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Financial Innovation and Public Revenue Performance in BRICS Countries: A lesson for Nigeria

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ABSTRACT: *The global revenue shortfall in emerging economies has created concern for quest into innovative techniques to broaden public revenue sources. Hence, this study on financial innovation and public revenue performance in BRICS countries. Sample data were collected from selected countries of Brazil and South Africa to benchmark Nigerian ; revenue performance from 2010 to 2020.The technique of Random Effect (RE) was suggested by Hausman test to study public revenue performance on cashless mobile payment (CMP), volume of electronic payment (EPV), and volume of web pay users (WPU).The findings suggest that, CMP and WPU significantly increase public revenue in the selected countries while, EPV exhibited negative relationship with public revenue. The study recommended amongst others that, the revenue generating authorities in Nigeria needs to implement sound digital economic policies to ensure ease of revenue collection; and Central Bank of Nigeria should develop state-owned payment system that is secured, efficient and reliable so as to restore public confidence in the use of electronic payment systems. Brazil and South Africa should enhance their country's technical capacity to streamline electronic payment systems in order to competitively confront declined revenue stream from electronic sources compared to the industrialized economies.*

KEYWORDS: Financial innovation, public revenue, panel data, Fintech

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INTRODUCTION

Payment innovation as a critical component of financial innovation have a significant impact not only on private sector stakeholders, but also on governments and other public sector entities such as central banks. Payment and settlement systems have long been used to facilitate the clearing and settlement of monetary and other financial transactions around the world BIS (2021). It is, however, a secure, affordable, and accessible revenue collection mechanism for both the private sector and the government.

Financial innovation is a process, carried out by any public institution that involves the creation, promotion and adoption of new products, platforms, and processes or an enabler of technologies that introduce new ways or changes to the way a financial activity is carried out Chen (2018). In a micro sense of it, the financial innovation promotes savings culture and that 'consumers' who are educated in the use of new financial instruments and deploy same in their financial transactions earn incomes higher than those who are technologically ignorant, because the users seem to be rewarded for embracing the new technology Effiong and Edet (2020). The foregoing is the same in public institutions who employed innovative techniques to enhance revenue generation through taxation and other public finance instruments. Public finance is a strategic issue for any country, as it provides the resources needed to build infrastructures and to supply services to the entire population as well as to contribute to the economic development of the country Monda & Giogino (2014). The health of any economy is measures by its proportion of tax – GDP ratio. Tax to GDP ratio represents the proportion of gross domestic product collected by government in form of taxation from which infrastructural development occurs. Hence, countries tax revenues above 15 percent of a country's gross domestic product (GDP) are a key ingredient for economic growth and, ultimately, poverty reduction (world bank ,2012; Raul & Bernard,2018) but, public revenue growth of 6.2 per cent in Nigeria in spite the Central Bank of Nigeria provisional benchmark of 10 per cent in 2019/20 was worrisome. Opuala – Charles (2019) in his book [1] argued extensively on how Nigerian public revenue can be enhanced to match 20 per cent global benchmark of tax-GDP ratio. The argument follows that financial innovation is chiefly attained through the contributory role of fin-tech in facilitating public revenue collection. Hence posing a question on; Can financial technology services enhance public revenue collection in emerging economies?

Governments at all levels entered into financial transaction with its citizens and the rest of the world. This is enforced through payments to, and receipt of payments from individuals, businesses and foreign institutions. Financial resources are also transferred between the various government agencies, and these flows cover a wide range of economic sectors and activities. Improvements in government revenue collection channel significantly impact the economic growth prospect World Bank (2012). This re enforces the importance of financial innovation to economic development, as it is perceived that financial development correlates with implementation of safe, reliable and efficient national payments systems, and has been adjudged to be crucial in fostering economic development and, this is accentuated by the support for financial stability in every global economy World Bank (2020). In addition, financial innovation attained through payments systems foster transparency and efficiency in the international remittances markets. Specifically, governments are typically the largest users of payment services in an economy, giving and receiving payments. As a result, they stand to gain significantly the benefits of digitalization, which include lower transaction costs, less fraud, blocked revenue leakage from taxes, and curb financial corruption. Many governments including national and local are aiming to improve the "customer" experience by minimizing the need for physical presence and/or submission of paper documents Eze, Adelekan, Majekodumni and Nwaba (2018). Just like many private sector entities are going fully digital, governments are accelerating their engagement in e-government projects that provide an

end-to-end digital experience. This high tech innovative strategy is usually attained by encouraging digital economy; a break away from brick-and- mortar means of revenue collection.

Therefore, financial innovation support the digitization of government payments that manifest in the form of online electronic government payments gateways. Online e-government payments uses cards and, to some extent, automated clearing house-based electronic fund transfers. And, the electronic government payment channel facilitates revenue collection and expenditure to fuel economic growth Gerben , Lande & Nijboer (2016). The stimulation of economy can come through a developed financial and innovative payment getaway. The gateway programmes enables tax collection, public sector salary payments, public procurement and other government to person payments. The wave of payment innovation has also had a significant impact on government agencies, which interact with citizens through the provision of government services and programmes that involve making payments Delort et al (2022). The e -government payments include request to pay and electronic fund transfer running on fast payment systems; some mobile wallets that use e-money and other internationally accepted platforms that enable governments to create wonderful experiences with regards to revenue from taxes and transfer of foreign remittances for domestic capital formation.

Public revenue collection is principally mirrored by the strength of efficient payments channels that typically accept larger amounts, has an integrated electronic invoicing processes, and could collect revenue such as value added tax as part of the payments processes. In a closer survey of selected BRICS economies, typically Brazil and South Africa, the study objective intends to run a comparative analysis of these two emerging economics with respect to Nigeria in terms of the extent of adoption of financial innovation to improved revenue collection.

South African revenue service (SARS) meaningfully employed electronic tax filing system by creating an innovative payment gateway MobiSite application which allows taxpayers to submit their tax returns from their mobile phone Newman and Egbosa (2019). In Nigeria, the adoption of International Monetary Fund (IMF) suggested integrated tax administration system (ITAS), subdivided e payment structure and processes into e-registration, e-stamp duty receipt, e - filling and e- tax clearance certificate. Yet, many states internal revenue services except few like Lagos, uses manual processes for tax collection. Brick and mortar strategy of public revenue mobilization and collection had had a negative impact on revenue from value added tax (VAT) especially NCS[1]-Import VAT and Non-Import VAT. This fact was validated by findings (Ademola in FIRS ,2020),NCS-imported and non-imported VATs for half year 2020 amounted to N653.11 billion, a decrease of 11.49 per cent compared to N737.92 billion generated in the corresponding period of 2019 The broad range of Nigerian revenue performance is graphically presented below

The Nigeria – Global Benchmarked Tax revenue Differential

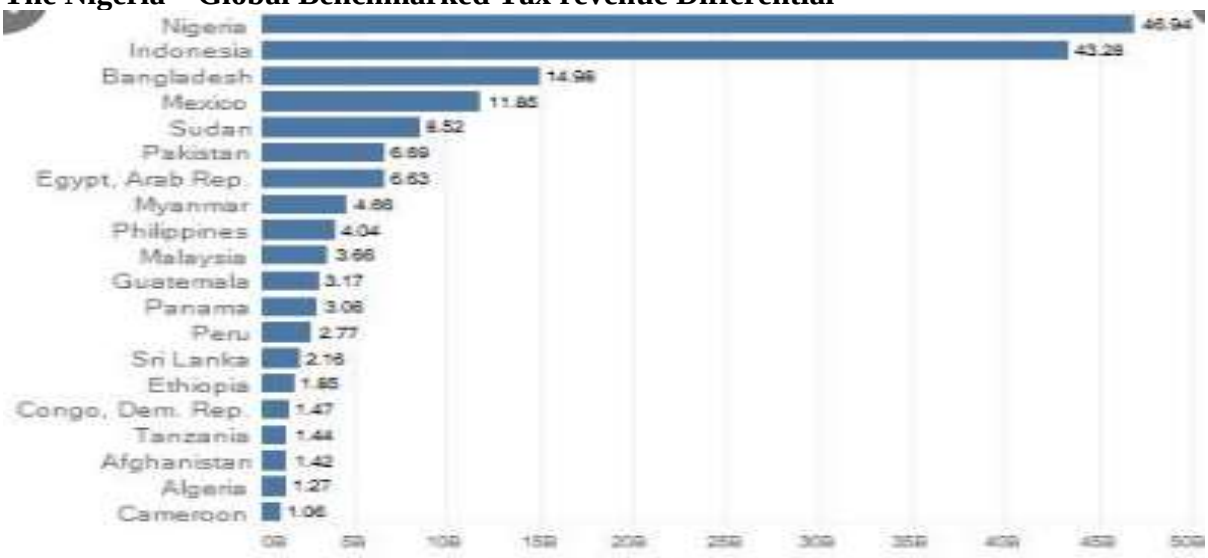
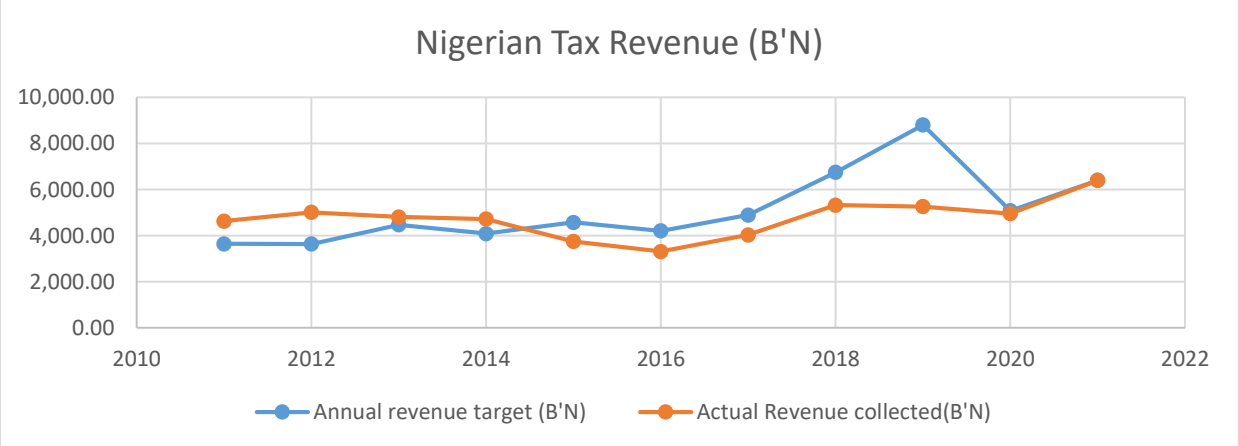


Fig.1.1: Tax Revenue Gap from Global Benchmark of 15% of GDP for Africa (USD Billions)

Source: World Bank group (2019); Nicholas Nam, Creator from tax review dataset, World Bank & IMF.

The result of Table 1.1 showed the tax revenue gap from global benchmarked of 15 percent of GDP in 2019. Specifically, Nigeria's tax differential with respect to global benchmark is *6.8 per cent. A significant decrease of about 8.2 per cent from global threshold, indicating the degree of infrastructure decay, economic contraction and poverty level in Nigeria. A further review of Nigerian revenue gap is showed in Table 1.1

Table 1.1 Graphical Analysis of Nigeria Tax Revenue Gap



Source: Authors Computation with FIRS[1] data (2022).

Tax is a crucial component of public revue sources meant to achieve economic growth and stabilize any economy. Unfortunately, most developing countries do not employ sound tax policies, and had limited their capacity to improving on revenue to GDP ratio (Opuala- Charles, 2019; Cihak, 2012). The total tax revenue target and the actual received by the highest tax authority In Nigeria for the period of 2010 to 2022, shows a wide positive and negative distortions in the trend lines. Evidence from data in Fig 1.1 showed that, the revenue target was not met from 2015 to 2020, showing a wide negative distortion in revenue collection. As it were, the annual revenue target of 8.8billion naira in 2019 was not achieved, given a realization of about 5.2billion, reflecting a revenue gap of 3.6billion in 2019. This figure is akin to the tax to gross domestic product ration in Nigeria. The tax-to-GDP ratio in Nigeria decreased by 0.3 percentage points from 6.3% in 2018 to 6.0% in 2019 OECDs (2021). Using a graphical illustration to show a comparative position of tax to GDP ratio of South Africa and Nigeria in same period, we present the following:

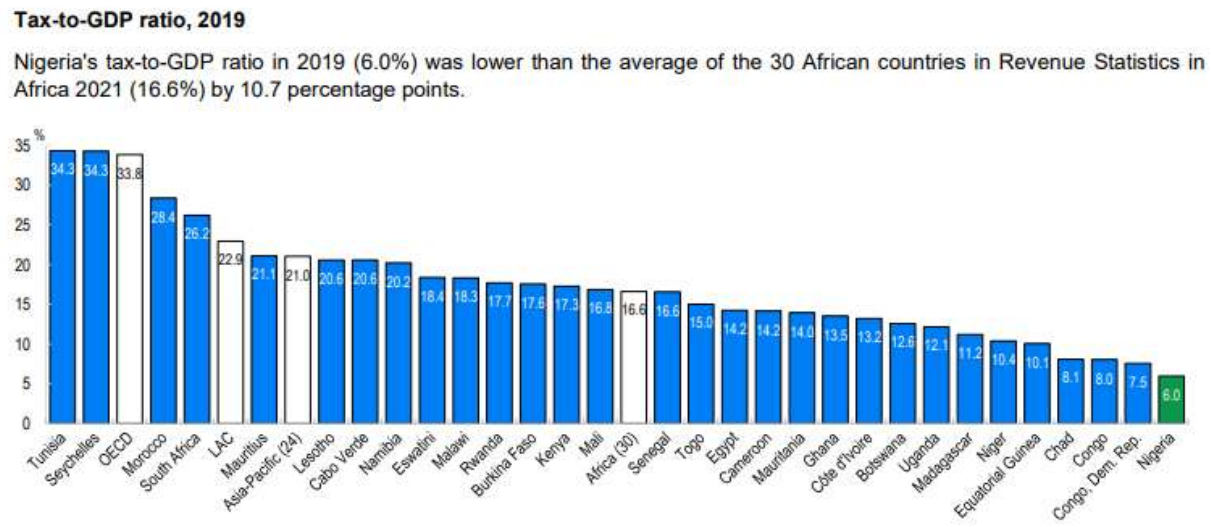


Fig 1.2 Graphical Comparison of South Africa and Nigeria Revenue Strength in 2019.
Source: OECDs (2022).

From Fig 1.2, the fifth bar represents South Africa's proportion of tax – GDP – ratio in 2019. The tax-to-GDP ratio in South Africa, although decreased by 0.4 percentage points from 26.6% in 2018 to 26.2% in 2019 yet, exceeded that of the most sub Saharan African countries including Nigeria. In comparison, the average South Africa's tax-to-GDP ratio in 2019 (26.2%) was higher than the average of the 30 African countries including Nigeria with a 6.0 per cent point OECDs (2022).

Whereas, within the purview of Latin American countries (LAC), Brazilian revenue performance showed a significant improvement within the same period. Evidence from a stylized fact revealed that the Brazil's tax-to-GDP ratio in in 2019 stood at 32.5 % but decreases by 0.9 % point to hit 31. 6 % in 2020 yet, was above the entire Latin American Countries average of 21.9% OECDs (2022). Having graphically represented the problem statement, this research shall be guided by the following Hypotheses stated in their null forms:

H_{01}: Utilization of mobile pay gateway does not statistically enhance public revenue collection in selected countries.

H_{02}: Adoption of web pay gateway does not statistically influence public revenue collection in selected countries.

It is against this backdrop, the research study seek to conduct a cross country survey to explain the influence of financial innovation and public revenue performance in BRICS countries, a case of Brazil and South Africa.

However, the emergence of this study type was meant to critically shift a focus from conventional study of private sector financial inclusion driven by innovative payment infrastructure to capturing the public revenue performance of emerging economies vis -a -vis Nigerian economy. In addition, the dearth of extant literature on this topical issues of global financial liberalization created an empirical need to shift attention from other related studies. Also, the global market place requires a common ground to exchange payment receipts of goods and services in its cheapest form; and the need for institutions to achieve these expectations to boosting public and private transfers of income and payments receipts across the globe led to the search for a robust explanation to why financial innovation is catalytic to countries revenue growth. Finally, a cross country survey of payment systems in South- South cooperation economies, BRICS, will be a fresh insight to global financial institutions, investors and researcher community.

Hence, the study is arranged in these order:-Introduction; Literature: revenue compositions of countries under study, Summary of financial innovation in focused countries; Methodology, and Results and discussion.

LITERATURE REVIEW

The review of pertinent issues that assist in the explanation of public revenue organic composition, financial innovation of emerging economies under review and empirical works form items of discourse.

2.1 Revenue Composition of Countries under Review: A stylized Fact.

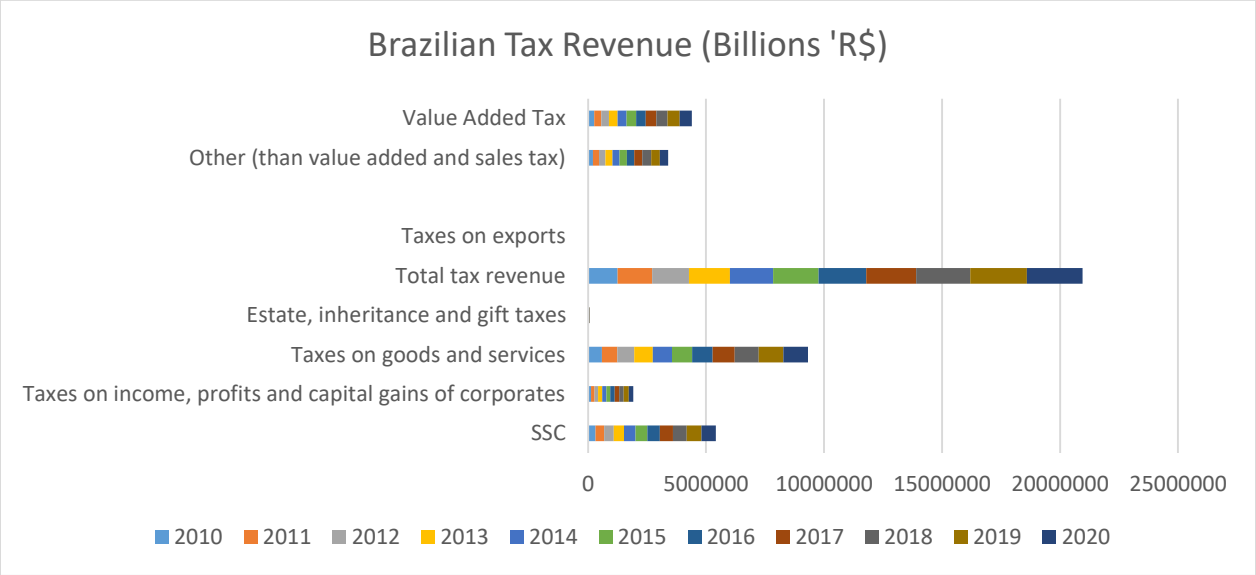


Fig. 2.1 Major Taxonomy of Brazilian Revenue Strength
Source: Authors Computation (2022) with OECDs data [(2) ;(**)]

The Brazilian [1]total tax revenue measured in national currency was valued at 2.35 billion BRL (456.664billionUSD) in 2020, a growth of about 29% in total tax revenue from 2.286BRL (443.486 billion USD) in 2018.In which about 1.038BRL was soured from goods and services in 2020 thereby, accounting for more than 44 % of total tax revenue accrued to Brazilian government. Also, about 611,542BRL from social security contribution accounts for about 26 % of total tax revenue in 2020.Whereas, 522,690BRL (about 22 %) came from value added tax. This significant revenue increase was a clear result of leverage on financial innovation. Given that Brazil is expected to increase GDP by 5.4billion dollars annually in 2025 in line with the record of about 147 million unique subscribers in 2019; clinching the position of the largest market in Latin America (GISMA ,2022; Bank of Brazil (2022). Whereas, Brazil and other BRICS members states adopted society for worldwide interbank financial telecommunication (SWIF) lunched HVPS[3] to facilitate intentional payments and bi lateral remittances. Nigeria payment systems is found wanting in the global scheme of adoption of [*]ISO 20022 high value payment systems .

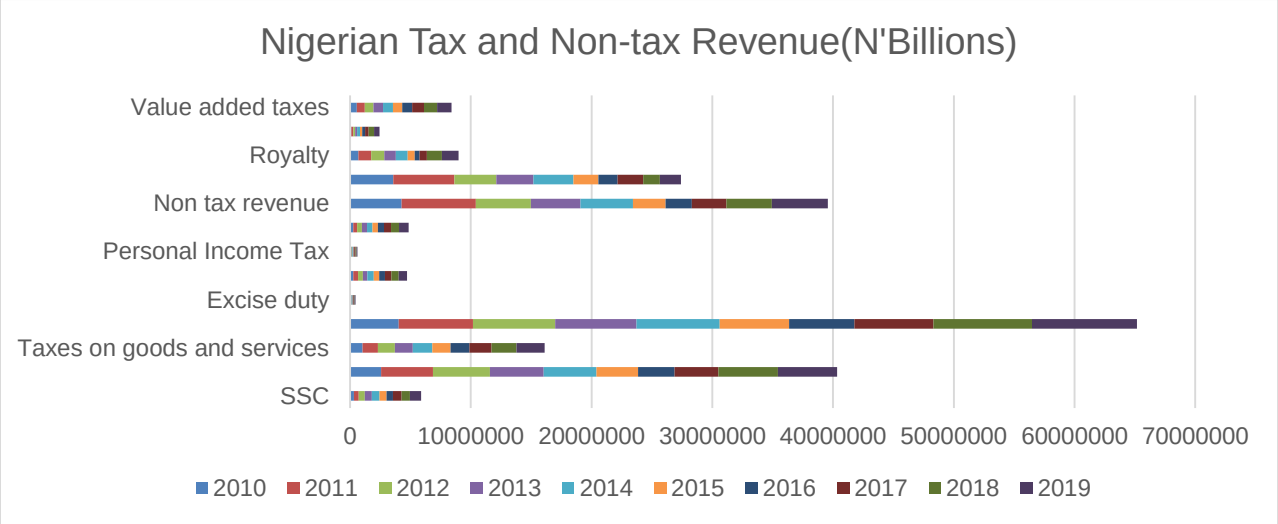


Fig 2.2 Tax Composition of Nigeria's Public Revenue
Source: Authors Computation (2022). Data extracted on 06 Sep 2022 10:47 UTC (GMT) from OECD.Stat

The Fig. 2.2 result showed that, large proportion of public revenue accrued to Nigeria are basically sourced from petroleum profit tax and non- oil taxes accounting for about over 50% of total revenue streams. Although, corporate income tax accounts for 46 % out of 8.679Trillion NGN (20.499 billion USD) collected as total tax revenue in 2019. Other revenue sources account for the remaining fraction. Comparatively, Nigerian tax base has unexplored area to leverage on other than oil and non-oil revenue sources

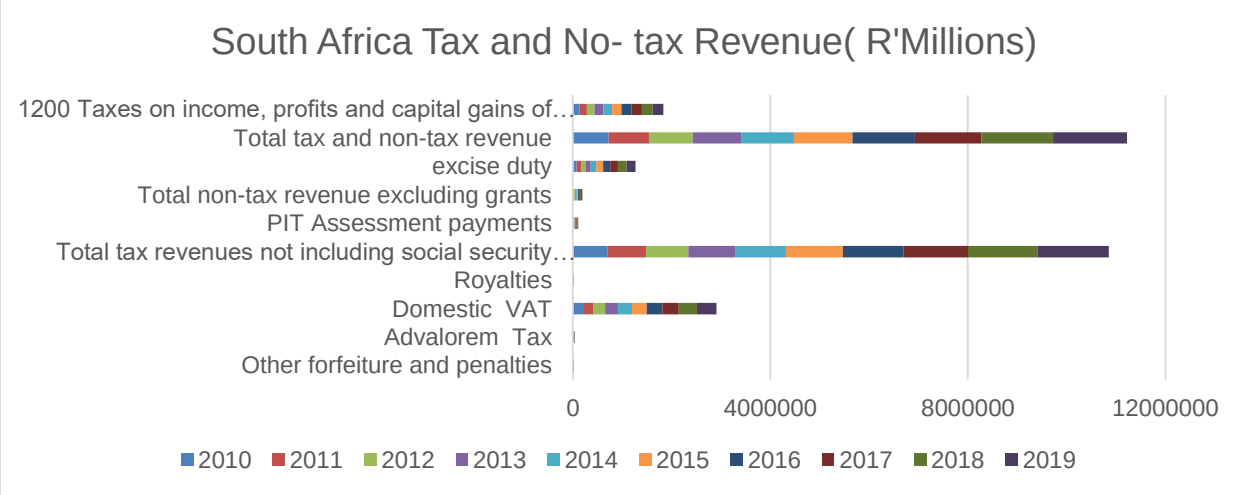


Fig 2.3 Graphical analysis of South Africa Revenue Composition
Source: Authors Computation (2022). Data extracted on 06 Sep 2022 11:55 UTC (GMT) from OECD.Stat

The result of Fig 2.3 showed that various revenue sources in South Africa. A total generated revenue of about 1.498, 287.464 ZAR (87,649.82 billion USD) in 2019 comprises of total tax revenue of 1.449, 093.189ZAR, representing about 96 % of totally generated revenue in 2019.
In sum, the tax revenue composition of BRICS member countries under review is significantly large compared to that of Nigeria.

Summary of Financial Innovation in Focused Countries.
Innovations and how they are changing the world around us are prompting governments to reconsider how they can use digital payment services to better serve their citizens. The effort by monetary authority in Nigeria to promote sound financial inclusion and income generation created the need for payment systems vision 2020 (PSV). As part of the effort to see innovative finance gain greater height, the earliest financial technology organizations emerged, namely – E tranzact, Sysytemspecs and Interswitch. These unicorns operated in Nigeria financial technologies space facilitating electronic payments gateway. 'E-tranzact' was the first unicorn to carve a niche with government agencies that were collecting revenue, such as the Lagos Water Corporation and most Nigerian tertiary education institution. It had over 70 universities utilizing its platform to process tuition and other payments by students Effiong and Edet (2020).

In a similar fashion, Systemspecs launched 'Remita' in 2005 but, currently it had beaten other players to win the treasury single account (TSA) contract of federal government of Nigeria. The presence of Fintechs in Nigeria financial market has led diversification of payments and switching operations, as well as the dominance of mobile banking used for public revenue mobilization and subsequent collection. It is against the backdrop of internet failures, high cost of service fees and lack of adequate regulatory sandboxes to drive financial technology that led to the growth of competitive environment, creating room for growth of unicorns such as Cowrywise, PiggyVest, Mines.io, Paga, Kudi, Paystack, Wallets Africa, and Flutterwave etcetera. Recently, MTN* launches its first telco, its mobile payment platform, in response to **CBN's Payment Service Bank Regulation, 2018.

In spite the growth of number of payment gateways through banking and non-banking financial technology firms, some of the payment systems channel in Nigeria has been tainted by duality operations of State Internal Revenue Service's handling large volumes of cash transactions while using a few electronic-based channels, particularly in handling transactions involving tax collection Eze et al (2018). The heavy presence of Fintechs in Nigeria has not yet yielded the expected benefit in terms of digital tax collection. The digital tax debate has also featured discussions around how African governments can derive revenue from big multinational companies such as Facebook which are domiciled abroad but have a significant number of users on the continent Evelyn in Jacob (2021).

African countries have expanded the scope of their indirect taxes to cover digital services, but only a few have thus far implemented some form of direct digital services tax that applies to non-residents with no physical presence in their respective countries, Deloite (2020). It essential to note

that, social media platform generates about 98% of its revenue from advertising, only about 8-9% of that revenue comes from emerging economies in Africa ,Monye (2019). Yet, the Nigeria public revenue generation, collection and external fund remittance is found wanting within the digital tax space. In addition to the challenges faced in revenue collection in Nigeria by digital platforms, there is no public institution owned payment gateways other than saving the role of regulators to Fintechs. In the other climes, South African Reserve Bank (SARB) operates its own real time gross Settlement systems known as SAMOS[1]. Each settlement participant has an account with the SARB from which interbank settlement obligations are settled. Participants must provide enough funds to ensure that the settlement system functions smoothly. Settlement in SAMOS is considered final and irrevocable SARB (2022).This robust domestic payment platform accepts transaction from foreign owned banks and its correspondent bank outside South Africa. Brazilian public revenue mobilization is not a left over as the Banco du Brazil launched an innovative instant payment platform called "pix"[8], with the aim to attracting big tech players such as Google and Facebook to boost revenue collection especially value added taxes through digital platforms McGreever et al (2022).

Financial Technology Environment

Global financial innovation largely revolves around the critical stakeholders within the financial technologies ecosystem. Essentially, for effective implementation of revenue generation, collection and transfer from payers to payee, there be need to have a sound cooperation amongst participants in the financial market, government revenue collection agency and private sector. Government functions as both regulators and enablers of financial innovation who provides regulatory sandboxes for Fin techs to partner with financial institutions as well as provide enabling environment for investors to thrive. Then, the participants within the financial ecosystems are levied, and such levies are collected through a sound payment system gateway in form of tax revenue accrual to government.

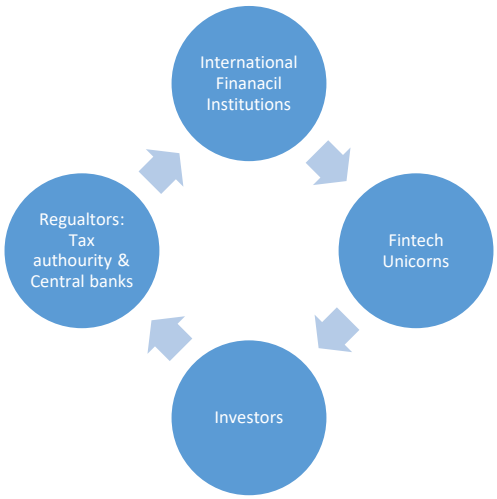


Fig. 2.2 Agents of Financial innovation and Revenue Cycle
Source: Authors Formation (2022).

THEORETICAL REVIEW

Disruptive Innovation Theory

The quick emergence of creative methods of handing financial services using modern integrated devices to facilitate financial transactions in an efficient manner was the ideal ingenuity of financial technology firms. Essentially, the term was attributed to Clayton Christensen (1997);as encapsulated in the study by Thompson and MacMillan (2010) , who referred Clayton as having described innovation theory as the gradually but unanticipated quick takeover of a product or services that was initial at the bottom of the market pyramid. Clayton's description is akin to the application of big data, artificial intelligence and analytics that has enabled banks and government revenue institutions to collate historical data relating to tax payers, track transactions and record outputs. The technology of storage of historical data stands as inflection point for upturning the traditional technique of revenue collection and financial transactions in banks. Technologies act as innovation catalyst within the banking and financial services sector. Traditional banks and financial services are under increasing competition from global IT companies such as Google, Apple, Amazon and PayPal whilst facing pressure from investors to reduce costs, increase soundness and improve stakeholders' satisfaction Chen (2018). Technologies such as blockchain, cloud computing, mobile technologies, big data analytics and social media therefore have more potential to mobilize revenue and re distribute funds within financial industry and government institutions Theo Lynn et al (2020).

Schumpeter Theory of Innovation

The character of entrepreneur to find a new kingdom birthed the creative thought to fashion out new processes, methods and fine turn the existing arrangement to reign over his environment. This axiomatic expression captures Joseph Schumpeter (1989) theory of innovation as explained in Diamond (2009) empirical study. Peter's innovation thinking emanated from the concept of creative destruction. In his view, entrepreneur venture and quest to find a new ground led to replacing old methods and structures with newly created and better processes or methods. Judging the within the purview of Peter's innovation standpoint, innovation cannot said to be complete without commercialization. Therefore, innovation could inferred to represent creativity and delivery Opuala-Charles (2021).

Theory of Convergence.

Convergence theory is essential for comparison of one country productive strength, per capita income and the gamut of economic activities. It follows that, the theory specifically examined cross country level of convergence and growth rate of income per capita as implied by the neo-classical growth model: the Solow-Swan and Rampsey-Cass-Koopmans versions Capolupo (1998).The neo classical thought of possibility of underdeveloped economies' ability to catch up with developed counterpart in terms of per capita income comes under these assumptions - law of diminishing marginal returns which is said to play a major role due to the unstable nature of investment capital in rich countries, causing returns on investment to decline in the long run. Whereas, the poor countries level of investment which is usually low and stable, will eventually

picked and catch up with that of the capital rich nations in the longer term Abramovitz (1986). Also, the maxim that under developed economies can easily replicate, copy and learn the technic of production, processes, and institutions of developed countries makes them stand on the vantage position to catch up with pace of per capita income level. This catch up effect is accentuated by access to the developed markets and ability to utilized social capability of the poor nations to advance revenue as well as per capita income. Sala-i-Martin (1990) explained conditional convergence to mean, when poor countries grow rapidly to catch up with rich ones. Implicitly, all the economies should converge to the same income per-capita. Whereas, Cass-Koopmans hypothesis advocates for conditional convergence for countries in a steady state.

$$Y\,(t) = [K\,(t)^{\alpha}\,, A(t)L\,(t)^{1-\alpha}\,] \qquad 0 < \alpha < 1 \qquad (2.1)$$

Where, Y (t) is aggregate output, K (t) and L (t) is capital-labour inputs, α and 1- α is income elasticity of capital and labour respectively, A (t) is state of technology or financial innovation. However, economy can grow per capita income faster from initial steady state to catch up with advanced economies if there exist similar technological innovation. This is proven by Cass - Koopman's log linear model of average rate of per capita output

$$\frac{1}{T}\ \frac{\log[y(t0+T)]}{y(t0)} = g + \frac{[(1-e^{\beta T})]}{T} \times \frac{\log y}{y(t0)} \qquad (2.2)$$

Where β in (2.2) is the decreasing returns to factor inputs, g is rate of technical progress (financial innovation growth rate), log (t_0) is initial steady state, T is the advanced steady state of improved per capita income, and log(y) is growth rate of national income. Hence, Cass Koopman postulated growth rate of national income is same with rate of technical progress. Thereby closing the gap between initial steady state value and income level. By implication, countries with similar technological innovation could easily converged in terms of per capita output far more than its initial steady state.

Keynesian Taxation Theory

The effective result of government intervention in periods of economic downturn underlines the critical role played by government in its stabilization function Musgrave and Musgrave (1989). It is in line with this thought the theory on taxation was developed by British economist John Maynard Keynes (1883-1946) in the 1940s. John Keynes advocated the important function of government in the macroeconomic stability especially during recession. According to Keynes, critical macroeconomic fundamentals such as interest rate, taxation and social programs should be closely monitored by government CFI (2021). Specifically, Keynes advises government to employ tax tool to regulate the aggregate demand and aggregate supply accordingly Russo (1991). During recession, tax revenue should decrease to incentivized consumption spending and boost aggregate demand while the opposite effect should apply during boom. Taxation is a major revenue medium of government aimed at achieving major development prospects, although, (Michael 1999) in his empirical study argue that developing countries rate of economic development is largely dependent on its level of taxation but countries with lower marginal tax rates have higher economic growth.

Empirical Review

Okello Candiya Bongomin et al (2020) employed tax exemption as a moderator to empirically explain the relationship between mobile money adoption and usage and financial inclusion in Uganda. The instrument of questionnaire were used to collate samples and estimated with partial least squares techniques. The findings revealed that, tax exemptions on mobile money transfers exact significant and positive impact engendering financial inclusion in Uganda. As this tax waver will stimulate mobile transfer activities by the unbanked public. In a similar study within the sub-Saharan African context, Daniel et al (2022) empirically queried whether financial inclusion arts as a mediator between financial innovation and economic growth in 26 six selected sub Saharan African countries. The technique of generalized method of moment (GMM) was applied to show that financial innovation indeed mediates with economic growth in the selected African countries. Graziela, et a; (2019) researched on the role of Brazilian development bank in financing innovation. Although no notable methodology was employed rather a simple survey was conducted to show trends of Brazilian development bank financial strength to supporting innovation.

METHODOLOGY

The study incorporates the cross country panel design aimed at critical understanding of the heterogeneity as well as specific influences in each of the countries under study. According to the prescription of Gujarati and Porter (2009), the ideal usability of this method is in its inherent quality of provision of informative data, more degree of freedom which lessen collinearity and ensure efficiency. Data for panel estimation was drawn from organization for economic cooperation and developments (OECDs) statistical bulletin, Banco du Brazil bulletin, Bank for international settlements (BIS) and central bank of Nigeria bulletin. The adoption of panel technique follows the formation of Chamberlain (1984)[1], who confirmed that, panel data was suited for the study of dynamics of change, and "can better detect and measure effects that simply cannot be observed in pure cross-section or pure time series data". Panel techniques as described by Gujarati and Porter (2009) will form the frame work guiding functional relationships.

Model Specification

Revenue = f (Cashless mobile pay, transaction volume of electronic payments, volume of web pay users) (3.1)

By transformation of equation (3.1) to standardized form subjecting it to natural logarithms, it yields (3.2) as:

$LREV_{it} = \alpha_{it} + \beta_1 LCMP_{it} + \beta_2 LEPV_{it} + \beta_3 LWPU_{it} + \varepsilon_{it}$ (3.2)

A priori expectation: $\beta_1 > 0$; $\beta_2 > 0$; $\beta_3 > 0$

Where, β_1 to β_3 = parameters, α_{it} ; ϵ_{it} = intercept terms and idiosyncratic term for cross sectional and time series units. L = natural logarithms notation.

1. Pooled least square equation

$$\gamma_{it} = \alpha + \beta_{it}^{1} + \varepsilon_{it} \quad (3.3)$$

For ith = 1, 2, 3…N and t = 1, 2 …10th

Where, i= cross sectional unit of observed individual countries, t= time series of unit.

2. Fixed effect equation

$$\gamma_{it} = \alpha_{it} + \beta_{it}^{1} \chi_{it} + \varepsilon_{it} \quad (3.4)$$

3. Random effect equation

$$\gamma_{it} = \alpha + \beta_{it}^{1} \chi_{it} + \mu_i + \varepsilon_{it} \quad (3.5)$$

Where μ_i measures the heterogeneity across the countries; and ε_{it} is the composite error term consisting of cross section and time series. Equation (3.3) pooled the 33 observations neglecting the time series and cross sectional components to allow for grand regression estimates. The results may not obviously show individual countries uniqueness in relation to another rather, it subsumed in error term (μ_{it}). While it may not be strictly exogenous, equation (3.4) fixed for cross country intercepts with the assumption of error tern followed normal distribution $\mu_{it} \sim$ iid(0, σ_t^2) Equation (3.5) assumed the mean value of intercepts is same across the three (3) countries, and heterogeneity is captured as error term[9].The classical assumption of uncorrelated error terms with regressors is shown to ascertain model appropriateness using Husman test. In Husman's application, correlation of cross sectional error term assumed homoscedastic[8]:

$$\in= (\varepsilon_{it}) = 0 \quad (3.6)$$

$$var\ (\varepsilon_{it}) = \sigma_t^2 + \sigma_t^2 \quad (3.7)$$

$$\rho = Corr\ (\varepsilon_{it}\ ;\ t_{is}) = \frac{\sigma_t^2}{\sigma_t^2 + \sigma_t^2} \quad t \neq s \quad (3.8)$$

RESULTS AND DISCUSSION

The section presents a summary descriptive analysis of variables in the model, test to the existence of multi collinearity. The pre diagnostic tests was employed to ensure appropriate estimate result is used for testing the hypotheses in section 1.

Table 4.1 Summary Descriptive Statistics

	LREV	LCMP	LEPV	LWPU
Mean	7.552168	8.611782	3.507091	4.600970
Median	7.391422	9.298901	3.708927	4.709530
Maximum	8.579396	10.71442	4.489310	4.969813
Minimum	6.539473	0.000000	0.000000	3.828641
Std. Dev.	0.638795	2.427448	1.102831	0.344306
Skewness	0.361144	-2.723902	-1.911101	-1.231103
Kurtosis	1.774182	10.30478	6.855437	3.281319
Jarque-Bera	2.783452	114.1778	40.52622	8.444692
Probability	0.248646	0.000000	0.000000	0.014664
Sum	249.2216	284.1888	115.7340	151.8320
Sum Sq. Dev.	13.05787	188.5601	38.91959	3.793493
Observations	33	33	33	33

Source: Authors' Computation (2022).

The summary descriptive statistic in Table 4.1 revealed the average values of web pay users (LWPU) and volume of electronic payments (LEPV) jointly accounted for a lesser value compared to cashless mobile pay (LCMP) which accounted to about 8.61.Whereas, the mean value of total revenue (LREV) yielded 7.55.Hence, the degree of departure from the mean values of individual variables statistically converged within the expected threshold. This is evident from the measures of asymmetry (skewness) which showed that explanatory variables of LCMP, LEPV and LWPU lies on the left side of the curve while, the LREV value is positively skewed. Also, Jacque – Bera probability yielded a mixed results for rejecting the null hypothesis of normality.

Table 4.2 Multi collinearity Test

	LREV	LCMP	LEPV	LWPU
LREV	1			
LCMP	-0.1875404	1		
LEPV	-0.5439941	0.65278330	1	
LWPU	-0.6001123	0.574374246	0.71218629	1

Source: Authors' Computation (2022).

The result of Table 4.2 revealed that, the coefficients of dependent and independent variables in the payoff table are all below 80 per cent. Representing a strong indication of no multi collinearity amongst the explanatory variables. A further review of absence of multi collinearity is shown by **the variance inflation factor in Table 4.3.**

Table 4.3 Variance Inflation Factor Test

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
C	0.608596	494.5588	NA
LCMP	0.001247	79.54802	4.392485
LEPV	0.006183	65.34760	3.552751
LWP	0.036758	634.0067	1.690479

Source: Authors' Computation (2022).

The output of Table 4.3 (centered VIF) revealed that all the explanatory variables are below 5.0, the necessary condition for test of induced multi collinearity.

Table 4.4 Redundancy Test

The likelihood test is used to determine the most suitable model between Constant Effect (CE) and Fixed Effect model. Hence, it follows the following null hypotheses:

$H_0 = Constant\ Effect\ is\ more\ appriorate\ model$

$H_1 = Fixed\ Effect\ model\ is\ appriorate$

Effects Test	Statistic	d.f.	Prob.
Cross-section F	71.437894	(2,27)	0.0000
Cross-section Chi-square	60.694611	2	0.0000

Source: Authors' Computation (2022).

Decision rule: Reject H_0 if cross – section Chi-square (prob.) is < 0.05 otherwise, do not reject. From the results of Table 4.4, the prob. value (0.000) of cross- section Chi-square is less than conventional 5 per cent level of significance, we reject H_0 and accept the H_1 at 5 per cent sig., level.

Hausman Test

This is statistical test to select whether random effect (RE) or fixed effect (FE) is most appropriate in estimating parameters of our panel data. The basis for acceptance of suitable model follows similar hypothesis as stated in Table 4.3., except the H_0 hypothesis which states that random effect (RE) model is appropriate, as against the H_1 hypothesis which prefers fixed effect (FE) model as a suitable model. Therefore, from the results of Table 4.4 showed, the probability value of cross-section random (0.98) is greater than (0.05) conventional threshold. Thereby, not rejecting H_0 hypothesis that random effect model is suitable for estimating the parameters of panel data.

Table 4.4 The Hausman Test of cross-section random effects.

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	0.129151	3	0.9881

Source: Authors' Computation (2022).

With the recommendation of Hausman Test, we can proceed to estimate the coefficients of random effect in order to jointly test our hypotheses along the country's heterogeneity both observed and unobserved. "In a random effects model, the unobserved variables are assumed to be uncorrelated with (or, more strongly, statistically independent of) all the observed variables" Koutsoyiannis (1977). Hence, employing random effect capture the effect of time invariant heterogeneity such as different regulatory environment for tax collection, provision of Fintech sandboxes, institutional quality, degree of trade openness and developed market.

Results of Regression Analysis

Dependent Variable: LREV
Method: Panel EGLS (Cross-section random effects)
Wallace and Hussain estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	6.508146	0.858320	7.582424	0.0000
LCMP	0.037721	0.032886	1.147015	0.2608
LEPV	-0.089264	0.073306	-1.217682	0.2332
LWP	0.224351	0.179275	1.251433	0.2208
	Effects Specification			
			S.D.	Rho
Cross-section random			0.784376	0.9450
Idiosyncratic random			0.189170	0.0550
R-squared	0.916031	Mean dependent var		7.552168
Adjusted R-squared	0.900482	S.D. dependent var		0.638795
F-statistic	58.90978	Durbin-Watson stat		0.558793
Prob(F-statistic)	0.000000			

Source: Authors' Computation (2022).

Joint Hypotheses Testing:

$\boldsymbol{H_0 : \varphi_1 = \varphi_2 = 0}$

$Where: \varphi_1 =$ *Mobile pay does not enhance public revenue collection in selected countries.*

φ_2 $= Web\ pay\ gateway\ does\ not\ impact\ public\ revenue\ collection\ in\ selected\ countries.$

The result of random effect showed the core indicators for measuring country specific time invariant factors. Which include observed factors (cashless mobile pay, volume of transaction with electronic payment, and volume of web pay users), and unobserved factors (different country's regulatory environment for tax collection, leadership quality, and institutional quality).According to the report of Table 4.5, the value of Rho of 0.94 implied that, total variation in different countries under study with respect to observed heterogeneity accounts for about 94 per cent, on average, leaving about 6 per cent to unobserved country – specific factors. In order words, total variation in country's specific characteristics that enhances revenue mobilization and collection accounted for a fraction of about 6 per cent while, factors common to the selected countries under study explained about 94 per cent to revenue growth performance.

In that regard, cashless mobile payment increases revenue collection by about 04 per cent, on average, due to a unit increase in the volume of transactions using cashless mobile payment in selected countries. All other things been equal. The value of coefficient of cashless mobile payment conformed to a priori expectation, and it is evident by the extent of revenue growth of emerging

economies which uses diverse Fintech innovative cashless infrastructure to mobilized and collect public revenue from tax and non-tax sources as there accrued. Whereas, public revenue performance declined by about 08 per cent, on average, owing to a shift is electronic payment system generally. In countries under study, inadequate internet network connection such as the use of bandwidth below 5G, lack of adequate and reliable payment infrastructure , security issues, as well as lack of sufficient knowledge of internet by the user public have had significant negative impact on public revenue generation. In the same vein, public revenue uptick reached about 22 per cent, on average, as a result of increase in the volume of application of web payment gateways in countries under review.

Above all, the test of hypotheses to ascertain whether or not explanatory variables jointly impact revenue collection in selected countries. Given the result of Table 4.5, the probability of F-statistic (0.0000) is lower than conventional 0.05 threshold. We reject the H_0 , and accept the alternative that the explanatory variables of our model exhibit a joint statistically impact on public revenue collection I selected countries within the review period.

CONCLUSION AND POLICY RECOMMENDATION

The major aim of this study is to empirically evaluate techniques of improving public revenue in some selected emerging economics through leveraging on financial innovation. A cross country study of three (3) sovereign states: Brazil, South Africa and Nigeria were brought to the fore using panel data analytical method, and the output of findings suggest amongst other things as follows: The positive significant relationship exist between public revenue growth and the cashless mobile payment system. This is accentuated by the growth of internet awareness as well as the speed at which government institutions accept the modern technological sweep to enhancing public revenue growth path. In the light of this development, public revenue can increase by more than 4 per cent per annum as a results of increase liberalization of internet technology to public revenue growth. Specifically, electronic payment systems has had it fair share of challenges across countries especially emerging economies wherein, it was identified to have lags in interoperability and interconnectivity of networks, non-transparent pricing and lack of consumer confidence in the safety, reliability and security of e payment systems. With these established challenges, public revenue plummeted across country by a significant proportion of 8 per cent, on average. While, Brazil and South Africa had taken bold steps to curb technical hitches through effective strategies of regulatory and administrative mechanism to abate e payment distrust via introduction of ‘Pix’ and South African multiple option settlement system (SAMOS) respectively. Whereas, Nigeria is grappling with sound policy framework to liberalized Fintech activities, and the adoption renewed real time gross settlement (RTGS) still limit users of enough master cards and euro pay for international transactions.

Whereas, the use of web pay contributed significant to growth of public revenue by over 22 per cent. The global adoption of Fintech payment infrastructures increases the acceptability of web payment systems due to strong confidence and less risky nature of it. Hence, the use of e wallets

and easy to create account reposed significant trust level to public and private institutions to transact with.

From the above conclusion, the study makes the following recommendations;

- The Federal Inland Revenue Service, Nigerian Custom Service, Nigerian National Petroleum Company Limited, and other revenue generating agencies should develop Secured – User friendly Apps to facilitate electronic revenue collection and transmission.
- Governments of selected countries should implement sound digital economic policies to ensure ease of revenue collection
- Central bank of Nigeria should develop state-owned payment system that is secured, efficient and reliable so as to restore public confidence in the use of electronic payment systems.
- There should be institutional collaboration amongst public revenue generating agencies, financial technology firms and central banks of Nigeria so as to develop a functional road map to broaden revenue sources and dimension.
- Nigerian government should work to increase tax and non-tax revenue in order to defray their debt stock, a necessary condition for membership of BRICS countries.
- Nigerian government should implement import - substitution strategy through partnership with foreign firms to domesticate their plant in Nigeria so as to allow for technical transfer and development of local skills.
- Government should create a Federal ministry saddled with responsibility of managing Nigerian non-oil exports.
- Brazil and South Africa should enhance their country technical capacity to streamline electronic payment systems in order to competitively confront declined revenue stream from electronic sources compare to the industrialized economies.

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