THE EFFECT OF ELECTRONIC PAYMENT SYSTEMS ON ECONOMIC GROWTH IN NIGERIA: EVIDENCE FROM 2010 TO 2023

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The effect of electronic payment systems on economic growth in Nigeria was investigated in this study using secondary data obtained from the CBN Statistical Database and NBS for the years 2010q1–Q4 to 2023q1–Q4. The impact of the transaction values of ATM, Mobilepay, POS, and Webpay on Nigeria's real GDP was specifically examined. The work used descriptive statistics and ARDL technique; and adopted an ex-post facto research design. ATM, Mobilepay, and Webpay were found to have positive and significant effects on real GDP in the short and long-term, with coefficient values of 0.26, 0.18, and 0.15 and p-values of 0.0000, 0.0482, and 0.0008 respectively, as opposed to POS, which showed a negative and significant effect on real GDP with a coefficient of -0.07 at a p-value of 0.0137. According to the study's findings, Webpay, Mobilepay, and ATM all positively impacted Nigeria's economic expansion while POS Payment System had a negative impact on real GDP growth. Given the beneficial effects of ATM use on economic growth, the study suggested that banks should promote and facilitate ATM access and use. Additionally, banks should work to increase cyber security and e-payments trust to maintain the positive effects of Webpay on real GDP.

Keywords: Cashless Policy; Economic Growth; Financial Transactions; Payment Systems

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1. INTRODUCTION

The rapid expansion of information and communication technology (ICT) worldwide has caused a significant change in how economic transactions are carried out, moving us away from cash-based systems and into the exciting world of electronic payments (Khando, Sirajul, & Shang, 2022). Transactions carried out digitally, using electronic platforms and technologies to transmit money and settle financial obligations, are referred to as electronic payment systems (EPS). According to Abubakar, Aiyedogbon, and Obumneke (2024), it is a technology system that combines tools, establishments, structures, rules, and ethics solely to exchange financial values and/or settling financial transactions between related parties, thereby fulfilling mutual economic obligations.

Before technology, economic activity was defined by a variety of payment methods, from bartering to using actual cash as payment instruments to prevent double dipping and issues with the parties' ability to divide. According to Oyewole et al. (2018), EPS has recently emerged as a conduit for the easy movement of economic assets inside the country. Electronic payment systems have taken off in Nigeria and are now a crucial component of the country's financial environment. Automated Teller Machines (ATMs), Mobile banking apps, Web/Internet payments, Point of Sales (POS), E-Bills Pay, Central Pay, and Remita are a few common electronic payment channels used in Nigeria to conduct business. It's interesting to note that these channels provide quick, easy, and safe ways to pay for commercial transactions. (Anuforo, Joel, Ndirmbitah, & Maindo, 2024).

As a result, the Central Bank of Nigeria (CBN) has put in place some policies and programs to encourage digital payments to support and boost the nation's economic expansion. According to CBN (2012), an effective e-payments framework has a significant impact on overall economic performance and financial soundness, and EPS is the cornerstone of modern society and the digital banking system.

Additionally, the CBN's implementation of a cashless policy aimed at encouraging the usage of e-payment methods and reducing the dependence on banknote transactions has strengthened the acceptance of EPS (CBN, 2022). According to available data, there were 10,000 ATMs in all Nigerian banks as of 2011, the year the policy was implemented. This number increased to 17,000 in 2015 and 18,000 in 2017, and as of December 2022, it has reached 22,500 ATMs across all banks. Similarly, as of December 2021, around 8.5 million point-of-sale terminals were installed and connected throughout the country, and the total value of POS transactions reached 4.72 trillion, with a steady increase to 6.4 trillion in 2021 (Nigeria Inter-Bank Settlement System [NIBSS], 2022).

On the other hand, mobile payment platforms have grown in popularity. Even though many banks may have technical issues, they are still a common way for various businesses to pay with cash. Accordingly, in 2021, the platform reportedly recorded a volume of 831 million and a transaction value of 53 trillion (CBN, 2022). Additionally, online payment platforms like Interswitch Web Pay, Flutterwave, PayPal, Paystack, and Monnify, among others, have grown in popularity in Nigeria because they offer a secure way for individuals and trades to settle bills for goods and services through credit or debit cards or through mobile banking without having to go to a bank or physical store (Nwaka-Nwandu, Patrick, Obainoke, & Ugege, 2024)

The deployment of EPS in Nigeria is fraught with difficulties, including short infrastructure, a high level of financial illiteracy, costly internet services, ATM card fraud, and hacking of accounts (Nwakoby et al., 2020). These difficulties discourage adoption and lead to an increase in fraudulent operations that harm the nation's economic growth by making banks and users fearful and anxious. Consequently, there have been mixed findings about EPS's impact on the economy. In contrast to Onalo et al. (2021), Nwankwo et al. (2022), and other researchers who reported conflicting findings, some researchers, like Yahaya (2022) and Ikechi et al. (2020), have shown beneficial effects on the growth of Nigeria's economy. Additionally, Mamudu (2021) claimed that e-payments hurt the economy. For stakeholders, this lack of agreement makes decision-making more difficult. Therefore, it is imperative to consider the impact of EPS on real GDP growth from a Nigeria perspective. This study aims to investigate the effect of ATM, POS, mobile, and web payment transaction values on the nation's economic growth.

Moreover, despite its many advantages, EPS has not gained widespread acceptance or resulted in the anticipated economic growth of the nation. Furthermore, it has been observed that the traditional cash-based system (physical cash) still dominates financial transactions in Nigeria, which harms the economy despite the CBN's past and current policies to automate Nigerian payment systems to support and propel the nation's economic growth. (Anyanwu, Henry, and Amakor, 2024). To further improve the economy and advance the previously implemented cashless policy, the CBN, for example, announced the Naira redesign program, withdrawal limitations, and encouraged Nigerians to use automated payment methods such ATMs, POS systems, Web Pay, mobile banking apps, and USSD in 2022. However, business environments suffered when the regulation went into effect in 2023 since many individuals and businesses had trouble getting cash. Long ATM lineups, naira purchasing (using naira to buy naira), bank officials' collusion, and unsuccessful transactions through a variety of payment channels (such as ATMs, point-of-sale systems, Web/internet pay, etc.) put many Nigerians in risk and issues with banks' mobile apps, which created a great deal

of pain for a lot of Nigerians. Additionally, the nation's banking halls were empty as disgruntled people and businesses turned to other methods of cash withdrawal, while the agency banking operators (POS operators) who receive cash sought it out from other sources like pharmacies, filling stations, and marketplaces at a fee. (Haruna, Beida, & Aidonojie, 2024).

Additionally, because Nigerians are struggling with a lack of cash, alternative payment methods like ATM, POS, Web/Internet pay, mobile pay, and USSD have become more and more popular in the nation for financial and commercial activities (Gbanador, 2023). The subject of how electronic payment systems affect the nation's economic growth is raised by the surprising fact that many people reverted to the old cash-based manner of making payments for commercial transactions when normalcy returned and cash became available.

In light of the above, some studies have been carried out on the effect of EPS on the economic growth of Nigeria using GDP as the macroeconomic variable. However, the results of these studies have been inconsistent about the various payment channels that are relevant to this study, and most of them have not extended their findings past 2019. Therefore, this study looks into the bond between EPS and Nigeria's economic growth. utilizing fresh data and the macroeconomic indicator (real GDP) as the dependent variable.

The core objective of this work is to examine the effect of e-payment systems on economic growth in Nigeria. And specifically to:

i. examine how Automated Teller Machine transactions move Economic growth in Nigeria.

ii. determine the level of influence of Mobile Payments on Economic growth in Nigeria.

iii. investigate how Point of Sales payments influence Economic growth in Nigeria.

iv. ascertain the effect of Web/Internet payments on Economic growth in Nigeria.

2. LITERATURE REVIEW
Electronic Payment Systems (EPS)

E-payment systems, usually referred to as online payment systems, are a way to settle financial transactions and economic commitments without using currency, claims Esperance (2024). According to Amin et al. (2018), e-payment systems are computerized ways for business players to exchange and distribute financial resources over the Internet. E-payment systems are also described by Nakajima (2017) as a procedure that makes it simple for financial institutions, buyers, and sellers to exchange money or conduct transactions. The Bank of International Settlement (BIS, 2018) defines EPS as a group of tools, banking policies, and usually interbank money transfer methods that guarantee the distribution of funds. (Oyadeyi, 2024)

Furthermore, electronic payments, as a platform for resolving financial transactions and commitments

between parties (consumer and vendor), offer a way to complete payment from one end to the other using information and communication technology (ICT) without the need for cash or manual intervention. This makes it easier for people to exchange money and move it around the economy, which lessens the burden on everyone. EPS can be viewed in terms of their roles as e-money, e-banking, e-finance, e-broking, etc., according to Akanni's (2019) study, which explains that e-payment is a multi-channel that offers computerized transfer of monetary values without the executing parties' physical contact. In the same way, it is a way to pay employees and importers electronically (Udeghi & Hanzace, 2018).

E-Payment Channels in Nigeria

There are many e-payment systems in Nigeria. According to CBN, Nigeria currently offers a number of e-payment methods for conducting financial transactions online. Point of Sale (POS), REMITA, M-Cash, E-Bills Pay, Central Pay, Automated Teller Machines (ATM), Mobile Pay (MMO), NIBSS Instant Pay (NIP), National Electronic Funds Transfer (NEFT), NIBSS Automated Payment Services (NAPS), and Cheque are some of these methods. In support of this, Nigeria's EPS infrastructures have advanced significantly, and the volume and number of transactions has increased dramatically year over year. Ikpefan *et al.*, (2018) stated that ever since EPS and the cashless program were introduced in the country, the reliability of the e-payment infrastructure has significantly upgraded, the presentation of modern payment channels which have resulted in a notable rise in the usage of EPS and an increase in transactions across different channels.

Accordingly, 1.96 billion electronic payments were made in Q1 2021 via POS, WEB, ATM, NEFT, RTGS, USSD, mobile, and direct channels in Nigeria, according to available data on various e-payment channels. In Q2 2021, there were 2.22 billion e-payment transactions, up 13.11%, while in Q3 2021, there were 2.43 billion, representing a 9.49% growth rate. However, the number of e-payment transactions fell by 2.16% to 2.38 billion in Q4 2021. The total value of transactions in Q1 and Q2 was 238.87 trillion and 269.73 trillion, respectively. More so, Q3 2021 recorded N269.82 trillion transactions, indicating 0.03% growth, while Q4 2021 recorded N285.95 trillion, signifying a 5.98% growth rate (National Bureau of Statistics [NBS], 2022). From the foregoing, selected e-payment channels examined in this study were discussed as follows.

In Nigeria, the most noticeable type of electronic fund transfer (EFT) in retail banking technology is the Automated Teller Machine (ATM). Nevertheless, there are not enough ATMs to accommodate the 200 million people, 52 million of whom have bank verification numbers. Although web/internet payment platforms, mobile payment systems, and point of sale (POS)

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provide safe substitutes for cash, the value of web payment transactions fell by 98.6 trillion in 2021.

Economic Growth

Economic growth refers to an increase in the economy's output overtime as expressed in terms of goods and services. Akan (2023) states it as the pace of change in actual output. As a result, the pace of economic growth is usually expressed as an annual percentage change. Furthermore, economic growth is the pace at which a nation's GDP increases each year. Chima (2023) emphasized that economic progress requires steady or continuous increases in real production per capital, which includes increases in actual output per worker and per capita. when the time is right. Isibar (2018) said that in addition to private and public consumption, a country's GDP was calculated by taking into account all government spending, money invested, building expenditures, increases in private inventories, and the global trade balance.

More importantly, a nation's economy expands due to a number of interconnected elements that affect the economy's growth rate. However, researchers and economists constantly have different opinions about the relative relevance of each determinant. According to Liliana and Florina (2015), economic growth is influenced by both direct and indirect factors, including financial institutions, aggregate demand, saving and investment rates, fiscal and budgetary policies, labor and capital mobility, the effectiveness of the economic system, and governmental competency. On the contrary, direct causes include things like technological improvements, growth in capital employed, and human and natural resources.

E-payment Systems and Economic Growth

Electronic transactions have increased exponentially since the advent of the internet. Customers can now use their handsets to make online payments for goods and services. In both developed and emerging economies, payments are essential. Additionally, the pace at which money is transferred is greatly accelerated by e-payments systems. A contemporary, effective payment system has a positive association per real GDP according to CBN (2017). The widespread adoption of electronic payments has reduced geographical restrictions on trade and exchange in general, lowered barriers to rapid financing and liquidity, and greatly increased the price of goods and services traded. According to Afaha (2019), an economy that relies on electronic payments does not entirely eliminate cash transactions; rather, it reduces the volume of cash-based transactions that take place.

Theoretical Review

Diffusion of Innovation Theory (DOI)

This theory was developed in 1976 by Rogers. It is a model that envisage factors inducing the embracing of information systems. The idea states that potential adopters evaluate innovations based on five factors: trialability, observability, compatibility, complexity, and comparative benefit. It also emphasizes how important perceived relative advantage and better organizational performance as drivers of the acceptance of new innovations. In other words, adoption rates rise as expected comparative benefit increases. Rogers (1995).

The argument against this hypothesis is that not all technical advancements can be described by the same set of characteristics, even when innovations are advantageous, not all of them are adopted, according to Afaha, (2019). Innovation adoption may take some time. Cashless transactions will eventually be accepted by the community or society as e-payments proliferate. This will depend on the kinds of innovators who embrace them and the innovation-decision process. Because of this, the impact of adopting cashless payments varies according to how quickly the public is ready to embrace new technologies during the development process. This theory will be helpful for this research since it clarifies the reasons behind the widespread adoption of electronic payments by users in the economy as well as how their innovation has spread over time. Afaha (2019) and Ireokwu et al. (2022) are among the researchers who have embraced the innovation diffusion theory as the theoretical foundation for their research.

Technology Acceptance Model (TAM)

The Davis (1989) Technology Acceptance Model (TAM) models how people utilize and embrace technology via the application of information system theory. It explains the fundamental element of users' acceptability and how it affects the users' surroundings. It also specifies manner in which people or businesses decide whether to adopt new technologies. More so, the theory postulates that two philosophical ideas majorly influence consumers' acceptance of an information system which include perceived usefulness (PU) and perceived ease of use (PEU).

According to Davis, Perceived Usefulness is the extent to which a user thinks using new technology will enhance their ability to accomplish their job while Perceived Ease of Use explains the degree to which one thinks using a given technology would require less physical and mental work. Moreso, several empirical research have established that TAM is a stable model for information technology. TAM has since been generally used to conduct behaviors of technology acceptance for different facets of information technology. The theory put forward that a strong link exists between perceived utility and perceived ease of use. Afaha (2019) explained that the model highlights the usability of new technology as the major determinant of technology usage and adaptability. However, this theory has been criticized for its failure to justify the cost implication of setting up new technology. For instance, as many organizations or individuals would want to adopt a new technology, there may be no or insufficient financial resources to acquire it.

From the foregoing theoretical review, this work is underpinned by the diffusion of innovation theory developed by Rogers. The theory helps us to understand the reason behind the rising adoption of electronic payments system in Nigeria which includes relative advantage, compatibility, complexity (ease of use) among others. The hypothesis also provides a thorough explanation of the different categories of adopters of a new technology which include the innovators, the first adopters, the first majority, the late majority, and the laggards. This means that the effect of a new technology may not be felt instantly or even a few years after the technology is introduced as some people may adopt the technology immediately, while it will take years after the innovation before it is being experimented by others. This helps to explain the reason why few studies found that using certain e-payment channels had no substantial influence on real GDP growth, especially in the near future.

Empirical Review

The effect of e-payment systems on Nigeria's GDP was examined by Isamade et al. in 2022. The study used secondary data from a few cellular firms as well as CBN Statistical Bulletins. The Auto Regressive Distributed Lag Model (ARDL) approach was used to evaluate the data in this ex-post facto investigation. The results showed that the Point of Sale (POS), mobile payment systems, and ATM hold a major impact on Nigeria's GDP development. According to the report, banks should always upgrade their systems whenever a new feature that improves security is made available.

Ireokwu et al. (2022) evaluated the effect of technology-based payment channels on economic growth in Nigeria employing quarterly data gathered from the CBN Statistical Bulletin between 2009 and 2018. To evaluate the data, the work employed the ARDL and co-integration technique. The outcomes exposed that both in the short and long term, automated teller machines (ATM) significantly and favorably impacted Nigeria's economic growth. Short-term GDP growth was positively and significantly impacted by the Point of Sales (POS) technology-based payment system; But over time, it had a small but beneficial impact. Additionally, the Web Payments (WEP) system made a considerable and positive contribution to Nigeria's economic growth in the near term, but it had a major and negative influence on the state's economy in the long-term. In the near term, the Mobile Payments (MOP) system hold a great adverse impact on GDP growth, but in the long-term, it had a positive and considerable benefit. The work suggested that since the acceptance of technology-based banking products benefited Nigeria's economy, banks and the government should educate the public more about how to utilize them.

Yahaya (2022) conducted additional research on electronic payment systems and their impact on nation's economic expansion. Data for the study between 2006 and 2014 were sourced from the CBN Statistical Bulletin. The work used descriptive and inferential statistics to evaluate the data. The outcomes showed that economic growth and e-payment systems (ATM, POS, Web/Internet Payments, Mobile Payments, NIBSS, and NEFT) were positively correlated. Results also showed that the most important factor in the connection between economic performance and external reserve.

Mamudu (2021) investigated the e-payment system and its impact on the economy of Nigeria with quarterly data, mostly from the CBN Statistical Bulletin, from Q1–Q4 of 2011 to Q1–Q4 of 2019. Multiple regression analysis and descriptive statistics were employed in the investigation. The results showed that ATMV, MOBP, NEFT, and WEBP had a favorable and significant effect on GDP. The results also showed that POSV, NIPV, and CHEV had a detrimental effect on Nigeria's economic expansion. It was suggested that the monetary authority and financial organizations invest in internet and electricity supplies to fortify e-payment systems. This would assist in resolving concerns with the point-of-sale value, the negative value of cleared checks, and the instant payment provided by the Nigerian interbank settlement process.

The impact of electronic payment systems on Nigeria's economic growth was examined by Onalo et al. in 2021. The CBN statistical bulletin offered the quarterly data used in the work, which covered an 11-year period from 2009 to 2019. The ARDL technique was used in the work. The outcome showed a insignificant long-term association between the variables. In the near term, there was a substantial positive correlation between POS volume and GDP, but there were also significant negative correlations between GDP and ATM, Web Pay, and Mobile Pay volume, respectively. The findings indicated that, in terms of transaction value, only MOP had a long-term negative correlation with GDP; in contrast, ATM, POS, and WEB had negligible negative correlations with GDP. Only POS demonstrated a significant positive association with GDP growth in the short term. The study concluded that Nigeria's GDP is only stimulated by the bulk and value of POS transactions.

Ikechi et al.'s (2020) researched into the relationship between the amount of money in circulation in Nigeria between 2009 and 2018 and the adoption of electronic payment systems. The work analyzed time-series data sourced through the CBN statistical bulletin using the least squares regression method. While the deployment of ATMs and POS systems shown a strong and positive link with the amount of currency in circulation, the results indicated that just two payment methods (remita and webpay) had a substantial undesirable relationship with the volume of money in movement in Nigeria. The report suggested that regulatory agencies should strengthen their capacity to keep a closer and more careful eye on an economy powered by e-money.

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Joseph (2020) investigated the way Nigeria's cashless policy affected the nation's economic development. The study analyzed secondary data from the Statistical Bulletin of CBN from 2008 to 2018 and employed an ex post facto research design. The least square regression method was used to evaluate the data. The findings showed that while POS was a significant predictor of real GDP, real GDP growth in Nigeria was not significantly impacted by ATM, RET, or WEB. The study came to the conclusion that regulatory bodies should enforce the implementation of the policy through ongoing supervision and that the public should be encouraged to embrace the cashless policy by incorporating the various channels into their routine business operations.

Afaha (2019) looked on the relationship between Nigeria's GDP growth and e-payment systems. The work used monthly data between 2012 and 2017 and analyzed the data using the ARDL approach. Results demonstrated that automated teller machines (ATM), point of sale (POS), and internet-based transactions all considerably and favorably effect economic growth. The results also showed that MOP contributed negatively to actual GDP growth, but interbank transactions had no discernible effect on GDP growth. According to the study, steps should be taken to enhanced the internet security framework in order to stop online fraud and support economic growth.

Akanni (2019) looked into Nigeria's economic progress as affected by e-payment systems from 2009 to 2018. The study employed monthly data from the NBS and CBN Statistical Bulletin. Additionally, ARDL technique of analysis was used in the study. The results demonstrated that POS, ATM and online payments (WEP) all possessed a favorable and considerable impact on economic growth, while interbank transactions have relatively little effect on GDP growth. Also mobile payments (MOP) have a negative effect on actual GDP growth. In order to enhance the real GDP, the study suggested that enough regulations be passed that address all aspects of financial operations and a cashless system. This would guarantee adequate protection for both users and system operators.

Using quarterly data from 2011 to 2017, Mamudu and Gayovwi (2019) explored the impact of Nigeria's cashless policy on the nation's economy. Point of Sale (POSV), Mobile Payment (MPV), Web/Internet payments, Automated Teller Machine Payment (ATMV), National Electronic Funds Transfer (NEFTV), and Cheques Cleared (CHEV) transaction values were the variables considered. The work employed the OLS and ECM regression technique, and Johansen Co-integration test. The results demonstrated that the implementation of cashless program has a positive and sizable influence on Nigeria's GDP. The co-integration test also showed that there is a long-term bond among the variables and that the cashless instruments have significant and positive short-term influence on GDP.

3. RESEARCH METHOD

This work is premised on ex-post facto research design. It serves as the model and foundation for this study. It involves observing events that have already occurred (Abubakar et'al, 2024). Additionally, the study is quantitative in nature, and analysis of data was done using econometric techniques to examine to examine how independent variables (e-payment systems) influence dependent variable (realGDP). The model of the study measured the relationship based on value of e-payment transactions in the analysis. The independent variables include the transactions value of ATM, Mobile Pay, POS and Web/Internet Pay while the dependent variable is the real GDP proxy of economic growth.

Also, the study's population includes payments channels as highlighted by the CBN which include: REMITA, M-Cash, E-Bills Pay, Central Pay, NIBSS Instant Payment (NIP), National Electronic Funds Transfer (NEFT), NIBSS Automated Payment Services (NAPS), Mobile Pay (MMO), Web/Internet Pay, Automated Teller Machines (ATM), Cheque, and Point of Sale (POS)

Given the significance and impact of the above mentioned channels on economic activity, the researcher selected four of Nigeria's current e-payment systems—ATM, Mobile Pay, POS, and Web Pay—as the sample size for this work. According to Akintayo (2019), the e-payment channels were chosen using the purposeful sampling technique, as it facilitates the chosen of the participants based on demographic characteristics and study objectives. Additionally, the researcher uses this technique to deliberately select particular groups or individuals as representative samples, mostly based on the participants' relevance to the study being conducted (Ogunlade & Amodu, 2024).

Moreso, the CBN Statistical Database and NBS Database provided the secondary data used in this study for 14 years, from 2010 to 2023. Also, the numbers of observations were augmented to 56 by making use of quarterly data instead of yearly which most of the previous studies used. To analyze the data, the study used statistical and econometric tools. While the econometric tools include tests like the unit root, cointegration, and autoregressive distributed lag (ARDL) model, the statistics tools included descriptive statistics, graphs, and charts. To further determine whether the variables and model used for this study are appropriate for carrying out the analysis, post-estimation tests such as Serial Correlation Test and Heteroscedasticity Test were carried out. The unit root test of the Augmented Dickey-Fuller (ADF) was carried out to determine whether the variables used in this research are stationary using the following three requirements: none, constant, and constant and trend:

$$\gamma = \delta \gamma_{t-1} + \varepsilon_t \qquad \text{... 3.1}$$
$$\gamma = \beta_1 + \delta \gamma_{t-1} + \varepsilon_t \qquad \text{.. 3.2}$$
$$\gamma = \beta_1 + \delta \gamma_{t-1} + \beta_2 + \varepsilon_t \qquad \text{............................. 3.3}$$

Where, y represents the variables RGDP, VAATM, VAMOP, VAPOS, VAWEP.

Decision rule: if $\delta < 1$, the series is stationary; if $\delta = 1$, the series is non-stationary and if $\delta > 1$, then the series is regarded as volatile and non-stable.

Afaha (2019) specified ARDL model which captured an empirical investigation into e-payment systems and Nigeria's economic growth. The model is stated as follow:

$$RGDP = f \text{ (E-Payments)} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{ eqn 3.4}$$

$$RGDP = f \text{ (WBT, POS, ATM, MOP, INTERBANK)} \ldots\ldots\ldots\ldots\text{ eqn 3.5}$$

$$RGDP = \beta_0 + \sum_{i=1}^{n} \beta WBT_{t-i} + \sum_{i=1}^{n}\beta POS_{t-i} + \sum_{i=1}^{n}\beta ATM_{t-i} + \sum_{i=1}^{n}\beta MOP_{t-i} + \sum_{i=1}^{n}\beta INTERBANK_{t-i}$$

$$RGDP = \beta_0 + \beta_1 WBT + \beta_2 POS + \beta_3 ATM + \beta_4 MOP + \beta_5 INTERBANK + \mu \ldots.$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{ eqn 3.6}$$

where ;
Real Gross Domestic Product (RGDP)
Web-Based Transaction, or WBT
Point of Sales (POS)
Automated Teller Machine (ATM)
Mobile Payment, or MOP
Interbank money transfer transactions are referred to as INTERBANK.

This model was adapted to suit the research objectives. The revised model is thus expressed as follows in a functional form:

$$RGDP = f \text{ (ATM, MOP, POS, WEP)} \ldots\ldots\ldots\ldots\ldots\text{ eqn 3.7}$$

The estimable econometric ARDL model is formulated as:

$$RGDP = \beta_0 + \sum_{i=1}^{n} \beta VAATM_{t-i} + \sum_{i=1}^{n}\beta VAMOP_{t-i} + \sum_{i=1}^{n}\beta VAPOS_{t-i} + \sum_{i=1}^{n}\beta VAWEP_{t-i}$$

$$RGDP = \beta_0 + \beta_1 VAATM + \beta_2 VAMOP + \beta_3 VAPOS + \beta_4 VAWEP + \mu \ldots\ldots$$

$$\ldots\ldots\ldots \text{ eqn 3.8}$$

Where:
ATM = ATM Transaction Value
MOP = Mobile Pay Transaction Value
POS = POS Transaction Value
WEP = Web/Internet Pay Transaction Value
β_0 = Constant (Intercept) term
β_1 - β_4 = Coefficient parameters of the independent variables
μ = Scholastic (Error) term assumed to fulfill the standard ordinary least square.

A 95% confidence level is used to determine significance. This allows for a 5% margin of error or the alpha (α) of 0.05.

4. RESULTS AND DISCUSSION
The table above shows that the mean value of all the variables is positive. This means that all the data have positive valued observations. The standard deviation values are approximately 1592.412, 2742.149, 1762.054 and 2008.66 billion for ATM, MobilePay, POS, and Webpay respectively. It indicates that in relation to the independent variables, Webpay posses the maximum value of standard deviation. This suggests that Web Pay is the most unstable variable as it can switch easily. The standard deviation value of (dependent variable) RGDP proxy of economic growth is 1822.395 billion implying that there is a deviation in the RGDP over the years. Also, all the variables are positively skewed except RGDP which is skewed negatively. Regarding the kurtosis values, each value is positive. The kurtosis values of all variables except RGDP exceed 3 showing that all of them are leptokurtic in nature. Also, the estimated Jarque-Bera p-value of the variables is significant (evidenced by a p-value more than a significance level of 0.05%) proof that the variable series has a typical distribution except for ATM which has a p-value less than 5 percent alpha value.

Table 1

Descriptive Statistics
Results of Descriptive Analysis of Research Variables

	RGDP	ATM	MOBILE PAY	POS	WEB PAY
Mean	17488.65	1587.613	1968.228	621.5006	16328.60
Median	15444.46	1064.185	127.3600	139.9750	37.82410
Maximum	19329.01	5469.490	13035.60	6423.600	120273.2
Minimum	12583.48	72.5900	0.870000	1.870000	3.3700000
Std. Dev.	1822.395	1592.412	2742.149	1762.054	2008.66
Skewness	-0.084843	1.508131	1.976799	2.823657	1.999541
Kurtosis	2.545327	4.097507	5.262804	9.891210	5.393479
Jarque-Bera	0.485781	20.60472	41.50243	159.5906	43.44281
Probability	0.784357	0.000034	0.062000	0.085620	0.069742
Sum	791466.6	76205.43	89674.92	34632.56	687772.3
Sum Sq. Dev.	1.60E+07	1.06E+08	6.94E+09	94675425	5.16E+11
Observation	56	56	56	56	56

Source: Author's computation, 2025

Interpretation of Results:

Table 2

Unit Root Test
Augmented Dickey-Fuller Stationarity Test

Variable	ADF Test Stat	Test Critical Values		P-value	Order of Integration
RGDP	-3.092174	-3.563723	1%	0.0348	I(0)
		-2.925101	5%		
		-2.710658	10%		
ATM	-3.805801	-3.614153	1%	0.0070	I(1)
		-2.938909	5%		
		-2.827932	10%		
MOBILEPAY	-3.888008	-3.621723	1%	0.0060	I(1)
		-2.823427	5%		
		-2.610263	10%		
POS	-5.326360	-3.570509	1%	0.0000	1(1)
		-2.929123	5%		
		-2.723064	10%		
WEBPAY	-7.853261	-3.512352	1%	0.0000	I(1)
		-2.914422	5%		
		-2.656424	10%		

Source: Author's computation, 2025

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For all variables, the ADF trial statistic at absolute value is greater than the absolute critical value at the five percent significant level, as indicated by the results shown in table 3 above. That is, at a 5-percent alpha value, all of the variables are stationary. Also, the result revealed that RGDP is stationary at level I(0) while ATM, Mobile Pay, POS, and Web Pay are stationary at first difference I(1). Consequently, proof of mix integration is established, hence the work employed ARDL F-Bounds co-integration test due to fusion of the I(1) and I(0) series.

Co-integration Test

To empirically evaluate the short and long-term dynamic correlation among the variables, the research used ARDL F-Bounds co-integration technique.

Table 3

ARDL F-Bounds Co-integration Test

F-Bounds Test		Null Hypothesis: No levels of relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	25.34570	10%	3.8	3.8
K	0	5%	4.6	4.6
		2.5%	5.39	5.39
		1%	6.44	6.44
Actual Sample Size	50		Finite Sample: n=56	
		10%	3.935	3.935
		5%	4.815	4.815
		1%	7.065	7.065
			Finite Sample: n=52	
		10%	3.95	3.95
		5%	4.895	4.895
		1%	7.265	7.265

Source: Author's computation, 2025

According to the table, there is a strong indication of a long-term bond between the independent variables (ATM, Mobile Pay, POS, and Web Pay) and real GDP in Nigeria because the F-statistic value is higher than critical values in the lower bound I(0) and upper bound I(1) at all levels of significance for the asymptotic sample and when both the finite sample n is 56 and 52, correspondingly. Consequently, the study discards the null hypothesis and estimates the long-run model.

ARDL Long run and Short run Estimation

Since the variables are found cointegrated with the help of ARDL F-Bounds test, both short and long-run models were estimated as follows:

The R-squared statistic in the result table above shows that every explanatory variable in the model (ATM, Mobile Pay, POS and Web Pay) accounted for approximately 72% of variation in output growth per capita (explained variable) during the period, while 28% of the deviation are associated with elements outside the scope of the model. The Durbin Watson (DW) statistics that assess whether autocorrelation

exists in the model is nearly 2 (1.98) and is within the acceptable range. This indicates that there is no first-order autocorrelation as the general rule of thumb dictates (less than 2). Also, the joint F-test statistic (showing the joint test results with all model variables included) value of 13.93281was discovered to be significant (0.0000) on all levels, indicating that the series are jointly significant in explaining economic growth at 95% confidence level.

Table 4

ARDL Long run Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
RGDP(-1)	0.484324	0.135464	3.876131	0.0003
RGDP(-2)	-0.542031	0.134423	-4.032277	0.0002
ATM	0.264577	0.460340	5.438865	0.0000
MOBILEPAY	0.182092	0.446776	2.636450	0.0482
POS	-0.071072	0.658417	-2.552939	0.0137
WEBPAY	0.153340	0.036422	3.600601	0.0008
C	0.156456	2.154190	6.998437	0.0000
R-squared	0.721632	Mean dependent var		16651.08
Adjusted R-squared	0.676062	S.D dependent var		1642.008
S.E. of Regression	1011.312	Akaike info criterion		16.79548
Sum squared resid	41109431	Schwarz criterion		17.07321
Log likelihood	-389.2955	Hannan-Quinn criter.		16.89970
F-statistic	13.93281	Durbin-Waston stat.		1.976546
Prob(F-statistic)	0.000000			

Source: Author's computation, 2025

Also from the result table, the coefficient value of ATM. Mobile Pay, POS and Web Pay are approximately 0.26, 0.18, -0.07 and 0.15 with accompanying p-values of 0.0000, 0.0482, 0.0137 and 0.0008 respectively. In the long-run ATM and Mobile Pay have positive and statistically significant influences on real GDP. This implies that as the transactions value of ATM and Mobile Pay are increasing, they will have a major and positive effect on actual growth of GDP. However, POS though with a coefficient of -0.07 (-7%) is slightly negative and statistically significant at 0.01 p-value. Also, Web Pay has a positive coefficient with a significant p-value at 0.0008. This submits that it will have a major and positive effect on actual GDP growth in the long run.

The effect of ATM. Mobile Pay, POS and Web Pay transactions value is further tried in the short run below.

Table 1

ARDL Short Run Estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
D (RGDP (-1))	0.642054	0.142562	4.131765	0.0002
ATM	0.255771	0.675298	6.419241	0.0000
MOBILEPAY	0.175042	0.576350	3.302095	0.0429
POS	-0.076097	0.676373	-2.696459	0.0126
WEBPAY	0.138162	0.044168	3.912384	0.0004
CointEq (-1) *	0.125061	0.152386	7.181365	0.0000

Source: Author's computation, 2025

From the above result, the coefficient value of ATM and Mobile Pay transactions value are positive and significant in short run as established in the long-run estimation. While POS showed a negative coefficient with a significant p-value of 0.01. Also, Web Pay maintains a positive coefficient value with a significant p-value as observed in the long-run estimation. More so, the CoinEq (-1)* of 0.0125061 which connotes error correction (ECM) coefficient is positive with a significant p-value. The coefficient indicates the rate of adjustment from short-run to long-run equilibrium at 12.5% quarterly.

Table 5

Post – Estimation
Breusch-Godfrey Serial Correlation LM Test

Null hypothesis: No serial correlation at up to 2 lags			
F-statistic	0.065704	Prob. F (2, 37)	0.8159
Obs*R-squared	0.168259	Prob. Chi-Squared (2)	0.9004

Source: Author's computation, 2025

From the above-mentioned Breusch-Godfrey Serial Correlation LM test result, both chi-square and F-statistics have p-values higher than the 5% alpha value. This suggests that the residuals are not serially correlated, and the investigation is unable to reject the null hypothesis.

Table 6

Heteroscedasticity Test: ARCH

F-statistic	0.496132	Prob. F (1, 43)	0.4961
Obs*R-squared	0.52182	Prob. Chi-Squared (1)	0.4814

Source: Author's computation, 2025

The p-values for the F-statistics and chi-squared in the table exceed the threshold at the 0.05% significance level. Thus, the study is unable to rule out the null hypothesis demonstrating that the residuals are homoscedastic. This indicates that the residuals are distributed with equal variance and that the model does not have an arch effect.

Discussion of Findings

Findings from this work contribute significantly to the existing literature on electronic payment systems and economic growth in Nigeria. The R-squared value of approximately 72% suggests a relatively strong explanatory power of the selected electronic payment indicators, consistent with prior studies that reported similar high explanatory power using digital finance variables.

Moreso, the positive and statistically significant long-run effects of ATM and Mobile Payments on GDP growth align with the findings of (Mamudu, 2021; Isamade, et al., 2022; Yahaya, 2022) who emphasized the role of mobile penetration and ATM accessibility in promoting financial inclusion and economic activity. Similarly, the positive impact of Web/Internet payments supports earlier conclusions of ((Afaha, 2019; Akanni, 2019; Mamudu, 2021; and Yahaya,

2022) that highlight the growing role of Internet-based transactions in boosting e-commerce and service sector output. However, the long-run negative impact of POS transactions on real GDP diverges from a few previous studies (Akanni, 2019; Onalo *et al*. 2021; Ireokwu *et al*. 2022) that generally reported a positive relationship. This deviation may be attributed to issues such as infrastructure deficiencies, transaction failure rates, or inefficiencies in POS deployment across key sectors of the Nigerian economy. It suggests that not all electronic payment channels contribute equally or positively to economic growth, underscoring the importance of channel-specific policy interventions. In the short run, the consistency of results, particularly the significant and positive impact of ATM and Mobile Payments, further strengthens the robustness of the model. The presence of a cointegrating relationship validated by the ECM confirms a long-run equilibrium relationship, which is in line with studies such as (Ireokwu *et al*. 2022) thereby reinforcing the theoretical expectation that digital payment systems have both immediate and enduring effects on economic performance.

Overall, this study not only validates some earlier empirical findings but also contributes novel insights, especially regarding the contrasting role of POS transactions, thereby opening new avenues for more granular investigation into electronic payment sub-channels and their sector-specific impacts on economic growth.

5. CONCLUSION

This research has given compelling evidence of the transformational influence of electronic payment systems on the economic and financial landscape in Nigeria. The adoption of e-payment systems has ushered in a new era marked by increased efficiency and reduced bottlenecks in the financial sector. This shift was driven by the pressing need to address issues such as overcrowded banking halls, payment delays, and failed transactions. Furthermore, this study validated that electronic payment systems and real GDP growth (growth of a nation) have a relationship that lasts.

More so, the test of both the short-run and long-run yielded valuable insights. ATM, Mobile Pay and Web/Internet were discovered to significantly and favorably affect real GDP growth, indicating that an increase in ATM, Mobile Pay and Web/Internet transactions value contribute positively to real GDP growth. Contrary to say, POS transactions value has a significant influence on real GDP growth based on a p-value of (0.01), although its real GDP growth contribution is negative at (-7%).

Conclusively, the adoption of electronic payment systems has brought about significant improvements in Nigeria's economic and financial landscape. This study underscores the importance of continually promoting and fine-tuning these systems to maximize their positive impact on economic growth. As Nigeria continues to embrace technological innovations in

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its financial sector, these results serve as a valuable guide for decision-makers seeking to foster sustained economic growth and development.

Recommendations

These are specific recommendations based on the thorough findings on each payment method's impact on Nigeria economic growth:

i). Banks should encourage and facilitate ATM access and usage. Given the positive impact of ATM usage on economic growth, efforts should be made to maintain a reliable network of ATMs and reduce transaction costs as these could enhance their contribution to GDP growth.

ii). Banks should foster Mobile Payment adoption for economic and financial transactions. Since the payment channel was found to have a positive impact on economic growth, policymakers should focus on promoting the adoption of mobile payment platforms. This can be achieved through public awareness campaigns, digital literacy programs, and collaborations with telecommunications companies to enhance mobile payment infrastructure.

iii). Apex bank and other stakeholders should address undue charges associated with the channel and improve user experience. Given the negative impact of POS transactions on economic growth, addressing the issue of excessive charges is crucial. Regulatory measures can be implemented to ensure fair and transparent fees for POS transactions. Additionally, efforts to enhance the user experience, reduce transaction time, and improve network reliability could mitigate the negative effect on economic growth.

iv). Efforts should be made by banks to enhance cybersecurity and trust in E-Payments. To improve the positive impact of web/internet transactions on economic growth, there is a need to bolster cybersecurity measures and build trust among users. Collaboration between financial institutions, payment service providers, and regulatory bodies can help establish robust security protocols, educate users about online safety, and improve consumer protection.

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ВПЛИВ ЕЛЕКТРОННИХ ПЛАТІЖНИХ СИСТЕМ НА ЕКОНОМІЧНЕ ЗРОСТАННЯ В НІГЕРІЇ: ЕМПІРИЧНІ ДОКАЗИ ЗА 2010–2023 рр.

У цьому дослідженні проаналізовано вплив електронних платіжних систем на економічне зростання в Нігерії на основі вторинних даних, отриманих зі статистичних баз Центрального банку Нігерії (CBN) та Національного бюро статистики (NBS) за період з I кварталу 2010 р. по IV квартал 2023 р. Особливу увагу приділено оцінці впливу обсягів транзакцій через банкомати (ATM), мобільні платежі (Mobilepay), платіжні термінали (POS) та інтернет-платежі (Webpay) на реальний валовий внутрішній продукт Нігерії. Методологічну основу дослідження становлять описова статистика та авторегресивна модель із розподіленими лагами (Autoregressive Distributed Lag, ARDL), а також дизайн дослідження ex post facto. Результати емпіричного аналізу свідчать, що банкоматні операції, мобільні та вебплатежі мають позитивний і статистично значущий вплив на реальний ВВП як у короткостроковому, так і в довгостроковому періодах, з відповідними коефіцієнтами 0,26; 0,18 та 0,15 і значеннями p 0,0000; 0,0482 та 0,0008. Натомість платіжна система POS продемонструвала негативний і статистично значущий вплив на реальний ВВП із коефіцієнтом –0,07 при $p = 0{,}0137$. Загалом результати дослідження підтверджують, що Webpay, Mobilepay та ATM сприяють економічному зростанню Нігерії, тоді як використання POS-платежів чинить стримувальний вплив на динаміку реального ВВП. З огляду на позитивний ефект використання банкоматів на економічне зростання, у дослідженні рекомендовано банківським установам активно сприяти розширенню доступу до ATM та стимулювати їх використання. Крім того, підкреслено необхідність посилення кібербезпеки та довіри до електронних платежів з метою збереження позитивного впливу Webpay на реальний ВВП.

Ключові слова: безготівкова економіка; економічне зростання; фінансові транзакції; платіжні системи.