of Economic Studies. 6(1), 93-109.*

David, O., Abu, A. A., Alabi, J. O., & Mohammed, A. (2012). The effect of foreign direct investment on the Nigerian manufacturing sector. *International Business and Management*, *4*(2), 140-148.

Dekle, R. (1998). The Yen and Japanese manufacturing employment. *Journal of International Money and Finance*, 17(5), 785–801.

Dhasmana, A. (2013). Transmission of real exchange rate changes to the manufacturing sector performance. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2359320.

Dogruel, A. S., Dogruel, F., & Izmen, U. (2010). Changes in exchange rates and the performance of the manufacturing sectors in Turkey. *Topics in Middle Eastern and North African Economies*, *12*2-136

Dornbusch, R. (1987). Collapsing exchange rate regimes. *Journal of Development Economics*, *27*(1-2), 71-83.

Ehinomen C., & Oladipo T.I. (2012): "Exchange rate management and manufacturing sector performance in the Nigerian economy". *Journal of Humanities and Social Sciences.* 5(5), 01-12.

Enu, P & Havi, E.D K. (2014). The Manufacturing Sector of Ghana: Are There Any Macroeconomic Disturbances. *Asia Pacific Journal of Multidisciplinary Research. 4(3),* 111-122.

Foreign Exchange Risk and its management. (201). Exchange Rates and International Financial Economics. *Journal of Empirical Studie*7(3), 216-228.

G, A. M., & E., I. O. (2013). The determinants of Real Exchange Rate Volatility in Nigeria. *Academic Journal of Interdisciplinary Studies*. 6(2), 612-620.

Gonenc, R., & Yilmaz, G. (2008). How did the Turkish industry respond to increased competitive pressures, 8(4), 199-200

Habibi, A. (2019). Non-linear impact of exchange rate changes on U.S. industrial production. *Journal of Economic Structures*, *8*(1), 172-188.

Hassan, H. H. (2020). Contributing factors to performance of Islamic Mutual Funds. *International Journal of Psychosocial Rehabilitation*, *24*(02), 795–803.

Huchet-Bourdon, M., & Korine, J. (2011). To What Extent Do Exchange Rates and their Volatility Affect Trade? *OECD Trade Policy Working Paper Series No. 119*.

Judith, M. N., & Chijindu, E. H. (2016). Dynamics of inflation and manufacturing sector performance in Nigeria: Analysis of effect and causality. *International Journal of Economics and Financial Issues*, *6*(4), 1400-1406.

Kayamo S. E (2021). Asymmetric impact of real exchange rate on inflation in Ethiopia: a non-linear ARDL approach. *Journal for Cogent Economics & Finance. 9(10), 1-16.*

Kilian, L., & Zhou, X. (2022). Oil prices, exchange rates and interest rates. *Journal of International Money and Finance, 12(6),* 102-167.

Luckstead J. (2018), Asymmetric exchange rate pass-through in U.S. imports of cocoa. *Journal of Agricultural and Applied Economics.* 50(3), 369-386.

Mensah, M., Awunyo-Vitor, D., & Asare-Menako, H. (2013). Exchange rate volatility and employment growth in Ghana's manufacturing sector. *International Journal of Business and Social Sciences*, 4(4) 199-211.

Menzel, V., Smagin, J., & David, F. (2010). Can Companies Profit from Greener Manufacturing? *Measuring Business Excellence*, *14*(2), 22–31.

Mesagan, E. P., Alimi, O. Y., & Vo, X. V. (2022). The asymmetric effects of exchange rate on trade balance and output growth. *The Journal of Economic Asymmetries*, *2(6)*, 222-272.

Moyo, C., & Jeke, L. (2019). Manufacturing sector and economic growth: A panel study of selected African countries. *J. Bus. Econ. Review*, *4*(3), 114-130.

Musa S. O. G. (2018). The asymmetric effects of exchange rate on manufacturing sector performance in Nigeria. *International Journal of Research in Arts and Social Sciences*. 11(2), 129-140.

Muteba Mwamba, J., & Dube, S. (2014). The impact of exchange rate volatility on international trade between South Africa, China and USA: The case of the manufacturing sector. *The Journal of Risk Finance*. 8(2), 77-91

Nurudeen, A. (2010). Economic and political determinants of public sector budget deficits: The case of Nigeria. *Studies in Business and Economics*, 15(2), 55–68.

Nyarko, P. A., Nketiah-Amponsah, E., & Barnor, C. (2011). Effects of exchange rate regimes on FDI inflows in Ghana. *International Journal of Economics and Finance*, *3*(3), 277-286.

Ofori, I. K., Obeng, K. C., & Yeltulme Mwinlaaru, P. (2021). Effect of exchange rate volatility on tax revenue performance in Sub-Saharan Africa. Retrieved from SSRN 3844224.

Ofori, K. I., Obeng, C. K., & Armah, M. K. (2018). Exchange rate volatility and tax revenue: Evidence from Ghana. *Cogent Economics & Finance*, *6*(1), 1537822.

Ogunjimi, J. (2020). Exchange rate dynamics and sectoral output in Nigeria: A symmetric and asymmetric approach. *American Journal of Social Sciences and Humanities*, *5*(1), 178-193.

Onuora J.K.J, Obiamaka A. M, Dominic A. O (2019). Effect of exchange rate fluctuations on Nigerian manufacturing sector. *Interdisciplinary Journal of African and Asian Studies*, 8(3), 207-221**.**

Onwuka, C. E. (2022). Exchange rate volatility and the performance of manufacturing sector in Nigeria: An econometric analysis of exchange rate. *International Journal of Economics and Finance. 3(2), 133-140.*

Opaluwa D, Umeh J.C, Ameh A. A (2018). The Effect of Exchange Rate Fluctuations on the Nigerian Manufacturing Sector. *African Journal of Business Management*. 4(14), 2994-2998.

Oriji, A., Ogbuabor, J. E., Okeke, C., & Oriji, O. A. (2019). Another side of the coin: exchange rate movements and the manufacturing sector in Nigeria. Retrieved from https://jour nals.sagepub.com/doi/abs/10.1177/ 0974930618811499.

Oseni, I. O., Adekunle, I. A., & Alabi, M. O. (2019). Exchange rate volatility and industrial output growth in Nigeria. *Journal of Economics and Management*, *38*, 129–156.

Prause, G. (2015). Sustainable business models and structures for industry 4.0. *Journal of Security and Sustainability Issues, 5*(2), 159–169.

Qian, Y., & Varangis, P. (1994). Does exchange rate volatility hinder export growth? *Empirical Economics*, *19*(3), 371-396.

Rathnayaka, I. W., & Dunusinghe, D. D. (2022). The impact of exchange rate volatility on industrial exports: A case of sri lanka. *Sri Lankan Journal of Banking and Finance*, *5*(2), 77-81.

Revenga, A. L. (1992). Exporting jobs?: The impact of import competition on employment and wages in U. S. manufacturing. *The Quarterly Journal of Economics*, *107*(1), 255–284.

Riaz, M. F., & Cantner, U. (2019). Revisiting the relationship between corruption and innovation in developing and emerging economies. *Crime, Law and Social Change*, *73*(4), 395–416.

Rincón-Castro, H., & Rodríguez-Niño, N. (2016). Nonlinear pass-through of exchange rate shocks on inflation: A Bayesian smooth transition var approach. *Journal of International Money and Finance, 3(2*), 221-230.

Rowbotham, N. K., Saville, A., & Mbululu, D. (2014). Exchange rate policy and export performance in efficiency-driven economies. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.2443280.

Salifu, Z., Osei, K. A., & Adjasi, C. K. D. (2007). Foreign exchange risk exposure of listed companies in Ghana. *The Journal of Risk Finance*, *8*(4), 380–393.

Uche E & Nwamiri S.I (2021). Dynamic effects of exchange rate movements on productivity levels: new evidence from Nigeria based on NARDL. *Journal of Development Policy and Practice.* 7(1) 96–111.

Vo, D. H., Vo, A. T., & Zhang, Z. (2019). Exchange rate volatility and disaggregated manufacturing exports: Evidence from an emerging country. *Journal of Risk and Financial Management*, *12*(1), 12-29.

Wonyra, K. O. (2018). Industrialization and economic growth in sub-Saharan Africa: the role of human capital in structural transformation. *Journal of Empirical Studies*, *5*(1), 45-54

APPENDIX

Wald Test:

Equation: NARDL01

Test Statistic	Value	df	Probability
t-statistic	-2.381943	8	0.0444
F-statistic	5.673652	(1, 8)	0.0444
Chi-square	5.673652	1	0.0172

Null Hypothesis: C(4)=C(8)

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(4) - C(8)	-3.439235	1.443878

Restrictions are linear in coefficients.