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Article

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Cogent Economics & Finance

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Suggested Citation: Chamisa, Moses G.; Sunde, Tafirenyika (2024) : Key determinants of tax revenue in Zimbabwe: assessment using autoregressive distributed lag (ARDL) approach, Cogent Economics & Finance, ISSN 2332-2039, Taylor & Francis, Abingdon, Vol. 12, Iss. 1, pp. 1-20, <https://doi.org/10.1080/23322039.2024.2386130>

This Version is available at:

<https://hdl.handle.net/10419/321560>

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To cite this article: Moses G. Chamisa & Tafirenyika Sunde (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](https://doi.org/10.1080/23322039.2024.2386130)

To link to this article: <https://doi.org/10.1080/23322039.2024.2386130>



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Published online: 13 Aug 2024.



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Key determinants of tax revenue in Zimbabwe: assessment using autoregressive distributed lag (ARDL) approach

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ABSTRACT

The study investigates the determinants of tax revenue in Zimbabwe using the ARDL approach for the period 1980 to 2022. This study aims to offer a thorough summary of the different factors that influence tax revenue within the framework of economic and social factors. The variables included in the analysis are GDP growth, the share of agriculture in GDP, private consumption expenditure, inflation, foreign direct investment, real interest rates, trade openness, shadow economy and population growth. The results indicate that private consumption expenditure and share of agriculture in GDP negatively and significantly impact tax revenue in the long run. GDP growth, inflation, foreign direct investment and real interest rates exhibit a positive but insignificant impact on tax revenue. Trade openness, shadow economy and population growth are negatively and insignificantly related to tax revenue. The short-run analysis indicates that lagged tax revenue, GDP growth, private consumption expenditure, inflation, and trade openness significantly impact tax revenue, while the share of agriculture in GDP and the shadow economy significantly hinder tax revenue. Real interest rates and population growth have positive but insignificant impacts on tax revenue. The study's findings provide valuable guidance to policymakers in formulating policies and strategies that enhance tax revenue collection and support the government's domestic resources mobilisation agenda by uncovering the relationships between tax revenue and its determinants.

IMPACT STATEMENT

This research paper provides an in-depth analysis of the determinants of tax revenue in Zimbabwe from 1980 to 2022 using the Autoregressive Distributed Lag (ARDL) approach. By examining various economic and social factors, such as GDP growth, private consumption expenditure, the share of agriculture in GDP, inflation, foreign direct investment, and the shadow economy, the study uncovers both short-term and long-term relationships between these variables and tax revenue. The findings have significant implications for policymakers, offering valuable guidance on enhancing tax revenue collection and supporting Zimbabwe's domestic resource mobilisation agenda.

SIGNIFICANCE

The research offers crucial insights into the factors influencing Zimbabwe's tax revenue performance, which is vital for economic stability and government prosperity. By identifying both the positive and negative impacts of various economic and social factors on tax revenue, the study provides policymakers with a robust foundation for designing effective fiscal policies. The findings emphasise the need for targeted strategies to enhance tax compliance, broaden the tax base, and address challenges the shadow economy poses. Additionally, the research contributes to the broader understanding of tax revenue dynamics in developing countries, making it a valuable resource for economists, analysts, and policymakers working in similar contexts.

ARTICLE HISTORY

Received 16 May 2024

Revised 27 June 2024

Accepted 11 July 2024

KEYWORDS

Tax revenue; determinants of tax revenue; economic growth; ARDL approach; economic and social variables; share of agriculture in GDP; FDI; inflation; shadow economy

SUBJECTS

Economics; Econometrics; Public Finance

1. Introduction

Tax revenue is crucial for government prosperity, as it funds public services and infrastructure development and enhances economic stability. Taxation has a historical significance and enhances social order (Jiang, 2017). Insufficient tax revenue leads to spending shocks and increased borrowing costs for the government. In addition to raising revenue, taxation helps establish a social contract between citizens and the government based on service provision in exchange for taxes paid. Recently in Zimbabwe, the combination of global economic challenges, declining official development assistance, and environmental catastrophes such as climate change and COVID-19 has amplified the importance of tax revenue as a government's priority. The government has implemented various initiatives to improve tax revenue collection to support its developmental goals. These efforts encompassed launching programs like the Zimbabwe Agenda for Sustainable Socio-Economic Transformation (ZIMASSET) in 2013, implementing the Transitional Stabilisation Programme (TSP) in 2019, and introducing National Development Strategy 1 (NDS1) in 2020. Additionally, reform measures involved instituting new taxes, including an Intermediated Money Transfer Tax, a Digital Services Tax, and a VAT on E-Commerce. These measures were aimed at expanding the revenue base, enhancing tax enforcement, and mobilising resources from various sectors of the economy (Saungweme & Odhiambo, 2018).

However, the nation's socio-economic conditions have worsened and are marked by a high inflationary environment, low utilisation of industrial capacity, and decreases in GDP. The financial flexibility is limited due to weak tax revenue performance amidst increasing current spending and a shrinking tax foundation. Additionally, the country is burdened with significant debt due to its inability to secure international capital and investment inflows. The country faces relatively low tax-to-GDP ratios compared to most Sub-Saharan African countries. The tax-to-GDP ratio measures the extent to which taxes are collected relative to the available economic capacity. It reflects both the effectiveness of tax policy design and the efficiency of tax administration. According to Modica et al. (2018), levels of taxation in an economy indicate the resources accessible for funding government activities. The considerable fluctuations in Zimbabwe's tax-to-GDP ratios impact its ability to finance public services. For example, from 1980 to 2022, there was a drop in the tax-to-GDP ratio from 16.3% in 1980 to 14.9% in 2020, with significant declines between 2005 and 2008 caused by worsened economic conditions. Volatility in tax revenue performance stems from various factors that need careful examination by policymakers, economists, and analysts alike as it illuminates influences on revenue generation and suggests potential remedies for issues related to collecting taxes.

Numerous investigations have examined the correlation between tax revenues and changes in GDP, revealing a positive association (Abate, 2013; Gupta, 2007; Velaj & Prendi, 2014). However, these studies overlooked other important determinants of tax revenues, such as additional macroeconomic variables, social factors, and demographic characteristics. Research on the determinants of tax revenue specific to Zimbabwe is limited. Most analyses that included Zimbabwe used panel data, making isolating the country's unique behaviour regarding tax revenue determinants challenging.

Other studies, such as those by Ndedzu et al. (2013) and Peter, Binha, Jeketera and Chamisa (2022) focused solely on the buoyancy of tax revenues without identifying specific impacting factors, and Peter (2017) and Binha (2020) did not include key socio-economic variables. This study aims to offer a thorough summary of the different factors that influence tax revenue within the framework of economic indicators (such as GDP growth, private consumption spending, the share of agriculture in GDP, inflation, foreign direct investment, real interest rates and trade openness) and social indicators (shadow economy and population growth). The null hypothesis is that economic and social indicators negatively influence tax revenue, while the alternative hypothesis is that they positively affect tax revenue. By consolidating existing research and empirical data, the study will pinpoint crucial elements that consistently impact tax revenue performance while emphasising areas requiring additional exploration.

The structure of this article is as follows: Section 2 provides a literature review that discusses the determinants of tax revenue. Section 3 outlines the research methodology, detailing the econometric model specifications used. Section 4 presents the analysis of the data and discusses the findings. Finally, Section 5 concludes the paper by synthesising the main findings and their implications for policymakers, economists and academics interested in fiscal policy and economic development.

2. Brief literature review

2.1 Studies that utilised the ARDL approach

Several empirical works on the determinants of tax revenue have been conducted, and the literature analysis reveals varying results. Below is a brief review of the empirical work on this critical topic.

A study by Mawejje and Munyambonera (2016) in Uganda found that the dominance of the agricultural and informal sectors poses the most significant impediments to tax revenue performance, while the two-period lagged values of GDP and tax revenues had a positive effect on tax revenue. Azime et al. (2017) studied the responsiveness of tax revenue to the economy's broad sectors, including the agriculture and industry sectors, as well as services and components of government public expenditure. The results indicated that the dominance of the agricultural sector impeded tax revenue performance.

Ikhataua and Ibadin (2019) investigated the determinants of tax revenue in Nigeria using time series data covering the period from 1980 to 2015. The results of the study indicated that the shares of the agriculture and tourism sectors in GDP, trade openness, and human capital development had a positive and significant influence on tax revenue. However, productivity in the manufacturing and telecommunication sectors, as well as capital flight, had significant deleterious effects on tax revenue. Akintoye et al. (2019) evaluated the influence of political variables jointly with economic variables on tax revenue in Nigeria. The study's results showed a significant relationship between political stability and the absence of violence or terrorism and tax revenue. Furthermore, insignificant positive relationships were found between control variables (shares of agriculture and industry in GDP, trade openness, and inflation) and tax revenue.

Adesanya (2020) analysed the impact of macroeconomic variables on corporate tax revenue in Nigeria. The results revealed that foreign direct investment and exchange rate were significant positive determinants of corporate tax revenue, while GDP per capita and unemployment rate significantly reduced it. Other variables such as trade openness, public debt, corporate tax rate, and inflation were not significant determinants of corporate tax revenue.

A study by Soro (2020) examined the effect of institutional quality on tax revenue in Cote d'Ivoire from 1984 to 2016 and found that low-quality institutions, high informality (shadow economy), and trade openness hinder tax revenue mobilisation. On the other hand, GDP per capita, official development assistance, the share of services in GDP, and income distribution were positively related to tax revenue. In analysing the effect of exchange rate volatility on Ghana's tax revenue from 1984 to 2014, Ofori et al. (2020) concluded that exchange rate volatility and trade openness negatively impacted tax revenue. However, control variables such as GDP per capita and inflation positively influenced tax revenue. AL-Qudah (2021) studied the determinants of tax revenue in Jordan and revealed that per capita GDP, fiscal deficit, and government expenditure positively impacted tax revenues. Foreign aid had a significant negative impact on tax revenues. Industrial sector value-added and trade openness exhibited positive significance in the short run while having a positive insignificant impact in the long run. Atolagbe and Abiodun (2022) assessed the impact of trade liberalisation on tax revenue mobilisation in Nigeria. The study found that trade liberalisation, coupled with a share of petroleum in GDP, positively impacted tax revenue, while foreign direct investment, inflation, real GDP per capita, and the share of agriculture in GDP negatively influenced it. Sike and Anyanwu (2022) examined the relationship between economic growth and tax revenue in Nigeria from 1970 to 2021 and found that economic growth is a significant positive determinant of tax revenue.

Mohammed et al. (2021) analysed the impact of the shadow economy and corruption on Algeria's tax revenue from 1996 to 2020. The shadow economy and corruption were found to have a negative effect on tax revenue, while positive shocks to real GDP resulted in high tax revenue. Similarly, Hallunovi and Vangjel (2023) investigated the impact of the shadow economy on tax revenue in Albania for the period from 1996 to 2019 and found that the shadow economy erodes tax revenue. Other variables, such as economic growth and tax rate, also negatively affected tax revenue.

Tarawalie and Hemore (2021) investigated the determinants of Sierra Leone's tax revenue from 1990 to 2020. The results indicated that real GDP growth, trade openness, and official development assistance were the main positive determinants of tax revenue. Like most literature, inflation was negatively related to tax revenue.

Jeza et al. (2016) analysed the effect of foreign direct investment on tax revenue in Ethiopia for the period from 1974 to 2014. The study found that both foreign direct investment and GDP had a negative impact on tax revenue. Ali and Audi (2018) found a negative relationship between Pakistan's tax revenue, foreign direct

investment, and inflation. Kiang et al. (2021) examined the determinants of tax revenue in Malaysia from 1989 to 2018 and found that public debt, trade openness, and foreign direct investment positively impacted tax revenue. GDP per capita, inflation, and manufacturing had a negative impact. Desta et al. (2022) studied the factors affecting tax revenue in Ethiopia from 1996 to 2020 and found that inflation, the share of service in GDP, political stability, and tax reforms were positive influencers of tax revenue. However, the share of agriculture in GDP and corruption impeded tax revenue. In their study on the impact of foreign direct investment on tax revenue mobilisation in South Africa, Jemiluyi and Jeke (2023) revealed that foreign direct investment significantly reduces tax revenue while GDP growth, financial development, trade openness, and consumption expenditure positively impact it. However, Musah et al. (2024) established a positive and significant relationship between foreign direct investment and tax revenue in the long run, while in the short run, its influence is insignificant. Economic factors such as economic growth, inflation, and financial development also exhibited a positive relationship with tax revenue. Using data for Turkey from 2006 to 2022, Gökpinar (2023) found that broad money supply, industrial production index, interest rate, and export services positively affect tax revenue while unemployment and exchange rate decrease it.

2.2. Studies that utilised other approaches

Peter (2017) used the OLS approach to analyse the potential impact of the shadow economy on tax revenues in Zimbabwe and found a positive and significant relationship between the shadow economy and tax revenue. The study also indicated a compelling, significant influence of foreign direct investment, government expenditure, real interest rate, and inflation on tax revenue. Macha et al. (2018) used the same approach to examine tax ratios and efforts in Kenya and Malawi. The results revealed that GDP per capita, the share of agriculture in GDP, and the share of industry in GDP influenced tax revenue in Kenya, while in Malawi, all variables under study explained changes in tax revenue. Ade et al. (2018) employed panel analysis to investigate the determinants of tax revenue performance in all 15 SADC states from 1990 to 2010. The study found that tax rates and policies influence tax revenue performance in the region.

Andrejovska and Pulikova (2018) quantified the impact of macroeconomic indicators on tax revenue in 28 EU countries. The study revealed that tax revenue is strongly related to the employment rate, followed by foreign direct investment and gross domestic product. Boukbech et al. (2018) explored the determinants of tax revenues in developing countries from 2001 to 2014 using panel analysis. The results showed that per capita GDP and the value-added of agriculture are significantly and positively related to tax revenue, while trade openness had a positive and insignificant effect on tax revenue. The effect of population growth was found to be negative and significant.

Using the OLS approach, Okonkwo (2018) examined the determinants of tax revenue in Nigeria and concluded that tax revenue was significantly influenced by real GDP, broad money supply, interest rate, and inflation. In Tanzania, employing multiple regression analysis, Bitababaje (2020) found that GDP, reforms, and corruption are positively related to tax revenue. Binha (2020) utilised the OLS regression to investigate the impact of foreign direct investment on tax revenue in Zimbabwe. The study's results revealed that foreign direct investment significantly enhances tax revenue while foreign aid and GDP per capita impede it. Puspita et al. (2020) analysed the role of population, inflation, and economic growth on local tax revenue in East Java Province, Indonesia. The study showed that the population positively and significantly affected local tax revenue, while inflation and economic growth had no effect. Mueni et al. (2021) studied the effects of political risks on tax revenue in Kenya. The study showed that enhanced bureaucracy quality, institutional efficiency, and democratic accountability significantly led to increased tax revenue, while internal conflicts had deleterious effects on tax revenue.

Chigome and Robinson (2021) utilised the stochastic tax frontier and unbalanced panel data approaches to investigate the drivers of tax capacity and tax effort in SADC. The results concluded that economic growth, trade openness, inflation, financial deepening, political stability, and population growth positively drove tax capacity and effort. Chikwede (2021) found similar results in his study on SADC countries. Harahap et al. (2018) used panel data analysis to determine the effects of various economic factors on tax revenue in Indonesia, finding that inflation, GDP, exchange rates, and interest rates positively influenced tax revenue. Sari and Aswitari (2020) employed the same approach for the Regency/City of Bali Province, Indonesia. They discovered that household consumption negatively impacted locally generated revenue,

while economic growth had a positive impact, and investment did not affect the locally generated revenue. Using the Johansen Cointegration and VECM estimation techniques, Prowd and Kollie (2021) found that tax revenue was positively influenced by GDP growth and inflation, while social development from agriculture and mining, the real exchange rate, and population growth exhibited negative impacts.

To analyse the determinants of tax revenue in upper-middle-income countries, Tsaurai (2021) utilised the generalised Methods of Moments (GMM), pooled OLS, and fixed and random effects models. The study indicated that foreign direct investment, economic growth, financial development, urbanisation, human capital development, and population growth significantly and positively impacted tax revenue, while trade openness and the exchange rate reduced it. Hanrahan (2021) used panel data analysis in OECD countries and found that GDP per capita, trade openness, and the share of agriculture in GDP positively impacted tax revenue. Foreign direct investment, government debt, population growth, and digitalisation negatively affected tax revenue. Andrejovská and Golva (2023) employed panel regression analysis to investigate the determinants of corporate income tax revenue in 27 EU member states. The results showed that GDP per capita, public debt, and corruption negatively affected corporate income tax revenue, while the nominal tax rate was an insignificant determinant, and the effective tax rate significantly enhanced tax revenue. Corporate tax revenue was also positively influenced by the harmonised index of consumer prices, foreign direct investment, and trade openness.

Ihuarulam et al. (2021) analysed the macroeconomic determinants of tax revenue in 6 ECOWAS countries using the panel data approach. They found that GDP and inflation significantly and positively influence tax revenue, while the effect of the exchange rate is positive but insignificant. Unemployment and trade openness have a negative but insignificant impact on tax revenue.

Other studies utilised the panel data analysis approach on developing countries. Lombo (2021) found that in a developed financial sector, GDP growth, trade openness, natural resources rents, and policy significantly and positively impact tax revenue, while the share of agriculture in GDP impedes it. Dale (2022), in his study on five East African countries, revealed that economic growth and political stability positively drive tax revenue, while population growth and corruption pose deleterious effects. Saptono et al. (2022) used the instrumental variable (IV) and System Generalized Method of Moments (SGMM) techniques in 79 developing countries. They found that GDP per capita, trade openness, industry share in GDP, control of corruption, governance index, and trust in politicians enhance tax revenue. Employing the Generalized Method of Moments (GMM) approach on 83 countries from 1990 to 2012, Zarra-Nezhad et al. (2016) found that trade openness positively impacts tax revenue. Other factors that significantly influence tax revenue are the GDP growth rate, the share of agriculture in GDP, the official exchange rate, urbanisation, and democracy. Using panel data analysis, Gnangnon (2023) investigated the effects of the shadow economy on tax revenue. The results indicated that the shadow economy, GDP per capita, inflation, governance quality, and the share of natural resource rents in GDP undermine tax revenue. Trade openness and unemployment exhibited a positive influence on tax revenue.

This extensive review of empirical studies across diverse geopolitical and economic contexts demonstrates factors influencing tax revenue. These studies, utilising various econometric approaches such as ARDL, OLS, and panel data analysis, collectively underscore the significant influence of economic growth, sectoral contributions (notably agriculture), foreign direct investment, and institutional quality on tax revenue dynamics. Although occasionally contradictory, the results reflect the different fiscal environments and the varying impacts of economic determinants. This comprehensive analysis advances our understanding of tax revenue determinants and highlights the adaptability and robustness of econometric methods in capturing economic relationships.

3. Research methodology

3.1. Choice of methodology

The study utilised the Autoregressive Distributed Lag (ARDL) approach to determine the long and short-run impact of selected macroeconomic and social factors on tax revenue. Pesaran and Shin (1998) introduced and developed the ARDL approach, while Pesaran et al. (2001) refined it a few years later. Several studies (Atolagbe & Abiodun, 2022; Desta et al., 2022; Gökpinar, 2023; Musah et al., 2024; Sike &

Anyanwu, 2022; Soro, 2020) have adopted this approach to investigate the determinants of tax revenue in various countries. The ARDL approach amalgamates both autoregressive and distributed lag models. Therefore, under the ARDL approach, a time series is a function of its lagged values and the function of current and lagged values of one or more explanatory variables. The ARDL approach was used because it has several advantages that include (i) the ability to capture both the dynamic effects of the lagged dependent variable and lagged exogenous variables; (ii) elimination of autocorrelation in the error term if enough lags of both dependent and explanatory variables are included; (iii) use of only a single reduced form equation to estimate long-run relationships; (iv) handling mixed order of integration of $I(0)$, $I(1)$ or both; (v) applicable to limited sample data while still providing robust and consistent results.

3.2. Data sources

This study utilises time series secondary data from 1980 to 2022, chosen primarily based on data availability. The primary variable of interest, total tax revenue (TTR), is measured as a percentage of GDP, representing the government's tax collection efficiency relative to the overall economy size. Data on TTR were sourced from the Government Finance Statistics (GFS) database of the International Monetary Fund (IMF). The independent variables were obtained from various reputable international and local institutions, including the World Bank Development Indicators (WBDI) and the Zimbabwe Revenue Authority (ZIMRA). The dataset includes annual data points, providing a total of 43 observations for each variable. This extensive period allows for a thorough analysis of trends and the impact of various economic and social factors on tax revenue in Zimbabwe. The data from IMF GFS and the World Bank's database are freely accessible online for download. For data from ZIMRA, formal requests were made, involving direct contact with the authority to explain the study's purpose and request the necessary data, which was subsequently provided.

3.2.1. Relationship between independent and dependent variables

Table 1 below summarises the variables, expected signs and data sources. In Equation (1), tax revenue is examined in relation to various economic and social variables, each hypothesised to exert either a positive or negative influence. GDP growth is expected to impact tax revenue positively; as the economy expands, the increased business activity, employment, and incomes typically enhance collections from income, corporate, and consumption taxes. This growth broadens the tax base, leading to an overall increase in tax revenue (Besley & Persson, 2014; Çiğdem & Altaylar, 2021). Similarly, higher private consumption expenditure implies more spending on goods and services, likely resulting in greater collections from sales taxes and value-added taxes (VAT), positively affecting tax revenue (Silva, 2018).

Conversely, a larger share of agriculture in GDP often negatively impacts tax revenue due to significant tax exemptions for agricultural outputs and inputs, combined with lower profitability and the

Table 1. Summary of variables, expected signs and data sources.

Variable	Measurement	Expected sign	Data source
Total tax revenue (TTR)	Total tax revenue (% GDP)	Dependent variable (The lagged value can either be $+/ -$)	IMF GFS, WBDI, ZIMRA
GDP growth (GDPGROWTH)	Proxy for economic development	+	WBDI
Private consumption expenditure (PCE)	Private consumption expenditure (% GDP)	+	WBDI
Share of agriculture in GDP (AGRIC)	Agriculture sector (% GDP)	-	WBDI
Foreign direct investment (FDI)	Foreign direct investment (% GDP)	+	WBDI
Inflation (INFL)	Annual inflation rate (deflator of GDP)	-	WBDI
Real interest rates (RINTR)	Real interest rates (proxy of real lending rates)	-	WBDI
Openness Level (OPP)	Exports and imports (% GDP)	+	WBDI
Shadow Economy (SE)	Dynamic general equilibrium model-based (DGE) estimates of informal output (% of official GDP)	-	WB Informal Economy Statistics
Population Growth (POPGROWTH)	Rate of population growth	+	WBDI

prevalence of small-scale farming, which often escapes formal taxation (Brun & Diakate, 2016; Hanrahan, 2021; Soro, 2020). On the other hand, foreign direct investment (FDI) tends to positively influence tax revenue through various channels, such as corporate taxes from profits generated by foreign enterprises and taxes on employee wages, enhancing the overall tax intake (Gul & Naseem, 2015; Tsaurai, 2021).

Inflation generally has a negative effect on tax revenue as it can erode the real value of money, leading to lower real tax collections if the tax system is not indexed to inflation. Furthermore, inflation can alter consumer and business behaviour, pushing them towards non-taxable or less-taxed goods and services, thereby reducing tax revenue (Kitessa & Jewaria, 2018; Muchiri, 2014). Higher real interest rates may also negatively impact tax revenue by slowing economic activities, as increased borrowing costs can suppress both investment and consumption, thus reducing income and sales tax collections (Huang & Frentz, 2014; Onakoya et al., 2020; Tanzi, 1989).

A greater degree of trade openness is associated with a positive impact on tax revenue. Open economies typically experience increased business activities and receive higher income from customs and tariffs, fostering overall economic growth and enhancing tax revenue (Binha, 2020; Ikhata & Ibadin, 2019; Minh Ha et al., 2022). However, a substantial shadow economy usually indicates untaxed economic activities, which drain potential tax revenues as transactions in this sector typically evade formal taxation systems, negatively impacting official tax revenue (Chelliah, 1971; Chikwede, 2021; Gnangnon, 2023). Finally, population growth is expected to positively influence tax revenue by increasing the number of taxpayers and potentially boosting consumption and overall economic activity, thereby enhancing tax collection from various sources (Khujamkulov, 2016; Jiang, 2017; Puspita et al. (2020).

3.3. Model specification and estimation technique

The study models tax revenue as a function of macroeconomic and social variables.

$$TR = f(\text{Economic Variables, Social Variables}) \quad (1)$$

where:

TR = Tax revenue

Economic variables = (GDP Growth (GDPGrowth), private consumption expenditure (PCE), share of agriculture in GDP (AGRIC), inflation (INFL), foreign direct investment (FDI), real interest rates (RINTR) and trade openness (OPP)).

Social Variables = (shadow economy (SE) and population growth (POPGROWTH))

After intercept, error term and transforming all variables in the form of natural logarithms, Equation (1) has the new form specified as:

$$\begin{aligned} \ln TR_t = \alpha_0 + \beta_1 \ln GDPGROWTH_t + \beta_2 \ln PCE_t + \beta_3 \ln AGRIC_t + \beta_4 \ln INFL_t + \beta_5 \ln FDI_t + \beta_6 \ln RINTR_t \\ + \beta_7 \ln OPP_t + \beta_8 \ln SE_t + \beta_9 \ln POPGROWTH_t + \varepsilon_t \end{aligned} \quad (2)$$

The study adopted the approaches of Amin et al. (2014), Ahmad et al. (2016), and Hassan et al. (2016) to develop its ARDL models. The ARDL models used to test for long-run relationships of variables in Equation (2) are presented below:

$$\begin{aligned} \alpha_1 + \sum_{i=0}^n \beta_1 \Delta \ln TR_{t-i} + \sum_{i=0}^n \beta_2 \Delta \ln GDPGROWTH_{t-i} + \sum_{i=0}^n \beta_3 \Delta \ln PCE_{t-i} + \sum_{i=0}^n \beta_4 \Delta \ln AGRIC_{t-i} \\ + \sum_{i=0}^n \beta_5 \Delta \ln INFL_{t-i} + \sum_{i=0}^n \beta_6 \Delta \ln FDI_{t-i} + \sum_{i=0}^n \beta_7 \Delta \ln RINTR_{t-i} + \sum_{i=0}^n \beta_8 \Delta \ln OPP_{t-i} + \sum_{i=0}^n \beta_9 \Delta \ln SE_{t-i} \\ + \sum_{i=0}^n \beta_{10} \Delta \ln POPGROWTH_{t-i} + \lambda_1 \ln TR_{t-i} + \lambda_2 \ln GDPGROWTH_{t-i} + \lambda_3 \ln PCE_{t-i} + \lambda_4 \ln AGRIC_{t-i} \\ + \lambda_5 \ln INFL_{t-i} + \lambda_6 \ln FDI_{t-i} + \lambda_7 \ln RINTR_{t-i} + \lambda_8 \ln OPP_{t-i} + \lambda_9 \ln SE_{t-i} + \lambda_{10} \ln POPGROWTH_{t-i} + \varepsilon_{1t} \end{aligned} \quad (3)$$

where Δ represents the difference level of the variable, α_1 is a drift component. $\beta_1, \dots, \beta_{10}$ represent the short-run dynamic coefficients while $\lambda_1, \dots, \lambda_{10}$ are the long-run multipliers. ε_{1t} is white noise error term of the ARDL model.

3.4. F-bounds Bounds cointegration test

A rigorous cointegration test was conducted to evaluate the long-term relationships among the variables specified in the model. The assessment involves testing the null hypothesis, which posits the absence of cointegration, against the alternative hypothesis, suggesting the presence of cointegration. These hypotheses are scrutinised using the F-statistic, with critical values derived from the seminal work of Pesaran and Pesaran (1997), Pesaran and Shin (1999), and refined thresholds by Pesaran et al. (2001). This methodology confirms cointegration if the F-statistic exceeds the upper critical threshold, indicating a long-term equilibrium relationship among the variables. Conversely, no cointegration is concluded if the F-statistic falls below the lower threshold. Should the F-statistic lie within these bounds, the results are deemed inconclusive, necessitating further analysis or additional data to clarify the relationships.

Upon establishing a cointegration relationship, the model advances to quantifying both long-run and short-run dynamics using the dynamic error correction model (ECM), a sophisticated extension of the ARDL model. The ECM is formulated through a straightforward linear transformation, effectively merging short-term fluctuations with the long-run equilibrium path. This integration is crucial as it retains the integrity of long-term information while promptly adjusting for short-term deviations, thus avoiding the common pitfalls of spurious results often associated with non-stationary time series data. This approach aligns with the practices outlined by Shrestha and Bhatta (2018), who emphasise the ECM's capability to deliver robust and meaningful results on the relationship between tax revenues and their determinants over time.

The ECM version of the ARDL model [Equation \(3\)](#) is given by:

$$\begin{aligned} \Delta \ln TR_t = & \alpha_1 + \sum_{i=1}^p \beta_1 \Delta \ln TR_{t-i} + \sum_{i=1}^p \beta_2 \Delta \ln GDPGROWTH_{t-i} + \sum_{i=1}^p \beta_3 \Delta \ln PCE_{t-i} + \sum_{i=1}^p \beta_4 \Delta \ln AGRIC_{t-i} \\ & + \sum_{i=1}^p \beta_5 \Delta \ln INF_{t-i} + \sum_{i=1}^p \beta_6 \Delta \ln FDI_{t-i} + \sum_{i=1}^p \beta_7 \Delta \ln RINTR_{t-i} + \sum_{i=1}^p \beta_8 \Delta \ln OPP_{t-i} \\ & + \sum_{i=1}^p \beta_9 \Delta \ln SE_{t-i} + \sum_{i=1}^p \beta_{10} \Delta \ln POPGROWTH_{t-i} + \lambda_{it} ECM_{t-1} + \varepsilon_{1t} \end{aligned} \quad (4)$$

The first part of [Equation \(4\)](#) with $\beta_1, \beta_2, \dots, \beta_{10}$ represent the short-run relationships or dynamics of the model. Similarly, the second part of [Equation \(3\)](#), with λ_{it} represent the long-run relationship in the model. ECM_{t-1} is the error correction term resulting from the verified long-run equilibrium relationship and λ_{it} is the parameter indicating the speed of adjustment to the equilibrium level. The sign of the ECM_{t-1} must be negative and significant to ensure convergence of the dynamics of the long-run equilibrium (Abonazel & Elnabawy, 2020). The value of the coefficient λ_{it} which signifies the speed of the convergence to the equilibrium process, ranges between -1 and 0 , where -1 signifies perfect and rapid convergence, and 0 means no convergence to equilibrium. Abonazel and Elnabawy (2020) pointed out that the ECM term is crucial to policymakers as it assists them in analysing how fast policies impact the economy. The coefficient λ_{it} is expected to be negative and statistically significant to confirm the existence of a cointegration relationship further.

3.5. Test for stationarity

To eliminate the possibility of spurious regression and erroneous inferences, the study determined the order of integration of time series variables through unit root tests in both levels and the first difference. The stationarity test was conducted to ensure that none of the variables is integrated of order 1 (2) because if 1 (2) variables are present, the ARDL procedures will be senseless, and it is difficult to interpret the F-statistic values. The study employed the Augmented Dickey-Fuller (ADF) and Phillips-Peron (PP)

tests as they are considered reliable and are widely accepted in econometric analysis for testing unit roots. The ADF is specified as follows:

$$\Delta X_t = \beta_1 + \lambda_1 X_{t-1} + \sum_{i=1}^n \rho_i \Delta X_{t-i} + \varepsilon_{1t} \quad (5)$$

Where X_t represents the series at a time t , Δ is the first difference operator, β , ρ , λ are the parameters to be estimated, ε is the stochastic random disturbance item. The PP test is specified as follows:

$$\Delta X_t = \alpha + \lambda_2 X_{t-1} + \varepsilon_{2t} \quad (6)$$

In both Equations (5) and (6), ε_{1t} ; ε_{2t} are the covariance stationary random error terms. In both cases, the null hypothesis that the variable is non-stationary is tested against the alternative that the variable is stationary. The decision rule or criteria is that if the ADF and PP statistics are higher (in absolute terms) than the critical values, reject the null hypothesis and conclude that there is no unit root.

3.6. Lag length criteria

Selection of the appropriate lag length is essential as it determines the results of the ARDL model. Several methods or criteria are available to determine the optimal lag length. The study employed the most used methods: the Akaike Information Criteria (AIC) and the Schwarz-Bayesian Information Criteria (SBC) (see Equations (7) and (8)). The following equations define the AIC and SBC:

$$AIC = -2\log(L) + 2m \quad (7)$$

$$SBC = -2\log(L) + m\log(n) \quad (8)$$

Where:

- $\log \log(L)$: The natural logarithm of the likelihood function L . This measures how well the model fits the data; a higher likelihood implies a better fit.
- m : The number of estimated parameters in the model. This part of the formula penalises the complexity of the model. Adding more parameters can improve the fit of the data but may lead to overfitting.
- m : The number of parameters in the model.
- n : The number of data points or observations in the dataset. The $\log(n)$ term in SBC imposes a heavier penalty for the number of parameters than in AIC, particularly when the sample size n is large. This makes BIC more stringent against model complexity, especially as the sample size increases.

Both criteria are used so that the model with the lower AIC or SBC value is generally preferred, reflecting a better balance between goodness of fit and model simplicity.

4. Data analysis and results discussion

First, the empirical analysis starts with the descriptive analysis of the variables, followed by a unit root test to determine the order of integration of the variables. Next, the short and long-run estimation of the coefficients using the ARDL approach is performed. Finally, the diagnostic tests are conducted.

4.1. Descriptive statistics

The analysis of Zimbabwe's tax revenue from 1980 to 2022 provides valuable information of economic fluctuations. The median tax revenue is 18.50%, slightly higher than the average of 19.00%. This suggests that more than half of the time, tax receipts hovered above the average, indicating a skewed distribution of tax revenue performance over the years. The range of tax revenue, from a low of 2.28% to a

high of 35.40%, with a standard deviation of 6.62%, reflects significant volatility in the nation's tax collection efforts.

Economic growth in Zimbabwe averaged 2.30% of GDP, closely mirrored by the median growth rate of 2.10%. The broad range, from a contraction of 17.67% to an expansion of 21.45%, highlights the extreme economic instability experienced by the country. This volatility is particularly evident in the private consumption data, which averaged 75.85% of GDP and varied widely from 50.42% to 119.41%. This pattern suggests that Zimbabwe's economy relies heavily on consumer spending, which may fluctuate widely based on economic conditions. The agriculture sector, an essential component of Zimbabwe's GDP, contributed an average of 13.27%. The variation in this sector's contribution, from 6.75% to 21.20%, can likely be attributed to external factors such as global commodity price changes, shifts in agricultural policy, and climatic conditions, which affect agricultural output and, consequently, its GDP contribution.

Inflation presents the most significant variability, with a hyperinflation peak of 604.95%. The stark contrast between the average annual inflation rate of 35.27% and the median of 2.71% underscores the severe inflationary episodes that have marked Zimbabwe's recent economic history. Such episodes distort economic planning and fiscal stability, impacting both government revenue and expenditures. Foreign direct investment (FDI) averaged a modest 0.53%, with variations indicating occasional net outflows. The high standard deviation of 356.90% for real interest rates indicates intense macroeconomic turbulence and uncertainty, affecting investment decisions and economic stability. Trade openness, measured by the sum of exports and imports relative to GDP, averaged 62.43%, indicating moderate integration with the global market (see Table 2). This openness is essential for a small economy like Zimbabwe, where trade can be a significant growth lever.

The shadow economy, estimated to average 60.83% of GDP, suggests a substantial informal sector. This large shadow economy size indicates potential challenges in tax collection and reflects the broader difficulties in formalising economic activities. Population growth, with an average rate of 2.09%, indicates steady demographic trends. This steady population growth provides both opportunities and challenges for economic planning and fiscal policy. Tables 2 and 3 present descriptive statistics and the correlation between the variables, respectively.

Table 2. Descriptive statistics.

Variable	Observation	Mean	Median	Std. Deviation	Minimum	Maximum
TTR	43	19.00	18.50	6.62	2.28	35.40
GDPGROWTH	43	2.30	2.10	8.14	-17.67	21.45
PCE	43	75.85	73.87	14.22	50.42	119.41
AGRIC	43	13.27	13.55	4.23	6.75	21.20
INFL	43	35.27	2.71	108.90	-27.05	604.95
FDI	43	0.53	0.55	0.52	-0.37	2.07
RINTR	43	104.87	30.00	356.90	-81.13	2250.00
OPP	43	62.43	61.78	16.60	35.92	109.52
SE	31	60.83	60.43	1.34	58.45	64.44
POPGROWTH	43	2.09	2.02	1.28	0.52	6.28

Source: Authors' computation.

Table 3. Correlation matrix.

	TTR	INCTR	CTR	GDP GROWTH	PCE	AGRIC	IND	INFL	FDI	RINTR	OPP	SE	POP GROWTH
TTR	1												
GDP GROWTH	0.27	0.06	0.40	1									
PCE	-0.61	-0.72	0.12	-0.14	1								
AGRIC	-0.06	0.24	-0.70	-0.27	-0.03	1							
INFL	-0.24	-0.31	0.11	-0.16	0.06	-0.30	0.32	1					
FDI	0.18	0.05	0.12	0.21	0.08	-0.06	-0.14	-0.08	1				
RINTR	-0.47	-0.35	-0.44	-0.45	0.61	0.44	0.22	-0.16	-0.02	1			
OPP	-0.03	0.08	-0.32	-0.10	0.35	0.58	-0.13	-0.37	0.25	0.63	1		
SE	-0.38	-0.57	0.30	0.31	0.79	-0.12	-0.13	-0.01	0.26	0.35	0.31	1	
POP GROWTH	0.11	-0.08	0.27	0.24	-0.25	-0.59	0.38	0.20	0.15	-0.34	-0.63	-0.17	1

Source: Authors' computation.

4.2. Stationarity tests

The Augmented Dickey–Fuller (ADF) and the Phillips–Perron (PP) tests were used to check for the stationarity of the variables. The ADF and PP stationarity test results at levels and first difference are presented in Tables 4 and 5, respectively. The results exhibit a mixed order of integrations as some variables are stationary at levels $I(0)$, and others are stationary at the first difference $I(1)$. The unit root results also indicate that none of the variables are integrated of order two $I(2)$, indicating the suitability of the ARDL approach for econometric analysis. More specifically, the results show that GDPGROWTH, INFL, FDI AND RINTR are integrated of order zero while the rest are integrated of order one.

4.3. F-bounds cointegration test

Since it was established that none of the variables are integrated of order 2, long-run cointegration was tested using the bounds test, which involves computing the F-statistic and comparing it to critical values. Table 6 presents the results of the F-Bound test. The F-statistic, at 2.370544, is greater than the upper critical bound at the 5% significance level, indicating the presence of long-run relationships among the variables. This suggests that the variables are related over the long term, and any short-run

Table 4. ADF stationarity test results.

Variable	Level (p-value)		First difference (p-value)	
	Constant	Constant and trend	Constant	Constant and trend
TTR	0.20	0.06*	0.03**	0.12
GDPGROWTH	0.00***	0.02**	–	–
PCE	0.39	0.51	0.00***	0.00***
AGRIC	0.14	0.12	0.00***	0.00***
INFL	0.00***	0.00***	–	–
FDI	0.00***	0.00***	–	–
RINTR	0.00***	0.00***	–	–
OPP	0.41	0.78	0.00***	0.01**
SE	0.42	0.83	0.00**	0.00**
POPGROWTH	0.41	0.89	0.01**	0.00**

(*), (**), (***), and (no) imply significance at 10%, 5%, 1% and not significant, respectively.

Source: Authors' computation.

Table 5. PP stationarity test results.

Variable	Level (p-value)		First difference (p-value)	
	Constant	Constant and trend	Constant	Constant and trend
TTR	0.01**	0.03**	–	–
GDPGROWTH	0.00***	0.01**	–	–
PCE	0.39	0.51	0.00***	0.00***
AGRIC	0.18	0.14	0.00***	0.00***
INFL	0.03**	0.01**	–	–
FDI	0.00***	0.00***	–	–
RINTR	0.00***	0.00***	–	–
OPP	0.22	0.44	0.00***	0.00***
SE	0.44	0.80	0.00***	0.00***
POPGROWTH	0.01**	0.41	0.00***	0.00***

(**), (***), and (no) imply significance at 5%, and 1% and not significant, respectively.

Source: Authors' computation.

Table 6. F-bound test results.

Dependent variable	ARDL model	F-statistics		
		5% F-statistics critical values		
		Lower	Upper	Calculated F-statistic
Tax revenue	(1,0,0,0,1,0,0,0,0)	2.04	2.08	2.370544

Source: Authors' computation.

fluctuations among them are expected to converge back to the long-run equilibrium. Consequently, the error correction model (ECM) is specified in [Equation 4](#).

4.4. Optimal lag length selection

The optimal lag length selection was based on two common statistical criteria: the AIC and SIC ([Table 7](#)). A lag length of 1 was selected for both the AIC and SIC, as indicated in [Table 6](#).

4.5. Estimation of short-run and long-run relationships

[Table 8](#) presents the short-run and long-run estimations for analysing the determinants of tax revenue.

4.5. Analysis and discussion of results

The empirical analysis in [Table 7](#) demonstrates that in the short-run, the one period lagged total tax revenue positively and significantly impacted total tax revenue. The result is supported by Dzingirai and Tambudzai (2014), Castro and Camarillo (2014), Amouzou et al. (2019), AL-Qudah (2021) and Musah et al. (2024). GDP growth has a positive and insignificant long-term relationship with tax revenue. This observation is consistent with the theoretical expectation that an expanding economy broadens the tax base, corroborated by similar findings across various studies, including Basheer et al. (2019), Polat (2019), Bitababaje (2020), Prowd and Kollie (2021), and Ihuarulam et al. (2021). The consistency of these results

Table 7. Optimal lag length selection results.

Criterion	TR as dependent variable	
	0	1
AIC	6.634155	2.501437*
SIC	7.101221	7.639160*

(*) means the selected optimal lag length.

Source: Authors' computation.

Table 8. Short-run and long-run estimation results.

Variable	Levels equation Dependent variable: LN(TR)			
	Coefficient	Std. Error	t-statistic	Prob
<i>Long run relationships</i>				
C	44.30435	38.23420	1.158762	0.2609
LNGDPGROWTH	0.095291	0.064282	1.482394	0.1546
LNPCE	-3.004827	1.082054	-2.776965	0.0120**
LNAGRIC	-0.997154	0.361306	-2.759860	0.0125**
LNINFL	0.178964	0.087347	2.048888	0.0545*
LNFDI	0.129989	0.254234	0.511298	0.6150
LNRINTR	0.146978	0.073090	2.010908	0.0587*
LNOPP	-0.012905	0.664791	-0.019413	0.9847
LNSE	-6.458745	10.20816	-0.632704	0.5345
LNPOPGROWTH	-0.208756	0.269628	-0.774239	0.4483
<i>Short run relationships</i>				
$\Delta LNTR (-1)$	0.796792	0.185228	4.301679	0.0004***
$\Delta LNGDPGROWTH$	0.100697	0.034113	2.951883	0.0082***
$\Delta LNPCE (-1)$	3.194778	0.773687	4.129288	0.0006***
$\Delta LNPCE (-2)$	1.517965	0.629673	2.410720	0.0262**
$\Delta LNAGRIC$	-0.567957	0.266903	-2.127956	0.0467**
$\Delta LNINFL (-1)$	0.132545	0.033070	4.007979	0.0008***
$\Delta LNRINTR$	0.054196	0.047277	1.146340	0.2659
$\Delta LNOPP (-1)$	1.134013	0.484967	2.338329	0.0305**
$\Delta LNSE$	-21.22894	6.295071	-3.372311	0.0032***
$\Delta LNPOPGROWTH (-2)$	0.395212	0.195329	2.023317	0.0573*
ECT _{t-1}	-0.955863	0.245291	-3.896845	0.0010***

(*), (***) and (****) imply significance at 10%, 5% and 1%, respectively.

Source: Authors' computation.

underscores the robustness of GDP growth as a reliable predictor of tax revenue enhancements in diverse economic settings.

Private consumption expenditure negatively but insignificantly impacts tax revenue in the long run, while its short-run impact is positive and significant. This finding suggests a potential shift in consumer behaviour towards non-taxable or lower-taxed goods and services, possibly as a coping mechanism against economic strain or in response to changes in taxation policies. Such a shift may indicate the need for policy adjustments to broaden the tax base or enhance tax compliance. The long-run interpretation aligns with Muttaqin and Halim (2020), though it contrasts with the findings of Bikas and Andruskaite (2013) and Silva (2018), suggesting that local economic conditions and consumption patterns could significantly influence these dynamics. On the other hand, the short-run interpretation at lag one aligns with Boukbech et al. (2018), and Jemiluyi and Jeke (2023), while at lag two contradicts them. The mixed short-run results indicate the shortness of the periods to reveal the effects of private consumption expenditure on tax revenue.

The share of agriculture in GDP negatively impacts tax revenue in both timeframes analysed, reflecting the sector's lower tax contributions, which may stem from prevalent tax exemptions and its largely informal nature. This relationship aligns with studies like Mawejje and Munyambonera (2016), Zarra-Nezhad et al. (2016), Azime et al. (2017), Macha et al. (2018), Kobyagda (2019), Soro (2020), Atolagbe and Abiodun (2022), Hanrahan (2021) and Desta et al. (2022) but contradicts the results by Boukbech et al. (2018) and Piancastelli and Thirlwall (2020), highlighting the variability in agricultural tax policies across different economies.

Inflation has a long-run positive but statistically insignificant relationship with tax revenue, while in the short run, it is positive and significant. This result could imply that while inflation generally increases nominal tax revenue through mechanisms like bracket creep, the volatility and other economic disruptions associated with high inflation rates in Zimbabwe may dampen this effect. This interpretation is consistent with the findings of Akintoye et al. (2019), Soro (2020), Onakoya et al. (2020), Ofori et al. (2020), Ihuarulam et al. (2021), Minh Ha et al. (2022), and Desta et al. (2022), however, it contrasts with those from Ali and Audi (2018), Atolagbe and Abiodun (2022), Hanrahan (2021), Kiang et al. (2021), Mueni et al. (2021), and Tarawalie and Hemore (2021).

Foreign direct investment (FDI) positively impacts tax revenue in the long run. This finding underscores the importance of creating a stable and conducive investment climate to harness the long-term tax benefits of FDI, supported by literature such as Peter (2017), Andrejovska and Pulikova (2018), Bayer and Ozturk (2018), Ade et al. (2018), Binha (2020), Kiang et al. (2021), Minh Ha et al. (2022) and Camara (2023) but opposes findings by Nasibu (2021) and Jemiluyi and Jeke (2023).

Real interest rates exhibited a positive and insignificant relationship with tax revenue both in the long and short run. The result corroborates Basheer et al. (2019) and Gökpınar (2023) but opposes Onakoya et al. (2020). The long-term relationship between trade openness and tax revenue was negative, indicating that increased trade might be associated with challenges such as tax evasion through imports or competitive pressures on domestic industries. This outcome is supported by Kobyagda (2019), Anuar (2019), Soro (2020), Hanrahan (2021), Ihuarulam et al. (2021), and Tsaurai (2021) but contradicted by Atolagbe and Abiodun (2022), Binha (2020), Kiang et al. (2021), Mueni et al. (2021), Tarawalie and Hemore (2021), and Minh Ha et al. (2022), suggests the complexity of trade dynamics and its dualistic impact on tax systems, potentially calling for a review of tariff structures and compliance mechanisms.

The shadow economy showed a negative linkage with tax revenue, revealing its deleterious impact on tax revenue mobilisation. This corroborates the concern that the informal sector is large, estimated to be around 60%. Such findings align with Kobyagda (2019), Omodero (2019), Chigome and Robinson (2021), Chikwede (2021), Mohammed et al. (2021), Gnangnon (2023) and Hallunovi and Vangjel (2023) but contradicting findings by Peter (2017) and Soro (2020), highlighting the subtle understanding required to address the shadow economy's role in fiscal policy.

Population growth's positive and negative but insignificant short-run and long-run influence on tax revenue suggest that demographic factors may have complex effects on the tax base, potentially due to shifts in labour markets or consumption patterns over time. This finding is consistent with findings from

Table 9. Diagnostic test results.

Diagnostic test	Type of test	F-statistics	p-value
Autocorrelation test	Breusch-Godfrey Serial Correlation LM Test	0.395158	0.6796
Heteroscedasticity test	Breusch-Pagan-Godfrey Test	1.144799	0.3856
	ARCH Test	0.193117	0.6638
Normality test	Jarque-Bera Test	1.177878	0.554916
Functional misspecification test	Ramsey RESET Test	0.611241	0.5487

Source: Authors' computation.

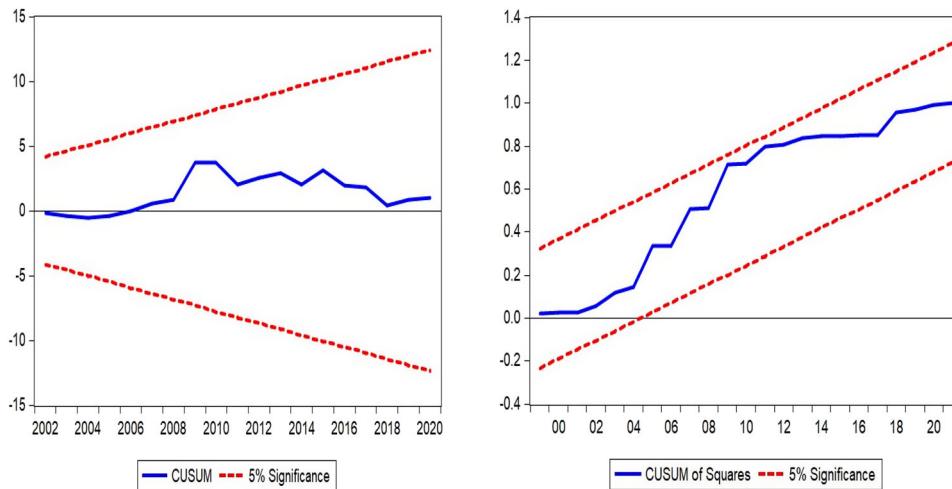


Figure 1. Stability test results. Source: EViews output.

Hasan (2010) and Puspita et al. (2020) but opposes Mahdavi (2008), Boukbech et al. (2018) and Tsaurai (2021).

Finally, the significant and near-unity error correction term indicates a rapid adjustment of tax revenue towards its long-term equilibrium following shocks, highlighting the resilience of the tax system and the efficacy of current tax policies in maintaining stability.

4.6. Diagnostic tests

Various diagnostic tests were carried out to check the robustness of the estimated model. The Breusch-Godfrey Serial Correlation LM Test was employed to test for autocorrelation, while the Breusch-Pagan-Godfrey and ARCH tests were employed for heteroscedasticity. The Jarque-Bera test was used to test for normality. Finally, the Ramsey RESET test was applied to test the model specification. Table 9 presents the results of the diagnostic tests. The null hypothesis of the autocorrelation, heteroscedasticity, normality and functional form misspecification test is accepted since the *p*-values of their respective tests are insignificant at the 5% level for the estimated model.

The stability of the estimated model was examined through the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMSQ) test. The graphical representation of the results is presented in Figure 1. The results reveal that the model's coefficients are stable over time as they fall within the 5% significance level. Therefore, the estimated results are reliable.

5. Conclusion, policy implications and future research

The novelty and contribution of this article lie in its comprehensive examination of Zimbabwe's tax revenue determinants from 1980 to 2022 using the ARDL approach. This method uniquely captures both short-run and long-run dynamics, integrating a broad spectrum of economic and social variables, such as GDP growth, private consumption expenditure, agriculture's GDP share, inflation, FDI, real interest rates, trade openness, the shadow economy, and population growth. The results indicate that in the

long run, private consumption expenditure and the share of agriculture in GDP significantly impede tax revenue, while GDP growth, inflation, foreign direct investment, and real interest rates have insignificant positive effects. Trade openness, the shadow economy, and population growth have insignificant negative impacts. In the short run, total tax revenue, GDP growth, private consumption expenditure, inflation, and trade openness positively and significantly influence tax revenue, while the share of agriculture in GDP and the shadow economy significantly erode tax revenue. The impacts of real interest rates and population growth are positive but insignificant. These insights provide crucial guidance for policymakers aiming to enhance tax revenue collection and support domestic resource mobilisation in Zimbabwe.

The positive relationship between GDP growth and tax revenue implies that more tax revenue is collected because of economic growth. Thus, policymakers should develop and implement prudent policies to enhance economic growth and support the domestic resources mobilisation agenda. Foreign direct investment exhibited a positive influence on tax revenue, indicating the impact of its positive spillover, which enhances the productivity of local firms. Therefore, policymakers should create and nurture a sustainable environment that attracts foreign direct investment directed to the productive sectors of the economy. On the other hand, policymakers should not be waylaid by the insignificant positive influence of foreign direct investment as its effects on tax revenue are long-term. The long-run negative impact on private consumption expenditure tax revenue implies a shift in the citizenry's consumption towards basic non-taxable or lower-taxed goods and services as they endure the prevailing economic hardships and an increase in informalisation outside the tax net. Hence, policymakers are encouraged to develop policies that encourage consumption and investment in taxable goods and services and promote formal economic activities that are easy to tax.

Trade openness is negatively associated with tax revenue, indicating the negative effects of tariff reductions and unfair competition associated with trade liberalisation. Policymakers should try to balance the non-revenue advantages and revenue disadvantages of trade openness to achieve successful trade reforms. This may mean revising trade policies to improve collections from expanded trade. A negative and significant association between the share of agriculture in GDP was revealed, implying the difficulty of collecting taxes from the sector due to its heavy subsistence nature. The sector also enjoys significant tax exemptions, which hinder tax revenue collection. Policymakers should work on modernising and transforming subsistence agriculture into commercial agriculture and collect tax from the outputs or the sector's value added. The long-run and short-run impact of population growth on tax revenue is negative. This calls for policymakers to invest in policies that will alleviate the negative effects of population growth on tax revenue. Inflation and real interest rates positively influence tax revenue, but the influence is insignificant, albeit significant for inflation in the short run. This implies that although these are not critical factors for now in increasing tax revenue, policymakers should aim to keep them at reasonable and acceptable levels to ensure macroeconomic stability. However, the shadow economy negatively impacts tax revenue, reflecting its huge size, estimated at around 60%. Thus, policymakers must develop and implement policies to reduce shadow economy activities and enhance tax revenue collection.

In addressing the gaps identified in this research, future studies should consider a more extensive array of macroeconomic variables, such as technological advancements and their impact on tax compliance and collection efficiency. Additionally, incorporating structural changes, such as major policy reforms or significant economic events, would provide a deeper understanding of their effects on tax revenue dynamics. Exploring qualitative factors, like governance quality and taxpayer attitudes, could also enrich an understanding of the complexities involved in tax revenue generation. By broadening the analytical framework in these ways, subsequent research can offer better guidance for policymakers aiming to enhance tax revenue collection in contexts similar to Zimbabwe's or other settings with comparable economic challenges.

Informed consent statement

Not applicable.

Author contributions

Conceptualisation, M.G.C. and T.S.; methodology, M.G.C. and T.S.; software, M.G.C. and T.S.; validation, T.S.; formal analysis, MGC.; investigation, MGC.; resources, M.G.C. and T.S.; writing-original draft preparation, M.G.C.; writing-review and editing, M.G.C. and T.S.; supervision, T.S.; project administration, M.G.C. Both authors have read and agreed to the published version of the manuscript.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Funding

This research received no external funding.

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Data availability statement

Data used and presented in this study are available at: <https://data.mendeley.com/datasets/j3mf93dsjn/1>.

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