UNIVERSITY OF CAPE COAST

INDUSTRIALIZATION, ECONOMIC GROWTH, AND HEALTH STATUS IN GHANA

BY

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A thesis submitted to the Department of Economic Studies of the School of Economics, College of Humanities and Legal studies, University of Cape Coast, in partial fulfillment of the requirements for the award of Master of Philosophy degree in Economics

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DECLARATION

Candidate's Declaration

I hereby declare that this thesis is the result of my own original work and that no part of it has been presented for another degree in this university or elsewhere.

Candidate's Signature………………………… Date…………………………..

Name: Gideon Mawutor Kwasi Adjandeh

Supervisor's Declaration

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

Supervisor's Signature…………………………Date:…………………………

Name: Prof. Emmanuel Ekow Asmah

ABSTRACT

Changes and issues surrounding standards of living, fertility rates (increasing fertility rate) and high levels of mortality have an effect on the decision of couples. Knowledge about the mortality rate and changes in standards of living influences the decision making of couples. The research aimed to identify the association that exist amongst industrialization, health status and economic growth. The study used vector error correction model and impulse response function to analyze the data. The findings showed that there is an upward association between industrialization and economic growth in the long run. The vector error correction model output showed that there is a positive association between life expectancy rate and GDP growth rate as well as agricultural sector. The findings of this study confirm the Preston Curve model by obtaining a positive relationship between GDP growth rate and life expectancy. The impulse response shows that GDP growth rate does not show an upward or downward continues change when there is a shock life expectancy rate. The research commends that government must ensure the three sectors of the economy perform well and invest in better health systems and other infrastructures that improve the health system in the country since poor health status will lead to a fall in the GDP growth rate.

KEYWORDS

Industrialization

Economic Growth

Life Expectancy

Health Status

Impulse Response Functions

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DEDICATION

To Mr. Adjandeh Dickson and Hellen Adjandeh

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LIST OF ACRONYMS

ASDR:	Age Specific Death Rate
CDR:	Crude Death Rate
CSDR:	Cause Specific Death Rate
EKC:	Environmental Kuznet Curve
IMR:	Infant Mortality Rate
IPAT:	Impact Population Affluence Technology
IRF:	Impulse Response Function
LE:	Life Expectancy
MMR:	Maternal Mortality Rate
PYL:	Person Years Lived
SSA:	Sub-Saharan Africa
VAR:	Vector Auto Regression
VECM:	Vector Error Correction Model

CHAPTER ONE

INTRODUCTION

Background of Study

Changes and issues surrounding standards of living, fertility rates (increasing fertility rate) and high levels of mortality have an effect on the decision of couples. According to Nobles, Frankenberg, and Thomas (2015), knowledge about the mortality rate and changes in standards of living influences the decision making of couples. Changes in mortality rate and fertility rate of countries have characterized human existence, where events such as the occurrence of World Wars and major international conflicts have impacted the fertility rate and mortality rate of several countries (Bongaarts, and Casterline, 2013). A significant change occurred in the narrative of human existence in the early stages of the 19th century, where the Western world experienced some level of economic and demographic shifts (Van de Kaa, 2002). The economic and demographic changes were accompanied with increasing per capita incomes and growth in technological innovations and a rise and fall pattern of infertility rate and a rapid decreasing in mortality rate. The quest for development in less developed and developing countries such as sub-Saharan African countries has increased the demand for industrialization. Industrialization has been identified as the major driver of growth in an economy (Lavopa, & Szirmai, 2012).

The changes caused by industrialization on the environment include pollution and degradation of land, which has effects on the health status of individuals. The life expectancy level, infant mortality rate, pollution-related diseases are health concerns that are related to pollution as stated by WHO. A report by Bloom, et al., (2018) shows that at the commencement of the 20th century, the life expectancy rate on average was above 40 years worldwide. Real GDP per capita as of the same period was less than a sixth of its current values. There is a growing concern about health changes and healthy living is not only a human right concern but also an economic concern for development. Although there are positive outcomes of industrialization and economic growth on the health of the population there are some negative outcomes that have been identified by researchers.

Szreter, (2004) stated that industrialization and economic growth leads to the exposure of the population to new diseases and lifestyle due to the movement of individuals from one geographical location to another. From this point, industrialization can be seen to be the cause of major disease spread and movement of communicable diseases. On a global scale economic growth achieved through trade expansion has increased the movement of people across national borders leads to the spread of communicable diseases. Another adverse effect of the migration of individuals from one point to the other is the increase in population density in more industrial areas which puts pressure on social amenities. This implies industrialization and economic development or growth are the causes of health problems, in the same vein industrialization and economic growth can be a solution to health problems. Industrialization and economic growth have increased innovation and the need to satisfy new markets which has helped to develop solutions to health challenges worldwide. Through trade to achieve economic growth less developed countries can have access to technologies needed to cure some diseases, and provide raw materials needed for the developed world to manufacture medical supplies.

Economic development in Ghana have led to several reforms in the manufacturing industry of Ghana since independence, as industrialization was identified to be a key driver in the growth and development of the nation. Significantly, the first president of the country after independence launched industrialization policies which succeeded in increasing the input of the manufacturing sector to GDP from about ten percent in 1960 to the next decade (1970). According to Addo (2017), the industries created were mostly infant industries that needed to be protected and with the changing conditions in the economic indicators of the country – depreciating exchange rate and inflation, etc. – the protectionism was not sustainable leading to the implementation of Enterprise Resource Planning policies. The industrialization of Ghana is currently dependent on production of mostly raw materials for exports and the manufacturing of some finished goods in the country. The country also has significant growth in industry with the sector contributing about 25.3% of the country's current GDP and growing at a rate of 7.8%. This implies the industrial sector in Ghana is growing and needs regulation to identify its effect on the environment especially the health of the population.

Statement of Problem

The Ghanaian economy has recorded fluctuations in growth over the years. However, industrialization has exhibited mostly increased growth over the years (Fosu & Aryeetey, 2008). The effects of industrialization on the economy can be both positive and negative. Most developed countries achieved economic development through industrialization, hence the need for developing economies to also industrialize (Viotti, 2002). Industrialization can lead to higher levels of pollution, increased destruction of natural habitat, and other negative outcomes. Growth in the Ghanaian economy from industrialization could imply higher levels of pollution and other forms of degradation which has health effects on the countries inhabitants. According to United Nations Economic Commission for Africa, the African continent faces three major challenges – macroeconomic vulnerability, social inequality, and natural resource dominance – which need to be solved on a global scale to deal with risks in Africa (Africa, 2016). A major policy proposition to solve this problem was industrialization which is to emulate Asian Tigers (China specifically) to develop (Rodrik, 2018). A major concern for the proposition is ensuring a green economy in the face of industrialization, which implies there is the need to measure the effect of industrialization on the environment which includes the health needs of the population as well as the effect of industrialization on the economic development and growth of the continent.

Solving this problem is in line with solving the issues and challenges raised in the Sustainable Development Goals. Good health requires good drinking water, economic growth must be achieved through industrialization and there is the need to ensure responsible production processes. Industrialization in Ghana implies there is the need to understand the responsible production methods to ensure the environment is not destroyed whiles achieving the goal of economic growth. This research employed the Kuznet curve analysis, the IPAT identity equation, and the Preston curve hypothesis. This research aims at identifying the level of industrialization and how it affects the health conditions of Ghanaians in the long run. The aim of this research is to find out the effect of industrialization on the Ghanaian economy and the health systems in the country. The study also aimed at testing the premises of the Preston curve on Ghana. The Preston curve draws a conclusion between the life expectancy of a person at birth and the GDP per capita.

The Preston curve was first documented in a seminal contribution by Samuel Preston (1975). The seminal paper proposed that in a country individuals with higher levels of per capita income are associated with better life expectancy whiles individuals with relatively less levels of per capita income are associated with unfavourable life expectancy. This discovery in the 1975 was dubbed the "Preston curve". The idea from the Preston (1975) suggest that prosperity increases the longevity implying the higher the income inequality the lower average longevity.

The conclusions from Preston's curve can be used to provide a distinct difference between the developed and less developed or developing countries.

The developed countries could be identified as prosperous hence having higher per capita income which implies their life expectancy levels will be higher. On the other hand, less developed countries and developing countries like most countries in Sub-Saharan Africa (SSA) will have lower longevity due to lower per capita income.

The ideas of the Preston curve have been subjected to testing by several researchers (Marmot, 2002; Bloom and Canning, 2007; and Lutz and Kebede, 2018) leading to questions being asked as to whether the income level exactly influences the longevity or the other factors. Marmot (2002) replaced income with education to determine if education rather has an effect on life expectancy and not income. Factors such as the nature of a countries health care, climate change issues, and natural disasters can affect the longevity of a country regardless of the country's economic development. Deaton (2003) identifies a key issue pertaining to the Preston curve that must be answered, if income is the determinant of longevity then the efficient threshold at which when income is redistributed will contribute to enhancement in the health of individuals must be identified.

The study on the relationship between life expectancy and income continues as the best determinant of life expectancy continued to be researched. Lartey, Khanam, and Takahashi (2016) conducted a study on Preston's curve in Ghana using child survival as a measure of life expectancy. Husain (2011) conducted a cross-country study for selected countries, including Ghana. The findings for the study in Ghana are diverse, with different variables being identified as the determinants of life expectancy. This study aims at contributing to the discussion on Preston's curve analysis by identifying the effect of economic growth and industrialization on health status.

Purpose of the Study

The main focus of the research is to identify the effect of industrial activities on economic growth (EG) and health conditions in Ghana and also find the reverse causality between the three variables in the study.

Objectives of the Study

The specific objectives are to;

- Identify the association between, economic growth (EG) industrialization and health status.
- Determine the effect of shocks on the relationship between industrialization, economic growth and health status.

Hypothesis of the Study

Hypothesis 1

H_0 : Industrialization has a negative effect on economic growth

H_1 : Industrialization has a positive effect on economic growth

Hypothesis 2

H_0 : Economic growth has a negative effect on health status

H_1 : Economic growth has a positive effect on health status

Hypothesis 3

H_0 : Industrialization has a negative effect on health status

H_1 : Industrialization has a positive effect on health status

Hypothesis 4

H_0: Health status (Life expectancy rate) is not affected by GDP growth rate and industrialization.

H_1: Health status (Life expectancy rate) is affected by GDP growth rate and industrialization.

Hypothesis 5

H_0: Economic growth is not affected by health status (life expectancy rate) and industrialization

H_1: Economic growth is affected by health status (life expectancy rate) and industrialization

Hypothesis 6

H_0: Industrialization is not affected by health status (life expectancy rate) and economic growth

H_1: Industrialization is affected by health status (life expectancy rate) and economic growth

Significance of Study

The findings of the study will inform stakeholders in the environmental protection agency who need information on the effects of pollution from industrialization on the environment. The study will also help individuals in the industrial sector as well as other sectors to determine the effect of their activities on the economic growth of the country. The findings of the study will also help individuals working in the industrial sector to identify the effect of industrialization on their health. The study will also contribute to the knowledge base on understanding the Preston's curve and Environmental Kuznet Curve. The study will also provide literature on impulse response functions estimated through an autoregressive model called Vector Error Correction Model.

Delimitations

A major challenge faced by the study was identifying the best measure for health status. Several variables can be used to measure the health status of a person. This includes life expectancy, infant mortality rate, fertility rate, morbidity rate among others. The study used life expectancy rate which was originally used by Preston, as well as infant mortality rate and fertility rate to measure health status. However, the main measure employed by the study was life expectancy rate.

Limitation

The study employed a secondary data from World Bank Development Indicators (WDI) data which was one of the limitations of the study. If primary data were used, there would be a small variation of the findings since the researcher could possibly manipulate the dataset. However, the life span of the data was short period of time (1984-2022). Also, some of the observations were negative which made the analyses a little bit tedious and missing observations could not make it possible for the use of an additional frame. This could influence the findings to some extent.

Definition of terms

Health status

The study was conducted with health status being the main dependent variable. Health conditions and/or status indicates an individual's relative level of wellbieng and illness. The wellness or illness of the individual includes, symptoms, biological or physiological dysfunction and functional impairment present on the individual (Streiner, Norman, and Cairney, 2015). The health status of an individual is a subjective issue which is based on the perception of the individual. An individual could be sick but based on his perception is healthy since he is able to perform his daily routines. Health status can also be refferred to as the perceived health status of person which is based on the perspecitves of an individual on his or her health status.

Life expectancy

Life expectancy at birth is a measure of health that shows a summary of mortality patterns that exists in a country across all age groups. On average the number of years a person is expected to live if the person experiences the age-specific mortality rates that are prevailing in a given country at a particular period. A person's life expectancy rate is not affected by changes in future mortality rates. The methodologies used in calculating the life expectancy rates differ from country to country.

Fertility rate

Fertility rate can be referred to as the total number of children that would be born to a woman if she had lived to the end of her childbearing age and gave birth to children in line with age-specific fertility rates of a particular year. The fertility rate can be expressed as the ratio between the number of live births in a year and the total number of female population in the child bearing age. Mathematicaly fertility rate can be expressed as;

$$Fertility\ rate = \frac{Sum\ of\ age\ specific\ fertility\ rate * width\ of\ age\ group}{1000}$$

Morbidity rate

The morbidity rate is one of the modern measures of health status due to the changing methods of health care delivery as well as civilization (Maji, Ghosh and Ahmed, 2018). Morbidity rate refers to the level at which a disease spreads in a society. The disease could be chronic, long-lasting conditions or acute in nature. According to Miettinen et al. (2019), Morbidity could refer to a depature or shift from a state of physiological or psycholgical wellness of an individual. Morbidity rate is calculated as;

$$Morbidity = \frac{Number\ of\ affected\ individuals}{total\ number\ of\ population} x\ 100$$

Industrialization

Industrialization will be measured using the productivity level of the industrial sector in the economy, pollution levels, and the number of manufacturing firms in the country. The industrialization will also be measured using service sector data. This is to identify if changes in health status are due to only issues related with industrial operations or due to service sector activities. Measuring industrialization begins with understanding what industrialization is and the context of measuring industrialization. It is important to identify industrialization as a process and not a single event. Industrialization consists of series of related or unrelated events which affects the rate of industriaizaion. Industrialization as a process can be seen as activities occuring in a system which could be a country or economy, with the activities or events having similarities and the events occur gradually overtime. The operations of a single entrepreneur in an economy at a particular time cannot be referred to solely as industrialization. Opening of a new plant for industrial purposes by an entrepreneur cannot be referred to as industrialization since the single event does not detail the entire process of industrialization. However, when more entrepreneurs in the economy build more plants and operate businesses that have similarities and are able to affect the economy as a whole overtime, this can be classified as industrialization by stakeholders. Measuring industrialization in this research will be based on the contributions of the industrial sector to the Ghanaian economy, and the industrial growth rate of the country.

Service sector

The study collected data on the service sector from the World Development indicators which corresponds. The WDI defines the service sector as any value addition to wholesale and retail trading activities in the hotel, transport, and restaurant industry. The service sector also includes government, financial professionals, or personal services. Educational services, healthcare services, and real estate services are also included in the service sector. Financial services included in the service sector are bank charges, import duties, and all forms of statistical discrepancies due to rescaling. The value-added calculation is based on subtracting intermediate inputs from all outputs from the various components of the service sector.

Agriculture sector

The agriculture sector was used as one of the contributors to the GDP of the economy. The data for the agriculture sector collected from the WDI indicators is based on value-addition from forestry activities, hunting activities, fishing activities, cultivation of all types of crops, and the production of livestock. The value-addition is calculated as the net output of the agriculture sector activities after all outputs are summed, and subtracting all intermediary inputs. The calculation of value addition does not include the deductions for the degradation of natural resources nor the depreciation of manmade resources.

Foreign Direct Investment

Foreign Direct Investment (FDI) was computed based on the origin of the investor. According to the WDI estimations, FDI is the net inflows from an investment where the investor receives lasting management interest in a venture that does not operate in the economy of the investor. Lasting management interest is an interest that is ten percent or more of voting stock. FDI includes equity capital, all long-term capital, earnings from reinvestment, and all short-term capital. The net inflows of an investor are calculated as the difference between the new investment's inflows and the disinvestment.

Economic growth

Economic growth was determined based on changes in GDP. The study also used economic indicators such as Foreign Direct Investment (FDI) and Unemployment rate. The use of this economic indicators is to cater for changes in the economy that might not be contributed by the industrialization process or changes in the industrial sectors contribution to GDP in the country. Aside the industrial sector, the study aso used the agriculture and the service sector to determine their effects on the economic growth of the economy.

Organization of study

The structure of the study is based on five distinct chapters, with each chapter having the appropriate sub divisions to ensure all aspects of the research are covered. The first chapter is the introductory chapter of the study which presents background to the study, the problem statement of the study, the purpose of the study, hypothesis of the study, the delimitations of the study, the significance of the study and the organization of the study. The second chapter (chapter two) focused on the review of literature regarding the health status in

Ghana, economic performance, industrialization as well as theories and empirical studies that are in line with the subject of the study.

Chapter three consist of the model specifications and the various estimation techniques used in conducting the research. The fourth chapter was used to estimate the models using time series data and the results discussed as well in the fourth chapter. The chapter five consists of the summary of findings, conclusions and recommendations. The conclusions and recommendations given by the research were based on the findings from the research.

CHAPTER TWO

LITERATURE REVIEW

Introduction

The literature review of the research is distributed into three major sections. The beginning section consists of the definition of relevant terms that are used in the study and definition of the variables to be used for the research, while the second part talks about the theories that were used in the study. Theories on economic growth, health changes and industrialization were also considered. The third part consists of the empirical evidence available on the subject where the researcher compares results from previous researchers.

Theoretical review

Preston curve model

The Preston curve was first documented in a seminal contribution by Samuel Preston (1975). The seminal paper proposed that in a country individuals with higher levels of per capita income are associated with better life expectancy whiles individuals with relatively less levels of per capita income are associated with unfavourable life expectancy. This discovery in the 1975 was dubbed the "Preston curve". The idea from the Preston (1975) suggest that prosperity increases the longevity implying the higher the income inequality the lower average longevity.

The conclusions of from the Preston's curve can be used to provide a distinct difference between the developed and less developed or developing countries. The developed countries could be identified as prosperous hence having higher per capita income which implies their life expectancy levels will be higher. On the other hand less developed countries and developing countries like most countries in Sub-Saharan Africa (SSA) will have lower longevity due to lower per capita income.

Preston curve shows the relationship between mortality rate and level of economic development. The two variables were used to represent longevity and prosperity or per capita income respectively. The ideas of Preston curve have been subjected to testing by several researchers leading to questions being asked as to whether the income level exactly influences the longevity or the other factors. Factors such as nature of a countries health care, climate change issues, and natural disasters can affect the longevity of a country regardless of the country's economic development. Deaton (2003) identifies a key issue pertaining to the Preston curve that must be answered, if income is the determinant of longevity then the efficient threshold at which when income is redistributed will lead to improvement in the health of individuals must be identified.

Although studies have identified that the Preston curve have been changing in the 20th century which implies that the life expectancy rates of countries have improved regardless of their income levels, Preston gave some suggestions and reasons which could lead to the changes in life expectancy.

According to Preston education, improved technologies, vaccinations and improved health services provision can be attributed to the changes in longevity. Preston associated 75% to 90% of changes in life expectancy to changes in health technology with the rest attributed to the improvement in income of the country.

Scatter-diagram of relations between life expectancy at birth (e_0^o) and national income per head for nations in the 1900s, 1930s, and 1960s.

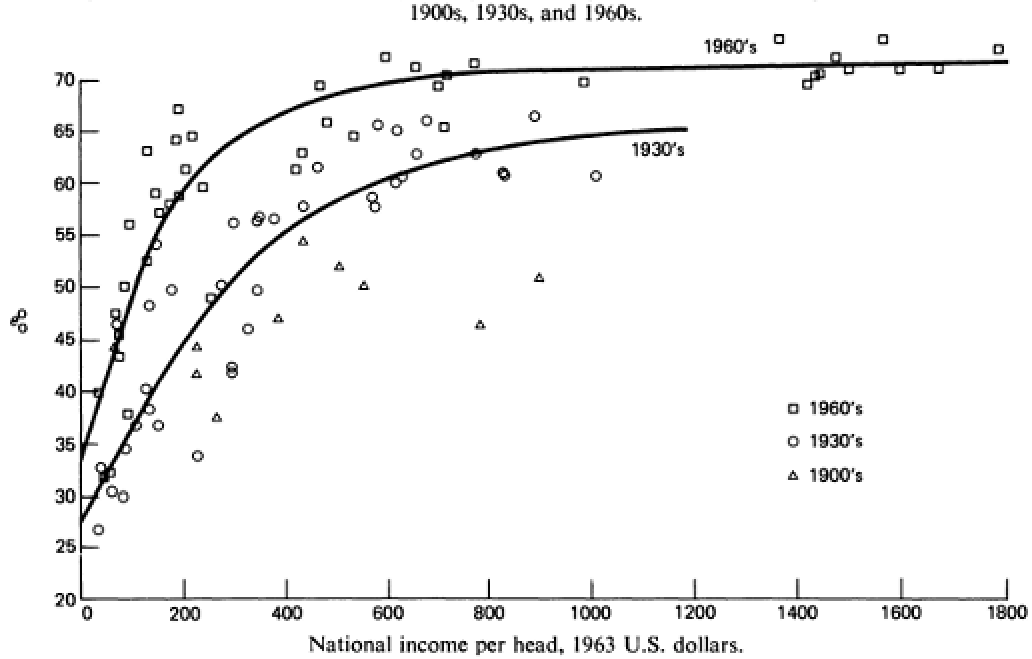

Figure 1: Original Preston Curve

Source: Öğüt, & YURTSEVEN, (2016)

The figure above shows the original Preston curve based on the national income per head in US dollars for 1963 and the life expectancy of US citizens at birth. The figure shows that all things being equall a person born in a richer country will have a better life expectancy level as compared to a person born in a relatively poorer country.

Critiques about the Preston curve include Georgiadis,., Rodriguez, and Pineda, (2010), who wrote a paper on human development research and investigating the possibility of the Preston curve breaking down. The main hypothesis in their paper is that the magnitude of the Preston curve slope is spurious in nature. The spurious nature comes from the overstated nature of the curve. The critiques mention that the association existing between life expectancy (LE) and GDP does not come from only life expectancy in developing countries due to the lack of technology in developing countries. Distance from health technologies in most developing countries makes it difficult for the countries to provide good health systems which support health of their citizens. There is the need to derive two distinct Preston curves for countries closer to the health technology frontier and those far from the health technology frontier. The Preston curve should be higher for countries closer to the health technology frontier and the Preston curve for countries far from the health technology frontier should be lower.

Unified theory on life expectancy human capital and technological process

The unified theory is premised on the ideology of human capital being a central concern of production, and also helps to improve productivity of future generations. The theory implies that the decision making of individuals about their human capital accumulation is based on the life expectancy and the economic environment. For example the individual's decision on education is based on the cost of training and the time used in training compared with the returns of investing in education and the time available to enjoy the returns from the education (Cervellati and Sunde 2005). Ability of educational investment to generate significant technological progress is a major benefit that motivates human capital acquisition. Since human capital formulation leads to increase technological progress which influences longevity through improved healthcare delivery. This situation leads to a virtuous cycle of increased investment in education leading to human capital acquisition, increase in technological progress leading to improved longevity (Galor, 2005).

The IPAT identity

The foundations for the IPAT equation were laid down by Ehrlich and Holdren and Commoner. This proposed unique identity shows the relationship existing between the inter-relating variables and the effect they have on the environment. The model or identity can be stated as;

Impact = Population ·Affluence ·Technology.

$$I = P * A * T$$

$$Impact = Population * \frac{Goods\ and\ Services}{Population} * \frac{Impact}{Goods\ and\ Services}$$

Cancelling out like terms in the above equation gives;

$$I = I$$

According the model stated above, pressure on the environment denoted as impact (I) is expressed as a relationship depending on three variables. They are the number of people in a geographical area ie. Population (P), the per head consumption of individuals which is affluence (A) and the technological capability of the society (T). The stated IPAT identity gives an answer to the question: how to lower the impact on environment. The total pressure on environment can be decreased under the condition that at least one of the presented variables decreases in magnitude, while the product of growth for remaining variables do not offset the decline achieved. Nevertheless, the IPAT identity has a rather general framework, it can also be used to analyse a specific environmental issue, where the identity is starting point for the exploration of changes in the past, forecasting for future and, moreover, identification of effective leverage points where policy tools could give the greatest benefit.

Environmental Kuznet Curve (EKC) theory

The environmental Kuznet Curve (EKC) theory is one of the major theories in environmental economics that is used to explain the relationship between income and the changes in the environment (Ficko & Boncina., 2019). The EKC theory states that improvement in economic growth leads to destruction of the environment in the beginning and with time the relationship changes with improvements in economic growth leading to improvements in the environment. Depending on the point at which the society is currently, the EKC theory can depict a good situation for one country and a negative situation for another. Income elasticity of demand is greater than zero or sometimes greater than one for environmental quality due to the identification of environmental quality as a normal good and in some cases as a luxury good (Ficko & Boncina, 2019). The higher the income of a country the more demand for environmental quality will rise and in the richer countries, the developed systems and capabilities of the country will be able to meet the rising demand for environmental quality (Alstine & Neumayer, 2010)

According to Bekhet, (2020) economic development also has the possibilities of improving man made capital which will lead to the development of technologies that will be able to help in managing environmental damages which might be due to economic growth. However the average growth in pollution in the country might be going down but the absolute pollution level in the country will still be rising hence the effects of the economic growth improving man made capital hence improving technological advancements to curb environmental degradation is inconclusive.

The results general suggests three qualitative ideal-type cases to be distinguished as shown in the figure below. The figure shows the three distinct situations that occur on the EKC model. In the first case as economic growth of the country improves the level of environmental destruction also grows leading to a positive relationship. This relationship implies as the country is obtaining higher economic growth level, the environment is getting destroyed which is characterized in the pre-industrial economic era. In the industrial economic era the economy is at a turning point where the country has the highest level of environmental degradation as economic growth is increasing. After the turning point the society moves to the postindustrial economic era also known as the service sector economy (Adejumo 2018). It is assumed the economy is able to build some human capital and manmade capital to mitigate the effects of industrialization on the environment and also build technologies and institutions that will be able to deal with environmental degradation.

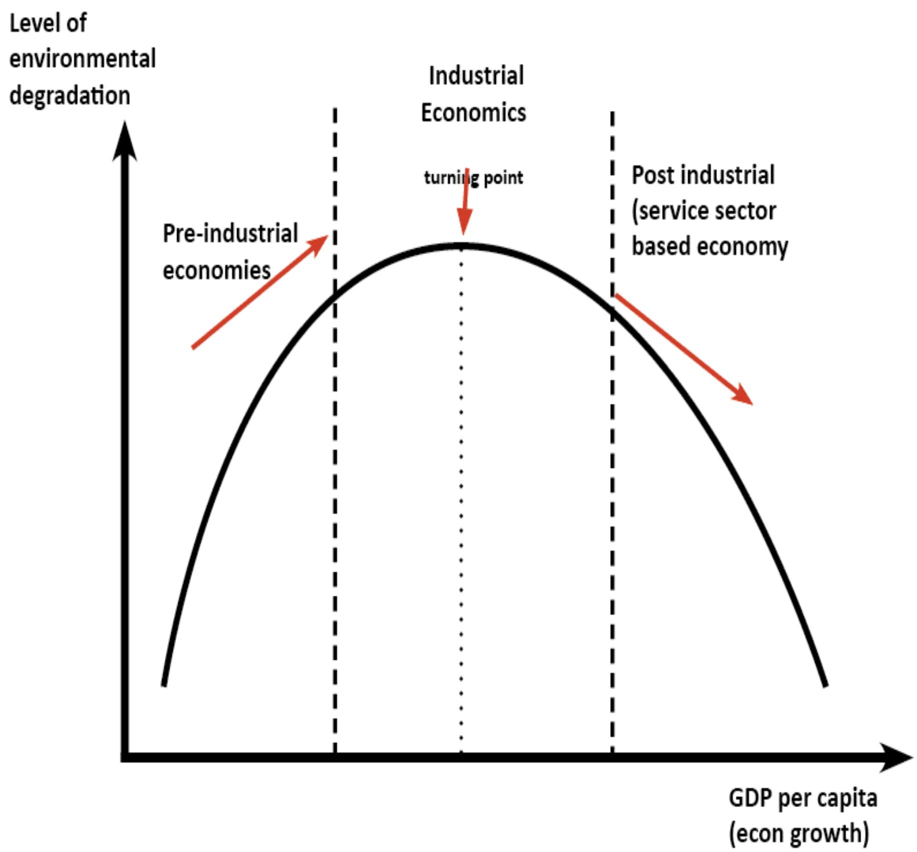

Figure 2: Environmental Kuznet Curve (EKC)

Source: Miguel, Molod, J., Velardo, and Pigao, (2022)

In most studies, the EKC studies was stated as follows;

$$E_{it} = (\alpha + \beta_i F_i) + \delta Y_{it} + \phi (Y_{it})^2 + k_t + \varepsilon_{it}$$

Where;

E_{it} is the environmental indicator which could be in the form of per capita consumption or in the form of concentration of emissions levels.

Y_{it} is the per capita income

F_i is the country specific effect which is being tested for. The country specific effect does not consider the time period being studied hence does not have the subscrip *t*.

$k_t$is a time dummy created to identify effects in specific years. The time dummy does not consider the specific country effect being studied hence has no subscript *i* which is country specific effect.

A change in $\delta,\ and\ \varphi$ determines the pattern of the model. When δ is negative and statistically significant while φ is insignificant statistically, then the pattern of the model is determined to be in the pre-industrial economic era. This shows there is a situation in which per capita income of the country is increasing as well as rising environmental concerns such as lack of good drinking water and other environmental concerns. In the case of a positive and significant δ while φ is insignificant statistically, the country is in the third face which is the developed economy state or the service sector state. This stage shows the country has very high per capita income levels while they are able to manage and control emissions in the environment as well as have the capacity to manage the externalities associated with industrialization. This state is rarely achieved by most countries. The pattern which is experienced by most countries and economies is the second pattern which is the turning point level. When δ is positive and significant φ is negative and significant the country is in the turning point stage.

Empirical review

Bloom et al., (2018) researched on health and economic growth and focused on three key areas which are to assess the causal association amongst healthiness and economic growth (EG), secondly to identify the relationship existing between health and changes in economic growth over the development of countries, and finally to finally access the effect of different health variables on the economic growth. The study paid attention to the effect of demographic health concerns and the effect on the economy. Specifically, the study used mortality rate, child and mother's health, morbidity and healthiness at old age. The main theory of the study was the Preston curve model. A major conclusion drawn by Bloom et al., (2018) is the case for direct effect of health on economic growth particularly for less developed economies.

The study concluded that the health improvements in this countries increase the rate of productivity hence improving the economic status of the economy. The study however found a complex relationship for developed economies where institutions and advancement in medicine and health systems in general leads to the reduction in death related to chronic diseases. This implies the younger generations are protected and hence are able to work more but also grow into their old ages. The study however found out the elderly tend not to be productive but also use the available resources in the economy. However the situation differs for different economies based on the ability of the economy to create systems and institutions that are able to utilize the services of the elderly.

A study on the relationship amongst economic growth and health was studied by Babatunde (2012) which paid attention to the mathematical model used in estimating the relationship between the two variables. The researcher studied the association amongst health and economic development. The study was conducted in Nigeria using data from 1970 to 2008. Just as identified the Preston curve model, the findings of Babatunde (2012) showed that there is a positive association between per capita income and life expectancy. The study showed that the growth in income is rapid when national income levels are low and there is a change in the life expectancy rate. The study stated that when the income of the economy becomes higher, changes in life expectancy tend to have a lesser effect on the per capita income. Similarly the study found out that there is a negative relationship between death rate and per capita income of Nigeria. As in the case of life expectancy rate, at a low economic development, death rates decline faster when per capita income of citizen's increase slightly.

Addo (2017), conducted a study on manufacturing industries and economic growth in Ghana. The study was based on identifying methods to empower the private sector, to expand employment, improving agro-based industrialization, and to ensure spatial distribution of industries to reduce situation of over-concentration of industries. The study identified management skills, capital adequacy and external relations management as the factors that are impeding the operations of manufacturing companies in Ghana.

A review of empirical evidence on economic development and health was conducted to identify how economic growth affects the health of a population. Lange and Vollmer (2017), conducted the empirical study and found out that in the short-run the growth of a country's economy varies based on the developmental state of the economy. When health of a population is measured using the mortality rate of the country there is a pro-cyclical and counter-cyclical outcome with economic growth for developing and developed countries respectively. The study also found that there is a difference in the effects of shocks on the permanent income of individuals. There exist a positive relationship between increase in permanent income and health of a population according to (Lange & Vollmer 2017).

Or (2000) investigated health expenditure on industrialized countries and the effect it has on health status of individuals in an economy. The study found out that contrary to what has been suggested by other researchers, there is a significant direct association amongst health expenditure and health particularly in the case of women. The study also stated the importance of environmental factors more than health factors explain differences in premature mortality in industrialised countries.

The research on health expenditure and the effect it has on the economy was studied by Anyanwu and Erhijakpor (2009). The study conducted a panel analysis for African countries. The study used econometric tools of analysis to determine whether health expenditure in African countries improves the health status in Africa. The study was conducted to contribute to the empirical evidence that exist about the subject and the paper intended to support the idea that overall state or government expenditure on health related issues is key to improving health outcomes.

The findings indicate how important health financing is in Africa's fight to achieve the MDGs. The coefficients of the results indicate an increasing expenditure on health in Africa will help in achieving the targets of the MDGs. Although increasing health expenditure will not solve all the MDG problems, it is helpful in most parts of the region since health concerns are important factors to be considered. As a direct relationship exist between health outcomes and health expenditure it is important to give importance to the reforms in the health industry. If authorities in African countries are to develop health systems in their countries to improve infant mortality and other health concerns, it is necessary for the stakeholders to identify the needed levels of investment and the right channels of investment which would lead to the investment into the health sector meeting the needs of the intended targets.

Lartey, Khanam and Takashi (2016) researched on the impact of household wealth on child survival in Ghana. The study was conducted using child survival as a sole measure of life expectancy. The study used data from Demographic and Health Survey dataset from 1993 to 2008. The study used a dataset of about 6000 households where questionnaires were administered to females who were between the reproductive age of 15 to 49 years. Wealth effect in the study was estimated using the gamma frailty estimate.

The study by Lartey et al. (2016) found out that wealth status has a significant effect on the child survival rate in Ghana. The study concluded that a child born in Ghana or who stays in Ghana is more likely to be in the survival range when the child is from a wealthy home. The study also found out that birth spacing and parental education could also have an effect on child mortality. This study only identified the effect of wealth on the survival of children but did not consider the health of their parents. However, in the case where the parent of the child or the guardian of the child is not available or has bad health, this has a potential of affecting the health of the child.

Chapter Summary

The third chapter contained the review of literature relevant to the study. The chapter discussed the theories that are relevant for the study. The theories reviewed are the Preston's curve model, the environmental kuznet curve, and the IPAT identity. The main model used was the Preston's curve. The literature review section also reviewed some empirical works that were on economic growth, industrialization and health status.

CHAPTER THREE

RESEARCH METHODS

Introduction

The methodology chapter of the research was used to identify the methods and techniques that the researcher used to conduct the study to identify the effect of industrialization on the environment and the health of the people in Ghana. The study employed econometric tools of analysis as well as other data management techniques such as data transformation, lag length selection, stationarity test and the auto regressive models to identify long and short run effects of industrialization on the Ghanaian economy.

Research Philosophy and Approach

The positivist philosophy is the research philosophy underpinning this research. The positivist philosophy also known as the positivist paradigm uses the quantitative research approach under an objective epistemology. This allows for the methods of natural science to be applied to social science studies. According to Pham (2018), this approach shows that to understand a phenomenon the issue must be measured and empirical evidence must be available to support the findings. This philosophy allows for the researcher to use statistical approaches to analyze the data. This research used the positivist approach to offer more room for replication and reliability of the findings of the study. This approach also helped the researcher to make scientific assumptions which helped in providing foundation for the findings of the research.

Research Design

The researcher employed the Quasi Experimental research design. This design was used to help conduct a time series analysis on the relationship between industrialization, economic growth and health status in Ghana. The quasi experimental research design is consistent with the assumptions of a quantitative research approach therefore the research design helps to examine the cause and effect relationship between the right hand and the left hand variables overtime with utmost objectivity (Bunte, Desai, Gbala, Parks, & Runfola, 2018).

Sources of data

The study collected annual data on the variables of interest to the study from the world development indicator dataset, as well as the World Bank data portal. The study collected data from 1984 to 2020 which implies a time period of 37 years was used as the range for the time series data collected. To measure industrialization the study collected data on value added through industrialization as a percentage of GDP annually. The value addition to industrialization shows the changes in industrialization and the level of growth in the industrial sector yearly as a percentage of the GDP of Ghana. Life expectancy was used as the major measure of changes in health status for a country since it measures the overall health impacts on the number of years a person can leave in Ghana. Aside the life expectancy rate the study also used factors such as fertility rate and mortality rate of mothers and infants respectively in Ghana. The study also used GDP growth which is calculated as change in the gross domestic product of the country annually. Aside the industrial sector having an effect on performance of the economy other factors also play a key role. For example the unemployment rate in the country, the foreign direct investment and performance of the service sector has an influence on the economic performance of the country. Hence economic variables such as foreign direct investment and unemployment as well as services sector value addition to GDP were used in the study.

Pre-estimation Tests

Unit root test

Most economic and finance data exhibit some form of trending and non-stationarity overtime when their means are accessed. Economic variables such as real GDP, exchange rate and others are some variables that have been identified by researchers to be non-stationary or show signs of trending. Most economic and finance research aim at identifying the long-run relationship that exist between variables. Non-stationary time series data are not suitable for long-run analysis hence the need for the researcher to conduct the unit root test to check for stationarity and identify the level of stationarity and how the data can be detrended to ensure stationarity.

Two forms of detrending mostly used by econometricians include first differencing and time trend regressions. Based on the level of differencing the presence of trend at specific levels, the researcher can employ any of the two methods or use both of the methods. The unit root test analysis helps the researcher to know whether to apply differencing or to regress on deterministic functions of time to ensure the data is stationary. The researcher can conduct long-run analysis when the data is stationary at $I(1)$ and employ a co-integration analysis to determine the long-run relationships that exist among the variables.

To perform the unit root test, several techniques and test are available to researchers. The PP test, the Dickey Fuller test, the ADF test and other test for stationarity are available for researchers to use. This study used the breakpoint ADF test. The study will proceed to conduct the co-integration test when the level of stationarity is determined.

Lag length selection test

After conducting the stationarity test, the researcher will conduct the maximum lag length and order selection test. The study will use the optimum lag length selection test to identify the appropriate lag length suitable for the econometric model being employed. The lag length can be 1 or 2 for an annual time series data but can range from 6 to 24 for monthly datasets. Nevertheless there is no fixed lag length that a researcher must depend on in conducting a time series analysis but rather conduct the necessary lag length selection test to identify the needed lag length to employ in a study. It is important to note that in conducting the lag length selection model the researcher must be aware of the effect of the lag length on the number of observations and the generalizability power of the findings. The higher the lag length the more degrees of freedom is lost and the number of observation also reduces as the lag length increases. Including too many lags in a model can lead to multicollinearity through reduced degrees of freedom and also not including the appropriate lag length in the model can lead to specification error. For a researcher to be on the safe side a selection criterion can be employed to determine the optimum lag length needed for the modelling process. Some popular lag length selection test include sequential modified LR test statistic, Final Prediciotn Error (FPE) test, Akaike Information Criterion (AIC) test, Schwarz Information Criterion (SC) test, and Hannan-Quinn Information Criterion (HQ) test. Although the researcher will not depend on all the test results, using multiple tests to confirm the lag length to be used is advisable.

Cointegration test

The study after determining the required lag length used a cointegration test to determine the existence of long-run relationship between the variables under study. The study will base on the findings from the cointegration test to determine whether to employ a VECM model or a standard VAR model.

The standard Vector Auto Regressive (VAR) model

In analyzing time series data with more than one variable it is important to use the VAR model where each variable comprises a linear function of previous lags of the variable itself and the previous lag of other variables in the model (Usman, Fatin, Barusman and Elfaki, 2017). The generalized form of the VAR model can be stated as:

$$y_t = c + \sum_{i=1}^{p} \emptyset_i y_{t-1} + \varepsilon_t \quad \text{.......... } 1$$

Where

y_t is the element of y at time t

$\emptyset_i$ is the matrixorder n x n with the coefficients being the vector y_{t-1} for $i = 1,2, \dots, p$

p is the lenght of lag

c Is the vector intercept and

ε_t is the randome vector of shock.

Equation (1) can also be written as follows;

$y_t = A_0 + A_1 X_{t-1} + e_t$.......................................2

Where:

$A_0 = B^{-1}\mathcal{T}_0$

$e_t = B^{-1}\varepsilon_t$ and

$A_1 = B^{-1}\mathcal{T}_1$

VECM (Vector Error Correction Model)

Vector autoregressive (VAR) model is a framework generally used in economics when variables are stationary to describe the dynamic interrelationship between them. In cases where the timeseries variables are stationary but in different orders the VAR model is not able to estimate the relationship. Secondly if the variables are integrated the original VAR model as a technique to estimate the dynamic interrelationship between stationary variables cannot be used (Pesaran, , et al., 2000). A special form of the VAR model is required to deal with the differences in stationarity and the integrated nature of the variables. The Vector Error Correctional Model is a special form of VAR which is used when the variables are cointegrated and also have different levels of stationarity.

In the general form, the VEC model is th extended form of the VAR model hence takes the form of the former. The generally accepted stated form of a VEC model can be stated as shown in the equation below.

$$\Delta y_t = \beta_{y0} + \beta_{yy1}\Delta y_{t-1} + \beta_{yx1}\Delta x_{t-1} + \lambda_y(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + v_t^y \dots\dots\dots\dots\dots\dots 3$$

$$\Delta x_t = \beta_{x0} + \beta_{xy1}\Delta y_{t-1} + \beta_{xx1}\Delta x_{t-1} + \lambda_x(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}) + v_t^x \dots\dots\dots\dots\dots\dots 4$$

Equations 3 and 4 above shows the VEC model for one lag for two variables x and y. The coefficiencts of λ shows the error-correction coefficients which measures the rate of response of the individual variables to the level of deviation from the long run equilibrium. The term in bracket that is $y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}$ shows the cointegration level of the variables.

Replicating this model for more than two variables and for multiple lags based on the variables in the study gives;

$$\Delta GDP_t = \upsilon_1 + \beta_{11}\Delta GDP_{t-1} + \cdots + \beta_{1\rho}\Delta GDP_{t-\rho} + \alpha_{11}\Delta IND_{t-1} + \cdots + \alpha_{1\rho}\Delta IND_{t-\rho} + \delta_{11}\Delta SERV_{t-1} + \cdots + \delta_{1\rho}\Delta SERV_{t-\rho} + \sigma_{11}\Delta AGRIC_{t-1} + \cdots + \sigma_{1\rho}\Delta AGRIC_{t-\rho} + \mu_t^{\Delta GDP} \ldots\ldots 5$$

$$\Delta LE_t = \upsilon_1 + \beta_{11}\Delta LE_{t-1} + \cdots + \beta_{1\rho}\Delta LE_{t-\rho} + \alpha_{11}\Delta GDP_{t-1} + \cdots + \alpha_{1\rho}\Delta GDP_{t-\rho} + \delta_{11}\Delta UNEMP_{t-1} + \cdots + \delta_{1\rho}\Delta UNEMP_{t-\rho} + \sigma_{11}\Delta AGRIC_{t-1} + \cdots + \sigma_{1\rho}\Delta AGRIC_{t-\rho} + \phi_{11}\Delta MR_{t-1} + \cdots + \phi_{1\rho}\Delta MR_{t-\rho} + \mu_t^{\Delta LE} \ldots\ldots 6$$

$$\Delta LE_t = \upsilon_1 + \beta_{11}\Delta LE_{t-1} + \cdots + \beta_{1\rho}\Delta LE_{t-\rho} + \alpha_{11}\Delta IND_{t-1} + \cdots + \alpha_{1\rho}\Delta IND_{t-\rho} + \delta_{11}\Delta GDP_{t-1} + \cdots + \delta_{1\rho}\Delta GDP_{t-\rho} + \sigma_{11}\Delta FDI_{t-1} + \cdots + \sigma_{1\rho}\Delta FDI_{t-\rho} + \mu_t^{\Delta LE} \ldots\ldots 7$$

Where;

"t" represents the time period (time series model).

υ_1 in each model is the constant three models.

$\mu_t^{\Delta GDP}, \mu_t^{\Delta LE}, and\ \mu_t^{\Delta LE}$ are the error terms in the three models estimated (equations 5, 6 and 7)

GDP – Gross Domestic Product

IND – Industrialization

SERV – Service sector

AGRIC – Agricultural sector

LE – Life expectancy

UNEMP – Unemployment

MR – Mortality rate

FDI – Foreign Direct Investment

The equations stated above are the VEC model specifications used for the study. Equation 5 shows the VEC model used to analyse the first sub objective of the first objective of the study. Equation 6 was used to analyse the second sub objective of objective one and equation 7 was used to analyse the third sub objective of objective one. The study only stated the first equations for the VEC models since the long run relationships were of interest to the researcher.

Impulse response function

This study aims at identifying the shocks of different economic situations on the economy. The impulse response function helps to identify how the various variables in the study are affected when there is a shock from any of the variables in the economy. In basic terms impulse response function helps economists to trace the dynamic impact to a system of a shock in an economy. Impulse response functions helps to understand clearly the dynamic structure of the model. According to Baffoe-Bonie (1998) impulse response function helps to trace the effect of a particular variable on current and future values of other indicators in the economy. The impulse response hence helps in annalyzing the dynamic effect of a shock on the behavior of variables. Shan (2002) also stated that impulse response function helps to identify the time path of shocks on a variable in a VAR model. Impulse response will help to determine which variables in the VAR model are affected or how a particular variable in a VAR model is affected by shocks from an endogenous variable. The expected shock is estimated over a time period which includes the current period and the future periods. This study uses the impulse response function which is based on the VECM model estimated in the research. From the VAR model in equation 2, Vector error can be stated as follows;

$$\begin{bmatrix} e_{1t} \\ e_{2t} \\ e_{3t} \end{bmatrix} = \frac{1}{\det(A_1)} \sum_{1=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}^{i} x\ adj(A_1)\ x \begin{bmatrix} e_{1t-i} \\ e_{2t-i} \\ e_{3t-i} \end{bmatrix} \text{........................ } 8$$

$\det(A_1)$ is a determinant value of A_1 and $adj(A_1)$ is the adjoint matrix of A_1. This gives;

$$\begin{bmatrix} m_t \\ n_t \\ k_t \end{bmatrix} = \begin{bmatrix} \widehat{m} \\ \hat{n} \\ \hat{k} \end{bmatrix} + \frac{1}{\det(A_1)} \sum_{1=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}^i x\ adj(A_1)\ x \begin{bmatrix} e_{1t-i} \\ e_{2t-i} \\ e_{3t-i} \end{bmatrix} \text{.................9}$$

With $\emptyset$ matrix, equation 9 becomes;

$$\begin{bmatrix} m_t \\ n_t \\ k_t \end{bmatrix} = \begin{bmatrix} \widehat{m} \\ \hat{n} \\ \hat{k} \end{bmatrix} + \sum_{1=0}^{\infty} \begin{bmatrix} \emptyset_{11}(i) & \emptyset_{12}(i) & \emptyset_{13}(i) \\ \emptyset_{21}(i) & \emptyset_{22}(i) & \emptyset_{23}(i) \\ \emptyset_{31}(i) & \emptyset_{32}(i) & \emptyset_{33}(i) \end{bmatrix} \begin{bmatrix} \varepsilon_{mt-i} \\ \varepsilon_{nt-i} \\ \varepsilon_{kt-i} \end{bmatrix} \text{..................................10}$$

Introducing $\emptyset_{jl}(i)$ equation 10 becomes:

$$\emptyset_i = \frac{1}{\det(A_1)} \sum_{1=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix}^i x\ adj(A_1) \text{ ....11}$$

Equation 11 can then be written as

$$Z_t = \mu + \sum_{1=0}^{\infty} \emptyset_i\, \varepsilon_{t-i} \text{...12}$$

The impulse response function can be estimated based on $\emptyset_{jl}(i)$. To plot the impulse response or the shocks the best way is to visualize the response from $\emptyset_{jl}(i)$.

Definition of terms

Health status

The study was conducted with health status being the main dependent variable. Health conditions and/or status indicates an individual's relative level of wellbieng and illness. The wellness or illness of the individual includes, symptoms, biological or physiological dysfunction and functional impairment present on the individual (Streiner, Norman, & Cairney, 2015). The health status of an individual is a subjective issue which is based on the perception of the individual. An individual could be sick but based on his perception is healthy since he is able to perform his daily routines. Health status can also be refferred to as the perceived health status of person which is based on the perspecitves of an individual on his or her health status.

Mortality rate

Mortality rate was used as one of the variables or measures to analyze health status. The study used the total mortality rate which includes adult mortality rate (both male and female) and death of children. Definitions and measurement of mortality rate are in different forms with differences based on the parameters used in the measurement and the availability of data. Some of the methods employed in measuring mortality rate are, age specific death rate (ASDR), crude death rate (CDR), cause specific death rate (CSDR), infant mortality rate (IMR), standardised death rate (SDR), marternal mortality rate (MMR) and others.

Crude death rate (CDR) can be defined as the number of deaths in every 1000 people yearly as a relationship with the population. Mathematically, Crude death rate (CDR) can be defined as;

$$Crude\ Death\ Rate\ (CDR) = \frac{rd}{mpop} x\ k$$

Where rd is the total number of registered deaths in a year, mpop is the total mid-year population for a particular year, and k is constant which is equal to 1000. This measurement implies the measurement of mortality rate is based on the number of reported and registered deaths in a country. This implies the measurment does not capture deaths that occured but were not duely registered by the appropriate authorities. This measurement also puts together deaths that occured in all categories in the country ie. all age groups, all forms of sicknesses that occured in a country. The CDR measure of mortality rate also lacks credibility due to the source of the data collection, the population data is collected from census while the death rate is collected from the death registeration department.

However the CDR is easy to compute using the simple mathematical formular with the variables in the formular easy to identify and collect. To also correct for the defect of not aggregating the measurement of measuring mortality rate the age specific death rate measurement is used.

Age specific death rate (ASDR) can be referred to as a modification of the CDR with the death rate collected based on the specific age group of the dead person. Classifiying of death rates into age groups is to identify the age groups that are vulnerable more in a country and the categories in which death occurs most. The aged as compared to the youth are expected to die faster hence the need to segregate the death rates. ASDR can be measured as the totoal number of deaths in a particular age bracket per year divided by the total half year population in that age group per 1000 people. Mathematically it can be expressed as;

$$Age\ Specific\ Death\ Rate\ (ASDR) = \frac{rd`age}{mpop} x\ k$$

Where rd`age is the total number of registered deaths in a year for a specific age group, mpop is the total mid-year population for a particular year, and k is constant which is equal to 1000.

Another important measure of mortality rate is the specific cause of death measurment known as the Cause Specific Death Rate (CSDR). Death could be caused by several factors which could be natural or caused by non-natural situations. Death maybe caused by a person growing old and experiencing some old age diseases which can lead to death. Accidents, injuries, mortality during child birth, mortality during pregnancy and other sicknesses such as chronic diseases are some causes of death. Cause of Specific Death Rate (CSDR) can be measured as the number of death due to a particular sickness divided by number of mid-year deaths per 1000 individuals. Mathematically it can be expressed as;

$$Cause\ of\ Specific\ Death\ Rate\ (CSDR) = \frac{DC}{MidD} x\ k$$

Where DC is the total number of registered deaths in a year for a specific cause of death, MidD is the total mid-year deaths for a particular year, and k is constant which is equal to 1000.

Specific attention is given to death of infant which leads to death rate measured based on the age of a child being an infant. Infant mortality rate (IMR) referres to death of an infant which is a child between the ages of 0 and 1. IMR is calculated as the total number of registered infant deaths in a period as a ratio of the number of registered births per year. Mathematically Infant Mortality Rate can be expressed as;

$$Infant\ Mortality\ Rate(IMR) = \frac{DI}{AB} x\ k$$

Where DI is the total registered infant deaths per year, AB is the total annual registered births for a particular year, and k is constant which is equal to 1000.

Martenal death or martenal mortality is the death of a pregnant woman, who has just ended pregnancy before the past 42 days, or any situation arising from the pregnancy or during the pregnancy that leads to the death of the woman. This doesnot include accidental causes such as motor accidents. Martenal Mortality Rate is measured as the ratio between the number of martenal deahts in a period and the age of the person which is normally between 15 and 49 years of age. Mathematically Martenal Mortality Rate can be expressed as;

$$Martenal\ Mortality\ Rate(MMR) = \frac{MD}{PYL} x\ k$$

Where MD is all maternal dearths occuring per annum, PYL is the person years lived by women of reproductive age, and k is constant which is equal to 1000.

The study also used mortality rate attributed to unntentional poisoning. Death could occur due to poisoning by a person interntionally. Death that could occur due to unintentional poisoning could be due to accidents occuring using household chemicals such as kerosene, carbon monoxide, and medicines. The unintentional poisoning could also occur due to environmental contamination or occurpational chemical exposure which is mostly the case in manufacturing companies.

Life expectancy

Life expectancy at birth is a measure of health that shows a summary of mortality patterns that exists in a country across all age groups. On average the number of years a person is expected to live if the person experiences the age-specific mortality rates that are prevailing in a given country at a particular period. A person's life expectancy rate is not affected by changes in future mortality rates. The methodologies used in calculating the life expectancy rates differ from country to country.

Fertility rate

Fertility rate can be referred to as the total number of children that would be born to a woman if she had lived to the end of her childbearing age and gave birth to children in line with age-specific fertility rates of a particular year. The fertility rate can be expressed as the ratio between the number of live births in a year and the total number of female population in the child bearing age. Mathematicaly fertility rate can be expressed as;

$$Fertility\ rate = \frac{Sum\ of\ age\ specific\ fertility\ rate * width\ of\ age\ group}{1000}$$

Morbidity rate

The morbidity rate is one of the modern measures of health status due to the changing methods of health care delivery as well as civilization (Maji, Ghosh and Ahmed, 2018). Morbidity rate refers to the level at which a disease spreads in a society. The disease could be chronic, long-lasting conditions or acute in nature. According to Miettinen et al. (2019), Morbidity could refer to a depature or shift from a state of physiological or psycholgical wellness of an individual. Morbidity rate is calculated as;

$$Morbidity = \frac{Number\ of\ affected\ individuals}{total\ number\ of\ population} x\ 100$$

Industrialization

Industrialization will be measured using the productivity level of the industrial sector in the economy, pollution levels, and the number of manufacturing firms in the country. The industrialization will also be measured using service sector data. This is to identify if changes in health status are due to only issues related with industrial operations or due to service sector activities. Measuring industrialization begins with understanding what industrialization is and the context of measuring industrialization. It is important to identify industrialization as a process and not a single event. Industrialization consists of series of related or unrelated events which affects the rate of industriaizaion. Industrialization as a process can be seen as activities occuring in a system which could be a country or economy, with the activities or events having similarities and the events occur gradually overtime. The operations of a single entrepreneur in an economy at a particular time cannot be referred to solely as industrialization. Opening of a new plant for industrial purposes by an entrepreneur cannot be referred to as industrialization since the single event does not detail the entire process of industrialization. However, when more entrepreneurs in the economy build more plants and operate businesses that have similarities and are able to affect the economy as a whole overtime, this can be classified as industrialization by stakeholders. Measuring industrialization in this research will be based on the contributions of the industrial sector to the Ghanaian economy, and the industrial growth rate of the country.

Akinsanmi, Olusegun, and Clement, (2019) defined air pollution as presence of pollutants in the air which is inhaled by societies. The pollutants include sulphur dioxide, particale substances, nitrogen oxides and ozone three (O_3). Pollution in the environment is not only in the form of air pollutions but wastewater polluting water bodies, and land pollution (Rahaei, 2013). The pollution level will be measured using the CO_2 emmissions in the country. CO_2 emmissions is a major measure of pollution which helps to determine the amount of ozone depleting substances in the atmosphere.

Economic growth

Economic growth was determined based on changes in GDP. The study also used economic indicators such as Foreign Direct Investment (FDI) and Unemployment rate. The use of this economic indicators is to cater for changes in the economy that might not be contributed by the industrialization process or changes in the industrial sectors contribution to GDP in the country. Aside the industrial sector, the study aso used the agriculture and the service sector to determine their effects on the economic growth of the economy.

Chapter Summary

The third chapter provided the development of a methodogical framework which is best for conducting the research. The theoretical model used in the chapter is based on the Prestons curve model and the environmental kuznet curve model. The data used was annual time series data from 1984 to 2020. The study conducted the Augmented Dickey Fuller test (ADF) to test for the stationarity of the variables which is a pre-requisite for time series analysis. The study further used the Vector Error Correction Model (VECM) which is a dynamic VAR model to estimate the short run and long run dynamics of the variables which are health status, industrialization and economic growth. The chapter also highlighted the Impulse Response Function (IRF) which helped to determine the specific dynamics in terms of response of variables when there is a shock in the economy.

CHAPTER FOUR

RESULTS AND DISCUSSIONS

Introduction

The fourth chapter of the research considers the results from the analysis and discussion of the findings. The result section includes all the transformational techniques applied to the data and their interpretations. The results section talks about the descriptive output of the variables employed by the researcher. The result section also contain the cointegration output and interpretation, the VAR estimation and the interpretation of the impulse response analysis to determine the effect of industrialization on health conditions and economic growth in Ghana. The chapter also provides a discussion of the findings of the relationships and shocks in line with existing literature and theories such as the IPAT identity and the environmental Kuznet curve. The following sections contains the analysis and the findings.

Descriptive Statistics

Table 1 below shows the descriptive statistics of the variables used in the study. The descriptive statistics includes measures of central tendency such as mean and median, as well as measures of shape ie. Skewness and kurtosis. The table shows that the minimum GDP growth rate of Ghana for the period was 0.93 percent while the highest growth rate for the period was 14.05 percent with a standard deviation of 2.36. The mean GDP growth rate for the period was 5.40 percent with a median of 4.85. GDP growth rate had a skewness of 1.42 which implies it is positively skewed and a kurtosis value of 6.36 which implies the data set is peaked.

The rate of industrialization of Ghana for the period from 1984 to 2020 has a min figure of 10.58 percent and a max figure of 34.86 percent which shows the highest and lowest level of value addition as a percentage of the country's GDP. The mean level of industrialization is 23.54 percent and the median is 24.82 with a standard deviation of 5.93. The life expectancy rate of individuals in averaged 58.87 years between the period 1984 and 2020. This implies a person born in Ghana on the average will leave for about 59 years with a standard deviation of 2.95. The minimum life expectancy rate is 53.69 years while the highest age a person could leave in Ghana for the period is 64.17 years.

Table 1: Descriptive Statistics

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Observation
UNEM	5.53	5.32	10.36	2.21	2.06	0.52	2.84	37.00
SERV	36.27	35.05	48.18	26.25	7.46	0.25	1.57	37.00
MR	61.13	59.7	97	33.70	18.77	0.21	1.95	37.00
LE	58.87	57.62	64.17	53.69	2.95	0.30	2.03	37.00
INDUS	23.55	24.82	34.86	10.58	5.93	0.05	2.30	37.00
GDP	5.40	4.85	14.05	0.93	2.36	1.42	6.37	37.00
FR	4.80	4.68	6.22	3.80	0.71	0.42	2.03	37.00
FDI	3.28	2.24	9.47	0.045	2.89	0.66	2.23	37.00
AGRIC	33.74	35.78	50.60	17.12	10.41	-0.07	1.85	37.00

Source: Adjandeh, (2022)

Stationarity test

A prerequisite for time series analysis expecially for VAR modes is to ensure the variables used in the study are stationary. This implies the variable must not have any unit roots. The study conducted the stationarity test using the breakpoint Augmented Dickey Fuller test.

Stationarity at level

The table 2 below shows the outcome of the stationarity test at level. The table shows the p-value and the conclusion which shows whether the variable is stationary or not. From the table, Industrialization, Agricultural sector, service sector, and fertility rate were stationary at level with p-values lesser than 5 percent. GDP growth rate, life expectancy, unemployment, mortality rate and FDI were not stationary since they have a p-value greater than 5 percent which implies the presence of unit root.

Table 2: Stationarity at level

Level		
Variables	t-statistics	p-value
GDP growth rate	2.7692	0.2828
Industrialization	8.0123	0.0137***
Agricultural sector	7.6877	0.0170***
Services sector	-2.2099	<0.01***
Life Expectancy	3.3069	0.5070
Fertility rate	-5.8059	<0.01***
Unemployment	-3.0321	0.6676
Mortality Rate	-3.6286	0.3168
FDI	5.9125	0.2952

Source: Adjandeh, (2022)

Unit root test First Difference

The study conducted the Breakpoint ADF test at first difference since some of the variables were not stationary at level. It is necessary to conduct the stationarity test at first difference to ensure all the variables are stationary at the same level, which is a requirement for the application of the VECM. The table 3 below shows that all the variable had a p-value which is lower than 1 percent which implies all the variables are stationary at first difference and there is no unit root. Meeting this requirement allows the study to use the time series variables to conduct the econometric analysis to help determine the long-run relationships that exist between the variables and identify the variables have on each other.

Table 3: Unit root test First difference

First difference		
Variables	t-statistics	p-value
GDP growth rate	-6.9448	<0.01***
Industrialization	-7.2533	<0.01***
Agricultural sector	2.8850	<0.01***
Services sector	-8.3041	<0.01***
Life Expectancy	-5.4648	<0.01***
Fertility rate	6.6031	<0.01***
Unemployment	-7.9246	<0.01***
Mortality Rate	-5.9289	<0.01***
FDI	--6.8953	<0.01***

Source: Adjandeh, (2022)

Objective one

The first objective of this research was to determine the effect of industrialization, economic growth and health status on each other. This implies all the three variables will become the dependent variable based on how the model is stated. The study divided the first objective into three distinct sub objectives which are to examine the effect of industrialization on economic growth, to analyze the effect of economic growth on health status and to identify the effect of industrialization on health status.

Co-integration test

When estimating the relationship that exist between economic variables there is the need to ensure there is stationarity in the time series variables or there exist no unit roots. The use of non-stationary time series economic variables leads to some problems associated with the estimation. A major consensus agreed upon by economists is the need for some stable long-run relationship should exist between the variables in the estimation. When the time series variables exhibit some form of co-integration the possibility of showing the long run relationship between the variables is possible.

The time series variables used for the study were subjected to the stationarity test to determine their suitability for time series analysis. The variables based on the Break point ADF test for stationarity test have shown that at first difference all the variables employed by the researcher for the study are stationary. The study then can perform the co-integration test to identify possible existence of long-run relationship between the variables. To conduct the co-integration test, the study used the Johansen co-integration test. The co-integration test is one of the best test that is used to determine if variables are co-integrated or whether there exist some long-run relationship between variables in a group of variables.

The table 4 below shows the output from the Johansen co-integration and shows the output from the trace statistic. The table shows the hypothesized number of co-integration equations, the Eigen values, as well as the probability values. Based on the significance level of the hypothesized number of co-integration equations, the study will be able to determine the number of long-run equations. The trace statistics indicates at least two co-integration equation exist since we reject the null hypothesis of None and At most 1 due to their level significance. None has a probability of 0.0008 which is significance under 5 percent and At most 1 also has a significance level of 0.0057 hence we reject both hypothesis and accept the alternate hypothesis of at most 2 since it is insignificant with a p-value of 0.0848.

Table 4: Trace statistic

No. of CE(s)	Eigen-value	Trace stats	5% Critical Value	Prob.**
None *	.651900	117.2848	95.75	.0008
Atmost 1 *	.632400	80.35050	69.82	.0057
Atmost 2	.500691	45.32393	47.86	.0848
Atmost 3	.297334	21.01540	29.80	.3567
Atmost 4	.207163	8.664816	15.49	.3973
Atmost 5	.015310	0.539981	3.84	.4624

Source: Adjandeh, (2022)

The max-eigen statistics just like the Trace statistics also helps to determine the presence of a long-run relationship between the variables in the study. The table 5 below shows the max-eigen statistics. The table 5 shows the hypothesized number of co-integration equations (null hypothesis) the max-eigen values and the probability values. The max-eigen test shows that at least there exist two co-integration equations since we reject the null hypothesis of at most 1 co-integration equation with a p-value of 0.0363.

Table 5: Max-Eigen Statistic

No. of CE(s)	Eigen-value	Max-Eigen Stats	5% Critical Value	Prob.**
None	0.651900	36.93426	40.08	0.1084
At-most 1 *	0.632400	35.02657	33.88	0.0363
At-most 2	0.500691	24.30853	27.58	0.1243
At-most 3	0.297334	12.35059	21.13	0.5134
At-most 4	0.207163	8.124835	14.26	0.3662
At-most 5	0.015310	0.539981	3.84	0.4624

Source: Adjandeh, (2022)

Industrialization and economic growth

The first sub objective of the study was to identify the effect of industrialization on economic growth. The study conducted the VEC model which is a VAR model to determine the effect. The study based on the co-integration equation identified that it is suitable to use the VEC Model to determine the relationship between the variables. The study will pay attention to the long-term relationship that exist between the variables since the variables exhibit stationarity and there also exist a long-run relationship between the variables.

Lag length selection

After the study conducted the unit root test to determine the sequence of integration for the variables, the study determined the lag length for the model to determine the optimum lag length for the model. The table 6 below shows the lag length and the optimum lag to be used for the model. To determine the optimum lag length the study used the Akaike information criterion. Although Akaike information criterion was the main decision making model for the optimum lag length selection, the researcher also compared the Hannan-Quinn information criteria, the SBC, AIC and the FPE model. The table below shows that the FPE, AIC, LR and the HQ model all shows that the optimum lag is 1.

Table 6**: **Lag length selection criteria

Lag	LogL	L.R	F.P.E	A.I.C	S.C	H.Q
0	-299.8617	NA	10957.90	17.81540	17.95008	17.86133
1	-219.1360	142.4573*	161.7231*	13.59623*	14.13495*	13.77995*
2	-215.4113	5.915662	223.8164	13.90655	14.84930	14.22805
3	-211.4736	5.559132	312.4353	14.20433	15.55112	14.66362

Source: Adjandeh, (2022)

VECM (Industrialization and economic growth)

Table 7 shows the output from the VECM with the standard errors in round brackets or parenthesis with the t-statistics in square brackets. The table shows that there is a positive relationship between the three independent variables (industrialization, service sector and the agricultural sector) and GDP growth rate in Ghana. All the relationships are significant with a t-statistics greater than 2. The table shows that when industrialization increases the GDP growth rate of Ghana also increases, when the performance of the service sector also increases the GDP growth rate of the country increases, and when the performance of the service sector increases the GDP growth rate of the country increases.

The output had a co-integration error correction term with a negative coefficient and a t-statistic which is significant implying the existence of a long-run relationship. The output also had an r-squared of 0.4985 which implies about 50% change in the GDP growth rate of Ghana can be explained by the changes in industrial, agricultural and service sector.

Table 7: VECM (Industrialization and economic growth)

Co-integrating Equation	Coefficients
GDPG(-1)	1.000000
IND(-1)	42.61707
	(15.1939)
	[2.80487]
SERV(-1)	35.82625
	(13.6436)
	[2.62586]
AGRIC(-1)	37.58965
	(13.6811)
	[2.74757]
C	-397.5975
Error Correction:	D(GDPG)
CointEq1	-0.559299
	(0.21296)
	[-2.62631]
R-squared	0.498525

Source: Adjandeh, (2022)

Vector Error Correction Residual Serial Correlation LM Tests

The study conducted the VEC residual serial correlation test using the LM test. Table 8 shows the null hypothesis of no serial correlation at lag h and no serial correlation at lags 1 to h. based on the probability values of the test the study concludes the VEC model is free of autocorrelation which is of concern to econometric analysis. The table 8 shows that we accept the null hypothesis of no serial correlation at lag h and other lags since all the p values are greater than 5%.

Table 8: VEC Residual Serial Correlation LM Tests

Hypothesis (Null): No serial correlation at lag h						
Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
ONE	12.05584	16	0.7401	0.737014	(16, 52.6)	0.7442
TWO	6.543156	16	0.9811	0.381460	(16, 52.6)	0.9815
Hypothesis (Null): No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob	Rao F-stat	df	Prob
ONE	12.05584	16	0.7401	0.737014	(16, 52.6)	0.7442
TWO	25.91898	32	0.7672	0.765091	(32, 49.5)	0.7874

*Edgeworth expansion corrected likelihood ratio statistic.

Source: Adjandeh, (2022)

VEC Residual Heteroskedasticity Tests

The study also conducted the heteroskedastiity test to check for the presence of heteroskedasticity in the VEC model as shown in the table 9 below.

The joint output from the VEC residual heteroskedasticity test shows that we accept the null hypothesis of no heteroscedasticity.

Table 9: VEC Residual Heteroskedasticity Tests

Joint test:		
Chi-square	Degrees of freedom	Probability value
172.6582	180	0.6395

Source: Adjandeh, (2022)

Economic growth and health status

The second sub aim of the research was to identify the effect of economic growth on the health status of citizens in the economy. The study conducted the VEC Model which is a VAR model to determine the effect.

The study based on the co-integration equation identified that it is suitable to use the VECM to determine the relationship between the variables. The study will pay attention to the long-term relationship that exist between the variables since the variables exhibit stationarity and there also exist a long-run relationship between the variables.

Lag length selection criteria

After the study conducted the unit root test to determine the sequence of integration for the variables, the study determined the lag length for the model to determine the optimum lag length for the model. The table 10 below shows the lag length and the optimum lag to be used for the model. To determine the optimum lag length the study used the Akaike information criterion. Although Akaike information criterion was the main decision making model for the optimum lag length selection, the researcher also compared the Hannan-Quinn information criteria, the SBC, AIC and the FPE model. The table 10 below shows that the FPE, AIC, LR and the HQ model all shows that the optimum lag is 4.

Table 10: Lag length selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	114.8416	NA	8.84e-10	-6.657068	-6.430325	-6.580776
1	343.2885	373.8221	3.99e-15	-18.98718	-17.62672	-18.52943
2	426.0327	110.3256	1.35e-16	-22.48683	-19.99265	-21.64761
3	494.5888	70.63356	1.31e-17	-25.12659	-21.49870	-23.90592
4	572.4150	56.60087*	1.09e-18*	-28.32818*	-23.56657*	-26.72604*

Source: Adjandeh, (2022)

VECM (Economic growth and health status)

Table 11 below shows the output from the VECM with the standard errors in round brackets or parenthesis with the t-statistics in square brackets. The

VECM results show that there is a direct relationship existing between life expectancy rate and GDP growth rate as well as agricultural sector. The VECM results also shows that there is a negative relationship between life expectancy rate and unemployment as well as mortality rate. The output shows that when the GDP growth rate increases the life expectancy rate of citizens also increase. A unit increase in GDP growth rate will lead to about 2.% increase in the life expectancy rate of citizens. However, the life expectancy rate of an individual will decrease by 2.3% if there is a unit increase in unemployment in Ghana. Increasing mortality rate will also decrease the life expectancy of a person by 5.4%.

The VECM result in table 11 also has an error correction term which is negative and significant, confirming the presence of a long-run relationship. The R-squared of the model is 0.725 which implies the independent variables explain about 72% of the changes in life expectancy rate in Ghana.

Table 11: VECM (Economic growth and health status)

Co-integrating Equation	Coefficients
LNLE(-1)	1.000000
LNGDP(-1)	0.020184
	(0.00243)
	[8.30174]
LNUNEMP(-1)	-0.023794
	(0.00546)
	[-4.35719]
LNAGRIC(-1)	0.188001
	(0.01989)
	[9.45330]
LNMR(-1)	-0.054465
	(0.02223)
	[-2.45051]
C	-4.500202
Error Correction:	D(LNLE)
CointEq1	0.063217

	(0.02340)
	[2.70205]
R-squared	0.725155

Source: Adjandeh, (2022)

Vector Error Correction Residual Serial Correlation LM Tests

The study conducted the VEC residual serial correlation test using the LM test. Table 12 shows the null hypothesis of no serial correlation at lag h and no serial correlation at lags 1 to h. based on the probability values of the test the study concludes the VEC model is free of autocorrelation which is of concern to econometric analysis. The table 12 shows that we accept the null hypothesis of no serial correlation at lag h and other lags since all the p values are greater than 5%.

Table 12: VEC Residual Serial Correlation LM Tests

Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
ONE	38.39673	25	0.0423	1.844171	(25, 27.5)	0.6020
TWO	43.91189	25	0.0111	2.291361	(25, 27.5)	0.1820
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	df	Prob	Rao F-stat	df	Prob
ONE	38.39673	25	0.0423	1.844171	(25, 27.5)	0.6020
TWO	90.45282	50	0.0004	2.729595	(50, 12.5)	0.2801

*Edgeworth expansion corrected likelihood ratio statistic.

Source: Adjandeh, (2022)

VEC Residual Normality Tests

The residual normality test shows the probability values of the individual variables as well as the joint probability as shown in table 13. The test shows the residual distribution of the individual variables and the combined residual distribution. Table 13 shows that the third and the fifth components are normally distributed while the other variables do not have their residuals normally distributed. The overall joint probability shows that the residuals of the variables are normally distributed.

Table 13: VEC Residual Normality Tests

Component	Jarque-Bera	Degrees of freedom	Probability values
One	0.717839	2	0.6984
Two	0.469732	2	0.7907
Three	1.416078	2	0.0206
Four	0.541242	2	0.7629
Five	0.398836	2	0.0192
Combined	3.543728	10	0.0256

Source: Adjandeh, (2022)

Industrialization and health status

The third sub objective of the study was to identify the effect of economic growth on the health status of citizens in the economy. The study conducted the VEC Model which is a VAR model to determine the effect.

The study based on the co-integration equation identified that it is suitable to use the VEC Model to determine the relationship between the variables. The study will pay attention to the long-term relationship that exist between the variables since the variables exhibit stationarity and there also exist a long-run relationship between the variables.

Lag length selection criteria

Table 14: Lag length selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	8.130030	NA	9.15e-06	-0.250305	-0.068910	-0.189271
1	143.4428	229.6217	6.68e-09	-7.481383	-6.574409	-7.176214
2	191.3123	69.62838	1.02e-09	-9.412869	-7.780315	-8.863564
3	219.5602	34.23977	5.47e-10	-10.15516	-7.797028	-9.361721
4	252.4302	31.87399*	2.54e-10*	-11.17759*	-8.093875*	-10.14001*

Source: Adjandeh, (2022)

After the study conducted the unit root test to determine the sequence of integration for the variables, the study determined the lag length for the model to determine the optimum lag length for the model. Table 14 shows the lag length and the optimum lag to be used for the model. To determine the optimum lag length the study used the Akaike information criterion. Although Akaike information criterion was the main decision making model for the optimum lag length selection, the researcher also compared the Hannan-Quinn information criteria, the SBC, AIC and the FPE model. Table 14 shows that the FPE, AIC, LR and the HQ model all shows that the optimum lag is 4.

VECM (Industrialization and health status)

Table 15 shows the output from the VECM with the standard errors in round brackets or parenthesis with the t-statistics in square brackets. Table 15 shows that there is a negative relationship between industrialization and life expectancy which implies the health status of a person deteriorates when industrialization increases. GDP growth rate and foreign direct investment on the other hand has a positive effect on the life expectancy rate of an individual.

The VECM result also has an EC term which is negative and significant, confirming the presence of a long-run relationship. The R-squared of the model is 0.826 which implies the independent variables explain about 82% of the changes in life expectancy rate in Ghana.

Table 15: VECM (Industrialization and health status)

Coefficients	Cointegration Equation
LNLE(-1)	1.000000
LNIND(-1)	-0.805723
	(0.14916)
	[-5.40187]
LNGDP(-1)	0.597862
	(0.10550)
	[5.66681]
LNFDI(-1)	0.097351
	(0.02337)
	[4.16500]
C	-0.630376
Error Correction:	D(LNLE)
CointEq1	-0.003370
	(0.00144)
	[-2.34460]
R-squared	0.825521

Source: Adjandeh, (2022)

VEC Residual Heteroskedasticity Tests

The study also conducted the heteroskedastiity test to check for the presence of heteroskedasticity in the VEC model as shown in table 16. The joint output from the VEC residual heteroskedasticity test shows that we accept the null hypothesis of no heteroscedasticity.

Table 16: VEC Residual Heteroskedasticity Tests

Joint test:		
Chi-square	Degrees of freedom	Probability values
161.7977	180	0.8310

Source: Adjandeh, (2022)

VEC Residual Serial Correlation LM Tests

The study conducted the VEC residual serial correlation test using the LM test. Table 17 shows the null hypothesis of no serial correlation at lag h and no serial correlation at lags 1 to h. based on the probability values of the test the study concludes the VEC model is free of autocorrelation which is of concern to econometric analysis. The table shows that we accept the null hypothesis of no serial correlation at lag h and other lags since all the p values are greater than 5%.

Table 17: VEC Residual Serial Correlation LM Tests

Null hypothesis: No serial correlation at lag h						
Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	26.58366	16	0.0463	1.848009	(16, 52.6)	0.4882
2	9.730559	16	0.8803	0.583019	(16, 52.6)	0.8825
Null hypothesis: No serial correlation at lags 1 to h						
Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	26.58366	16	0.0463	1.848009	(16, 52.6)	0.4882
2	32.09177	32	0.4622	0.997261	(32, 49.5)	0.4942

*Edgeworth expansion corrected likelihood ratio statistic.

Source: Adjandeh, (2022)

Objective two

The second objective of the study was to identify how the variables will react due to shocks from other variables. The study in the first objective estimated the effects of the variables on each other (effect of industrialization on economic growth, effect of economic growth on health status and effect of industrialization on health status) and used the VAR estimate to determine the shocks the variables will have on each other. The impulse response output of the variables are represented below.

Response of GDP growth rate and industrialization to life expectancy rate

The Figures 3 and 4 below shows the response of GDP growth rate and industrialization to shocks in health status measured with the changes in life expectancy rate. The figure 4 shows that GDP growth rate does not show an upward or downward continues change when there is a shock life expectancy rate. The GDP growth rate grows and falls when there is a shock in the health status. The GDP growth rate takes only two periods to correct the shocks from changes in health status. That is when there is a shock in life expectancy rate implying health status changes, the GDP growth rate of Ghana can initially decrease but recover within a two year period.

From Figure 3, industrialization although does not show a perfect upward looking trend, decreases for the first five periods when health status changes. The industrialization level increases from the 8th period and continues to increase although showing some periodic falls but does not fall to the initial shock level.

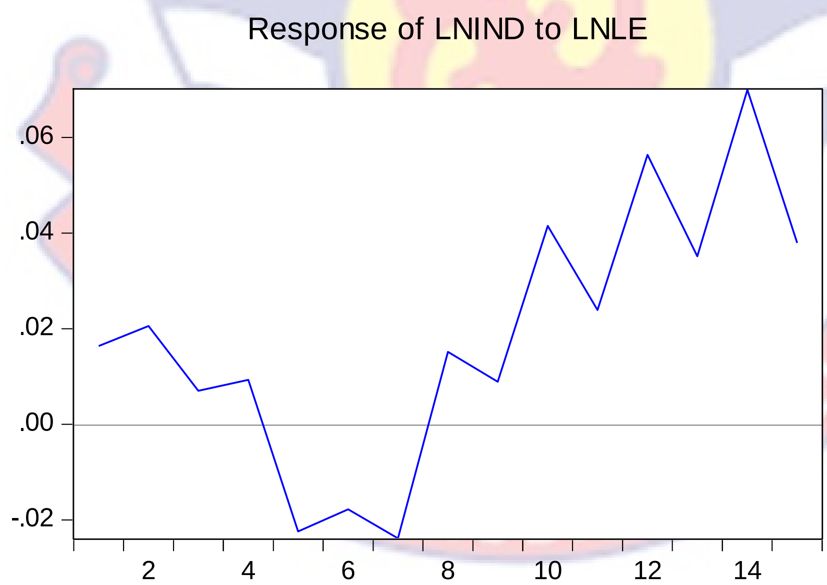

Figure 3: Response of industrialization to life expectancy

Source: Adjandeh, (2022)

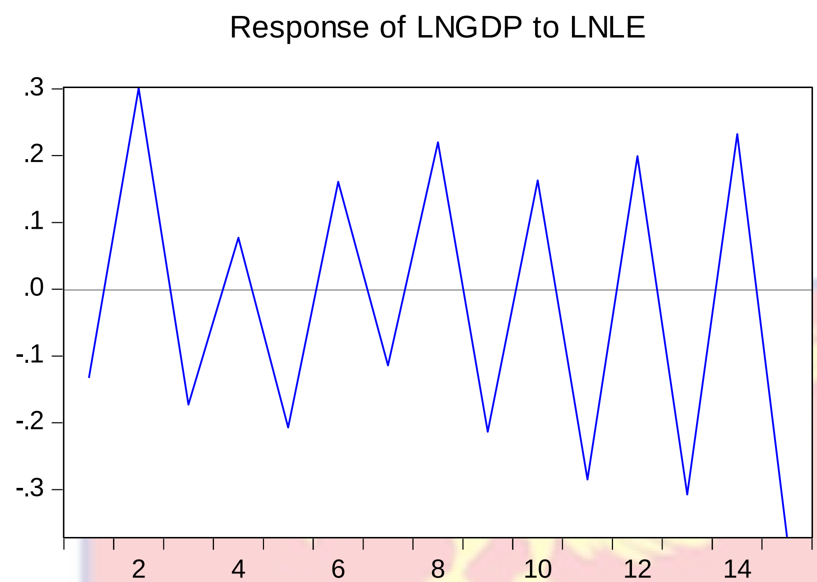

Figure 4: Response of GDP growth rate to life expectancy

Source: Adjandeh, (2022)

Response of life expectancy rate and industrialization to GDP growth rate

From Figure 5, life expectancy shows a unique behavior when there is a shock from the GDP growth rate in Ghana. Figure 5 shows that when there is a change in the GDP level, the life expectancy responds by increasing for about 10 periods before reaching a peak and falling. The figure 5 shows a single shock in GDP growth rate could improve the health status of citizens for about a decade.

Figure 6 shows that industrialization declines in the initial stages when there is a shock in GDP. However this change is not consistent due to the explosive nature of the shock.

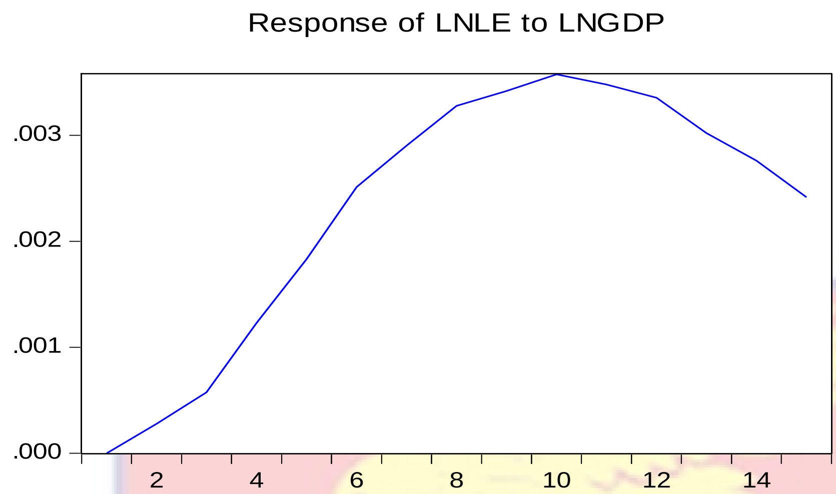

Figure 5: Response of life expectancy to GDP growth rate

Source: Adjandeh, (2022)

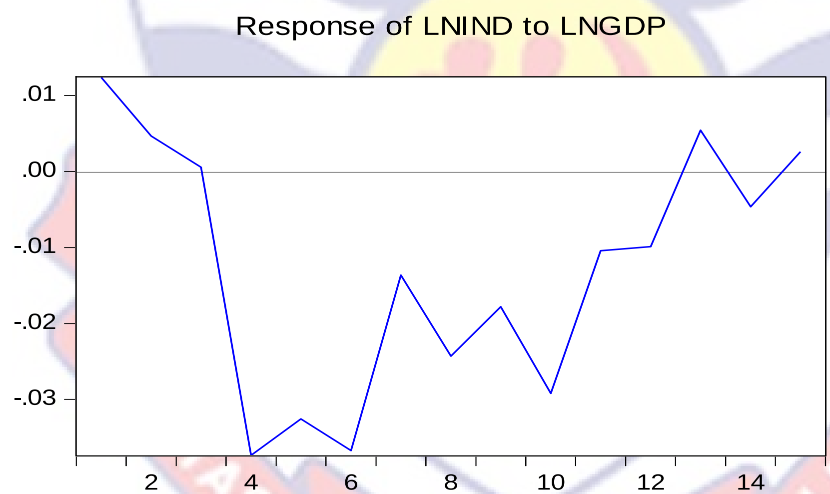

Figure 6: Response of industrialization to GDP growth rate

Source: Adjandeh, (2022)

Response of life expectancy rate and GDP growth rate to industrialization

Figures 7 and 8 below shows the response of life expectancy rate and GDP growth rate to industrialization. Figure 7 shows that a shock in industrialization will lead to a decrease in life expectancy rate for the initial periods. Life expectancy rate will increase however in the fifth period till the about the tenth period. Figure 8 shows that there is not consistent change in GDP when there is an industrial shock.

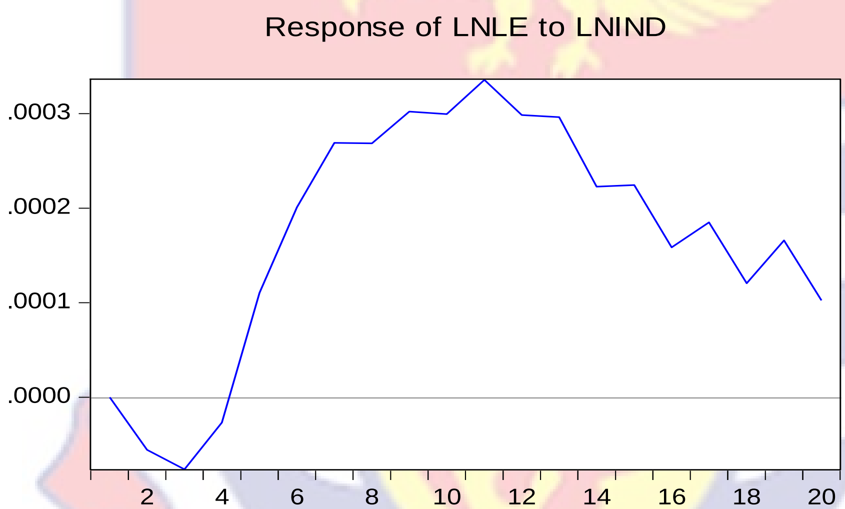

Figure 7: Response of life expectancy to industrialization

Source: Adjandeh (2022)

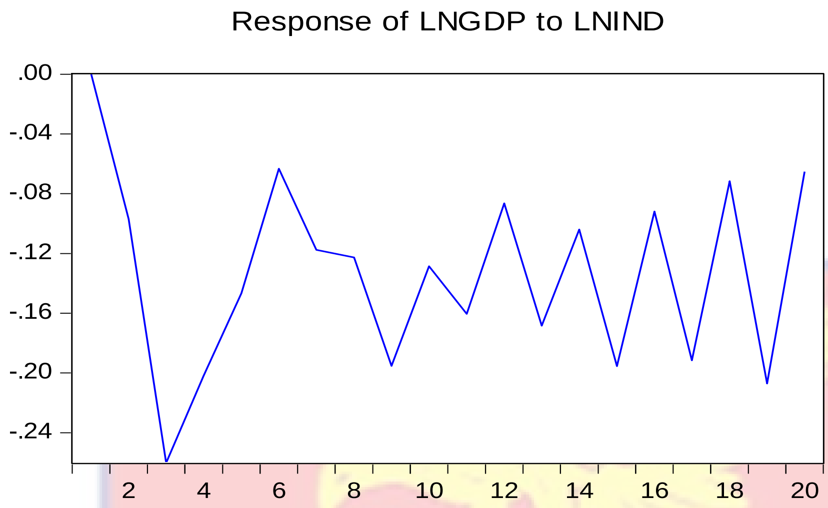

Figure 8: Response of GDP growth rate to industrialization

Source: Adjandeh, (2022)

Discussion

The study was conducted to determine the relationship between industrialization, health status and economic growth in Ghana. The study used three variables to measure health status which is mortality rate, fertility rate and life expectancy rate. The study employed VAR model specifically Vector Error Correction Model to answer the objectives of the study.

An important theory reviewed by the study is the Preston curve model which states that individuals with better incomes in a country have the chance of living longer while individuals with lower incomes have a shorter life expectancy (Preston, 1975). This analogy implies countries with higher income (GDP) have a longer life expectancy rate as compared to countries with lower income. The conclusion according to the Preston Curve model shows that there is a positive relationship between GDP and life expectancy.

The findings of this study confirms the Preston Curve model by obtaining a positive relationship between GDP growth rate and life expectancy. The findings shows that when the income of the country is growing the number of years individuals can live in the country also increases. The impulse response of life expectancy when there is a shock in the GDP growth rate also shows there is a rise in life expectancy when there is shock in GDP growth rate increases. This shock can last for about 10 years in the economy before the effects become to varnish or reduce.

Another theory considered by the study is the Environmental Kuznet Curve which explains the relationship between environmental degradation and per capita income. The theory shows the relationship between activities relating to pollution (industrialization) and the per capita income (GDP) of a country. The theory states that initially pollution will lead to an increment in per capita income and with the time the relationship becomes negative. The findings of this study shows that there is a positive relationship as stated by theory.

This positive relationship can be attributed to the benefits of industrialization due to the increased income for the country from the industrial activities. The period under study for Ghana has seen several industrial activities being undertaking in the country. Different government investing into industries and a boost in public private partnerships in the country. The study based on the findings from the impulse response analysis found out that GDP responds to industrialization in a similar manner. GDP increases and decreases but the pattern is repetitive in every 2 to 3 years.

Findings from studies conducted on the effect of health expenditure on the health status of individuals in developing and less developed countries show that there is a significant relationship between health expenditure and healthy living. The findings of Anyanwu and Erhijakpor (2009) and Or (2000) suggest that when there is increased expenditure on health there is a positive effect on the life expectancy and mortality rate and especially the health status of women. Findings of this study also suggest there is a positive relationship between GDP growth rate and life expectancy. Findings of Anyanwu and Erhijakpor (2009) also suggested that African countries will improve their life expectancy when there is an improvement in the investment in health care systems which implies GDP spent on health systems will lead to improved life expectancy.

Another important relationship that was considered in the study is the relationship between health and economic growth considering the angle where health status has an effect on the economic growth of a country. The findings of Bloom et al., (2018) suggest that healthy populations will lead to improved economic growth. Specifically improvements in health the population will increase human capital investment (female labor force participation) and reduce fertility. The findings of this study are in line with those of Bloom et al., (2018), in that there is a positive relationship between life expectancy rate and GDP growth rate in Ghana. This relationship is also shown in the response of GDP growth rate to shocks in the life expectancy rate in Ghana. The study found out that when there is an increase in life expectancy rate (number of years a person lives in Ghana increases), the GDP growth rate of the country increases for about a decade.

CHAPTER FIVE

SUMMARY, CONCLUSION AND RECOMMENDATION

Introduction

The final chapter of the study concludes the study and summarizes the findings of the study. The chapter five also contains the recommendations and policy implications of the study. The researcher give recommendations in the chapter based on the findings of the study and the results of the study.

Summary

This study was conducted to identify the relationship between industrial activities, economic growth and health conditions in Ghana. The research aimed at identifying effect of each of the variables on each other which implies the effect of the variables on another and the reversed causality between the variables. To complete the research, to main objectives were used; first is to identify the association between, economic growth industrialization and health status. The second objective was to determine the effect of shocks on the relationship between industrialization, economic growth and health status. The study developed six hypothesis which guided the research in answering the research objectives.

The research employed the positivist philosophy to conduct the research which uses the quantitative research approach under an objective epistemology. This allows for the methods of natural science to be applied to social science studies. The research design employed in the study is a Quasi Experimental research design. This design was used to help conduct a time series analysis on the relationship between industrialization, economic growth and health status in Ghana. The main theories underpinning the study are the environmental kuznet curve theory and the Preston's curve hypothesis. The study used the Vector Error correction Model (VECM) to identify the association or relationship between the variables and used the Impulse Response Function (IRF) to identify the reaction of the variables to shocks in the economy.

The findings of the study based on the VECM analysis and the IRF analysis are presented below;

- The study found out that some of the variables are not stationary at level but after applying the first differencing method using the ADF test all the variables were significant. The study proceeded to conduct a co-integration test to identify the existence of a long run relationship and both the max-eigen statistics and the trace test confirm the existence of a long run relationship. The optimal lag length identified for the research is 4 based on the lag length selection criterions.
- The findings from the relationship between industrialization and economic growth shows that there is a positive relationship between the three independent variables (industrialization, service sector and the agricultural sector) and GDP growth rate in Ghana. All the relationships are significant with a t-statistics greater than 2. Findings also show that when industrialization increases the

GDP growth rate of Ghana also increases, when the performance of the service sector also increases the GDP growth rate of the country increases, and when the performance of the service sector increases the GDP growth rate of the country increases.

- The findings from the relationship between economic growth and health status shows that, there is a positive relationship between life expectancy rate and GDP growth rate as well as agricultural sector. The VECM results also shows that there is a negative relationship between life expectancy rate and unemployment as well as mortality rate. The output shows that when the GDP growth rate increases the life expectancy rate of citizens also increase. A unit increase in GDP growth rate will lead to about 2% increase in the life expectancy rate of citizens. However, the life expectancy rate of an individual will decrease by 2.3% if there is a unit increase in unemployment in Ghana. Increasing mortality rate will also decrease the life expectancy of a person.
- The findings from the relationship between industrialization and health status shows that, there is a negative relationship between industrialization and life expectancy which implies the health status of a person deteriorates when industrialization increases. GDP growth rate and foreign direct investment on the other hand has a positive effect on the life expectancy rate of an individual.

- The findings on the response of economic growth and industrialization to life expectancy shows that GDP growth rate does not show an upward or downward continues change when there is a shock in life expectancy rate. The GDP growth rate grows and falls when there is a shock in the health status. The GDP growth rate takes only two periods to correct the shocks from changes in health status. That is when there is a shock in life expectancy rate implying health status changes, the GDP growth rate of Ghana can initially decrease but recover within a two year period. Industrialization although also does not show a perfect upward looking trend, decreases for the first five periods when health status changes. The industrialization level increases from the 8th period and continues to increase although showing some periodic falls but does not fall to the initial shock level.
- The findings on the response of life expectancy rate and industrialization to economic growth shows that, Life expectancy shows a unique behavior when there is a shock from the GDP growth rate in Ghana. Also when there is a change in the GDP level, the life expectancy responds by increasing for about 10 periods before reaching a peak and falling. That is a single shock in GDP growth rate could improve the health status of citizens for about a decade.

- The findings on the response of life expectancy rate and economic growth to industrialization shows that, a shock in industrialization will lead to a decrease in life expectancy rate for the initial periods. Life expectancy rate will increase however in the fifth period till the about the tenth period.

Conclusions

The aim of this study was to identify the relationship that exist between industrialization, economic growth and health status. Specifically the study sought to identify the effects industrialization on the health status of Ghana and the economy as a whole, as well as the effect of health status on the economic growth of the country. The study was conducted based on the need to identify the effect industrialization has on the health status of the country and how it also affects the economic growth of the country. The specific objectives of the study were to identify the relationship between industrialization, economic growth, and health status in Ghana and secondly to identify the effect of shocks on the relationship between industrialization, economic growth and health status in Ghana.

To answer this objectives, the researcher reviewed some theories which are critical to the study, namely the Preston Curve model, and the environmental Kuznet curve. The study also reviewed relevant literature which is based on the study. The study used an econometric model to answer analyze the data to answer the stated objectives. The study employed the Vector Error Correction Model which is a VAR model that can help determine the long run relationship that exist between time series variables that are co-integrated.

Before applying the VAR model, the study ensured the time series data was stationary. Stationarity is a prerequisite for conducting a time series analysis to determine long run relationships. The study also used the impulse analysis method to identify the shocks that variables have on each other. The study collected data from the World Bank Data Portal to help in answering the research objectives.

The findings of the research shows that all the variables were not stationary at level but at first difference all the variables were stationary. The stationarity test was done using the breakpoint Augmented Dickey Fuller test (ADF). The co-integration test conducted showed that there exist a long run relationship between the variables with Trace statistics as well as the Max-Eigen test for stationarity based on the Johansen stationarity test shows there were about two co-integration equations.

The first sub hypothesis of the first objective was based on identifying the relationship between industrialization and economic growth in Ghana. The findings showed that there is a positive relationship between industrialization and economic growth in the long-run. The findings also showed that there exist a positive long-run relationship between service sector and the agriculture sector and economic growth in the long-run. This shows that when the three sectors of the economy are performing well, the economic growth rate of the country will also improve. Inversely when the three sectors of the economy do not perform effectively leading to fall in their output, the economic growth of the country will reduce.

The second sub objective of the first objective was to identify the relationship between economic growth and health status. The VECM results show that there is a positive relationship between life expectancy rate and GDP growth rate as well as agricultural sector. The VECM results also shows that there is a negative relationship between life expectancy rate and unemployment as well as mortality rate. The output shows that when the GDP growth rate increases the life expectancy rate of citizens also increase. A unit increase in GDP growth rate will lead to about 2% increase in the life expectancy rate of citizens.

The third sub objective the first objective was to identify the relationship between industrialization and health status. The results shows that there is a negative relationship between industrialization and life expectancy which implies the health status of a person deteriorates when industrialization increases. GDP growth rate and foreign direct investment on the other hand has a positive effect on the life expectancy rate of an individual.

The second objective of the study was to identify how the variables will react due to shocks from other variables. The study in the first objective estimated the effects of the variables on each other (effect of industrialization on economic growth, effect of economic growth on health status and effect of industrialization on health status) and used the VAR estimate to determine the shocks the variables will have on each other.

The impulse response shows that GDP growth rate does not show an upward or downward continues change when there is a shock life expectancy rate.

The GDP growth rate grows and falls when there is a shock in the health status. The GDP growth rate takes only two periods to correct the shocks from changes in health status. That is when there is a shock in life expectancy rate implying health status changes, the GDP growth rate of Ghana can initially decrease but recover within a two year period. Industrialization although also does not show a perfect upward looking trend, decreases for the first five periods when health status changes. The industrialization level increases from the 8^{th} period and continues to increase although showing some periodic falls but does not fall to the initial shock level.

Life expectancy shows a unique behavior when there is a shock from the GDP growth rate in Ghana. The impulse response shows that when there is a change in the GDP level, the life expectancy responds by increasing for about 10 periods before reaching a peak and falling. The impulse response shows a single shock in GDP growth rate could improve the health status of citizens for about a decade. The impulse response shows that a shock in industrialization will lead to a decrease in life expectancy rate for the initial periods. Life expectancy rate will increase however in the fifth period till the about the tenth period.

Recommendations

The study was conducted to identify the relationship that exist between economic growth, industrialization and health status in Ghana. The research found a positive relationship between industrialization, and economic growth. The same relationship exist between agriculture sector and service sector on economic growth. This implies the government must ensure the three sectors of the economy perform well. Specifically the industrial sector must be given unique attention since it has the potential of improving health status (life expectancy rate) through improved GDP.

Unemployment was also found to have a negative effect on the health status of individuals which can be deduced from individuals who are not working will not be able to have enough resources to use the health facilities and also perform activities to improve their health in the country hence their life expectancy rate will reduce.

The study also recommends for government to invest in better health systems and other infrastructures that improve the health system in the country since poor health status will lead to a fall in the GDP growth rate. The impulse response shows that a shock in the health status of the economy will lead to a fall in GDP growth rate. It is important to ensure the country has healthy citizens to ensure economic growth continues to increase.

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Appendix

VAR Estimates

Sample :1986 2020

Observations: 35 after adjustments

Standard errors in ( ) & t-statistics in [ ]

	GDPG	INDUSTRIALIZATION	SERVICES	AGRIC
GDPG(-1)	0.213469	0.245962	0.587533	-0.620858
	(0.21997)	(0.29574)	(0.50759)	(0.28978)
	[0.97046]	[0.83169]	[1.15750]	[-2.14248]
GDPG(-2)	0.080930	0.200795	0.060390	-0.328801
	(0.19537)	(0.26267)	(0.45084)	(0.25738)
	[0.41423]	[0.76443]	[0.13395]	[-1.27747]
INDUSTRIALIZATION(-1)	-0.865774	0.747518	-0.954590	0.829375
	(0.35905)	(0.48273)	(0.82852)	(0.47301)
	[-2.41131]	[1.54854]	[-1.15216]	[1.75341]

INDUSTRIALIZAT				
ION(-2)	0.143564	0.126699	0.946150	-1.299381
	(0.36113)	(0.48552)	(0.83332)	(0.47575)
	[0.39754]	[0.26095]	[1.13539]	[-2.73124]
SERVICES(-1)	-0.317284	-0.067253	0.403524	0.326029
	(0.20154)	(0.27096)	(0.46505)	(0.26550)
	[-1.57434]	[-0.24821]	[0.86769]	[1.22798]
SERVICES(-2)	0.122344	0.125817	0.320465	-0.524633
	(0.18406)	(0.24747)	(0.42474)	(0.24248)
	[0.66469]	[0.50842]	[0.75450]	[-2.16358]
AGRIC(-1)	-0.317850	-0.114445	-0.420420	1.191083
	(0.19021)	(0.25573)	(0.43892)	(0.25058)
	[-1.67104]	[-0.44752]	[-0.95784]	[4.75324]
AGRIC(-2)	-0.096518	0.108938	0.358954	-0.555204
	(0.19911)	(0.26770)	(0.45946)	(0.26231)
	[-0.48474]	[0.40694]	[0.78125]	[-2.11661]
C	42.04697	-0.944495	9.420393	34.55287

	(14.4375)	(19.4107)	(33.3155)	(19.0200)
	[2.91233]	[-0.04866]	[0.28276]	[1.81666]
R-squared	0.530292	0.845572	0.760762	0.956225
Adj. R-squared	0.385766	0.798056	0.687150	0.942756
Sum sq. resids	88.78103	160.4786	472.7447	154.0821
S.E. equation	1.847878	2.484402	4.264093	2.434386
F-statistic	3.669185	17.79544	10.33479	70.99372
Log likelihood	-65.95228	-76.31206	-95.21898	-75.60026
Akaike AIC	4.282988	4.874975	5.955370	4.834300
Schwarz SC	4.682934	5.274922	6.355317	5.234247
Mean dependent	5.311192	24.11453	36.45089	32.97958
S.D. dependent	2.357797	5.528488	7.623575	10.17478
Determinant resid covariance				
(dof adj.)		301.5881		
Determinant resid covariance		91.84074		
Log likelihood		-277.7524		
Akaike information criterion		17.92871		
Schwarz criterion		19.52849		
Number of coefficients		36		

Vector Autoregression Estimates

Sample (adjusted): 1986 2020

Included observations: 35 after adjustments

Standard errors in ( ) & t-statistics in [ ]

	LNLE	LNGDPG	LNUNEMPLOYMENT	LNAGRIC	LNMR
LNLE(-1)	1.729126	72.86421	-21.49197	6.937933	-0.977344
	(0.07213)	(49.9223)	(11.5096)	(5.92699)	(0.62859)
	[23.9737]	[1.45955]	[-1.86730]	[1.17057]	[-1.55483]
LNLE(-2)	-0.844524	-55.80731	25.36261	-10.19276	0.912624
	(0.06509)	(45.0505)	(10.3864)	(5.34859)	(0.56724)
	[-12.9752]	[-1.23877]	[2.44190]	[-1.90569]	[1.60888]
LNGDPG(-1)	9.41E-05	0.406026	-0.012173	0.001386	-0.003192
	(0.00040)	(0.27976)	(0.06450)	(0.03321)	(0.00352)
	[0.23275]	[1.45133]	[-0.18873]	[0.04172]	[-0.90627]
LNGDPG(-2)	-9.95E-05	0.040034	0.103012	-0.064357	-0.000839
	(0.00039)	(0.27174)	(0.06265)	(0.03226)	(0.00342)
	[-0.25356]	[0.14732]	[1.64425]	[-1.99480]	[-0.24511]

LNUNEMPLOYMENT(-1)	-0.000764	-0.461616	0.989824	0.141663	-0.001434
	(0.00112)	(0.77518)	(0.17872)	(0.09203)	(0.00976)
	[-0.68226]	[-0.59550]	[5.53849]	[1.53927]	[-0.14694]
LNUNEMPLOYMENT(-2)	-3.33E-05	1.207590	-0.164074	-0.119798	-0.010171
	(0.00122)	(0.84309)	(0.19437)	(0.10010)	(0.01062)
	[-0.02737]	[1.43234]	[-0.84411]	[-1.19684]	[-0.95809]
LNAGRIC(-1)	-0.000969	0.851118	-0.237336	0.563950	0.011790
	(0.00199)	(1.37837)	(0.31778)	(0.16365)	(0.01736)
	[-0.48654]	[0.61748]	[-0.74685]	[3.44616]	[0.67933]
LNAGRIC(-2)	-0.001324	-0.054268	0.590269	-0.308871	0.017504
	(0.00197)	(1.36460)	(0.31461)	(0.16201)	(0.01718)
	[-0.67144]	[-0.03977]	[1.87619]	[-1.90648]	[1.01872]
LNMR(-1)	-0.069693	1.957204	-4.161680	1.889481	1.800924
	(0.02142)	(14.8264)	(3.41825)	(1.76026)	(0.18668)
	[-3.25355]	[0.13201]	[-1.21749]	[1.07341]	[9.64693]
LNMR(-2)	0.054772	0.356870	4.513097	-1.621276	-0.850966

	(0.02157)	(14.9310)	(3.44236)	(1.77267)	(0.18800)
	[2.53905]	[0.02390]	[1.31105]	[-0.91459]	[-4.52640]
C	0.539180	-82.33098	-18.29894	14.80195	0.391177
	(0.08839)	(61.1826)	(14.1057)	(7.26386)	(0.77037)
	[6.09970]	[-1.34566]	[-1.29727]	[2.03775]	[0.50778]
R-squared	0.999858	0.306658	0.942915	0.981173	0.999746
Adj. R-squared	0.999798	0.017765	0.919130	0.973329	0.999640
Sum sq. resids	1.05E-05	5.018125	0.266732	0.070733	0.000796
S.E. equation	0.000661	0.457262	0.105422	0.054288	0.005758
F-statistic	16852.75	1.061495	39.64275	125.0785	9447.789
Log likelihood	213.2206	-15.67274	35.68219	58.91055	137.4435
Akaike AIC	-11.55546	1.524157	-1.410411	-2.737746	-7.225345
Schwarz SC	-11.06664	2.012980	-0.921587	-2.248922	-6.736521
Mean dependent	4.079137	1.576235	1.674896	3.445030	4.036458
S.D. dependent	0.046515	0.461379	0.370713	0.332417	0.303540

Determinant resid covariance	
(dof adj.)	3.09E-17
Determinant resid covariance	4.68E-18
Log likelihood	450.0014
Akaike information criterion	-22.57151
Schwarz criterion	-20.12739

Number of coefficients	55

Vector Autoregression Estimates

Sample (adjusted): 1986 2020

Included observations: 35 after adjustments

Standard errors in ( ) & t-statistics in [ ]

	LNLE	LNINDUS	LNGDPG	LNFDI
LNLE(-1)	2.071336	-15.38238	42.07446	-11.78897
	(0.07591)	(6.04229)	(24.6921)	(35.5793)
	[27.2869]	[-2.54578]	[1.70396]	[-0.33134]
LNLE(-2)	-1.104982	17.41391	-46.51509	17.27398
	(0.08191)	(6.52019)	(26.6451)	(38.3933)
	[-13.4896]	[2.67077]	[-1.74573]	[0.44992]
LNINDUS(-1)	0.002835	0.702442	-0.418456	-0.780140
	(0.00220)	(0.17495)	(0.71493)	(1.03016)
	[1.28998]	[4.01516]	[-0.58531]	[-0.75730]
LNINDUS(-2)	0.002319	-0.134804	-0.798655	0.288267
	(0.00210)	(0.16721)	(0.68330)	(0.98458)
	[1.10380]	[-0.80621]	[-1.16882]	[0.29278]
LNGDPG(-1)	0.000928	0.033173	0.103322	0.073788

	(0.00073)	(0.05831)	(0.23830)	(0.34336)
	[1.26681]	[0.56889]	[0.43359]	[0.21490]
LNGDPG(-2)	0.000144	0.031854	-0.239533	-0.081774
	(0.00067)	(0.05305)	(0.21680)	(0.31239)
	[0.21598]	[0.60044]	[-1.10487]	[-0.26177]
LNFDI(-1)	-0.000190	-0.026764	-0.015957	0.870092
	(0.00042)	(0.03344)	(0.13664)	(0.19689)
	[-0.45119]	[-0.80043]	[-0.11678]	[4.41916]
LNFDI(-2)	0.000527	0.006678	0.332277	-0.089166
	(0.00044)	(0.03514)	(0.14361)	(0.20693)
	[1.19362]	[0.19004]	[2.31379]	[-0.43091]
C	0.118477	-6.913232	23.32102	-20.49073
	(0.03965)	(3.15640)	(12.8988)	(18.5861)
	[2.98775]	[-2.19023]	[1.80800]	[-1.10248]
R-squared	0.999508	0.876145	0.470806	0.878049
Adj. R-squared	0.999357	0.838035	0.307977	0.840526
Sum sq. resids	3.62E-05	0.229348	3.830088	7.952178
S.E. equation	0.001180	0.093921	0.383811	0.553040
F-statistic	6601.479	22.99026	2.891415	23.40012

Log likelihood	191.5196	38.32475	-10.94480	-23.72956
Akaike AIC	-10.42969	-1.675700	1.139703	1.870261
Schwarz SC	-10.02974	-1.275753	1.539649	2.270207
Mean dependent	4.079137	3.156740	1.576235	0.646763
S.D. dependent	0.046515	0.233373	0.461379	1.384878

Determinant resid covariance (dof adj.)	4.37E-10
Determinant resid covariance	1.33E-10
Log likelihood	199.3078
Akaike information criterion	-9.331876
Schwarz criterion	-7.732090
Number of coefficients	36