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The Impact of Savings and Portfolio Investment in the Sustainability of the Digital Economy in Nigeria

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ABSTRACT

This study examines the critical role of personal savings and portfolio investments in the sustainability of the Nigerian economy given the new age of computerization. Today's nations are actively adopting and developing a new economic model called the "Digital Knowledge Based Economy" characterized by a high reliance on knowledge, information, critical skill levels, as well as the growing demand for quick access to all of these by the public and private sectors. The knowledge based economy enforces production, exchange, distribution, and use of knowledge as main drivers of economic growth, by promoting employment generation, and wealth creation. Nigeria, with its unique set of complex issues, has not made significant headway in adopting this new economy; hence this study aims at assessing the country's attentiveness to the digital economy, in order to provide guidance on how to overcome some of the major obstacles preventing the digital sustainability of the economy. Thus, we collect time series data from the period of 1990 to 2023 in the various issues of the Central Bank of Nigeria Statistical bulletin, thereby giving a period of 33 observations for the collective variables of Personal Saving (PSV), Portfolio Investments (PFI), Interest rate (INT), Money Supply (MSP), Digital Infrastructure (DIF), and Gross Domestic Product (GDP). The method of Ordinary Least Square (OLS) is used to determine the consistent relationships in the variables and their significant contributions to the enhancement of the digital economy of Nigeria. The findings exhibit a significant positive relationship between the variables of power infrastructure which proxy's for information and communication technology (ICT), savings, portfolio investment, and GDP which is used to represent the Sustainability of a digital economy. On the contrarily, interest rate exhibits a negative relationship with GDP, implying a high lending rate of interest that does not support and growth and sustainability of the digital economy. The study however suggests that the government should provide an enabling environment for personal savings, and portfolio investments in order to build a more resilient and diversified digital economy in Nigeria. The study concludes with recommendations for policymakers, and supportive regulatory frameworks to boost the supply of infrastructure, increase savings and investment activities across the country for a more resilient digital economy.

Keywords:
Savings, Portfolio investment, power supply, sustainability, and digital economy. JEL Classification: E21, G11, Q40, Q01, O33.

1. Introduction

The foundation of any economy is its savings and investments, which can also increase the digital economy's durability. The dilemma of insufficient infrastructure and insufficient savings for profitable investments has been experienced by developing nations, such as Nigeria. The digital sustainability of the Nigerian economy, investment methods, and personal finance are all critically entangled in this study. Though the digital economy in Nigeria is growing quickly and becoming more significant, its sustainability is still in doubt because of a number of economic issues, including low domestic savings and diminutive portfolio investments, which are crucial for supplying the funds and resources required for innovation, digital infrastructure, and business expansion.

Given the nation's numerous economic problems, such as inflation, unemployment, and infrastructure deficiencies, it is crucial to comprehend how individual savings and investments may support the long-term viability of Nigeria's digital economy. The knowledge economy, sometimes referred to as the digital economy, is focused on technology, data, and information, which is being generated by the digital technologies in a matter of seconds in order to make more effective decisions. Hence, economic growth and the long-term viability of the digital economy will be significantly influenced by the degree of infrastructure development in this area.

It is impossible to overstate the need for drastic structural changes in light of the economic obstacles and deficiencies in institutions, fiscal, current account, capital market, and epileptic power supply that still impede sustainable development in Nigeria. The government has enacted significant economic reforms in response to these issues, such as

eliminating fuel subsidies, coordinating currency rates, and encouraging growth driven by the private sector. This has led to a more thorough analysis of the part that individual financial practices play in maintaining economic stability and fostering the expansion of the digital economy. However, householders can manage unforeseen expenses and invest in possibilities that foster economic resilience with great recognition to personal savings, which act as a buffer against financial instability. However, through capital influx into different sectors, portfolio investments made up of stocks, bonds, and other financial instruments are bid to promote economic growth.

According to Okonyi (2021), E-Readiness highlights how technological and knowledge-based advancements can support sustainable development. It speaks volume of a country's preparedness to adopt digital practices, which is able to enhance access to education, digital skills, and economic participation. As a measure of a nation's readiness, preparedness, or wiliness to use the advantages of information and communication technology or electronic activities, it has the tendency of enhancing productivity, competitiveness, wealth, and prosperity of an economy, and is a crucial element needed for the growth and sustainability of the digital economy of Nigeria (Ehinomen & Adeleke, 2020). This covers a nation's overall ICT adoption as well as related services and applications including video and audio conferencing, e-commerce, e-government, e-business, e-learning, and e-health. Other indicators of a nation's or economy's e-Readiness include its telecommunications infrastructure, human resource reserves, and supportive laws and regulations.

According to the World Bank (2010), there is a great need across developing economies for digital transformation and infrastructure, and this depends on coordinated policies, skilled labour, and investment in human capital. In affirmation, the Centre for International Development (2006) holds that planning and wise investment choices in a knowledge economy depend on having a comprehensive picture of a country's level of e-readiness. Nigeria is now ranked 112 out of 144 nations with a Network readiness score of 3.31and 131 out of 143 in terms of e-Readiness (World Economic Forum, 2014).

It is obvious that the present pace of the digital sector would be adversely affected in the absence of a solid foundation of financial resources and investment in ICT. (Uwajie, 2014).

Government policies can occasionally have a beneficial or negative impact on portfolio investments, as x-rayed in the government's recent implementation of a cashless policy through the Central Bank of Nigeria (CBN) in January 2023. The policy was such that: 500,000,000 pieces of new money will be ordered from the Mint, subject to the following terms. The maximum weekly withdrawal for individuals of #500,000, and any amount over that is subject to a 3% fee. The maximum weekly withdrawal is #5,000,000, for corporate organizations and any sum over that is subject to a 5% fee. A third party may withdraw up to $100,000 from the cheque. The settlement cheque for the third party account being #10m. Despite being designed to bring about a new macroeconomic dawn, the strategy had some shortfalls including the declined in economic activities because there was insufficient money for business operations, and the impoverished masses were taken advantage of by using "Points of Sale (POS)" to get instant cash. The ensuing death and property loss of some people who were unable to cope with the annoyance of the moment was also anti-productive (Otitoju, Dirisu, Ojokojo, & Abdul, 2023).

It is crucial to comprehend the function of portfolio investments and personal savings as Nigeria negotiates these complexities. This study explores how these financial practices affect the long-term viability of Nigeria's digital economy, offering insights into how personal financial choices might support the digital economy and enhance national economic resilience. Hence, examining the effects of portfolio investments and individual savings on the sustainability of the Nigerian economy is the goal of this study, with the credence to look into Nigerians' saving habits and the most common kinds of portfolio investments available for the combined effect on economic metrics, including social welfare, employment rates, and GDP growth. This study aims to provide light on how improving individual savings and encouraging diversified investment portfolios might support a more robust and sustainable Nigerian economy by examining the connection between personal savings and port folio investment practices on the sustainability of the digital economy. The study will provide a thorough grasp of this crucial problem, and the research will use a combination of quantitative and qualitative methodologies, drawing from surveys, economic data, and existing literature. The ultimate goal of the study is to educate individuals, financial institutions, and governments on the value of encouraging saving and investing as a way to improve the digital economic sustainability of the Nigerian economy. In other words, the study emphasizes the significance of developing a strong savings culture by encouraging investment climate as tactics to promote economic growth and sustainability through an examination of the body of existing literature and economic data.

1.1 Statement of the Problems

The purpose of this study is to examine historical patterns in personal savings and portfolio investments and how they impact the long-term viability of the Nigerian economy. Also, how Nigerians' personal saving and portfolio investment practices are impacted by fluctuations in interest rates and exchange rates. Thus, the study aims to investigate topics like the correlation between the rate of personal savings and the digital sustainability of Nigeria's economic expansion.

ii. How does inflation impact Nigerians' returns on portfolio investments and personal savings?

iii. How Nigeria's digital economy's sustainability is impacted by infrastructure, as indicated by the power supply.

The study's hypothesis is that there is no meaningful correlation between Nigeria's economic growth and individual savings.

ii. The sustainability of the digital economy is not significantly correlated with infrastructure facilities.

Conceptual Literature

2.1 Personal Saving

Personal savings are funds that a person sets aside for future needs. The person sets away a certain amount of money from his disposable income over time, depriving himself of current consumption in favor of a future-oriented one. In economics, it is the sum of money that remains after a person has subtracted their lifetime consumption expenses from their disposable income. Personal savings is the art of an individual, not a business or organization, preserving funds for future use, according to the Longman Business Dictionary. By providing a tax holiday or individual pay break, this might be promoted. Personal savings can also be thought of as the gap between consumption and disposable income. Therefore, S=Y-C.Y stands for income, C for consumption, and S for saving. While the relationship between saving and income is known as the saving function or the inclination to save, the amount of savings is reliant on the quantity of income. A functional relationship between S and Y is indicated by the expression S=f (Y), in which S is the dependent variable and Y is the independent variable. This relationship assumes that all factors influencing saving are held constant "other things being equal" and that income and saving grow by a fixed amount. The amount of investments in the national economy and national savings are tightly correlated, as is widely known from economic research.

The savings of individuals implicitly contribute to the economic system and future economic growth. However, as saves equal real investment in the eyes of macroeconomic policy, these savings represent a crucial component of the investment resources for the growth of the real sector. The state encourages citizens to save and reduce their reliance on foreign investments in response to necessity demands, believing that domestic savings will support long-term, sustainable growth and development.

2.2 Investment

Purchases of stocks, bonds, and other securities from the stock market are considered investments by the average person. But since it's only a transfer of existing resources from one unit to another, it's more of a financial or portfolio investment than a true investment. According to Keynes, a real investment is one that upgrades capital equipment and boosts revenue and productivity by increasing production and capital goods purchases. New machinery and equipment, building projects, roads, dams, net foreign investment, inventories, stocks, and shares of new businesses are all examples of investment. Investments are defined as those that increase the stock of already-existing products. According to the Classicists, an economy cannot be fully employed unless savings equal investment and they are both affected by interest rates.

Symbolically, S=f(r) and I=f(r) where r is the interest rate, so S=I. In a period of less than full employment, when there is a clear difference between savings and investments, keep in mind that when interest rates rise, savings rise and investments fall, and when interest rates fall, savings fall and investments rise. If at any given time saving is less than investment, an increase in the rate of interest will bring down the investment and increase saving until saving equals investment. Similarly, if savings exceeds investment, the rate of interest falls, investment increases and savings decreases until the two are equal at the new interest rate.

Owning stocks, bonds, or other financial assets with the hope of receiving a return or seeing their value increase over time is known as portfolio investing. Instead of investing in a single asset, this strategy uses a collection of assets (equity, debt, mutual funds, derivatives, or even bit coins) to generate returns that match the investor's risk tolerance. It is important to remember that returns on investment are directly correlated with the level of risk involved, even though portfolio investments can vary from one tiny investment segment to another. Therefore, compared to treasury bonds, which have no risk and very poor returns on investment, investments in such assets as the bit coin are more risky but yield higher returns.

2.3 Inflation:

A prolonged rise in the average price of goods and

services within an economy over time is known as inflation, and it lowers the purchasing power of money. In other words, a given amount of money can purchase fewer goods and services as prices grow. Indexes such as the producer price index or the consumer price index, which monitor average price increases over time, are commonly used to measure inflation. A number of factors can lead to inflation, including demand-pull inflation, which occurs when prices rise as a result of a surplus in demand for products and services. In Nigeria, inflation has a significant impact on the digital economy's ability to remain sustainable. As inflation increases, the price of investments, technology, and digital tools might rise, making technological innovations less accessible. Additionally, inflation affects portfolio investments and savings, which in turn affects the financial landscape as a whole and the expansion of the digital economy (Mishkin, 2019).

2.4 The knowledge-based economy or digital economy

According Oghorodi, Okpako, & Ako, (2019), the digital economy, also known as the knowledge-based economy, is one in which "the business and public sectors increasingly need ready access to information. Due to the high dependence on knowledge, and high skill levels information, the production, sharing, distribution, and application of information in the knowledge economy are the primary forces behind economic expansion, job creation, and wealth accumulation in this economy. The Organization for Economic Co-operation and Development (OECD, 2005) is of the view that knowledge plays a major role in creating wealth, and therefore regarded as a "factor of production" similar to the economy's classical factor of production with a market value.

2.5 Knowledge Economic Index

The knowledge indexes were designed as a tool for benchmarking a country's position in relation to others in the global knowledge economy. It was created by the World Bank Institute using the knowledge Assessment Methodology in order to measure the preparedness of a country or region towards knowledge-based economy. The Knowledge Economy Index (KEI) takes into cognizance whether the environment is good enough for knowledge to be effectively used for economic development. It is a sum index that represents the total level of development of a country, and its calculation is based on all four pillars of the knowledge economy - economic incentive and institutional regime, educated and skilled workers, effective innovation system of firms, research centers, and a modern and adequate information infrastructure that can facilitate the effective communication, dissemination, and processing of information and knowledge. (Chen & Dahlman, 2006).

2.6 Knowledge Assessment Methodology (KAM) Framework.

The Knowledge Assessment Methodology (KAM) framework was developed by the World Bank as a benchmark for assessing nations. The indicators that constitute the four quadrants of a Knowledge Economy include the following; Economic Incentive and Institutional Regime (EIR) index, which is used for assessing efficient use of existing and new knowledge where entrepreneurship will flourish;

Two: Innovation and Technological Adoption index, used for assessing innovation system of organizations to ascertain whether they assimilated and adapted the growing stock of global knowledge to local needs and create new technological solutions ; Three: Education and Training index used for assessing whether the educated and appropriately trained population are capable of creating, sharing and using existing knowledge ; and Four: Information and Communication Technologies (ICT) Infrastructure index, used for assessing the extent to which modern and accessible ICT infrastructure facilitate effective communication dissemination and processing of information within the economy.

2.7 Theory of Endogenous Growth

This theory was developed by Paul Romer, and Robert Lucas in the 1980s. It emphasizes that investment in human capital, innovation, and knowledge can enhance long-term growth without the diminishing returns, as seen in neoclassical models. According to the theory, technological progress is the result of the economic decision made within the economy that is internal variables, as opposed to external ones, are mostly responsible for economic growth. Emphasis is given to information, innovation, and human capital investments which are important forces behind economic growth. Thus, the sustainability of Nigeria's digital economy among other things include, growing savings and portfolio investments that are properly directed into digital infrastructure, technology, and innovation.

2.8 Infrastructures for Information and Communication Technologies

In a digital knowledge economy, information and communication technology infrastructures are the mediums required for the flow of knowledge. A Nigerian digital knowledge economy requires the availability and accessibility of ICT infrastructures as well as the ability to use them. The Intellectual Development Index (IDI) access Sub-index, which covers information and communication technology

infrastructure, has gradually improved from a low of 0.94 in 2007 to a high of 3.16 in 2017, representing a 70.25% improvement, and in 2023 has ranked 109 out of 132 countries, among the most innovative countries in the world, with an increase from 16.9 points from 2022 to 18.44 points in 2023 according to the Global Innovation Index for Nigeria (2023). Although there is still considerable space for improvement, this is a positive development for a nation that desires to tap and embrace a knowledge-based economy. The GII ranking highlights both the strengths and weaknesses of each economy, and is based on the criteria which includes institutions, human capital and research, infrastructure, credit, investment, linkages, the creation, absorption and diffusion of knowledge; and creative output. An additional crucial prerequisite for a Nigerian digital knowledge economy is sustainable power and energy. This is due to the fact that both the information and communication technology and telecommunications infrastructures that are necessary for the economy's knowledge flow depend on energy and power.

With a population of 234,428,016 million as at November 2024, (Worldometer, 2024), only 20% of the population have access to relatively fairly good power supply Nigerians therefore turn to self-generation of electricity, with around 81% producing electricity from alternative sources to make up for the country's erratic power supply due to insufficient electricity availability from the national grid (Akua, Twum, & Otu, 2024).Thus, there is a connection between the severe power shortages and the low electricity use per capital resulting to slow growth rate due to these power outages. Additionally, to effectively and efficiently propel Nigeria's developing digital knowledge economy, Nigeria needs sustainable energy sources like nuclear, solar, and wind power to replace fossil fuels in more developed countries. This is especially important since that Nigeria is unable to refine its crude oil, which is abundant in the Nigerian Niger Delta. Although there have been attempts to promote and develop nuclear energy for the production of electricity, such as the creation of the Nigeria Atomic Energy Commission by Act 46 of 1976, these efforts have not been successful and eventually went dormant before being resurrected by the Jonathan Administration in 2011 (Onuah, 2011). It is now essential to build solar, wind, and nuclear power plants that are comparable to the largest wind farm in Africa.

3.0 Empirical Literature

Adekunle and Aderemi (2021) using the Autoregressive Distributed Lag (ARDL) model, investigated how investments and savings affected Nigeria's economic growth. Their findings, which were based on time series data collected between 1980 and 2020, indicate that the nation's low savings rate has made it more difficult to raise money for long-term investments in important areas, such as the digital economy.

Conversely, Osahon and Ekene (2022) investigated how both domestic and foreign portfolio investments affected Nigeria's digital industry. Through the use of panel data analysis, their study discovered a significant correlation between economic growth and digital economy indices such as internet penetration, the development of digital infrastructure, and the rise of tech startups.They suggest that infrastructure should be provided by the government to support the digital economy.

Similarly, Ibrahim, Yusuf, & Alabi (2023) conducted research on the contribution of investments and savings to the sustainability of the digital economy in sub-Saharan Africa, including Nigeria. They established causality between the variables of domestic savings rates, portfolio investments, and important sustainability indicators within the digital economy by applying the Generalized Method of Moments (GMM) approach to time series data gathered from 2000 to 2021. They discovered that nations with more diverse investment portfolios and greater domestic savings rates were better equipped to foster the growth of technology innovation hubs, digital infrastructure, and digital literacy initiatives.

In Nigeria, Okechukwu and Abiola (2023) investigated the connection between investment, financial inclusion, and the digital economy. They investigated the long-term relationship between savings rates, financial inclusion, and the expansion of the digital economy using the Vector Error Correction Model (VECM). In order to mobilize savings and direct them toward profitable investments that facilitate digital transformation, they advocate for expanding financial inclusion.

Adebayo and Fashola (2022) examined how macroeconomic policies affected Nigerians' investment and saving patterns. They used macroeconomic time series data from 1995 to 2022 and employed a structural equation modeling (SEM) technique. According to their results, the Nigerian economy's potential depends on its capacity to stabilize portfolio investment and mobilize domestic savings. It is their recommendation that the government implement policies that would increase saving rates and foster an atmosphere that is favorable to investments in digital infrastructure and technical innovations. As a result, they recommend that government initiatives focus on expanding the production and delivery of electricity. In addition,

they encouraged Nigerians to develop sustainable energy sources like solar and wind power, particularly in light of the declining oil and gas reserves in the Niger Delta, and suggested that the government reconsider the privatization of this sector since it has not produced the expected results. Additionally, they recommend that the government take a strong stance against poverty, unemployment, and illness because each of these factors contributes to the growth of the Nigerian digital knowledge economy. The effect of savings and portfolio investments on Nigeria's economic sustainability was examined by Nwonye (2022). According to their findings, by promoting capital accumulation, lowering reliance on foreign debt, and promoting economic diversity, both domestic savings and overseas portfolio investments favorably impact economic growth. Similarly, Oghorodi, Okpako, and Ako (2019) in their research on the roadmap to a Nigerian digital knowledge economy recommend, among other things, that the government deals with the issue of energy and power since information and communication infrastructure cannot operate effectively without these resources.

3.0 Methods and Data

3.1 Theoretical Structure and Model Details:

3.1.1 The Solow-Swan Model of Growth

The significance of savings for capital accumulation and long-term economic growth is emphasized by this neoclassical growth model. The digital economy in Nigeria can be strengthened to attain economic sustainability by combining higher savings rates with prudent portfolio investments in capital-intensive industries like infrastructure. As a result, a more resilient and varied industrial foundation that is sustainable can be established. Therefore, the mobilization of individual savings and their efficient allocation into profitable portfolio investments and digital infrastructure investments are critical to the Nigerian economy's viability.

This theory is modified, and our model is as follows:

$$lnGDP_t = \alpha_0 + \alpha_1 lnPSV_t + \alpha_2 lnDIF_t + \alpha_3 lnPFI_t + \alpha_4 lnMSP_t + \alpha_5 lnINT_t + \mu_t \quad \dots (4)$$

Where: $\alpha_0, \alpha_1, \alpha_2, \alpha_{3,} \alpha_{4\,,}$ $and\ \alpha_5$ are the long-run parameter coefficients.

μ_t= Error term, ln = Logarithm of the variable. GDP = Gross Domestic Product, PSV = Personal savings, DIF = Digital Infrastructure, PFI = Portfolio Investment, MSP = Money Supply, INT = Interest rate.

The a priori signs of all the explanatory variables are expected to be positive, except for int which represents interest rate..

Symbolically, the a priori expectations are: $\alpha_0, \alpha_1, \alpha_2, \alpha_{3,} \alpha_4, > 0, and\ \alpha_5 < 0.$

Meanwhile considering the short-run and long-run dynamic as well as the causal interactions among the variables, an ARDL representation of equation (4) is formulated in the expression as follows;

$$\Delta(GDP_t) = \alpha_0 + \alpha_1 PSV + \alpha_2 DIF_{t-1} + \alpha_3 PFI_{t-1} + \alpha_4 MSP_{t-1} + \alpha_5 INT_{t-1} + \sum_{i=1}^{P} \alpha_{1i}\,\Delta(GDP_{t-1}) + \sum_{i=0}^{P} \alpha_{2i}\,\Delta(PSV_{t-1}) + \sum_{i=0}^{P} \alpha_{3i}\,\Delta(DIF_{t-1}) + \sum_{i=0}^{P} \alpha_{4i}\,\Delta(PFI_{t-1}) + \sum_{i=0}^{P} \alpha_{5i}\,\Delta(MSP_{t-1}) + \sum_{i=0}^{P} \alpha_{6i}\,\Delta(INT_{t-1}) + \mu_t \quad (5)$$

Where Δ is the first difference operator, α_0 is the drift component, and ut is the white noise residual.

$$\Delta(GDP_t) = \sum_{i=1}^{P} \alpha_{1i}\,\Delta(GDP_{t-1}) + \sum_{i=0}^{P} \alpha_{2i}\,\Delta(PSV_{t-1}) + \sum_{i=0}^{P} \alpha_{3i}\,\Delta(DIF_{t-1}) + \sum_{i=0}^{P} \alpha_{4i}\,\Delta(PFI_{t-1}) + \sum_{i=0}^{P} \alpha_{5i}\,\Delta(MSP_{t-1}) + \sum_{i=0}^{P} \alpha_{6i}\,\Delta(INT_{t-1}) + \lambda ECT_{t-1} + \mu_t \text{ --} \quad (6)$$

Where λ is the speed of adjustment parameter and ECT is the residual obtained from the estimation of equation (6).

In this context, the symbol λ represents the speed of adjustment parameter, while ECT refers to the residual derived from the estimation of equation (6).

The utilization of co-integration analysis and the Error Correction Model (ECM) is employed to ascertain the associations among the variables and establish the immediate dynamics between Gross domestic product and the explanatory variables inside the timeframe of 1990-2023. The data estimation approach employed in this study is the Ordinary Least Squares (OLS) regression method. Additionally, the Granger Representation theorem, as proposed by Granger in 1981 and 1986, provides a formal theoretical foundation for error corrective modeling.

Where: Y_t is the dependent variable; X_t' is a set of explanatory variables and μ_t is the residual.

The utilization of the Error Correction Model (ECM) entails the incorporation of the lagged residual in order to rectify discrepancies between observed values and the long-term equilibrium values.

Using the ECM symbol, equation (6) may be rewritten as:

$$\Delta GDP_t = \beta \Delta X_t' + \alpha ECM(-1) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

This results from differencing the non-stationary series Y_t and X_t' before using them for the regression but adding an error correction term – , a period lagged residual, α is the error correction coefficient. This is expected to be negative and significant to rightly correct for any deviations of actual values from the long-run equilibrium values.

For the co-integration analysis we conduct a unit root test for each variable in equation (6). The study utilizes a more efficient univariate Augmented Dickey-Fuller test to explore the order of integration (stationarity) of the variables.

Hence, we consider an OLS regression of the quasi-differenced data $d(Y_t|a)$ on the quasi-differenced $(X_t|a)$:

$d(Y_t|a) = d(X_t|a)'\delta(a) + \mu_t$..... (8)

Where: X_t contains either a constant, or a constant and trend, and let $\hat{\delta}(a)$ be the OLS estimates from this regression.

The Augmented Dickey-Fuller (ADF) test constructs a parametric correction for higher-order correlation by assuming that the Y series follows an $AR(p)$ process and adding p lagged difference terms of the dependent variable Y to the right-hand side of the test regression given as:

4.0 EMPIRICAL FINDINGS AND DISCUSSION

4.1 Analysis of Result

Table 1. Descriptive Statistics

	GDP	PSV	DIF	PFI	MSP	INT
Mean	425023.22	18.78718	2.402764	1066065	6473867.57	134.8196
Median	6234.490	12.01000	4.500000	2568065.	13211060	125.066
Maximum	154252.3	72.84000	18.20000	57248976	43011684	8530000
Minimum	187.8300	5.390000	-31.50000	27389.80	1413900	0.893800
Std. Dev.	46090.21	17.04279	9.590112	15724114	11854904.8	174.07426
Skewness	1.232631	1.671194	-1.262622	1.528062	1.289700	2.2417785
Kurtosis	3.264586	4.672785	5.616028	4.487900	3.6431595	8.7306014
Jarque-Bera	9.989717	22.70087	21.48325	18.77483	11.483075	86.030874
Probability	0.006773	0.000012	0.000022	0.000084	0.003200	2.0827e-19
Sum	1365905.	779.5000	101.5000	4.47E+08	338280913.2	6154.9657
Sum Sq. Dev.	8.07E+10	11037.35	3494.870	9.40E+15	5340473205	1151470.16
Observations	33	33	33	33	33	33

Source: Authors Computation from Eviews.

From the table 1 above, we have 33 observations; the mean tells us the average values for each of the variables. For instance, the average value of GDP is 425023-22, while that of PSV is 18.78718. The maximum and the minimum tell us the highest and the lowest figures in each of these variables. The highest figure in DIF is 18.20000 and the lowest figure is -31.50000. On measures of normality, we consider the Kurtosis which measures the peak or flatness of the distribution of the series. From the table all the variables have normal distribution with kurtosis values of more 3, so the distribution is Leptokurtic, having a positive kurtosis, and peak curve indicating there are higher values than the sample mean for each of the variables used in the study.

The skewness measures the degree of asymmetry of the series. From the table, it is obvious that the distribution has a normal skweness, which implies the distribution is symmetric around the mean, and the skweness value is positive. By implication, the distribution has a long right tail, meaning there are higher values than the sample mean. However, DIF has a negative skewness of -1.2626 which implies that this distribution has a long left tail with lower values than the sample mean. .

The Jarque-Bera statistic tells the difference between the skweness and the kertosis of each of these variables with those from a normally distributed variable, and below them are their respective probability values. The null hypothesis for the jacquic bera test is that the distribution is normal. For each of the variables in table 1, their probability values are less than 5% so they all maintain a normal distribution,

denotes differencing, σ is the coefficient of adjustment expected to be negative.

$Y_{t-1} + X_t'\delta + \beta_1\Delta Y_{t-1} + \beta_2\Delta Y_{t-2} + \ldots + \beta_p\Delta Y_{t-p} + V_t$.....(9)

Once co-integration is established, equation (6) is estimated using the Least Squares technique to obtain the long run parameters of $\alpha_i(for\ i = 0, 1, 2, \ldots, 4)$. The next step is to obtain the short-run dynamic parameters by estimating an Error Correction Model (ECM) associated with the long run estimates. This is specified as:

$\Delta lnGDP_t = \partial\Delta lnPSV_t + \theta\Delta lnDIF_{t-1} + \emptyset\Delta lnPFI_t + \tau\Delta lnMSR_t + \pi\Delta lnINT_t + \sigma ecm(-1) + \varepsilon_t$... S.....(10)

Here, $\partial, \theta, \emptyset, \tau, \pi$ is the short run dynamic coefficients of the model's convergence to equilibrium and are expected to be positive; Δ

4.2 Stationarity Tests

This section is preoccupied with the presentation and

attendant discussion of the results of the unit root and cointegration tests conducted. It further elucidates the insight underlying the findings emerging from the estimated error correction models.

Cointegration is typically in the offing when each variable is integrated of the same order $d \geq 1$. This is necessary, but rarely sufficient condition, implying that the series share a common trend. Hence, as a preliminary step, we ascertain whether mean reversion is characteristic of each variable using ADF test (Dickey and Fuller, 1979). This is conducted with intercept only and intercept and trend respectively, on the levels and first difference of the series. From the result in table 2, we find that all the variables are stationary on differencing once, using Augmented Dickey-Fuller unit root testing.

4.3 Analysis of Cointegration

We proceed to formally test for cointegration among the variables, and we adopt the Johansen's maximum likelihood based approach using an optimal lag structure in the unrestricted VAR. From our result, we observe the existence of a long-run association between the dependent and the independent variables.

Table 2 Augmented Dickey-Fuller (ADF) Test Result.

Source: Extract from E-views 13

Note: i. Pro-values are represented in parenthesis, ii. The ADF Statistic is compared to 5 percent critical value.

Variable	Lag	Test statistic @ levels	5% Critical Value @ levels	Test statistic @ 1st Diff	5% Critical value @ 1st Diff	Order of integration	Remark
GDP	0	-1.707068	-2.954021 (0.4185)	-5.360852	-2.957110 (0.0001)	I(1)	Stationary
PSV	2	-0.633411	-2.971853 (0.8475)	-5.194963	-2.971853 (0.0002)	I(1)	Stationary
PFI	1	-3.637641	-2.986225 (0.0122)	-6.681713	-2.960411 (0.0000)	I(1)	Stationary
INT	0	-2.960086	-2.954021(0.0494)	-5.098953	-2.957110 (0.0002)	I(1)	Stationary
DIF	1	-3.624903	-2.986225 (0.0125)	-6.786068	-2.960411 (0.0000)	I(1)	Stationary
MSP	1	-2.805672	-2.954021 (0.0684)	-4.574706	-2.957110 (0.0009)	I(1)	Stationary

Table 3a Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.866138	180.0447	103.8473	0.0000
At most 1 *	0.818882	119.7163	76.97277	0.0000
At most 2 *	0.597224	68.45811	54.07904	0.0016
At most 3 *	0.539804	41.17686	35.19275	0.0101
At most 4	0.320750	17.89376	20.26184	0.1026
At most 5	0.189166	6.290764	9.164546	0.1694

Trace test indicates 4 cointegrating equation(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Authors computation from E-views.

The Trace test shows there are four cointegrating equations among the series, thus establishing a long run relationship among the variables.

Table 3b Unrestricted Cointegration Rank Test (Max-Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.866138	60.32835	40.95680	0.0001
At most 1 *	0.818882	51.25822	34.80587	0.0003
At most 2	0.597224	27.28125	28.58808	0.0727
At most 3 *	0.539804	23.28311	22.29962	0.0364
At most 4	0.320750	11.60299	15.89210	0.2102
At most 5	0.189166	6.290764	9.164546	0.1694

Max-eigenvalue test indicates 2 cointegrating equation(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The cointegration analysis rejects the null hypothesis that there is no long run equilibrium relationship between the variables used. The results confirm that there exist a long run relationship between the Digital Economy as proxy by the GDP and the explanatory variables. The Max-Eigen test shows the existence of three cointegrating equations each at the five percent level of significance. We therefore conclude that there exist a long-run relationship among GDP, PSV, PFI, INT MSP, and DIF. The null hypothesis of no co-integration relationship among the variables in the model is rejected at the five percent level of significance.

Finally, we use the cointegrated variables to estimate the VECM (in log differences). This is to further investigate the long-run relationship and short-run dynamics among the relevant variables, illuminating how shocks to one variable affect the dynamic behavior of the others.

Given that there are cointegrating vectors, economic interpretation of the long run GDP can be obtained by normalizing the estimates of the unrestricted cointegrating vector for the long run on GDP. The normalized cointegrating equation suggest that there is a negative long run relationship between the dependent variable GDP, PSV and DIF, and a positive long run relationship between GDP, INT, MSP and PFI. All variables except INT are statistically significant in the long run at the five percent level.

The error correction model was estimated and it shows how the system adjusts to the long run equilibrium implied by the cointegrating equation. ECM_{t-1} is the lagged error correction term, that is the fitted residuals from the cointegrating equation

Table 4. Error Correction Representation.

Dependent Variable: GDP

Method: Least Squares, Sample: 1990 2023, Included observations: 33 adjustment.

Regressor	Coefficient	Std-Error	T-Stat	Prob
C	0.304949	-0.614992	0.048445	0.0272
INT	0.012095	0.265702	0.045521	0.9640
MSP	0.820200	0.174816	4.691791	0.0001
PFI	1.102120	0.336412	3.276105	0.0028
PSV	-0.167768	0.050167	-3.344197	0.0024
DIF	-4.837258	2.362846	-2.047217	0.0501
ECM(-1)	-1.2031540	-0.432410	-1.646122	0.0057

Source: Authors Computation from E-Views.

R-Squared 0.799445, Mean dependent variable 9.333852, Adjusted R-Squared 0.770794, S.D. dependent var 1.995907, S.E. of regression 0.955550, Akaike info criterion 2.885667, Sum squared resid 25.56611, Schwarz criterion 3.112411, Log likelihood -42.61351, F-Statistic 20.92794, Durbin-Watson stat 2.082165, Prob(F-statistic) 0.000077 sig. at 5% .

The error correction result indicates a good fit with an F-ratio of 20.29794, and a p-value of 0.000077, an R^2 of 79.94% and adjusted R^2 of 77.08%, which means the model explains approximately 79.9% of the variations in GDP. Furthermore, MSP exert positive and significant impact on the sustainability of the digital economy, while one-period lag of GDP, PSV and DIF unlag exert negative and significant influence on GDP. In the same vein, INT (interest rate) impacts positively but not significant on the sustainability of the knowledge economy. The D-W statistic is approximately 2.1 and shows absence of autocorrelation. The error correction term is low, has the appropriate negative sign and shows that approximately 12.03% of disequilibrium in the model is corrected by changes in the explanatory variables. Thus, it provides evidence for equilibrium to be restored after short-term disturbance as indicated by the statistically significant and negatively signed coefficients of the error disturbance term (ECT).

Conclusion and Proposals for Policy: In order to ensure macroeconomic stability and support the growth of the digital economy, personal savings and portfolio investments are crucial. Hence, it is essential to build robust financial institutions that finance the market to enable the accumulation and conversion of savings into investments. Stout financial institutions make it easier for money to move from savings to investments. In a nation without robust capital markets and financial intermediaries, even if savings are large, there will inevitably be little to no route for investments in digital infrastructure necessary for the digital economy to be sustainable. Furthermore, a poorly developed financial intermediary system slows economic growth and makes it improper to use savings. The ability of savings capacity to change

people depends on how well financial intermediaries have developed and the availability of appealing financial products. Therefore, in order to address the issue of low investments that impede economic growth of the digital economy in emerging nations, policymakers should concentrate on raising the level of domestic private savings, and investment in digital infrastructure.

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