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The Impact of Macroeconomic Dynamics on Domestic Tax Revenue Mobilisation in Zambia

John Musantu[1], Richard Kampamba[2], Benson Mutambo[3]
[1,2,3]Department of Economics, School of Humanities and Social Sciences, University of Zambia, P.O.Box 32379, Great East Road, Lusaka, Zambia

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Abstract

Purpose: This paper seeks to evaluate the impact of selected macroeconomic and structural factors on tax revenue performance in Zambia from 1990 to 2023, specifically analysing how economic growth, unemployment, foreign direct investment, industrialisation, and trade openness influence domestic revenue mobilisation in a developing economy context.

Methodology: The study employed the Vector Error Correction Model (VECM) framework, supported by the Autoregressive Distributed Lag (ARDL) model as a robustness check, to examine both short-run and long-run relationships among the study variables. Pre-estimation tests included unit root (ADF and PP), lag length selection, and Johansen cointegration tests, while post-estimation diagnostics verified model stability and reliability.

Findings: The empirical results reveal a stable long-run relationship between tax revenue and the selected macroeconomic variables. In the long run, economic growth and trade openness exert positive and statistically significant effects on tax revenue, whereas foreign direct investment (FDI) has a negative and significant long-run impact. In the short run, FDI positively influences tax revenue, while industrial output, trade openness, and economic growth (at the second lag) exhibit negative effects. The error correction mechanism confirms gradual adjustment towards long-run equilibrium, correcting approximately 26.6% of short-run disequilibrium annually. Unemployment remains statistically insignificant in both time horizons, and industrialisation shows no significant long-run effect, reflecting structural rigidities and the dominance of the informal sector. Granger causality tests indicate that FDI, industrialisation, and trade openness cause tax revenue, while variance decomposition shows FDI and industrialisation as major long-run contributors.

Recommendations: These results underscore the need for Zambia to adopt balanced fiscal and structural policies to enhance domestic revenue mobilisation. Key policy recommendations include: promoting inclusive and formal-sector-led economic growth to broaden the tax base; reforming foreign direct investment incentive frameworks to reduce excessive tax exemptions, profit shifting, and revenue leakages; strengthening industrial value chains and domestic linkages to convert industrial expansion into sustained fiscal gains; deepening trade and domestic tax reforms, including strengthened customs administration and VAT compliance, to mitigate short-run revenue losses; and broadening the direct tax base by formalising informal employment and improving labour market compliance. By pursuing these measures, Zambia can enhance fiscal resilience, reduce dependence on external borrowing, and achieve sustainable domestic resource mobilisation.

Keywords: *Tax Revenue, Economic Growth, Foreign Direct Investment, Industrialization, Fiscal Policy, Trade Openness, Unemployment, Vector Error Correction Model* (VECM)

JEL Classification: F43, F62, H25, P45

INTRODUCTION

Taxation is an age-old fiscal instrument whose origins can be traced back to as early as 3000 BC. Across history, taxes have played a fundamental role in state formation, economic organisation, and social stability. In modern economies, taxation remains the most reliable and sustainable source of public revenue, enabling governments to finance public goods and services, promote equitable income distribution, and pursue macroeconomic objectives such as economic growth, employment creation, and stabilisation (Meagher, 2018). Efficient and effective tax systems strengthen domestic revenue mobilisation, reduce public sector borrowing, minimise reliance on foreign aid, and enhance national ownership of the development agenda (Tanzi & Zee, 2000). Furthermore, taxation represents a social contract between citizens and the state, promoting fairness in income distribution and influencing expenditure priorities.

Given its centrality to sustainable development, it is critical to understand the factors that influence tax revenue performance. In modern public finance theory, tax revenue performance is closely linked to macroeconomic conditions, structural characteristics of the economy, and institutional capacity (Musgrave & Musgrave, 1989). Macroeconomic variables such as economic growth, employment levels, and foreign direct investment (FDI) play a decisive role in shaping the size and efficiency of a country's tax base. In addition, structural factors such as the level of industrialization and the degree of trade openness influence the composition, formality, and sustainability of taxable economic activities. Extensive research has explored the nexus between tax revenues and macroeconomic variables, recognizing that a deeper understanding of these relationships is important for effective fiscal planning and economic management. This relationship is especially important in developing economies, where fiscal imbalances and macroeconomic instability pose significant challenges to growth and development. In Zambia, the relevance of these variables is closely tied to the country's long-standing dependence on copper, which continues to dominate export earnings and macroeconomic performance. Available evidence shows that the copper still accounts for about 70 percent of Zambia's merchandise exports and contributes roughly 15 percent of GDP (World Bank, 2025). However, while mining remains central to output and foreign exchange generation, its capital-intensive nature has limited its employment contribution, making industrialisation and employment outcomes critical indicators of the extent to which the economy has diversified into broader and more taxable productive activities.

The empirical literature suggests that economic growth is one of the most important determinants of tax revenue performance. Higher growth rates increase taxable income, corporate profits, and consumption, leading to improved tax buoyancy and revenue elasticity. Conversely, periods of economic stagnation constrain revenue mobilisation and exacerbate fiscal imbalances (Gupta, 2007). Unemployment also plays a critical role in determining tax performance. High unemployment reduces personal income tax revenues, weakens indirect tax collections through lower consumption, and often expands the informal sector, further eroding the tax base (Ali & Audi, 2018). This is particularly relevant in Zambia, where economic growth has historically been driven by mining, yet a large share of employment remains concentrated in agriculture and services, much of it informal and low-productivity, thereby weakening the tax base despite the economy's mineral wealth. Similarly, industrialisation contributes to tax revenue performance by facilitating structural transformation from informal, low-productivity activities to formal, higher value-added sectors that are easier to tax. For Zambia, industrialisation is not only a growth

variable but also a diversification strategy away from excessive copper dependence toward a broader productive base capable of generating employment and expanding the domestic tax base. Industrialisation has also been identified as an important factor in strengthening exchange rate stability and improving the balance of payments position in small commodity-dependent economies such as Zambia (Mutambo & Musantu, 2025)

Foreign direct investment (FDI) represents another key macroeconomic variable affecting tax revenues. FDI can contribute positively to tax performance by expanding economic activity, generating employment, and increasing corporate tax payments. However, the fiscal benefits of FDI are often limited in developing countries due to tax holidays, investment allowances, transfer pricing practices, and profit repatriation. As a result, the net effect of FDI on tax revenues remains theoretically ambiguous and empirically contested (Kubaje, Amoasi-Andoh, Eklemet, & Wassan, 2025). In Zambia, where foreign investment has historically been concentrated in mining and other enclave sectors, the ambiguity raises questions about the extent to which investment inflows translate into broad domestic value addition, employment creation, and sustained tax revenue gains.

While existing empirical studies on Zambia have largely focused on the relationship between tax revenues and variables such as GDP growth, inflation, exchange rates, and trade openness, limited attention has been paid to the joint role of unemployment and foreign direct investment in shaping tax performance. This gap is especially important in a commodity-dependent economy such as Zambia, where employment creation, industrial diversification, and external sector developments are closely intertwined with fiscal performance. Moreover, relatively little empirical work has simultaneously examined the role of structural transformation, as captured by industrialisation, alongside external sector integration in explaining tax revenue performance. Given Zambia's historical dependence on copper exports and recurrent vulnerability to commodity price shocks, understanding whether industrialisation and labour market conditions broaden or constrain the tax base is essential for designing durable domestic revenue strategies. This lack of evidence constrains policymakers' ability to design coherent macro-fiscal strategies that simultaneously promote growth, employment, and revenue mobilisation. Therefore, this study seeks to assess how economic growth, unemployment, FDI, industrialisation, and trade openness influence tax revenue performance in Zambia from 1990 to 2023. By identifying the magnitude and direction of these relationships, the study aims to inform evidence-based fiscal policy and strengthen the country's capacity for sustainable domestic resource mobilisation.

Problem Statement

Despite recent improvements in domestic revenue mobilisation in nominal terms, revenue sufficiency remains a persistent challenge in Zambia amid rising public expenditure pressures. Over the past three decades, Zambia's tax-to-GDP ratio has averaged approximately 16%, significantly below the 25–30% benchmark associated with lower-middle-income countries. This structural revenue gap has constrained fiscal space, contributing to chronic fiscal deficits and limiting the government's capacity to finance essential public services and infrastructure. Inadequate tax revenue has also fueled rapid public debt accumulation in recent years, culminating in a sovereign debt default in November 2020, after which Zambia embarked on a debt restructuring process. Although these efforts have eased immediate fiscal pressures, debt servicing obligations continue to compete with development financing needs, underscoring the urgent need

to optimise tax revenue through evidence-based policy to support debt servicing and financing the national development agenda.

Tax revenue performance is shaped by various factors ranging from tax base, institutional factors, political and economic environment, and corruption levels, among others. (Morrissey, 2016) argues that lower- and middle-income countries are, however, prone to macroeconomic shocks and thus remain critical in influencing the size and efficiency of the tax base compared to other factors. Consequently, in economies such as Zambia, where fiscal performance remains closely linked to growth volatility, labour market conditions, external sector developments, and structural transformation, macroeconomic dynamics provide an important lens for understanding variations in tax revenue performance alongside institutional and administrative factors of revenue mobilisation**.** Several studies have been undertaken to establish the impact of macroeconomic variables such as real GDP growth, inflation, exchange rate movements, and government expenditure conditions on tax revenue. However, despite the relevance of structural transformation and external sector integration in developing economies, limited empirical evidence exists on how industrialisation and trade openness interact with labour market conditions and foreign capital inflows to influence tax revenue performance in Zambia. Furthermore, the magnitude and direction of these relationships often vary across countries and over time.

This study seeks to bridge this multifaceted empirical gap. By employing time-series econometric analysis, it will investigate the individual and interactive effects of GDP growth, unemployment rates, net FDI inflows, industrialisation, and trade openness on Zambia's total tax revenue. The findings provide evidence-based insights for policymakers to design more holistic revenue strategies that not only attract investment but also create employment and strengthen the tax base.

LITERATURE REVIEW

Theoretical Review

This study is anchored in four complementary theoretical frameworks: Keynesian Growth Theory, Labour Market Theory, Investment-Led Growth Theory, and Revenue-Trade Elasticity Theory. These theories provide a structured explanation of how macroeconomic performance and structural characteristics influence the mobilisation of tax revenue.

Keynesian Growth Theory

Keynesian Growth Theory, advanced by John Maynard Keynes (1936), emphasises aggregate demand as the primary driver of economic activity. In the Keynesian framework, national income is determined by:

$$Y = C + I + G + (X - M) \quad \ldots\ldots(1)$$

where Y= output, C = consumption, I = investment, G = government expenditure, and (X-M) = net exports. Economic expansion increases employment, income, and consumption, thereby broadening the tax base. If tax revenue is expressed as:

$$TR = \tau Y \quad \ldots\ldots(2)$$

where τ is the effective tax rate, then revenue is positively related to output such that:

$$\frac{\partial TR}{\partial Y} > 0 \quad \ldots\ldots(3)$$

Subsequent contributions by Musgrave and Musgrave (1989) and Tanzi and Zee (2000) emphasise that sustained and inclusive growth enhances tax buoyancy, particularly in developing economies. However, the effect of growth on revenue depends on economic structure, as large agricultural and informal sectors can weaken tax collection efficiency. This theoretical proposition underpins the inclusion of economic growth as a central determinant of tax revenue in the present study.

Labour Market Theory

Labour Market Theory, grounded in Okun's Law (Okun, 1962), establishes an inverse relationship between unemployment and output. The relationship can be expressed as:

$$\Delta Y = -\beta(U - U^{*}) \quad (4)$$

where U denotes the unemployment rate, U* the natural rate of unemployment, and β>0. Higher unemployment reduces labour utilisation and aggregate income, thereby weakening the tax base. Tax revenue derived from labour income may be expressed as:

$$TR = \tau(\omega L) \quad (5)$$

Where ω represents wages and L employment. Since rising unemployment reduces L, it follows that:

$$\frac{\partial TR}{\partial U} < 0 \quad (6)$$

Empirical extensions by Ali and Audi (2018) confirm that labour market slack constrains both direct and indirect tax collections. This framework justifies the inclusion of unemployment as a potential drag on revenue mobilisation.

Investment-Led Growth Theory

Investment-Led Growth Theory originates from the neoclassical growth model proposed by Solow (1956), where output is defined as:

$$Y = AK^{\alpha}L^{1-\alpha} \quad (7)$$

with A representing technology, K capital stock, L Labour, and 0<α<10. Foreign direct investment contributes to capital accumulation through:

$$K = K_d + K_f \quad (8)$$

where K_f denotes foreign capital inflows. In principle, higher capital stock increases output and, by extension, tax revenue:

$$TR = \tau Y \quad (9)$$

However, in developing economies, the effective tax yield from FDI may be reduced by investment incentives and exemptions. If θ represents the share of output exempted from taxation, effective revenue becomes:

$$TR = \tau(1 - \theta)Y \quad (10)$$

This formulation explains why FDI may stimulate economic activity while generating limited or even negative net revenue effects in the long run. The theory, therefore, predicts an ambiguous relationship between FDI and tax revenue.

Revenue -Trade Elasticity Theory

Revenue-Trade Elasticity Theory, associated with early contributions by Harberger (1964) and later elaborated by Tanzi (1992), explains how trade integration influences fiscal capacity. Total tax revenue can be expressed as:

$$TR = \tau_d Y + \tau_t (X + M) \quad (11)$$

where τ_d represents domestic tax rates and τ_t trade tax rates. Trade openness is measured as:

$$TO = \frac{X+M}{Y} \quad (12)$$

Substituting yields:

$$TR = \tau_d Y + \tau_t (TO.Y) \quad (13)$$

The responsiveness of tax revenue to trade openness is therefore:

$$\frac{\partial TR}{\partial TO} = \tau_t Y \quad (14)$$

Trade liberalisation may reduce τ_t in the short run, lowering tariff revenue, while any medium- to long-run recovery in revenue is hypothesised to depend on the effectiveness of domestic tax substitution mechanisms. This framework supports the inclusion of trade openness as a structural determinant of tax revenue performance.

Empirical Studies

Empirical studies examining the determinants of tax revenue performance have predominantly employed panel data and time-series econometric techniques, including fixed effects models, dynamic panel estimators, Feasible Generalised Least Squares (FGLS), Autoregressive Distributed Lag (ARDL) models, and error correction frameworks. These approaches enable the analysis of both cross-country variation and country-specific dynamics in revenue mobilisation.

A substantial body of literature finds that economic growth positively influences tax revenue performance by expanding the tax base. Kalaš et al. (2020) report a strong and statistically significant positive relationship between GDP growth and tax revenue in European Union countries. Similarly, Nguyen-Phuong et al. (2022) and Ihuarulam et al. (2021) find that economic growth significantly enhances tax revenue across Asian, European, and ECOWAS economies, respectively. However, recent evidence highlights important deviations. Chamisa and Sunde (2024), using ARDL estimation for Zimbabwe, find that although economic growth has a positive effect, it is statistically insignificant, suggesting that the growth–revenue nexus may be weakened in economies characterised by structural constraints, informality, and limited tax capacity.

The empirical relationship between foreign direct investment (FDI) and tax revenue remains mixed. Ade et al. (2018) find a positive and statistically significant relationship in SADC countries, suggesting that FDI expands the tax base through increased economic activity. In contrast, Gasparėnienė et al. (2022) report a negative relationship in European Union countries due to tax competition and profit shifting. Pratomo (2019) further shows that the fiscal impact of FDI depends on its composition, with greenfield investment generating stronger revenue gains than brownfield investment. Extending this debate, Omodero and Yado (2024) find that FDI exerts a negative long-run effect on tax revenue in Sub-Saharan Africa, reinforcing concerns regarding revenue leakages and aggressive tax planning. Similarly, Chamisa and Sunde (2024) find that FDI has a positive but

statistically insignificant effect in Zimbabwe, while Chamisa and Sunde (2025) demonstrate that FDI effects vary across tax categories. These findings indicate that the fiscal impact of FDI is context-dependent and influenced by tax policy design, incentive structures, and enforcement capacity.

With respect to trade openness, empirical findings identify it as an important determinant of revenue mobilisation, although the evidence remains mixed and context-specific, similar to FDI. Omodero and Yado (2024) report divergent results across Sub-Saharan Africa, with exports positively affecting tax revenue in South Africa but negatively affecting it in Nigeria. Le, Ngoc, and Van (2025) find a positive causal relationship between trade openness and tax revenue through the expansion of taxable economic activity, although they caution that de-globalisation may undermine fiscal capacity**.** In contrast, Soro (2020) and Ofori et al. (2020) find that trade openness negatively affects tax revenue due to weak institutional quality and reliance on trade taxes. Consistent with this ambiguity, Chamisa and Sunde (2024) find that trade openness has a negative and statistically insignificant effect, reflecting short-term revenue losses and weak domestic tax substitution mechanisms.

Empirical evidence directly linking industrialisation to tax revenue remains relatively limited, with most studies treating industrialisation as an indirect or structural channel. Recent African evidence from Ofori et al. (2021) and Busari et al. (2024) confirms that industrialisation strengthens income, profit, and consumption tax mobilisation by expanding formal-sector activity. However, emerging evidence suggests that this relationship is not linear. Gnidehou and Alinsato (2024) demonstrate that the effect of taxation on industrial performance is subject to threshold effects, beyond which taxation becomes distortionary. This introduces important non-linear dynamics that are often overlooked in conventional macro-fiscal models.

With respect to labour market conditions, most studies identify unemployment as a constraint on revenue mobilisation. Kalaš et al. (2020) and Đurović et al. (2024) show that rising unemployment reduces income and consumption-based tax revenues. However, Buzugbe et al. (2024) report a positive long-run effect of unemployment on tax revenue in Nigeria. This divergence may be explained by structural factors such as the dominance of the informal sector, which weakens the link between employment and tax revenue mobilisation as observed by Sebele-Mpofu (2021). This reinforces the argument that the unemployment–tax revenue nexus is highly sensitive to structural and institutional conditions.

Evidence for Zambia remains limited and inconclusive. Funjika and Gatawa (2024) find a negative relationship between GDP per capita and tax revenue, contrary to global trends, and attribute this outcome to structural rigidities, informality, and a narrow tax base. They also report a positive effect of trade openness, while labour market indicators remain insignificant. Haabazoka and Kaulu (2023) find that foreign direct investment has no significant effect on revenue mobilisation, reflecting weak enforcement capacity and generous tax incentives. These country-specific findings further support the broader empirical conclusion that macroeconomic determinants do not uniformly translate into improved tax performance in developing economies.

Overall, the empirical literature reveals increasing divergence and complexity in the relationship between macroeconomic variables and tax revenue performance. While some studies suggest relatively stable relationships, others demonstrate that these effects are highly context-dependent, non-linear, and influenced by structural and institutional factors. This evolving empirical

landscape underscores the need for comprehensive, country-specific analysis, such as the present study, to better understand the drivers of tax revenue performance in Zambia.

Table 1: Summary of Literature Review

Name of Author & Year	Study Title / Focus	Methodology	Key Findings	Limitations / Identified Gap
Kalaš et al. (2020)	Macroeconomic determinants of tax revenues in the EU	Panel Regression (FE)	GDP (+), Unemployment (–)	Findings assume strong formal economies; do not account for informality which limits applicability to Zambia and developing contexts
Nguyen-Phuong et al. (2022)	Tax revenue determinants (ASEAN & EU)	FGLS Panel	GDP (+), FDI (+)	Contradicts studies showing negative/insignificant FDI, highlighting unresolved FDI–tax debate
Ofori et al. (2021)	Industrialisation and tax revenue (Africa)	System GMM	Industrialisation (+)	Regional focus masks country-specific structural constraints (e.g., Zambia's weak industrial base)
Busari et al. (2024)	Industrial performance and tax revenue (SSA)	System GMM	Industrialisation (+)	Aggregated results hide heterogeneity; assumes uniform structural transformation across countries
Funjika & Gatawa (2024)	Tax revenue determinants in Zambia	ARDL	GDP (–), Trade (+)	Contradicts global evidence on GDP; excludes key variables
Haabazoka & Kaulu (2023)	FDI and tax revenue (Zambia)	ARDL	FDI (insignificant)	Does not integrate broader macroeconomic variables
Ali & Audi (2018)	Tax revenue determinants (Pakistan)	ARDL	Unemployment (+)	Contradicts theory → highlights structural differences in tax systems not yet tested in Zambia
Ihuarulam et al. (2021)	Tax revenue in ECOWAS	Panel FE	GDP (+), Unemployment (–)	Panel approach masks country-specific dynamics thus limits policy relevance
Ade et al. (2018)	Tax revenue in SADC	Panel	FDI (+)	Contradicts Zambia-specific evidence, reinforcing need for country-level analysis
Chamisa & Sunde (2024)	Macroeconomic determinants (Zimbabwe)	ARDL	GDP (+, insignificant), FDI (+, insignificant), TO (–)	Shows weak/inconsistent macro effects; suggesting structural constraints but does not fully explain mechanisms
Chamisa & Sunde (2025)	Disaggregated tax analysis	Dynamic Panel	Mixed effects across tax types	Reveals aggregation problemas it ignore tax structure differences like most studies
Omodero & Yado (2024)	FDI & trade openness (SSA)	Panel ARDL	FDI (–), Trade (mixed)	Confirms conflicting FDI evidence; highlights role of tax competition and leakages
Gnidehou & Alinsato (2024)	Taxation & industrialisation	Threshold Model	Non-linear relationship	Introduces threshold effects → gap in linear models like most tax studies
Buzugbe et al. (2024)	Unemployment & tax revenue (Nigeria)	ARDL	Unemployment (+ long run)	Contradicts conventional theory reinforcing unresolved unemployment–tax debate
Le et al. (2025)	Trade openness & tax revenue	IV + SFA	Trade (+ causal effect)	Highlights methodological gap ignore endogeneity like many studies
Sebele-Mpofu (2021)	Taxing the informal sector in Zimbabwe	Qualitative / Policy Analys	Informality weakens tax base; presumptive taxes have mixed effects	Introduces critical structural dimension (informality) often omitted in empirical models; explains why macro variables (GDP, employment) may not translate into tax revenue in developing economies

Source: Researcher (2026)

As summarised in Table 1, the empirical literature reveals significant inconsistencies, unresolved debates, and methodological limitations in explaining tax revenue performance. There is no consensus on the effect of foreign direct investment, with studies reporting positive, negative, and insignificant relationships, reflecting issues such as tax incentives, profit shifting, and weak enforcement. Similarly, while economic growth is generally expected to enhance tax revenue, evidence from Zambia shows contradictory outcomes, suggesting that growth does not

automatically translate into fiscal capacity in structurally constrained economies. The relationship between unemployment and tax revenue also remains ambiguous, with both negative and positive effects reported, depending on tax structure and reliance on indirect taxation. In addition, recent evidence shows that the effects of industrialisation and trade openness are non-linear, context-dependent, and sometimes insignificant, highlighting the limitations of conventional linear models.

Methodologically, many studies rely on panel data that mask country-specific dynamics or analyze variables in isolation, leading to fragmented findings. Evidence from Zambia is particularly limited and does not comprehensively model the joint effects of key macroeconomic variables. This study, therefore, addresses these gaps by providing a country-specific and integrated analysis of how economic growth, unemployment, foreign direct investment, industrialisation, and trade openness shape tax revenue performance in Zambia.

Conceptual Framework

A conceptual framework illustrates the logical relationships between variables under investigation and provides a structured foundation for empirical analysis. In this study, the framework is grounded in macroeconomic theory, which posits that tax revenue performance is largely influenced by the overall level of economic activity, labour market conditions, external capital inflows, trade openness, and industrialisation.

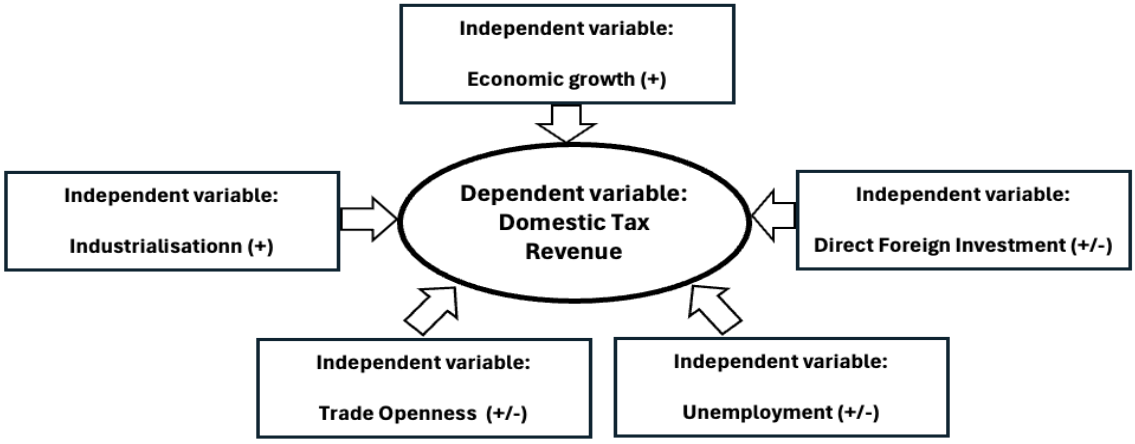

Figure 1: Conceptual Framework

Source: Author's representation (2026)

Contribution to Extant Literature

The empirical literature establishes economic growth as a key driver of tax revenue, yet reveals profound ambiguity regarding the effects of FDI and unemployment. In addition, global and regional evidence suggests that trade openness and industrialisation can enhance tax revenue mobilisation, but their effects are highly context-dependent and mediated by economic structure, informality, and tax system capacity. The Zambian context compounds this uncertainty, with local studies contradicting global trends by finding a negative GDP–revenue relationship and an insignificant impact from FDI. While trade openness appears to positively influence tax revenue in Zambia, evidence on industrialisation remains indirect and underexplored. Furthermore, the unemployment–revenue nexus remains entirely unexamined for Zambia. This analysis identifies a

clear research gap: the absence of a unified study that simultaneously estimates the dynamic effects of economic growth, unemployment, FDI, trade openness, and industrialisation on tax revenue performance in Zambia. This study addresses this gap by employing a Vector Error Correction Model (VECM) on data from 1990 to 2023 to clarify these contested relationships. The Autoregressive Distributed Lag (ARDL) model is used as a robustness check to validate the VECM findings. By doing so, the study provides definitive, policy-relevant evidence for enhancing fiscal resilience.

MATERIAL AND METHODS

This section outlines the empirical approach employed to examine the impact of macroeconomic factors on tax revenue performance in Zambia. It describes the data sources, model specification, variable measurement, and econometric procedures used in the analysis.

Data and Sources

The study utilises annual secondary time-series data for Zambia covering the period 1990–2023. Data on total tax revenue as a percentage of GDP were obtained from the Zambia Revenue Authority and cross-validated with the World Bank's World Development Indicators (WDI). Independent variables, including GDP growth rate, unemployment rate, foreign direct investment inflows (as a percentage of GDP), trade openness, and industrial value added, were sourced from the WDI to ensure consistency. To enhance econometric estimation and interpretation, variables expressed as ratios or shares were transformed into natural logarithms, while variables already measured in percentage terms, such as GDP growth and unemployment, were retained in their original form. This approach supports a semi-logarithmic specification and facilitates elasticity interpretation.

Research Design and Model Specification

The study adopts a quantitative research design based on time-series econometric analysis. This approach is appropriate for examining dynamic relationships among macroeconomic variables over time. The empirical analysis is grounded in the Vector Error Correction Model (VECM), which is suitable for estimating short-run and long-run relationships among cointegrated variables. The functional relationship is specified as:

$$TR_t = f(\mathrm{GDPGR_t}, \mathrm{FDI_t}, \mathrm{UNEMP_t}, \mathrm{IND_t}, \mathrm{TO_t}) \quad \text{.....(15)}$$

The Linear Econometric model is expressed as:

$$TR_t = \beta_0 + \beta_1 GDPGR_t + \beta_2 FDI_t + \beta_3 UNEMP_t + \beta_4 IND_t + \beta_5 TO_t \quad \text{.....(16)}$$

In semi-logarithmic form, the model becomes:

$$logTR_t = \beta_0 + \beta_1 GDPGR_t + \beta_2 logFDI_t + \beta_3 UNEMP_t + \beta_4 logIND_t + \beta_5 logTO_t \quad \text{.....(17)}$$

Where;

- TR_t is Tax revenue as a percentage of GDP
- $GDPGR_t$ is GDP growth rate.
- FDI_t is Foreign direct investment inflows as a percentage of GDP

- *UNEMP*$_t$ is the unemployment rate
- *IND is* Industrialisation (industry value added as a percentage of GDP)
- *TO is* Trade openness (exports plus imports as a percentage of GDP)

The error correction representation is specified as:

$$\Delta logTR_t = \lambda ECM_{t-1} + \sum_{i=1}^{K-1} \delta_i \Delta log\, X_{t-l} + \\ + U_t \quad \text{.....(18)}$$

Where Δ denotes the first difference operator, ECM_{t-1} is the error correction term, λ measures the speed of adjustment, and U_t is the error term.

Pre-Estimation Procedures

Before estimation of the Vector Error Correction Model (VECM), a sequence of statistical procedures was undertaken to ensure data validity, model suitability, and econometric robustness.

Descriptive Statistics

Descriptive statistics were computed to summarise the central tendency, dispersion, and distributional properties of the variables. Measures including the mean, standard deviation, minimum, and maximum values provide preliminary insights into data variability, scale differences, and potential outliers (Gujarati & Porter, 2009). This step facilitates an initial assessment of the stability and comparability of the macroeconomic variables before formal econometric analysis.

Stationarity Test

A time series Y_t is stationary if its mean and variance are constant over time and its covariance depends only on the time interval between observations. The presence of a unit root indicates non-stationarity and may lead to spurious regression results (Granger & Newbold, 1974). Consequently, testing for stationarity is a prerequisite for valid time-series modelling. To strengthen the robustness of the stationarity analysis, both the Augmented Dickey–Fuller (ADF) test developed by Dickey and Fuller (1979) and the Phillips–Perron (PP) test developed by Phillips and Perron (1988) were employed to determine the order of integration of each variable. The Augmented Dickey–Fuller (ADF) test developed by Dickey and Fuller (1979) was employed to determine the order of integration of each variable. The ADF regression is specified as:

The ADF regression is specified as:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^{p} \partial_i \Delta Y_{t-1} + \\ U_t \quad \text{.....(19)}$$

Where Δ is the first difference operator, t is a time trend, p is the lag length, and γ tests for the presence of a unit root. The null hypothesis H_0: γ=0 indicates non-stationarity, while rejection implies stationarity. The Phillips–Perron test complements the ADF approach by correcting for serial correlation and heteroskedasticity using non-parametric adjustments without including lagged difference terms. The ADF results, which confirmed that the variables are predominantly integrated of order one, together with the Phillips–Perron results, which provided mixed evidence for some variables but confirmed that none of the variables are integrated of order two, I(2), justified the use of the Johansen cointegration test and the VECM as the primary estimation

framework. The ARDL model was additionally employed as a robustness check because it accommodates variables integrated at either I(0) or I(1), provided none are integrated of order two.

Lag Length Selection

Appropriate lag length selection is essential to ensure model parsimony while avoiding serial correlation and over-parameterisation, particularly given the limited sample size (1990-2023). The optimal lag length for the underlying Vector Autoregressive (VAR) system was determined using standard information criteria, including the Akaike Information Criterion (AIC), Schwarz Bayesian Information Criterion (SBIC), and Hannan-Quinn Information Criterion (HQIC) (Akaike, 1974; Schwarz, 1978). Following conventional econometric practice, the Akaike Information Criterion was prioritised due to its superior performance in small samples. The AIC is defined as: The AIC is defined as:

$$AIC = -2In(L) + 2k \quad \text{.....(20)}$$

Where L is the maximised likelihood function, k is the number of estimated parameters.

Johansen Cointegration Test

Cointegration analysis is used to examine the existence of long-run equilibrium relationships among non-stationary variables that are integrated of the same order. According to Engle and Granger (1987), cointegration occurs when a linear combination of non-stationary variables is stationary, indicating long-run co-movement. After confirming that all variables are integrated of order one, the Johansen (1988) maximum likelihood procedure was employed to test for cointegration. The Johansen framework is based on the Vector Autoregressive representation: The Johansen framework is based on the Vector Autoregressive representation:

$$\Delta Y_t = \pi X_{t-1} + \sum_{i=1}^{k-1} \tau_i \Delta X_{t-1} + U_t \quad \text{.....(21)}$$

Where X_t is a vector of endogenous variables, Π contains long-run information. If the rank of matrix Π is $r > 0$, then there exist r cointegrating relationships. The test statistics include the Trace Statistic:

$$Trace = -T \sum_{i=r+1}^{n} In(1 - \lambda_i) \quad \text{.....(22)}$$

and the Maximum Eigenvalue Statistic:

$$Max - Eigen = -TIn(1 - \lambda_{r+1}) \quad \text{.....(23)}$$

where λ are eigenvalues and Tis the sample size. The presence of at least one cointegrating vector confirms the existence of a stable long-run relationship among tax revenue and the selected macroeconomic variables, thereby justifying the estimation of the VECM.

Post-Estimation Procedures

Post-estimation diagnostic tests were conducted to assess the adequacy, reliability, and robustness of the estimated Vector Error Correction Model (VECM). These tests were implemented to verify whether the key assumptions underlying multivariate time-series analysis were satisfied. All diagnostic tests were evaluated at the 5 percent level of significance, whereby the null hypothesis

was rejected if the associated p-value was less than 0.05. Consistent with standard practice in system-based cointegration modelling, emphasis was placed on testing for residual serial correlation, normality, and parameter stability. In the VECM framework, residual autocorrelation and dynamic instability pose the most serious threats to valid inference and long-run equilibrium analysis (Lütkepohl, 2005). The Johansen maximum likelihood approach is relatively robust to certain forms of heteroskedasticity and multicollinearity (Johansen, 1995), while cointegration analysis addresses key specification concerns by explicitly modelling long-run relationships (Engle & Granger, 1987). Accordingly, the diagnostic strategy focused on tests most critical to validating the dynamic structure and stability of the model.

Serial Correlation Test: Lagrange Multiplier (LM) Test

Serial correlation, also referred to as autocorrelation, occurs when model residuals are correlated with their lagged values, violating the assumption of error independence. The presence of serial correlation leads to inefficient parameter estimates and biased statistical inference. To examine residual autocorrelation, the Lagrange Multiplier test developed by Breusch and Godfrey (1981) was employed. The test is based on the auxiliary regression:

$$\hat{u}_t = \alpha + \sum_{i=1}^{p} p_i \hat{u}_{t-i} + \sum_{i=1}^{p} \beta_j X_{j,t} + U_t \quad \text{.....(24)}$$

where $\hat{u}_t$ represents the residuals from the estimated model. The LM statistic is computed as:

$$LM = TR^2 \quad \text{.....(25)}$$

where T is the sample size, and R^2 is obtained from the auxiliary regression. The null hypothesis of no serial correlation is rejected if the LM statistic exceeds the critical chi-square value. Absence of serial correlation confirms that the dynamic structure of the VECM is correctly specified.

Normality Test: Jarque-Bera Test

Normality testing assesses whether the distribution of model residuals conforms to a normal distribution. While large samples reduce concerns regarding non-normality, normal residuals remain important for valid hypothesis testing, particularly in small samples. The Jarque–Bera test (Jarque & Bera, 1980) was employed to examine the normality of residuals based on their skewness and kurtosis.

The test statistic is given by:

$$JB = \frac{T}{6}\left(S^2 + \frac{(K-3)^2}{4}\right) \quad \text{.....(26)}$$

where S denotes skewness and K kurtosis of the residuals. The null hypothesis of normality is rejected if the test statistic exceeds the chi-square critical value. Normal residuals indicate reliable inference based on standard test statistics.

Stability Test: Inverse Roots of the Characteristic Polynomial

Parameter stability is essential for reliable long-run and short-run inference, forecasting, and policy analysis. Structural instability may distort estimated relationships and weaken predictive performance. Stability of the VECM was assessed using the inverse roots of the companion matrix.

According to Lütkepohl (2005), the model is stable if all inverse roots lie within the unit circle. Formally, stability requires:

$|\lambda_i| < 1 \; \forall_i$ ……..(27)

where λ_i are the eigenvalues of the companion matrix. Satisfaction of this condition indicates that the system converges to equilibrium following external shocks.

FINDINGS

This section presents the empirical findings on the relationship between selected macroeconomic factors and tax revenue performance in Zambia over the period 1990–2023. The results are reported for pre-estimation tests, Vector Error Correction Model estimation, and post-estimation diagnostics.

Pre-Estimation

Descriptive Statistics

The table below presents the descriptive statistics of the study variables. Tax revenue (logTR) records a mean value of 2.745 and low variability, indicating relative stability over the study period. Economic growth (GDPGR) exhibits substantial volatility, ranging from -8.63 percent to 10.30 percent. Foreign direct investment (logFDI) also shows considerable fluctuations, reflecting sensitivity to macroeconomic conditions. Unemployment displays moderate variation, while industrial output (logIND) and trade openness (logTO) remain relatively stable. Table 2 below offers a summary of the descriptive statistics.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max
logTR	34	2.74463	0.10847	2.45852	2.96954
GDPGR	34	4.24188	3.83498	-8.6254	10.2982
UNEMP	34	11.4272	4.89749	4.529	19.7
logFDI	34	1.38815	0.70089	-0.9763	2.29298
logIND	34	3.47985	0.1899	3.12763	3.83479
logTO	34	4.2036	0.11849	4.02752	4.45677

Source: Authors Computation (2026)

Overall, the results suggest that tax revenue, industrial output, and trade openness were relatively stable, whereas economic growth and foreign direct investment were highly volatile, justifying further econometric analysis.

Unit Root Test

The Augmented Dickey–Fuller test indicates that all variables are non-stationary in levels but become stationary after first differencing at the 5 percent significance level. All series are therefore integrated of order one, I (1), satisfying the requirement for cointegration analysis. The table below details the ADF Test results.

Table 3: ADF Test

Variable	Level t-statistic	p-value	First Difference t-statistic	p-value	Order of Integration
logTR	-1.86	0.351	-4.459*	0.0002	I(1)
GDPGR	-2.585	0.096	-7.099*	0	I(1)
UNEMP	-1.595	0.486	-5.169*	0	I(1)
logFDI	-1.67	0.447	-7.749*	0	I(1)
logIND	-2.328	0.163	-3.809*	0.0028	I(1)
logTO	-1.864	0.349	-5.644*	0	I(1)

Source: Authors Computation (2026)

* Denotes significance at the 5% level, implying rejection of H_0

Lag Selection

Lag length selection based on AIC, LR, HQIC, and SBIC criteria produces mixed results. The AIC and LR criteria select three lags, while other criteria favour a more parsimonious structure. Given the annual frequency and limited sample size, a maximum lag length of three was adopted for VECM estimation. The details of the lag length output is summarised in table 4.

Table 4: Lag Length

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	-99.2763	—	0.000045	7.01842	7.10807	7.29866
1	3.19123	204.94	5.60E-07	2.58725	3.21481*	4.54893*
2	40.4733	74.564	7.10E-07	2.50178	3.66724	6.14489
3	87.9344	94.922*	9.00E-07	1.73771*	3.44108	7.06226
4	.	.	3.6e-24*	.	.	.

Source: Authors' Computation (2026)

* Indicates the selected lag order by the respective criterion.

Johansen Cointegration Test

The Johansen cointegration test reveals the presence of one cointegrating relationship among the variables at the 5 percent significance level. The null hypothesis of no cointegration is rejected, confirming the existence of a stable long-run equilibrium relationship between tax revenue, economic growth, foreign direct investment, unemployment, industrial output, and trade openness. This result justifies the application of the Vector Error Correction Model. The details of the Johansen Test is detailed in table 5 below.

Table 5: Johansen Test for Cointegration

Rank (r)	Trace	5% Critical	Decision
0	105.2133	94.15	Reject H_0
1	66.4710*	68.52	Do NOT Reject H_0
2	35.8659	47.21	Do NOT Reject H_0
3	17.6600	29.68	Do NOT Reject H_0
4	8.6127	15.41	Do NOT Reject H_0

Source: Authors' Computation (2026)

* Selected rank

VECM Estimation Results

Long-Run Results

Table 6: Long-Run Cointegration Estimates

Variable	Coefficient	Std. Error	Z-statistic	p-value
GDPGR	0.0756*	0.021	3.6	0
UNEMP	–0.0008	0.0108	0.07	0.943
logFDI	–0.3349*	0.131	2.56	0.011
logIND	0.1375	0.2347	0.59	0.558
logTO	1.2742*	0.5118	2.49	0.013
Constant	2.8942	—	—	—

Source: Authors' Computation (2026)

*Significant at 5% level

From the Johansen-normalised cointegrating vector, the long-run relationship is:

$$logTR_t = 2.8942 + 0.0756GDPGR_t - 0.0008UNEMP_t - 0.3349logFDI_t + 0.1375logIND_t + 1.2742logTO_t \quad \ldots\ldots(28)$$

The long-run results reveal that economic growth significantly enhances tax revenue in Zambia. A one-unit increase in GDP growth increases tax revenue by approximately 7.6 percent in the long run. This finding aligns with Keynesian growth theory (Keynes, 1936), which emphasises income expansion as a driver of tax capacity and is consistent with empirical findings by Nguyen-Phuong et al. (2022) and Kalaš et al. (2020). Trade openness also exerts a positive and statistically significant long-run effect. The elasticity of 1.274 suggests that greater trade integration substantially strengthens revenue mobilisation through customs duties and indirect taxation. This supports revenue-trade elasticity theory and corroborates Le et al. (2025), who argue that trade integration broadens the taxable base when supported by effective tax administration. Long-Run Cointegration Estimates are summarised in Table 6.

In contrast, foreign direct investment exhibits a negative and statistically significant long-run effect. A 1 percent increase in FDI reduces tax revenue by approximately 0.33 percent. This contradicts the predictions of investment-led growth theory (Solow, 1956) and suggests revenue leakages arising from tax incentives, profit repatriation, and transfer pricing practices. Similar findings are reported by Omodero and Yado (2024) and Gasparėnienė et al. (2022). In the Zambian context, this likely reflects generous fiscal incentives and limited domestic value retention.

Unemployment and industrialisation are statistically insignificant in the long run. While labour market theory (Okun, 1962) predicts a negative relationship, the insignificance suggests that Zambia's revenue structure, dominated by indirect taxation and informality, insulates tax performance from labour market fluctuations. Likewise, industrialisation has not yet matured sufficiently to generate sustained fiscal gains, contrasting with findings by Ofori et al. (2021) and Busari et al. (2024), who found that industrialisation significantly enhances tax revenue in African economies and Sub-Saharan Africa, respectively.

Short-Run Results

Table 7: Short-Run VECM Estimates (Dependent Variable: ΔlogTR)

Variable	Coefficient	Std. Error	z-Statistic	p-value
ECM(-1)	–0.2657*	0.0714	–3.72	0
ΔGDPGR(-1)	–0.0070	0.0057	–1.24	0.216
ΔGDPGR(-2)	–0.0111*	0.0045	–2.46	0.014
ΔUNEMP(-1)	–0.0054	0.0114	–0.47	0.638
ΔUNEMP(-2)	0.0177	0.0111	1.6	0.11
ΔlogFDI(-1)	0.0756*	0.0315	2.4	0.016
ΔlogFDI(-2)	0.0618*	0.0253	2.44	0.015
ΔlogIND(-1)	–0.2066	0.2174	–0.95	0.342
ΔlogIND(-2)	–0.6584*	0.2313	–2.85	0.004
ΔlogTO(-1)	–0.2374	0.1787	–1.33	0.184
ΔlogTO(-2)	–0.4464*	0.1725	–2.59	0.01
Constant	–0.0029	0.0139	–0.21	0.833

Source: Authors' Computation (2026)

*Significant at 5% level

The Estimated Short-Run Model

$$\Delta logTR_t = -0.2657ECM_{t-1} + \sum \beta_i \Delta X_{t-i} + u_t \quad (29)$$

where the significant short-run effects include:

$$\Delta logFDI_{t-1}, \Delta logFDI_{t-2,} \Delta logIND_{t-2}, \Delta logT0_{t-2} \quad (30)$$

The results of the Short-Run VECM Estimates are detailed in Table 1. The error correction term (–0.266) is negative and statistically significant, indicating that approximately 26.6 percent of short-run disequilibrium is corrected annually. This confirms a stable long-run adjustment mechanism. In the short run, foreign direct investment has a positive and statistically significant effect on tax revenue. This suggests that initial capital inflows stimulate production and consumption, thereby increasing taxable activity. However, the reversal in the long run indicates that these gains are not sustained. Industrial output and trade openness exert negative short-run effects, particularly at the second lag. These findings reflect transitional adjustment costs associated with industrial expansion and trade liberalisation, including capital import dependence, tariff reductions, and tax concessions. Similar short-run revenue losses have been documented in reforming developing economies (Le et al., 2025; Gnidehou & Alinsato, 2024). Economic growth and unemployment remain largely insignificant in the short run, suggesting that revenue responses to macroeconomic fluctuations are gradual and mediated by structural rigidities. This supports Tanzi and Zee (2000), who argue that sustained and inclusive growth is required for durable revenue expansion in developing economies.

Post-Estimation Diagnostic Tests

Test for Serial Correlation

The Lagrange Multiplier (LM) test was employed to examine whether the residuals of the Vector Error Correction Model are serially correlated. The null hypothesis states that there is no autocorrelation at the specified lag order. The test results indicate that the null hypothesis cannot be rejected at lags 1, 2, and 3, as the corresponding p-values of 0.802, 0.535, and 0.056 respectively, exceed the 5 percent significance level. Although the p-value at lag 3 is marginal, it remains above the conventional threshold. Therefore, the null hypothesis of no serial correlation is not rejected, implying the absence of autocorrelation in the residuals. This confirms that the dynamic structure and lag specification of the VECM are adequately specified and that the estimated results are reliable for inference. Table 8 summarises the test for serial correlation.

Table 2: Lagrange Multiplier Test for Serial Correlation

Lag	χ^2	p-value	Decision
1	28.67	0.802	Do not reject H_0 (No autocorrelation)
2	34.6	0.535	Do not reject H_0 (No autocorrelation)
3	50.41	0.056	Do not reject H_0 (No autocorrelation)

Source: Authors' Computation (2026)

Test for Normality of Residuals

The normality of the residuals was examined using the Jarque–Bera test. The null hypothesis states that the residuals are normally distributed. The results indicate that most individual equations satisfy the normality assumption, as their p-values exceed the 5 percent significance level. However, the residuals of the unemployment and industrial output equations deviate from normality. The joint Jarque-Bera test for the system as a whole is statistically significant (χ^2 = 39.149, p = 0.0001), indicating that the residuals are not jointly normally distributed. Although this suggests some departure from normality, it does not invalidate the VECM estimates, as the model remains consistent under large-sample properties. Therefore, the results are considered reliable for inference. Table 9 summarises the test for Jarque-Bera normality.

Table 3: Jarque-Bera Normality Test Results

Equation	χ^2	p-value	Decision
D_logTR	0	0.9999	Normal
D_GDPGR	0.94	0.6251	Normal
D_UNEMP	8.976	0.0112	Not normal
D_logFDI	2.589	0.274	Normal
D_logIND	26.397	0	Not normal
D_logTO	0.246	0.8842	Normal
ALL (Joint test)	39.149	0.0001	Not normal

Source: Authors' Computation (2026)

Test for Parameter Stability

In figure 2, we present the roots of the companion matrix for the VECM stability test. The stability of the estimated VECM was examined using the inverse roots of the companion matrix. The results show that all eigenvalues lie within the unit circle, satisfying the stability condition. This indicates that the VECM is dynamically stable and that any short-run shocks to the system converge towards

the long-run equilibrium over time. Therefore, the estimated model is considered reliable for policy analysis and inference.

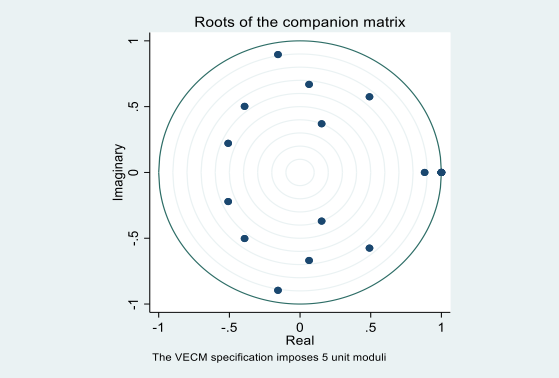

Figure 1: Roots of the Companion Matrix for the VECM Stability Test

Source: Authors' Computation (2026)

Granger Causality Test

The Granger causality test was conducted to examine the direction of causality among the variables. The results indicate that foreign direct investment, industrialisation, and trade openness Granger-cause tax revenue, as their p-values (0.003, 0.002, and 0.018) are below the 5 percent significance level. In contrast, economic growth and unemployment do not exhibit statistically significant causal relationships with tax revenue. Overall, the findings suggest that external sector and structural variables play an important role in shaping short-run tax revenue dynamics in Zambia.

Table 4: Granger Causality Test Results (Dependent Variable: logTR)

Equation = logTR			
Variable	**χ^2**	**p-value**	**Decision/Interpretation**
GDPGR	3.6168	0.306	Do not reject H_0 (Insignificant - No causality)
UNEMP	5.5537	0.135	Do not reject H_0 (Insignificant - No causality)
logFDI	13.913	0.003	Reject H_0 (Significant - Causality)
logIND	14.376	0.002	Reject H_0 (Significant - Causality)
logTO	10.064	0.018	Reject H_0 (Significant - Causality)
ALL	65.963	0	Jointly significant

Source: Authors' Computation (2026)

Impulse Response Function Analysis

The impulse response functions were employed to examine the dynamic effects of shocks in macroeconomic variables on tax revenue over time. The results show that a positive shock to economic growth leads to a gradual increase in tax revenue, confirming the long-run positive relationship. Trade openness also exhibits a stable positive response over time. In contrast, foreign direct investment generates a weak and initially negative response, indicating limited long-run benefits. Industrialisation shows an initial negative response followed by mild recovery, reflecting adjustment costs, while unemployment has no meaningful effect. Overall, tax revenue responds more strongly to growth and trade-related shocks than to labour market or industrial dynamics.

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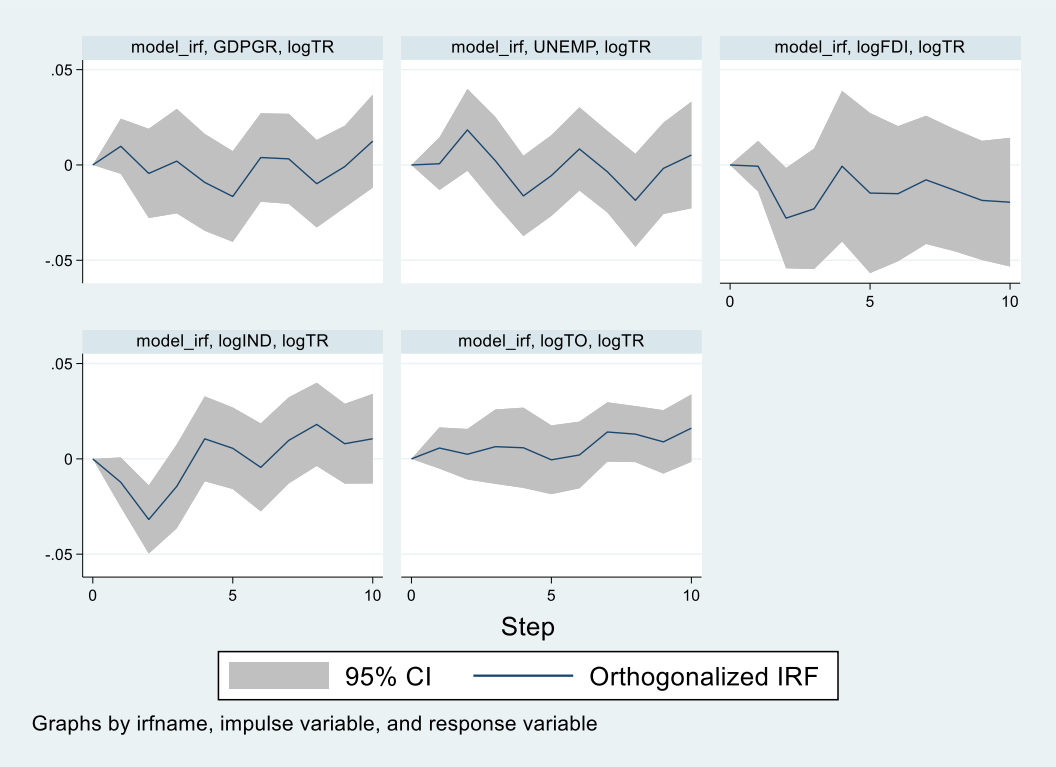

Figure 2: Impulse Response Functions (Response Variable: logTR)

Source: Authors' Computation (2026)

Forecast Error Variance Decomposition

The forecast error variance decomposition was used to assess the relative contribution of each variable to fluctuations in tax revenue over time. The results indicate that tax revenue is largely explained by its own shocks in the short run. However, the contribution of macroeconomic variables increases gradually over the forecast horizon. Foreign direct investment and industrialisation emerge as the most important contributors in the long run, explaining approximately 24.4 percent and 21.1 percent of tax revenue fluctuations at Step 10, respectively. In contrast, economic growth, unemployment, and trade openness contribute relatively smaller shares. Overall, the findings suggest that structural and external sector variables play an important role in explaining long-run tax revenue dynamics in Zambia.

Table 5: Forecast Error Variance Decomposition of Tax Revenue (%)

Variable	Step 1	Step 5	Step 10	Interpretation
logTR	100	42.7	31.3	Own shocks dominate initially but decline over time
GDPGR	0	3.1	6.3	Modest but increasing contribution
UNEMP	0	9.4	11.2	Small but gradually increasing influence
logFDI	0	20.2	24.4	Major contributor in the long run
logIND	0	22.9	21.1	Significant and stable contribution
logTO	0	1.7	5.9	Gradually increasing contribution

Source: Authors' Computation (2026)

ARDL Model Comparison

To assess the robustness of the findings, the ARDL long-run estimates in Table 12 below were compared with the VECM results. The comparison reveals broad consistency regarding foreign direct investment and trade openness. Both models indicate that FDI negatively affects tax revenue, while trade openness exerts a positive and statistically significant effect. Unemployment remains statistically insignificant across both specifications, suggesting a limited long-run influence on tax revenue performance.

Table 6: ARDL Long Run Results

Variable	Coefficient	p-value	Interpretation
GDPGR	−0.011	0.003	Negative significant
UNEMP	0.001	0.83	Insignificant
logFDI	−0.150	0	Negative significant
logIND	−0.412	0	Negative significant
logTO	0.335	0.013	Positive significant

Source: Authors' Computation (2026)

However, differences emerge for economic growth and industrialisation. As shown in Table 13 below, while the VECM results indicate a positive long-run effect of economic growth, the ARDL estimates reveal a negative relationship. Industrialisation also appears statistically significant under the ARDL framework but not under VECM. These differences are not contradictions but reflect the different underlying assumptions and estimation techniques of the two models.

Table 7: Comparison of VECM and ARDL Long-Run Results

Variable	VECM Long Run	ARDL Long Run	Consistency
GDPGR	Positive significant	Negative significant	Mixed evidence
UNEMP	Insignificant	Insignificant	Consistent
logFDI	Negative significant	Negative significant	Strongly consistent
logIND	Insignificant	Negative significant	Partial consistency
logTO	Positive significant	Positive significant	Strongly consistent

Source: Authors' Computation (2026)

The VECM explicitly models cointegration and distinguishes between short-run and long-run dynamics, whereas the ARDL approach (in its standard form) estimates a single long-run relationship without the same error-correction structure. Given that the Johansen cointegration test confirms exactly one cointegrating vector, the VECM results are econometrically preferred for long-run inference. The ARDL results are reported as a sensitivity check; the divergence in the sign of GDP growth highlights the sensitivity of the growth-revenue nexus to model specification - a finding that itself is informative for policymakers. The paper, therefore, bases its conclusions on the VECM estimates, while acknowledging the ARDL differences as a caution against over-generalisation.

CONCLUSION AND RECOMMENDATIONS

Conclusion

This study investigated the dynamic effects of economic growth, unemployment, foreign direct investment, industrialisation, and trade openness on tax revenue performance in Zambia using a Vector Error Correction Model. The results confirm the existence of a stable long-run relationship

among the variables, supported by a statistically significant error correction mechanism, indicating that the model is dynamically stable. The additional Granger causality, impulse response, and forecast error variance decomposition analyses further confirm the robustness and dynamic consistency of the estimated relationships. The findings show that economic growth has a positive and statistically significant long-run effect on tax revenue, while its short-run impact remains weak. This suggests that the fiscal benefits of growth materialise gradually and depend on structural and institutional conditions. Unemployment exhibits a negative but statistically insignificant long-run relationship with tax revenue, implying that labour market conditions have limited influence on revenue mobilisation under the current tax structure, largely due to informality and reliance on indirect taxation.

Foreign direct investment has a negative and statistically significant long-run effect on tax revenue, despite positive short-run contributions. This reflects the prevalence of tax incentives, profit repatriation, and limited domestic value addition, which constrain the long-term fiscal benefits of foreign investment. The variance decomposition results further show that foreign direct investment accounts for a substantial share of tax revenue fluctuations over time, highlighting its importance in shaping Zambia's fiscal dynamics despite its adverse long-run effect. Industrialisation shows a positive but statistically insignificant long-run relationship with tax revenue, while its short-run effect is negative, indicating that Zambia's manufacturing sector has not yet developed sufficiently to generate sustained fiscal gains. However, the Granger causality and variance decomposition results suggest that industrialisation remains an important driver of short-run and medium-run revenue dynamics. Trade openness exerts a positive and statistically significant long-run effect on tax revenue, although its short-run impact is negative. The Granger causality and impulse response results further confirm that trade openness is one of the most important and consistent drivers of tax revenue performance in Zambia. This suggests that trade integration enhances revenue mobilisation over time but is associated with short-term adjustment costs. Overall, the findings demonstrate that Zambia's tax revenue performance is primarily shaped by long-run structural and institutional factors rather than short-term macroeconomic fluctuations. Sustainable revenue mobilisation, therefore, depends on improving growth quality, strengthening industrial capacity, and enhancing the effectiveness of fiscal and investment policies. The robustness comparison between the ARDL and VECM frameworks further strengthens confidence in the reliability of the core findings, particularly regarding the roles of foreign direct investment and trade openness.

Recommendations

Based on the empirical findings, the study proposes the following policy recommendations:

i. **Promote Inclusive and Tax-Buoyant Economic Growth:** The government should prioritise growth strategies that expand the formal sector and strengthen tax buoyancy. This includes supporting value addition in agriculture and mining, promoting small and medium enterprise formalisation, investing in productive infrastructure, and encouraging private sector development. Growth policies should emphasise inclusiveness to ensure that economic expansion translates into a broader and more sustainable tax base.

ii. **Reform Foreign Direct Investment Incentive Frameworks:** Investment incentive regimes should be rationalised by reducing excessive tax exemptions, strengthening monitoring of profit shifting and transfer pricing, improving transparency in investment agreements, and aligning investment promotion policies with domestic revenue objectives.

This will enhance the long-term fiscal contribution of foreign investment. Given the strong influence of foreign direct investment on tax revenue dynamics observed in the variance decomposition and Granger causality results, improving the quality and fiscal accountability of foreign investment is essential for sustainable domestic revenue mobilisation.

iii. **Strengthen Industrial Development for Revenue Mobilisation:** Industrial policy should focus on promoting domestic value chains, reducing import dependence in manufacturing, encouraging linkages between foreign and local firms, and gradually phasing out inefficient industrial tax holidays. These measures will strengthen the formal industrial base and improve revenue-generating capacity. Greater emphasis should also be placed on improving industrial productivity and domestic value retention to convert industrial expansion into sustained fiscal gains.

iv. **Deepen Trade and Domestic Tax Reforms:** Trade liberalisation should be complemented by strengthened customs administration, improved value-added tax compliance systems, enhanced domestic tax substitution mechanisms, and expanded digital monitoring of cross-border transactions. These reforms will help mitigate short-run revenue losses and maximise long-run fiscal benefits. Given the consistent significance of trade openness across the VECM, Granger causality, and impulse response analyses, strengthening trade-related tax administration remains critical for improving fiscal performance.

v. **Broaden the Direct Tax Base and Formalise Employment:** Policy efforts should be intensified to expand personal income tax coverage, formalise informal enterprises, strengthen labour market information systems, and promote employment in high-productivity sectors. Improving labour formalisation and compliance will enhance direct tax mobilisation and reduce excessive dependence on indirect taxation.

Limitations of the Study

The study is subject to several limitations. First, the sample size of 34 annual observations (1990-2023) is relatively small for a VECM with three lags and six variables, which may affect the precision of estimates. Second, the divergence between VECM and ARDL results for economic growth and industrialisation suggests that the choice of econometric model influences inference; future research should explore non-linear or threshold models. Third, data on informality and tax compliance were not directly incorporated due to data unavailability, yet these factors likely mediate the relationship between macroeconomic variables and tax revenue. Finally, the study uses aggregate tax revenue; disaggregating by tax type (e.g., income tax, VAT, trade taxes) could reveal heterogeneous effects.

Data Availability

The dataset used in this study is available on reasonable request from the corresponding author.

Declaration of Funding

The authors did not receive any funding for this study.

Conflicts of Interest

The authors declare no conflicts of interest.

REFERENCES

Bati, B. (2025). Institutional and macroeconomic determinants of tax revenue in Sub-Saharan African countries. *Journal of Economic Structures*, 14(3), 1–19. DOI: 10.1186/s43093-025-00638-z

Busari, A. T., Sadiq, M., & Salami, O. (2024). Industrialisation and income, profit and capital gains taxes in Sub-Saharan Africa. *Journal of African Business*. https://doi.org/10.14738/abr.1210.17519

Buzugbe, J. N., Ologunla, S. E., & Santeli, J. N. (2024). Impact of tax revenue on unemployment rate in Nigeria. *FULafia International Journal of Business and Allied Studies*, 2(3), 163–180. https://fijbas.org/index.php/FIJBAS/article/view/112?utm_source=chatgpt.com

Chamisa, M. G., & Sunde, T. (2024). Key determinants of tax revenue in Zimbabwe: Assessment using autoregressive distributed lag (ARDL) approach. *Cogent Economics & Finance*, 12(1), 2386130. DOI: 10.1080/23322039.2024.2386130

Chamisa, M. G., & Sunde, T. (2025). The impact of macroeconomic and social variables on income and consumption tax revenues: A case of Zimbabwe. *Cogent Economics & Finance*, 13(1), 2506700. DOI: 10.1080/23322039.2025.2506700

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association*, 74(366), 427–431. DOI: 10.1080/01621459.1979.10482531

Đurović Todorović, J., Đorđević, M., & Vera, M. (2024). Modeling tax revenue determinants: The case of Visegrad Group countries. *Economies*, 12(1), 15. DOI: 10.3390/economies12060131

Engle, R. F., & Granger, C. W. J. (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrica*, 55(2), 251–276. DOI: 10.2307/1913236

Gasparėnienė, L., Kliestik, T., Škare, M., Remeikienė, R., & Eitmantas, M. (2022). Impact of foreign direct investment on tax revenue: The case of the European Union. *Journal of Competitiveness*, 14(1), 43–60. DOI: 10.7441/joc.2022.01.03

Gnidehou, M. G., & Alinsato, A. S. (2024). Effect of tax rates on industrial profits on industrial production in Sub-Saharan Africa. *African Multidisciplinary Tax Journal*, 4(1), 18–36. DOI: 10.47348/AMTJ/V4/i1a2

Granger, C. W. J., & Newbold, P. (1974). Spurious regressions in econometrics. *Journal of Econometrics*, 2(2), 111–120. DOI: 10.1016/0304-4076(74)90034-7

Gupta, A. S. (2007). Determinants of tax revenue efforts in developing countries. *IMF Working Paper WP/07/184*. DOI: 10.5089/9781451867480.001

Haabazoka, L., & Kaulu, B. (2023). External debt, FDI and copper prices and their relationship with tax revenue mobilisation: The case of Zambia. *Proceedings of IEOM International Conference*. DOI: 10.46254/BA01.20230051

Ihuarulam, G. I., Sanusi, G. P., & Oderinde, L. O. (2021). Macroeconomic determinants of tax revenue in ECOWAS. *European Journal of Economics, Finance and Administrative Sciences*, 107, 62–75. DOI: 10.1142/9789811233418_0004

Jarque, C. M., & Bera, A. K. (1980). Efficient tests for normality, homoscedasticity and serial independence of regression residuals. *Economics Letters*, 6(3), 255–259. DOI: 10.1016/0165-1765(80)90024-5

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control*, 12(2–3), 231–254. DOI: 10.1016/0165-1889(88)90041-3

Johansen, S. (1995). *Likelihood-based inference in cointegrated vector autoregressive models*. Oxford University Press. DOI: 10.1093/0198774508.001.0001

Kalaš, B., Todorović, J. D., & Đorđević, M. (2020). Panel estimating effects of macroeconomic determinants on tax revenue level in the European Union. *Industrija*, 48(2), 27–47. Available from Central and Eastern European Online Library (CEEOL).

Keynes, J. M. (1936). *The general theory of employment, interest and money*. Macmillan. DOI: 10.1007/978-1-349-81807-5_4 (2018 ed.)

Kubaje, T. A., Amoasi-Andoh, R., Eklemet, I., & Wassan, S. N. (2025). Foreign direct investments, tax revenue, and economic growth in Sub-Saharan Africa. *Cogent Economics & Finance*, 13(1). DOI: 10.1080/23322039.2025.1234567

Le, T.-H., Bich Ngoc, P. T., & Van, P. H. (2025). International trade and tax performance. *eJournal of Tax Research*, 23(1), 162–190. URL: https://ssrn.com/abstract=5083275

Lütkepohl, H. (2005). *New introduction to multiple time series analysis*. Springer. DOI: 10.1007/978-3-540-27752-1

Meagher, K. (2018). Taxing times: Taxation, divided societies and the informal economy. *Journal of Development Studies*, 54(1), 1–17. DOI: 10.1080/00220388.2016.1262035

Morrissey, O. (2016). Tax revenue performance and vulnerability in developing countries. *Journal of Development Studies*, 52(12), 1689–1703. DOI: 10.1080/00220388.2016.1153071

Musgrave, R. A., & Musgrave, P. B. (1989). *Public finance in theory and practice* (5th ed.). McGraw-Hill. URL: https://www.mheducation.com

Mutambo, B., & Musantu, J. (2025). A Quantitative Analysis of the Balance of Payment Performance Using an Alternative Evaluation Approach: A Case of Zambia (1980-2020). *American Journal of Economics*, 9(1), 17-48. DOI: 10.47672/aje.2645

Nguyen-Phuong, L., Nguyen, T. P., & Hoang, T. T. (2022). Determinants of tax revenue: A comparison between ASEAN and European countries. *International Journal of Business and Society*, 23(1), 244–259. DOI: 10.33736/ijbs.4611.2022

Ofori, I. K., Ofori, E., & Asongu, S. A. (2021). Industrialisation, ICT diffusion and tax revenue in Africa. *Information Technology for Development*, 27(3), 559–578. DOI: 10.1080/02681102.2021.1887079

Okun, A. M. (1962). Potential GNP: Its measurement and significance. *Proceedings of the Business and Economics Statistics Section, American Statistical Association*, 89–104. DOI: 10.1057/978-1-349-95189-5_2346 (2019 ed.)

Omodero, C. O., & Yado, J. L. (2024). Effects of foreign direct investment and trade openness on tax earnings: A study of selected Sub-Saharan African economies. *Economies*, 12(12), 342. DOI: 10.3390/economies12120342

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3), 289–326. DOI: 10.1002/jae.616

Pratomo, A. W. (2019). The effect of foreign direct investment on tax revenue in developing countries. *International Institute of Social Studies Working Paper*. DOI: 10.2139/ssrn.3425825

Schwarz, G. (1978). Estimating the dimension of a model. *Annals of Statistics*, 6(2), 461–464. DOI: 10.1214/aos/1176344136

Sebele-Mpofu, F. Y. (2021). Taxing the informal sector through presumptive taxes in Zimbabwe: An avenue for a broadened tax base, stifling informal sector activities, or both. *Journal of Accounting and Taxation*, 13(4), 269–288. DOI: 10.5897/JAT2021.0469

Solow, R. M. (1956). A contribution to the theory of economic growth. *Quarterly Journal of Economics*, 70(1), 65–94. DOI: 10.2307/1884513

Tanzi, V. (1992). Structural factors and tax revenue in developing countries. In *Open economies: structural adjustment and agriculture* (pp. 267–285). Cambridge University Press. URL: https://www.cambridge.org

Tanzi, V., & Zee, H. H. (2000). Tax policy for emerging markets. *IMF Working Paper WP/00/35*. DOI: 10.5089/9781451845341.001

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APPENDIX

Appendix 1: Granger Causality

```
. var logTR GDPGR UNEMP logFDI logIND logTO, lags(1/3)

Vector autoregression

Sample: 1993 thru 2023                          Number of obs     =         31
Log likelihood =   63.12695                     AIC               =   3.282132
FPE            =   3.59e-06                     HQIC              =    5.00112
Det(Sigma_ml)  =   6.86e-10                     SBIC              =   8.555505

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
logTR                 19   .063347   0.8286   149.879    0.0000
GDPGR                 19   2.72508   0.7782   108.7826   0.0000
UNEMP                 19   1.32749   0.9652   858.7578   0.0000
logFDI                19   .624277   0.6647   61.46596   0.0000
logIND                19   .074981   0.9190   351.5893   0.0000
logTO                 19   .082078   0.8007   124.5134   0.0000
------------------------------------------------------------------
```

Appendix 2: Varsoc (Lag Selection Criteria)

```
Lag-order selection criteria

  Sample: 1994 thru 2023                                Number of obs = 30
```

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-99.2763				.000045	7.01842	7.10807	7.29866
1	3.19123	204.94	36	0.000	5.6e-07	2.58725	3.21481*	4.54893*
2	40.4733	74.564	36	0.000	7.1e-07	2.50178	3.66724	6.14489
3	87.9344	94.922*	36	0.000	9.0e-07	1.73771*	3.44108	7.06226
4	.	.	36		.-3.6e-24*	.	.	.

```
  * optimal lag
```

Appendix 3: Johansen Cointegration Test

```
Johansen tests for cointegration
Trend: Constant                                 Number of obs   = 31
Sample: 1993 thru 2023                          Number of lags =  3
```

Maximum rank	Params	LL	Eigenvalue	Trace statistic	Critical value 5%
0	78	10.520319	.	105.2133	94.15
1	89	29.891466	0.71342	66.4710*	68.52
2	98	45.194003	0.62740	35.8659	47.21
3	105	54.296973	0.44417	17.6600	29.68
4	110	58.820578	0.25312	8.6127	15.41
5	113	63.114712	0.24198	0.0245	3.76
6	114	63.126951	0.00079		

```
* selected rank
```

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Appendix 4: VECM

. vec logTR GDPGR UNEMP logFDI logIND logTO, trend(constant) lags(3)

Vector error-correction model

Sample: 1993 thru 2023		Number of obs =	31
		AIC =	3.813454
Log likelihood =	29.89147	HQIC =	5.155471
Det(Sigma_ml) =	5.86e-09	SBIC =	7.930385

Equation	Parms	RMSE	R-sq	chi2	P>chi2
D_logTR	14	.062059	0.6561	32.43372	0.0035
D_GDPGR	14	2.72017	0.8097	72.31677	0.0000
D_UNEMP	14	1.42061	0.4974	16.82619	0.2656
D_logFDI	14	.637854	0.6314	29.12217	0.0101
D_logIND	14	.070424	0.5728	22.79814	0.0636
D_logTO	14	.078678	0.5792	23.4024	0.0540

	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
D_logTR						
_ce1 L1.	-.2656801	.0714206	-3.72	0.000	-.4056619	-.1256984
logTR LD.	.0167545	.2055658	0.08	0.935	-.386147	.419656
L2D.	-.1559464	.1916171	-0.81	0.416	-.531509	.2196163
GDPGR LD.	-.006995	.005651	-1.24	0.216	-.0180708	.0040808
L2D.	-.011088	.0045082	-2.46	0.014	-.0199239	-.0022522
UNEMP LD.	-.0053674	.0114152	-0.47	0.638	-.0277408	.017006
L2D.	.0176516	.0110536	1.60	0.110	-.004013	.0393163
logFDI LD.	.0756004	.0314614	2.40	0.016	.0139371	.1372637
L2D.	.0618339	.0253245	2.44	0.015	.0121988	.1114689
logIND LD.	-.2065576	.2174238	-0.95	0.342	-.6327003	.2195851
L2D.	-.6583661	.2313221	-2.85	0.004	-1.111749	-.2049832
logTO LD.	-.2373505	.1787044	-1.33	0.184	-.5876048	.1129038
L2D.	-.4464432	.1724862	-2.59	0.010	-.7845099	-.1083765
_cons	-.0029329	.0139317	-0.21	0.833	-.0302386	.0243728
D_GDPGR						
_ce1 L1.	9.196766	3.130521	2.94	0.003	3.061058	15.33247
logTR LD.	-10.99195	9.010399	-1.22	0.222	-28.652	6.668111
L2D.	-12.11788	8.398999	-1.44	0.149	-28.57962	4.343854
GDPGR LD.	-.0062201	.2476968	-0.03	0.980	-.491697	.4792568
L2D.	.0307626	.1976036	0.16	0.876	-.3565332	.4180585
UNEMP LD.	-.0734617	.5003533	-0.15	0.883	-1.054136	.9072127
L2D.	-.6027908	.4845039	-1.24	0.213	-1.552401	.3468193
logFDI LD.	-6.511527	1.379024	-4.72	0.000	-9.214364	-3.808689
L2D.	-3.603545	1.110027	-3.25	0.001	-5.779159	-1.427932
logIND LD.	12.54969	9.53016	1.32	0.188	-6.129084	31.22846
L2D.	15.38795	10.13935	1.52	0.129	-4.484815	35.26072
logTO LD.	16.48715	7.833008	2.10	0.035	1.134732	31.83956
L2D.	6.449798	7.560447	0.85	0.394	-8.368406	21.268
_cons	.0770101	.6106589	0.13	0.900	-1.119859	1.27388
D_UNEMP						
_ce1 L1.	2.210334	1.634916	1.35	0.176	-.9940436	5.414711
logTR LD.	-.7853821	4.705687	-0.17	0.867	-10.00836	8.437594
L2D.	3.249468	4.386382	0.74	0.459	-5.347684	11.84662
GDPGR LD.	.1058404	.1293598	0.82	0.413	-.1477002	.359381
L2D.	.0229881	.1031986	0.22	0.824	-.1792774	.2252537
UNEMP LD.	.6862705	.2613098	2.63	0.009	.1741127	1.198428
L2D.	-.5871259	.2530324	-2.32	0.020	-1.08306	-.0911914
logFDI LD.	-.7942112	.7201962	-1.10	0.270	-2.20577	.6173473
L2D.	-.1452986	.5797125	-0.25	0.802	-1.281514	.9909171
logIND LD.	2.563284	4.977132	0.52	0.607	-7.191716	12.31828
L2D.	5.434352	5.295284	1.03	0.305	-4.944214	15.81292
logTO LD.	.0400228	4.090793	0.01	0.992	-7.977785	8.05783
L2D.	3.574566	3.948448	0.91	0.365	-4.164251	11.31338
_cons	-.3097304	.318917	-0.97	0.331	-.9347962	.3153355
D_logFDI						
_ce1 L1.	.3661093	.7340771	0.50	0.618	-1.072655	1.804874
logTR LD.	-1.97602	2.112852	-0.94	0.350	-6.117134	2.165094
L2D.	-1.198869	1.969485	-0.61	0.543	-5.058988	2.66125
GDPGR LD.	-.0194373	.0580825	-0.33	0.738	-.133277	.0944023
L2D.	.0568811	.0463361	1.23	0.220	-.033936	.1476983
UNEMP LD.	-.0674339	.117328	-0.57	0.565	-.2973926	.1625248
L2D.	.0521424	.1136115	0.46	0.646	-.1705321	.2748169
logFDI LD.	-.934128	.3233679	-2.89	0.004	-1.567918	-.3003386
L2D.	-.7599603	.2602908	-2.92	0.004	-1.270121	-.2497998
logIND LD.	-2.370353	2.234731	-1.06	0.289	-6.750346	2.00964
L2D.	1.583645	2.377581	0.67	0.505	-3.076328	6.243619
logTO LD.	.0181006	1.836765	0.01	0.992	-3.581893	3.618094
L2D.	-.7205404	1.772852	-0.41	0.684	-4.195267	2.754187
_cons	-.0559802	.1431937	-0.39	0.696	-.3366346	.2246743
D_logIND						
_ce1 L1.	-.0922685	.0810481	-1.14	0.255	-.2511199	.0665829
logTR LD.	-.114755	.2332762	-0.49	0.623	-.5719679	.3424579
L2D.	.2586414	.2174472	1.19	0.234	-.1675473	.6848301
GDPGR LD.	-.0022504	.0064128	-0.35	0.726	-.0148193	.0103184
L2D.	-.0058679	.0051159	-1.15	0.251	-.0158949	.0041591
UNEMP LD.	.0259684	.012954	2.00	0.045	.0005791	.0513578
L2D.	-.0029907	.0124836	-0.24	0.812	-.0275758	.0215944
logFDI LD.	.0142941	.0357025	0.40	0.689	-.0556814	.0842697
L2D.	.0339189	.0287382	1.18	0.238	-.022407	.0902448
logIND LD.	.5131281	.2467326	2.08	0.038	.0295411	.9967152
L2D.	-.3896122	.2625044	-1.48	0.138	-.9041114	.124887
logTO LD.	-.2601231	.2027939	-1.28	0.200	-.6575919	.1373456
L2D.	.0072232	.1957374	0.04	0.971	-.3764151	.3908614
_cons	.0056015	.0158098	0.35	0.723	-.025385	.0365881
D_logTO						
_ce1 L1.	-.2034581	.0905467	-2.25	0.025	-.3809265	-.0259898
logTR LD.	.0116706	.2606155	0.04	0.964	-.4991263	.5224676
L2D.	-.2068174	.2429314	-0.85	0.395	-.6829542	.2693195
GDPGR LD.	-.0207165	.0071643	-2.89	0.004	-.0347584	-.0066747
L2D.	-.0113894	.0057155	-1.99	0.046	-.0225915	-.0001873
UNEMP LD.	-.0017489	.0144721	-0.12	0.904	-.0301058	.026624
L2D.	.0313624	.0140137	2.24	0.025	.003896	.0588288
logFDI LD.	.0672215	.0398867	1.69	0.092	-.010955	.145398
L2D.	-.0029602	.0321063	-0.09	0.927	-.0658873	.059967
logIND LD.	-.4329096	.275649	-1.57	0.116	-.9731717	.1073524
L2D.	-.6013801	.2932602	-2.05	0.040	-1.176177	-.026583
logTO LD.	-.5281663	.2265608	-2.33	0.020	-.9722173	-.0841153
L2D.	-.3805168	.2186771	-1.74	0.082	-.8091164	.0480828
_cons	.0167029	.0176626	0.95	0.344	-.0179152	.051321

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	5	26.40848	0.0001

Identification: beta is exactly identified

Johansen normalization restriction imposed

beta	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
_ce1						
logTR	1	.	.	.	.	.
GDPGR	-.0755608	.021012	-3.60	0.000	-.1167436	-.034378
UNEMP	.0007753	.0108271	0.07	0.943	-.0204454	.0219959
logFDI	.3349275	.1309592	2.56	0.011	.0782522	.5916028
logIND	-.1375127	.2346518	-0.59	0.558	-.5974217	.3223963
logTO	-1.274157	.5117722	-2.49	0.013	-2.277212	-.2711016
_cons	2.894182	.	.	.	.	.

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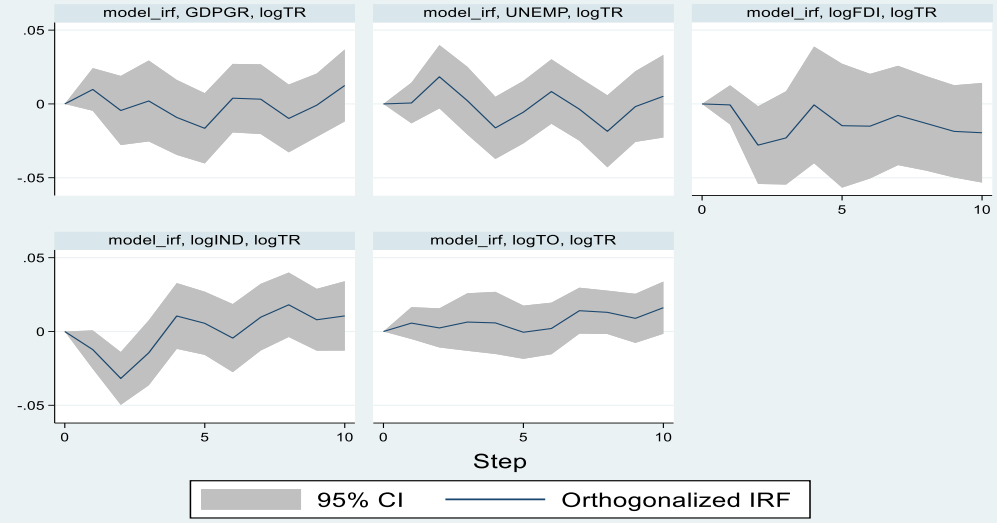
Appendix 5: Impulse Response Functions



Appendix 6: Companion Matrix