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Digital Accounting Reform, Structural Instability, and Corruption Dynamics in Nigeria: A Robust Empirical Analysis

Olaniyan Joseph Olawale[1] & Obabire Akinleye Alaba[2]
[1]Federal Polytechnic Ile-Oluji, Ondo State, Nigeria
[2]Federal Polytechnic Orogun, Delta State, Nigeria
josolaniyan@fedpolel.edu.ng

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Abstract

Digital transformation has become central to Nigeria's public financial management reforms through initiatives such as the Treasury Single Account (TSA), Government Integrated Financial Management Information System (GIFMIS), and electronic procurement platforms. However, empirical evidence regarding their effectiveness in improving transparency and reducing corruption remains methodologically limited. This study integrates institution-level non-parametric analysis with macro-level structural-break modeling to evaluate whether digital accounting reforms were associated with changes in transparency and corruption dynamics in Nigeria from 2001 to 2023. Institutional data from 20 federal agencies were analyzed using Wilcoxon signed-rank tests. Annual national time-series data on the Corruption Perceptions Index and other governance indicators were examined using regression models incorporating Chow and Bai–Perron structural-break tests, heteroskedasticity-consistent standard errors, quantile regression, and bootstrap inference. The findings reveal statistically significant post-2015 improvements in transparency and audit compliance, accompanied by reductions in financial irregularities. Structural-break analysis identified a significant regime shift temporally aligned with the implementation of the TSA and GIFMIS reforms. Robustness analyses involving alternative break dates, recursive stability tests, bootstrap inference, and quantile regression supported the consistency of these results. The findings indicate that digital accounting reforms were associated with meaningful changes

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in Nigeria's corruption trajectory. This study contributes a robust empirical framework for evaluating governance reforms and demonstrates the value of combining distribution-free and break-adjusted methods in public financial management research.

Keywords: Corruption Dynamics; Digital Accounting Reform; Public Financial Management; Structural Break Analysis; Treasury Single Account

INTRODUCTION

Corruption continues to represent a fundamental impediment to economic performance and institutional effectiveness in Nigeria, with far-reaching consequences for fiscal discipline, public resource allocation, and governance credibility (Aidt, 2016; Klitgaard, 1988). Despite the proliferation of anti-corruption frameworks and oversight institutions, persistent weaknesses in public financial management systems have sustained avenues for leakages, misappropriation, and limited accountability (Okonjo-Iweala, 2018; IMF, 2022). This persistent divergence between formal institutional arrangements and observed governance outcomes underscores the necessity for structurally grounded and system-wide reforms in financial administration.

In response to these challenges, the Federal Government of Nigeria implemented a series of digital accounting and public financial management reforms beginning in the mid-2010s. These reforms were designed to enhance transparency, improve fiscal control, and curtail corruption risks through the deployment of information and communication technologies (OECD, 2019; UNDP, 2021). A central pillar of this transformation is the Treasury Single Account (TSA), introduced in 2015, which consolidated government revenues into a unified structure to reduce fragmentation and improve oversight (Federal Ministry of Finance, 2015–2016; Olaoye & Adebayo, 2021). Complementary initiatives, including the Government Integrated Financial Management Information System (GIFMIS) and the expansion of electronic procurement platforms, introduced automation, real-time monitoring, and process integration across budgeting, payments, and procurement functions (Heeks, 2006; Bertot et al., 2010). Collectively, these reforms signify a transition from fragmented, opaque financial practices to integrated, technology-enabled governance systems.

Notwithstanding the policy relevance of these reforms, empirical evidence on their effectiveness remains limited, fragmented, and methodologically constrained (Andersen et al., 2020; Zhao & Patten, 2016). A substantial proportion of existing studies relies on conventional parametric econometric approaches that may inadequately account for the statistical properties of governance-related data, which are often characterized by non-normality, outliers, and structural discontinuities associated with major policy interventions (Bai & Perron, 2003; Okonjo-Iweala, 2018). Such limitations raise concerns regarding the robustness and validity of empirical inferences in this domain.

Moreover, institutional reforms of this magnitude are unlikely to yield linear or incremental outcomes. Rather, they are more plausibly associated with discrete structural shifts in governance dynamics, particularly where they fundamentally alter monitoring, enforcement, and financial control mechanisms (North, 1990; Acemoglu & Robinson, 2019). This highlights the importance of adopting analytical frameworks capable of detecting regime changes and capturing heterogeneous effects across institutional and macroeconomic dimensions.

Against this backdrop, this study advances a multidisciplinary and methodologically robust evaluation of Nigeria's digital accounting reforms. It integrates micro-level institutional analysis with macro-level time-series techniques to provide a comprehensive assessment of reform outcomes. Specifically, non-parametric methods are employed to examine changes in institutional transparency, audit compliance, and financial irregularities across federal agencies, while structural break models are applied to identify shifts in national corruption dynamics (Bai & Perron, 2003; Chow, 1960). This integrative approach enables a more nuanced and reliable understanding of the governance implications of digital transformation.

The study is guided by three core research questions: (i) whether digital accounting reforms have produced measurable improvements in institutional transparency and audit compliance; (ii) whether the implementation of these reforms, particularly the 2015 TSA, corresponds to a structural break in national corruption indicators; and (iii) whether the estimated effects remain robust across alternative model specifications and estimation techniques. By addressing these questions, the study contributes to both the empirical and methodological literature on governance and public sector reform, offering evidence-based

insights into the role of digital transformation in shaping corruption trajectories in developing economies (Andersen et al., 2020; Nam, 2018).

Theoretically, the study is anchored in the principal–agent framework, which conceptualizes corruption as a consequence of information asymmetry and discretionary authority. Reducing opacity in public financial processes, as argued by Klitgaard (1988) and Heeks (2006), constrains opportunities for rent-seeking by aligning the incentives of public officials with broader societal objectives. Digital governance systems such as integrated financial management platforms and e-procurement frameworks enhance transparency, improve traceability, and strengthen monitoring mechanisms, thereby mitigating agency problems.

Empirical literature further supports the efficacy of digital governance reforms. Studies by Bertot et al. (2010) and Andersen et al. (2020) demonstrate that the adoption of digital technologies in public administration improves transparency, strengthens audit outcomes, and reduces financial irregularities. From an institutional economics perspective, such reforms are transformative rather than incremental. North (1990) posits that institutional change redefines the "rules of the game," while Acemoglu and Robinson (2019) emphasize that durable governance improvements arise from reforms that enhance enforcement and reduce extractive practices. In this regard, digital accounting initiatives such as TSA and GIFMIS can be conceptualized as structural interventions with the potential to induce regime shifts in corruption dynamics.

Although recent studies (e.g., Nam, 2018; Zhao & Patten, 2016; Olaoye & Adebayo, 2021) provide supportive evidence on the governance benefits of digital reforms, methodological challenges remain prominent. Many analyses continue to rely on parametric techniques that impose restrictive assumptions regarding data distribution and parameter stability. However, governance data in developing contexts frequently violate these assumptions, necessitating the adoption of more flexible and robust analytical approaches. As emphasized by Bai and Perron (2003), failure to account for structural breaks may result in biased and inconsistent estimates.

Accordingly, this study addresses these gaps by integrating non-parametric institutional analysis with structural break modeling, thereby offering a more rigorous and multidisciplinary framework for evaluating the impact of digital accounting reforms in

Nigeria. This approach not only enhances empirical reliability but also contributes to methodological advancement in the study of governance and public financial management.

METHODS

Data and Institutional Context

This study adopts a mixed empirical framework combining micro-level institutional data with macro-level time-series data spanning 2001–2023. Institutional data were obtained from twenty federal ministries, departments, and agencies implementing digital financial systems, including the Treasury Single Account (TSA), GIFMIS, and e-procurement platforms. Key variables include institutional transparency scores, audit compliance scores, and reported financial irregularities.

These data were sourced from the Office of the Accountant-General of the Federation (OAGF), Federal Ministry of Finance reports, and Nigeria Extractive Industries Transparency Initiative (NEITI) disclosures, ensuring data reliability through triangulation.

At the macro level, annual data include:

- Corruption Perception Index (CPI) (Transparency International, 2022)
- Digital governance indicators (UNDP, 2021; OECD, 2019)
- Macroeconomic controls (World Bank, 2023; CBN, 2023)

The 2015 TSA/GIFMIS implementation is treated as the primary structural break.

Micro-Level Institutional Analysis

Given the non-normality of institutional data (confirmed using Shapiro–Wilk tests), the **Wilcoxon signed-rank test** is employed.

To evaluate institutional changes before and after digital accounting reforms, with the **Wilcoxon signed-rank test**. Let $X^{pre}{}_i$ and $X^{post}{}_i$ denote the observed institutional scores for agency i, where i = 1,2,3,…, n and n = 20.

The paired differences are defined as:

$$D_i = Xi^{post} - Xi^{pre}.$$

Observations with Di = 0 are excluded. The absolute differences |Di| are ranked and signs are assigned accordingly.

The Wilcoxon signed-rank statistic is:

$$W = \sum_{i=1}^{n} s_i R_i$$

Where

- R_i = rank of $|D_i|$
- s_i = sign (D_i)

The standardized test statistic is

$$Z = \frac{W - E(W)}{\sqrt{Var(W)}}$$

Where

$$E(W) = 0, \qquad Var(W) = \frac{n(n+1)(2n+1)}{6}$$

The effect size is computed as:

$$r = \frac{Z}{\sqrt{n}},$$

Bootstrap inference

Bootstrap resampling is applied to enhance robustness. Let $Di^{*(b)}$ denote the resampled differences at bootstrap iteration b, b=1,…,B.

The bootstrap estimator of the median is:

$$\widehat{D}^{*(b)} = median(Di^{*(b)}, \ldots., Dn^{*(b)})$$

and the empirical percentile distribution of $\widehat{D}^{*(b)}$ yields distribution-free confidence intervals.

Macro-Level Structural Break Model

At the macro level, the Corruption Perception Index (CPI) and digital governance indicators were analyzed from 2001 to 2023. The regression model included a time variable and a reform dummy for the 2015 TSA/GIFMIS implementation. Structural breaks were assessed using the Chow test and the Bai–Perron procedure. Data for CPI were obtained from Transparency International (2022), while digital governance metrics were sourced from UNDP (2021) and OECD (2019). These sources ensure that structural break detection reflects both objective international assessment and national reform milestones.

Macroeconomic impact of digital reforms on corruption dynamics is evaluated using the following specified time-series regression model:

$$CPI_t = \beta_0 + \beta_1 t + \beta_2 D_t + \gamma'' Z_t + \varepsilon_t$$

where:

- CPI_t = Corruption Perception Index
- t = time trend
- R_t = reform dummy
- X_t = vector of control variables (GDP growth, inflation, revenue)
- ε_t = error term

The reform dummy is defined as:

$$R_t = \begin{cases} 0, & t < 2015, \\ 1, & t \geq 2015, \end{cases}$$

Chow Structural Break Test

The Chow test evaluates parameter stability:

$$F = \frac{(SSR_r - (SSR_1 + SSR_2))/k}{(SSR_1 - SSR_2)/(n_1 + n_2 - 2k)}$$

- RSS_t = residual sum of squares (pooled model)
- RSS_1, RSS_2 = subsample residual sums
- k = number of parameters

Bai–Perron Multiple Break Model

The model allowing multiple structural breaks is:

$$y_t = X_t'' \beta_j + u_t \quad t = T_{j-1} + 1, \ldots, T_j,$$

for regimes j = 1,…,m+1, where breakpoints T_j are endogenously determined.

HAC Estimation

To address heteroscedasticity and autocorrelation, the **HAC covariance estimator** is used:

$$\widehat{\Omega} = \Gamma_0 + \sum_{l=1}^{L} w_l (\Gamma_l + \Gamma'_l)$$

where:

- Γ_l =E($\varepsilon_t \varepsilon_t$−l)
- w_l = kernel weights
- L = truncation lag

Quantile Regression

Quantile regression was applied at the 25th, 50th, and 75th percentiles of CPI to assess heterogeneity of reform effects across sectors with different corruption levels. This method highlights whether improvements are uniform or concentrated in sectors with historically higher corruption. This is demonstrated as thus**:**

For quantile τ $\epsilon(0,1)$, the conditional quantile function is

$$\varrho CPI_t(\tau|X_t) = X'_t\beta_\tau$$

The estimator solves:

$$min_\beta \sum_{t=1}^{T} \rho_\tau (CPI_t - X'_t\beta),$$

where the check function is

$$\rho_\tau(u) = u(\tau - 1_{\{u<0\}}).$$

Recursive Stability Analysis

Recursive residual w_t is defined as:

$$w_t = \frac{y_t - x'_t\beta_{t-1}}{\sqrt{1+x'_t(X'_{t-1}X'_{t-1})^{-1}x_t}}$$

The CUSUM statistic is

$$S_t = \sum_{i=k+1}^{t} w_i$$

Parameter stability is confirmed if S_t remains within critical bounds.

RESULTS

Institutional-Level Analysis

Table 1. Wilcoxon Signed-Rank Test Results for Institutional Data

Variable	N	Median (Pre)	Median (Post)	Z	p-value	Effect Size (r)	Data Source
Transparency Score	20	58	82	-4.12	<0.001	0.92	OAGF, MoF Reports
Audit Compliance Score	20	61	85	-3.87	<0.001	0.86	OAGF, MoF Reports
Reported Financial Irregularities	20	15	6	-3.95	<0.001	0.88	NEITI, Audit Service

Table 1 presents the Wilcoxon signed-rank test results comparing institutional metrics before and after digital accounting reforms. All variables show statistically significant improvements. These results indicate that institutional transparency and audit compliance significantly improved, while reported irregularities declined. Bootstrap confidence intervals confirm these findings, reinforcing their robustness.

Macro-Level Structural Break Analysis

Table 2 presents regression results for the impact of the 2015 reforms on CPI using HAC-consistent errors. Structural break tests confirm that 2015 corresponds to a significant regime change in CPI (Chow test $F = 18.64$, $p < 0.001$). These results indicate that institutional transparency and audit compliance significantly improved, while reported irregularities declined. Bootstrap confidence intervals confirm these findings, reinforcing their robustness.

Table 2. Regression Results with Structural Break Dummy

Variable	Coefficient	Std. Error	t-value	p-value	Data Source
Constant	24.15	2.38	10.14	<0.001	Transparency Int'l CPI
Time (t)	0.53	0.12	4.42	<0.001	World Bank, CBN
Reform Dummy	8.72	1.85	4.71	<0.001	TI, UNDP, OECD

Quantile Regression

Table 3 illustrates heterogeneous reform effects across CPI quantiles. The reform effect is strongest in sectors with initially higher corruption, highlighting the targeted effectiveness of digital accounting interventions.

Table 3. Quantile Regression of CPI on Reform Dummy

Quantile	Reform Dummy Coefficient	t-value	p-value	Data Source
0.25	10.23	5.12	<0.001	TI, UNDP
0.50	8.72	4.71	<0.001	TI, UNDP
0.75	6.45	3.92	<0.001	TI, UNDP

DISCUSSION

The findings of this study provide strong empirical evidence that digital accounting reforms in Nigeria have produced significant improvements in institutional performance and have contributed to measurable shifts in corruption dynamics at both micro and macro levels. At the institutional level, the observed increases in transparency and audit compliance, coupled with reductions in reported financial irregularities, indicate that the adoption of digital financial management systems has strengthened internal control structures and enhanced accountability mechanisms across public sector organizations. These outcomes corroborate earlier empirical evidence which shows that digital governance systems enhance monitoring capacity and reduce opportunities for discretionary manipulation in public resource management (Bertot et al., 2010; Andersen et al., 2020).

Importantly, the estimated effect sizes are not only statistically significant but also economically meaningful, as confirmed through robust bootstrap validation procedures. This suggests that the impact of digital accounting reforms extends beyond marginal improvements to substantive institutional transformation. This evidence is consistent with cross-country studies indicating that integrated financial management information systems and e-procurement platforms significantly improve fiscal transparency and reduce corruption risks, particularly in developing economies with historically weak enforcement structures (Zhao & Patten, 2016; Nam, 2018). In the Nigerian context, these findings extend the work of Olaoye and Adebayo (2021) by providing stronger econometric validation and demonstrating that the observed improvements are both statistically robust and practically relevant.

At the macro level, the identification of a structural break in 2015 coinciding with the implementation of key reforms such as the Treasury Single Account (TSA) and GIFMIS provides evidence of a regime shift in Nigeria's corruption trajectory. This supports institutional change theories which argue that major governance reforms can fundamentally alter institutional rules and generate discontinuous shifts in economic and political outcomes (North, 1990; Acemoglu & Robinson, 2019). Unlike studies that assume gradual and linear progress in governance outcomes, the present results demonstrate that digital reforms can produce abrupt and structural improvements when they significantly reconfigure financial processes and reduce information asymmetries.

Further insights are provided by the quantile regression results, which reveal heterogeneous effects of digital accounting reforms across the corruption distribution. The stronger impacts observed at lower quantiles representing sectors or institutions with higher initial corruption levels suggest that digital reforms are particularly effective in high-risk governance environments. This finding aligns with recent empirical literature indicating that digital transparency mechanisms tend to generate larger gains in contexts characterized by weak baseline governance (Andersen et al., 2020). It also implies that digital reforms may function as redistributive governance tools, narrowing accountability gaps across institutions with varying levels of integrity.

From a methodological standpoint, this study contributes to the literature by combining non-parametric institutional analysis with structural break detection and robust estimation techniques. Unlike conventional parametric approaches that often assume normality and parameter stability, this study adopts methods that are more appropriate for governance data, which are typically characterized by volatility and structural shifts (Bai & Perron, 2003). The use of heteroscedasticity-consistent estimators, distribution-free methods, and recursive stability diagnostics enhances the reliability of the empirical results and addresses a key limitation in prior studies.

The robustness of the findings across multiple specifications, structural break tests, and quantile estimations further reinforces their validity. Overall, the evidence suggests that digital accounting reforms in Nigeria operate through both institutional and systemic channels improving compliance and reducing irregularities at the micro level, while simultaneously reshaping broader corruption trends at the macro level. This dual mechanism highlights the transformative potential of digital governance reforms when supported by strong institutional commitment and effective implementation frameworks.

CONCLUSION

This study provides robust empirical evidence that digital accounting reforms have significantly improved governance outcomes in Nigeria over the period 2001–2023. By integrating micro-level institutional indicators with macro-level time-series analysis, the study demonstrates that key reforms such as the Treasury Single Account (TSA), GIFMIS, and e-procurement systems have collectively enhanced transparency, strengthened audit compliance, and reduced financial irregularities across public sector institutions. These

improvements suggest that digital transformation in public financial management has played a central role in reinforcing accountability and improving institutional efficiency.

At the macro level, the identification of a structural break in 2015 provides strong evidence that these reforms induced a significant shift in Nigeria's corruption trajectory. This finding indicates that governance outcomes did not evolve gradually but instead experienced a regime change following the implementation of major digital reforms. The result supports the argument that institutional reforms which fundamentally restructure financial processes can produce discontinuous and system-wide improvements in governance quality by reducing information asymmetry and limiting opportunities for resource mismanagement.

The study also confirms that the effects of digital accounting reforms are not uniform across institutions. The quantile-based results reveal stronger impacts in sectors with initially higher levels of corruption, suggesting that digital interventions are particularly effective in high-risk governance environments. This heterogeneity highlights the redistributive nature of digital reforms, where improvements in accountability are more pronounced where governance challenges are most severe. Overall, the evidence demonstrates that digital accounting reforms can deliver both institutional strengthening and systemic improvements in public sector governance when properly implemented and sustained.

Policy Implication

The findings underscore the need for sustained investment in digital financial management systems as a cornerstone of public sector reform in Nigeria. Policymakers should prioritize continuous capacity building for public sector personnel to ensure effective utilization of platforms such as TSA, GIFMIS, and e-procurement systems. In addition, strengthening system interoperability, enhancing data integrity, and enforcing compliance mechanisms are essential for consolidating the gains already achieved. Embedding real-time monitoring and advanced evaluation tools within governance frameworks will further enhance transparency, improve early detection of financial irregularities, and support more responsive and evidence-based policy formulation.

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