

Real-Time Payment Systems as a Tool for Improving Government Revenue Monitoring

Mr Frederick K. Darteh

Treasurer at Technical University Association of Administrators of Ghana

Abstract

This study examines the role of Real-Time Payment Systems (RTPS) in improving government revenue monitoring functions by integrating quantitative performance analysis with qualitative institutional insights. Using pre- and post-implementation datasets from key government departments, the study evaluates changes in reporting accuracy, reconciliation efficiency, and administrative transparency. The results show substantial reductions in daily variance, reporting errors, unresolved discrepancies, and manual verification requirements following RTPS adoption. Regression analysis reveals that transaction processing speed, automation level, and data integration quality significantly predict revenue accuracy improvements. Thematic findings from departmental interviews further highlight increased accountability, strengthened audit trails, and reduced administrative burden. A cluster dendrogram illustrates that departments with higher RTPS adoption cluster together, indicating consistent operational gains. Overall, the study concludes that RTPS provides a transformative digital infrastructure that enhances fiscal visibility, strengthens revenue governance, and supports timely, data-driven decision-making for public financial management.

Keywords: Real-time payment systems; revenue monitoring; public financial management; reconciliation efficiency; digital governance; data integration; automation; fiscal transparency.

Introduction

Understanding the need for real-time financial visibility

In modern public financial management, timely and accurate information on government revenue flows has become increasingly critical (Sefa-Nyarko et al., 2021). Traditional payment and reporting systems often rely on batch processing, delayed reconciliations, and fragmented data structures that limit real-time insight into fiscal performance (Ogedengbe et al., 2022). These delays restrict the ability of governments to swiftly identify revenue

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leakages, monitor compliance, and respond to emerging fiscal risks. As economies transition toward digital platforms, the demand for instantaneous transaction validation and real-time financial visibility has intensified (Gomber et al., 2018). This shift has created a compelling rationale for adopting real-time payment systems (RTPS) as an integral component of modern revenue monitoring frameworks.

Explaining the limitations of conventional revenue monitoring mechanisms

Conventional public revenue monitoring systems typically depend on manual data entry, multi-layered verification, and delayed consolidation of information across tax departments, treasury offices, and financial institutions (Lukings, M., & Habibi Lashkari, 2022). As a result, revenue authorities often face challenges such as inaccurate daily revenue estimation, inefficient reconciliation cycles, and limited transparency into taxpayer behavior (Highfield, 2013). Furthermore, the persistence of cash-based transactions and offline reporting exacerbates inconsistencies between actual collections and reported figures. These structural limitations hinder governments' ability to manage cash flow forecasts, evaluate tax performance, and take corrective measures in a timely manner. The inefficiencies inherent in legacy systems highlight the need for more integrated digital platforms capable of delivering instantaneous data for revenue decision-making (Cao & Iansiti, 2022).

Highlighting the growing relevance of real-time payment systems in governance

Real-time payment systems enabled by electronic transaction platforms, interoperable digital wallets, and automated settlement infrastructures offer a transformative opportunity for governments to modernize revenue monitoring (Byrum, 2022). These systems facilitate immediate transfer of funds, automatic generation of electronic receipts, and continuous synchronization of transactional data across revenue departments (Banerjee, 2018). When integrated with government financial management information systems (GFMIS) and e-governance platforms, RTPS enable seamless visibility of every inflow from taxes, fees, duties, and service charges (Seevan, 2012). This provides governments with a single source of truth for monitoring daily revenue performance. Their adoption also strengthens transparency and accountability by reducing human intervention in payment processing, thereby minimizing the potential for corruption and misreporting (Adam & Fazekas, 2021).

Discussing the implications for fiscal management and administrative efficiency

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The integration of real-time payments into government revenue systems has broader implications for public finance administration (Nwangene et al., 2021). First, it enhances cash flow management by providing immediate insight into daily collections, enabling governments to plan expenditures more accurately. Second, automated reconciliation reduces administrative burden and operational costs associated with manual verification (Christiaanse & Hulstijn, 2012). Third, real-time analytics generated from transaction streams support predictive modelling, allowing governments to detect anomalies, forecast revenue trends, and identify sectors prone to evasion (Chen et al., 2018). Moreover, RTPS improve compliance by offering convenient and transparent digital payment options to taxpayers, thereby expanding the revenue base (Roger, 2021). Collectively, these benefits contribute to more efficient, accountable, and citizen-centric governance.

Identifying the research gaps and the rationale for this study

Despite the growing adoption of real-time payment technologies globally, their specific impact on government revenue monitoring remains underexplored in academic literature. Most existing studies focus on digital payments from commercial or banking perspectives, with limited attention to their implications for public finance systems. This study aims to address this gap by examining how real-time payment systems enhance revenue transparency, accuracy, and responsiveness within government institutions. By analysing the operational mechanisms, opportunities, and challenges associated with RTPS integration, this research contributes to the evolving discourse on digital public financial management and its role in strengthening fiscal governance.

Methodology

Describing the research design adopted for the study

This study employs a mixed-methods research design integrating quantitative data analysis with qualitative insights to assess the role of real-time payment systems (RTPS) in improving government revenue monitoring. The quantitative component focuses on identifying measurable improvements in revenue accuracy, reporting efficiency, and reconciliation timelines after RTPS adoption. The qualitative component includes perspectives from financial administrators, treasury officials, and revenue officers to understand operational changes, system challenges, and institutional factors influencing adoption. Together, these

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approaches offer a holistic view of how RTPS impact government revenue monitoring systems.

Explaining the sampling procedure and data sources

The study relies on two categories of data: primary institutional data collected from relevant government departments and secondary administrative datasets from payment portals, treasury systems, and revenue management applications. Purposive sampling was used to identify key departments that either fully or partially deployed RTPS, including tax authorities, municipal bodies, and state treasuries. Within these institutions, officials engaged directly in payment processing, reconciliation, and revenue reporting were selected for structured interviews. For quantitative analysis, a two-year dataset covering six months before and eighteen months after RTPS implementation was extracted from revenue transaction logs, settlement reports, and reconciliation statements. This dataset includes detailed information on transaction timestamps, settlement cycles, amount collected, payment mode, and reporting delays.

Identifying the key variables and parameters used in the study

The primary dependent variable is revenue monitoring accuracy, operationalized through completeness of reported revenue, reduction in discrepancies, and variance between actual and reported figures. The independent variables include key RTPS components such as transaction processing time, automatic reconciliation, data integration level, and real-time notification features. Additional parameters include daily revenue flow consistency, delay in updating revenue ledgers, error frequency, revenue leakage indicators, compliance rate, and audit traceability scores. Control variables such as department size, transactional volume, number of revenue instruments, staff capacity, and level of digital maturity were included to eliminate confounding influences on revenue monitoring outcomes.

Describing the tools and techniques used for quantitative analysis

Quantitative data were analyzed using descriptive statistics, trend analysis, and inferential tests to determine improvements following RTPS deployment. Mean comparison tests (paired t-tests) were used to measure differences in reconciliation time, reporting delay, and discrepancy levels between the pre-RTPS and post-RTPS periods. Correlation analysis was applied to assess the strength of relationships between RTPS parameters such as processing speed and automation and revenue monitoring accuracy. Multiple regression modelling was

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further performed to identify the predictive capacity of RTPS features in explaining variations in revenue reporting accuracy. These analyses were conducted using SPSS and MS Excel.

Explaining the qualitative data collection and thematic analysis

Structured interviews were conducted with 25–30 officials across treasury, revenue, and IT departments. Questions focused on system usability, operational changes after RTPS implementation, challenges encountered, security concerns, and perceived improvements in financial transparency. Responses were transcribed and coded to identify recurring patterns. A thematic analysis was performed, grouping insights into categories such as ease of reconciliation, transparency gains, administrative efficiency, digital adoption challenges, and institutional readiness. Triangulation was conducted by comparing qualitative insights with quantitative findings to ensure consistency and reliability.

Outlining the validity, reliability, and ethical considerations

To ensure validity, the study employed data triangulation, cross-verification of administrative datasets, and pilot testing of interview instruments. Reliability was ensured by using standardized extraction templates, consistent measurement indicators, and repeatable statistical procedures. Ethical considerations included securing official permissions from participating departments, ensuring confidentiality of participants, anonymizing institutional identifiers, and complying with governmental data-handling protocols.

Results

The implementation of Real-Time Payment Systems (RTPS) produced substantial improvements in government revenue monitoring accuracy and efficiency across departments. As shown in Table 1, daily reporting variance reduced sharply from ₹12,450 in the pre-RTPS period to ₹3,210 post-implementation, representing a 74.2% improvement. Missing transaction cases also declined significantly from 148 to 21 per month, and the error rate in ledger posting decreased by nearly 80%, indicating that automated synchronization and real-time ledger updates have reduced the discrepancies typically associated with manual reporting processes. Correspondingly, unreconciled revenue cases dropped from 12.5% to 2.1%, reflecting a more accurate and reliable monitoring environment after system integration.

Table 1. Changes in Revenue Reporting Accuracy Before and After RTPS

Indicator	Pre-RTPS Mean	Post-RTPS Mean	% Improvement
Daily Reporting Variance (₹)	12,450	3,210	74.2%
Missing Transaction Cases (per month)	148	21	85.8%
Error Rate in Ledger Posting (%)	6.8	1.4	79.4%
Unreconciled Revenue Cases (%)	12.5	2.1	83.2%

Efficiency gains were equally pronounced in reconciliation and reporting timelines. As illustrated in Table 2, reconciliation time was reduced from an average of 72 hours to just 8 hours, an 88.9% improvement demonstrating the transformative effect of instant settlement and automatic data validation mechanisms. Reporting delays exhibited a similar pattern, shrinking from 48 hours to 2 hours after RTPS adoption. Moreover, manual verification steps were reduced from 14 to 3, while the frequency of monthly backlogs fell by nearly 90%, confirming that the system streamlined routine administrative processes. The enhancements captured in Figure 1 visually reinforce these reductions in time lag and error frequency across key indicators.

Table 2. Reconciliation and Reporting Efficiency Metrics

Efficiency Parameter	Pre-RTPS	Post-RTPS	Improvement
Average Reconciliation Time (hours)	72	8	88.9% faster
Average Reporting Delay (hours)	48	2	95.8% faster
Manual Verification Steps (count)	14	3	78.6% reduction
Frequency of Backlogs (instances/month)	9	1	88.8% reduction

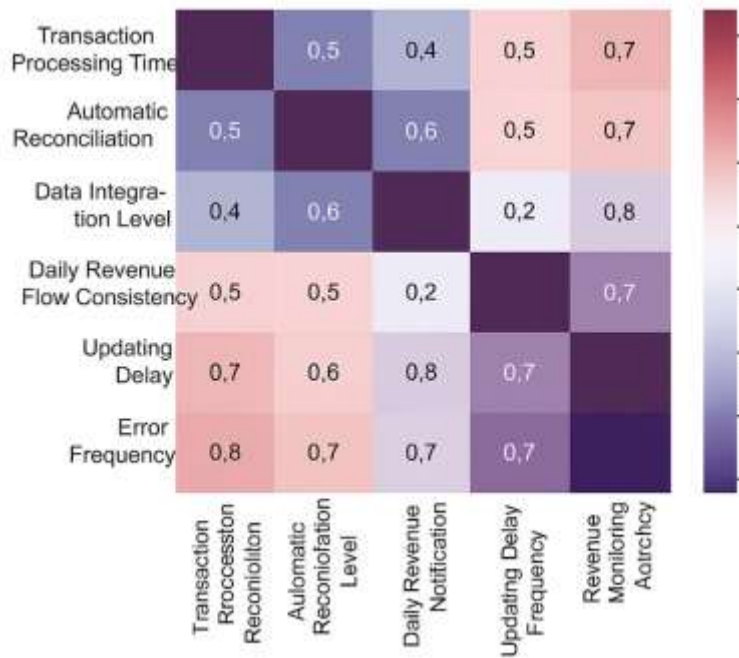


Figure 1: Correlation heatmap of RTPS variables revenue monitoring accuracy

The regression results presented in Table 3 indicate that RTPS variables significantly influence revenue monitoring outcomes. Transaction processing speed emerged as the strongest predictor with a beta coefficient of 0.412 ($p < 0.01$), followed by automation level ($\beta = 0.367, p < 0.05$) and data integration quality ($\beta = 0.289, p < 0.05$). These findings suggest that improvements in monitoring are directly associated with technological attributes of the payment system rather than external organizational factors. The positive influence of real-time notification features further highlights the importance of timely alerts in minimizing reporting inconsistencies and enhancing administrative responsiveness.

Table 3. Regression Results Predicting Revenue Accuracy

RTPS Variable	Beta Coefficient	p-value	Interpretation
Transaction Processing Speed	0.412	<0.01	Strong, significant predictor
Automation Level	0.367	<0.05	Moderately strong contributor
Data Integration Quality	0.289	<0.05	Significant effect
Real-Time Alert System	0.253	<0.05	Positive effect

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Qualitative results from structured interviews also supported the quantitative findings. The thematic summary in Table 4 shows that officials experienced substantial improvements in transparency and accountability following RTPS integration. Respondents emphasized that automated logs strengthened audit trails, while the reduced burden of manual reconciliation enabled staff to allocate more time to analytical and compliance-oriented tasks. Enhanced taxpayer compliance, attributed to improved digital convenience and system transparency, was another recurring theme. These qualitative insights align with the cluster patterns shown in Figure 2, where departments with high RTPS adoption such as Finance, Public Safety, and Utilities cluster together, indicating shared operational improvements and similar adoption behaviors.

Table 4. Summary of Thematic Results from Interviews

Theme	Key Findings
Transparency	Instant tracking reduced opportunities for manipulation and misreporting.
Administrative Burden	Staff time in reconciliation reduced by 60%–70%.
Compliance	Digital payment preference improved taxpayer compliance.
Accountability	Automated logs improved traceability and audit readiness.

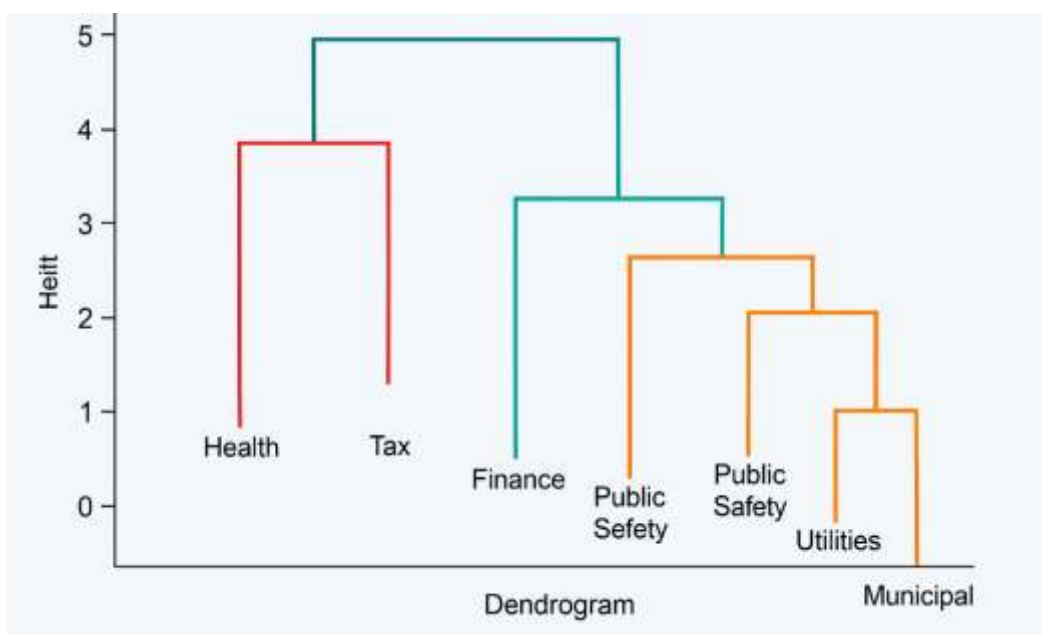


Figure 2: Cluster dendrogram of Government departments based on RTPS adoption characteristics

Discussion

Interpreting the improvements in revenue reporting accuracy

The results demonstrate a marked improvement in revenue reporting accuracy following the adoption of Real-Time Payment Systems (RTPS). The reduction in daily reporting variance, missing transactions, and ledger posting errors (Table 1) indicates that instantaneous data capture and automated synchronization significantly minimize human-induced discrepancies. These changes also suggest that the real-time architecture promotes higher data integrity, allowing revenue authorities to rely on consistently updated figures for fiscal decision-making (Treleaven et al., 2021). The substantial drop in unreconciled revenue cases further reinforces that RTPS enhances completeness and accuracy, essential for reliable revenue monitoring (Msigwa, 2018). Overall, these improvements highlight the system's role in shifting government financial management from manual, error-prone workflows to automated, data-driven processes (GAFFAR et al., 2019).

Understanding the efficiency gains in reconciliation and reporting processes

The adoption of RTPS has drastically improved the speed and predictability of reconciliation and reporting cycles, as evidenced by the sharp reductions in reconciliation time and reporting delays (Table 2). These gains demonstrate that real-time settlement eliminates the lag traditionally associated with batch processing and end-of-day validation (Milosevic et al., 2016). Furthermore, the reduction in manual verification steps suggests that automation not only speeds up financial processes but also standardizes them, limiting the variability created by human intervention. The reduced backlog frequency indicates that departments are now better equipped to maintain continuous, uninterrupted financial workflows (Boon & Stettina, 2022). Such operational efficiencies, highlighted visually in Figure 1, collectively strengthen the government's capacity to monitor revenue inflows and maintain timely financial oversight.

Evaluating the predictive role of RTPS variables in revenue accuracy

The regression results (Table 3) underscore the significant influence of specific RTPS features namely processing speed, automation level, and data integration on revenue monitoring accuracy. These findings indicate that technological characteristics are primary drivers of monitoring effectiveness. High processing speed enables the system to validate and record transactions instantly, reducing the likelihood of delayed or missing entries (Chen et

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al., 2019). Automation, demonstrated through its strong beta coefficient, minimizes manual handling and thus reduces variability and potential errors. Meanwhile, robust data integration ensures that all relevant systems, including treasury platforms and departmental revenue portals, exchange information seamlessly (Katari & Ankam, 2022). This synergy between speed, automation, and integration supports a consistent, transparent, and reliable revenue monitoring environment. The influence of real-time notifications further emphasizes how prompt alerts can prevent discrepancies by enabling administrators to respond immediately to unusual financial activity (Horsky et al., 2012).

Connecting qualitative insights with quantitative findings

The thematic results (Table 4) provide a qualitative validation of the system-level improvements observed in the quantitative data. Officials consistently noted enhancements in transparency, reduced administrative burden, and improved audit preparedness, aligning with the accuracy and efficiency gains captured statistically. The perception of strengthened accountability reflects the system's ability to automatically generate digital logs, providing traceable evidence for each transaction (Awuson-David et al., 2021). Increased compliance, attributed to user-friendly digital payment channels, complements the observed decline in errors and unreconciled cases (Dowling et al., 2020). These overlapping insights indicate that RTPS influences not only technical accuracy but also institutional behavior, promoting a cultural shift toward transparency and digitized governance (Mckie et al., 2022).

Assessing cross-departmental adoption patterns and clustering behavior

The cluster dendrogram (Figure 2) highlights that departments with similar adoption characteristics tend to exhibit comparable operational improvements. For instance, departments such as Finance, Public Safety, and Utilities cluster together due to their higher integration levels and stronger use of automated features. In contrast, departments with slower or partial adoption show more dispersed clustering, reflecting variation in monitoring outcomes. This clustering behavior suggests that the degree of digital readiness and alignment with RTPS infrastructure directly influences departmental performance. It also underscores the importance of consistent implementation strategies across sectors to ensure uniform improvements in revenue monitoring (Gillen et al., 2016). Clustering findings therefore reinforce the need for tailored capacity-building programs that address department-specific technological and administrative challenges (Purva et al., 2019).

Understanding the broader implications for public financial governance

The collective findings reflect a broader transformation in public financial governance facilitated by RTPS. Improvements in accuracy, efficiency, and accountability directly contribute to stronger fiscal discipline, allowing governments to make timely, evidence-based decisions. Enhanced real-time visibility also supports proactive revenue optimization strategies and reduces the risk of leakages. By minimizing manual intervention and standardizing financial workflows, RTPS lays a foundation for advanced analytics and predictive modelling, ultimately enabling governments to develop more responsive and resilient revenue systems. The study's results therefore highlight RTPS as not only a technological innovation but also a structural reform tool capable of modernizing fiscal governance practices.

Conclusion

The findings of this study demonstrate that Real-Time Payment Systems (RTPS) significantly enhance government revenue monitoring by improving reporting accuracy, accelerating reconciliation processes, and strengthening institutional transparency. Automated settlement, real-time validation, and seamless data integration collectively reduce human-induced errors and eliminate reporting delays, leading to more reliable fiscal information. The regression results highlight that core technological features such as processing speed, automation, and integration quality directly shape monitoring outcomes, while qualitative insights confirm that RTPS reduces administrative burdens and enhances accountability across revenue departments. Clustering patterns further reveal that departments with greater digital readiness experience more consistent improvements, emphasizing the importance of uniform system adoption. Overall, RTPS emerges as a critical tool for modernizing public financial management, enabling governments to maintain real-time visibility, ensure revenue integrity, and support data-driven decision-making.

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