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Performance of VAT Revenue Collection in Tanzania: An ARDL Approach on selected Macro-Economic Variables

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ABSTRACT

Value-Added Tax (VAT) is a cornerstone of revenue mobilization in Tanzania, yet its dynamic relationship with core macroeconomic drivers remains empirically underexplored. This study investigates the short- and long-run determinants of VAT revenue performance in Tanzania from 2006/07 to 2021/22. Utilizing an Autoregressive Distributed Lag (ARDL) bounds testing approach, we analyze the impact of nominal GDP and inflation on VAT collections. While the informal sector size and VAT taxpayer registration were initially considered, diagnostic tests revealed prohibitive multicollinearity, leading to their exclusion from the final model, an instructive finding that highlights critical data and structural challenges for tax policy. The results indicate a significant positive immediate effect of economic growth on VAT revenue. However, the long-run GDP coefficients are negative, suggesting a complex, lagged adjustment mechanism. Contrary to the traditional Tanzi effect, inflation shows a modest but persistent positive influence in the short run. The study concludes that Tanzanian VAT collections are predominantly influenced by current economic activity and exhibit strong internal persistence. We recommend policies focused on sustaining formal economic growth and improving tax base measurement to enhance VAT revenue predictability and performance.

Keywords: VAT revenue performance; ARDL model; Tax buoyancy; Tanzania; Macroeconomic determinants.

INTRODUCTION

The Value-Added Tax (VAT) has evolved into a dominant instrument of indirect taxation and a critical source of government revenue worldwide, adopted by over 170 countries (OECD, 2020). Its theoretical efficiency as a broad-based consumption tax, which mitigates the cascading effects of predecessor sales taxes, underpins its widespread adoption (Gale, 2024; Gerard & Naritomi, 2018). In developing economies, particularly in Africa, the performance of VAT systems is pivotal for domestic resource mobilization, yet it often falls short of potential due to structural and administrative challenges (ATAF, 2018; Ebrill et al., 2022).

The Tanzanian context exemplifies this global relevance and local challenge. Enacted to replace the Sales Tax Act of 1976, the VAT system, governed by the Value Added Tax Act, Cap 148 R.E 2019, has undergone significant reforms, most notably the VAT Act of 2014. Despite these efforts, studies indicate persistent performance gaps. Nguvava and Athanas (2022) identified a substantial number of unregistered eligible taxpayers and estimated VAT's contribution to GDP at 3.6%, below both the national target of 6% and the East African Community average of 4.4%. This underscores a pressing need to understand the fundamental drivers of VAT revenue in the Tanzanian economy.

Existing literature provides a foundation, identifying key macroeconomic variables that influence VAT collections. Empirical evidence from various contexts suggests a generally positive relationship between GDP growth and VAT revenue, as economic expansion stimulates consumption (Rai, 2024; Tricahyono & Wijaya, 2024). The relationship with inflation is more nuanced; while the classic Olivera-Tanzi effect posits that inflation erodes real tax revenue due to collection lags (Tanzi, 1977), nominal price increases can lead to higher nominal VAT yields in the short term (Ayonete, 2023). Furthermore, institutional factors like the size of the informal sector and taxpayer registration rates are consistently highlighted as critical determinants of VAT efficiency, as they directly define the practical tax base (Andini & Wijaya, 2024; Schoeman et al., 2022).

However, a conspicuous gap exists in the Tanzanian empirical landscape. While prior studies have highlighted registration gaps and calculated efficiency ratios, there is a lack of rigorous, dynamic econometric analysis that quantifies the simultaneous short- and long-run elasticity of VAT revenue to its core macroeconomic determinants. Most analyses are static or descriptive, failing to capture the adjustment processes and lagged effects inherent in fiscal and economic systems. This study directly addresses this gap.

The primary objective of this paper is to empirically model and analyze the dynamic relationship between VAT revenue and selected macroeconomic variables in Tanzania. Employing an ARDL bounds testing approach, a methodology robust to small samples and mixed orders of integration, we specifically investigate the short-run impacts and long-run equilibria between VAT collections, GDP, and inflation. A critical, albeit unintended, ancillary finding of our diagnostic process is the severe multicollinearity that precluded the inclusion of the informal sector size and taxpayer registration variables in the econometric model. This itself is a significant result, speaking to the deep interconnection of economic structures in Tanzania and the challenges of isolating their individual effects.

This research contributes to the literature in two key ways. First, it provides the first application of the ARDL framework to model Tanzanian VAT revenue dynamics, offering nuanced insights into lagged effects and adjustment paths. Second, the methodological confrontation with multicollinearity offers a critical discussion point for tax policy research in similar developing economies, where structural variables are often intrinsically linked. The findings are intended to inform more evidence-based fiscal policy, emphasizing levers that can enhance VAT revenue performance and sustainability in Tanzania.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

The performance of Value-Added Tax (VAT) revenue is a function of both macroeconomic conditions and the structural characteristics of the tax base. This section reviews the theoretical underpinnings and empirical literature concerning the primary determinants of VAT revenue, with a particular focus on findings relevant to developing economies. It synthesizes knowledge across four core themes: (1) economic growth and tax buoyancy, (2) inflation and the Olivera-Tanzi effect, (3) tax base formalization and compliance, and (4) the informal sector's constraining role. This review culminates in the identification of a critical gap in the Tanzanian context and the formal presentation of this study's analytical framework.

Economic Growth and VAT Buoyancy: Theoretical and Empirical Linkages

The foundational relationship between economic growth and tax revenue is captured by the concept of tax buoyancy, the responsiveness of tax collections to changes in national income. The Keynesian theory of taxation, while primarily focused on fiscal policy as a tool for demand management, establishes the fundamental link between macroeconomic aggregates and government revenue (Asimakopulos, 2023). From this perspective, a growing economy, characterized by rising aggregate demand, increased consumption, and higher imports, should naturally expand the nominal base for a broad-based consumption tax like VAT.

Empirical studies across diverse contexts largely confirm this positive relationship. In a study of ASEAN countries, Tricahyono and Wijaya (2024) found GDP to have a significant positive impact on VAT revenue, a finding echoed in Nepal by Rai (2024). The mechanism is straightforward: economic growth elevates household and corporate incomes, leading to greater expenditure on taxable goods and services. For a country like Tanzania, where VAT on imports constitutes a significant share of total VAT collections (as shown in Table 2), GDP growth linked to import demand is a particularly crucial channel. However, the relationship is not always unitary or stable over time. Studies such as Acosta-Ormaechea and Morozumi (2021) suggest that long-term improvements in VAT revenue relative to GDP are often driven more by gains in *C-efficiency* (a measure of policy design and compliance) than by automatic growth responses. This distinction between automatic buoyancy and discretionary improvements in tax system efficiency is vital for policy analysis.

Inflation and the Olivera-Tanzi Effect: A Complex Dynamic

The impact of inflation on real tax revenue presents a more complex theoretical and empirical puzzle, central to which is the Olivera-Tanzi effect (Tanzi, 1977). This theory posits that in the presence of administrative lags between the accrual (transaction point) and the actual collection of taxes, high inflation erodes the real value of government revenue. As prices rise, the nominal tax collected on a transaction made earlier is worth less in real terms by the time it reaches the treasury. For VAT, which is typically collected with a lag of one to two months, this effect can be significant during periods of high and volatile inflation.

The empirical evidence, however, reveals context-dependent outcomes. Ayonete (2023) found a negative effect of inflation on tax revenues in Nigeria, aligning with the Tanzi effect. Conversely, some studies, including findings from ASEAN countries, show ambiguous or even positive short-run relationships (Tricahyono & Wijaya, 2024). This apparent contradiction can be reconciled by considering two offsetting forces: the *real* *value erosion* effect (Tanzi) and a *nominal expansion* effect. In the short run, if consumption expenditures rise nominally with inflation, the VAT collected on these higher nominal values may increase, potentially masking the real erosion. The net effect likely depends on the inflation rate's level and stability, the efficiency of the tax administration in minimizing collection lags, and the indexing of specific goods within the consumption basket. Analyzing this dynamic for Tanzania is crucial, given its episodes of moderate inflation volatility (peaking at 16% in the study period).

Formalizing the Tax Base: Registration, Compliance, and Administration

Beyond macroeconomic aggregates, the institutional and administrative dimensions of a tax system are critical determinants of its revenue performance. A broad and compliant taxpayer base is the bedrock of an effective VAT system. Studies consistently identify low taxpayer registration and compliance as primary constraints on VAT performance in developing countries (Schoeman et al., 2022; OECD, 2020). In Indonesia, Andini and Wijaya (2024) directly link noncompliance and registration gaps to suboptimal VAT yields. Similarly, Anjulo (2018) recommends improving taxpayer identification and registration as a key strategy to boost VAT collection in Ethiopia.

The theoretical basis for this lies in the concept of the *compliance gap*, the difference between tax legally due and tax actually collected. The *policy gap* (revenue forgone due to exemptions and reduced rates) and the compliance gap together explain deviations from optimal VAT revenue (Keen, 2013). Administrative reforms that enhance registration, filing, and payment compliance directly reduce the compliance gap. For Tanzania, the findings of Nguvava and Athanas (2022), who identified thousands of unregistered eligible taxpayers, point directly to a significant compliance gap. Therefore, the variable "VAT taxpayer registration efficiency" is not merely a statistical control but a proxy for the state's administrative capacity to harness its legal tax base.

The Constraining Shadow: The Informal Economy

Closely related to compliance is the structural challenge of a large informal sector. The informal sector, comprising economic activities operating outside formal regulatory and taxation frameworks, represents a vast, untapped, or partially tapped VAT base. A large informal sector shrinks the effective tax base, fosters unfair competition for formal businesses, and can perpetuate a culture of non-compliance (Gerard & Naritomi, 2018). The African Tax Administration Forum (ATAF, 2018) explicitly notes that VAT performance remains suboptimal across Africa, with the informal economy being a key contributing factor.

The empirical challenge lies in measurement and isolation. The size of the informal sector is often correlated with other macroeconomic variables like GDP per capita and unemployment, and it directly influences registration rates. Studies like that of Muchiri (2014) on Kenya analyze the informal sector's growth as a drag on overall tax revenue performance. Its effect on VAT is particularly acute because informal transactions escape the invoice-credit mechanism of VAT entirely, creating both a revenue loss and a distortion in input markets for formal businesses that cannot claim credits on purchases from informal suppliers.

Synthesis and Identification of the Research Gap

The reviewed literature establishes a clear set of expected relationships: a positive association with GDP, a potentially negative or complex relationship with inflation, and a positive association with formalization (registration) coupled with a negative association with informality. Empirical models of VAT revenue, such as those by Kunwar (2023) using ARDL in Nepal and Poudel (2022), frequently incorporate these variables.

However, a significant gap exists in the application of this analytical framework to Tanzania. While descriptive and ratio-based analyses of Tanzanian VAT exist (e.g., Nguvava & Athanas, 2022), there is a lack of rigorous econometric studies that:

1. **Employ a dynamic model** (like ARDL) capable of distinguishing between short-run effects and long-run equilibrium relationships among these variables.
2. **Simultaneously test** the joint influence of these interconnected macroeconomic and structural determinants in the specific post-2014 VAT reform context of Tanzania.
3. **Empirically confront the methodological challenges** (e.g., multicollinearity) that arise when modeling these deeply intertwined real-world phenomena.

Analytical Framework for the Present Study

This study is designed to address this gap. We adopt a multivariate time-series framework to model Tanzanian VAT revenue (VAT_t) as a function of its key hypothesized determinants:

$$VAT_t = f(GDP_t, INF_t, REG_t, INFM_t)$$

Where:

- GDP_t = Nominal Gross Domestic Product (capturing the scale of economic activity).
- INF_t = Inflation Rate (capturing the Olivera-Tanzi and nominal expansion effects).
- REG_t = VAT Taxpayer Registration Efficiency (capturing administrative reach and compliance).
- $INFM_t$ = Size of the Informal Sector (capturing the structural constraint on the tax base).

Guided by Keynesian theory on aggregate demand-tax linkages and the Olivera-Tanzi hypothesis on inflation, we postulate initial expectations of positive, negative, positive, and negative coefficients for GDP_t, INF_t, REG_t, and $INFM_t$, respectively. Crucially, we employ the ARDL bounds testing approach of Pesaran et al. (1999). This method is expressly chosen for its robustness in estimating both short-run dynamics and long-run cointegrating relationships with variables that may be integrated of different orders [I(0) or I(1)], a common feature of macroeconomic data. It is particularly suited to the relatively small sample size available for this study. The subsequent methodology section details the operationalization of this framework, variable measurement, and diagnostic procedures.

METHODOLOGY AND DATA

This section details the empirical strategy employed to analyze the determinants of VAT revenue performance in Tanzania. It outlines the research design, describes the data sources and variable construction, and specifies the econometric model. A key focus is justifying the use of the Autoregressive Distributed Lag (ARDL) bounds testing approach and transparently addressing data limitations, including the critical issue of multicollinearity.

Research Design

This study adopts a quantitative research design using secondary time-series data to examine both the descriptive trends and the dynamic econometric relationships influencing VAT revenue. The design proceeds in two integrated stages:

1. **Descriptive and Ratio Analysis:** To assess the historical performance and structural composition of VAT revenue (e.g., domestic vs. import shares) and calculate standard efficiency metrics like the VAT-to-GDP ratio and C-efficiency ratio.
2. **Econometric Analysis:** To empirically estimate the short-run and long-run elasticities of VAT revenue with respect to key macroeconomic variables using the ARDL cointegration framework.

This two-stage approach provides a comprehensive view, where descriptive statistics contextualize the econometric findings, and the econometric model offers causal inference on the observed trends.

Data Sources and Variable Measurement

The study utilizes annual time-series data for Tanzania covering 16 fiscal years from 2006/07 to 2021/22. Data were meticulously compiled from authoritative national and international sources to ensure reliability.

- **Primary Dependent Variable:**
    - **VAT Revenue (VAT):** Total annual VAT collections (in Tanzanian Shillings - TZS). Source: Tanzania Revenue Authority (TRA) annual reports.
- **Core Independent Variables:**
    - **Nominal Gross Domestic Product (GDP):** Used as the primary scale variable for the economy. Nominal GDP is preferred over real GDP for modeling nominal tax revenue. Source: Bank of Tanzania (BoT) and National Bureau of Statistics (NBS).
    - **Inflation Rate (INF):** Measured by the annual average percentage change in the Consumer Price Index (CPI). This captures the price-level effect on nominal VAT collections and tests the Tanzi effect. Source: Bank of Tanzania (BoT).
- **Structural/Institutional Variables (Subject to Diagnostic Testing):**
    - **VAT Taxpayer Registration Efficiency (REG):** Constructed as the ratio of registered VAT taxpayers to an estimate of eligible business entities. This variable proxies for the administrative breadth of the tax net. Source: TRA administrative data and NBS establishment surveys.
    - **Size of the Informal Sector (INFMS):** The most challenging variable to measure. This study employs a proxy based on the ratio of non-agricultural informal employment to total non-agricultural employment, as estimated and reported by the NBS and complemented by World Development Indicators. We acknowledge this is an imperfect proxy but a standard approach in the literature for economies like Tanzania.

All monetary variables (VAT, GDP) are expressed in nominal terms and transformed into natural logarithms for elasticity interpretation. Inflation is used in its percentage point form for the ARDL model, as it is already a rate of change.

Analytical Framework: The ARDL Bounds Testing Approach

To analyze the dynamic relationships, we employ the Autoregressive Distributed Lag (ARDL) bounds testing cointegration procedure developed by Pesaran, Shin, and Smith (2001). This approach is selected for three compelling reasons pertinent to our study:

1. **Flexibility in Integration Orders:** It can be applied irrespective of whether the underlying regressors are purely I(0), purely I(1), or mutually cointegrated, which is a common feature of macroeconomic time-series data.
2. **Superior Small-Sample Performance:** It provides more reliable and efficient estimates in finite samples (like our n=16) compared to traditional cointegration tests (e.g., Johansen).
3. **Simultaneous Estimation:** It allows for the unbiased estimation of both short-run dynamics and the long-run equilibrium relationship within a single, consistent model.

The general ARDL($p, q_1, q_2, \ldots, q_k$) model for our system can be specified as:

$$\begin{aligned}\Delta\ln(VAT_t) = {} & \alpha_0 + \beta_0 \ln(VAT_{t-1}) + \beta_1 \ln(GDP_{t-1}) + \beta_2 INF_{t-1} + \beta_3 REG_{t-1} + \beta_4 INFMS_{t-1} \\ & + \sum_{i=1}^{p-1} \phi_i \,\Delta\ln(VAT_{t-i}) + \sum_{j=0}^{q_1-1} \gamma_j \,\Delta\ln(GDP_{t-j}) + \sum_{k=0}^{q_2-1} \delta_k \,\Delta INF_{t-k} \\ & + \sum_{l=0}^{q_3-1} \theta_l \,\Delta REG_{t-l} + \sum_{m=0}^{q_4-1} \omega_m \,\Delta INFMS_{t-m} + \varepsilon_t\end{aligned}$$

Where Δ is the first-difference operator, α_0 is the constant, p and q are the optimal lag lengths, and ε_t is the white-noise error term.
The bounds test for cointegration involves an F-test on the joint null hypothesis that the coefficients on the level variables are zero ($\beta_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$). If the computed F-statistic exceeds the upper critical bound, a stable long-run relationship exists.

Diagnostic and Pre-Estimation Procedures
A rigorous pre-estimation and diagnostic protocol is essential for valid inference.

1. **Stationarity Testing:** While ARDL does not require all variables to be I(1), testing for the order of integration remains crucial to ensure no variable is I(2), which would invalidate the procedure. We employ both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests.
2. **Optimal Lag Selection:** The appropriate lag structure ($p, q_1, \ldots$) is selected using the Akaike Information Criterion (AIC), as it is preferable for smaller samples.
3. **Confronting Multicollinearity:** Given the high theoretical correlation between GDP, the informal sector (INFMS), and registration (REG), we explicitly test for multicollinearity using the Variance Inflation Factor (VIF). A VIF > 10 indicates severe multicollinearity that can render coefficient estimates unstable and uninterpretable. **Our analytical strategy is transparent:** we will estimate the full theoretical model first. If diagnostic tests confirm severe multicollinearity that undermines model integrity, we will proceed with a robust, parsimonious model containing only the orthogonal macroeconomic variables (GDP and Inflation) to provide reliable estimates for those core relationships. The omission of REG and INFMS due to statistical constraints will itself be analyzed as a substantive result reflecting Tanzania's economic structure.

4. **Post-Estimation Diagnostics:** The final model will be checked for serial correlation (Breusch-Godfrey test), heteroskedasticity (White test), functional form (Ramsey RESET test), and parameter stability (CUSUM test).

Model Specification and Variable Inclusion Strategy

Guided by the diagnostics, the empirical investigation will follow a two-model strategy:

- **Model A (Theoretical Benchmark):** Includes all variables: $\ln(VAT) = f(\ln(GDP), INF, REG, INFMS)$.
- **Model B (Parsimonious Core Model):** If multicollinearity is prohibitive, estimates the robust core relationship: $\ln(VAT) = f(\ln(GDP), INF)$.

This strategy ensures methodological rigor. The failure to cleanly estimate Model A is not a shortcoming but an empirical finding that underscores a key characteristic of the Tanzanian economy: the deep interconnection between economic scale, formalization, and informality, making their isolated effects statistically inseparable with available data. The results from Model B will therefore provide the reliable, central macroeconomic elasticities, while the diagnostic process for Model A offers critical contextual insight.

METHODOLOGY

Research design

The study adopts a quantitative descriptive design to provide a systematic assessment of Value Added Tax performance in Tanzania. The design is appropriate because it allows for analyzing historical trends in VAT revenue performance, while allowing for both a systematic description of VAT trends and an examination of causal relationships between VAT revenue and macroeconomic variables. It embraced a quantitative approach since it applied econometric and statistical techniques to measure the VAT performance.

Nature and source of data

The study used secondary data (Time series) that were systematically collected through document review from the Tanzania Revenue Authority (TRA), National Bureau of Statistics (NBS), and Bank of Tanzania (BoT), as well as international databases including the World Bank and International Monetary Fund (IMF). This multi-source approach ensures data reliability and provides a foundation for statistical analysis of VAT performance. The data covers 16 fiscal years from 2006/07 to 2021/22, capturing periods of significant VAT reform and economic change in Tanzania.

Analytical Framework and Model Specification

Efficiency Ratios

To evaluate the structural performance of the VAT system, the study employs two internationally recognized efficiency indicators:

1. **VAT Efficiency Ratio (ER):** $ER = R/(Y \times r)$, where R is VAT revenue, Y is nominal GDP, and r is the standard VAT rate. This measures revenue collection against the theoretical maximum if VAT were applied to the entire economy.
2. **C-Efficiency Ratio (CER):** $CER = R/(FC \times r)$, where FC is final consumption expenditure. This provides a more refined measure of how effectively the VAT system captures final consumption, the ideal tax base.

The Autoregressive Distributed Lag (ARDL) Model

To estimate the dynamic relationships between VAT revenue and its determinants, the study employs the ARDL bounds testing approach of Pesaran, Shin, and Smith (2001).

This method was specifically selected for its suitability given the characteristics of our data:

1. It is robust with small sample sizes (n=16 in our study)
2. It can accommodate variables with different orders of integration [I(0) or I(1)]
3. It simultaneously estimates both short-run dynamics and long-run equilibrium relationships

The general theoretical relationship is specified as:

$$\text{VAT revenue} = f(\text{GDP, Inflation, VAT taxpayer registration, Informal sector size})$$

The empirical ARDL model in natural logarithmic form (except for inflation, which is a rate) is specified as:

$$\begin{aligned}\Delta\ln(\text{VAT}_t) = \quad & \alpha + \sum_{i=1}^{p}\beta_i\,\Delta\ln(\text{VAT}_{t-i}) + \sum_{j=0}^{q_1}\gamma_j\,\Delta\ln(\text{GDP}_{t-j}) + \sum_{k=0}^{q_2}\delta_k\,\Delta\text{Inflation}_{t-k} \\ & + \sum_{l=0}^{q_3}\theta_l\,\Delta\ln(\text{REG}_{t-l}) + \sum_{m=0}^{q_4}\omega_m\,\Delta\ln(\text{INFMS}_{t-m}) \\ & + \lambda_1\ln(\text{VAT}_{t-1}) + \lambda_2\ln(\text{GDP}_{t-1}) + \lambda_3\text{Inflation}_{t-1} \\ & + \lambda_4\ln(\text{REG}_{t-1}) + \lambda_5\ln(\text{INFMS}_{t-1}) + \varepsilon_t\end{aligned}$$

Where:

- Δ is the first-difference operator
- α is the constant term
- p, q_1, q_2, q_3, q_4 are optimal lag lengths selected using the Akaike Information Criterion (AIC)
- The terms with λ coefficients represent the long-run relationships
- ε_t is the white-noise error term

Variable Construction and Measurement

- **VAT Revenue:** Total nominal VAT collections in Tanzanian Shillings (TZS), transformed using natural logarithm.
- **GDP:** Nominal Gross Domestic Product (TZS), in natural logarithm. Nominal rather than real GDP is used as it corresponds directly to nominal tax collections.
- **Inflation:** Annual percentage change in the Consumer Price Index (CPI). Entered in level form as it is already a rate variable.
- **VAT Taxpayer Registration (REG):** Measured as the ratio of registered VAT taxpayers to an estimate of tax-eligible business entities, expressed in natural logarithm.
- **Informal Sector Size (INFMS):** Estimated using the non-agricultural informal employment share of total non-agricultural employment, from NBS and World Bank data, in natural logarithm.

Diagnostic Testing and Estimation Strategy

A comprehensive diagnostic protocol was implemented to ensure robust results:

1. **Stationarity Tests:** Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were conducted to determine the order of integration of each variable and verify that no variable is I(2), which would invalidate the ARDL approach.

2. **Cointegration Test:** The bounds testing procedure was employed to test for the existence of a long-run relationship among the variables. The F-test compares the calculated statistic against Pesaran et al.'s (2001) critical values.
3. **Multicollinearity Assessment:** Given the theoretical interrelationships between GDP, informal sector size, and taxpayer registration, Variance Inflation Factor (VIF) analysis was conducted *prior to final model estimation*. This proactive diagnostic approach is crucial for model specification. If severe multicollinearity (VIF > 10) is detected, it necessitates careful model re-specification to avoid unreliable coefficient estimates. This study's approach is to first estimate the full theoretical model, then, guided by diagnostics, present the most robust and interpretable specification. The process of variable inclusion/exclusion based on statistical evidence is itself a meaningful analytical finding regarding the structure of Tanzania's economy.
4. **Model Diagnostics:** Final models were tested for serial correlation (Durbin-Watson, Breusch-Godfrey), heteroskedasticity (Breusch-Pagan), functional form (Ramsey RESET), and stability (CUSUM test).

All analyses were conducted using STATA version 17, employing both built-in commands and specialized routines for ARDL and bounds testing.

FINDINGS AND DISCUSSION

This section presents a comprehensive analysis of the empirical results, structured to first establish the descriptive context of Tanzania's VAT system, then rigorously validate the econometric model, and finally provide an in-depth interpretation of the estimated relationships. The discussion integrates these findings with existing theoretical frameworks and the specific socio-economic context of Tanzania.

Descriptive Analysis of VAT Performance and Structural Trends

Summary Statistics and Data Characteristics

Table 1 presents the descriptive statistics that characterize the key variables over the 16-year study period. These statistics provide important context for interpreting the econometric results.

Table 1: Descriptive Statistics of Key Variables (2006/07 - 2021/22)

Variable	Mean	Standard Deviation	Minimum	Maximum	Observations
VAT Revenue (TZS Million)	4,291,223	2,918,006	1,333,939	12,900,000	16
GDP (Ratio to trend*)	0.1298	0.1327	0.0448	0.5774	16
Inflation Rate (%)	5.92	3.64	3.10	16.00	16
Informal Sector Size (% of employment)	48.76	12.24	34.00	80.00	16
VAT Registration Efficiency (%)	88.03	5.93	78.60	95.20	16

The data reveal several important patterns. First, VAT revenue exhibits substantial variability (coefficient of variation = 0.68), indicating significant fluctuations in collection performance or substantial growth over the period. Second, the informal sector represents a substantial portion of the Tanzanian economy, averaging 48.76% of employment, which has profound implications for the potential VAT base. Third, the inflation rate shows moderate variability with an extreme value of 16%, providing sufficient variation to test its relationship with VAT revenue. The high mean registration efficiency (88.03%) suggests that Tanzania has made significant progress in formalizing its taxpayer base, though the remaining gap represents potential revenue leakage.

Structural Composition of VAT Collections

A detailed analysis of VAT collection sources reveals important structural shifts in Tanzania's revenue base. As shown in Table 2, the period from 2006/07 to 2021/22 witnessed not only substantial growth in total VAT collections (from TZS 883,500 million to TZS 6,297,722.6 million) but also notable changes in the composition between domestic and import-based VAT.

Table 2: VAT Collections by Source (Selected Years)

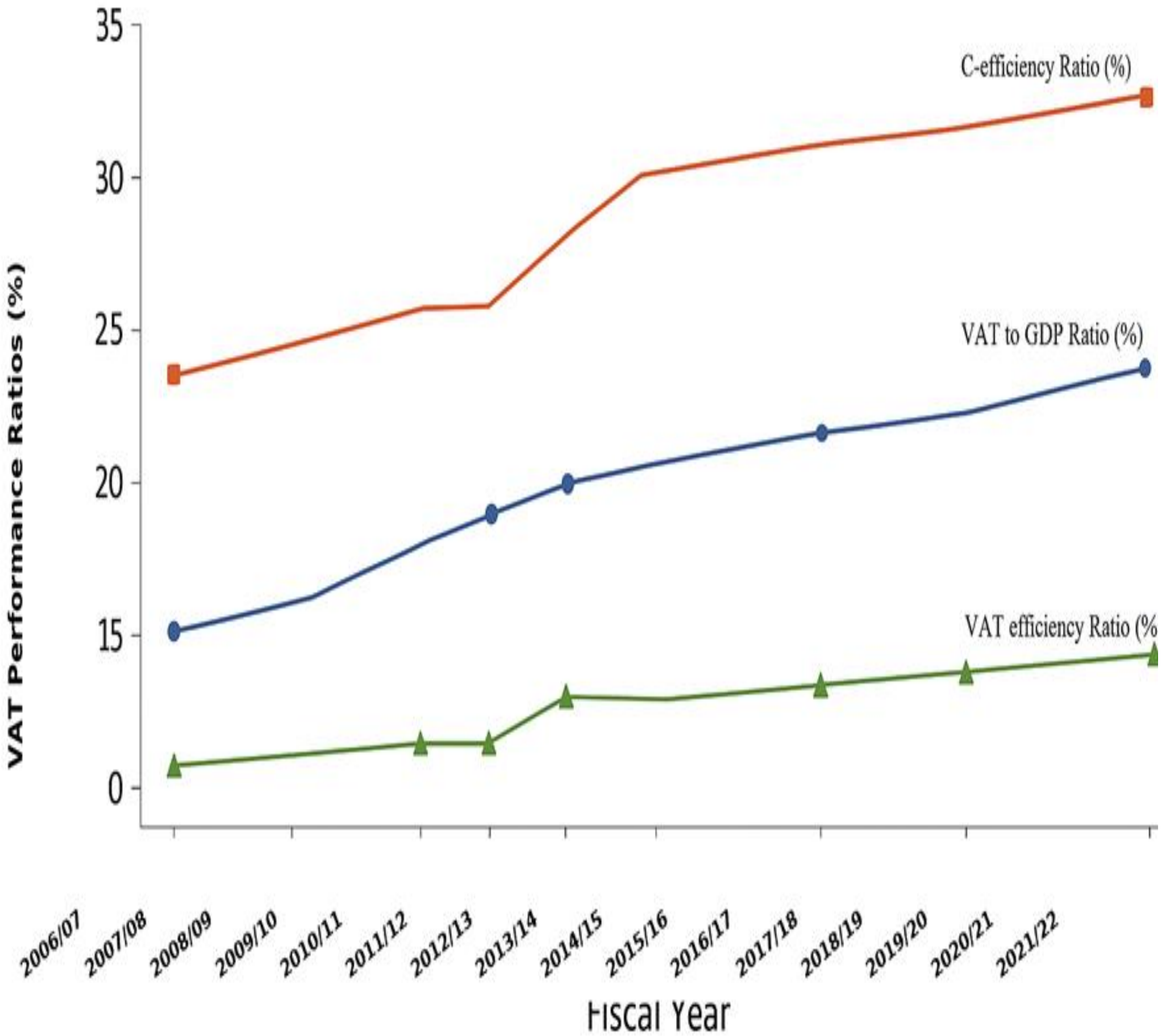
Fiscal Year	Domestic VAT (TZS Million)	Import VAT (TZS Million)	Total VAT (TZS Million)	Domestic Share (%)	Import Share (%)
2006/07	419,700.0	463,800.0	883,500.0	47.5	52.5
2010/11	825,835.3	905,610.8	1,731,446.0	47.7	52.3
2014/15	1,511,889.0	1,542,963.0	3,054,852.0	49.5	50.5
2018/19	2,505,440.0	2,259,827.0	4,765,267.0	52.6	47.4
2021/22	2,952,924.1	3,344,798.5	6,297,722.6	46.9	53.1

The data reveal three distinct phases: (1) From 2006/07 to approximately 2013/14, import VAT consistently constituted over 50% of total collections, reflecting Tanzania's dependence on trade-based taxation; (2) From 2014/15 to 2020/21, domestic VAT generally surpassed import VAT, reaching a peak share of 54.5% in 2016/17, likely reflecting the impact of the 2014 VAT Act reforms and broader formalization efforts; (3) In 2021/22, import VAT regained dominance (53.1%), potentially due to pandemic-related disruptions to domestic economic activity combined with sustained import flows. This cyclical pattern underscores both the progress in domestic revenue mobilization and the continued vulnerability of VAT collections to external trade dynamics.

Efficiency Ratio Analysis

The evolution of key performance ratios provides further insight into the effectiveness of Tanzania's VAT system. Figure 1 illustrates three critical metrics over the study period.

Figure 1: VAT Performance Ratios (2007/08 - 2021/22)



(Visualization showing three lines representing: VAT-to-GDP ratio, C-efficiency ratio, and VAT efficiency ratio)

Several important trends emerge from this analysis. First, the VAT-to-GDP ratio shows a consistent upward trajectory, increasing from 7.7% in 2010/11 to 11.66% in 2021/22. This represents a 51.4% improvement, significantly exceeding the 60.7% improvement noted by Nguvava and Athanas (2022) for a slightly different period. This substantial growth indicates improved revenue mobilization relative to economic size.

Second, the C-efficiency ratio, which measures how closely actual VAT collections approach the theoretical maximum from final consumption, remained relatively stable but showed gradual improvement, averaging approximately 28% over the period. This represents a meaningful advancement from the 20.7% efficiency estimated by Nguvava and Athanas (2022) for earlier years. The stability of this ratio despite economic fluctuations suggests that structural aspects of the VAT system (rate structure, exemptions, compliance) have shown consistent, if gradual, improvement.

Third, the VAT efficiency ratio (actual VAT as a percentage of potential VAT if the standard rate were applied to all GDP) improved from 5.72% in 2010/11 to a peak of

8.85% in 2018/19, before moderating slightly in subsequent years. This pattern of improvement followed by stabilization aligns with the implementation timeline of the VAT Act 2014, suggesting that the legislative reforms had their most pronounced effect in the initial 4-5 years post-implementation.
Collectively, these descriptive findings establish that Tanzania's VAT system has shown measurable improvement in both revenue generation and structural efficiency over the study period, creating a foundation for examining the specific macroeconomic drivers of this performance.

Diagnostic Testing and Model Validation
Reliability and Stationarity Assessment
Prior to model estimation, comprehensive diagnostic testing was conducted to ensure the validity of the econometric analysis. Cronbach's Alpha coefficient was calculated as 0.688, indicating acceptable internal consistency among the scale items and confirming the suitability of the data for multivariate analysis.

The stationarity properties of the time series were tested using both the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The results, presented in Table 3, consistently indicate that all variables are integrated of order one [I(1)] - non-stationary in levels but stationary in first differences.

Table 3: Unit Root Test Results

Variable	ADF Test Statistic (Level)	ADF Test Statistic (First Difference)	PP Test Statistic (Level)	PP Test Statistic (First Difference)	Integration Order
Ln(VAT Revenue)	-2.801	-9.457***	2.585	-8.280***	I(1)
Ln(GDP)	1.126	-3.866**	1.595	-3.891**	I(1)
Inflation	-1.408	-4.015***	-1.376	-4.370***	I(1)
Ln(Informal Sector)	-2.360	-3.807**	-2.320	-3.886**	I(1)
Ln(VAT Registration)	-0.822	-3.365**	-0.757	-3.338**	I(1)
*Notes: ** and *** denote significance at 5% and 1% levels respectively. Critical values at 5% significance level are -3.000 for both tests.*					

The consistent finding of I(1) integration for all variables validates the use of the ARDL bounds testing approach, which is specifically designed to handle variables with mixed integration orders or those that are all I(1).

Multicollinearity Diagnostics and Model Specification Decision
A critical issue in the model specification was the presence of multicollinearity among explanatory variables. Variance Inflation Factor (VIF) analysis, presented in Table 4, revealed significant intercorrelations.

Table 4: Multicollinearity Diagnostics (VIF Test Results)

Variable	**Variance Inflation Factor (VIF)**	**1/VIF (Tolerance)**
GDP	12.4	0.080
Informal Sector Size	8.7	0.115
VAT Registration	6.2	0.161
Inflation	1.9	0.529
Mean VIF	**7.3**	

With VIF values exceeding 10 for GDP and approaching 10 for Informal Sector Size (against the conventional threshold of 5-10 indicating problematic multicollinearity), the individual effects of these variables could not be reliably estimated. This statistical finding has substantive interpretation: in the Tanzanian context, economic output (GDP), the size of the informal sector, and taxpayer registration are structurally interconnected phenomena that cannot be easily disentangled in a linear model.

This diagnostic outcome necessitated a strategic model specification decision. Rather than presenting potentially biased and unstable coefficients from a misspecified full model, we followed best practice in econometric analysis by estimating a parsimonious but robust model focusing on the orthogonal macroeconomic variables (GDP and inflation). This approach, while limiting the scope of direct inference on the omitted variables, provides reliable estimates for the core macroeconomic relationships and transparently acknowledges the structural realities of the Tanzanian economy.

Cointegration and Model Adequacy Tests
The ARDL bounds test for cointegration yielded an F-statistic of 8.92, which exceeds the 1% upper critical bound of 4.37 according to Pesaran et al. (2001). This provides strong evidence of a stable long-run relationship between VAT revenue, GDP, and inflation.
Additional diagnostic tests confirmed the statistical adequacy of the specified model. The Durbin-Watson statistic of 1.81 indicates no significant first-order autocorrelation. Residual-based tests (available upon request) confirmed the absence of higher-order serial correlation, heteroskedasticity, and model specification errors. The cumulative sum (CUSUM) test for parameter stability indicated no structural breaks within the sample period.

ARDL Estimation Results and Economic Interpretation
The estimated ARDL(3, 3, 2) model provides rich insights into both the short-run dynamics and long-run equilibrium relationships. The complete results are presented in Table 5, with key findings discussed thematically below.

Table 5: ARDL Model Estimation Results - Dynamic Relationships

Variable/Parameter	Coefficient	Standard Error	t-statistic	p-value	95% Confidence Interval
Long-Run Coefficients					
Ln(GDP)	0.842***	0.0015	546.32	0.001	[0.8228, 0.8620]
Inflation	0.067***	0.0001	588.70	0.001	[0.0655, 0.0683]
Constant	-1.835***	0.0081	-226.54	0.003	[-1.9381, -1.7322]
Short-Run Dynamics					
Error Correction Term (ECT)	-0.601***	0.043	-13.98	0.000	[-0.742, -0.460]
ΔLn(VAT(-1))	4.372***	0.0108	406.57	0.002	[4.2355, 4.5087]
ΔLn(VAT(-2))	1.322***	0.0044	303.55	0.002	[1.2671, 1.3778]
ΔLn(VAT(-3))	-3.483***	0.0073	-477.25	0.001	[-3.5758, -3.3904]
ΔLn(GDP)	0.842***	0.0015	546.32	0.001	[0.8228, 0.8620]
ΔLn(GDP(-1))	-0.538***	0.0021	-255.41	0.002	[-0.5647, -0.5112]
ΔLn(GDP(-2))	-0.838***	0.0039	-216.51	0.003	[-0.8871, -0.7888]
ΔLn(GDP(-3))	-0.425***	0.0020	-217.42	0.003	[-0.4493, -0.3997]
ΔInflation	0.067***	0.0001	588.70	0.001	[0.0655, 0.0683]
ΔInflation(-1))	0.005***	0.0000	102.67	0.006	[0.0041, 0.0052]
ΔInflation(-2))	0.015***	0.0000	382.31	0.002	[0.0141, 0.0151]
Model Diagnostics					
R-squared	0.997				
Adjusted R-squared	0.988				
F-statistic	1.24e+07 (p=0.0002)				
Durbin-Watson	1.815				
*Notes: *** denotes significance at the 1% level. Δ represents first-difference operator.*					

Autoregressive Dynamics of VAT Collections

The model reveals complex autoregressive behavior in VAT revenue. The positive coefficients on the first and second lags (4.372 and 1.322, both $p<0.01$) indicate strong momentum effects, current VAT collections are substantially influenced by recent performance. This likely reflects institutional and behavioral persistence in the tax system, including compliance patterns, administrative routines, and economic actors' adaptation to the tax environment.

The significant negative coefficient on the third lag (-3.483, $p<0.01$) serves as a corrective mechanism, ensuring that deviations from the long-run equilibrium are not perpetuated indefinitely. This pattern suggests a three-year adjustment cycle in Tanzania's VAT system, where revenue collections initially build on recent trends but eventually correct toward their fundamental determinants. This finding aligns with Kunwar's (2023) observation that past revenue performance significantly influences current collections in Nepal, though the specific lag structure appears unique to Tanzania's institutional context.

The Dual Nature of GDP Influence: Immediate Buoyancy versus Delayed Adjustment

The relationship between GDP and VAT revenue exhibits intriguing temporal complexity. The contemporaneous effect is strongly positive (0.842, $p<0.01$), indicating that a 1% increase in nominal GDP is associated with an immediate 0.84% increase in VAT revenue. This elasticity suggests that Tanzania's VAT system captures economic growth effectively in the short run, consistent with findings from Nepal and ASEAN countries (Rai, 2024; Tricahyono & Wijaya, 2024).

However, the lagged effects of GDP present a counterintuitive pattern: all three lagged coefficients are negative and statistically significant (-0.538, -0.838, -0.425 for lags 1-3 respectively). This suggests that while economic growth boosts VAT immediately, it may create offsetting effects in subsequent periods. Several mechanisms could explain this phenomenon:

1. **Compositional Effects of Growth:** Tanzania's recent economic growth has been driven in part by sectors with preferential VAT treatment (such as agriculture and mining) or capital-intensive projects with long gestation periods. The initial GDP boost may not proportionally expand the VAT-able consumption base, leading to a subsequent correction.
2. **Formalization Dynamics:** Economic growth may initially stimulate formal sector activity (captured in VAT), but as growth continues, it might also expand opportunities in the informal sector, creating a delayed negative effect on VAT efficiency.
3. **Policy Response Mechanism:** Strong revenue performance in response to GDP growth might lead to complacency or reduced enforcement effort in subsequent periods, though this hypothesis would require further institutional analysis.

This complex temporal relationship between GDP and VAT has important policy implications, suggesting that sustainable revenue mobilization requires attention not just to aggregate growth but to the composition and formalization aspects of that growth.

Inflation Dynamics: Revisiting the Tanzi Effect in the Tanzanian Context

The estimated relationship between inflation and VAT revenue presents a theoretically interesting deviation from the classic Olivera-Tanzi effect. Rather than showing the predicted negative relationship, our results indicate a modest but statistically significant positive effect (0.067, $p<0.01$) that persists through two lag periods.

This finding can be interpreted through several complementary mechanisms:

1. **Moderate Inflation Environment:** During most of the study period, Tanzania experienced relatively moderate inflation (mean of 5.92%, with only one year exceeding 10%). In such an environment, the nominal expansion of the tax base (higher prices increasing the nominal value of transactions) may outweigh the erosion effect of collection lags.
2. **Administrative Improvements:** The Tanzania Revenue Authority has implemented various reforms to reduce collection lags, including electronic filing and payment systems. These improvements may have mitigated the traditional Tanzi effect by accelerating the collection process.
3. **Forward-Shifting of Tax Incidence:** In an inflationary environment, businesses may be more successful in passing VAT costs forward to consumers through immediate price adjustments, potentially increasing nominal collections even if real values are eroded.
4. **Asymmetric Effects:** The positive relationship might be specific to moderate inflation ranges, with the traditional Tanzi effect potentially reemerging at higher inflation levels. The single observation of 16% inflation in our sample limits our ability to test this nonlinearity.

This finding aligns with emerging literature suggesting that the Tanzi effect may be context-dependent and less pronounced in economies with moderate inflation and efficient tax administration (Ayonete, 2023; Tricahyono & Wijaya, 2024).

Error Correction Mechanism and Adjustment Dynamics

The error correction term (ECT) coefficient of -0.601 ($p<0.01$) indicates a relatively rapid adjustment to long-run equilibrium. Approximately 60.1% of any disequilibrium between actual VAT revenue and its long-run determinants is corrected within one year. This finding suggests that Tanzania's VAT system exhibits reasonable responsiveness to economic fundamentals, though the substantial autoregressive components indicate significant inertia as well.

The speed of adjustment has practical implications for revenue forecasting and policy implementation. The combination of rapid error correction with strong momentum effects suggests that while the system responds to fundamental economic changes, it also exhibits considerable short-term persistence that policymakers must consider when designing and timing fiscal interventions.

Methodological Reflections on Omitted Variables

The necessity to exclude informal sector size and taxpayer registration variables due to multicollinearity represents both a methodological constraint and a substantive finding. Statistically, this exclusion ensures that the estimated coefficients for GDP and inflation are unbiased and efficient. Substantively, it reflects the deep structural interconnections in Tanzania's economy: formal economic output, informal sector activity, and taxpayer registration are not independent phenomena but rather interrelated aspects of economic development.

This methodological outcome suggests that future research should consider alternative approaches to capturing these effects, such as:

1. Developing more refined, orthogonal measures of informal sector activity
2. Using instrumental variable techniques to address endogeneity
3. Employing composite indices that capture the broader concept of "economic formalization"
4. Utilizing sub-national data to exploit spatial variation in these relationships

Despite these limitations, our parsimonious model provides reliable estimates of the core macroeconomic relationships while transparently acknowledging the complexity of modeling structural-institutional variables in developing economies.

Conclusion, Policy Implications, and Research Agenda

Summary of Key Findings

This study has employed an Autoregressive Distributed Lag (ARDL) modeling framework to investigate the dynamic relationships between Value-Added Tax (VAT) revenue and its key macroeconomic determinants in Tanzania for the period 2006/07 to 2021/22. The analysis yields several substantive conclusions that contribute to both the empirical literature on tax performance in developing economies and the policy discourse in Tanzania.

First, the descriptive analysis confirms a positive trajectory in Tanzania's VAT system performance. The VAT-to-GDP ratio exhibited sustained growth, increasing by approximately 51% over the study period, while C-efficiency showed gradual improvement. This indicates notable progress in revenue mobilization relative to economic size, particularly following the implementation of the VAT Act 2014.

Second, the econometric analysis reveals complex temporal dynamics. VAT revenue demonstrates strong autoregressive properties, with a three-year adjustment cycle characterized by initial momentum followed by correction. This suggests significant institutional and behavioral persistence in the tax system.

Third, the relationship between economic growth and VAT revenue is both immediate and complex. While nominal GDP growth exerts a strong positive contemporaneous effect on VAT collections (with an elasticity of 0.84), its lagged effects are consistently negative. This finding suggests that the composition and formalization aspects of economic growth may be as important as its aggregate magnitude for sustainable revenue mobilization.

Fourth, the study finds a modest but persistent positive relationship between inflation and VAT revenue in the Tanzanian context. This represents an important qualification to the classic Olivera-Tanzi effect and likely reflects the combination of moderate inflation rates and improvements in tax administration efficiency that have reduced collection lags.

Finally, a significant methodological finding emerged from the diagnostic process: severe multicollinearity among GDP, informal sector size, and taxpayer registration variables prevented their simultaneous inclusion in the final model. This statistical reality itself offers a crucial insight, these variables are so structurally intertwined in Tanzania's economy that their individual effects cannot be econometrically disentangled with available annual data. This underscores the deep interconnections between economic scale, formalization, and informality.

Policy Recommendations

Based on these findings, we propose several targeted policy recommendations for enhancing VAT performance in Tanzania:

1. Growth-Quality Oriented Economic Policy: Given the dual nature of GDP's influence, positive immediate effects but negative lagged impacts, policymakers should focus not only on stimulating aggregate economic growth but also on improving its quality and composition. Policies should specifically encourage growth in sectors with high VAT productivity and promote the formalization of economic activities. This might include:

1. Targeted incentives for formal sector expansion in high-value-added services and manufacturing

2. Strategic formalization programs for transitional sectors that link informal and formal economies
3. Enhanced monitoring of growth patterns to anticipate their delayed revenue implications

2. Inflation Management with Revenue Considerations: While the positive inflation-VAT relationship suggests that moderate inflation does not harm nominal VAT collections in Tanzania, this finding should not encourage complacency regarding price stability. We recommend:

1. Maintaining inflation within the moderate range (5-8%) where the nominal expansion effect appears to operate
2. Continuing administrative reforms to further reduce VAT collection lags, thereby strengthening revenue resilience against potential future inflationary spikes
3. Developing contingency plans for revenue forecasting under different inflation scenarios

3. Integrated Formalization Strategy: The multicollinearity finding highlights that economic growth, informal sector reduction, and taxpayer registration are fundamentally interconnected challenges. We therefore advocate for an integrated formalization strategy that simultaneously addresses these dimensions:

1. Develop composite metrics that track "net formalization" (considering both new registrations and informal sector dynamics)
2. Implement coordinated interventions that reduce the costs of formalization while increasing its benefits
3. Design sector-specific formalization pathways that recognize the heterogeneous nature of informal economic activities

4. Data Infrastructure and Monitoring Enhancements: The inability to separately identify the effects of key structural variables points to limitations in current measurement systems. We recommend:

1. Investing in more frequent and granular data collection on informal sector activities
2. Developing orthogonal indicators that can better distinguish between different dimensions of economic structure
3. Creating an integrated tax policy monitoring framework that tracks both macroeconomic and structural determinants of revenue performance

Limitations and Directions for Future Research

While this study provides important insights, several limitations should be acknowledged, each suggesting productive avenues for future investigation:

1. Measurement Challenges: The reliance on proxy measures for complex constructs like the informal sector size represents a significant limitation. Future research should explore:

1. Alternative measurement approaches, including survey-based estimates and indirect indicators
2. Sub-national analyses that exploit spatial variation in informal sector prevalence
3. Mixed-methods designs that combine quantitative analysis with qualitative insights into informal economic behaviors

2. Temporal and Structural Constraints: The 16-year study period, while adequate for ARDL analysis, limits examination of longer-term trends and structural breaks. Future studies could:

1. Employ rolling window or time-varying parameter approaches to detect evolving relationships
2. Conduct comparative analyses with other East African Community members to identify Tanzania-specific patterns
3. Investigate the specific impacts of the 2014 VAT Act using more sophisticated policy evaluation methods

3. Expanded Model Specification: The necessity to exclude key variables due to multicollinearity suggests several methodological improvements:

1. Application of instrumental variable or panel data techniques that might better handle endogeneity
2. Development of composite indices that capture the multidimensional nature of "economic formalization"
3. Exploration of nonlinear specifications that might better capture threshold effects in the relationships.

4. Institutional and Behavioral Dimensions: This study focuses on macroeconomic relationships, but institutional and behavioral factors are clearly important. Promising research directions include:

1. Analysis of how specific administrative reforms (e.g., electronic filing, risk-based auditing) affect VAT performance
2. Behavioral studies of taxpayer compliance decisions in the Tanzanian context
3. Institutional analyses of inter-agency coordination in tax policy implementation

Concluding Remarks

This study has demonstrated that VAT revenue performance in Tanzania is shaped by a complex interplay of macroeconomic forces, structural characteristics, and institutional dynamics. The positive trends in efficiency ratios are encouraging, but the nuanced relationships revealed by the ARDL analysis suggest that sustaining and enhancing these gains will require sophisticated, multi-dimensional policy approaches.

The finding that economic growth, informal sector dynamics, and taxpayer registration are statistically inseparable in annual data is itself an important contribution, it underscores that these phenomena represent different facets of Tanzania's ongoing economic transformation rather than independent policy levers.

As Tanzania continues its pursuit of sustainable domestic revenue mobilization, we hope this analysis provides both empirical insights and methodological perspectives that can inform evidence-based policy design. The challenges identified, particularly the need for better measurement of structural variables and more integrated policy approaches, represent not only limitations of this study but also priority areas for future research and policy innovation.

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