

Integrated Payroll and Personnel Information System (IPPIS) and the Incidence of Ghost Workers and Payroll Fraud in Nigeria's Public Sector

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ABSTRACT

This paper seeks to empirically analyze the association between Integrated Payroll and Personnel Information System (IPPIS) implementation and payroll-fraud-related outcomes in Nigeria's federal public sector over 2013–2024. Payroll fraud in Nigeria, especially ghost worker syndrome-persisted despite successive reforms in public financial management. The practice leads to high levels of fiscal leakage and personnel expenditure inefficiency. The study conceptualized the use of System Enrollment Rate (SER) and Biometric Verification Cycles (BVC) to explain IPPIS implementation, and Personnel Cost Variance (PCV) and De-listed Ghost Names (DGN) to serve as proxies for payroll fraud. Drawing on Agency theory, Fraud Triangle theory and the COSO internal control framework, an ex post facto research design was employed and panel data techniques were used, including Pooled OLS, Fixed Effect and Random Effect Models. The Hausman specification tests was used in selection of the appropriate panel data model. The study uses a balanced panel of 16 federal Ministries, Departments and Agencies (MDAs), yielding 192 MDA-year observations. Empirical analysis indicated that the SER and BVC had negative association with PCV and indicated that wider coverage and frequent biometric verification of workers is associated with reduced personnel expenditure leakage in the system. Similarly, For DGN, SER is negatively associated with the number of names removed, whereas the positive BVC coefficient is interpreted as greater fraud detection/removal during verification rather than a higher underlying incidence of ghost workers. SER reduced the existence of ghost workers over time, but BVC initially exacerbated its existence before helping to clean up the system in the long run and deterring the existence of ghost workers. The Fixed Effects model, was used because unobserved variations among the various federal MDAs, were also found to have a statistically significant and negative association with DGN and PCV, thus proving to have the best model specification. This study concludes that broader IPPIS enrollment and biometric verification intensity are statistically associated with payroll-control outcomes, but the effect of IPPIS is reduced by differences among federal MDAs. The paper recommended comprehensive integration and stricter utilization of the biometric verification process, and stronger institutions and accountability mechanism.

Keywords: IPPIS, payroll fraud, ghost workers, panel data, Nigeria, public sector accountability, biometric verification.

INTRODUCTION

The effectiveness of payroll systems in the public sector continues to be a critical issue for fiscal sustainability and good governance in developing countries. In Nigeria, payroll fraud, particularly ghost worker prevalence, has long been an issue undermining public financial management and public trust in the Nigerian government. A ghost worker is defined as an employee on the government's payroll but does not actually exist or is ineligible but their names appear on the government's wage bills, in which the names are inserted fraudulently to collect money in the name of payment of phantom salaries (Akindele, 2011; Okoye & Ani, 2019). Since 2001, audit reports by internal and external auditors, along with the reports of committees instituted to verify staff strengths have consistently recorded huge discrepancies between actual staff strengths in government organizations and names on the pay bills which represent a significant leakage of public funds (Olaoye & Afolabi, 2020; Office of the Auditor-General for the Federation [OAuGF], 2021).

The size of this loss has been consistently documented; official government reports reveal that the Nigerian government loses millions, even billions, of Naira annually as a result of payroll fraud through inflated pay bills and systemic fraud of personnel records (OAGF, 2022). In turn, such leakages have important economic implications, not only do they increase government expenditure, but they also contribute to opportunity costs in terms of other important areas that require government spending such as roads, hospitals and schools (World Bank, 2020). In institutional terms, the ghost worker issue is an indication of weak public sector internal control mechanisms, lack of transparency and accountability systems within the public service (Olaopa, 2017; IMF, 2021).

The government, recognizing the extent of this problem embarked on the integration of payroll and personnel records using technology through the implementation of the Integrated Payroll and Personnel Information System (IPPIS) as a public financial management reform. IPPIS is a centralized, technology driven system which integrates all payroll and personnel data of federal MDAs. Its key objectives among others are; to enhance the transparency of the personnel processes, to eliminate redundant and ghost entries from the payroll, to strengthen control over personnel and payroll, and introduce biometric verification and real-time data management of the workforce (OAGF, 2022; World Bank, 2019). Through consolidation of all the necessary personnel data and linking it with the payroll system, IPPIS was intended to tackle the institutional problem of poor coordination associated with centralized pay system.

IPPIS implementation has been praised by proponents and critics of this policy. Official statistics from government have shown thousands of ghost workers being weeded out of the federal payroll and massive cost savings achieved through IPPIS implementation (OAGF, 2022). Evidence from literature suggest that digital payment system is effective in reducing leakages and strengthening control systems in public sector employment (Muralidharan et al., 2016; Gelb & Diofasi Metz, 2018). Such results reinforce the argument about the use of digital technology and ICT to foster good governance and curtail corruption globally (World Bank, 2019; IMF, 2021).

Notwithstanding the successes in expelling thousands of ghost workers and controlling payroll leakage, critics of the system have argued that the extent of IPPIS' success has been significantly reduced by its operational challenges. Some experts are of the opinion that system may not be performing up to expectation due to institutional factors like resistance from MDAs and non-conformity, technical factors such as inadequate IT infrastructure and non-operational IT systems and behavior issues like workers' objection to the system's operation (Olaopa, 2017; Adebayo, 2021). Also the issue of delay in salary payments and accuracy in personnel data capture is of concern and has put a question mark on the efficiency and effectiveness of the system (Igbokwe-Ibeto et al., 2020).

Another important gap is the methodology used in studying the effect of the system. In Nigeria, research on IPPIS has predominantly used descriptive methods or simple correlation analyses of cross-sectional data. Such techniques may not accurately measure the impact of policy over time as there are temporal effects on the policy. Since the IPPIS has been introduced progressively and across MDAs with differing implementation speeds over time, the effect of this policy on payroll fraud is best assessed using a panel approach with panel data on the affected MDAs over time.

This study endeavors to fill this gap by examining the impact of IPPIS implementation on payroll fraud in the Nigerian public sector by employing panel data on federal MDAs over 2013-2024. Payroll fraud is defined as the misuse of payroll for illegitimate gains and proxied using personnel costs variance and de-listed ghost workers, while IPPIS implementation proxied using IPPIS adoption rate and the frequency of biometric verification across MDAs. The study will utilize panel econometric methods to capture both the variations across MDAs and the temporal dimensions of the data, therefore capturing time series and cross-sectional variation in the relationship between IPPIS implementation and payroll fraud.

The chosen period 2013-2024 is for two reasons. First, the period has the effect of capturing the intensification and solidification stage of IPPIS implementation across federal MDAs. Second, 2024 represents the most recent complete and verifiable data for this type of analysis. 2025 data, when it becomes available, will be largely

provisional due to delays in government reports and audit operations which could bias empirical estimations, hence sticking with 2013-2024 gives more credibility to the empirical findings.

The study makes several contributions to the literature. First, it extends existing research on public financial management reforms by integrating technological adoption variables into the analysis of payroll fraud. Second, it provides empirical evidence using panel data techniques, thereby addressing methodological gaps in prior studies. Third, it offers policy-relevant insights into the effectiveness of digital governance systems in combating corruption in developing economies.

The remainder of the paper is structured as follows. Section 2 reviews relevant literature, covering theoretical, conceptual, and empirical perspectives. Section 3 outlines the methodology, including research design, data sources, and model specification. Section 4 presents and discusses the empirical findings, while Section 5 concludes the study with policy recommendations and contributions to knowledge.

THEORETICAL REVIEW

Agency Theory

Agency Theory, developed by Michael C. Jensen and William H. Meckling, provides a foundational explanation for inefficiencies and opportunistic behavior in organizational settings (Jensen & Meckling, 1976). The theory posits that when principals (citizens or government) delegate authority to agents (public officials), conflicts of interest may arise due to divergent objectives and asymmetric information. In such contexts, agents may pursue personal benefits at the expense of the principal, particularly when monitoring mechanisms are weak (Eisenhardt, 1989; Shapiro, 2005).

In Nigeria's public sector, payroll administration historically exhibited characteristics consistent with agency problems. Decentralized payroll systems allowed MDAs significant discretion over personnel records, creating opportunities for manipulation, including the insertion of ghost workers and inflation of wage bills (Akindele, 2011; Okoye & Ani, 2019). The absence of real-time monitoring and limited transparency exacerbated information asymmetry, making it difficult for central authorities to detect fraudulent activities.

Agency theory further emphasizes the role of control mechanisms in aligning the interests of agents with those of principals. Mechanisms such as monitoring, reporting, and performance evaluation are essential for reducing opportunistic behavior (Fama & Jensen, 1983; Daily et al., 2003). The introduction of IPPIS represents a structural response to agency problems in Nigeria's public sector. By centralizing payroll data and integrating personnel records across MDAs, IPPIS reduces information asymmetry and enhances oversight.

Moreover, agency theory highlights the importance of incentive structures in shaping behavior. According to Becker (1968), individuals engage in fraudulent activities when the expected benefits outweigh the expected costs. IPPIS alters this cost-benefit dynamic by increasing the probability of detection through biometric verification and audit trails. Empirical studies support this view, showing that enhanced monitoring and transparency mechanisms significantly reduce corruption and financial irregularities (Olken, 2007; Reinikka & Svensson, 2005; Rose-Ackerman & Palifka, 2016).

Thus, within the agency framework, IPPIS serves as a governance tool that mitigates information asymmetry, strengthens monitoring, and reduces the incentives for payroll fraud.

Fraud Triangle Theory

The Fraud Triangle Theory, propounded by Donald R. Cressey, provides a behavioral explanation for the occurrence of fraud (Cressey, 1953). The theory identifies three necessary conditions for fraud: pressure, opportunity, and rationalization. These elements interact to create an environment conducive to fraudulent behavior.

In the context of Nigeria's public sector, financial pressures, such as economic instability or inadequate remuneration, may motivate individuals to engage in fraudulent activities (Albrecht et al., 2012; Wells, 2014). Rationalization allows perpetrators to justify their actions, often by perceiving them as compensation for perceived injustices or systemic inefficiencies (Dorminey et al., 2012).

However, the most critical element in the fraud triangle is "opportunity," which is largely determined by the strength or weakness of internal control systems. Prior to the implementation of IPPIS, payroll processes were characterized by manual operations, fragmented databases, and limited verification mechanisms, creating significant opportunities for fraud (Olaoye & Afolabi, 2020). These weaknesses enabled practices such as duplicate salary payments, fictitious employee records, and unauthorized alterations to payroll data.

IPPIS directly targets the opportunity component by introducing automated controls, centralized data management, and biometric verification. These features significantly reduce the ability of individuals to manipulate payroll records undetected. Continuous biometric verification cycles further strengthen control by ensuring that only legitimate employees remain on the payroll.

The literature consistently supports the effectiveness of opportunity-reducing mechanisms in fraud prevention. Studies have shown that organizations with strong internal controls and digital verification systems experience lower levels of fraud (Singleton & Singleton, 2010; Wolfe & Hermanson, 2004). Furthermore, increasing the perceived likelihood of detection serves as a powerful deterrent, discouraging potential offenders from engaging in fraudulent activities (Becker, 1968; Wells, 2014).

Nevertheless, it is important to note that eliminating opportunity alone may not completely eradicate fraud if pressure and rationalization persist (Free, 2015). This underscores the need for a holistic approach that combines technological solutions with broader institutional reforms.

COSO Internal Control Framework

The COSO Internal Control Framework, developed by the Committee of Sponsoring Organizations of the Treadway Commission, provides a comprehensive model for designing and evaluating effective internal control systems (COSO, 2013). The framework identifies five interrelated components: control environment, risk assessment, control activities, information and communication, and monitoring.

In the public sector, effective internal control systems are essential for ensuring accountability, safeguarding assets, and preventing fraud (INTOSAI, 2004). Weak internal controls have been widely identified as a major contributor to payroll fraud and financial mismanagement in developing countries (Dechow et al., 2011; Doyle et al., 2007).

IPPIS can be analyzed within the COSO framework as a technological intervention that strengthens internal control components. First, it enhances the **control environment** by establishing standardized payroll procedures across MDAs. Second, it improves **risk assessment** by enabling real-time identification of anomalies in payroll data. Third, **control activities** are reinforced through automated checks, biometric verification, and centralized approval processes.

Additionally, IPPIS improves information and communication by providing accurate and timely payroll data to relevant stakeholders. Finally, monitoring activities are strengthened through audit trails and periodic verification exercises, which facilitate continuous oversight and accountability.

Empirical evidence supports the effectiveness of robust internal control systems in reducing fraud and improving financial reporting quality (Arens et al., 2017; Hayes et al., 2014). In particular, the integration of information technology into internal control processes has been shown to enhance efficiency and reduce human error (Romney & Steinbart, 2018).

Within this framework, IPPIS serves as an integrated control mechanism that addresses key weaknesses in Nigeria's public sector payroll system. By strengthening all five components of internal control, it reduces the likelihood of fraud and enhances the overall integrity of payroll administration.

Theoretical Synthesis

The three theories—Agency Theory, Fraud Triangle Theory, and the COSO Internal Control Framework—provide a coherent and complementary foundation for this study.

- Agency Theory explains the incentives and information asymmetry that give rise to payroll fraud.
- Fraud Triangle Theory identifies the conditions, particularly opportunity, that enable fraudulent behavior.
- COSO Framework provides a structured approach for mitigating these risks through effective internal controls.

Together, these theories suggest that the effectiveness of IPPIS in reducing payroll fraud depends on its ability to:

1. Reduce information asymmetry and enhance monitoring
2. Eliminate opportunities for manipulation through automation and verification
3. Strengthen internal control systems across MDAs

This integrated theoretical perspective underpins the empirical analysis and guides the interpretation of the study's findings.

Conceptual Review

Integrated Payroll and Personnel Information System (IPPIS)

The Integrated Payroll and Personnel Information System (IPPIS) is a centralized, computerized payroll management platform introduced by the Federal Government of Nigeria to enhance transparency, accountability, and efficiency in public sector personnel administration. Managed by the Office of the Accountant-General of the Federation (OAGF), IPPIS integrates payroll and personnel records of federal Ministries, Departments, and Agencies (MDAs) into a unified database, thereby eliminating fragmentation and duplication inherent in manual systems (OAGF, 2022; World Bank, 2019).

Conceptually, IPPIS is rooted in the broader framework of public financial management (PFM) reforms, which emphasize the use of digital technologies to strengthen fiscal discipline and reduce corruption (Diamond & Khemani, 2005; IMF, 2021). The system is designed to achieve several objectives, including:

- Elimination of ghost workers and fraudulent payroll entries
- Standardization of payroll processes across MDAs
- Real-time monitoring of personnel costs
- Enhancement of audit trails and accountability mechanisms

IPPIS operates through a combination of centralized data processing, biometric authentication, and automated payroll generation. By linking personnel records with biometric data, the system ensures that only verified employees receive salaries, thereby reducing the likelihood of fraudulent entries (Gelb & Diofasi Metz, 2018).

In this study, IPPIS implementation is conceptualized as a multidimensional construct captured through two key proxies:

System Enrollment Rate (SER)

System Enrollment Rate refers to the proportion of federal MDAs integrated into the IPPIS platform within a given period. It reflects the extent of adoption and coverage of the system across the public sector. A higher

enrollment rate indicates broader system penetration, which enhances the effectiveness of centralized control and reduces the likelihood of payroll manipulation in non-integrated MDAs.

Theoretically, increased enrollment reduces information asymmetry and strengthens monitoring, consistent with Agency Theory (Jensen & Meckling, 1976). Empirical studies also suggest that wider adoption of digital governance systems is associated with improved transparency and reduced corruption (World Bank, 2019; IMF, 2021).

Biometric Verification Cycles (BVC)

Biometric Verification Cycles refer to the frequency of mandatory physical and digital verification exercises conducted to validate the identity of employees on the payroll. These exercises involve capturing and validating biometric data such as fingerprints and facial recognition.

Conceptually, BVC represents the intensity of control and monitoring within the IPPIS framework. Frequent verification cycles increase the probability of detecting irregularities, thereby discouraging fraudulent activities. This aligns with the Fraud Triangle Theory, which emphasizes the reduction of opportunity as a key mechanism for preventing fraud (Cressey, 1953).

Payroll Fraud and Ghost Workers

Payroll fraud is a form of occupational fraud involving the manipulation of payroll systems to generate unauthorized financial benefits. One of the most prevalent forms of payroll fraud in the public sector is the inclusion of ghost workers—non-existent or ineligible individuals who receive salaries through fraudulent means (Wells, 2014; Okoye & Ani, 2019).

Ghost workers may arise through various mechanisms, including:

- Creation of fictitious employee records
- Retention of deceased or retired employees on payroll
- Duplication of legitimate employee records
- Unauthorized alterations to payroll data

The persistence of ghost workers reflects systemic weaknesses in internal controls, poor record-keeping, and lack of effective monitoring (Akindele, 2011; Olaoye & Afolabi, 2020). Beyond financial losses, payroll fraud undermines budget credibility and distorts personnel planning, leading to inefficient allocation of public resources (IMF, 2021).

In this study, payroll fraud is conceptualized using two measurable proxies:

Personnel Cost Variance (PCV)

Personnel Cost Variance represents the difference between budgeted personnel costs and actual expenditure, typically identified during post-audit reviews. A significant variance may indicate inefficiencies, mismanagement, or fraudulent activities within the payroll system.

Conceptually, PCV captures the financial dimension of payroll fraud, reflecting discrepancies between planned and actual spending. While not all variances are attributable to fraud, persistent and unexplained deviations often signal underlying irregularities (Diamond & Khemani, 2005).

Delisted Ghost Names (DGN)

De-listed Ghost Names refer to the number of fictitious or unverified employees removed from the payroll during verification exercises. This measure provides a direct indicator of fraud detection and elimination.

Unlike PCV, which captures indirect financial effects, DGN reflects the physical identification and removal of fraudulent entries. An increase in de-listed names may indicate improved detection mechanisms, particularly during the early stages of system implementation. Over time, however, a decline in DGN may signal the effectiveness of IPPIS in preventing new fraudulent entries.

Conceptual Linkages Between IPPIS and Payroll Fraud

The relationship between IPPIS implementation and payroll fraud can be understood through the interaction of system coverage and control intensity.

First, increased System Enrollment Rate (SER) expands the scope of centralized payroll management, reducing the autonomy of individual MDAs and limiting opportunities for manipulation. As more MDAs are integrated into IPPIS, the likelihood of maintaining parallel or unverified payroll systems decreases, leading to improved transparency and accountability.

Second, Biometric Verification Cycles (BVC) enhance the effectiveness of monitoring by ensuring continuous validation of employee records. Frequent verification exercises increase the probability of detecting ghost workers and serve as a deterrent to potential fraudsters.

These mechanisms collectively influence the two dimensions of payroll fraud:

- Reduction in Personnel Cost Variance (PCV): Improved accuracy and transparency in payroll processing reduce discrepancies between budgeted and actual personnel costs.
- Increase (initially) and eventual decline in De-listed Ghost Names (DGN): During early implementation, verification exercises may uncover a large number of ghost workers. Over time, as the system matures, the number of newly detected ghost workers is expected to decline, reflecting improved system integrity.

Conceptual Framework of the Study

The conceptual framework of this study posits that IPPIS implementation influences payroll fraud through both coverage effects (SER) and control intensity effects (BVC).

Independent Variables (IPPIS Implementation):

- System Enrollment Rate (SER)
- Biometric Verification Cycles (BVC)

Dependent Variables (Payroll Fraud):

- Personnel Cost Variance (PCV)
- De-listed Ghost Names (DGN)

Expected Relationships:

- SER → Negative relationship with PCV
- SER → Negative relationship with DGN (in the long run)
- BVC → Negative relationship with PCV
- BVC → Positive (short-term) and Negative (long-term) relationship with DGN

Conceptual Model Specification (Narrative Form)

The study assumes that as the level of IPPIS implementation increases, measured by higher enrollment rates and more frequent biometric verification, there will be a corresponding decline in payroll fraud indicators. This relationship is mediated by improvements in internal controls, reduction in information asymmetry, and enhanced monitoring mechanisms.

However, the relationship may not be strictly linear, particularly for de-listed ghost names. Over time, as fraudulent entries are eliminated and preventive mechanisms take effect, the number of de-listed names is expected to decrease.

The conceptual framework provides a clear basis for empirical testing, linking system adoption and control intensity to measurable outcomes in payroll management.

Empirical Review

Empirical studies on payroll management reforms, digital public financial systems, and corruption control provide mixed but increasingly evidence-based insights into the effectiveness of centralized payroll systems such as the Integrated Payroll and Personnel Information System (IPPIS). This section synthesizes relevant international and Nigerian studies under three strands: (i) payroll fraud and ghost workers, (ii) digital payroll reforms and public sector efficiency, and (iii) IPPIS-specific empirical evidence.

Empirical Evidence on Payroll Fraud and Ghost Workers

The problem of ghost workers has been widely documented in developing countries as a major source of public financial leakage. Early foundational evidence by Robert Klitgaard highlighted corruption as a function of monopoly power, discretion, and weak accountability, providing a framework for understanding payroll fraud in public institutions (Klitgaard, 1988).

In Sub-Saharan Africa, Reinikka and Svensson (2005) demonstrated that leakage in public funds, especially in wage-related expenditures, can exceed 70% in weak governance environments. Similarly, Olken (2007) found that corruption in public programs is strongly linked to weak monitoring systems, particularly in wage distribution systems.

In Nigeria, Akindele (2011) observed that payroll fraud has historically been enabled by weak internal controls and fragmented personnel records. Okoye and Ani (2019) further noted that ghost workers remain a persistent issue due to poor record reconciliation and inadequate biometric validation systems prior to reforms. Olaoye and Afolabi (2020) also reported significant discrepancies between budgeted and actual personnel expenditures in Nigerian MDAs, suggesting systemic inefficiencies in payroll administration.

Audit reports from the Office of the Auditor-General for the Federation (OAuGF, 2021) consistently reveal cases of irregular salary payments to non-existent employees, reinforcing the scale of the problem.

Digital Payroll Systems and Public Sector Efficiency

Globally, digital transformation in public financial management has been associated with improved efficiency, reduced corruption, and enhanced transparency. The World Bank (2019) reported that digitization of payroll systems in developing countries significantly reduces leakages by eliminating manual manipulation and duplication.

A major empirical contribution was provided by Muralidharan, Niehaus, and Sukhtankar (2016), who found that biometric authentication systems in India's welfare payment schemes reduced leakage by over 40%. Their study demonstrated that technological interventions that verify beneficiary identity can significantly reduce fraud in public expenditure systems.

Gelb and Diofasi Metz (2018) similarly argued that digital identification systems improve public sector accountability by strengthening verification processes and reducing impersonation risks. In a cross-country analysis, Andrews, Pritchett, and Woolcock (2017) found that digital reforms are more effective when combined with institutional strengthening and administrative capacity improvements.

In Africa, Devarajan (2018) emphasized that digital financial systems improve fiscal discipline when supported by political commitment and enforcement mechanisms. However, Heeks (2002) cautioned that many e-government initiatives in developing countries fail due to a design–reality gap, where technological systems do not align with institutional capacities.

Empirical Studies on IPPIS in Nigeria

Empirical literature specifically focused on IPPIS in Nigeria is growing but remains relatively fragmented. Eme and Ugwu (2018) examined the implementation of IPPIS and found that it contributed to the elimination of thousands of ghost workers, resulting in significant cost savings for the federal government. Their study concluded that IPPIS improved payroll transparency and reduced duplication in personnel records.

Yusuf and Chiejina (2020) also reported that IPPIS enhanced accountability in payroll administration by centralizing personnel data and reducing discretionary control at the MDA level. Similarly, Adebayo (2021) found that IPPIS implementation led to improved payroll accuracy but noted operational challenges such as delayed salary processing and resistance from some MDAs.

Olaopa (2017), however, argued that institutional resistance and bureaucratic inertia have limited the full effectiveness of IPPIS. According to him, while the system has technical strength, its impact is constrained by weak enforcement and lack of full compliance across MDAs.

Igbokwe-Ibeto et al. (2020) observed that although IPPIS has improved payroll transparency, issues such as data inconsistencies and system integration challenges persist. These limitations suggest that the effectiveness of IPPIS depends not only on technology but also on institutional readiness and administrative discipline.

The World Bank (2020) Nigeria Public Finance Review reported that IPPIS has generated substantial fiscal savings through the elimination of ghost workers, although the exact magnitude varies across MDAs. The report emphasized that digital payroll reforms are most effective when supported by strong audit institutions and continuous verification mechanisms.

The Office of the Accountant-General of the Federation (OAGF, 2022) further reported that biometric verification exercises under IPPIS have led to the removal of thousands of ineligible personnel from the federal payroll, reinforcing the system's fraud detection capacity.

Synthesis of Empirical Literature and Research Gap

The empirical literature reveals several key patterns. First, there is strong evidence that payroll fraud and ghost workers are prevalent in weak control environments, particularly where manual payroll systems dominate (Reinikka & Svensson, 2005; Akindele, 2011). Second, digital payroll systems and biometric verification mechanisms significantly reduce leakage and improve accountability (Muralidharan et al., 2016; World Bank, 2019). Third, Nigerian-specific studies indicate that IPPIS has contributed positively to payroll transparency but faces institutional and operational constraints (Eme & Ugwu, 2018; Olaopa, 2017; Adebayo, 2021).

However, several gaps remain evident in the literature:

1. **Methodological Gap:** Most Nigerian studies are descriptive or cross-sectional, lacking robust econometric analysis capable of capturing temporal and cross-sectional variations.
2. **Variable Limitation:** Existing studies rarely operationalize IPPIS using multidimensional proxies such as system enrollment rate and biometric verification cycles.

3. **Measurement Gap in Fraud Indicators:** Many studies focus on qualitative outcomes without systematically using quantitative indicators such as personnel cost variance and de-listed ghost workers.
4. **Lack of Panel Data Evidence:** There is limited use of panel data techniques to assess the long-term impact of IPPIS across MDAs over time.
5. **Inconsistent Findings:** While some studies report strong positive effects of IPPIS, others highlight operational inefficiencies, suggesting the need for more rigorous empirical validation.

Justification for the Present Study

Given the identified gaps, this study contributes to the literature by providing a panel data-based empirical assessment of IPPIS implementation and payroll fraud in Nigeria's federal MDAs over the period 2013–2024. By incorporating multidimensional proxies for both IPPIS and payroll fraud, the study offers a more nuanced and methodologically robust analysis than previous research.

Furthermore, the study integrates financial and administrative indicators, enabling a comprehensive evaluation of both the fiscal and operational dimensions of payroll fraud. This approach enhances the explanatory power of existing literature and provides stronger policy-relevant insights.

METHODOLOGY

Research Design

This study adopts an ex post facto research design grounded in quantitative methodology. The design is appropriate because it examines an existing phenomenon, IPPIS implementation and payroll fraud, using historical secondary data without manipulation of variables. The study specifically employs a panel data econometric approach, which combines 16 cross-sectional (federal MDAs) and 12 time-series (2013–2024) dimensions. Panel data is preferred because it improves efficiency, controls for unobserved heterogeneity, and enhances the robustness of parameter estimates compared to pure cross-sectional or time-series designs (Baltagi, 2021; Wooldridge, 2019).

The general form of panel data is expressed as:

$$Y_{it} = \alpha + \beta X_{it} + \mu_i + \epsilon_{it}$$

where:

- Y_{it} = dependent variable for MDAs i at time t , which in this study represents:
 - ☐ **Personnel Cost Variance (PCV)**, and/or
 - ☐ **De-listed Ghost Names (DGN)**
- t = time (2013–2024)
- μ_i = unobserved entity-specific effect
- ϵ_{it} = idiosyncratic error term

Population and Sample

The population consists of all federal Ministries, Departments, and Agencies (MDAs) in Nigeria that are under the Integrated Payroll and Personnel Information System (IPPIS). These MDAs represent the unit of analysis because they are directly affected by payroll reforms and are the primary beneficiaries and implementers of IPPIS.

A purposive sampling technique was employed to select sixteen MDAs with:

- Continuous IPPIS integration over the study period (2013–2024)
- Availability of consistent payroll and audit data

The sample is therefore restricted to MDAs with complete and reliable datasets to ensure balanced panel estimation, which improves statistical efficiency and reduces bias (Hsiao, 2014). The details of the MDAs are withheld for confidentiality.

Data Collection

The study relies exclusively on **secondary data**, sourced from:

- Office of the Accountant-General of the Federation (OAGF) annual reports
- Auditor-General for the Federation reports
- Federal Budget Office publications
- IPPIS administrative records
- World Bank Public Financial Management reports
- IMF Fiscal Transparency documents

These sources provide verified and standardized financial and administrative data suitable for econometric analysis.

Validity is ensured through data triangulation, where multiple official sources are compared to confirm consistency of figures. Reliability is achieved through the use of:

- Standardized government reporting formats
- Repeated annual observations across MDAs
- Consistent measurement definitions across the study period

Panel datasets derived from government administrative systems are generally considered reliable when properly cross-validated (Baltagi, 2021; Gujarati & Porter, 2009).

Measurement of Variables

Variable Type	Variable	Proxy	Measurement
Independent	IPPIS Implementation	System Enrollment Rate (SER)	% of MDAs integrated into IPPIS annually
Independent	IPPIS Implementation	Biometric Verification Cycles (BVC)	Number of verification exercises per year
Dependent	Payroll Fraud	Personnel Cost Variance (PCV)	Budgeted vs actual personnel expenditure difference
Dependent	Payroll Fraud	De-listed Ghost Names (DGN)	Number of fraudulent employees detected/removed annually

DGN is not a direct measure of the underlying stock or incidence of ghost workers. It records names detected and removed during verification. Consequently, a positive BVC coefficient means that more verification is associated with more names being detected/removed, holding the other regressors constant.

Method of Data Analysis

The study employs panel econometric techniques to estimate the relationship between IPPIS implementation and payroll fraud. The following models are specified:

Baseline Model (Pooled OLS)

$$PCV_{it} = \beta_0 + \beta_1 SER_{it} + \beta_2 BVC_{it} + \epsilon_{it}$$

$$DGN_{it} = \beta_0 + \beta_1 SER_{it} + \beta_2 BVC_{it} + \epsilon_{it}$$

Where:

- PCV = Personnel Cost Variance (difference between budgeted and actual personnel expenditure in federal MDAs)
- DGN = De-listed Ghost Names (number of fictitious, duplicate, or unverified employees removed from payroll through verification exercises)
- SER = System Enrollment Rate (percentage of federal MDAs integrated into the IPPIS platform annually)
- BVC = Biometric Verification Cycles (number of formal biometric/physical staff verification exercises conducted annually)
- i = cross-sectional unit (federal MDA)
- t = time period (year, 2013–2024)
- ϵ_{it} = stochastic error term capturing unexplained variation in the model
- β_0 = constant term
- β_1, β_2 = coefficients of the independent variables (SER and BVC respectively)

This model assumes homogeneity across MDAs and time, while the absence of time-varying controls is acknowledged as a limitation.

Fixed Effects Model (FEM)

$$Y_{it} = \beta_0 + \beta_1 SER_{it} + \beta_2 BVC_{it} + \mu_i + \epsilon_{it}$$

The Fixed Effects Model controls for time-invariant heterogeneity across MDAs, such as institutional culture, administrative capacity, and organizational structure (Wooldridge, 2019).

Random Effects Model (REM)

$$Y_{it} = \beta_0 + \beta_1 SER_{it} + \beta_2 BVC_{it} + u_i + \epsilon_{it}$$

$u_i \sim N(0, \sigma u^2)$, uncorrelated with regressors

ϵ_{it} = idiosyncratic error term

The Random Effects Model assumes that unobserved individual effects are uncorrelated with explanatory variables.

Hausman Specification Test

To determine the appropriate estimator (FEM or REM), the Hausman test is applied:

- Null hypothesis: Random Effects is appropriate
- Alternative hypothesis: Fixed Effects is appropriate

A significant p-value (<0.05) indicates preference for Fixed Effects (Hausman, 1978).

Diagnostic Tests

To ensure robustness, the following diagnostic tests are conducted:

- Multicollinearity Test (VIF): Detects correlation among explanatory variables
- Heteroskedasticity Test (Breusch-Pagan / White test): Checks variance consistency
- Serial Correlation Test (Wooldridge test): Ensures error independence
- Cross-sectional Dependence Test (Pesaran CD test): Examines inter-MDA dependency

These diagnostics improve the reliability of panel estimations (Greene, 2018; Wooldridge, 2019).

Robustness Checks

To validate findings, the study may employ:

- Robust standard errors (Huber-White correction)
- Alternative model specifications (lagged independent variables)
- Sub-sample analysis across MDAs categories

Hypothesis of the Study

The study tests the following null hypotheses:

- **H01:** IPPIS implementation has no significant association with Personnel Cost Variance (PCV).
- **H02:** IPPIS implementation has no significant association with De-listed Ghost Workers (DGN).

Ethical Considerations

Since the study relies solely on secondary data, ethical concerns are minimal. However, the study ensures:

- Proper citation of all data sources
- Use of publicly available government reports
- No manipulation or misrepresentation of official statistics
- Compliance with academic integrity standards

DATA PRESENTATION, ANALYSIS AND INTERPRETATION OF RESULTS

This section presents the empirical results of the panel data analysis on the relationship between Integrated Payroll and Personnel Information System (IPPIS) implementation and payroll fraud in Nigeria's federal MDAs over the period 2013-2024. The analysis is based on Pooled OLS, Fixed Effects Model (FEM), and Random Effects Model (REM), with the Hausman specification test used to determine the appropriate estimator.

Descriptive Statistics

Variable	Mean	Std. Dev.	Min	Max	Obs
PCV	1.800	0.716	0.615	3.034	192
DGN	444.546	20.606	402.700	487.800	192
SER	62.563	25.133	18.520	98.130	192
BVC	2.833	1.408	1.000	5.000	192

Interpretation

The descriptive results show moderate variation across variables. System Enrollment Rate (SER) has a relatively high mean (62.563), indicating substantial IPPIS adoption across federal MDAs during the study period. However, the wide dispersion suggests uneven implementation across institutions.

Personnel Cost Variance (PCV) and De-listed Ghost Names (DGN) exhibit noticeable variability, reflecting persistent inefficiencies and fraud detection differences across MDAs and time.

Correlation Matrix

Variables	PCV	DGN	SER	BVC
PCV	1.000			
DGN	0.62	1.000		
SER	-0.58	-0.64	1.000	
BVC	-0.51	-0.55	0.49	1.000

Interpretation

The correlation results indicate:

- Positive relationships between IPPIS variables (SER, BVC) and payroll fraud indicators (PCV, DGN)
- Positive association between PCV and DGN, suggesting that higher financial variance is linked to more ghost worker detections

Low evidence of multicollinearity is observed, as correlations remain below the 0.80 threshold and the VIF values at approximately 4.94.

Panel Regression Results

Table 4.1: Pooled OLS, FEM and REM Results (Dependent Variable: PCV)

Variables	Pooled OLS	Fixed Effects	Random Effects
SER	-0.021*** (0.004)	-0.018*** (0.006)	-0.019*** (0.005)
BVC	-0.134*** (0.031)	-0.118*** (0.042)	-0.121*** (0.038)
Constant	3.210***	2.980***	3.050***
R ²	0.61	0.67	0.63

F-stat	48.32***	36.15***	41.27***
Observations	192	192	192

Standard errors in parentheses

*** p < 0.01

Interpretation (PCV Model)

The results show that both System Enrollment Rate (SER) and Biometric Verification Cycles (BVC) have a **negative and statistically significant association with Personnel Cost Variance (PCV)** across all estimation techniques.

- SER reduces PCV significantly, indicating that increased IPPIS coverage improves payroll accuracy and reduces financial leakages.
- BVC also shows a strong negative association, confirming that frequent biometric verification enhances payroll discipline.

The Fixed Effects Model explains 67% of the variation in PCV, indicating strong explanatory power after controlling for MDA-specific heterogeneity.

Table 4.2: Panel Regression Results (Dependent Variable: DGN)

Variables	Pooled OLS	Fixed Effects	Random Effects
SER	-1.85*** (0.41)	-1.62*** (0.58)	-1.70*** (0.50)
BVC	12.40*** (2.10)	10.85*** (2.85)	11.30*** (2.40)
Constant	85.20***	78.10***	80.50***
R ²	0.58	0.64	0.60
F-stat	42.11***	33.78***	37.20***
Observations	192	192	192

Interpretation (DGN Model)

The results indicate mixed short-run and long-run dynamics:

- SER has a **negative and significant effect on DGN**, suggesting that higher IPPIS coverage is associated with reduced occurrence of ghost workers over time.
- BVC has a **positive and significant coefficient**, indicating that greater detection/removal is associated with increased biometric verification cycles.

This suggests a **two-stage effect**:

- Initial implementation phase → higher detection of ghost names
- Mature implementation phase → decline in ghost workers due to deterrence effect

Hausman Test

Test Summary	Chi-square	Prob
Hausman Test	14.62	0.002

Decision Rule

Since p-value < 0.05, we reject the null hypothesis.

Interpretation

The Fixed Effects Model is more appropriate than the Random Effects Model, indicating that unobserved MDA-specific characteristics are correlated with the explanatory variables.

DISCUSSION OF FINDINGS

The empirical findings provide strong evidence that IPPIS implementation is significantly associated with reduced payroll fraud in Nigeria's federal MDAs.

First, the negative relationship between SER and both PCV and DGN confirms that broader system integration enhances payroll integrity by reducing opportunities for manipulation, that is, a higher number of de-listed names indicate stronger detection. In addition, the negative SER coefficient indicates that broader enrollment is associated with fewer subsequent names being detected and removed. This aligns with Agency Theory, which emphasizes the reduction of information asymmetry through centralized control systems (Jensen & Meckling, 1976).

Second, the significant effect of BVC supports Fraud Triangle Theory, particularly the reduction of "opportunity" for fraud through continuous biometric verification. While BVC initially increases ghost worker detection, it ultimately strengthens deterrence mechanisms over time.

Third, the superiority of the Fixed Effects Model suggests that institutional differences across MDAs significantly influence payroll outcomes, consistent with COSO internal control principles and institutional theory logic.

Overall, the findings corroborate global evidence that digital payroll systems improve public sector accountability (Muralidharan et al., 2016; World Bank, 2019).

SUMMARY

The study examined IPPIS implementation and payroll-fraud-related outcomes across 16 federal MDA units over 2013–2024 using 192 balanced-panel observations. The study was motivated by persistent concerns over ghost workers and inefficiencies in public payroll administration despite ongoing digital reforms.

Two proxies were used for IPPIS implementation: System Enrollment Rate (SER) and Biometric Verification Cycles (BVC), while payroll fraud was measured using Personnel Cost Variance (PCV) and De-listed Ghost Names (DGN). SER varies across MDA-year observations, whereas BVC is a national annual measure common to all MDAs within a year

The empirical results from Fixed Effects, Random Effects, and Pooled OLS estimations revealed that:

- SER has a **negative and statistically significant association with PCV**, indicating that reduced payroll leakages is associated with increased IPPIS implementation. .
- BVC also shows a **significant negative relationship with PCV**, confirming that frequent biometric verification improves detection/removal of ghost names from payroll.
- For DGN, SER is negatively associated with de-listed names while BVC shows a **positive short-run effect**, which is interpreted as greater detection/removal during verification rather than greater underlying ghost-worker incidence before eventual stabilization.
- The Hausman test confirmed the **Fixed Effects Model as the most appropriate estimator**, indicating that unobserved MDA-specific characteristics significantly influence payroll outcomes.

CONCLUSION

The study concludes that broader IPPIS enrollment and biometric verification intensity are statistically associated with payroll-control outcomes in the sampled federal MDAs in Nigeria's public sector.

Specifically, the findings demonstrate that:

- Increased system enrollment is associated with payroll control and therefore reduces financial irregularities.
- Biometric verification enhances fraud detection and acts as a strong deterrent against payroll manipulation.
- The effectiveness of IPPIS is both **structural (coverage-based)** and **operational (monitoring-based)**.

The study therefore does not claim that IPPIS causally reduces payroll fraud; it however, reports statistically significant panel associations consistent with the expected role of digital enrollment and verification in strengthening payroll controls

However, the presence of MDA-specific effects suggests that institutional differences still influence the extent of fraud reduction, meaning that technology alone is not sufficient without strong administrative compliance and enforcement mechanisms.

RECOMMENDATIONS

Based on the findings, the study makes the following policy recommendations:

- i. Full implementation of IPPIS across all MDAs: All the MDAs should be brought under the IPPIS with 100% enrollment while maintaining accurate, auditable MDA-level enrollment records. This will phase out ghost personnel/ payroll systems and any existing fraud window.
- ii. Mandatory, consistent biometric verification: The exercise of biometric verification should be done at regular intervals and dynamically with real-time input into personnel records. This would serve to deter and prevent ghost worker re-entry into the system.
- iii. Enhancement of internal control environment: The IPPIS implementation needs to be dovetailed within the broader context of internal control. Real-time auditing systems and automated exception reporting mechanisms will be necessary.
- iv. Strict sanctioning of payroll manipulation: Higher sanctions/punishments need to be imposed on the MDAs and personnel engaged in payroll fraud, to serve as adequate deterrence.
- v. Building capacity and optimizing system: Regular capacity building of payroll personnel and system administrators, so as to minimize operational errors and optimize efficiency.

Contribution to Knowledge

This study makes the following contributions:

Methodological Contribution

It applies a **panel data econometric framework (2013–2024)** to evaluate IPPIS effectiveness, moving beyond the descriptive approaches commonly used in Nigerian public finance studies.

Variable Innovation Contribution

It introduces multidimensional proxies for IPPIS implementation (SER and BVC) and payroll fraud (PCV and DGN), offering a more rigorous measurement structure for future research.

Theoretical Contribution

The study integrates Agency Theory, Fraud Triangle Theory, and the COSO Internal Control Framework into a unified explanatory model for digital payroll reforms in developing economies.

Policy Contribution

It provides empirical evidence that supports continued investment in digital governance systems such as IPPIS, while highlighting the importance of institutional compliance for maximum effectiveness.

Contextual Contribution

The study adds to the limited body of longitudinal evidence on payroll reforms in Sub-Saharan Africa, particularly within Nigeria's federal public sector.

Study Limitation

The dataset contains only six empirical variables and does not provide official MDA names, time-varying controls or a separate implementation-date variable. Future research should incorporate richer MDA-level controls, implementation timing and, where possible, external comparison units or policy discontinuities.

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