An Econometric Assessment of the Impact of Crude Oil Production on Health in Nigeria

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ABSTRACT

Health is a fundamental human right. It additionally implies the ability to live socially and economically productive lives.

With rapid expansion of the Petroleum industry with oil accounting for seventy percent of the total export earnings during the 1970s, the Nigerian economy was re-structured from agriculture-driven to oil dependent. Expenditure on health depends on several factors. It is assumed that as natural resource grows, health expenditure will grow. However in case of Nigeria, this will depend on the oil revenue available t o the government from the exportation of oil.

The most significant environmental challenge facing the nation at present is that of pollution arising from oil exploration and production particularly in the oil-rich Niger-Delta region. Residents of these communities have suffered greatly from the effects of oil-spillage, exposure to oil-spills, gas flaring and other diminishing effects.

The major objective of this study is to assess the impact of crude oil production on the health sector in Nigeria. This research paper uses the co-integration and Error Correction Methods (ECM) to analyze the relationship between Health, oil-sourced health revenue, gas flaring, and domestic consumption of crude oil. After deriving the results of the error correction representation, we conclude that crude oil production has a significant impact on health in Nigeria. The study also makes one remarkable discovery: the negative impact gas flaring has on health in Nigeria. It is therefore recommended that incentives should be given to oil companies to undertake best practices together with adequate reward for prompt adherence while more revenue from oil earnings should be devoted to the health sector as this will surely impact significantly on the improvement of healthcare of Nigerians.

Key Words: Health, Petroleum, Crude oil, Gas flaring, Environmental, Revenue

INTRODUCTION

Background to the study

Health is a fundamental human right. The United Nations Declaration of Human Rights formulated in 1948 underpins the human rights of people to healthcare. ‘Rights’ here is defined in terms of individuals, communities, or groups. The most important thing is that such rights are recognized by the United Nations (UN). Article 12 of the International Covenant of Economic, Social, and Cultural Rights specifies the highest attainable standard of health. Health according to the World Health Organization (WHO) does not merely imply the absence of diseases or infirmity. It also implies the ability to live socially and

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economically productive lives.

In Nigeria, several policies have been enacted particularly the National Health Policy (1986) which was Nigeria's first comprehensive national health policy that was based on the Primary Health Care (PHC). The policy contributed to the establishment of PHCs in all local governments in Nigeria. It also achieved universal child immunization of over 80%, and devolved responsibility for PHC to local government areas. (Bolaji, Samina, 2017) Prior to the economic travails of the 1980s, the health sector witnessed appreciable growth particularly due to the unwavering support by government together with donor agencies. Except for some rural areas, access to` healthcare was readily available at public hospitals and clinics at no cost. By the mid-1980s however, this positive development was being rapidly eroded as a result of the daring economic decline.

It is expected that the high percentage of private health expenditure as a proportion of total health expenditure is bound to rise unless there is urgent and significant infusion of resources into the public health sector. The absence of this may mean that proportion of care providers at private facilities will continue to surge leading to diminished access and high cost to most people.

The National Health Insurance Scheme (NHIS) thankfully was promulgated in 1999 to reduce the cost and improve quality available in health services. However, while universal coverage is intended, beneficiaries have been limited to employees of the Federal Government and large corporations; thus, the majority of Nigerians continue to pay through their noses. Millions are left without coverage because of high poverty and therefore concerns have been expressed about this adding to the downward trend of key health indicators: the scourge of HIV/AIDS and already escalating and appalling life expectancy rate.

With rapid expansion of the Petroleum industry with oil accounting for seventy percent of the total export earnings during the 1970s, the economy was restructured from agriculture-driven to oil-dependent. The decline in the international crude oil market in the early 1980s led to the fall in oil revenue from $25billion in 1980 to $6 billion in 1986. Thus, the health sector became increasingly weak and disjointed with only 30% of the population having access to healthcare. Government allocations to health were then in 1991 equivalent to 30% of total expenditure. However, the rate of health expenditure in 1990 was about half its 1981 level.

Because Nigerian economy survived basically on exports of oil, the devaluation of the naira reduced the cost-effectiveness of many health program components. Furthermore, the attempt by SAP from September 1986 to cut down on government spending i.e. a policy of cost recovery saw a substantial fall in health sector services.

Thankfully, the gulf war crisis led to higher oil prices for Nigeria. Though this created a favourable economic climate, numerous capital intensive projects and high level of external debts reduced needed funding to the health sector thus widening the health needs of the populace. Even though the introduction of primary health care in 1980 was followed by increased budgetary allocations, inadequate PHC funding in the form of absolute resource shortage and inefficiencies of resource as well as management shortcomings posed as weaknesses.

It is thus readily seen that the expenditure on health depends on several factors. First, it is assumed that as natural resource grows, health expenditure will grow. However, in the case of Nigeria and given the Millennium Development Goals (MDG) of combating HIV/AIDS, Malaria and other diseases (Goal six), reducing child mortality (Goal Four) improving maternal health (Goal Five) and ensuring environmental sustainability (Goal Seven), this will depend on the oil revenue available to the government from the exportation of oil. Here is where the impact of crude oil production on health in Nigeria takes root.

With regards to the negative impact that the exploration of crude oil in commercial quantities in the oil-rich Niger Delta region by Multinational companies portends, there have been verifiable attestations by host communities and residents to the monumental destruction of farmlands and by extension, the livelihoods due to oil spilling and the worsening of health conditions due to gas flaring activities. Thus, crude oil production has polluted the host communities and released impurities to the land and air which affects the health condition of the host communities.

Empirically, a number of studies have shown that countries' oil production has disproportionate impact on indigenous population and sensitive remote ecosystem. However, none of these studies have attempted to assess the impact of crude oil production on health in Nigeria using any econometric procedure. It is this gap this study intends to cover.

Statement of Problem

In Nigeria, the general health of the population measured by life expectancy has been on the decline. In 1991, the life expectancy at birth was 53.8 and 52.6 for females and males respectively but dropped to 48 years for females and 47 years for males in 2005. This could be directly linked to the rising prevalence of HIV/AIDS which reached 700,000 by year 2000 (Federal ministry of Health). The maternal mortality index in Nigeria has been quite abysmal. It has been noted as one of the highest in the world – 800 deaths per 100,000 live births in year 2000 (World Health Organization). Though there are wide rural-urban disparities, urban areas recorded 351 per 100,000 live births compared with 828 in rural areas. There are also regional disparities with high figures recorded in the North-west and North-east than the South-south. These ratios can be explained by the high illiteracy and poor health statuses together with low allocations to the health sector even in the face of the rising oil earnings.

The most significant environmental challenge facing the nation at present is that of pollution arising from oil exploration and production, particularly in the oil-rich Niger-Delta region. Residents of these communities have suffered greatly from exposure to oil-spills, gas flaring and other diminishing effects.

What follows is a description of this so-called 'resource curse' using a health perspective.

The normal functioning of machines in the production, refining and transport of crude oil pollutes the environment. Air, surface and land are negatively affected by the toxic and hazardous waste that emanate from oil exploratory activities and subsequently inflicts injuries on health. These injuries are borne by host communities in oil-producing states. Periodic overflows of crude oil in the Delta leads to death of edible marine creatures thereby reducing nutritional levels.

Thousands of toxins linked to high cancer rates and waterborne diseases such as cholera, typhoid and diarrhea are being emitted from oil spills and this further provides veritable habitat for disease-spreading mosquitoes to thrive.

Crude Oil production and extractive activities lead to a wider range of chronic health impacts due to the exposure to radio-active materials, mercuries etc. Internally, noise vibrations and chemicals are very dangerous. Other health impacts include adverse dermatological conditions, pulmonary reactions and derma tides acne. Others are facial derelictions and respiratory diseases (Spickett, D'connor and Pelly). Oil refining activities also generate toxic and water emissions, thermal and noise pollutions, etc causing discomforts and hardships.

GAS FLARING ACTIVITIES due to the disposal of gas and separation of needed crude-oil from natural gas also poses grave health consequences through emissions that have been linked to cancer, asthma, chronic bronchitis, blood disorders and other diseases. These threats are real to Nigerians.

It is widely believed that the government deliberately ignores the activities of oil companies simply because of the significance of oil to the economy. The African commission on Human and People's right have identified and indicted Nigeria for violating the right of her citizens to health.

Other general health problems faced in Nigeria include the brain drain syndrome and mass efflux of health practitioners (due to low job morale and development). There is the high cost of health services, galloping mortality rates, high tuberculosis rate (8^{th} in the world according to the World Health Organisation), high malaria incidences particularly in the Delta, high casualty figures from epidemics, purchase of substandard drugs due to poverty and shortages etc

In spite of these problems and challenges, it is surprising that Nigeria is a signatory to many health-related treaties but without practical implementation; of course, impressive paperwork will not guarantee Nigerians' health.

Thus, measures that have been identified for re-energizing and resuscitating the health sector need adequate infusion of funds particularly as provided from crude oil production which is the main source of revenue to the Nigeria economy.

Objectives of the study

The major objective of the study will be to assess the impact of crude oil production on the health in Nigeria.

Other specific objectives of the study include:

- To assess the health implications of ongoing crude oil production on the immediate host communities particularly in the Niger Delta.
- To undertake a critical econometric analysis of the impact of crude oil production on the health sector in Nigeria.

Scope and Limitation of the study

The study does a thorough econometric assessment of the implications of increased crude oil production on health in Nigeria. Specifically, crude oil production in Nigeria is carried out majorly in the Niger Delta region comprising nine states of Delta, Bayelsa, Rivers, Edo, Akwa-Ibom, Ondo, Abia, Cross-Rivers and Imo.

For a current and up-to date assessment, the study is going to cover the years 1971-2020. This is meant to take account of Nigeria's post OPEC management and utilizations of proceeds on the health sector.

Limitation of the study

Though a comprehensive and in-depth assessment is carried out in this paper, the study howbeit suffers from some limitations that are bound to restrict certain results and most prominent of which is data unavailability.

There is a dearth of reliable and up-to-date data on the financing of the health system in Nigeria. Apart from

that which the Federal Government provides, available data does not aid proper conclusion about trends of health expenditure or the distribution of expenditure between the levels, tiers and types of government and their geographical areas.

Health concurrently on the Federal, State and Local Governments. Getting a full and clear picture of government spending on health would therefore require collection of data from these three tiers of government as well as from Parastatals involved in health financing.

Sadly, while it is easy getting Federal Government data, it is not so easy for States and LGAs. Even more difficult is securing data on private financing on health by individuals, companies, health insurance schem es or religious organizations and NGOs.

Additionally, no national or international agency currently collects or publishes data on community health impact from oil production activities apart from spatial UNEP reports. Virtually no data is available on chronic health impacts among communities living close to refineries or producing areas.

Hypothesis Formulation

We state the following hypothesis

Ho: Crude oil Production does not have a significant impact on health in Nigeria.

Significance of the study.

It is my view that an econometric assessment as is carried out in this work with a strong theoretical background will be germane in attempting to discover the nature of the relationship between crude oil production in Nigeria and health.

In this regard, the tools of correlation and multiple regression are applied to analyze the close-knit relationship or otherwise between the variables. There is every likelihood therefore of drawing dependable conclusions and results that would be useful for economic policy makers in government to plan and make predictions about future relationships and changes.

Thus far, there has not been any empirical research to find out the impact (using an econometric assessment) of crude oil production on health as a dynamic sector of the Nigeria economy within the period 1970-2020.

This study will add significantly to the scarce literature on the impact of petroleum on health and this will therefore provide a foundation for other researches and studies to be carried out on the subject matter.

Structure of the study

The rest of the study is organized into four chapters. Chapter two is the empirical literature of the study. Chapter three is a review of the methodology used in the work together with the theoretical framework that the model of the study is built on. The data variables are also presented. The model to be used in the paper is thereafter specified in clear terms.

In Chapter Four, we analyze and interpret the empirical results derived after econometric methods have been carried out. We conclude the study in Chapter five but not before outlining policy implications of results obtained and recommendations for future actions.

A Bibliography and Appendix is attached at the end of the work.

EMPIRICAL/THEORETICAL LITERATURE

Production and Health

Production is widely believed to be the transformation of raw materials into finished or semi-finished goods. It takes a wide range of dimensions in today's contemporary world.

However, one point worthy of note is that there can be no production without the secondary direct or indirect effect on human health and life. Almost all production activities impact either positively or negatively on human health. Whether it is crude oil production which is the focus of this study, or Nuclear production, Energy and technological production or even organic and agricultural production, all have a direct impact on health and environment.

In the case of Energy, it plays an important role in many aspects of our lives. For example, we use electricity for lighting, cooking, and heating. Thus, energy production and use is interconnected with many aspects of modern life. Historically, the production of technology was not guided by any particular concern for associated health effects. However, it is now becoming clear that future technological assessment will require some prior attention to health impacts.

For crude oil production, Bergensen and Haughland (2000) have shown that natural resource endowment has not been positively correlated with economic development; countries like Nigeria have performed rather poorly relative to less naturally endowed countries. Similarly, Karl's (1997) in-depth analysis of 'petro-states' which covers a wide range of countries including Venezuela, Iran, Nigeria, Algeria, and Indonesia reveals that they all fall prey to troubling development paths and health problems despite their natural resource wealth.

Contemporary views on oil development.

Various theories have been propounded and various proponents have taken diverse positions on the impacts of crude oil production and its associated revenue largely on the economy as a whole but less on particular sectors such as the health sector.

On the side of oil-led development, Yakubu (2008) and Hoffman (1979) believe that countries that are likely to have petroleum can base their development agenda on this scarce resource while highlighting several benefits this could have on the economy like technology, poverty alleviation etc

Particularly, Yakubu (2008) suggests that income from a nation's natural resource say petroleum has a positive influence on economic growth and development.

On the other hand, other proponents and studies came out with the result that natural resource income (e.g. from petroleum) negatively affects the economy. More precisely, Sachs and Warner (1997) while undertaking their study with a sample of ninety-five developing countries that included Indonesia, Venezuela, Malaysia, Ivory coast and Nigeria point out that countries that have a high degree of natural resource export to GDP are more likely to display slower rate of economic growth than those with a low degree of natural resource export to GDP.

A similar view is expressed by Collier and Hoeffler (2002) who are of the opinion that increases in natural resource income do not result in growth because according to them, natural resource i.e. petroleum abundance leads to recurring civil wars that tangentially affect economic development.

Still, Yakubu (2008) seems to support this view because to him, "increase in natural resource income result in vicious development cycle occasioned by rent seeking behavior by all economic units in the economy."

Unfortunately, the experiences of most oil producing nations like Nigeria have tended to contradict the oil and development positions. As in the case of Nigeria, Nafziger (1984) says that hers is a case of 'continuous degeneration to a state of chaos with 'brazen mismanagement while noting that basic national institutions like health, electricity, energy, transport, financial system, investment environment have been decreasing and inefficient'.

Quite frankly, Chironka et al (2011) finally assert that poverty, famine and disease afflict many nations including Nigeria.

Table 2.1: NIGERIA HEALTH INDICES

Many health indices have been analyzed in this study. They include:

Health Index	**Year**	**Score**
Crude birth rate, 1990	1990	44.00
Crude birth rate 2010	2010	40.00
Crude birth rate 2020	2020	37.47
Crude death rate 1990	1990	19.00
Crude death rate 2010	2010	14.00
Crude death rate 2020	2020	95.12
Neo-natal Mortality rate	1990	40.00
Neo-natal Mortality rate	2020	35.00
Life expectancy at birth, 1990	1990	46.00
Life expectancy at birth, 2010	2010	51.00
Life expectancy at birth, 2020	2020	52.89
Life expectancy: females as a percent of males, 2010	2010	103.00
Life expectancy: females as a percent of males, 2020	2020	101.64
Adult literacy rate: females as a percent of males, 1990	1990	69.00
Adult literacy rate: females as a percent of males, 2020	2020	76.76
Under- 5 mortality rate, 1990	1990	213.00
Under- 5 mortality rate, 2010	2010	143.00
Under- 5 mortality rate, 2020	2020	95.12
Total fertility rate, 1990	1990	6.40
Total fertility rate, 2010	2010	5.50
Total fertility rate, 2020	2020	5.31
Infant mortality rate (under 1) 1990	1990	126.00
Infant mortality rate (under 1) 2010	2010	88.00
Infant mortality rate (under 1) 2020	2020	72.30

SOURCE: UNICEF: At a glance, Nigeria.

From the above data, it can be seen that the crude birth rate decreased over the decade 1990 - 2020. This could be explained given the fertility rate over the same period. Death rate and neo-natal mortality rates also

recorded improvements except for the year 2020 when the crude death rate shot up very high. The average annual rate of reduction of under-5 mortality was 2% over the same period. Life expectancy as at 2010 was 51 years but increased marginally to 52.89 in 2020. However, relative to the males, the females continue to be saddled with high illiteracy all through till year 2020.

Table 2.2

YEAR	LIFE EXPECTANCY	CRUDE DEATH RATE (PER 1000 PEOPLE)	CRUDE BIRTH RATE (1000 PEOPLE)
1980	45.49	19.2	46.4
1981	45.64	19.4	46.8
1982	45.76	19.3	46.5
1983	45.84	19.2	46.3
1984	45.89	19.1	46
1985	45.9	19.1	45.7
1986	45.89	19	45.3
1987	45.85	19	44.9
1988	45.79	19	44.6
1989	45.72	18.9	44.2
1990	45.64	18.9	43.8
1991	45.53	18.9	43.5
1992	45.42	18.9	43.2
1993	45.29	18.9	43
1994	45.18	18.9	42.8
1995	45.12	18.9	42.6
1996	45.13	18.8	42.4
1997	45.25	18.7	42.3
1998	45.49	18.5	42.2
1999	45.83	18.2	42
2000	46.27	17.8	41.9
2001	46.79		
2002	47.35		
2003	47.92		
2004	48.47		
2005	49		
2006	49.51		
2007	50		
2008	50.48		
2009	50.95		
2010	51.41		

Source: WDI and GDF 2010 World Bank data Series

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Impact of Crude Oil Production on Health.

The primary health care financing and the necessary emphasis it deserves is needful. In Nigeria, most of the resources used to finance primary health care are derived from public sources particularly revenue which in Nigeria majorly comes from crude oil production. Karl (1997) analysis shows clearly that despite the huge reserves of crude oil popularly called petroleum in many states including Nigeria, these have not been well translated to falling negative indices currently prevalent in Nigeria. Ideally, the greater the amou nt of crude oil produced, the better the health indicators.

On the other hand, substantial body of research (Hodges, 2003; karl, 1997 and Watts, 2005) also suggest that despite the considerable wealth tied to oil extraction and exports, low income countries suffer economic deterioration and huge health problems.

In the case of Nigeria, Karl (1997) observation seems to be a true reflection of the present state of the health sector as proven by the percentage of crude oil revenue spent on health over the period (1970 – 2010). Data of this is provided and on table 2.2. As can be seen from the table, the trend in crude oil revenue has been a galloping one. Though period of increases were generally less sustained, they were no doubt monumental. Over the four decades, crude oil revenue shot up from an initial of N166million to N5.3trillion in 2010. It is expected that expenditure on health should have risen in similar fashion, but unfortunately, this was not the case as it rose from N12million in 1970 to N102billion in 2010. Though the increases less sustained than the crude oil revenue, they were steady and incremental over the period.

The relative impact of crude oil revenue on expenditure on health can be seen from the third column in table 2.2 which shows the percentage of crude oil revenue that is spent on health with the proviso that all sectoral expenditures in the economy were actually made out of crude oil earnings. Over the four decades, the highest share of oil revenue spent on health was 7% in 1970. For the greater part of the period under review, the share hovered around 1%. Indeed, the average percentage share over the period (1970-2010) is 1.5%.

The evidence provided above goes to show that the impact of crude oil production and earnings on health has been generally negligible though positive.

TABLE 2.3: OIL REVENUE AND RECURRENT EXPENDITURE ON HEALTH

YEAR	Oil Revenue (N' million)	Recurrent expenditure on health. (N' million)	Percentage of crude oil revenue spent on health.(%)
1970	166.6	12.48	7.5
1971	510.1	12.64	2.5
1972	764.3	14.26	1.9
1973	1016	14.68	1.4
1974	3732	16.29	0.4
1775	4271.5	36.07	0.8
1976	5365.2	52.85	1
1977	6080.6	59.47	1
1978	4555.8	40.48	1
1979	8880.8	15.32	0.1
1980	12353.3	52.79	0.4

1981	8564.4	84.46	1
1982	7814.9	95.95	1.2
1983	7253	82.79	1.1
1984	8269.2	101.55	1.2
1985	10923.7	132.02	1.2
1986	8107.3	134.12	1.7
1987	19027	41.31	0.2
1988	19831.7	422.80	2.1
1989	39130.5	575.30	1.5
1990	71887.1	500.70	0.7
1991	82666.4	618.20	0.7
1992	164078.1	150.16	0.09
1993	162102.4	3871.60	2.3
1994	160192.4	2093.98	1.3
1995	324547.6	3320.70	1.02
1996	408783	3023.71	1
1997	416811.1	3891.10	1
1998	324311.2	4742.21	1.5
1999	724422.5	16638.77	2.3
2000	1591675.8	15218.08	1
2001	1707562.8	24522.27	1.4
2002	1230851.2	40621.42	3.3
2003	2074280.6	33267.98	1.6
2004	3354800	34197.14	1
2005	4762400	55661.63	1.2
2006	5287566.9	62300.00	1.2
2007	4462910	81900.00	1.8
2008	6530630.1	98200.00	1.5
2009	3191937.98	90200.00	2.8
2010	5396091.05	102620.00	1.9
2011	8878969.88	231800.00	2.60
2012	8025970.59	197900.00	2.50
2013	6809230.51	180000.00	2.60
2014	6793820.00	195980.00	2.90
2015	3830096.00	257700.00	6.70
2016	2693900.00	200820.00	7.50
2017	4109686.31	245190.00	6.00
2018	5545754.62	296440.00	5.30
2019	5536661.36	388370.00	7.00
2020	4732501.11	423330.00	8.45

SOURCE: CBN Statistical Bulletin. Various issues.

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The revenue received can be further broken down into sub-allocations to the Niger Delta states as can be shown by chart 2.5 below

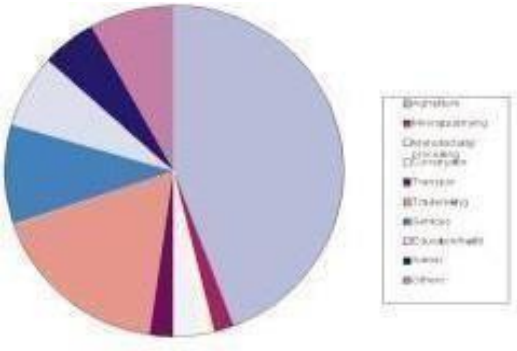
Chart 2.5 **Revenue allocation to Niger delta states 1995-2005**

Source: Federal Ministry of Finance Abuja.

Crude Oil Spillage and Health

Crude Oil spillage is a constant threat to the Nigeria environment. It is estimated that between 1976 and 1996, 4635 oil spill incidents were recorded resulting in the loss of 1,896,960 barrels of crude oil. There are very many causes of oil spillage, however, we can effectively identify the corrosion of oil pipes and tanks, sabotage, poor operations and, inadequate care in crude- oil production drilling as causes. The Niger Delta coastal area is highly dependent on Agriculture as primary source of income. Most people are involved in agricultural operations. This is evidenced from Chart 1 showing the percentage distribution of employed household members in Niger Delta. From the graph, it is readily seen that Agriculture, fishing, and forestry takes the bulk of employment of households in the Niger-Delta accounting for 44% of employment, Trading accounted for 17.4%, Services 9.8% and Miscellaneous activities 11.1%.

Chart 2.6: **Percentage Distribution of Employed Household Members by Industry of Employment (Niger Delta)**



Source: NDDC master plan 2003/2004

The effect of oil spillage has taken its toll on the environment and economic sustenance of the people in the

oil producing communities. Oil spills destroys agricultural production and floral of coastal areas. It could in fact lead to complete wipeout of the ecosystem. Empirical data from 1976 to 1998 as is provided in table 2. 3 below shows that the number of oil spillage of recent has been increasing. This, it is expected would have an adverse effect on health. Millions of barrels of crude oil are spilled each year reducing the amount realizable from crude oil exports and further reducing the ability to translate these revenue to health services for the Nigeria people.

TABLE 2.4: OIL SPILL DATA (1976- 2020)

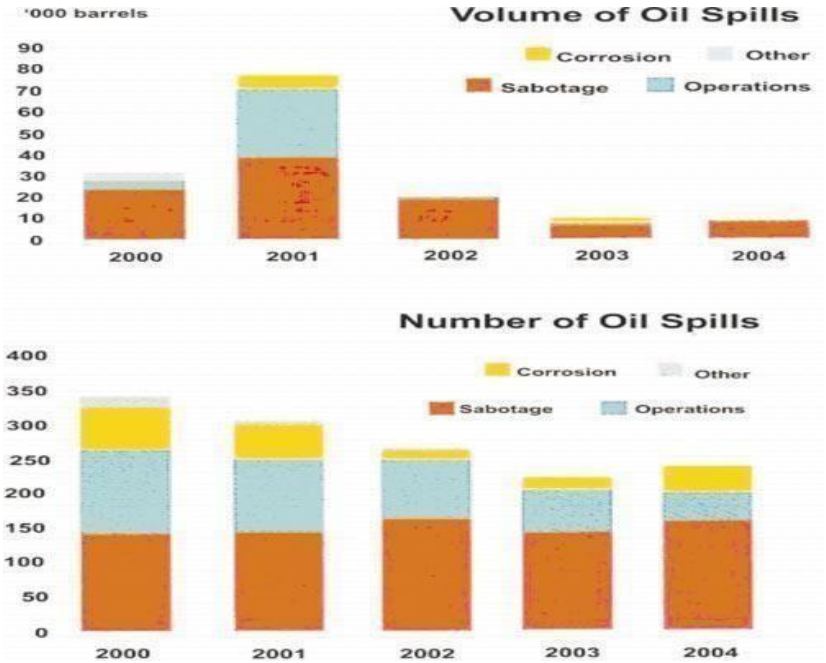
YEAR	Number of spill incidents	Quantity spilled (barrels)
1976	128	26157
1977	104	32879.3
1978	154	489295
1979	157	694117
1980	241	600511
1981	238	42700.5
1982	257	42841.5
1983	173	48351.3
1984	151	40209
1985	187	11876.6
1986	155	12905
1987	129	31866
1988	208	9172
1989	195	7628.16
1990	160	14940.8
1991	201	106828
1992	367	51131.9
1993	428	9752.22
1994	515	30282.7
1995	417.00	63677.17
1996	430.00	46353.12
1997	329.00	59272.30
1998	390.00	98345.00
1999	0.00	0.00
2000	0.00	0.00
2001	4.00	0.00
2002	3.00	0.00
2003	4.00	0.00
2004	9.00	450.00
2005	146.00	1852.96
2006	377.00	24723.91
2007	1012.00	70795.77
2008	997.00	96847.35
2009	858.00	36989.09

2010	890.00	47611.02
2011	1058.00	73131.01
2012	1135.00	41802.00
2013	1667.00	32295.16
2014	1521.00	78890.46
2015	921.00	47702.63
2016	688.00	42741.25
2017	605.00	35082.62
2018	720.00	28863.29
2019	711.00	38247.32
2020	431.00	20607.78

SOURCE: INTERNET SOURCES

Badjo and Njiojo (2012) have given the causes of spills as 50% corrosion, 20% sabotage, 21% oil production operations and 1% engineering drills. Many oil companies have admitted that high rate of spills is due to their operations but have largely blamed sabotage as its causes. A typical case is shell which in its annual report (2004) gave the percentage causes of spills as in chart 2.7

Chart 2.7: **Quantities and Causes of Oil Spills from Shell Petroleum Development Company Operations in the Niger Delta, 2000-2004**



Source: Shell annual Report 2004.

Gas flaring and Health

Gas flaring activities in the process of crude oil production continue to have disproportionate impact on host communities in the oil producing areas of the Niger Delta in Nigeria. Thankfully, the amount of gas flared has been on downward trend since the beginning of the millennium from a high of over 50% of gas produced flared at the start of the millennium. The table 2.4 shows the amount of gas produced, flared and the percentage of gas produced flared for the period 2002- 2010.

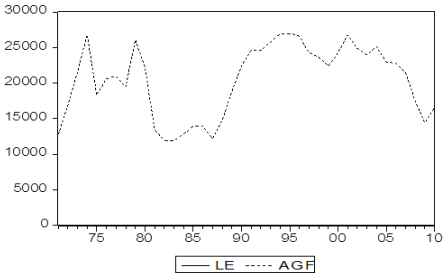
TABLE 2.5 Recent Gas flaring activities of multinational companies in the delta

Year	Gas Produced	Gas Flared	Percent Flared (%)
2002	1651591488	753801906	45.64
2003	1828541855	844978886	46.21
2004	2082283189	886540196	42.58
2005	2093628859	811315777	38.75
2006	2182432084	803661823	36.82
2007	2415649041	759688726	31.45
2008	2287547344	619398854	27.08
2009	1837278307	509351905	27.72
2010	2392838898	581568354	24.30
2011	2966650000	503940000	17.00
2012	2996040000	465260000	16.00
2013	2811980000	427970000	15.00
2014	3048550000	379170000	12.00
2015	3004550000	341350000	11.00
2016	2711800000	288880000	11.00
2017	2938050000	324300000	11.00

SOURCE: NNPC STATISTICAL BULLETIN AND INTERNET SOURCE

So much has been said about the effects of gas flaring on health in Nigeria in chapter one. The graph 2.1 below better summarizes the effects of gas flaring on life expectancy in Nigeria. It is shown that while gas flaring was high throughout the period, life expectancy was infinitesimal. This effectively depicts the negative effects of gas flaring on health in Nigeria.

GRAPH 2.1: IMPACTS OF GAS FLARING ON LIFE EXPECTANCY. SOURCE: Author's representation of data.



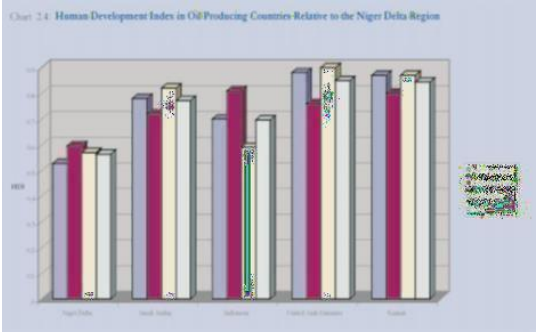
SOURCE: Author's representation of data

The World Bank (2005) estimated that Nigeria flares about 75 per cent of the gas it produces due to the lack of a local market and infrastructure.

Niger Delta and Development

Compared to other oil producing countries, the Niger delta has the lowest Human Development Index (HDI) as can be depicted by the graph 2.4 below. The graph shows that relative to other oil producing countries

who are also OPEC members- Saudi Arabia, Indonesia, UAE and Kuwait, the Niger delta has the lowest HDI, life expectancy, Education Index and GDP index.



Source: UNDP Report 2004.

Impact of crude Oil production on the Environment

Ever since the discovery of oil in Nigeria in the 1950s, the country has suffered the negative environmental consequences of oil development. The growth of the country's oil industry, combined with a population explosion and a lack of environmental regulations, led to substantial damage to Nigeria's environment, especially in the Niger Delta region, the center of the country's oil industry. On and off-shore production creates significant air pollution. Emissions from drilling equipment, hydrocarbons escaping from wells, flaring of natural gas, and emissions from support vehicles can degrade local air quality. Oil production activities not only seem to disrupt the environment but also threaten the survival of indigenous populations that live in these ecosystems.

Impacts of oil production have been identified to include deforestation, ecosystem destruction, chemical contamination of land and water, long-term harm to animal populations, human health and safety risks to neighboring communities in terms of displacement.

It was observed that 'oil production activities are the foremost sources and causes of pollution in the oil-producing environment. The catastrophic effect of pollution on the environment are well known to the industry sources and all those concerned and affected by it' (Frederick M. Ndito, 2000)

Sadly, in the presence of all these attestations, it is reported that a number of key oil producing countries either have weak environmental laws, weak enforcement of these laws or no laws at all. This view is widely supported by the U.S Energy Information Administration (US EIA) when it reported that Nigeria does not have a pollution control policy and the laws that do exist are not enforced"

Oil spills causes damages to the soil, aquatic resources and bio diversity of an area. Across the Niger-Delta for example, the water and soil have been poisoned with hydro-carbons, heavy metals and other substances (ERA /FOEN 2005)

Crude oil production, conflict and kidnapping in the Niger Delta.

The failure to invest oil profits for the development of the Niger Delta region has led to poverty in the Niger-Delta region. Also, the lack of accountability on the part of government and oil companies has led to conflict and militancy. There is now much insecurity in the Niger delta including the Kidnapping and execution of oil workers. New forms of this act has been introduced on a yearly basis including militancy, violence, crime including kidnapping (Akpan 2010).

The root of Kidnapping has been traced to national resource nationality according to Townsend (2008). The

communities in the Delta have been protesting injustices peacefully for decades before the rise of Kidnapping. The reason given by the Kidnappers is that laws relating to oil exploration and land ownership are disregarded, the nation's resource control is not fair and the Delta has not benefited from its own wealth.

However, this erstwhile economic and liberation tool – Kidnapping has been abused and now, jobless youths use it to complement robberies and crime. Nowadays, from the low to the high class in society, these criminals spare none. Thus, the use of kidnapping to press home demands for liberation if not checked will escalate crimes in the region.

Developmental Implications of Kidnapping

Kidnapping has posed many economic and developmental implications in Nigeria, especially for the Niger-Delta region. Since foreigners are the ones mostly Kidnapped, potential investment and development alliances are scared away. (Akpan, 2010). Many oil workers have fled the region and the inflow of investment and capital flows to the region has reduced drastically.

The impact of Kidnapping is summarily clear when the Director of the Department of Petroleum Resources (DPR) Mr. Tony Chukwueke admitted that 'we are experiencing one of the most difficult periods in the history of Nigeria's oil and gas industry. As I am talking to you now, Nigeria is losing over 800,000 bpd…so the entire western operations of the SPDC has been shut (Quoted from Guardian Newspaper June 12, 2006)

Empirical Literature on the Impact of Crude oil Production on Health.

A number of studies of recent have shown that countries' oil production has a disproportionate impact on indigenous populations and sensitive remote ecosystems. Kretzman and Wright (1998) for instance report that indigenous groups in six continents and 39 countries face an immediate to medium-term threat from new oil and gas production.

Rourke and Connoly assert that "on and offshore exploration, drilling, and extraction activities are inherent, invasive and affect the ecosystem, human health, and local cultures. They further stress the physical alteration of environment from exploration, drilling, and extraction can be greater than from large oil spills with major impact on the long-term human population, human health, and safety risks for neighbouring communities and workers".

It has been stated (Edoigiawerie and Spickett, 1995; O'connor (2000) and Pelly (2001) that "increasingly complicated and expensive processes for location of oil deposits in remote and hospitable locations, bringing the oil to the surface and then getting it to the market have major environmental and health impacts". Oil spills threaten human health but as Burger notes 'there are remarkable few studies of the health responses of local people exposed in months following a spill.

According to Ntido (1990) 'Gas flaring, apart from the huge economic loss it represents to the nation, the cost in the degradation of the environment and to the health of the people of oil communities is incalculable' He further adds frankly that 'Gas flaring, gas emissions and fires is hazardous to human and animal health'

Piller, et al (2007) in this regards adds that 'gas flaring reduce the immunity of children to diseases as polio and measles'. In one study in Scotland, following an oil spill, community members reported increased health problems including psychiatric symptoms. Ntido outlines several causes of oil spills including blow-outs, equipment failure, operator/maintenance failure, sabotage, sand-cuts (erosion) and accidents.

Another cause of ill-health is gas flaring. An estimated 2.5 billion cubic foot of gas is burnt on a daily basis (Osuoka and Roedrick, 2005) Flares from nearby oil plants have caused an epidemic of bronchitis,

rheumatic and eye problems (Quist- Avion, 2007)

Epstein and Selber (2002) report a number of health impacts from exposure to refining wastes including severe burns, skin irritation, risks to bronchitis and pneumonia, headaches and mental disorders, chronic lung disease from long term exposure to coke dust, psychosis and peripheral neuropathis, increased cancer risks from exposures to carcinogenic materials etc.

In recent years, public revenues have increased substantially due to the boom in world oil prices and some of this windfall is being chanelled into increased spending on primary health care. One would have expected a much higher level of human development achievement in Nigeria where oil export boosted the GDP. However, a number of studies find that the contribution of health spending to health status as measured by infant mortality or child mortality is either small or statistically insignificant (Musgrave 1996; Pritchett 1996; Filmer and Pritchett 1997 and Filmer et al 1998).

Odularu (2008) specified a model in order to attempt to determine the impact of crude oil production ultimately on economic growth in Nigeria. The model takes crude oil prices, external reserve, domestic consumption and crude oil exports as independent variables and gross Domestic Product as dependent variables (at constant prices) in an OLS econometric model using time series data from 1970-2005.

The model he specified was

RGDP= F (L, K, DC, E)

Where RGDP= real gross domestic production

L is labour; K signifies capital; Dc stands for domestic Consumption and E is crude oil exports.

After exploring associations between crude oil production and economic performance, the results obtained from estimating both with and without a correction for autocorrelation (using Cochrane Orcutt iterative estimation) showed that capital, labour and oil production can surely lead to economic growth. The overall model was found to be statistically significant at 10% and 5% levels of significance. All parameters also conformed to apriori specifications.

Adapting his model from the work of Odularu (2008), Gujarati (2006) and Dougherty (1992), a further study conducted by Ogbonna G.N and Ebimobowei. A (2012) investigates the effects of petroleum income on the Nigeria economy from the years 2000 to 2009. They employed the Gross Domestic Product (GDP), per capital income (PCI), and Inflation (INF) as the explained variables with oil revenue, petroleum profit tax/royalties (PPT/R), and licensing fees (LF) as explanatory variables. The sample quite interestingly covers all sectors of the economy both oil and non-oil sectors.

They identify the major sources of petroleum income as the sale of crude oil and gas (oil revenue), petroleum profits tax and royalties, licensing, and other incidentals as contained in the CBN Statistical Bulletin.

Their framework is built on the premise that oil revenue takes charge of the bulk of total revenue generated into the federation account.

Findings from the estimation of the models indicated that oil revenue had a positive and statistically significant relation with GDP and per capital income respectively but relationship with inflation is negative and not statistically significant. Similarly, petroleum profit tax and royalties have a positive and statistically significant relation with GDP and per capital income respectively but relationship with inflation is negative and not statistically significant. Finally, licensing fees has a negative and a non-statistically significant

relationship with GDP and per capital income respectively but relation with inflation is positive and statistically significant.

It was therefore concluded from model specifications and results that petroleum income has a significant positive impact on the Nigeria economy under the period in review.

The work of Odularu (2008) focusing on labour, capital, Real gross domestic product. Domestic crude consumption and crude oil export in Nigeria for the period 1970-2008 is in many ways similar to Ogbonna and Ebimebowei (2012)

While Odularu's (2008) period was 1970-2005, Ogbonna and Ebimebowei (2012) was 2000-2009.

Methods of measurement of crude oil production and health.

There has been a dearth of studies that directly assess the impact of crude oil production on health in Nigeria. Below is however a survey of available Empirical Literature on studies on crude oil production and its impacts on health and health-related indices.

TABLE 2.6 Review of Methodology.

S/N	Study and Year	Study Design and sample years.	Methodology	Model specification (if any)	Author(s)	OLS Result	Other Result	Source of data
1.	Crude oil and the Nigeria Economic Performance. (2007)	Time series. (1970-2005)	OLS regression method.	RGDP= f (L,K,E,D)	G.O Odularu.	R^2=0.98 Adj R^2 =0.97 F=421.58. DW=1.78	All parameters conformed to apriori expectation. There existed a positive ans significant impact of crude oil on the economy	Secondary sources: CBN and NNPC
2.	Health Expenditure and Nigeria Economic Growth. (2011)	Time series (1985-2009)	Regression Analysis	GDP=a + bCH + cL + dF+ eRH+ fTH+ u	O.M Adeniyi And L.N Abiodun	R^2= 0.89 Adj R^2= 0.87 D.W=2.01 F=32.3 S.E=0.65	Only Recurrent and capital Expenditure conformed to the Apriori expectation of positive significant relationship on economic growth.	Secondary source documents of the World Bank, IMFand UNDP.

3.	Petroleum income and the Nigeria Economy: empirical evidence (2012)	Time series	Simple regression estimation method	GDP = α_1 + β_1OR + U_1	Ogbonna G.N and Appiah Ebimebowei		Oil revenue has apositive and statistically significant relation with GDP and per capitalincome respectively. Thus income from natural resource has a positive influence on growth and Development.	Quantitative secondary sources: CBN, NBS and NNPC.
4.	Health effects of Reforms : an econometric Analysis. (1996)	Time series (1986-1993)	Simple linear regression method		Germano Morabu		Reforms in other sectors of the economy impact positively on health advancement.	Secondary data
5.	Environmental Implication of oil Exploration and Exploitation in the coastal region of ondo state Nigeria. A regional Planning Appraisal. (2011)	Cross-sectional	Qualitative data analysis		O.J.A Bayode; E.A Adewunmi and S. Odunwole.		Magnitude of negative impact of oil exploration in the coastal area. Magnitude and respondent: very high: 920. High: 109; fairly High:163; not high: 8	Primary and secondary sources. **Primary:** reconnaissance, observation, in interviews, questionnaires. **Secondary:** maps, literature.
6	Energy production in Nigeria: a Calibration analysis of the impact of oil production on Oil earnings.	Time series	OLS estrimation regression method		M.A Ijaiya	R^2= 0.6 F=4.98 t=9.03	Oil production impacts significantly on oil Earnings.	Secondary: CBN statistical Bulletin

7	Government Expenditure on Health: Economic growth and long waves in a C. G. E micro-simulation Analysis (2011)	Cross sectional	Computable General Equilibrium (CGE)model together with calibration of social Accounting Matrix (SAM) ofthe economy.		E.S OOdion		Re-allocation of Government Expenditure on health sector is significant in explaining economic growth in Nigeria.	Secondary
8.	Environmental effects of oil spillage on rural communities in Ughelli south LGA of Delta State, Nigeria (2002)	Cross-sectional data	Qualitative analysis		Z.O Opafunso and G.A Apena.		**Causes of frequent oil spillage in Ughelli.** Equipment Failure 37.7%. pipeline leakage: 37.3%. sabotage: 6.7%. vandalizatio n: 17.3% **Effects of oil spillage on Health.** Typhoid fever: 34.7%; cholera: 25%; Diarrheoa 10.7%; Malaria 6.7%; ringworm: 4%	Primary and secondary data. **Primary:** well-structured Questionnaires, field observation, interviews. **Secondary:** literatures, relevant journals. Textbooks and mimeography.

Source: Compiled by Researcher

From the above, it can be seen that none of these studies have attempted to assess the impact of crude oil production on health in Nigeria using any econometric procedure. It is this gap this study intends to cover.

THEORETICAL FRAMEWORK AND METHODOLOGY

Theoretical Framework

The theoretical framework of this study is based on the work of Mankiw, Romer and Weil (1992) as cited in Milbourne, Otto and Voss (2003).

Given the shortcomings of Solow's growth model (which is based on the premise that output in economy is produced by a combination of labour (L), and capital(K) and the criticisms of its assumptions of stable production function, perfect competition, constant returns to scale and complete homogeneity, an amplified version was specified by Mankiw, Romer, and Weil (1992).

In this enriched version of the model, a Cobb-Douglas production function was assumed adding human capital accumulation to the Solow model.

According to Mankiw, Romer and Weil (1992), the aggregate output of the economy can be written as:

$$\boldsymbol{Y}_t = \boldsymbol{A}_t \boldsymbol{K}_t^{\alpha} \boldsymbol{H}_t^{\beta} \boldsymbol{L}_t^{1-\alpha\beta} \quad (1)$$

Where

A – index of technical change that varies overtime but which is temporarily held constant,

K – the capital stock,

L – labour supply and

H is stock of human capital

Note that the coefficients α and β are assumed to lie between 0 and 1 and $(\alpha+\beta) < 1$ implying that there are decreasing returns to all capital.

Assuming *sk* to be the fraction of income invested in physical capital and *sh* the fraction invested in human capital, the evolution of the economy is determined by:

$$\boldsymbol{kt = skyt - (n + g + \delta)\, kt,} \qquad \boldsymbol{(2)}$$

$$\boldsymbol{ht = shyt - (n + g + \delta)\, ht.} \qquad \boldsymbol{(3)}$$

Where $y = Y/AL$, $k = K/AL$, and $h = H/AL$ are quantities per effective unit of labour. It is also assumed that the same production function applies to human capital, physical capital, and consumption. In other words, one unit of consumption can be changed at no cost into either one unit of physical capital or one unit of human capital.

Human capital (*H*) is the knowledge acquired by workers, often as the result of investment in education. Since human capital involves investment just as physical capital, it also depreciates.

In a case where $\alpha + \beta$ equals one, then there are no constant returns to scale in the reproducible factors and there will be no steady state for the model. It is implied in equations (2) and (3) that the economy converges to a steady state defined by:

$$k^* = \frac{(sk^{1-\beta} s^{\beta} h)^{1-a-\beta}}{(n+g+a)}, \qquad h^* = \frac{(sa k\, sh^{1-\beta})^{1-a-\beta}}{(n+g+a)} \quad (4)$$

Substituting (4) into the production function and taking the natural logs gives an equation:

$$\ln\left[\frac{Yt}{Lt}\right] = \ln A_0 + gt - \frac{a+Q}{1-a+Q}\ln(n+g+\sigma) + \frac{a}{1-a+Q}\ln(s_k) + \frac{Q}{1-a+Q}\ln(s_h)$$

This equation shows how per capita income (proxy for economic development –a superset of economic growth) depends on population growth and accumulation of physical and human capital.

While incorporating the model above, focus was restricted to human capital investment in the form of crudeoil, ignoring investment in health, among others.

Model Specification

Based on the foregoing, the model of the study is as specified below:

HET = f[REV, AGF, COP]

Where

HET = Total Expenditure on Health

REV = Crude-Oil–sourced health Revenue

AGF = Amount of gas flared

COP = Crude Oil Production (barrels)

Incorporating the variables into the Cobb- Douglas production function, we have

$HET = \beta_0 A\mathrm{REV}^{\beta 1}\,\mathrm{AGF}^{\beta 2} COP^{\beta 3}\, U$

The above can be specifically expressed in linear econometric form as

$\mathrm{HET}_t = \beta_0 + \beta_1 REV_t + \beta_2 AGF_t + \beta_3 COP_t + U_t$

U is the stochastic error (disturbance) term (with zero mean, constant variance and zero covariance) Adopting a double log specification by taking the natural log of both sides of the equation, we have:

$\mathrm{LNHET}_t = \beta_0 + \beta_1 \mathrm{LNREV}_t + \beta_2 \mathrm{LNAGF}_t + \beta_3 \mathrm{LNCOP}_t + U_t$

Apriori Expectation: The expected signs of the coefficient of the explanatory variables are as follows:

$\beta_1 > 0$, $\beta_2 < 0$, $\beta_3 > 0$

The sample period for the time series analysis is 1971-2020.

Methodology

This research paper uses the co-integration and error correction methods to analyse the relationship between Health, crude oil-sourced health revenue, gas flaring and domestic consumption of crude oil. For

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estimation purposes, we applied a multiple regression analysis to annual time series data from 1971-2020 using the Eviews 12 Econometric package**.**

The date 1971 was specifically chosen because Nigeria joined OPEC in 1971 and from that time onwards, saw its foreign oil export policy and structure re-organised by a quota and cartel pricing regulation that was aimed to benefit all her members.

Definition of Variables

- **Health Expenditure:** this is the total expenditure i.e. recurrent expenditure and capital expenditure spent on health in an economy. The Total health Expenditure in this paper is derived via the expenditure method of the National Product and Income accounts. The health expenditure is calculated on a yearly basis for the duration of the study.
- **Crude-oil-sourced Health Revenue:** Ideally, as will be expected, not all the derivation from crude oil is spent on just one sector of the economy given that there is high dependence of virtually all sectors on this one resource given the structure of the Nigeria economy. It was therefore necessary to generate a new series from existing data of crude oil revenue to account for that proportion of oil revenue that was actually spent on the health sector.

To do this, a health proportion in crude oil revenue scaled down total crude oil revenue. The formular used achieve this is stated as

(OR/TR)TE

Where:

OR = Crude oil Revenue.

TR = Total Revenue

TE = Total Expenditure on Health.

This formula succinctly derives the share in crude- oil Revenue as a proportion of total revenue (sum of oil and non-oil revenue) that was spent on total expenditure in health.

It is expected that crude oil provides substantial funding for the development of the health sector but whether this sector is given the much needed attention and priority as it should relative to other sectors is what we hope to discover.

- **Amount of gas flared:** the issue of gas flaring is one recurring decimal that has been ignored by quite a lotofresearchers while conducting health-related studies but has been discovered in this paper to be a very potent factor having grave consequences on the development of health especially in oil producing communities and nations.

Gas flaring still is high in Nigeria today as has been discovered from the data and chart provided in chapter two of this paper. Though it has been declining of recent due to the growing awareness and intervention of international independent organizations as the United Nations Environmental Programme (UNEP) who have taken giant strides in berating many oil companies, it is sad that many of these companies still flare a large amount of gas daily. In fact, while regular reports released by UNEP on impact that crude oil production has on health and on environment has been given great attention in other oil producing countries, the Nigeria government has been slow in full considerations and implementation of the recommendations of the report.

The resultant effect is that gas flaring has not been carried out to international best practices in Nigeria. Note that in this study, the amount of gas flared is calculated in standard thousand cubic metres measure.

- **Domestic production of crude oil**: as has been earlier stated, the importance of crude oil for domestic andindustrial purposes cannot be over emphasized given its attendant socio-economic and political impacts. Variants of crude oil are used for several purposes and whether it is for domestic cooking, power generation, industrial production or utilities, they all have consequences on health. The amount of crude oil consumed for various purposes domestically and industrially seems to be on the increase due to their high utility and direct impact on standard of living.

It is thus necessary to investigate how this resource has grown over the period of study and how the direct impact on health and standard of living has been either promoted negatively or positively.

Odularu (2007) made use of this variable in his model to capture the relationship between crude oil sector and the Nigerian economic performance using Labour, Capital and Crude Oil Exports as other explanatory variables with GDP as the explained variable.

Method of Data Collection

The sample of this study dwells on the Petroleum and health sectors of the economy. Relevant data used are quantitative and secondary, collected from established institutions and organizations mainly the Central Bank of Nigeria (CBN) statistical bulletin (various issues), the Nigerian National Petroleum Corporation (NNPC) statistical bulletin of various issues, the World Bank, United Nations International Children's Emergency Fund (UNICEF) publications. Other annual and periodic reports as the World Development Index report, the Central Bank annual reports and the United Nations Development Programme(UNDP) reports were used.

Tools of Data Analysis

This study makes extensive use of statistical tools as tables, line graph, bar chart, component bar graphs and charts and pie chart to give effective representation of data and to aid comprehensive analysis. These tools are very essential for the effective study of concepts and data.

EMPIRICAL RESULTS AND PRESENTATION OF DATA

Graph 4.1:

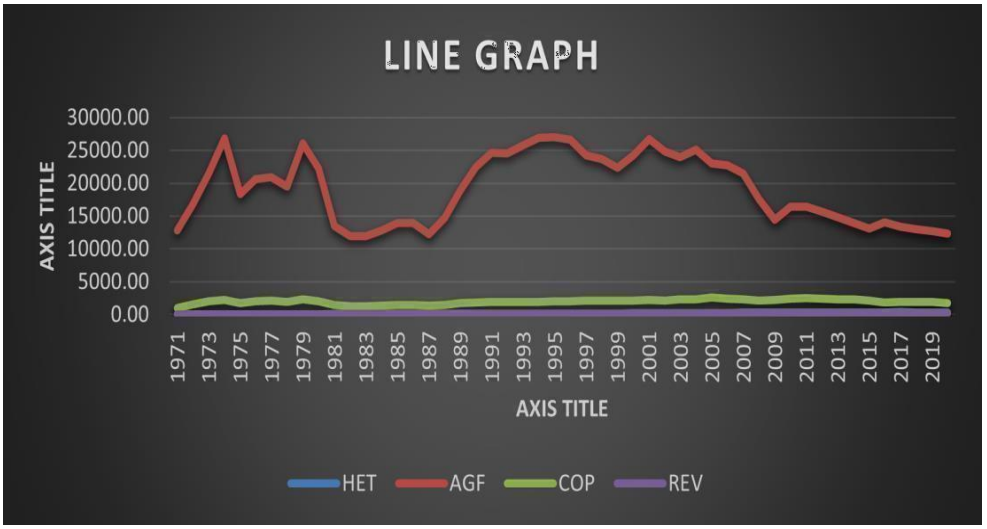
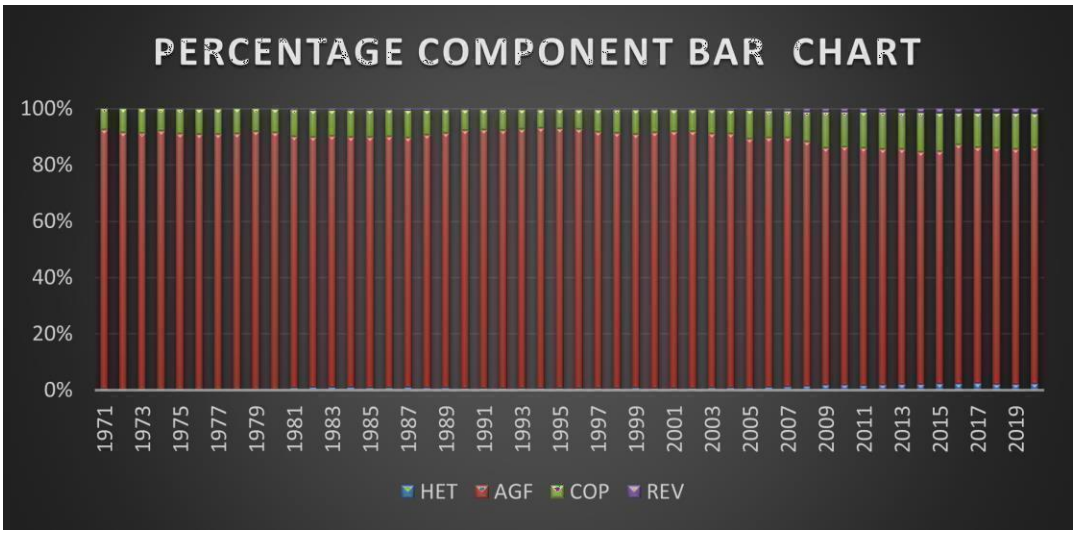


Chart 4.1:



The figures above show the data for the variables used in the analysis.

Descriptive Statistics

	LNHET	LNAGF	LNCOP	LNREV
Mean	186.8100	19148.66	1967.785	143.1830
Median	162.1500	19112.00	2027.225	129.1698
Maximum	375.0000	26986.00	2627.440	268.0920
Minimum	40.80000	11940.00	1031.170	17.80332
Std. Dev.	102.5228	5241.606	365.9769	81.46952
Skewness	0.377813	0.051162	-0.626784	0.292904
Kurtosis	1.957478	1.454251	2.722293	1.804795
Jarque-Bera	3.453796	4.999607	3.434492	3.691012
Probability	0.177835	0.082101	0.179560	0.157945
Sum	9340.500	957433.2	98389.27	7159.150
Sum Sq. Dev.	515035.4	1.35E+09	6563017.	325226.8
Observations	50	50	50	50

Source: Author's computation from Eviews 12

From the table above Jarque-Bera (1980) test is used to test for normality and it is observed that all variables except AGF, are normally distributed. The table also shows that the average values of all the variables fall between the minimum and the maximum values, indicating that the data is suitable for the analysis.

Empirical Results.

The Augmented Dickey Fuller (ADF) and Phillip Perron (PP) test were used to test for presence or otherwise of unit roots among the time series data employed in the model used in this study. This was necessary in order to be sure that the trend element in the time series data is eliminated.

Thereafter, we proceed to carry out the ARDL bound test on the time series data to be sure that there exists a long-run relationship among the variables employed the analysis. This is necessary in order to avoid 'spurious regression' situation in the model.

Finally, we derive the Error Correction Model (ECM) that corrects short term deviations to long run

equilibrium values, and then estimate the long-run relationship among the variables.

Unit Root Test

The results of the ADF Unit root tests is presented in table 4.1 and 4.2 below.

TABLE 4.1: ADF UNIT ROOT TEST RESULT

AUGMENTED DICKEY FULLER (ADF) AT LEVEL						
Intercept only				Trend and intercept		
Variables	Test Statistics	95% Critical	Comment	Test Statistics	95% Critical	Remark
LNHET	-0.504662	-2.922449	Not stationary	-2.035825	-3.504330	Not stationary
LNAGF	-1.957854	-2.923780	Not stationary	-2.096875	-3.506374	Not stationary
LNCOP	-3.004776	-2.922449	Stationary	-2.613154	-3.504330	Not stationary
LNREV	-0.316586	-2.923780	Not stationary	-2.640647	-3.504330	Not stationary

Source: Author's computation from Eviews 12

TABLE 4.2: ADF UNIT ROOT TEST RESULT

AUGMENTED DICKEY FULLER (ADF) AT FIRST DIFFERENCE						
Intercept only				Trend and intercept		
Variables	Test Statistics	95% Critical	Comment	Test Statistics	95% Critical	Remark
LNHET	-5.825949	-2.923780	stationary	-5.741366	-3.506374	stationary
LNAGF	-6.363151	-2.923780	stationary	-6.366572	-3.506374	stationary
LNCOP	-6.340347	-2.923780	stationary	-6.328651	-3.506374	stationary
LNREV	-9.991171	-2.923780	stationary	-9.883715	-3.506374	stationary

Source: Author's computation from Eviews 12

From these results, the time series data is integrated of order (1) at 5% significance levels with the exception of LNCOP which is integrated of order zero.

The results of the PP test is presented in tables 4.3 and 4.4 below:

TABLE 4.3: PHILLIP PERRON UNIT ROOT TEST RESULT

PP TEST AT LEVEL						
Intercept only				Trend and intercept		
Variables	Test Statistics	95% Critical	Comment	Test Statistics	95% Critical	Remark
LNHET	-0.526991	-2.922449	Not stationary	-2.035825	-3.504330	Not stationary
LNAGF	-2.082150	-2.922449	Not stationary	-2.244868	-3.504330	Not stationary
LNCOP	-3.139499	-2.922449	Stationary	-2.925145	-3.504330	Stationary
LNREV	-0.609690	-2.922449	Not stationary	-2.646848	-3.504330	Stationary

Source: Author's computation from Eviews 12

TABLE 4.4: PHILLIP PERRON UNIT ROOT TEST RESULT

PP TEST AT FIRST DIFFERENCE						
Intercept only				**Trend and intercept**		
Variables	**Test Statistics**	**95% Critical**	**Comment**	**Test Statistics**	**95% Critical**	**Remark**
LNHET	-5.734153	-2.923780	stationary	-5.640121	-3.506374	stationary
LNAGF	-6.363151	-2.923780	stationary	-6.366572	-3.506374	stationary
LNCOP	-6.395381	-2.923780	stationary	-6.362641	-3.506374	stationary
LNREV	-9.765818	-2.923780	stationary	-9.667533	-3.506374	stationary

Source: Author's computation from Eviews 12

With particular reference to the Augmented Dickey Fuller (ADF) unit root stationary test at trend as well as at trend and intercept, the results of the test indicates that the variables LNHET, LNAGF and LNREV are stationary at first difference while LNCOP is stationary at level.

The Phillip Perron (1988) unit root test is a non-parametric $Z(t_\alpha)$ test. The test is however not reported in this study.

Thus, we proceed to find out if any long run relationship exists among the variables in the model using the ARDL bond test. This test is carried out to examined the long-run relationship due to the mixed order of integration among the variables.

TABLE 4.5: ARDL BOND TEST

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.772293	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	46		Finite Sample: n=50	
		10%	2.538	3.398
		5%	3.048	4.002
		1%	4.188	5.328
			Finite Sample: n=45	
		10%	2.56	3.428
		5%	3.078	4.022
		1%	4.27	5.412

Source: Author's computation from Eviews 12

The findings from the bounds test are exhibited in the table 4.5 above. The examination for cointegration was conducted by considering the value of F-statistic contained in the table, the value is greater than the lower and upper bound at all levels of significance. This points to the presence of cointegration, implying the existence of a prolonged interrelationship among the variables. Consequently, the explanatory variables utilized will play a determinative role in shaping direction of the dependent variable over the extended term.

TABLE 4.6: SHORT-RUN ERROR CORRECTION RESULT

ARDL Error Correction Regression
Dependent Variable: D(LNHET)
Selected Model: ARDL(3, 0, 0, 4)
Case 2: Restricted Constant and No Trend
Date: 10/17/23 Time: 12:44
Sample: 1971 2020
Included observations: 46

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNHET(-1))	0.801408	0.173426	4.621030	0.0001
D(LNHET(-2))	0.343532	0.159534	2.153345	0.0383
D(LNREV)	0.569414	0.124048	4.590274	0.0001
D(LNREV(-1))	-0.986347	0.258960	-3.808886	0.0005
D(LNREV(-2))	-0.541375	0.224005	-2.416796	0.0210
D(LNREV(-3))	-0.377323	0.139341	-2.707915	0.0104
CointEq(-1)*	-1.291112	0.210190	-6.142585	0.0000

R-squared	0.637302	Mean dependent var	6.147826
Adjusted R-squared	0.581502	S.D. dependent var	17.25170
S.E. of regression	11.16036	Akaike info criterion	7.801882
Sum squared resid	4857.596	Schwarz criterion	8.080154
Log likelihood	-172.4433	Hannan-Quinn criter.	7.906125
Durbin-Watson stat	2.102143		

* p-value incompatible with t-Bounds distribution.

Source: Author's computation from Eviews 12

The short-run results above shows that one and two-periods lagged values of the total expenditure on health have positive and significant influence on the current value of the total expenditure on health. The formal is shown by the coefficient 0.801408 with its accompanying probability value 0.0001 indicating significance at all standard levels, while the latter is indicated by the coefficient 0.343532 with its associating probability value 0.0383 portraying significance at 5% level. This means that 1% increase in one-period lagged value induces 0.801408% in the current value of the total expenditure on health and 1% increase in two-period lagged value induces 0.801408% in the current value of the total expenditure on health.

The coefficient of the current value of the crude-oil–sourced health revenue is 0.569414 with its associating probability value 0.0001, indicating that the coefficient is significant at all levels. This implies 1% increase in the current value of the crude-oil–sourced health revenue induces a 0.569414% increase the current value of the total expenditure on health. By implication, the crude-oil–sourced health revenue also has a positive and significant impact on the current value of the total expenditure on health.

As for one, two and three-period lagged values of the crude-oil–sourced health revenue, the results also show that the coefficient of the one-period lagged value of the crude-oil-sourced health revenue is -0.986347 with associating probability value 0.0005. This means that 1% increase in the one-period lagged value of the crude-oil-sourced health revenue brings about 0.986347% decrease in the current value of the total expenditure on health. The coefficient of the two-period lagged value of the crude-oil–sourced health revenue is -0.541375 with associating probability value 0.0210. This implies that 1% increase in the two-period lagged value of the crude-oil-sourced health revenue brings about 0.541375% decrease in the current value of the total expenditure on health. The coefficient of the three-period lagged value of the crude- oil–sourced health revenue is -0.377323 with associating probability value 0.0104. This implies that 1% increase in the three-period lagged value of the crude-oil-sourced health revenue brings about 0.377323 % decrease in the current value of the total expenditure on health. This indicates that one, two and three-periods lagged values of the crude-oil–sourced health revenue have negative but significant impact on the current value of the total expenditure on health at 5% level of significance.

In conclusion, the co-integrating equation or error correction model (ECM) indicates a value of -1.291112, accompanied by a p-value of 0.0000, signifying its significance at the 1 percent confidence level. This

indicates that the speed of adjustment from the short-run dynamics back to the long-run equilibrium amounts to approximately 129 percent.

Error Correction Equation

EC = LNHET - (-0.0012*LNAGF + 0.0006*LNCOP + 1.2518*LNREV + 33.6116)

TABLE 4.8: LONG RUN RESULT

Levels Equation Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNAGF	-0.001161	0.000423	-2.745862	0.0095
LNCOP	0.000590	0.006757	0.087336	0.9309
LNREV	1.251772	0.028633	43.71791	0.0000
C	33.61157	8.164684	4.116701	0.0002

The Long-Run Interpretation

In the long run, the amount of gas flared exerts a negative but significant influence on the total expenditure on health depicted by its coefficient and the associating probability given as -0.001161 and 0.0095 respectively. This means that 1% increase in the amount of gas flared will induce a 0.001161% decrease in the total expenditure on health at all standard levels of significance.

As for the crude oil production (COP), the coefficient and the probability values are 0.000590 and 0.9309. This means that crude oil production has positive but insignificant impact on the total expenditure on health. By implication, 1% increase in crude oil production may not have any impact on the total expenditure on health.

Furthermore, the Crude-Oil–sourced health Revenue depicts a positive and significant relationship with the total expenditure on health indicated by its coefficient and associated probability value given as 1.251772 and 0.0000 respectively. This means that 1% increase in Crude-Oil–sourced health Revenue has the potential to engender a 1.251772% in the total expenditure on health.

The economic implication of the results can be duly encapsulated. The research findings hold significant economic implications for policymakers in oil-producing regions, indicating that high levels of gas flaring are associated with decreased health expenditure in the long run, highlighting the environmental and health-related challenges posed by gas flaring and the potential benefits of its reduction. While crude oil production shows a positive but statistically insignificant relationship with health spending, suggesting it may not be a major driver of healthcare funding, the significant positive impact of crude-oil-sourced health revenue underscores the vital role of oil income in supporting the healthcare sector. This underscores the need for diversifying revenue sources and reducing dependency on oil revenue to enhance the resilience of health expenditure. The findings also emphasize the impact of environmental and health policies, data-driven decision-making, and the importance of long-term planning and stability in healthcare funding and overall economic development.

SUMMARY

We have attempted in this study to trace the perceived relationship between crude oil production and health

in Nigeria. In the first chapter we saw the role crude oil plays in the Nigeria economy given the huge chunk of resource derivable from it. Crude oil is the mainstay of the Nigeria economy and health remains a fundamental human right of Nigerians of all classes, race, sex or religion. Whether this single resource has imparted positively or negatively on the health of Nigerians is what this paper has investigated.

After deriving the results of the Error Correction Representation, we are in good position to reject our earlier null hypothesis that crude oil production does not have a significant impact on health in Nigeria.

CONCLUSION

Using an Error Correction Model and after finding out that long run relationship exists among the variables employed in the study- Total Health Expenditure (a proxy for Health), Oil-sourced health revenue, Gas flaring and domestic Production of Crude oil, we concluded that crude oil impacts significantly on Health in Nigeria. Precisely, gas flaring impacts negatively on health in Nigeria while revenue generated from crude oil will increase total expenditure.

Several recommendations are therefore proffered after analyzing the policy implications of thestudy. It is hoped that the diligent and sincere adoption of some of the recommendations together with knowledge derived from the study will help improve the lives of Nigerians.

RECOMMENDATION

The result of this study has grave consequences for future policy-making in the Petroleum and Health sectors in Nigeria.

The study has made one remarkable discovery and that is the negative impact gas-flaring has on health in Nigeria. The earlier fears allayed in Chapter One have been well confirmed by the econometric assessment conducted. The continuous flaring of gas during crude oil production will continue to deteriorate the health of the indigenes of host communities and also those of oilworkers.

There is one thing that the government must do: devote the necessary urgency and priority to the use of policy regulations and control to stem this challenge. Policymakers can thus use this knowledge as the basis for proper regulations of the activities of stakeholders in the petroleum industry.

The local communities must be carried along, especially in the upstream sector. At the same time, the government should also provide an enabling environment security-wise for oil workers to carry out their activities and stem the tide of kidnapping and other criminal and social vices in the host communities.

On the other hand, policymakers can now use this study to determine the proportion of crude oil revenue that would achieve the desired objectives in the health sector in Nigeria. The health sectoris one of the most underfunded sectors in the Nigerian economy today as a deviation from the rule. The Health Ministry and agencies will do well to brace up for this call to service. Nevertheless, the diversification of revenue sources beyond crude Oil is germane as could be seen from findings fromthis study. Thus, the Nigerian government should halt the monocultural reliance on crude oil and invest in agriculture, and the manufacturing sector to secure more foreign exchanges from the saleof raw materials and semi-finished goods required for Health funding locally.

Other recommendations have been proffered by the researcher, and these will also go a long way in solving the previously highlighted problems in the petroleum and health sectors in Nigeria. These include:

- A ceiling on the proportion of gas to be flared and oil spills should be set by the FG.
- Gas flaring activities and other oil production activities should be conducted according to international best practices.
- The government should devote a higher proportion of oil earnings to the health sector as this will surely impact significantly on the improvement of healthcare of Nigerians.
- More revenue from Crude oil should be channeled to the PHC sub-sector as this is where the much-needed impact is felt by the poor populace.
- Incentives should be given to oil companies to undertake best practices together with adequate rewards for prompt adherence.
- Petroleum (Oil) companies and multinationals should employ the services of more Econometricians and Statisticians who can carry out environmental impact assessments.
- Working with the government, more hospitals and health services should be provided by stakeholders in the oil sector by stepping up Corporate Social Responsibilities to host communities.

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APPENDIX

YEAR	HET	AGF	COP	REV
1971	40.80	12790.00	1031.17	17.80
1972	50.80	16848.00	1545.04	27.63
1973	60.80	21487.00	2053.85	36.44
1974	55.20	26776.00	2255.10	45.31

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1975	53.30	18333.0(	1783.0	41.28
1976	54.20	20617.0(	2067.0	42.98
1977	54.20	20952.0(	2084.9	40.98
1978	53.90	19440.0(	1896.9	33.31
1979	54.10	26073.0(	2301.9	44.03
1980	54.00	22214.0(	2054.8	43.79
1981	121.70	13470.0(	1433.2	78.42
1982	124.60	11940.0(	1294.9	85.16
1983	127.40	11948.0(	1241.1	87.93
1984	130.30	12813.0(	1387.9	95.75
1985	133.10	13922.0(	1494.7	96.61
1986	136.00	13917.0(	1467.0	87.54
1987	138.80	12194.0(	1340.7	104.05
1988	141.60	14740.0(	1450.0	101.76
1989	144.50	18784.0(	1715.9	104.96
1990	147.30	22410.0(	1810.0	107.94
1991	148.90	24660.0(	1891.8	121.88
1992	153.20	24575.0(	1942.5	131.98
1993	157.60	25770.0(	1959.8	132.53
1994	159.90	26910.0(	1930.9	126.86
1995	159.80	26986.0(	1992.7	112.75
1996	164.40	26590.0(	2000.6	128.35
1997	167.20	24234.0(	2132.5	127.45
1998	170.10	23632.0(	2153.4	129.99
1999	172.90	22362.0(	2129.8	132.36
2000	175.80	24255.0(	2165.0	134.75
2001	178.60	26759.0(	2256.1	137.03
2002	180.00	24836.0(	2117.8	138.21
2003	183.70	23936.0(	2275.0	141.14
2004	203.60	25113.0(	2328.9	174.22
2005	224.00	22982.0(	2627.4	192.30
2006	247.10	22766.0(	2439.8	219.03
2007	272.70	21520.0(	2349.6	212.93
2008	301.00	17546.0(	2165.4	249.88
2009	315.70	14428.0(	2208.3	208.00
2010	338.70	16474.0(	2408.0	250.24
2011	332.00	16461.9[5]	2473.7	265.43
2012	336.00	15623.0[6]	2457.1	254.73
2013	342.00	14784.1[7]	2307.3	267.53
2014	335.00	13945.2[8]	2347.1	255.12
2015	358.00	13106.3[9]	2171.1	262.17
2016	365.00	14001.9[1]	1871.2	263.35

2017	375.0	13403.42	1945.9	264.5
2018	309.0	13033.40	1909.6	265.7
2019	299.0	12701.67	1945.6	266.9
2020	338.0	12369.95	1774.6	268.0

Null Hypothesis: LNREV has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.316586	0.9145
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNREV has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.640647	0.2650
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNCOP has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.004776	0.0414
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNCOP has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.613154	0.2765
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNHET has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.504662	0.8813
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNHET has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.035825	0.5676
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNAGF has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.957854	0.3040
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNAGF has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 1 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.096875	0.5343
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNREV) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.991171	0.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNREV) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-9.883715	0.0000
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNCOP) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.340347	0.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNCOP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.328651	0.0000
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNAGF) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.363151	0.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNAGF) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.366572	0.0000
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNHET) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.825949	0.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNREV has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.609690	0.8588
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNHET) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=10)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.741366	0.0001
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNREV has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.646848	0.2625
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNCOP has a unit root
Exogenous: Constant
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.139499	0.0301
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNCOP has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 3 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.925145	0.1639
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNAGF has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.082150	0.2525
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNAGF has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.244868	0.4550
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNHET has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-0.526991	0.8768
Test critical values:	1% level	-3.571310	
	5% level	-2.922449	
	10% level	-2.599224	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: LNHET has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.035825	0.5676
Test critical values:	1% level	-4.156734	
	5% level	-3.504330	
	10% level	-3.181826	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNREV) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.765818	0.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNREV) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.667533	0.0000
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNCOP) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.395381	0.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNCOP) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.362641	0.0000
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNAGF) has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.363151	0.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNAGF) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.366572	0.0000
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNHET) has a unit root
Exogenous: Constant
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.734153	0.0000
Test critical values:	1% level	-3.574446	
	5% level	-2.923780	
	10% level	-2.599925	

*MacKinnon (1996) one-sided p-values.

Null Hypothesis: D(LNHET) has a unit root
Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.640121	0.0001
Test critical values:	1% level	-4.161144	
	5% level	-3.506374	
	10% level	-3.183002	

*MacKinnon (1996) one-sided p-values.

Descriptive Statistics

	LNHET	LNAGF	LNCOP	LNREV
Mean	186.8100	19148.66	1967.785	143.1830
Median	162.1500	19112.00	2027.225	129.1698
Maximum	375.0000	26986.00	2627.440	268.0920
Minimum	40.80000	11940.00	1031.170	17.80332
Std. Dev.	102.5228	5241.606	365.9769	81.46952
Skewness	0.377813	0.051162	-0.626784	0.292904
Kurtosis	1.957478	1.454251	2.722293	1.804795
Jarque-Bera	3.453796	4.999607	3.434492	3.691012
Probability	0.177835	0.082101	0.179560	0.157945
Sum	9340.500	957433.2	98389.27	7159.150
Sum Sq. Dev.	515035.4	1.35E+09	6563017.	325226.8
Observations	50	50	50	50

ARDL RESULTS

Dependent Variable: LNHET
Method: ARDL
Date: 10/17/23 Time: 12:41
Sample (adjusted): 1975 2020
Included observations: 46 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LNAGF LNCOP LNREV
Fixed regressors: C
Number of models evaluated: 500
Selected Model: ARDL(3, 0, 0, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNHET(-1)	0.510296	0.155992	3.271295	0.0024
LNHET(-2)	-0.457876	0.181786	-2.518759	0.0165
LNHET(-3)	-0.343532	0.172098	-1.996148	0.0537
LNAGF	-0.001499	0.000574	-2.613576	0.0131
LNCOP	0.000762	0.008711	0.087467	0.9308
LNREV	0.569414	0.141208	4.032457	0.0003
LNREV(-1)	0.060417	0.171926	0.351410	0.7274
LNREV(-2)	0.444972	0.187626	2.371597	0.0233
LNREV(-3)	0.164052	0.206769	0.793408	0.4329
LNREV(-4)	0.377323	0.154878	2.436266	0.0201
C	43.39630	12.65112	3.430232	0.0016

R-squared	0.988851	Mean dependent var	198.5413
Adjusted R-squared	0.985665	S.D. dependent var	98.39686
S.E. of regression	11.78085	Akaike info criterion	7.975795
Sum squared resid	4857.596	Schwarz criterion	8.413079
Log likelihood	-172.4433	Hannan-Quinn criter.	8.139605
F-statistic	310.4219	Durbin-Watson stat	2.102143
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Bond test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
		Asymptotic: n=1000		
F-statistic	6.772293	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66
Actual Sample Size	46	Finite Sample: n=50		
		10%	2.538	3.398
		5%	3.048	4.002
		1%	4.188	5.328
		Finite Sample: n=45		
		10%	2.56	3.428
		5%	3.078	4.022
		1%	4.27	5.412

SHORT-RUN ERROR CORRECTION RESULT

ARDL Error Correction Regression
Dependent Variable: D(LNHET)
Selected Model: ARDL(3, 0, 0, 4)
Case 2: Restricted Constant and No Trend
Date: 10/17/23 Time: 12:44
Sample: 1971 2020
Included observations: 46

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNHET(-1))	0.801408	0.173426	4.621030	0.0001
D(LNHET(-2))	0.343532	0.159534	2.153345	0.0383
D(LNREV)	0.569414	0.124048	4.590274	0.0001
D(LNREV(-1))	-0.986347	0.258960	-3.808886	0.0005
D(LNREV(-2))	-0.541375	0.224005	-2.416796	0.0210
D(LNREV(-3))	-0.377323	0.139341	-2.707915	0.0104
CointEq(-1)*	-1.291112	0.210190	-6.142585	0.0000

R-squared	0.637302	Mean dependent var	6.147826
Adjusted R-squared	0.581502	S.D. dependent var	17.25170
S.E. of regression	11.16036	Akaike info criterion	7.801882
Sum squared resid	4857.596	Schwarz criterion	8.080154
Log likelihood	-172.4433	Hannan-Quinn criter.	7.906125
Durbin-Watson stat	2.102143		

* p-value incompatible with t-Bounds distribution.

ERROR CORRECTION EQUATION

EC = LNHET - (-0.0012*LNAGF + 0.0006*LNCOP + 1.2518*LNREV + 33.6116)

LONG RUN RESULT

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNAGF	-0.001161	0.000423	-2.745862	0.0095
LNCOP	0.000590	0.006757	0.087336	0.9309
LNREV	1.251772	0.028633	43.71791	0.0000
C	33.61157	8.164684	4.116701	0.0002