IMPACT OF HUMAN CAPITAL INVESTMENT ON AGRICULTURAL OUTPUT IN NIGERIA

BY

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CERTIFICATION

This declaration is to clarify that all of the submitted contents of this project are original in its figure, excluding those, which have been admitted specifically in the references. All the work process involved is from my own idea and creativity. All contents of this project have been submitted as a part of partial fulfillment of Bachelor of Science in Economics. I hereby declare that this project is the work of my own excluded for the references document and summaries that have been acknowledge.

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APPROVAL

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DEDICATION

This research work is dedicated to God Almighty for His grace and love. Also to my beloved family, for their support and encouragement.

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ABSTRACT

The study explores the effect of human capital investment on agricultural production in Nigeria from 1990 to 2024. It specifically quantified the impact of Government education expenditure, Government health expenditure on agricultural output based on multiple regression model. It was found that the variables tested were not stationary as revealed by the test on the unit root; however an LRU relationship was established through a cointegration test. Thus, the short and long run estimated the error correction model by the ordinary least squares method and the results show that agriculture output is in the short run related positively and significantly to government education expenditure and government health expenditure whereas in the long run, the government health expenditure is related in positive and significant way with the agriculture output, but government education expenditure is tied in negative and significant way with the agriculture output. The study recommended that human capital development in the agriculture sector should receive higher investments in education and health, better implementation of human capital policies and successful financing of agricultural support measures in the context of boosting agricultural productivity.

CHAPTER ONE

1.1 Background to the study

Hadir and Lahrech (2015) assert that human beings are the most precious and the most commendable resources in both the developed and developing nations. In order to be developed, it is thus a need that these assets are under proper management and their use properly done. The concept of human capital was introduced by the neo-classical economist in the 1960s among them being Schultz (1961) and Becker (1964). They asserted that, training and healthy workers, endowed to the society enables the efficient utilization of these aspects.

Human Capital may be defined as the combined skills, knowledge and un-quantifiable resource of people that may be utilized to generate economic value. Taking into consideration the human capital according to Schultz (1993), it can be defined as a device used in improving competitive advantage as it entails training, knowledge acquisition (education), initiatives and other activities that solely focus on skill acquisition.

Human empowerment can be applied to develop human capital because it is likely to ensure active participation and, based on that, can be validated as a significant contributor to agricultural economic growth. Despite the fact that developed countries have been very active in the usage of human capital however, a bigger number of developing countries have still remained silent to the realization that human capital can be employed as one of the significant energy to drive a better economy.

It is a key determinant in transforming all resources to the good of man and it involves education, health, labour, employment among others. As more people are invested in the sector, the agricultural sector in Nigeria will experience growth as long as there is sufficient security

in the country. The research will therefore be investigating a nexus between an agricultural output and human capital investment.

1.2 Statement of Problem

This is one of the economic sectors that carries out various roles in any economy. It is one of the main sources of economic development with regard to employment creation, ensuring food security, industrialization and wealth creation. In the late colonial/post-independence period, Nigeria was one of the major exporters of agricultural commodities including palm oil, groundnut, cocoa and rubber. The demand for cutting down the export of raw agricultural products also resulted in processing industries were established throughout the country to encourage industry growth and economies of scale. In Nigeria, the performance of the agricultural sector has always been poor despite the resources and efforts put by the government into the agricultural development in the implementation of various Agricultural Development Programmes (ADPs) which seeks to boost the agricultural output. Despite the fact that agricultural output has declined, several challenges including low productivity, poor adaptation of improved technologies of farming, lack of technical knowledge, poor management practices and poor utilization of agricultural resources have continued to exist. Inadequate human capital utilization and development in the agricultural sector is one of the key challenges contributing to these challenges. Lack of education, technical skills and modern training are malnutrition among most farmers which hinder their agricultural productivity. Poor investment in health and education also has lowered the efficiency and the productivity of labour in agriculture. This has hindered the ability of the farmers to embrace new technologies in farming, mechanised systems and modern farming methods required to enhance the production. Additionally the rural farmers are less educated, and have less technical knowledge, which has led to sub-optimal utilization of resources, less innovation, and consequently agriculture competitiveness

in Nigeria is low. Consequent on this, agricultural production remains low although there is adequate land available and governmental intervention in the agriculture.

1.3 Research Question

i. How does education affect Nigeria's agricultural output?

ii. How does health affect Nigeria's agricultural output?

1.4 Objective of Study

The broad objective is to evaluate human capital investment on agricultural output, other objectives of the study are as follows:

i. To examine the effect of education on Nigeria's agricultural output.

ii. To evaluate how health will influence Nigeria's agricultural output.

1.5 Research Hypothesis

$H0_1$: Education does not play an influential role in agricultural output in Nigeria.

$H0_2$: Health does not play a major role on Nigeria's agricultural output.

1.6 Scope of Study

In the paper, the researcher will direct his attention to the impacts of human capital investment on agricultural output in Nigeria. This will lie in 1990 to 2024. It would derive data of the Central Bank. The agricultural output rate is the explained variable and the explanatory parameters are aggregate education and health. other controlled variables are the government expenditure on agriculture, literacy rate, and labour force participation.

1.7 Significance of Study

This takes a strategic position of relevancy as it will go a long way in showing the impact of the study. The research outcomes are highly significant to the nation because it will be applicable to policy makers and the literature review will be a valuable resource of secondary database of reference material to the members of the academia and the general population. The implications to policy makers are derived by the same notion that food security will be achieved by greater agricultural production, workers would be hired and even increase in the percentage of export revenues in Nigeria.

CHAPTER TWO

LITERATURE REVIEW

2.1 Conceptual Literature

2.1 Conceptual Literature

2.1.1 Human Capital Investment

Education, health, training and skill development that translate into enhanced productivity and efficiency of human resources are treated as a form of human capital investment. Labour was known as one of the factors of production in the early economic theories and Schultz (1961) initiated the concept of human capital which contributes to the fact that investment of resources in education and health is not consumption but an investment (Fleischhauer, 2007). Becker (1964) also explained that human capital is analogous to physical capital, which also results from investing in it in order to increase future productive capacity and wages.

Human capital are capabilities shared by the people and are especially essential for their productive involvement in the process of human activity, including knowledge, skills, experience, health, intelligence and abilities (James 2021). Workers' productivity is enhanced and companies' performance enhanced through education and training (Djomo & Sikod 2012). Human Capital investments then enhance the productivity capacity of the people and spur economic growth.

2.1.2 Concept of Agriculture

The science and practice of raising crops, livestock, and natural resources to feed humans, raw materials and other products needed by society. Performing agricultural activities as the systematic cultivation of useful plants and rearing of animals for human use now gives agriculture the definition of agriculture according to Rimando (2019). According to Rubenstein (2020), agriculture is defined as deliberate alteration of the earth's surface by tilling of land and

raising of livestock for food or profit, and Black (2019) defines agriculture as the science (and art) of raising crops and productive livestock for food and economic gain.

In addition to the production of food, agriculture furnishes various forms of raw materials to industries, gives jobs, earns revenue and aids in economic growth to a great extent. It also provides raw materials that are used for fabrications like clothing, medicine, abatement and industrial production.

2.1.3 Agricultural Policy

Agricultural policy is defined as the set of decisions, programmes and measures taken by government to influence and guide agricultural production, marketing and rural development. Agricultural policies are meant to satisfy the purpose of the policy which includes objectives of food security, stable agricultural prices, boost in productivity, environmental sustainability, and farmers welfare (Hogan and Morris, 2010).

There are various aspects of agricultural financing, subsidies, research and extension services, adaptations to climate change, regulation of markets, and food quality standards that are included in agricultural policies. They also promote investment in agriculture by extending finance aids, developing infrastructure, and technological development. Good agricultural policies not only stimulate agricultural productivity, promote employment creation but also rural sustainable economic growth.

2.1.4 Types of Agriculture

Agriculture can generally be classified into two major types: subsistence agriculture and commercial agriculture.

2.1.5 Subsistence Agriculture

A farming system in which the farmer grows primarily food in small quantities . It is usually employed in the developing nations with small land holdings, easily accessible farm equipment, and personal labor. The lack of the use of modern agricultural technologies and continuous use of the same soil leads to low productivity and may decrease soil fertility over time.

2.1.6 Commercial Agriculture

Commercial Agriculture means cultivating crops and plants and rearing livestock for commercial reward and in large quantities for retailers. It entails using the latest agricultural techniques (adopted technologies), better seeds, fertilizers, machinery, and scientific methods of farming. Commercial agriculture also features plantation agriculture which focuses on one specific cash crop, such as cocoa, coffee, tea, rubber, sugarcane or cotton, cultivated on a large scale, mostly for production for industrial utilisation and export (Black, 2019).

2.1.7 Agricultural Output and Features

Agricultural output is output from agricultural activities, both in volume and in value, represented by all items produced with agricultural resources during a period with a given supply of these resources. It is a vital measure of agricultural productivity and is essential to guaranteeing food security, employment creation, reducing poverty, and economic growth especially in developing countries like Nigeria.

Starting from the farm, agricultural output is defined and measured.Agricultural output, starting on the farm, is defined and measured.

The output produced from agriculture can be defined as the amount of agricultural products generated with given production factors, namely technology, labour, capital and land (Fulginiti

& Perrin, 1998). It may also be assessed as the value of agricultural products produced in comparison to the amounts of inputs going into their manufacture (Olayide & Heady, 1982).

Labour productivity (output per person), land productivity (output per acre of land farmed), and total factor productivity (TFP: output per production inputs) are among several different measures used to quantify agricultural output. (See Wiebe, 2003.) Of these measures, the total factor productivity is more comprehensive in that it takes account of the contribution of all the production factors. Agriculture production is prominent in Nigeria as it is significant for food production, employment and development.

2.1.8 Human Capital Investment and Agricultural Output

Human capital investment is any government and private spending that aids in human skills development, health, and education to increase labour force productivity and efficiency. Agriculture investment in human capital increases farmers' knowledge, technical skills and capabilities to adopt better production technologies and modern production techniques.

An increase in the education gives better decision making skills to the farmers; improved health care services improve labour efficiency of the farmers and minimize the losses incurred due to lack of health care. As a result, human capital investment alleviates the pressures of low productivity in agriculture, optimizes resource use and enhances sustainable development in agriculture. Thus, improving education and health care are still critical for the country to increase agricultural output and food security in Nigeria.

2.2 Theoretical Literature

The study is based on theories that highlight the link between investment in human capital and agricultural output in Nigeria, these are as follows.

2.2.1 Human Capital Theory

The Human Capital Theory was elaborated by Theodore Schultz (1961) and even further by Gary Becker (1964). The theory is that the more educated individuals are, the healthier they are, the smarter they are, and the more productive they are, the more they will produce, and the more the economy will expand. As far as Agriculture is concerned, healthy and well educated farmers are more inclined to adopt world class technologies and run their businesses in a resourceful manner and productively. This theory is the principle theoretical basis of this study.

The Human Capital Theory is a powerful instrument to clarify the role of education and health in national development processes within the case of Nigeria. Being an extensive country, Nigeria has a highly populated and youthful population with great potential to leverage its human capital in transforming the economy. Still, the issue of inadequate financing of education, inequitable distribution of healthcare services and employment problems remain impediments to realizing this potential (UNESCO, 2023).

2.2.2 Modernization Theory

Modernisation theory is an explanation for the process of economic development as the absorption of modern knowledge, technology and innovation by societies. The theory states that training can alter an individual's attitude, stimulates innovations and promotes productivity. Modernization in agriculture fosters better farming techniques, mechanization and scientific methods which result in larger agricultural production.

2.2.3 Dependency Theory

According to dependency theory, the developing countries tend to be economically dependent on the developed countries which restricts their productive capability and development. The theory holds that too much outside resources and technology could impede the sustainable development of agriculture. It therefore, recommends increasing investments in local human

resources, technology and local agricultural production so as to become self-reliant and boost agricultural output.

2.3 Empirical Literature

The present study undertaken by Ogunjobi et al. (2025) was concerned with the assessment of influence exerted by human capital development on agricultural productivity in Nigeria but was based on annual time series data collected during the period of 1988-2023. Analysis of the correlation between human capital variables and agricultural output has revealed that both short-run and long-run relationships have been established through use of the Autoregressive Distributed Lag (ARDL) method. The investment into education, health care and skills development turned out to enhance significantly the productivity of the agricultural sector. The study found out that human capital stimulates innovation and efficiency in farming activities.

Ijirshar et al. (2025) conducted a study aimed at defining the determinants of agricultural output in Nigeria. Time series data have been used to assess the nature of correlation between human capital and agricultural productivity. It has been determined that there exists a positive correlation, which has been defined using econometric methods. The researchers found out that education and training are able to enhance adaptation capacity and agricultural productivity. They have also concluded that human capital makes agricultural sector resilient to economic and environmental shocks.

Alohan and Olufemi (2024) conducted a study focused on analysis of human capital efficiency and its impact on agricultural firms in Nigeria on the basis of panel data. It has significant positive correlation. This relationship has been established using pooled Ordinary Least Squares method. Enhancement of labour proficiency, training and experience has been found to stimulate productivity and profitability of agricultural industry. The researchers found out that agricultural growth is driven by knowledge and innovation.

Based on use of OLS and cointegration techniques Adebanjo et al. (2023) carried out a study focused on defining the determinants of agricultural output in Nigeria. Correlation between human capital and agricultural productivity revealed a significant positive correlation, which was determined using econometric techniques. Improved quality of labour has been recognized as a factor enhancing productivity and efficacy of other agricultural inputs. The research also found out that human capital enhances efficiency and innovation in agricultural production.

Omede and Adamu (2023) conducted a study focused on assessing the role played by development of human capital in poverty reduction and agricultural productivity in Nigeria using OLS and cointegration analysis. The correlation between human capital and agricultural output showed that there existed a mixed relationship that was defined using econometric methods. Improved education and health care were found to contribute to increased labour productivity and indirectly to enhanced agricultural output by virtue of decreasing poverty. Human capital has also been found to affect indirectly positively agricultural productivity.

Using the Autoregressive Distributed Lag (ARDL) model Ogbeide-Osaretin and Aliu (2022) have carried out a study focused on defining the nature of the relationship between rural development and agricultural productivity in Nigeria. Correlation between human capital and agricultural output proved to be positive and was established using econometric methods. Educated and skilled farmers were found to spend money efficiently and were therefore more productive than others.

Employment levels in relation to agricultural output in Nigeria were studied by Oluwafemi and Onyeka (2019) using ARDL and Granger causality techniques. Correlation between agricultural productivity and unemployment showed that there existed a strong relationship which had been proven by econometric analysis. Employment level was affected by agricultural productivity. The study found out that the mutual causality existed between these

two variables. It concluded that more agricultural production is needed to reduce unemployment.

For instance, Adams (2019) did some research analyzing the role of poultry farming in employment creation in Nigeria using descriptive statistics and questionnaires. Correlation analysis of the variables poultry production and employment demonstrated that there was a positive correlation which was derived using empirical analysis methods. Poultry farming was observed to contribute greatly to the creation of jobs and income generation. Additionally, availability of credit has resulted in increased productivity in poultry industry.

Also, Ojo and Baiyegunhi (2018) conducted some research investigating the impact of extension services on agricultural output in Nigeria. The relationship between the variables training and agricultural output was analyzed, and it was determined that there was a positive relationship which was empirically established. Extension services have been observed to be positively affecting productivity in agriculture and introduction of innovations to the sector. Additionally, transfer of knowledge was found to increase output efficiency and productivity.

Additionally, Abiodun et al. (2017) performed some research investigating the role of cooperative societies in agricultural productivity in Nigeria. The correlation analysis of cooperative participation and agricultural output proved that there was a positive correlation that was established on an empirical basis. In addition to that, it was found that cooperative societies promote the development of human capital and the usage of common resources. Moreover, it was discovered that educated farmers are much more effective in the utilization of resources. Therefore, the conclusion was drawn that the development of training programs within cooperatives is needed.

Furthermore, Bernard and Adenuga (2017) carried out a study aiming to explore the effectiveness of agriculture as an employment generator in Nigeria using error correction and

Granger causality techniques. Analysis of the variables agriculture production and employment demonstrated that the relationship between them was positive which was empirically determined. Thus, agricultural production has been shown to promote employment generation.

Moreover, Lawal et al. (2016) performed research examining the connection between poverty among the rural population and agricultural productivity in Nigeria. In particular, the relationship between human capital and agricultural output was empirically analyzed and it was established that there was a significant relationship. Poor education and skills were found to decrease agricultural productivity and intensify poverty level.

Further, Oni et al. (2015) conducted a research investigating the relationship between health care and agricultural productivity in Nigeria's rural areas. Thus, the positive relationship between agricultural output and health status was empirically revealed. It has also been discovered that good health conditions increase labor productivity while poor health conditions reduce the output level. In addition, increased spending on health was found to positively influence agricultural performance.

Olanrewaju (2014) conducted a research to test the hypothesis that agriculture and youth unemployment are correlated using chi-square and primary data. Correlation analysis of agricultural involvement and unemployment proved that there was a strong relation between the two that was achieved using statistical analysis methods. It has been discovered that youth participation in agricultural activities reduces unemployment, provided there are enough resources. The study has proved that youth participation is positively stimulated by the presence of financial and infrastructural factors.

Ogbalubi and Wokocha (2013) have conducted a study aimed at analyzing Nigerian agricultural growth and employment in 1973-2002. Analysis of the relation between agricultural output and

employment has revealed that there was a weak relation and this was achieved by means of empirical analysis.

Adofu et al. (2013) have carried out a research in order to analyze the role of education in agricultural production in Nigeria based on survey data. Analysis of the relation between education and agricultural productivity has proved that there was a positive relation achieved using empirical techniques. It has been observed that education contributes to improved decision making and proper management of resources.

Nwaru (2004) has conducted some research in order to investigate the significance of skills and experience in agricultural productivity in Nigeria. Correlation analysis of the experience and the output has revealed that experience and output had a positive relation which was achieved using empirical techniques.

Adeoti (2002) has conducted a research aimed at investigating the impact of technological adoption on agricultural productivity in Nigeria. Regression analysis of the relation between technology adoption and human capital has shown that there was a positive relation which was achieved using empirical techniques.

2.4 Gaps in Literature

An overview of previous studies examining the effect of human capital investment on agriculture productivity in Nigeria reveals that there are some notable gaps. While the earlier literature focuses mainly on education and health as individual determinants of human capital, it fails to consider the interdependence of other important variables, including literacy rate and labor force participation. The result is a limited reflection of the effect of human capital on agricultural productivity. Therefore, the connection between human capital and agriculture output is not fully established. In addition, most studies use a similar methodology and data for the short term, thereby making the findings less reliable. This paper addresses these gaps by

adopting a more holistic approach incorporating education expenditure, health expenditure, literacy rate, labor force participation, and government expenditure in the same model.

CHAPTER THREE

METHODOLOGY

3.1 Research Design

The research design used for this research work is known as ex-post factor. The reason why this research design was used was that it shows how the variables interact.

3.2 Theoretical Framework

Human Capital Theory: Human Capital Theory was originated by Theodore W. Schultz in 1961 and further explained by Gary S. Becker in 1964. The importance of investing in education, health and training in order to enhance their productivity and economic value was highlighted by this theory. According to this theory, such an investment helps people become productive assets and these are very much essential for economic development. The idea in this context is that human capital is just like physical capital in the sense that it is essential to invest in order to gain something out of it.

According to Human Capital Theory, human beings learn skills and acquire knowledge through education and training as well as health to become productive assets of economic value and raising their earning capacity. This theory is applied mostly in Labor Economics as well as Development economics because of its correlation between education, health and economic growth. According to this theory, those nations who have a highly educated and healthy populace stand better chances of achieving higher economic growth due to their efficient and effective workforce (Becker, 1994).

This research is based on the theory of Human Capital. According to this theory, when there is an increase in the value of the human capital factors such as health and education, there will be economic growth as a consequence. So, increase in health factor will cause an increase in the

production of agricultural goods. Health factor can be measured in terms of health status or health outcomes. Mathematically, Cobb-Douglas Production function is expressed as follows:

Production function is:

$Y=A*Ka*Lb$

Y= Total output

A= Total factor productivity

K= Capital input

L= Labour input

a and b= capital and labour elasticities

Including human capital into the formula:

$Y=A*Ka*LbH$

H=Human capital (Education and Health)

Human Capital Theory serves as an effective way of explaining the significance of education and health in economic development. Nigeria is an expansive country having a young and large population with enormous potential to exploit their human capital to develop its economy. However, problems like inadequate funding of education, health care and unemployment hinder its economic development (UNESCO, 2023).

3.3 Model Specification

In the proposed models, multiple regression analysis approach has been used which means that there are numerous econometric approaches adopted to express the relationship between two variables i.e., independent and dependent variables. This model demonstrates the correlations

between the variables and as follows according to the formula used. The ols equation model is

$y_i = \beta_0 + \beta_1 xi + \beta_2 xi + \beta_3 xi + \ldots\ldots + \beta_p x_p + \mu_p$

i. Functional model

AGOUT = f (EDUEXP, HLTEXP, LBF , LITR, GEXA) (1)

ii. Mathematical model

$AGOUTt = \beta 0 + \beta 1 EDUEXPt + \beta 2 HLTEXPt + \beta 3 LBFt + \beta 4 LITRt + \beta 5 GEXAt$ (2)

iii. Econometric model

$AGOUTt = \beta 0 + \beta 1 EDUEXPt + \beta 2 HLTEXPt + \beta 3 LBFt + \beta 4 LITRt + \beta 5 GEXAt + \mu t$ (3)

Where;

AGOUT = Agricultural output in Nigeria

EDUEXP = Eexpenditure on education in Nigeria

HLTEXP = Total government expenditure on health in Nigeria

LBF = Labour force participation in Nigeria

LITR = Literacy rate in Nigeria

GEXA = Government expenditure on agriculture

3.4 Description of Variables

Government expenditure on education: Government expenditure on education is looked upon as expenditure on construction of human capital in a way that raises the rate of employment. This spending on education is used to finance the government as well as the private institutions of education including administrations and subsidies to the households. It is used for financing the education sector where this involves the provision and maintenance of educational services both within the schools and universities as well as privately owned or government education

institutions. With this, the level of employment will rise when human capital rises through increased government expenditure on education. In another word, education and employment are positively correlated.

Government expenditure on health: This is the spending on health made by various levels of governments, as well as social security programs, related to the healthcare industry or sector. The health care spending of the government in Nigeria constitutes recurrent expenditures that are financed by government budgets, foreign loans and grants (including gifts donated by international organizations and other non-profit making organizations), as well as social health insurance funds. Just like the government expenditure on education, this too is among the important variables which positively influence the employment rate as the health financing is regarded as the investment in human capital.

Labour force participation: This is the percentage of a particular nation who participate in the labour market either through seeking employment or employment itself. The extent to which people are active economically is what is referred to as the labour force participation. Increase in the labour force participation is indicative of increased utilization of human capital in the economy.

.Literacy Rate: Literacy rate refers to the proportion of the population at particular age groups (15 years and above) who know a certain language that allows them to read and write. One of the important indicators of the level of education as well as human capital development of a nation is the literacy rate.

Government expenditure on agriculture: This refers to the sum of money expended by the government to aid the agricultural sector within a certain period. These expenditures are directed at improving productivity in agriculture, supplying the necessary agricultural input materials, building up the rural infrastructure, sustaining research and extension programs and

conducting agricultural development programs. Government expenditure on agriculture is a vital policy instrument that is used to enhance food security, rural development, generation of employment and economic growth.

Agricultural output: Agricultural output refers to the aggregate of value or volume of agricultural products produced within a period which is one year normally. Agricultural output involves all types of agricultural products from farming activities like crops, livestock, fisheries and forestry. The output from agriculture can be measured physically through the tons of agricultural products and monetarily through the value of such products in the market. The measurement of agricultural output is essential in ascertaining how productive the agricultural sector in the economy is. High agricultural production is evidence of food sufficiency, economic growth and rural development. However, poor agricultural output may arise due to poor farm conditions, low level of technologies used or even poor government policies.

3.5 Testing Methodology

This are preliminary tests that will be implemented to evaluate the accuracy of the data used. It is divided into:

3.5.1 Unit Root Test

The is a test carried out before carrying out estimation of any model. In this case, a parameter is said to be constant when the mean, variance and covariance are constants with respect to time. Why is this test necessary? The outcomes from a regression analysis conducted using non-stationary data could be spurious.

3.5.2 Co-integration Test

Following the unit root test, co-integration test was performed to check if a long-run equilibrium relation exists among the parameters involved in the study. If the variables are non-

stationary individually but are co-integrated if they move together in the long run. With co-integration, there are no spurious regression results, and the relationships among the variables can be estimated.

$$\hat{\mu}_t = \phi\hat{\mu}_{t-1} + \nu_t \qquad (3.4)$$

3.6 Parameter Signs Testing

This sign testing of the signs of the estimated coefficients of the explanatory variables shows whether the estimated coefficient values are consistent with the a priori hypothesis based on the economic theory.

Table 3.5 A prior assumption

PARAMETERS	ASSUMED SIGN
EDUEXP	+
HLTEXP	+
LBF	+
LITR	+
GEXA	+

3.6.1 Hypothesis Significance Testing

3.6.1.1 R-Squared (R^2)

The R-squared (R^2) indicates the proportion of the variability of the explained variable that is attributable to the explanatory variable(s) that were selected to be part of the model. R^2 ranges from a zero value to 1.0 value. By increasing, the explanatory variables becoming more significant of an increase in the variance of the dependent variable, the greater the fit of the regression.

3.6.1.2 Student's t-Test

To check the importance of the separate explanatory variables in the regression model, Student's t-test is used. It considers if any independent variable is statistically significant on their dependent variable. This decision is made at the 0.05 level, less than 0.05 means it is significant.

3.6.1.3 F-Test

To check the model fit of the regression model a F-test is applied. It shows whether the explanatory variables jointly have an effect on the explained variable. The probabilities value for the F-statistic is the basis for the decision rule, less than 0.05 means it is significant.

3.6.2 Econometrics Tests

3.6.2.1 Normality Test

The research will use the Jarque-Bera (JB) normality test to see if the residuals to the estimated model are normally distributed or not.This decision is made at the 0.05 level, greater than 0.05 means it is significant.

3.6.2.2 Autocorrelation Test

To check if the error terms in the estimated model are correlated the auto correlation test is conducted. In this study, This decision is made at the 0.05 level, greater than 0.05 means it is significant.

3.7 Required Sources of Data

Secondary time series data for the time spans from 1990 to 2024 is used for this study.. Data were gathered from the Central Bank of Nigeria (CBN).

3.8 Econometric Software

EViews 9 is used for estimation and analysis of the data because EViews is easy to use and appropriate for estimation of time-series based econometric models. The data were organized, transformed, and prepared before being imported into EViews 9 for estimation and analysis, using Microsoft Excel. The software was also utilized to create the regressions presented in the study.

CHAPTER FOUR

DISCUSSION AND PRESENTATION OF RESULTS

4.1Presentation of Results

The data gathered for this study is presented in this chapter and analyzed. It also reviews empirical evidence of the impact of human capital on agricultural production in Nigeria. This deals with descriptive statistics, unit root test, short-run analysis, evaluation of the estimated results on economic and statistical basis, diagnostic tests.

Table 4.1. Descriptive Statistics

Variable	Mean	Maximum	Minimum	Std. Dev	Jarque-Bera	Probability	Obs
AGOUT	10880.30	19626.80	3464.716	5828.490	3.367381	0.185687	35
EDUEXP	229.6426	752.9800	0.290000	235.1463	4.338991	0.114235	35
HLTEXP	140.9046	468.6400	0.150000	151.5593	4.641831	0.098184	35
GEXA	31.76889	94.28000	0.208700	29.34970	3.261799	0.195753	35
LBF	82.07694	84.09500	79.31400	1.233187	1.196558	0.549757	35
LITR	58.98029	70.41000	51.08000	4.958032	6.041154	0.058773	35

Descriptive statistics give information about the variables that are found at the beginning level. The variables considered are Agricultural Output (AGOUT), Education Expenditure (EDUEXP), Health Expenditure (HLTEXP), Government Expenditure on Agriculture (GEXA), Labour Force Participation (LBF), and Literacy Rate (LITR) for the time span 1990–2024.

The descriptive statistics show that the agricultural output had a mean of 10880.30, education expenditure 229.6426, health expenditure 140.9046, government expenditure on agriculture 31.76889, labour force participation and literacy rate 82.07694 and 58.98029 respectively.

Standard deviation quantifies the amount of variation or dispersion from the average (mean) in a set of values. The largest standard deviation was found in agricultural output with 5828.490,

which is a range in production that was influenced by many factors over time. The education expenditure and health expenditure also showed relative high variations with standard deviations of 235.1463 and 151.5593, respectively. The standard deviation of expenditure on agriculture was seen to be 29.34970, relatively low standard deviation of literacy rate (4.958032) and the standard deviation of labour force participation (1.233187), which shows greater stability with a smaller variation over the study period.

Additionally, all Jarque-Bera data are bigger than 5%. This indicates that the variables are distributed normally and hence appropriate to be analysed econometrically.

4.1.2 Unit Root Test

The unit root test was used to evade the problems of spurious correlation and to ascertain the unit root properties of the parameters.

Table 4..2: Unit Root Test Results

variable	At level	lag	prob	1st Difference	lag	prob	Note
AGOUT	-1.04	0	0.73	-5.15	0	0.00	I(1)
EDUEXP	-1.65	0	0.45	-8.10	0	0.00	I(1)
HLTEXP	-2.16	7	0.17	-9.60	0	0.00	I(1)
LBF	-2.10	7	0.15	-4.29	0	0.00	I(1)
LITR	-2.74	0	0.30	-7.33	1	0.00	I(1)
GEXA	-2.12	0	0.24	-6.49	8	0.00	I(1)
Error	4.34	2	0.00	NA	NA	NA	

Testing results indicates that all test variables are non-stationary in form 0. But all variables are stationary first difference, at the 0.05 level. Moreover, the value of the probability of the error correction residual is lesser than 0.05, which is ≤ 0.05. leading to short run model

4.2 Short run impact of Human Capital on Agricultural Output

Following the establishment of cointegration relationship between the variables, short run error correction model was estimated to examine the effect of public debt on the Nigerian economy.

Table 4.3: Model Result

Variable	Estimate	Standard value	t-value	Prob
C	0.040933	0.011234	3.643497	0.0011
D(LNEDUEXP)	0.606217	0.281119	2.156440	0.0384
D(LNHLTEXP)	0.432001	0.158247	2.729924	0.0101
D(LNLBF)	-0.612703	0.179580	-3.411861	0.0017
D(LNLITR)	0.145331	0.145362	0.999790	0.3263
D(LNGEXA)	0.311939	0.065704	4.747637	0.0000
ECM(-1)	-0.373587	0.092225	-4.050834	0.0004

4.3 Evaluation of the Results

The constant is 0.040933 with a direct correlation and critical at 5%. This means that there is some level of agricultural production in the void of all the exogenous parameters.

The coefficient of education expenditure [D(LNEDUEXP)] has direct correlation and critical with a value of 0.606217. This means that for every one percent rise in expenditure on education, agricultural output will rise by about 0.61%.

In a similar fashion, there is a direct coefficient of 0.432001 and it is critical for the variable health expenditure [D(LNHLTEXP)]. This means that for every one percent rise in expenditure on health, agricultural output will rise by about 0.43%.

The coefficient of labour force participation [D(LNLBF)] is negative (D(LNLBF) = -0.612703), and statistically significant. This implies that with an increase of one per cent of the labour force participation, agriculture output is diminished by about 0.61%.

Literacy rate [D(LNLITR)] has a direct coefficient of 0.145331 but is insignificant. This means that while literacy rate has a positive impact on agricultural production, the impact is not significant in the regression.

The agriculture expenditure [D(LNGEXA)] is positive and significant with the value being 0.311939. This means that every dollar that the government spends on agriculture adds about 0.31 percent to agricultural production.

The ECM(-1) is -0.373587 and significant. It suggests that the short-run disequilibrium is corrected by about 37.36 percent on an annual basis towards the path of the long-run equilibrium.

Table 4.4: Model Estimates

Coefficients	Predicted Signs	observed Sign	note
D(LNEDUEXP)	+	+	aligned
D(LNHLTEXP)	+	+	aligned
D(LNLBF)	+	-	does not aligned
D(LNLITR)	+	+	aligned
D(LNGEXA)	+	+	aligned

4.5 Evaluation of Results

4.5.1 Coefficient of Determination (R^2)

The r squared (R^2) is 0.413872 meaning that around 41.39 percent of the total variation in agricultural output can be explained by education expenditure, health expenditure, labour force participation, literacy rate and government expenditure on agriculture. The rest of the variation is due to other variables not accounted for in the model and to random disturbances.

4.5.2 T-Test

To test the significance of each of the explanatory parameters, the Student's t-test was used.

The probability values for education expenditure (0.0384), health expenditure (0.0101), labour force participation (0.0017) and government expenditure on agriculture (0.0000) are all below 5 percent (which is the significance level). Hence, all these variables have a significant effect on agricultural production in Nigeria.

The probability value of Literacy rate is 0.3263 and is more than 5 percent significance level. This suggests that literacy rate does not have a significant effect on agriculture production in the study period.

4.5.3 F-Test

The value is 3.177499 with a probability less than 0.05.

Hence, the null hypothesis is dismissed, this means that the explanatory variables are significant together in explaining the changes in agricultural output in Nigeria.

4.5.4 Test of Hypotheses

Hypothesis One

H_{01}: In Nigeria, there is no significant relationship between education expenditure and agricultural output.

The probability value of education expenditure is less than 0.05, that is 0.0384. So, the hypothesis is rejected. The study concludes that the expenditure on education has significant influence on agricultural output in Nigeria.

Hypothesis Two

H_{02}: Health expenditure has no significant effect on agricultural output in Nigeria.

The probability value of health expenditure is 0.0101, < 0.05. Thus, the null hypothesis is rejected. The study findings indicate that health expenditure has a significant effect on agricultural production in Nigeria.

4.6 Hypothesis Testing

4.6.1 Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test was performed to test for presence of serial correlation among residuals.

Table 4.5: Autocorrelation Test Result

	Coefficient		Prob
F-statistic	0.386888	Prob. F(2,25)	0.6832
Obs*R-squared	1.020742	Prob. Chi-Square(2)	0.6003

The probability value for the F-statistic (0.6832) and the Obs*R-squared (0.6003) values are larger than 0.05. Thus, the null hypothesis that there is no serial correlation is accepted. This means that the residuals will be uncorrelated and the estimated model will not be autocorrelated.

4.6.2 Heteroscedasticity Test

The Breusch-Pagan-Godfrey test was used to check the constancy of the variance of the error terms.

Table 4.6: Test Results

Test	Value	Probability
F-statistic	2.099713	0.5047
Obs*R-squared	1.620871	0.9025
Scaled explained SS	1.482117	0.9438

The probability values associated with the F-statistic (0.5047), Obs*R-squared (0.9025) and Scaled Explained SS (0.9438) are all higher than the 5 percent significance level. So, the hypothesis of homoscedasticity is accepted. This means that the model has no heteroscedasticity and the error is homoscedastic.

4.7 Normality Test

The Jarque-Bera statistic was used to check the normality of the residuals.

Jarque-Bera	0.81	Prob	0.67

The probability value is 0.67, which is not less than the 5 percent significance level. Hence, the null hypothesis, that the data are normally distributed, may be accepted. **4.6.4 Multicollinearity Test**

A Pairwise Correlation Matrix was used in order to investigate the level of correlation in the explanatory variables.

Table 4.8: Test Results

	LNEDUEXP	LNHLTEXP	LNLBF	LNLITR	LNGEXA
LNEDUEXP	1.000000	0.793219	-0.675864	0.530592	0.651662
LNHLTEXP	0.793219	1.000000	-0.703821	0.526229	0.758233
LNLBF	-0.675864	-0.703821	1.000000	-0.330100	-0.622933
LNLITR	0.530592	0.526229	-0.330100	1.000000	0.503468
LNGEXA	0.651662	0.758233	-0.622933	0.503468	1.000000

The model explained that the all coefficients do not exceed 0.80. Hence, no serious multicollinearity between the explanatory variables is to be found, so the explanatory variables are appropriate for the estimated model.

4.7 Long-run Impact of Human Capital on Agricultural Output

The long-run effect of human capital investment on agricultural output is examined in this chapter.

Table 4.9: Summary of the coefficients

Parameter	Estimate	Standard Error	t-value	Prob
C	52.72337	11.18772	4.712612	0.0001
LNEDUEXP	-0.230437	0.113729	-2.026187	0.0490
LNHLTEXP	0.406780	0.116693	3.485892	0.0016
LNLBF	-10.72585	2.530247	-4.239052	0.0002
LNLITR	0.777358	0.363347	2.139434	0.0409
LNGEXA	0.005714	0.051254	0.111491	0.9120

4.8 Evaluation of Results

The result shows that the value of education expenditure is (-0.230437), and important at 5% level of significance. This suggests that 100-point rise in education spending lowers agricultural production by 0.23 percent in the long-run.

The value of health expenditure was 0.406780, which shows that health expenditure has a positive and important relationship with agricultural output, with the value of 0.41 percent when the health expenditure increased by one percent, the agricultural output increased by about 0.41 percent.

Labour force participation also has a negative and statistically significant coefficient of -10.72585, his implies that with an increase of one per cent of the labour force participation, agriculture output is diminished by about 10.73%s

Literacy rate has a value of 0.777358 and is significant which indicates that for a one percent rise in literacy rate agricultural output will rise by around 0.77 percent.

The value of Government expenditure on agriculture is 0.005714 with a positive sign but not significant statistically. This means that the government spending on agriculture in the long term has no statistically significant impact on agricultural output, but it does have a positive effect in the short term.

The R^2 is 0.954879, meaning that around 95% of the total variation in agricultural output can be explained by explanatory variables

4.9 Discussion of Findings

The findings of this study gives evidence that education spending, health spending, literacy rate, and government spending on agriculture all have positive impacts on agricultural output; both income and food production in Nigeria, in the short run but the labour force participation rate has the negative impacts in Nigeria.

The positive effects of education expenditures, health spending, and literacy rate is consistent with the Human Capital Theory suggesting that an investment in education and health should increase the knowledge, skills, efficiency, and productivity of the workers. In the same way, the positive relationship between government spending on agriculture and agriculture output is in line with the Keynesian Theory which holds that government spending is a stimulator of economic activities and increases agricultural output by investing in infrastructure, agricultural research and extension services, and agricultural support programmes.

But the negative labour force effect indicates that simply increasing the labour force will not necessarily increase agricultural productivity. When the quantity of labour employed increases in a production process and the quantity of capital employed, the technology used and other complementary factors remain unchanged, the law of diminishing marginal returns implies that the production side of the economy could experience a fall in labour productivity.

Overall, the results suggest that investment in human capital and support to agriculture from governments are critical to enhancing agricultural production in Nigeria. However, the efforts to improve the agricultural productivity through labor participation should be supported by technological development and mechanization and proper capital injection to achieve sustainable development in agricultural production.

CHAPTER FIVE

5.1 Summary of the Findings

1. Agricultural output is found to be positively related to the education expenditure in short run but negative in long-run and it was shown to have a high influence on agricultural output in both runs.

2. The health expenditure has positive relationship to the agricultural output in both regression runs, and it was observed that significant effect was being exerted to it in both regression runs.

5.2 Conclusion

This research is an experimental approach of the effect of human capital investment on agricultural output in Nigeria. The research output model was estimated using ordinary least squares technique, and discovered that the independent variables positively affect agricultural output in Nigeria. Moreover, the controlled variables namely; literacy rate, and government expenditure on agriculture both have positive coefficient. Thus, positively affecting agricultural output. But labour force participation, have negative coefficient thereby negatively affecting agricultural output.

5.3 Recommendations

1. Government needs to continue and expand funding for education, as the results showed that in the short run expenditure on education has a significant effect on agricultural output. Greater investments in education will result in better human capital development, higher literacy, use of modern agricultural practices, and productivity in agriculture.

2. Government should improve investment in the health sector since health expenditure was found to have a positive upside on agricultural output in both regression runs. Improved health

care services will have a positive impact on the health status and productivity of farmers which will lead to better agricultural performance in Nigeria.

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APPENDIX

year	IO	Eglb	Cglb	Pglb	ER	CF	IR
1990	35.41033	3200	1200	6400	8.038285	7,331.16	17.46624
1991	36.96557	3000	1200	6600	9.909492	7,240.29	0.990847
1992	37.70961	3300	1400	7000	17.29843	7,277.43	-14.9872
1993	33.17434	3600	150000	7200	22.0654	7,825.69	-7.05247
1994	31.31839	3300	10000	7200	21.996	7,633.27	-15.9202
1995	36.54049	2800	8000	7300	21.89526	7,126.18	-31.4526
1996	37.44548	2800	1100	7400	21.88443	7,610.32	-5.26078
1997	35.24885	3000	1000	7500	21.88605	8,055.21	12.12661
1998	28.70244	3400	1500	7600	21.886	8,167.45	11.48467
1999	29.36369	4300	1800	7600	92.3381	8,385.96	6.047248
2000	33.823	4200	1700	7900	101.6973	8,996.91	-1.14089
2001	28.27627	4300	1600	8100	111.2313	6,860.44	12.1387
2002	23.04084	4000	1600	8000	120.5782	7,559.73	3.023542
2003	26.00241	4100	1800	8100	129.2224	9,178.17	9.935713
2004	28.39004	3800	1900	8100	132.888	7,348.34	-2.60485
2005	28.20158	3900	2000	8100	131.2743	7,520.47	-1.59368
2006	25.75164	4100	2100	8200	128.6517	10,557.89	-5.62797
2007	24.34472	4400	2400	8200	125.8081	8,246.21	9.187171
2008	24.71425	4100	2400	8300	118.5667	8,031.72	6.684909
2009	21.23676	4100	2600	8300	148.88	8,828.81	18.18
2010	25.31745	4000	2800	8300	150.2975	9,183.06	1.067736
2011	28.2778	4100	3000	8400	153.8625	8,425.76	5.68558
2012	27.07302	4000	3200	8500	157.5	8,640.77	6.224809
2013	25.74232	3600	3100	8400	157.3117	9,320.35	11.20162
2014	24.64361	3600	2600	8500	158.5526	10,570.47	11.35621
2015	20.16078	3500	2700	8500	192.4403	10,432.27	13.59615
2016	18.17313	3700	2100	8500	253.492	9,927.26	6.686234
2017	22.31512	4000	2500	8500	305.7901	9,631.70	5.790567
2018	25.73331	3900	2300	8500	306.0837	10,569.60	6.055977
2019	27.38254	3600	2800	8500	306.921	11,445.86	4.522188
2020	28.22051	3700	2800	8400	358.8108	9,761.50	5.37128
2021	31.40753	3800	2800	8400	401.152	10,216.82	1.227719
2022	30.77557	4100	3000	8400	425.9792	10,556.64	0.919232

UNIT ROOT AT LEVEL

Null Hypothesis: INTEREST_RATE has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.256675	0.1920
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INTEREST_RATE)
Method: Least Squares
Date: 05/21/25 Time: 10:34
Sample (adjusted): 1994 2022
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INTEREST_RATE(-1)	-0.534876	0.237020	-2.256675	0.0334
D(INTEREST_RATE(-1))	0.029154	0.227456	0.128173	0.8991
D(INTEREST_RATE(-2))	0.124316	0.204670	0.607396	0.5493
D(INTEREST_RATE(-3))	-0.029416	0.182099	-0.161537	0.8730
C	2.014663	1.816744	1.108942	0.2784

R-squared	0.277011	Mean dependent var	0.274886
Adjusted R-squared	0.156512	S.D. dependent var	9.711097
S.E. of regression	8.918826	Akaike info criterion	7.369791
Sum squared resid	1909.091	Schwarz criterion	7.605532
Log likelihood	-101.8620	Hannan-Quinn criter.	7.443622
F-statistic	2.298876	Durbin-Watson stat	1.877306
Prob(F-statistic)	0.088203		

Null Hypothesis: LNCGO has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.229039	0.6494
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNCGO)
Method: Least Squares
Date: 05/23/25 Time: 21:58
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNCGO(-1)	-0.090943	0.073995	-1.229039	0.2286
C	0.297053	0.220137	1.349399	0.1873

R-squared	0.047938	Mean dependent var	0.028634
Adjusted R-squared	0.016202	S.D. dependent var	0.157538
S.E. of regression	0.156256	Akaike info criterion	-0.814179
Sum squared resid	0.732479	Schwarz criterion	-0.722571
Log likelihood	15.02687	Hannan-Quinn criter.	-0.783814
F-statistic	1.510537	Durbin-Watson stat	2.111535
Prob(F-statistic)	0.228611		

Null Hypothesis: LNEGLO has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.460122	0.1349
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNEGLO)
Method: Least Squares
Date: 05/23/25 Time: 21:58
Sample (adjusted): 1993 2022
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEGLO(-1)	-0.308464	0.125386	-2.460122	0.0209
D(LNEGLO(-1))	0.321857	0.181151	1.776737	0.0873
D(LNEGLO(-2))	0.072356	0.189336	0.382159	0.7054
C	1.121293	0.454239	2.468508	0.0205

R-squared	0.227677	Mean dependent var	0.004703
Adjusted R-squared	0.138562	S.D. dependent var	0.077531
S.E. of regression	0.071959	Akaike info criterion	-2.301871
Sum squared resid	0.134631	Schwarz criterion	-2.115045
Log likelihood	38.52807	Hannan-Quinn criter.	-2.242104
F-statistic	2.554886	Durbin-Watson stat	1.911406
Prob(F-statistic)	0.077124		

Null Hypothesis: LNEXTR has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.888662	0.3332
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNEXTR)
Method: Least Squares
Date: 05/23/25 Time: 22:28
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEXTR(-1)	-0.079346	0.042012	-1.888662	0.0686
C	0.480097	0.194032	2.474320	0.0192

R-squared	0.106266	Mean dependent var	0.124068
Adjusted R-squared	0.076475	S.D. dependent var	0.270575
S.E. of regression	0.260023	Akaike info criterion	0.204367
Sum squared resid	2.028356	Schwarz criterion	0.295975
Log likelihood	-1.269867	Hannan-Quinn criter.	0.234732
F-statistic	3.567044	Durbin-Watson stat	2.006096
Prob(F-statistic)	0.068640		

Null Hypothesis: LNFCF has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.843420	0.7919
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNFCF)
Method: Least Squares
Date: 05/23/25 Time: 22:30
Sample (adjusted): 1993 2022
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFCF(-1)	-0.113993	0.135156	-0.843420	0.4067
D(LNFCF(-1))	-0.507542	0.158786	-3.196401	0.0036
D(LNFCF(-2))	-0.677040	0.143764	-4.709378	0.0001
C	1.058659	1.224599	0.864494	0.3952

R-squared	0.580638	Mean dependent var	0.012399
Adjusted R-squared	0.532250	S.D. dependent var	0.125107
S.E. of regression	0.085564	Akaike info criterion	-1.955545
Sum squared resid	0.190350	Schwarz criterion	-1.768719
Log likelihood	33.33318	Hannan-Quinn criter.	-1.895778
F-statistic	11.99965	Durbin-Watson stat	2.091991
Prob(F-statistic)	0.000041		

Null Hypothesis: LNIDO has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.038092	0.2699
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNIDO)
Method: Least Squares
Date: 05/23/25 Time: 22:32
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNIDO(-1)	-0.218869	0.107389	-2.038092	0.0504
C	0.724722	0.358280	2.022782	0.0521

R-squared	0.121621	Mean dependent var	-0.004384
Adjusted R-squared	0.092342	S.D. dependent var	0.116784
S.E. of regression	0.111261	Akaike info criterion	-1.493415
Sum squared resid	0.371370	Schwarz criterion	-1.401807
Log likelihood	25.89465	Hannan-Quinn criter.	-1.463050
F-statistic	4.153817	Durbin-Watson stat	1.615779
Prob(F-statistic)	0.050442		

Null Hypothesis: LNPGLO has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.543484	0.1810
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNPGLO)
Method: Least Squares
Date: 05/23/25 Time: 22:35
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNPGLO(-1)	-0.138345	0.054391	-2.543484	0.1810
C	0.613415	0.109139	2.620502	0.0000

R-squared	0.406012	Mean dependent var	0.008498
Adjusted R-squared	0.389546	S.D. dependent var	0.015087
S.E. of regression	0.010779	Akaike info criterion	-6.161916
Sum squared resid	0.003486	Schwarz criterion	-6.070307
Log likelihood	100.5906	Hannan-Quinn criter.	-6.131550
F-statistic	30.73021	Durbin-Watson stat	2.244961
Prob(F-statistic)	0.000005		

UNIT ROOT AT FIRST DIFFERENCE

Null Hypothesis: D(LNCGO) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.965274	0.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNCGO,2)
Method: Least Squares
Date: 05/23/25 Time: 22:06
Sample (adjusted): 1992 2022
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNCGO(-1))	-1.102495	0.184819	-5.965274	0.0000
C	0.032359	0.029520	1.096197	0.2820

R-squared	0.550976	Mean dependent var	0.002226
Adjusted R-squared	0.535492	S.D. dependent var	0.237596
S.E. of regression	0.161933	Akaike info criterion	-0.740924
Sum squared resid	0.760449	Schwarz criterion	-0.648408
Log likelihood	13.48432	Hannan-Quinn criter.	-0.710766
F-statistic	35.58449	Durbin-Watson stat	1.973884
Prob(F-statistic)	0.000002		

Null Hypothesis: D(LNEGLO) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.426889	0.0014
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNEGLO,2)
Method: Least Squares
Date: 05/23/25 Time: 22:01
Sample (adjusted): 1992 2022
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNEGLO(-1))	-0.805952	0.182058	-4.426889	0.0001
C	0.003642	0.013687	0.266095	0.7920

R-squared	0.403260	Mean dependent var	-0.000132
Adjusted R-squared	0.382682	S.D. dependent var	0.096806
S.E. of regression	0.076060	Akaike info criterion	-2.252247
Sum squared resid	0.167769	Schwarz criterion	-2.159731
Log likelihood	36.90983	Hannan-Quinn criter.	-2.222089
F-statistic	19.59735	Durbin-Watson stat	1.955593
Prob(F-statistic)	0.000124		

Null Hypothesis: D(LNEXTR) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.243886	0.0002
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNEXTR,2)
Method: Least Squares
Date: 05/23/25 Time: 22:29
Sample (adjusted): 1992 2022
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNEXTR(-1))	-0.972700	0.185492	-5.243886	0.0000
C	0.117876	0.055333	2.130315	0.0418

R-squared	0.486711	Mean dependent var	-0.004814
Adjusted R-squared	0.469011	S.D. dependent var	0.383130
S.E. of regression	0.279183	Akaike info criterion	0.348441
Sum squared resid	2.260347	Schwarz criterion	0.440956
Log likelihood	-3.400828	Hannan-Quinn criter.	0.378598
F-statistic	27.49834	Durbin-Watson stat	1.944962
Prob(F-statistic)	0.000013		

Null Hypothesis: D(LNFCF) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-10.45651	0.0000
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNFCF,2)
Method: Least Squares
Date: 05/23/25 Time: 22:31
Sample (adjusted): 1993 2022
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNFCF(-1))	-2.296650	0.219638	-10.45651	0.0000
D(LNFCF(-1),2)	0.718560	0.134349	5.348461	0.0000
C	0.025893	0.015709	1.648260	0.1109

R-squared	0.838656	Mean dependent var	0.000920
Adjusted R-squared	0.826704	S.D. dependent var	0.204438
S.E. of regression	0.085105	Akaike info criterion	-1.995220
Sum squared resid	0.195558	Schwarz criterion	-1.855100
Log likelihood	32.92830	Hannan-Quinn criter.	-1.950394
F-statistic	70.17197	Durbin-Watson stat	2.128142
Prob(F-statistic)	0.000000		

Null Hypothesis: D(LNIDO) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.855691	0.0000
Test critical values:	1% level	-3.670170	
	5% level	-2.963972	
	10% level	-2.621007	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNIDO,2)
Method: Least Squares
Date: 05/23/25 Time: 22:34
Sample (adjusted): 1993 2022
Included observations: 30 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNIDO(-1))	-1.313315	0.224280	-5.855691	0.0000
D(LNIDO(-1),2)	0.490453	0.170605	2.874784	0.0078
C	-0.009521	0.019840	-0.479921	0.6351

R-squared	0.572766	Mean dependent var	-0.001342
Adjusted R-squared	0.541119	S.D. dependent var	0.159963
S.E. of regression	0.108360	Akaike info criterion	-1.512071
Sum squared resid	0.317033	Schwarz criterion	-1.371951
Log likelihood	25.68106	Hannan-Quinn criter.	-1.467245
F-statistic	18.09862	Durbin-Watson stat	1.877806
Prob(F-statistic)	0.000010		

Null Hypothesis: D(LNPGLO) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.988120	0.0044
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNPGLO,2)
Method: Least Squares
Date: 05/23/25 Time: 22:36
Sample (adjusted): 1992 2022
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNPGLO(-1))	-0.675526	0.169385	-3.988120	0.0004
C	0.004933	0.002944	1.675408	0.1046

R-squared	0.354194	Mean dependent var	-0.000993
Adjusted R-squared	0.331924	S.D. dependent var	0.017316
S.E. of regression	0.014153	Akaike info criterion	-5.615381
Sum squared resid	0.005809	Schwarz criterion	-5.522866
Log likelihood	89.03841	Hannan-Quinn criter.	-5.585224
F-statistic	15.90510	Durbin-Watson stat	1.981527
Prob(F-statistic)	0.000413		

Null Hypothesis: D(INTEREST_RATE) has a unit root
Exogenous: Constant
Lag Length: 2 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-4.325046	0.0020
Test critical values:	1% level	-3.679322	
	5% level	-2.967767	
	10% level	-2.622989	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INTEREST_RATE,2)
Method: Least Squares
Date: 05/23/25 Time: 22:38
Sample (adjusted): 1994 2022
Included observations: 29 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INTEREST_RATE(-1))	-1.629289	0.376710	-4.325046	0.0002
D(INTEREST_RATE(-1),2)	0.343136	0.277649	1.235859	0.2280
D(INTEREST_RATE(-2),2)	0.224120	0.172990	1.295566	0.2070
C	0.352827	1.791591	0.196935	0.8455

R-squared	0.651173	Mean dependent var	-0.284248
Adjusted R-squared	0.609314	S.D. dependent var	15.39271
S.E. of regression	9.621191	Akaike info criterion	7.493255
Sum squared resid	2314.183	Schwarz criterion	7.681848
Log likelihood	-104.6522	Hannan-Quinn criter.	7.552320
F-statistic	15.55628	Durbin-Watson stat	1.871507
Prob(F-statistic)	0.000006		

LONG RUN EQUATION

Dependent Variable: LNIDO
Method: Least Squares
Date: 05/29/25 Time: 20:55
Sample: 1990 2022
Included observations: 33

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	13.22771	4.681134	2.825750	0.0089
INTEREST_RATE	-0.005188	0.002601	-1.994336	0.0567
LNCGO	1.090485	0.407758	2.674342	0.0128
LNEGLO	1.185945	0.449178	2.640256	0.0138
LNEXTR	0.028182	0.069112	0.407775	0.6868
LNFCF	-0.090899	0.255243	-0.356126	0.7246
LNPGLO	2.006542	0.854502	2.348201	0.0267

R-squared	0.628513	Mean dependent var	3.334138
Adjusted R-squared	0.542785	S.D. dependent var	0.183903
S.E. of regression	0.124351	Akaike info criterion	-1.145588
Sum squared resid	0.402042	Schwarz criterion	-0.828147
Log likelihood	25.90219	Hannan-Quinn criter.	-1.038778
F-statistic	7.331487	Durbin-Watson stat	1.032097
Prob(F-statistic)	0.000116		

COINTEGRATION TEST RESULT

Null Hypothesis: ECM has a unit root
Exogenous: Constant
Lag Length: 0 (Fixed)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.162266	0.0319
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(ECM)
Method: Least Squares
Date: 05/29/25 Time: 21:00
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
ECM(-1)	-0.519472	0.164272	-3.162266	0.0036
C	0.003748	0.017994	0.208287	0.8364

R-squared	0.249999	Mean dependent var	0.005932
Adjusted R-squared	0.224999	S.D. dependent var	0.115538
S.E. of regression	0.101713	Akaike info criterion	-1.672863
Sum squared resid	0.310366	Schwarz criterion	-1.581254
Log likelihood	28.76580	Hannan-Quinn criter.	-1.642497
F-statistic	9.999927	Durbin-Watson stat	1.665519
Prob(F-statistic)	0.003569		

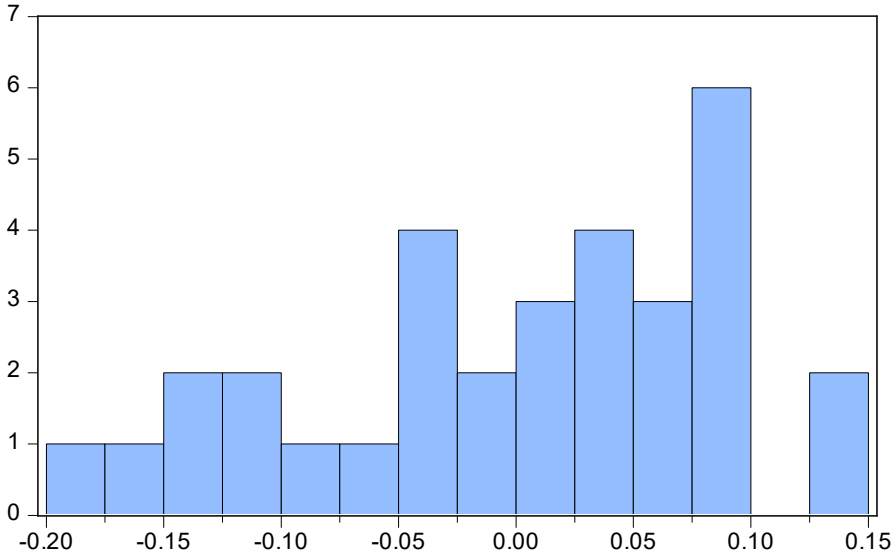
SHORT RUN ERROR CORRECTION MODEL

Dependent Variable: D(LNIDO)
Method: Least Squares
Date: 05/29/25 Time: 21:05
Sample (adjusted): 1991 2022
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.006150	0.022508	-0.273221	0.7870
D(INTEREST_RATE)	-0.003065	0.002104	-1.456588	0.1582
D(LNCGO)	0.122113	0.139578	0.874875	0.0361
D(LNEGLO)	0.024029	0.369793	0.064980	0.0487
D(LNEXTR)	-0.059649	0.089016	-0.670090	0.5092
D(LNFCF)	0.072083	0.153035	0.471023	0.6419
D(LNPGLO)	0.264085	1.226641	0.215291	0.0114
ECM(-1)	-0.602471	0.167632	-3.594004	0.0015

R-squared	0.426336	Mean dependent var	-0.004384
Adjusted R-squared	0.259017	S.D. dependent var	0.116784
S.E. of regression	0.100528	Akaike info criterion	-1.544449
Sum squared resid	0.242540	Schwarz criterion	-1.178015
Log likelihood	32.71118	Hannan-Quinn criter.	-1.422986
F-statistic	2.548043	Durbin-Watson stat	1.370260
Prob(F-statistic)	0.041149		

JARQUE-BERA NORMALITY TEST



Series: Residuals	
Sample 1991 2022	
Observations 32	
Mean	-1.73e-18
Median	0.013981
Maximum	0.148811
Minimum	-0.181921
Std. Dev.	0.088453
Skewness	-0.437975
Kurtosis	2.261872
Jarque-Bera	1.749497
Probability	0.416967

MULTI-COLLINEARITY TEST

	D(LNEGLO)	D(LNCGO)	D(LNPGLO)	D(INTR)	D(LNFCF)	D(LNEXTR)
D(LNEGLO)	1.000000	0.540291	0.037388	0.301528	0.139986	0.530988
D(LNCGO	0.540291	1.000000	0.105557	0.276428	0.090019	0.184495
D(LNPGLO)	0.037388	0.105557	1.000000	-0.113535	-0.008655	0.140602
D(INTR)	0.301528	0.276428	-0.113535	1.000000	-0.019117	-0.184131
D(LNFCF)	0.139986	0.090019	-0.008655	-0.019117	1.000000	-0.009318
D(LNEXTR)	0.530988	0.184495	0.140602	-0.184131	-0.009318	1.000000

AUTOCORRELATION TEST

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	5.529708	Prob. F(2,22)	0.0113
Obs*R-squared	10.70501	Prob. Chi-Square(2)	0.0047

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 05/29/25 Time: 21:16
Sample: 1991 2022
Included observations: 32
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.004897	0.019354	-0.253022	0.8026
D(INTEREST_RATE)	-0.000327	0.001802	-0.181217	0.8579
D(LNCGO)	-0.076498	0.121542	-0.629401	0.5356
D(LNEGLO)	0.045507	0.318269	0.142981	0.8876
D(LNEXTR)	0.112107	0.083700	1.339391	0.1941
D(LNFCF)	0.038452	0.134403	0.286093	0.7775
D(LNPGLO)	-1.007026	1.094017	-0.920485	0.3673
ECM(-1)	-0.468675	0.344670	-1.359780	0.1877
RESID(-1)	0.990832	0.361629	2.739915	0.0120
RESID(-2)	-0.180517	0.310259	-0.581828	0.5666

R-squared	0.334531	Mean dependent var	-1.73E-18
Adjusted R-squared	0.062294	S.D. dependent var	0.088453
S.E. of regression	0.085653	Akaike info criterion	-1.826713
Sum squared resid	0.161402	Schwarz criterion	-1.368670
Log likelihood	39.22741	Hannan-Quinn criter.	-1.674885
F-statistic	1.228824	Durbin-Watson stat	1.903805
Prob(F-statistic)	0.327876		

HETEROSKEDASTICITY TEST

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.339545	Prob. F(7,24)	0.9276
Obs*R-squared	2.883524	Prob. Chi-Square(7)	0.8956
Scaled explained SS	1.023367	Prob. Chi-Square(7)	0.9944

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 05/29/25 Time: 21:19
Sample: 1991 2022
Included observations: 32

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.008012	0.002100	3.815648	0.0008
D(INTEREST_RATE)	-3.81E-05	0.000196	-0.194183	0.8477
D(LNCGO)	-0.010228	0.013021	-0.785526	0.4398
D(LNEGLO)	0.012324	0.034497	0.357256	0.7240
D(LNEXTR)	0.004189	0.008304	0.504416	0.6186
D(LNFCF)	0.006933	0.014276	0.485651	0.6316
D(LNPGLO)	-0.092472	0.114429	-0.808120	0.4270
ECM(-1)	0.009073	0.015638	0.580188	0.5672

R-squared	0.090110	Mean dependent var	0.007579
Adjusted R-squared	-0.175274	S.D. dependent var	0.008650
S.E. of regression	0.009378	Akaike info criterion	-6.288611
Sum squared resid	0.002111	Schwarz criterion	-5.922177
Log likelihood	108.6178	Hannan-Quinn criter.	-6.167148
F-statistic	0.339545	Durbin-Watson stat	2.066867
Prob(F-statistic)	0.927557		

DATA SET

Year	AGOUT	EDUEXP	HLTEXP	LBF	LITR	GEXA
1990	3,464.72	2.4	0.5	81.789	55.4	0.26
1991	3,590.84	1.26	0.62	82.392	55.45	0.21
1992	3,674.79	0.29	0.15	83.018	55.6	0.46
1993	3,743.67	8.88	3.87	83.416	55.8	1.80
1994	3,839.68	7.38	2.09	83.96	56	1.18
1995	3,977.38	9.75	3.32	84.095	56.1	1.51
1996	4,133.55	11.67	3.18	83.892	56.2	1.82
1997	4,305.68	14.85	3.89	83.801	56.3	2.06
1998	4,475.24	13.59	4.74	83.67	56.4	2.89
1999	4,703.64	43.61	16.64	83.604	56.5	59.32
2000	4,840.97	57.96	15.22	83.371	57	6.34
2001	5,024.54	39.88	24.52	83.182	57.2	7.06
2002	7,817.08	80.53	40.62	82.942	57.5	9.99
2003	8,364.83	64.78	33.27	82.671	54.77	7.54
2004	8,888.57	76.5	34.2	82.435	53.9	11.30
2005	9,516.99	82.8	55.7	82.172	52.5	16.30
2006	10,222.47	119.02	62.25	81.963	70.2	17.92
2007	10,958.47	150.78	81.91	81.797	69.1	32.48
2008	11,645.37	163.98	98.22	81.609	51.08	65.40
2009	12,330.33	137.12	90.2	81.517	55	22.44
2010	13,048.89	170.8	99.1	81.282	56.9	28.22
2011	13,429.38	335.8	231.8	81.119	58	41.20
2012	14,329.71	348.4	197.9	81.055	59.6	33.30
2013	14,750.52	390.4	180	80.844	60.5	39.43
2014	15,380.39	343.75	195.98	80.765	61.3	36.70
2015	15,952.22	325.19	257.7	80.793	57	41.27
2016	16,607.34	339.28	200.82	80.843	58.22	36.30
2017	17,179.50	403.96	245.19	80.89	60	50.26
2018	17,544.15	465.3	296.44	80.955	62.02	53.99
2019	17,958.58	593.33	388.37	81.001	62.5	70.25
2020	18,348.18	646.75	423.33	79.314	63	76.61
2021	18,738.41	620.59	386.24	80.143	63.16	72.27
2022	19,091.07	702.98	437.52	81.268	64.2	81.87
2023	19,306.49	752.98	468.64	82.559	69.5	87.69
2024	19,626.80	510.95	347.52	82.566	70.41	94.28