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Tax Revenue Effect of Sectoral Growth and Public Expenditure in Tanzania:
An application of Autoregressive Distributed Lag Model

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Abstract: This paper analyses the effects of the sectoral growth and public expenditure on Tanzania's tax revenue performance both in the short run and long run. The paramount importance is to provide a policy mechanism that would help Tanzania raise tax revenue from different sectors of the economy as the requirements for financing service delivery increase and the demand for donors declines in the country. The paper employs the autoregressive distributed lag (ARDL) bounds testing approach over the 1990-2018 period. For the validity and reliability of the results, the assumptions of homoskedasticity, normality, serial correlations, and model stability were tested. Empirical results indicate that there is a strong positive relationship between tax revenue and main sectors of the economy namely, agriculture, industrial, and services sectors in both short-run and the long run. Similarly, recurrent and development public expenditures, as well as trade openness, tend to exert positive effects on tax revenue performance in the short run and long run. However, free trade is likely to lower the tax revenue ratio. The uniqueness of this paper is that first, the paper develops a simple analytical model for tax revenue performance based on key sectors of the economy. Second, findings suggest policies to support the development of value added linkages between major sectors of the economy and government expenditures while emphasizing the need to open the potentially large contribution of sectors of the economy with the view to widening the tax base. Third, trade policies should be designed to factor in the ambiguous relationship between trade liberalization and international trade taxes. Further trade liberalization is likely to reduce total tax revenue because international trade taxes, which constitute a large share of total tax revenue, decline in Tanzania.

JEL Classifications: C20, H20, H50

Keywords: Tax Revenue, Sectoral Growth, Government Expenditure, ARDL.

1. Introduction

The increase in revenues is an avowed objective of fiscal administrators in most underdeveloped countries (Weiss, 1969). To this extent, revenue policy

must be formulated as part of the overall development policy. Indeed, the increased financing requirements for service delivery, the need for money to settle debts, and to lower down demand for donors, developing countries tend to structure their ability to mobilize more tax revenues. Conceptually, the tax revenue share may be taken as a function of the tax bases available, rates applied to these bases, and the probability of collecting any specific levy. However, what affects tax revenues, measured as the ratio of tax revenues to GDP, has been the subject of a long debate. Underlying this argument, are a multitude of factors including, *inter alia,* the sectoral composition of output, level of development, the degree of trade and financial openness, government expenditure, administrative and political constraints on the fiscal system, the ratio of foreign aid to GDP and institutional factors such as the degree of political stability and corruption (Gupta, 2007; Epaphra, 2014; Castro & Ramírez, 2014; Epaphra & Massawe, 2017).

Tax revenue efficiency of the tax system of collection is contended to be attributable to the growth of sectors and the compliance both from a tax administration and tax rate (Mawejje & Munyambonera, 2016). It is worth noting that many developing countries have taken important measures to advance tax revenue collections including provision taxpayer's identification number, broadening tax bases, and the introduction of value-added tax which replaced sales tax. Despite all these measures, however, tax revenue performance in many countries remains below the international standards of 30 percent of GDP. In Tanzania, for example, the tax revenue-to-GDP ratio slightly increased from 9.8 percent in 1990 to 11.6 percent in 2018, while the ratio of non-tax-to-GDP declined from 1.6 percent in 1990 to 1 percent in 2018 after several years of fluctuations. This suggests that tax revenues have not been responsive to overall GDP growth as expected. At the same time, government expenditure has continuously exceeded revenue, leading to deleterious macroeconomics effects on the economy. Indeed, total government expenditure as a percentage of GDP increased from 11.86 in 1990 to 17.3 in 2018 (BoT, 2019). As a result, the budget deficit, which occupies great attention to policymakers because of its size and ways of financing it, has worsened in many years during the 1990-2018 period, drawing attention to its long term sustainability. Over this period, the budget deficit rose from 2 percent of GDP in 1990 to 5.7 percent in 2018, albeit, with a fluctuation of 7.6 percent on average during the 2004-2013 period (BoT, 2019). Nevertheless, as Tanzania and other low-income countries consistently operate the budget deficit, government debts tend to accumulate mainly due to ever-expanding government expenditure, inadequate revenue generation capacity of government, and increasing debt levels (Pomeyie 2001, Epaphra, 2017). Indeed, narrow tax base, structural

characteristics of the economies, and the unsophisticated nature of tax administration, Tanzania lacks the capacity to raise sufficient revenue from domestic sources (Epaphra 2017).

While the tax revenue performance has not been responsive to overall GDP growth, it is not clear which particular sectors of the economy are responsive or not. A clearer understanding of sector-specific tax elasticities can provide better policy options for improving tax revenue performance (Mawejje & Munyambonera, 2016). The sectoral composition of output matters because certain sectors of the economy are easier to tax than others. For example, the agriculture sector may be difficult to tax, especially if it is dominated by a large number of subsistence farmers, while the industry sector, a vibrant manufacturing and mining sub-sectors dominated by large firms can generate large taxable surpluses. Arguably, tax revenues in developing countries can only be paid from the surplus of income over the minimum subsistence' needs of the population. Moreover, despite, a vast empirical literature investigating the relationship between government size and tax revenue, the empirical evidence is still inconclusive. The spend-tax hypothesis, however, maintains that the government expenditure can be a root cause of change in tax revenue (Friedman, 1978; Darrat, 1998; Blackley, 1986), suggesting that governments should make decisions on expenditure first before adjusting tax policies and revenues to match expenditures. In the presence of crises or natural disasters such as drought, the demand for some services in that period would increase leading to an increase in expenditure, which in turn shifts tax revenue permanently. Similarly, if a political majority increases expenditure, then revenues will also be increased (Kiminyei, 2018).

Admittedly, there are a number of studies examining the effects of sectoral and expenditure on tax revenue but it has not been exhaustive, there are issues unresolved. Against this background, this paper examines the main determinants of tax revenue performance in Tanzania. The paper examines the responsiveness of tax revenue to growth ratio in the broad sectors of the economy namely, agriculture, industry, and services; and how public expenditure can be better prioritized to stimulate tax revenue growth in the country. The paper employs autoregressive distributed lag (ARDL) bounds testing techniques over the 1990-2018 period. The rest of the paper is organized as follows: section two provides an overview of Tanzania's tax revenue, public expenditure, and economic performance. Section three reviews the literature. Section four presents an analytical framework, the methods, and data used in the paper. The results and discussions thereof are presented in section five. Finally, conclusions and policy implications are presented in section six.

2. Revenue, Expenditure and Economic Performance in Tanzania

2.1. Tax Revenue and Expenditure

Government resources in Tanzania consist of tax revenue, non-tax revenues, and domestic borrowings. Government revenue from domestic sources, that is composed of tax and non-tax revenues was, on average, 72.3 percent of total government revenue in the 2007-2018 period, increasing from 63.4 percent in 2007 to 81.5 percent in 2018 (NBS, 2019). Government revenue from external sources, which consists of grants and loans, was on average, 27.2 percent of total government revenue over the same period; declining from 36.6 percent in 2007 to 18.5 percent in 2018 (NBS, 2019). The purpose of these loans and grants is to complement government-financing efforts in the implementation of the Second Five Year Development Plan. Notably, the current trajectory suggests a declining external funding gap and an increasing domestic revenue mobilization. In reality, however, the funding gap is still wide because domestic saving is low while the country at this stage of economic development need investment rates close to 30 percent of GDP or higher over a sustained period to achieve economic transformation. With the outlook for external financing looking increasingly more difficult and with debt levels on the rise in the country, the mobilization of domestic resources is imperative.

Direct and indirect taxes form a general taxation system in Tanzania. Direct taxes include taxes on payroll and workforce pay as you earn (PAYE), basic skills and development levy, taxes on profits (corporate tax), taxes on income (individual or personal income tax), withholding taxes, rental tax, gaming tax, and other income taxes. Broadly, indirect taxes in Tanzania consist of consumption taxes, international trade taxes and other domestic taxes and charges. Overall, the amount of indirect taxes, which is almost twice the amount of direct taxes, declined from 67.4 percent of total tax revenue in 2007 to 64.3 percent in 2018 whereas direct taxes rose from 32.6 percent to 35.7 percent during the same period (NBS, 2019). This is an indication of improved collection of direct taxes in recent years. PAYE tax dominates the share of all direct taxes, averaging 45.9 percent of total direct taxes, though it declined from 47.9 in 2007 to 43.1 percent in 2018 mainly due to likely significant underreporting of non-wage income including capital income and gains and hence, there is room to increase withholding rates on interest and dividend payments to individuals (IMF, 2016). International trade taxes made the largest contribution to the total indirect taxes during the 2007 to 2018 period, with 62.9 percent, though like PAYE, it slightly declined from 64.2 percent to 62.7 percent. The decrease in international trade taxes is a matter of empirical study. The main argument

is that, most developing countries tend to shift away from trade taxes since in the 1990s, largely due to the widespread liberalization of trade undertaken under the Uruguay Round. The effect of trade liberalization on revenue mobilization, however, may be ambiguous. If this liberalization occurs primarily through a reduction in tariffs then one expects losses in tariff revenue but according to Keen & Simone (2004) and Epaphra (2014), if trade liberalization occurs through tariffication of quotas, eliminations of exemptions, reduction in tariff peaks, and improvement in customs procedure tax revenue may increase.

The tax systems in Tanzania have experienced important tax administration and policy reforms aiming at increasing the tax base and making tax collection more efficient in response to the fiscal crisis and the demand for economic and social development. First, focusing on modernisation of the tax system and expanding the managerial and technical capacity within the Tanzania Revenue Authority (TRA) for more efficient and effective tax administration (IMF 2003 and Kim & Kim, 2019). Second, the establishment of a taxpayer identification number (TIN), installment of the Large Taxpayers Department, and unified the tax appeals system (BMZ 2003). Third, lowering both the personal income tax and the top marginal corporate tax rate to 30 percent in 1990; simplifying the customs tariff structure in 1992, and launching VAT in 1998 (Osoro 1993). Further, in 2004, a new Income Tax Act was enacted to broaden the tax base and lower the tax burden.

In general, Tanzania can be evaluated as a success case in pursuit of tax administration and policy reforms (Kim & Kim, 2019). Indeed, tax effort increased from 9.5 percent in 2007 to 11.6 in 2018, suggesting that there was an improvement in tax revenue collections. Similarly, total revenue, excluding grants, rose from 10.6 percent of GDP in 2010 to 12.9 percent in 2018. Income tax, excise, and other tax revenue increased significantly in the 2000s (IMF, 2016) as a consequence of structural reforms supported by a simplification of tax laws and regulations, notably with the 2004 Income Tax Act (Nord *et al.*, 2009). However, VAT revenue stagnated at a low level, mainly due to numerous exemptions including the elimination of VAT on petroleum products in 2006, the reduction of the main rate from 20 to 18 percent in 2010, and compliance issues (Nord *et al.*, 2009). Figure 1 reports the tax revenue, non-tax revenue, and grants as a percent of GDP in Tanzania over the 1967- 2016 period. It is observed that tax revenue contributes the largest share of total revenue in Tanzania. Between 1967 and 1986 tax revenue performance was impressive. Understandably, the drastic decline of tax revenue as a percent of GDP in the second half of the 1980s, 1990s, and early 2000 was mainly due to a substantial increase in GDP (Epaphra 2018). Nonetheless, this suggests weak revenue collections from a somewhat

wide tax base. Non-tax revenue and grants have been very low and fluctuating. In light of the country's large development needs, successive Governments have placed revenue mobilization at the center of economic policies with the objective to support investment in education, health, and critical infrastructure while safeguarding fiscal sustainability (IMF, 2016). Reliance on domestic revenue mobilization has emerged as a top priority because of the significant decline in donor support. Over the last 10 years, external grants dropped from 5.1 percent of GDP in 2003 to 1.1 percent of GDP in 2015 (Figure 1).

Notwithstanding the increase in tax effort and the improvements in the efficiency of tax revenue collection over the past two decades, the average tax effort in Tanzania remains one of the lowest in Africa (Figure 2). Other countries under the same geographical representation such as Botswana, Angola, Mauritius, Mozambique, Kenya, and Malawi have a relatively high tax revenue-to-GDP ratio. The tax revenue-to-GDP ratio of 10.9 percent in Tanzania over 1990-2028 is lower than 16.1 percent of sub-Saharan Africa. Indeed, the tax revenue-to-GDP ratio of Tanzania is well below the average of East African Community countries and low-income countries, respectively at 13.1 percent of GDP and 14.7 percent of GDP (IMF, 2016). However, tax revenue performance in Tanzania is higher than in some African countries such as Equatorial Guinea, Ethiopia, Sierra Leone, Democratic Republic of Congo, Congo Republic, and Nigeria. Lower tax capacity in many African countries is due primarily to the low level of economic development; the large share of agriculture in economic activity, and the large size of the shadow economy. There is scope to increase it further. According to IMF (2016) Tanzania's low tax revenue performance is not due to low tax rates but instead results from low tax productivity of indirect taxes, notably VAT suffers from creeping exemptions, compliance issues, and a weak refund mechanism. However, as Coulibaly & Gandhi (2018) suggest the objective of improving tax revenue collections will likely be a medium to long-term one as tax capacity is largely determined by structural factors, which take time to address. Improving governance, on the other hand, can yield near-term results. In the same vein, strengthening governance, including combating corruption and bolstering accountability, can significantly reduce inefficiencies, which in turn, lead to an increase in tax revenue collections (Coulibaly & Gandhi, 2018).

For most years, over the 1966-2018 period, as has been mentioned, government expenditure in Tanzania has exceeded government revenue leading to budget deficits. Expenditure has been rising steadily due to many reasons including an increase in demand for infrastructure and payment of interest on the debt (Epaphra, 2018). Tanzania has large development

needs. In line with the objectives of the Development Vision 2025, the Second National Strategy for Growth and Reduction of Poverty aimed at accelerating growth, alleviating poverty, improving living standards, and fostering good governance and accountability. The strategy required raising investment spending from 6.4 percent of GDP in 2010 to 9.6 percent of GDP by 2015 (IMF, 2016). After a steady increase in the 2000s, public expenditure has broadly stabilized as a share of GDP (Figure 3). Government spending increased significantly from 8.4 percent of GDP in 2000 to 19 percent of GDP in 2014 as the authorities ramped up priority spending to meet the Millennium Development Goals. Expenditure broadly stabilized as a share of GDP from recent years. In 2017 and 2018, for example, the ratio of Government expenditure to GDP was 17.7 percent and 17.3 percent respectively. Government spending priorities in the 2000s shifted towards development expenditure. Subsequently, the ratio of development expenditure to GDP increased from 2.7 percent in 2001 to 9.3 percent in 2012 (Figure 3), also the proportion of development expenditures in total expenditures increased from 21.9 percent in 2001 to 35.1 percent in 2012 (BoT, 2011). Likewise, the proportion of recurrent expenditure to total

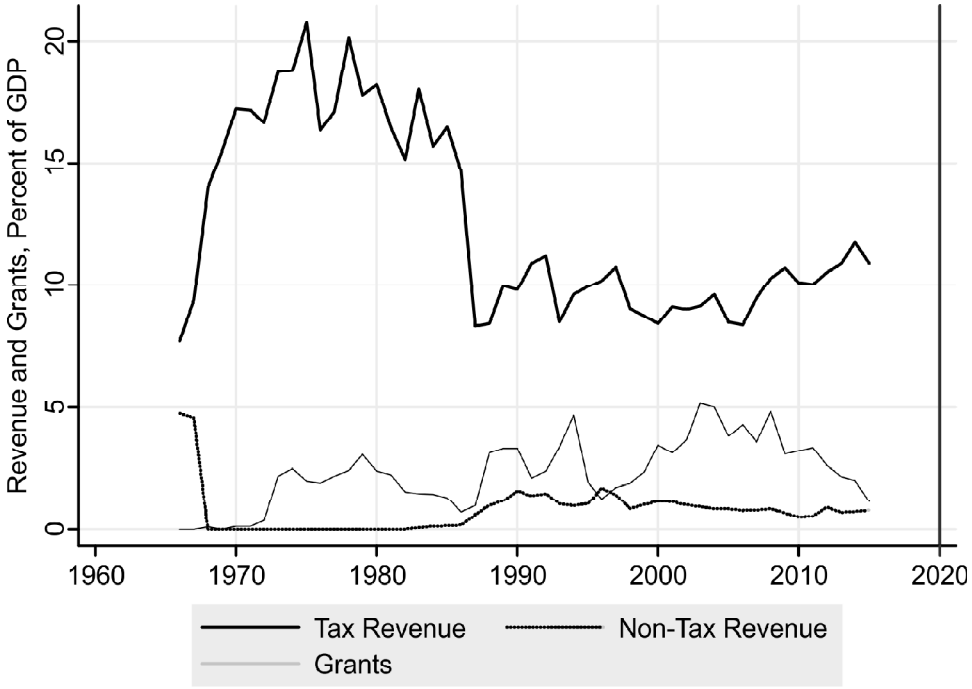

Figure 1: Tax revengue, Non Tax Revenue and Grants, percent of GDP

Data Source: Tanzania Revenue Authority (2019)

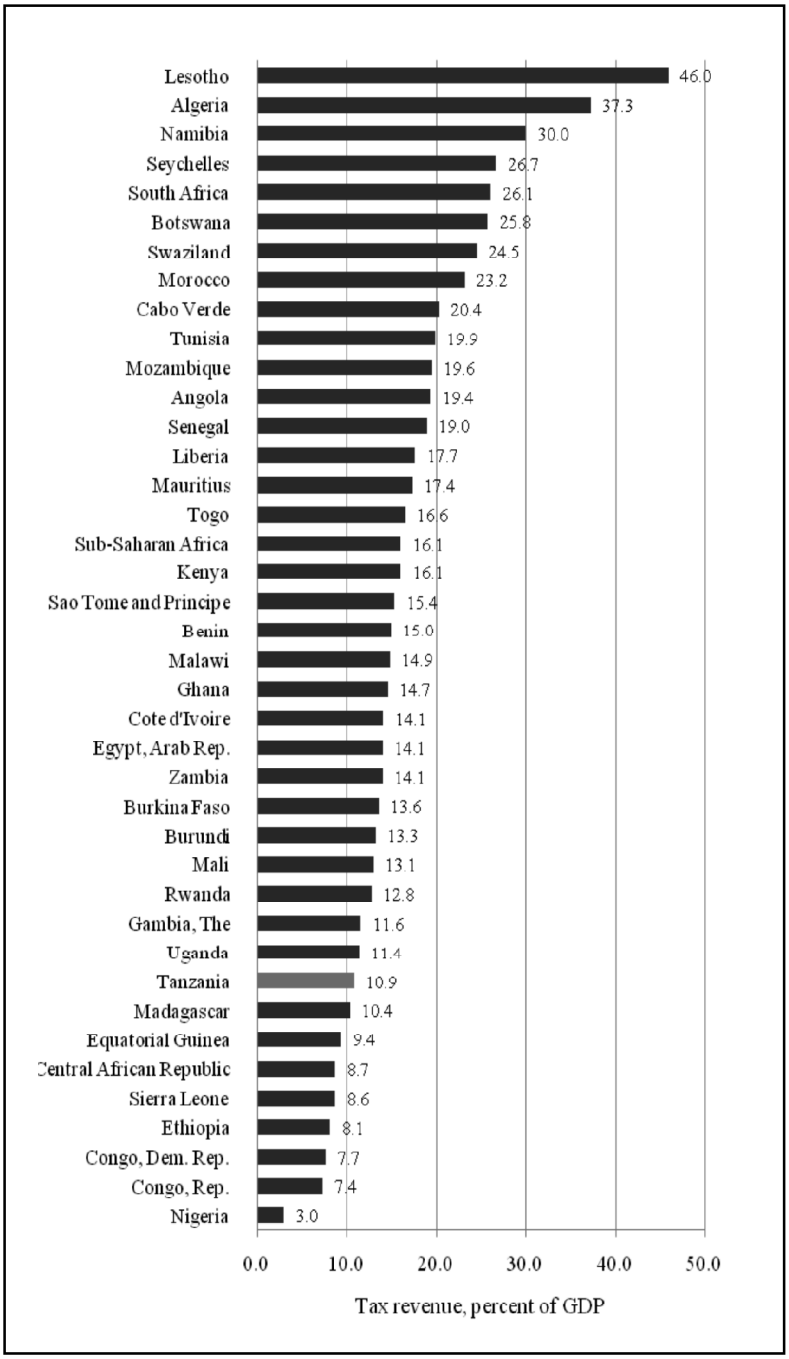

Figure 2: Regional Comparison of Tax revenue, percent of GDP

Data source: World Bank's WDI Dataset (2020)

Government expenditure decreased from 78.1 percent to 64.9 percent in 2012. It should be noted that the expenditure composition has deteriorated lately. The share of development expenditure declined from 35.1 percent of total expenditure and 9.3 percent of GDP in 2012 to 25.4 percent of total expenditure and 4.6 percent of GDP in 2015. This may be due to unrealistic budgeting, which requires adjusting expenditure in the course of the fiscal years and lower concessional project financing, partly offset by external non-concessional loans (IMF, 2016). The fact that improving spending efficiency helps ensure the value of money, reduces waste of resources, and maintains fiscal discipline, undoubtedly reducing inefficiency in spending implies that Tanzania can achieve the same output with fewer resources or achieve higher output with the same resources. However, according to IMF (2016), the process of improving the efficiency of public spending takes time and requires deep reforms to secure long-term gains.

2.2. Economic Performance and the Structure of the Economy

Tanzania has emerged from periods of significant economic transitions, namely colonialism, independence, socialism, and the market-oriented

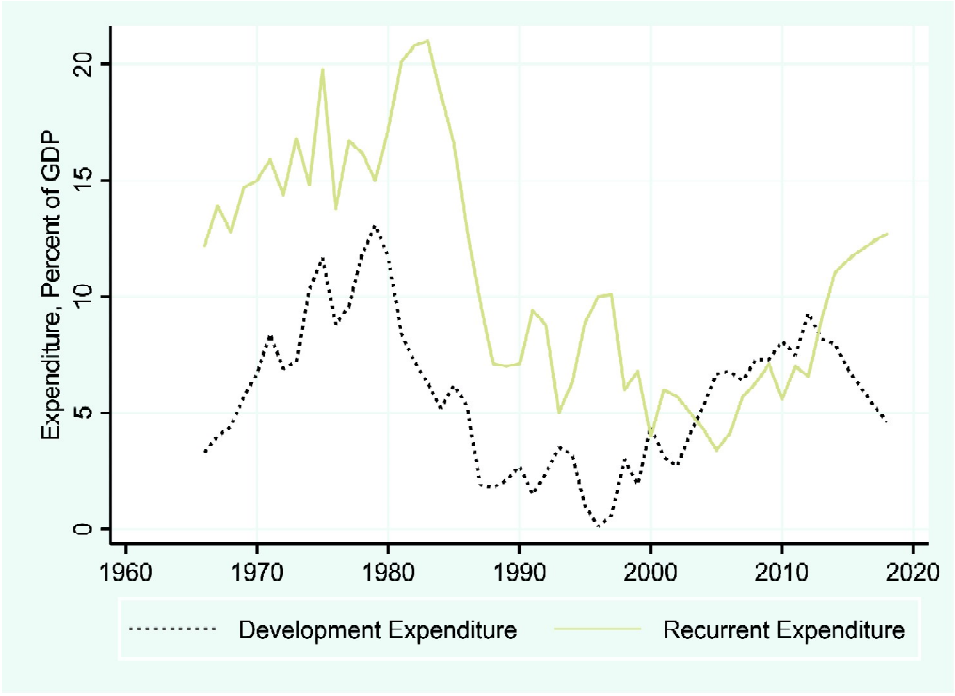

Figure 3: Recurrent and Development Expenditure, Percent of GDP

Data Source: Bank of Tanzania (2019)

developing economy as one of the most rapidly growing economies in sub-Saharan Africa. The economy of Tanzania can be divided into two phases: Before Structural Adjustment, ranging from 1961 to 86 and After Structural Adjustment Programme reform, ranging from 1987 to present. The period before Structural Adjustment can also be subdivided into the post-independence period (1961-1966) that was characterized by a market economy with the economic policy favouring the development of the private sector, and the socialism period (1967-1985) when the country adopted socialism under the Arusha declaration in 1967. Throughout the period of post-independence, the economy remained open and markets were free from government intervention, whereas the agricultural sector constituted the largest share of the economy, over 50 percent of GDP. About 60 percent of export earnings came from primary agricultural crops (Amani *et al.*, 2003). During that period, the share of the manufacturing sector was, on average, limited to 5 percent of GDP (Ruturagara, 2013). During socialism, most private enterprises including financial institutions were nationalized, and managed as state companies. Real GDP growth averaged 4.7 percent per year while annual inflation and balance payment, respectively, averaged 10 percent, and –4.3 percent of GDP (Ruturagara, 2013). Despite the decline of prices of export cash crops, export was impressive, accounting for 11.4 percent of GDP, dominated by traditional agricultural exports by 60 percent. Nonetheless, the economy experienced a negative balance of trade, deterioration of the balance of payment, a high inflation rate of about 36 percent per annum between 1980 and 1986, and the overall performance of the economy worsened. As a result, the Government instituted crisis policies and strategies including the National Economic Survival Programmes (NESP) of 1981 and 1982, aimed at reducing inflation, improvement of export production, and marketing to overcome the shortage of foreign exchange. The country also adopted Structural Adjustment Programmes (SAP) of 1983 prescribed by the IMF and the World Bank, aiming at increasing export revenue and eliminating food shortages through tighter control of public expenditure and increased production, prudent use of foreign currency, self-sufficiency in food, as well as interest rate liberalization. However, these policies failed to bring the expected result, over the 1980-1985 period, both per capita income and the real GDP growth declined. GDP growth rate fell from 4.2 percent in the early 1970s to -2.4 percent in 1983 because production in almost all sectors declined steadily. The manufacturing sector deteriorated and agricultural growth declined though its contribution to the economy remained high at 50 percent of GDP.

It should be noted that the oil crises of the 1970s, ignited a serious economic downturn, and thereby a wide range of policy restructuring

including economic liberalisation to overcome the recession. Similarly, the severe droughts of 1973 and 1974 caused a shortage of food and raw materials countrywide, while the collapse of East Africa in 1977 worsened the economic situation in Tanzania because most of the common infrastructures ceased to operate on a joint basis. In addition, the Kagera war of 1978-79 cost the country about TZS 4.1 billion, equivalent to the annual export earnings of 1979. From 1986, Tanzania adopted different policies and economic reforms in order to solve the economic problems that occurred under SAP. The Economic Recovery Programme, which was adopted in 1986 in response to weak growth, high inflation, and a balance of payments the crisis led to the gradual liberalisation of the exchange rate through the introduction of a crawling peg in 1986 and subsequent full exchange rate unification, as well as the removal of restrictions on current account transactions. In parallel, export and import procedures were simplified, and tariff and non-tariff trade barriers reduced. Marketing and distribution of agricultural crops were opened up to encourage private participation in the agriculture sector (IMF, 2016). During the second half of the 1990s, the country launched a comprehensive privatization programme in which underperforming manufacturing and commercial parastatals including state-owned banks were restructured, liquidated, or privatized. Financial sector interest rates were liberalized and banking supervision and regulation strengthened. A cash budget system was introduced to constrain government spending and improve fiscal management, while VAT was introduced and tax administration was improved in order to mobilize more revenue. Moreover, public investment in infrastructure was increased, with the aim of improving productivity and exports.

Although the economy remains agrarian which in turn generates fiscal problems, over the last 4 decades, the country has transformed from a largely agricultural, state-controlled economy to a more diversified, dynamic, and market-based one. The expansion of industry sector such as construction, mining, manufacturing, and overall services sector enhanced economic growth and led to an increase in employment in the modern sectors. The annual GDP growth rate has increased from 0.6 percent in 1992 to 6.9 percent in 2017, with an average growth of 5.2 percent over the 1990-2018 period (Figure 4). During the same period, the agriculture sector grew, on average, at 4.1 percent, whereas industry and service sectors grew at 6.7 percent and 5.2 percent respectively (Figure 4). The share of agriculture value-added in total output declined from 44.7 percent in 1992 to 28.7 percent in 2017, in favor of higher value-added industry and services (Figure 5). Indeed, industry value added as percent of GDP increased from 15.1 percent in

1992 to 25 percent in 2017, whereas service value-added rose from 33.3 percent of GDP to 37.9 percent of GDP suggesting that economic growth in Tanzania has become more broad-based and driven by services, construction, and manufacturing. According to IMF (2016), this economic success has been primarily fostered by sound macroeconomic policies and waves of structural reforms that started in 1986, and in the 1990-2000 period that were aimed at offering fertile ground for private sector development and inflow of foreign direct investment.

Economic growth in Tanzania has remained strong in recent years and become more capital intensive (IMF, 2016). Macroeconomic stability has remarkably been achieved, with inflation falling to a single digit. As the economy grew, the scope of taxation has considerably and steadily improved over the last 10 years. However, it should be noted that the economy is still dominated by the agricultural sector. Many cross-country studies find a negative relationship between agriculture share in GDP and tax revenue performance (Pession & Fenochietto 2010; Gupta 2007). A huge share of agricultural activities are politically exempted from taxes (Bird & Martinez-Vazquez 2008) and this affects the tax revenue performance. In

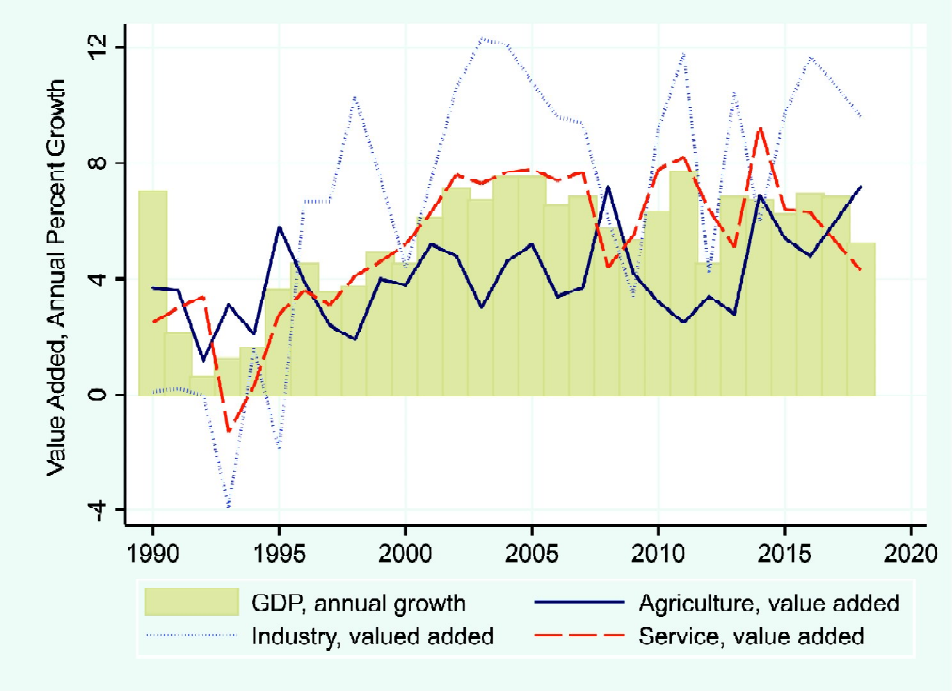

Figure 4: Performance of Economic Sectors

Data source: World Bank's WDI Dataset (2020)

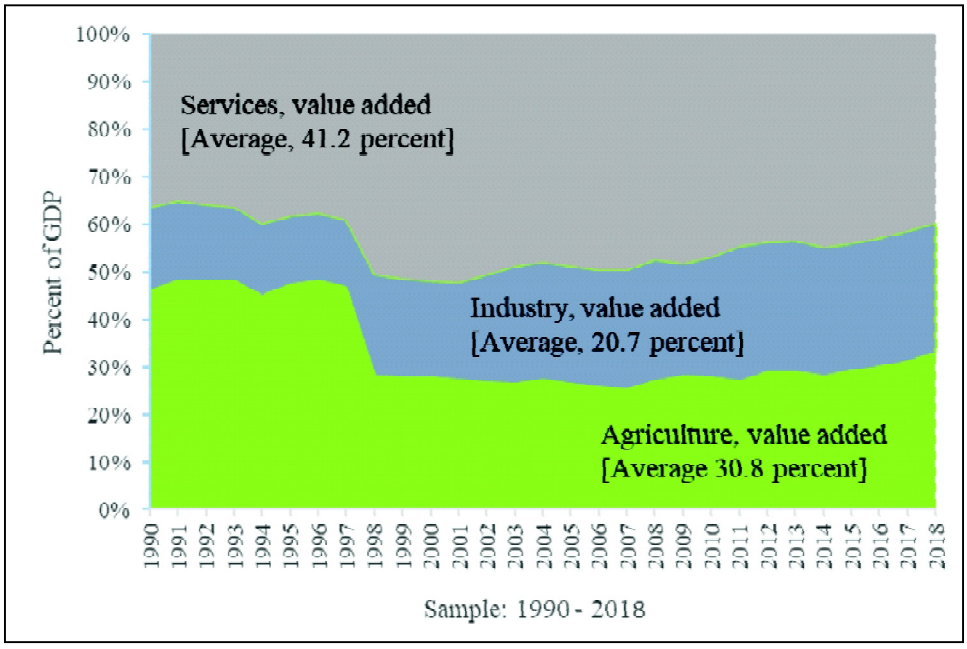

Figure 5: Sectoral Composition of the Economy, Percent of GDP

Data source: World Bank's WDI Dataset (2020)

Tanzania, the agriculture sector, which comprises crops, livestock, forestry, fishing and agricultural support services, employs about 65 percent of the labour force but has 30 percent contribution to GDP suggesting limited productivity in that sector. As such, the declining contribution of the agricultural sector to total GDP could be attributed to structural and/or institutional constraints other than systematic structural transformation (Mawejje & Munyambonera, 2016). The expansion of the services sector has been largely driven by innovation and technology, mainly due to reforms and expansion in the financial and insurance activities, transport, and storage, as well as information and communication. In 2018, for example, transport and storage sub-activity grew by 11.8 percent, attributed to an increase in the volume of transit cargo following improved efficiency at Dar es Salaam and Tanga ports, as well as increase in the number of air passengers (BoT, 2019).

Industry and construction activity which includes mining, quarrying, manufacturing, construction, electricity and gas supply, and water supply and sewage, grew by 9.3 percent in 2017 (BoT, 2019). The growth of construction was 12.9 percent in 2018, reflecting growing public investments notably the construction of standard gauge railways, bridges, airports, and

roads, as well as the expansion of ports. The contribution of manufacturing, and mining and quarrying to GDP in 2018 was 8.2 percent and 5.1 percent respectively (BoT, 2019). The industry has been an integral part of Tanzania's development strategies, and therefore the sector is expected to lead the process of transforming the economy from low productivity to high productivity and high revenue mobilization.

3. Literature Review

Tax revenue mobilization is a central concern of economic policymaking in many countries. In developing countries, enhancing the mobilization of tax revenue is integral for governments to create fiscal space to fund public investment and deliver public services. However, experience shows that while some countries exhibit marked increases in their tax-to-GDP ratios, others show little or no increase over extended periods, as a result this difference in tax revenues across countries has been a topic of the widespread debate in the relevant literature. In the literature, there are two main schools of thought explaining the factors that determine tax revenue mobilization namely, structural factors that include the composition of the economic activities, and institutional factors which include the government policies and political economy constraints (Mawejje & Munyambonera, 2016, Epaphra & Massawe, 2017). Structural factors that determine tax effort of the economy include the level of development, which is usually represented by the gross domestic product (GDP) per capita, the share of trade in GDP, which also indicates the degree of trade liberalization, the ratio of debt and aid to GDP, the productive specialization, or the structure of the economy, that can be explored through the sectoral composition of the GDP namely, the share of agriculture in GDP, the share of industry in GDP (Gupta 2007; Epaphra & Massawe, 2017; Pessino & Fenochietto, 2010; Piancastelli, 2001; Karagöz, 2013), external factors such as the level of foreign direct investment and trade (Cassou, 1997; Gupta, 2007; *Bird et al*., 2008), whereas the institutional factors that affect the ability and the efficiency of tax revenue collection include political stability, voice and accountability, governance, tax policies, and corruption (Bird & Martinez-Vazquez 2008; Ghura, 1998; Epaphra & Massawe, 2017; Bird *et al.,* 2008; Martin-Mayoral & Uribe, 2010). Some studies have explored the effect of social variables such as the educational level, measured by public expenditure on education or illiteracy rate (Pessino & Fenochietto, 2010; Piancastelli, 2001) and population growth (Bahl & Wallace, 2005).

Despite the fact that there is a vast empirical literature investigating the determinants of tax revenue, the empirical evidence of the revenue effects of the share of agriculture, industry, services, public expenditure as

well as the share of both development and recurrent expenditure in GDP using cross-country regressions is still inconclusive. Similarly, the relations among tax revenue, trade liberalization, and foreign aid are too ambiguous. The empirical findings have been mixed mainly because of their sensitivity to the set of countries and the period of analysis. Also, the majority of these studies employ cross-section empirical methods and hence ignore the variation over time. Some studies have applied dynamic general equilibrium models (Feltenstein & Cyan, 2013), while others have conducted diverse econometric techniques, employing cross-section methods (Lotz & Morss, 1970), panel version of a stochastic tax frontier model (Pessino & Fenochietto, 2010), fixed and random effect models and dynamic panel data techniques that use the generalized methods of moments (GMM)(Gupta, 2007; Martin-Mayoral & Uribe, 2010, Epaphra & Massawe, 2017). It is worth noting that very few previous studies reflect on the effect of lagged values of the tax revenue variable (Castro & Camarillo, 2014) or apply autoregressive distributed lag techniques (Mawejje & Munyambonera, 2016).

In the literature, however, it is common to find that GDP per capita is positively correlated with tax share, as it is a good indicator of the overall level of economic development and the sophistication of the economic structure (Gupta, 2007). A higher economic development suggests a lower average citizens' resistance to paying their taxes, because of their lower money's marginal utility and a greater proportion of them who surpass an exempt income level. In addition, a high rate of economic growth and a sizeable GDP per capita favour state capacity to collect taxes (Besley & Persson, 2009), and are related to greater tax bases namely, consumption and income (Muibi & Sinbo, 2013). Moreover, according to Wagner's law, since the demand for government services is income elastic, the share of goods and services provided by the government tend to rise with the level of development, which in turn increases the ratio of tax revenue-to-GDP. Other studies including Chelliah (1971), Bahl (1971), Tanzi (1987), Pessino & Fenochietto (2010), and Mahdavi (2008) also find a positive correlation between tax revenue and GDP per capita. The most notable contradictory findings are reported in Profeta & Scabrosetti (2010) analysis of determinants of tax revenue of 39 developing countries over the period 1990-2004, including 11 Asian, 19 Latin American, and 9 recent members of the European Union. They show that GDP per capita does not affect tax revenues in the Asian economies included in the sample, but it has a positive effect on Latin American countries.

The sectoral composition of the economy is considered to be one of the main determinants of tax effort because certain sectors of the economy are easier to tax than others (Gupta, 2007). Agriculture valued-added as a

percent of the economy may have a negative effect on tax revenue, because the economic activities in this sector are more difficult to tax, especially in developing countries, where production tends to be dominated by a large number of subsistence farmers, or organized on a small-scale basis. Moreover, studies show that higher agriculture share to GDP is expected to be associated with lower revenue because it is less monetized and largely informal, underreporting, and special or preferential tax treatment including exemptions and deductions, hence it has a negative impact on tax revenue (Ghura, 1998). It is possible that for political rather than economic reasons some countries exempt a large share of agricultural activities from taxes (Bird & Martinez-Vazquez 2008) and this affects the tax revenue performance. A number of empirical studies including Chelliah (1971), Bahl (1971), Tanzi (1987), Gupta (2007), Pessino & Fenochietto (2010), Agbeyegbe *et al*. (2004), and Bhushan & Samy (2010) confirm that the negative relationship between the ratio of agriculture-to- GDP and tax effort is indeed, statistically significant. By contrast, specialization in the industry can have positive effects on taxation as industrial enterprises are typically easier to tax. Manufacturing can generate larger taxable incomes than agriculture (Eltony, 2002). Similarly, a vibrant mining sector dominated by a few large firms can generate large taxable surpluses (Gupta, 2007). Studies such as Piancastelli (2001) and Stotsky & WoldeMariam (1997) also reveal a positive effect of manufacturing on tax ratio. Similarly, Chelliah (1971), Chelliah et al. (1975), Tait, *et al*. (1979), and Tanzi (1981) find that the mining share has a positive effect on tax ratio. However, Stotsky & WoldeMariam (1997) find that both agriculture and mining share are negatively related to the tax ratio, whereas Eltony (2002) observes that mining share has a negative impact on the tax ratio for oil-exporting countries, but a positive impact on non-oil exporting countries. This suggests that the effect of mining share, and indeed the ratio of industry-to-GDP on revenue performance is ambiguous. Nevertheless, the paramount importance here is vested in the argument that every sector, whether agricultural sector or non-agricultural sector, as well as industrialization, has a vital role in the tax revenue mobilization. Industrialization concomitant with economic growth creates new demands and requirements for government services (Weiss, 1969), which in turn lead to an increase in public spending and tax revenue mobilization.

Pessino & Fenochietto (2010) estimate tax effort and taxable capacity for 96 countries using the stochastic frontier analyses. The results show that, apart from the level of development as proxied by the per capita GDP, tax effort is determined positively by the level of trade openness, and public expenditure on education. According to Pessino & Fenochietto (2010), these

positive effects can, however, be undermined by macroeconomic instability, for example through extended periods of high inflation, and disparities in income distribution. In a similar study, Ghura (1998) shows for 39 Sub-Saharan African Countries, that the tax revenue-to-GDP ratios rise with declining inflation and level of corruption, emerging human capital a delegation for the provision of public services by the government, and the degree of openness. Ghura's findings on public service provision are consistent with Pessino & Fenochietto (2010) who show that public expenditure on education improves tax effort. Productive public expenditure can stimulate private sectors productivity and profitability (Aschauer, 1989), while a well-organized public expenditure is important in stimulating growth and poverty reduction (Sennoga & Matovu, 2013) that in turn may increase tax revenue mobilization. The main argument, however, is the degree to which tax revenue correlates with government expenditure because previous studies show mixed results depending on the economic groups (Lien & Thanh, 2017). While developed countries are likely to collect more taxes, spend less and maintain the slow speed of growing outcomes, developing countries keep spending more and collect less revenue for rapid growth in their economies (Lien & Thanh, 2017). To shed more light on Pessino & Fenochietto (2010) and Ghura (1998), studies such as Lotz & Morss (1967), Tait, *et al*. (1979), Leuthold (1991), Ghura (1998), Piancastelli (2001), WoldeMariam (1997), and Immurana *et al.* (2013) also find that either trade openness or the ratio of export-to-GDP has a positive effect on the tax revenue ratio. The effect of trade liberalization on revenue mobilization may be ambiguous both in theory and empirical evidence. Trade liberalisation in the form of converting quantitative restrictions to tariffs can initially lead to an increase in trade tax revenue (Gupta, 2009, Epaphra, 2014. Further liberalisation in the form of tariffs cut can cause trade tax revenue loss on one hand, but can also cause an increase in the the volume of imports, and hence the tax base and revenue. Indeed, Baunsgaard & Keen (2010) show that developing countries have not succeeded in offsetting reductions in trade tax revenues due to trade liberalization by increasing revenues from other sources. The net effect of trade liberalisation depends on many factors, including the structure of liberalisation and the elasticity of demand for imports (Brafo-Insaidoo & Obeng, 2008). Real exchange rate depreciation associated with trade liberalisation also affects the profitability of corporate firms through changes in the relative prices of imported inputs as well as exports (Pupongsak, 2009).

Taxes are levied on a nominal basis with no distinction drawn between real and purely inflationary components of the item that make up taxable

income (Jenkins & Lahouel, 1981). Inflation leads to a miscalculation of taxable liabilities both at the level of personal income and at the level of business income (Jenkins & Lahouel, 1981). Bilquees (2004) states that substantially a huge amount of taxes are persistently collected through indirect methods which are assumed to be affected to a greater extent by the inflation, whereas the direct method of taxation, is subject to an increase in the income and profitability resulting from such an inflationary trend. Victor (1996) and Gerald & Carroll (1999) state three effects that inflation may have on real tax liability namely, erosion of amounts expressed in national currency, erosion of the value of tax obligations, effects on the measurement of the tax base.

Along with the above variables, in the literature, there is an ongoing debate on the effect of foreign aid on fiscal tax revenues. Some studies argue that loans have a positive effect on tax revenue because of the obligation to repay them, whereas grants have a negative effect because the recipient treats them as free money and as a substitute for taxation. Clist & Morrissey (2011) build on Gupta *et al.* (2004) model to examine the impact of foreign aid (loans and grants) on tax efforts for 82 developing countries, classified as lower-middle income and low-income, over the 1970-1984 and 1985-2005 periods. The findings for the first set of data show that loans are positively related to tax revenue while grants have a negative relationship with tax revenue. The second set indicates that grants are positively related to tax revenue in the middle-income countries, primarily because they have better fiscal systems than the low-income countries. Similarly, the study by Hisali & Ddumba-Ssentamu (2013) shows that the long-run equilibrium tax is positively influenced by loans but bears a negative relationship with grants. These results are similar to the findings by *Crivelli et al.* (2012) and Gupta *et al.* (2003). However, other empirical studies, for example, Mbatia & Ellyne (2017) show that both concessional loans and grants have a negative effect on taxation revenue, while some authors reveal an insignificant relationship between the variables (Chaudhry & Munir, 2010). Indeed, according to Ouattara (2006) and Clist & Morrissey (2011) foreign aids need not suppress tax effort. This postulates that the causal relationship between the two variables is ambiguous.

The foregoing review of the literature shows that while there is substantial evidence that tax performance depends on many factors, some are structural while others are institutional. The strength and direction of the relationship, however, is likely to depend on the level of development and effectiveness of the tax system of the respective economy. The method of estimation also is like to affect the analysis. As a result, taxation has been a topic of discussion for decades in the global arena as countries strive to

maximise tax revenue collection in order to raise the revenue needed for economic development. In view of this and the fact that results have been contradictory, and that less attention has been paid to analyse the tax revenue effect of sectoral growth and expenditure using ARDL, this the paper contributes to the literature in this respect. The analyses further build on Mawejje & Munyambonera (2016) to investigate the effect of the growth of economic sectors and expansion of government expenditure on tax revenue in Tanzania.

4. Methodology

4.1. Analytical Framework

This paper adopts the framework developed by Mawejje & Munyambonera (2016) for Uganda. According to Mawejje & Munyambonera (2016), firms are the major micro production units that engage in the production of a final good but must rely on government expenditures for the provision of quality public infrastructures (G). Similarly, the firms hire labour units, N_i and invest in private capital, K_i. Government investment in public infrastructures acts as a catalyst for the productivity of labour and capital and as such, government expenditure is complimentary to firm performance. Assuming that government expenditures are financed by levying a constant tax rate, τ on firm profits, π, then the firms' production technology that follows a Cobb Douglas constant returns to scale function can be expressed as

$$q_i = \alpha K_i^{\beta} N_i^{1-\beta} G \tag{1}$$

where q_i = Output (GDP)

K_i = The private capital investment

N_i = Amount of labour employed by the i^{th} firm

G = Government spending

α = A measure of a firm's productivity from other sources.

$1-\beta$ and β = Coefficients

This production function has the property that the exponents of the inputs add up to one, which gives constant returns to scale. If capital and labour inputs are doubled, the output will also double. The function is assumed to be twice differentiable with positive marginal products and diminishing marginal rate of substitution, such that $f' > 0$ and $f'' < 0$. Public spending, G is a catalyst to firm productivity financed through

Government expenditure on public capital, such as in energy, water, communication, transport, education and health infrastructures (Mawejje & Munyambonera, 2016).

Given the return to labour, wage ω_i, and the return on private capital investments, the rate of return, ν_i, then the cost function can be presented as

$$c_i = \omega_i N_i + \nu_i K_i \tag{2}$$

So that the constrained output maximization problem will be as follows:

Maximise $$q_i = \alpha K_i^{\beta} N_i^{1-\beta} G \tag{3}$$

subject to $c_i = \omega_i N_i + \nu_i K_i$ (cost constraint)

The firms' profit function is given as

$$\pi_i = \alpha K_i^{\beta} N_i^{1-\beta} G - \omega_i N_i - \nu_i K_i \tag{4}$$

The first condition for profit maximization is that the first derivative of the function with respect to factor inputs be equal to zero. That is

$$\frac{\partial \pi_i}{\partial N_i} = (1-\beta)\alpha K_i^{\beta} N_i^{-\beta} G - \omega_i = 0 \tag{5}$$

$$\frac{\partial \pi_i}{\partial K_i} = \beta \alpha K_i^{\beta-1} N_i^{1-\beta} G - \nu_i = 0 \tag{6}$$

Profit maximization, therefore implies that

$$\omega_i = (1-\beta)\alpha K_i^{\beta} N_i^{-\beta} G \tag{7}$$

$$\nu_i = \beta \alpha K_i^{\beta-1} N_i^{1-\beta} G \tag{8}$$

Firms in the economy can be in agriculture (*agr*), industry (*ind*), and service (*ser*) sectors. The weighted geometric and natural logarithms functions of the aggregate activities in the economy can be expressed, respectively, as follows:

$$q = \left(agr^{\varphi_1}\right)\left(ser^{\varphi_2}\right)\left(ind^{\varphi_3}\right) \tag{9}$$

$$Log\ q = \varphi_1 \log agr + \varphi_2 \log ser + \varphi_3 \log ind \tag{10}$$

where φ_1, φ_2 and φ_3 are the shares of agriculture as percent of GDP, service as a percent of GDP, and industry as a percent of GDP.

In the formal sector[1], firms tend to report all their profit, π_i, for tax purposes. Since firms pay taxes on profits, then the tax revenue-to-GDP ratio is expressed as

$$\frac{\tau\pi_i}{q_i} = \frac{\tau}{q_i}\left(\alpha K_i^{\beta} N_i^{1-\beta} G - \omega_i N_i - \nu_i K_i\right) \tag{11}$$

Differentiating the tax revenue-to-GDP ratio with respect to profit gives the response of an increase in profitability to the tax revenue-to-GDP ratio at the margin, such that

$$\frac{d}{d\pi_i}\left(\frac{\tau\pi_i}{q_i}\right) = \frac{\tau}{q_i} > 0 \tag{12}$$

Expression (12) suggests that as firms expand their profitability the tax revenue-to-GDP ratio should increase, that is, there is a positive relationship between an increase in output or profit and tax revenue-to-GDP ratio.

4.2. Measurements of Variables and Sources of Data

As has been mentioned, the empirical analysis in this paper uses time-series dataset for Tanzania covering the 1990-2018 period. The choice of years is primarily motivated by the availability of data for the variables in questions. Table 1 gives a summary of variables' definitions and sources of data of the key variables. The variable of interest is tax revenue as a percentage of GDP, obtained from the Bank of Tanzania's Annual Reports (*various issues*). Among the explanatory variables, we include GDP per capita, the share of agriculture valued added in GDP, the share of industry value-added in GDP, the share of service value-added in GDP, and share of imports plus exports in GDP. Their sources are primarily the *World Development Indicators* (WDI). The other key explanatory variable is the public expenditure (recurrent and development) as a percentage of GDP, which is obtained from the Bank of Tanzania's Annual Reports (*various issues*). Moreover, we include inflation and official development assistance. The source of these variables is WDI.

1. Informal sector is beyond the scope of this paper.

Table 1
Definition of Variables and Sources of Data

Sn	*Variable*	*Abbr.*	*Definition*	*Expected sign*
1	Tax revenue	*tax*	Tax revenue, percent of GDP	
2	Output	*q*	Gross Domestic Product (TZS Million)	Positive
3	GDP per capita	*qp*	GDP/population	Positive
4	Public expenditure	*g*	Development g_1, and recurrent g_2, expenditure, percent of GDP	Positive
5	Agriculture	*agr*	Agriculture value added, percent of GDP	Negative
6	Service	*ser*	Service value added, percent of GDP	Positive
7	Industry	*ind*	Industry value added, percent of GDP	Positive
8	Trade	Γ	Export plus import of goods and services, percent of GDP	Positive/ Negative
9	Inflation	η	Inflation, consumer prices, percent	Negative
10	ODA	*da*	Official development assistance, percent of GDP	Positive/ Negative

Source: Authors' construction from literature review, 2020

All variables, except GDP per capita and inflation, are expressed as a percent of GDP to capture their relative sizes. GDP per capita, which captures income per person in the economy, is used as a proxy for the level of economic development. The level of development and the level of inflation are expected to have positive and negative signs, respectively. The main augment is that the degree of economic activities and macroeconomic instability are the main drivers of tax buoyancy and tax effort in the economy. Developed countries tend to have a higher tax revenue-to-GDP ratio. Agriculture valued-added represents the net output of the sector after adding up all the outputs and subtracting intermediate inputs and it is expected to have a negative sign because the economic activities in this sector are difficult to tax. Industry and services value-added, just like agriculture capture the net output after subtracting intermediate inputs from the total output of the sector. Both the industry and service sectors are expected to have a positive effect on tax revenue ratio because these sectors can generate large taxable surpluses. The impact of trade liberalization and official development assistance as has been stated already is not certain thus it can be positive or negative.

4.3. Model Specification

4.3.1. Autoregressive Distributed Lag Approach

Similar to Mawejje & Munyambonera (2016) for Uganda, we adopt the autoregressive distributed lag (ARDL) approach to cointegration analysis

to assess the responsiveness of tax revenue to sectoral GDP performance and public expenditure in Tanzania. ARDL, which is also known as bound testing the approach was proposed by Pesaran & Shin (1999) and further expounded by Pesaran *et al.* (2001). It is used to investigate the existence of cointegration relationships among variables (Matlasedi, 2017). It is worth noting that, in applied econometrics, the Granger (1981) and, Engle & Granger (1987), ARDL cointegration technique or bound test of cointegration (Pesaran & Shin,1999 and Pesaran *et al.,* 2001), as well as Johansen & Juselius (1990) cointegration techniques have become the solution to determining the long run relationship between series that are non-stationary, as well as reparameterizing them to the Error Correction Model (ECM). However, when compared to other cointegration procedures like the maximum likelihood-based Johanssen (1988) procedure and the residual-based Engle-Granger (1987) two-step estimation procedures, ARDL is favoured based on the fact that both the long-and short-run parameters of the model specified can be estimated simultaneously (Matlasedi, 2017).

If the variables in the model do not cointegrate, then we have the problems of spurious regression and the results therein become almost meaningless. To overcome the problem of non-stationarity and prior restrictions on the lag structure of a model, econometric analysis of time series data has increasingly moved towards the issue of cointegration (Nkoro & Uko, 2016). The reason being that, cointegration is a powerful way of detecting the presence of steady-state equilibrium between variables. One of the reasons for preferring the ARDL is its applicability irrespective of whether the underlying regressors are purely or mutually cointegrated. We then avoid the potential bias associated with unit roots and cointegration tests. Indeed, unlike the maximum likelihood-based Johanssen (1988) procedure which, requires all variables to follow *I(1)* processes, the ARDL approach is applicable irrespective of the order of integration whether the variables under consideration are purely *I*(0) (i.e. the variables are stationary at level form) or purely *I*(1) (i.e. the variables become stationary at first difference) or a combination of both. This means that the bound cointegration testing procedure may not require the pre-testing of the variables included in the model for unit roots and is robust when there is a single long-run relationship between the underlying variables. ARDL approach to cointegration helps in identifying the cointegrating vector(s). That is, each of the underlying variables stands as a single long-run relationship equation. If one cointegrating vector (i.e the underlying equation) is identified, the ARDL model of the cointegrating vector is reparameterized into the error correction model (ECM). The reparameterized result gives the short-run dynamics and long-run

relationship of the underlying variables. The distributed lag model simply means the inclusion of unrestricted lag of the regressors in a regression function. ARDL however, does not work with non-stationary variables integrated of order two I(2).

The ARDL approach involves two steps for estimating the long-run relationship (Pesaran *et al.*, 2001). The first step is to examine the existence of long-run relationships among all variables in the equations under estimation. The second step is to estimate the long-run and the short-run coefficients of the same equation and the associated ARDL error coercion model. We run the second step only if we find a long-run relationship in the first step (Narayan *et al.*, 2005). The ARDL model requires a priori knowledge or estimation of the orders of the extended ARDL. This appropriate modification of the orders of the ARDL model is sufficient to simultaneously correct for residual serial correlation and the problem of endogenous regressors (Pesaran & Shin, 1998). The order of the distributed lag on the dependent variable and the regressors is selected using either the Akaike Information Criterion (AIC) or the Schwartz Bayesian Criterion (SBC). This paper uses AIC as a lag selection criterion. Based on the previous discussion, a significant F-statistic for testing the joint level significance of the lagged level indicates the existence of long-run relationship.

In summary, the requirement for the Application of the ARDL approach to cointegration testing is that irrespective of whether the underlying variables are *I(0)* or *I(1)* or a combination of both, the ARDL technique can be applied. If the F-statistics (Wald test) establishes that there is a single long-run relationship and the sample data size is small or finite, the ARDL error correction representation becomes relatively more efficient. However, if the F-statistics (Wald test) establishes that there are multiple long-run relations, the ARDL approach cannot be applied. Hence, an alternative approach like Johansen & Juselius (1990) can be employed.

4.3.2. ARDL Model Specifications

As has been presented, the formal sector can be disaggregated into agriculture, industry, and services. The tax revenue-to-GDP ratio is expected to be positively associated with GDP or output. Similarly, productive Government expenditures are expected to be positively associated with profitability and output. Hence, the basic reduced form model arising from the analytical framework takes the form:

$$tax_t = f\left(q_t, g_t, qp_t, \Gamma_t, \eta_t, da_t\right) \tag{13}$$

since

$$q = f\left(agr_t, ser_t, ind_t\right) \tag{14}$$

it follows that the basic model that we estimate takes the form:

$$tax_t = f\left(agr_t, ser_t, ind_t, g_t, qp_t, \Gamma_t, \eta_t, da_t\right) \tag{15}$$

where tax_t = Tax revenue-to-GDP ratio
q_t = Output (GDP)
g_t = Government expenditure-to-GDP ratio
agr_t = Agriculture value added-to-GDP ratio
ser_t = Service value added-to-GDP ratio
ind_t = Industry value added-to-GDP ratio
qp_t = GDP per capita
Γ_t = Trade-to-GDP ratio
η_t = Inflation, consumer prices, annual percent
da_t = Official development assistance-to-GDP ratio

Using equation (15), the general ARDL representation is specified as:

$$\begin{aligned}\Delta tax_t = \theta_0 &+ \sum_{i=1}^{p_1} \theta_1 i\, \Delta \ln tax_{t-1} + \sum_{i=0}^{p_2} \theta_2 i \Delta \ln q_{t-i} + \sum_{i=0}^{p_3} \theta_3 i \Delta \ln g_{t-i} \\ &+ \sum_{i=0}^{p_4} \theta_4 i \Delta \ln qp_{t-i} + \sum_{i=0}^{p_5} \theta_5 i \Delta \ln \Gamma_{t-i} + \sum_{i=0}^{p_6} \theta_6 i \Delta \ln \Gamma_{t-i}^2 \\ &+ \sum_{i=0}^{p_7} \theta_7 i \Delta \ln \eta_{t-i} + \sum_{i=0}^{p_8} \theta_8 i \Delta \ln da_{t-i} + \varphi_1 \ln tax_{t-1} + \varphi_2 \ln q_{t-1} \\ &+ \varphi_3 \ln g_{t-1} + \varphi_4 \ln qp_{t-1} + \varphi_5 \ln \Gamma_{t-1} + \varphi_6 \ln \Gamma_{t-1}^2 + \varphi_7 \ln \eta_{t-1} \\ &+ \varphi_8 \ln da_{t-1} + u_t\end{aligned} \tag{16}$$

where all variables are as previously defined, Δ is the difference operator, θ_0 is the drift component, u_t is a white noise error term, and it is assumed to be serially uncorrelated. Lastly, $p_1, p_2, \cdots, p_8$ are the lag length. Note that q_t is disaggregated into agriculture (agr_t), industry (ind_t) and services (ser_t) and g_t is divided into development expenditure (g_1) and recurrent expenditure (g_2). Γ_t^2 is included to capture the Laffer curve effect of trade liberalization. To trace the existence of cointegration, F-statistic is computed from OLS regression equation (16). The null hypothesis of no cointegration (H_0) is tested by restricting the lagged level variable equal to zero, against the alternative hypothesis $\left(H_a\right)$ i.e.

$$H_0 : \varphi_1 = \varphi_2 = \ldots = \varphi_8 = 0 \tag{17}$$

$$H_a : \varphi_1 = \varphi_2 \neq \ldots \neq \varphi_8 \neq 0 \tag{18}$$

The bounds tests provide two asymptotic critical value bound. The lower bound assumes variable are *I*(0) whilst the upper bound assumes *I*(0) variables. The null hypothesis of no cointegration is rejected if the computed F-statistic is greater than the upper critical value bound, and conclude that there exists steady state equilibrium between the variables. If the computed F-statistics is less than the lower bound critical value, then we cannot reject the null hypothesis of no cointegration. However, it should be noted that if the computed F-statistic falls within the lower and upper bound critical values, then the result is inconclusive; in this case, following Kremers *et al.* (1992), the error correction term will be a useful way to establish cointegration.

The error correction model (ECM) is developed in order to test for the speed of adjustment and how the variables in the dataset converge towards equilibrium in the long run. Therefore, the ARDL version of the ECM for the tax revenue model can be expressed, in conformity with model (16) as

$$\begin{aligned}\Delta tax_t = \theta_0 &+ \sum_{i=1}^{p_1} \theta_1 i\, \Delta \ln tax_{t-1} + \sum_{i=0}^{p_2} \theta_2 i \Delta \ln q_{t-i} + \sum_{i=0}^{p_3} \theta_3 i \Delta \ln g_{t-i} \\ &+ \sum_{i=0}^{p_4} \theta_4 i \Delta \ln pq_{t-i} + \sum_{i=0}^{p_5} \theta_5 i \Delta \ln \Gamma_{t-i} + \sum_{i=0}^{p_6} \theta_6 i \Delta \ln \Gamma_{t-i}^2 \\ &+ \sum_{i=0}^{p_7} \theta_7 i \Delta \ln \eta_{t-i} + \sum_{i=0}^{p_8} \theta_8 i \Delta \ln oda_{t-i} + \delta\, \Re_{t-1} + u_t\end{aligned} \tag{19}$$

where $\theta_1, \theta_2, \cdots, \theta_8$ = Short run coefficients

δ = The extent of disequilibrium correction

$\Re_{t-1}$ = The error correction term (ECT)

δ explains the speed of adjustment and the error correction term, $\Re_{t-1}$, is derived from the residuals obtained in model (16). The coefficient of the lagged error correction term (δ) is expected to be negative and statistically significant to further confirm the existence of a cointegrating relationship.

4.2.3 Unit Root Tests

One of the first steps in econometric analysis is to test for the unit roots of the series, for which different tests such as Dickey-Fuller (1979) (DF),

Augmented Dickey-Fuller (1981) (ADF) test, Philip-Perron (1988) (PP) and Kwiatkowski-Phillips-Schmidt-Shin (1992) (KPSS) tests are described in the literature. The presence of a unit root implies that a time series under consideration is non-stationary while the absence of it entails that a time series is stationary. When non-stationary time series are used in estimation of an econometric model, the Ordinary Least Square traditional diagnostic statistics for evaluation of the validity of the model estimates such as, coefficient of determination *(R^2)*, Fisher's Ratio (F-Statistic), Durbin-Watson, t-statistic etc. become highly misleading and unreliable in terms of forecast and policy. In such series, the mean, variance, covariance and autocorrelation functions change overtime and affect the long run development of the series (Nkoro & Uko, 2016).

For the purposes of this paper, the standard version of the Augmented Dickey–Fuller (ADF) (Dickey, 1976; Dickey & Fuller, 1979) unit root test is employed to check the non-stationary assumption. The ADF test is considered superior because of its popularity and wide application. Indeed, the ADF test adjusts the DF test to take care of possible autocorrelation in the error terms by adding the lagged difference term of the dependent variable. If tax_t that is random walk process, that is, $tax_t = tax_{t-1} + u_t$, then the regression model becomes $tax_t = \rho tax_{t-1} + u_t$. Subtracting tax_{t-1} from both sides of the model, we present the restrictive and general ADF model as follow

Restrictive ADF model: $$\Delta tax_t = \rho_1 tax_{t-1} + \sum_{i=1}^{k} \psi_i \Delta tax_{t-i} + u_t \quad (20)$$

General ADF model: $$\Delta tax_t = \psi_0 + \rho_1 tax_{t-1} + \sum_{i=1}^{k} \psi_i \Delta tax_{t-i} + u_t \quad (21)$$

where u_t is a pure white noise error term and $\Delta tax_t = \left(tax_t - tax_{t-1}\right)$, $\Delta tax_{t-1} = \left(tax_{t-1} - tax_{t-2}\right)$. k is the lagged values of Δtax_t, to control for higher-order correlation assuming that the series follow an autoregressive process, $AR(\rho)$. The number of lagged difference term to be included is often determined empirically, the reason being to include enough terms so that the error terms are serially uncorrelated. The Schwartz-Bayesian Criterion (SBC) and Akaike Information Criterion (AIC) are widely used to determine the optimal number of lags included in the test. In practice, we test the hypothesis that the series has a unit root, $\rho = 0$. That is

$$H_0: \quad \rho_1 = 0 \qquad \rho_1 \sim I(1) \tag{30}$$

$$H_a: \quad \rho_1 < 0 \qquad \rho_1 \sim I(0) \tag{31}$$

An ADF value with less than its critical value shows that the underlying series has a unit root, in that case it is non-stationary. Contrarily, when an ADF value is greater than its critical value, then the underlying series has a unit root or it is stationary.

5. Empirical Results

5.1. Descriptive Data Analysis and Statistical Tests

Descriptive analysis and correlation matrix are conducted to ascertain the statistical properties of the variables. Table 2 and Table 3, respectively, report the descriptive statistics and correlation matrix of the variables. All variables are measured in logarithm forms. The descriptive statistics suggest that all variables except agriculture value added (*agr*) and development expenditure (g_1) are approximately normally distributed because their respective skewness is either not above 0.5 in absolute values or the probabilities of these variables fail to reject the null hypothesis of normal distribution. However, both skewness and probabilities of agriculture value added and development expenditure reject the null hypothesis of normal distribution.

The correlation matrix of the variables of the regression model as reported in Table 3 suggests that the tax revenue ratio is positively correlated with GDP per capita, trade-to-GDP ratio, government expenditure, but negatively correlated with official development assistance-to-GDP ratio, agriculture value added, and services value added. Indeed, the tax revenue ratio seems to be strongly positively correlated with the ratio of recurrent expenditure-to-GDP. The correlation between tax revenue ratio and inflation appears to have been positive but very weak. The correlation matrix also shows that the pair-wise correlations between explanatory variables, except GDP per capita and industry valued added on one hand, and agriculture valued added and industry value added on the other, are not quite high (i.e. less than 0.8) indicating that multicollinearity is not a serious problem. The strong negative correlation between industry and agriculture value added, and a strong positive correlation between GDP per capita and industry value added are expected in Tanzania, as the economy tends to move from an agrarian to industrial economy. This multicollinearity case was taken into consideration in the regression analysis.

Table 2
Descriptive Statistics and Correlation of Variables

	tax	*qp*	*agr*	*ind*	*ser*	g_1	g_2	Γ	η	*da*
Mean	1.00	5.62	1.48	1.31	1.61	0.56	0.85	1.61	1.00	1.01
Median	1.00	5.70	1.42	1.36	1.62	0.66	0.83	1.64	0.90	0.97
Maximum	1.07	6.38	1.65	1.42	1.69	0.97	1.10	1.82	1.55	1.48
Minimum	0.92	4.53	1.37	1.11	1.50	-1.00	0.53	1.38	0.54	0.64
Std. Dev.	0.05	0.56	0.10	0.10	0.06	0.42	0.16	0.13	0.30	0.23
Skewness	-0.08	-0.45	0.88	-0.75	-0.28	-2.07	-0.06	-0.24	0.49	0.50
Kurtosis	1.85	2.08	1.97	2.05	1.80	7.95	2.11	2.00	1.87	2.51
Jarque-Bera	1.63	2.01	5.04	3.78	2.11	50.4	0.98	1.50	2.68	1.48
Probability	0.44	0.37	0.08	0.15	0.35	0.00	0.61	0.47	0.26	0.48
Sum	28.9	163.1	42.8	37.9	46.7	16.3	24.6	46.8	28.9	29.3
Sum Sq. Dev	0.06	8.69	0.30	0.29	0.09	4.89	0.71	0.47	2.55	1.46
Observations	29	29	29	29	29	29	29	29	29	29

Source: Authors' computations

Table 3
Correlation coefficient Matrix

	tax	*qp*	*agr*	*ind*	*ser*	g_1	g_2	Γ	η	*da*
Tax revenue	1									
GDP per capita	0.34	1								
Agriculture	0.18	-0.79	1							
Industry	0.17	0.90	-0.89	1						
Services	0.51	0.47	-0.80	0.57	1					
Dev. Expenditure	0.04	0.62	-0.69	0.80	0.43	1				
Rec. Expenditure	0.87	0.18	0.34	-0.05	-0.57	-0.25	1			
Trade	0.23	-0.28	0.50	-0.34	-0.62	-0.08	0.14	1		
Inflation	0.01	-0.78	0.81	-0.77	-0.67	-0.48	0.10	0.68	1	
ODA	-0.25	-0.92	0.72	-0.78	-0.49	-0.43	-0.23	0.50	0.79	1

Source: Authors' computations

5.2. Tests for Stationarity

It was important to verify the stationarity properties of the variables used for the study in order to avoid the risk of spurious regression since literature has shown that most time series variables have stochastic trends, thus their variances and unconditional means are non-stationary. The Augmented Dickey-Fuller (ADF) method is conducted to check for a unit root for all variables in both levels and first differences. In carrying out the stationarity tests we considered constant and trend in the series. The results of this test are presented in Table 4, which indicates that the hypothesis of a unit root cannot be rejected in all variables in levels. It is therefore concluded that all variables are non-stationary at their levels. However, the hypothesis of a

unit root is rejected in first differences which indicates that all variables are integrated of degree one (Table 5). This also suggests that further estimations could be carried while in the first difference in order to avoid spurious correlation.

Table 4
ADF Unit Root Tests for Stationarity: Level Variables

No	*Variable*	*ADF test statistic*			*Decision*
		Intercept	*Intercept & trend*	*None*	
1	Tax revenue	-2.041	-2.538	0.274	Accept H_0
2	GDP per capita	-3.714	-1.398	2.420	Accept H_0
3	Agriculture	-1.563	-0.959	-0.759	Accept H_0
4	Industry	-1.038	-2.253	0.823	Accept H_0
5	Service	-1.638	-1.048	0.201	Accept H_0
6	Development expenditure	-2.080	-2.812	-1.091	Accept H_0
7	Rec. Exp.	-1.575	-1.792	0.144	Accept H_0
8	Trade	-1.996	-2.037	-0.443	Accept H_0
9	Trade Squared	-2.030	-2.092	-0.563	Accept H_0
10	Inflation	-2.449	-2.256	-2.708	Accept H_0
11	ODA	-1.424	-2.431	-2.207	Accept H_0
	Critical values: 5% level	-2.972	-3.581	-1.953	

Hypothesis: H_0: Series is non-stationary/has unit root.
H_1: Series has no unit root.
Source: Authors' computations

Table 5
ADF and PP Unit Root Tests for Stationarity: First Difference

No	*Variable*	*ADF test statistic*			*Decision*
		Intercept	*Intercept trend*	*None*	
1	Tax revenue	-6.152	-5.635	-6.271	Reject H_0
2	GDP per capita	-3.571	-4.675	-1.863	Reject H_0
3	Agriculture	-4.745	-5.029	-4.745	Reject H_0
4	Industry	-5.120	-5.021	-5.029	Reject H_0
5	Service	-4.369	-4.961	-4.433	Reject H_0
6	Development expenditure	-5.108	-4.996	-5.206	Reject H_0
7	Recurrent expenditure	-5.957	-6.176	-6.061	Reject H_0
8	Trade	-3.196	-3.666	-3.239	Reject H_0
9	Trade Sqaured	-3.194	-3.168	-3.241	Reject H_0
10	Inflation	-5.380	-5.318	-5.135	Reject H_0
11	ODA	-7.237	-7.087	-6.570	Reject H_0
	Critical values: 5% level	-2.976	-3.588	-1.954	

Hypothesis: H_0: Series is non-stationary/has unit root.
H_1: Series has no unit root.
Source: Authors' computations

5.3. Autoregressive Distributed Lag Cointegration Test

Results of the ARDL bound test for cointegration, which is based on the Wald-test (*F*-statistic) are reported in Table 6. In this test, as has been discussed, the lower critical bound assumes all the variables are *I*(0) meaning that there is no cointegration relationship between the examined variables, whereas the upper bound assumes that all the variables are *I*(1), meaning that there is cointegration among the variables. The Table also reports the null hypothesis of no cointegration (H_0) and the alternative hypothesis (H_a) of cointegration amongst the variables. The fact that the computed *F*-statistic $(F = 8.21)$ is greater than the upper bound critical value, at all levels of significance, i.e. 10 percent, 5 percent, and 1 percent; then the H_0 is rejected, meaning that the variables in the model are cointegrated. Similarly, the computed *t*-statistic $(t = -7.61)$ is greater than the upper bound critical value, at all levels of significance, also rejecting the H_0 of no cointegration among the variables in the model. The implication is that the bounds testing approach provides a proof that there is indeed a long run relationship between the variables in the model and therefore the long run cointegration model and coefficients can be estimated and specified.

Table 6
ADL Bounds and Critical Value Bounds Test for Cointegration

F-Bounds Test			*Null Hypothesis: No levels relationship*	
Test Statistic	*Value*	*Signif.*	*Lower bound I(0)*	*Upper bound I(1)*
			Asymptotic: *n* = 1000	
Wald F-statistic	8.207356	10%	2.03	3.13
k	7	5%	2.32	3.5
		1%	2.96	4.26
t-Bounds Test			*Null Hypothesis: No levels relationship*	
Test Statistic	*Value*	*Signif.*	*Lower bound I(0)*	*Upper bound I(1)*
t-statistic	-7.606863	10%	-2.57	-4.23
		5%	-2.86	-4.57
		1%	-3.43	-5.19

$H_0: \varphi_1 = \varphi_2 = \cdots = \varphi_8 = 0$ A Long-run relationship does not exist

$H_a: \varphi_1 \neq \varphi_2 \neq \cdots \neq \varphi_8 \neq 0$ A Long-run relationship exists

Source: Authors' computations

5.4. Autoregressive Distributed Lag Long-run Regression Results

It should be understood that if cointegration exists among the variables, ARDL approach can be used to determine long term relationships. Table 7 presents long-run results of the *ARDL* model, which can be summarized as follows:

$$Co\,\text{int}\,eq = \ln tax - \begin{pmatrix} 0.786\ln agr + 0.482\ln ind + 0.753\ln ser \\ +0.046\ln g_1 + 0.232\ln g_2 + 3.273\ln\Gamma - 0.998\Gamma^2 \end{pmatrix} \quad (22)$$

All the variables in the model are statistically significant at 1 percent and 5 percent. The elasticity of agriculture valued added (agr) is 0.786, suggesting that a 1 percent increase in the ratio of agriculture value added-to-GDP, will lead to an increase of about 0.78 percent in the tax revenue ratio in the long run. A large share of agriculture in crops such as tobacco, coffee, tea, coconuts, vegetables, fruits, cotton, as well as fish reflects an export industry amenable to taxation. Results also reflect an increase in VAT stimulated by the increase of consumption on importation boosted by the increase of imported capital and intermediate consumption goods used by farmers. Indeed, a positive correlation between agriculture and tax revenue is not uncommon. Terefe & Teera (2018) and Boukbech *et al*. (2019) reveal a positive and significant effect of agriculture on tax revenue ratio for Eastern African Countries and lower middle-income countries respectively.

The other most important determinants of tax revenue performance in Tanzania seem to be growth in industry and trade. The elasticity of industrial valued added (ind) is 0.48, while that of trade-to-GDP ratio (Γ) is 3.27 and are highly significant at 1 percent, thus confirming a positive effect on tax revenue ratio. Specifically, a 1 percent growth in industrial valued added will lead to a 0.48 percent increase in the tax revenue ratio, while a 1 percent growth in the ratio of trade-to-GDP will lead to a 3.27 percent growth in the tax revenue ratio in the long run. Notably, productivity in industrial sector in Tanzania, which comprises among others, manufacturing, processing, and assembling industries has been impressive. This in turn, widens the tax base for domestic taxes such as corporate and profit taxes. Similarly, the positive effects of trade openness on tax revenue suggest that an increase in the volume of imports resulting from openness exceeds the magnitude of tariff reduction. Further, an increase in imports may lead to an increase in VAT and corporate tax, which more than recoup declining international trade. This is consistent with the theory that higher import

lead to rising shares of both import duties and VAT. However, as expected, and consistent with Epaphra (2014), Khattry & Rao (2002) and Agbeyegbe *et al.* (2004), the results confirm the hypothesis that there is a diminishing tax revenue return to trade liberalization. The negative magnitude of the ratio of trade-to-GDP squared $\left(\Gamma^2\right)$ suggests that a potential Laffer effect exists for tax revenue. Measures such reduction in tariffs tend to reduce trade taxes in the long run, which in turn lead to a decline in total tax revenue because international trade constitutes large share of total tax revenue.

Like industrial sector, growth of services sector $\left(ser\right)$ is important for tax revenue performance. Services in Tanzania, which cover transportation and storage, information and communications, financial, banking, and insurance activities and all other private economic activities that do not produce material good, account for more than 40 percent of GDP, and about 25 percent share of total employment. Overall services sector displays high productivity, and unsurprisingly, a 1 percent growth in the sector is likely to lead to a 0.75 percent increase in the tax revenue ratio. Unsurprisingly, the coefficients on development expenditure (g_1) and recurrent expenditure (g_2) are positive and significant at 5 percent and l percent respectively. A 1 percent increase in the share of development expenditure in GDP results in a 0.05 percent increase in the ratio of tax-to-GDP, while a 1 percent increase in the share of recurrent expenditure leads to a 0.23 percent increase in the

Table 7
ARDL Long-Run Results

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
ln *agr*	0.7862***	0.2818	2.7898	0.0121
ln *ind*	0.4818***	0.1691	2.8494	0.0106
ln *serv*	0.7527**	0.3149	2.3903	0.0280
ln g_1	0.0462**	0.0174	2.6530	0.0189
ln g_2	0.2321***	0.0234	9.9235	0.0000
ln Γ	3.2733***	0.6852	4.7775	0.0002
ln Γ^2	-0.9978***	0.2115	-4.7184	0.0002
Normality		$JB = 2.4703$		Pr = 0.2908
Breusch-Godfrey Serial Correlation LM Test		$F = 1.3457$		$F(2, 21) = 0.2819$
ARCH		$F = 0.0086$		$F(1, 25) = 0.9265$
RESET Test		$F = 0.9562$		F(1, 17) = 0.3524

Dependent Variable: *D(lntax)*

***Denotes a 1 percent level of significance

**Denotes a 5 percent level of significance

Source: Authors' computations

tax revenue ratio. This result highlights the prominent role of recurrent expenditure in increasing the domestic liquidity and the economic activity, as well as productivity effects of development expenditure such as in building real businesses that tend to increase production and employment. The coefficients of inflation (π) and official development assistance (oda) turned out to be statistically insignificant, and therefore were dropped out in the regression. GDP per capita was also excluded in the analysis because it was highly correlated with both agricultural and industrial sectors.

5.5. Autoregressive Distributed Lag Error Correction Model

Since variables in the model are cointegrated, then the ARDL-ECM is estimated in order to test for the speed of adjustment and how the variables in the dataset converge towards equilibrium in the long-run. Figure 6a shows the top 20 of different ARDL models evaluated by Eviews and the final selected model as chosen by the Akaike Information criterion. The Figure shows that the final model used in the paper is an ARDL(1, 0, 0, 0, 0, 1, 0, 0) model. That is, 1 lag of the dependent variable, tax revenue ratio (tax), zero lag of agriculture value added (agr), industry value added (ind), service value added (ser), and development expenditure (g_1), one lag of the recurrent expenditure (g_2), and zero lag of both trade-to-GDP ratio (Γ) and square of the ratio of trade-to-GDP (Γ^2). It should be noted that both Schwarz Criteria and Hannan-Quinn Criteria, too, choose ARDL(1, 0, 0, 0, 0, 1, 0, 0) as the preferred model (Figure 6b and Figure 6c). Results of the short run ARDL version of the ECM for the tax revenue model associated with the ARDL(1, 0, 0, 0, 0, 1, 0, 0) are reported in Table 8. Table 9 reports associated diagnostic tests of the model, which are discussed in subsection 5.6. An ARDL-ECM has two important parts. First, estimated short-run coefficients and second, error correction term, $\Re_{-1}$, that provides the feedback or the speed of adjustment whereby short-run dynamics converge to the long-run equilibrium path in model.

Estimations show that the coefficients of all the regressors are statistically significant at either 1 percent or 5 per cent level. Only, the coefficient on the development expenditure that is statistically significant at the 10 percent level. The coefficient of the error correction term, $\Re_{-1}$, which measures the speed of adjustment is as expected, significantly negative at 1 percent, suggesting that the series is not explosive and that equilibrium in the long run will be attained. The coefficient of "1.00 reveals that 100 percent of the

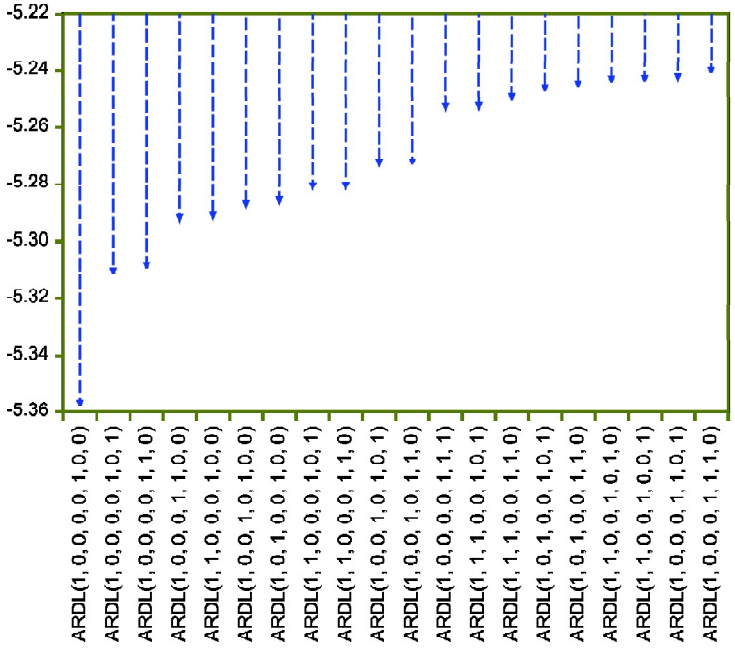

Figure 6a: Top 20 Model: Akaike Information Criteria

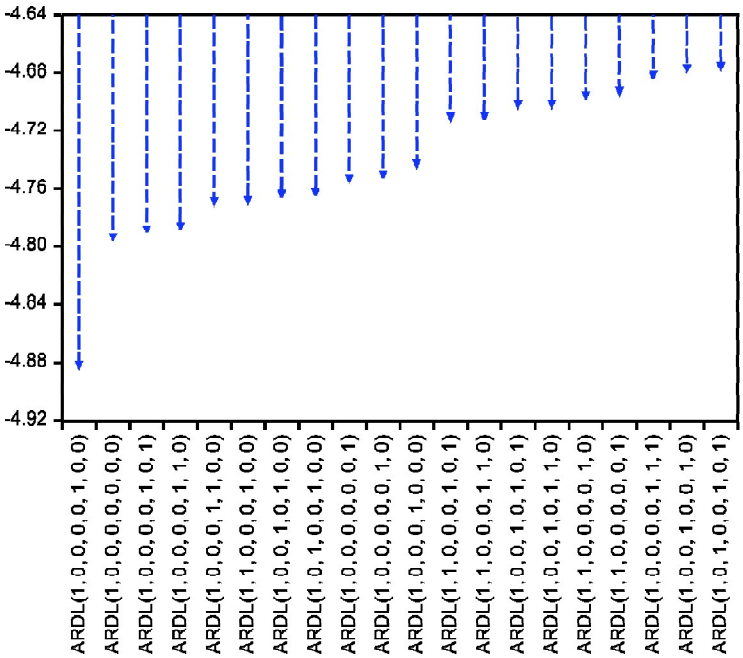

Figure 6b: Top 20 Model: Schwarz Criteria

Source: Authors' Computations

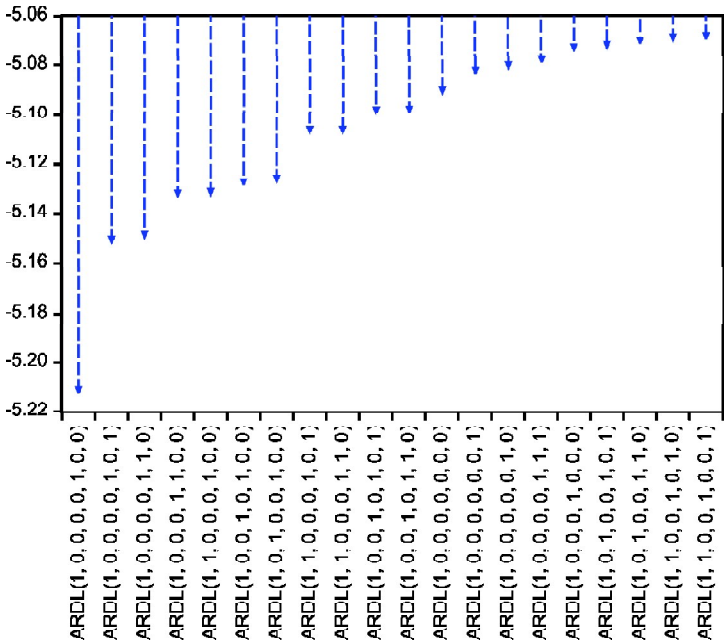

Figure 6c: Top 20 Model: Hannan-Quinn Criteria

Table 8
Autoregressive Distributed Lag Error Correction Model

Variable	*Coefficient*	*Std. Error*	*t-Statistic*	*Prob.*
$\Delta \ln tax\_1$	-0.2875**	0.1294	-2.2222	0.0410
$\Delta \ln agr$	1.2102***	0.3454	3.5038	0.0029
$\Delta \ln ind$	0.7092***	0.2089	3.3956	0.0037
$\Delta \ln ser$	1.1961***	0.3645	3.2813	0.0047
$\Delta \ln g_1$	0.0236*	0.0116	2.0244	0.0600
$\Delta \ln g_2$	0.2086***	0.0329	6.3330	0.0000
$\Delta \ln g_2\_1$	0.1247***	0.0429	2.9100	0.0102
$\Delta \ln \Gamma$	4.9431***	0.9263	5.3361	0.0001
$\Delta \ln \Gamma^2$	-1.5098***	0.2811	-5.3705	0.0001
$\Re_{-1}$	-1.0015***	0.2891	-3.6367	0.0022
Constant	-0.0004	0.0028	-0.1482	0.8841
R-squared	0.9160	Mean dependent var		0.0010
Adjusted R-squared	0.8635	Akaike info criterion		0.0380
S.E. of regression	0.0140	Schwarz criterion		-5.4013
Sum squared resid	0.0032	Hannan-Quinn criter.		-4.8734
F-statistic	17.4544	Durbin-Watson stat		1.6471
Prob(F-statistic)	0.0000			

ARDL(1, 0, 0, 0, 0, 1, 0, 0): Dependent Variable: $\Delta \ln tax$

***Denotes a 1 percent level of significance
**Denotes a 5 percent level of significance
*Denotes a 10 percent level of significance

Table 9
Model Diagnostic Tests

Diagnostic test	*Computed test statistic*	*p-value*
Normality	JB = 2.1401	0.3430
Breusch-Godfrey Serial Correlation LM Test	F = 2.3102	F(1, 15) = 0.1493
Breusch-Pagan-Godfrey test for heteroskedasticity	F = 0.4991	F(10, 16) = 0.8666
Glejser test for heteroskedasticity	F = 1.0099	F(10, 16) = 0.4756
ARCH LM test	F = 0.0052	F(1, 24) = 0.9430
Ramsey RESET test	F = 2.3265	F(1, 24) = 0.2635

Source: Authors' computations

disequilibrium in the tax revenue function for the current period will be corrected in the following year.

The ARDL-ECM results suggest that in the short-run growth in the agriculture sector, services sector, industrial sector, trade openness, as well as development and recurrent expenditure have positive and significant effects on tax revenues performance in Tanzania. On the contrary, trade openness squared, a proxy for unrestrictive trade practices, is negatively associated with tax revenue performance. Trade openness, the services sector, as well as the agricultural sector seem to have greater effects on tax revenue performance in the short-run. The coefficient on trade openness is 4.94, suggesting that a 1 percent growth in trade will lead to a 4.94 percent increase in the tax revenue ratio. However, free trade or unrestrictive trade practice is likely to halt tax revenue performance, as explained by a negative coefficient on trade openness squared. In the short run, the agricultural sector and services sector have almost identical effects on tax revenue performance. The tax revenue ratio will increase by 1.2 percent if either the agricultural sector or services sector increases by 1 percent. The industrial sector and recurrent expenditure, too, have a significant effect on tax revenue in the short run. A 1 percent growth in the industrial sector will lead to a 0.71 percent increase in the tax revenue ratio. Likewise, the ratio of tax revenue will increase by 0.21 percent if recurrent revenue increases by 1 percent in the short run.

The lag of the current government expenditure (g_2_1) is positively related to tax revenue in the short-run and with a coefficient of 0.13. This reveals that a 1 percent increase in the last period's current expenditure will lead to a 0.3 percent increase in the current period tax revenue performance in the short run. The lagged tax revenue variable (tax_1) is also significant at 5 percent and suggests that the current tax revenue is

directly influenced by the previous tax revenue value. Overall, these results suggest that efforts to improve tax revenue performance in the short run should focus on the growth effects of industry and services sectors, trade openness and both recurrent and development expenditures while unlocking the constraints in the agricultural sectors to increase productivity and income.

In general, the high adjust R-squared shows that the independent variables are highly correlated with the dependent variable.

5.6. Diagnostic and Stability Tests on the Error Correction Model

The validity of the results is dependent on the fit and stability of the model. Table 9 summarises the results of the various residual diagnostic and stability tests on the ARDL-ECM model. The Table reports that the residuals are normally distributed in the model as evidenced by the non-rejection of the null hypothesis using the Jarque–Bera test (Also see Figure 7). The Ljung–Box Q statistic also reports that there is no autocorrelation in the model (Table 10). Breusch-Godfrey Lagrange Multiplier test for serial correlation test also confirms that there is no serial correlation in the model. The model also appears to be free from heteroskedasticity as it passes all the heteroskedasticity tests including the Breusch-Pagan-Godfrey test, Glejser test, and ARCH LM test.

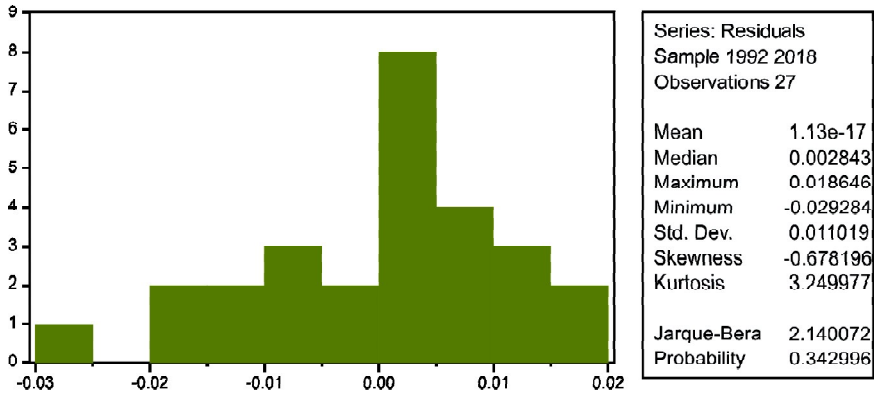

Figure 7: Normality test, Skewness and Kurtosis of the Residuals

H0: Residuals are normally distributed

Ha: Residuals are not normally distributed

Dependent Variable: $\Delta \ln tax$

Notes: The Normality test indicates that residuals are normally distributed as we unable to reject the null hypothesis of normality using Jacque-Bera at 5 percent.

Source: Authors Estimates

Further, the Ramsey RESET test results suggest that the model is correctly specified as evidenced by a probability value of 26 percent, which is greater than the 5 percent level of significance. Therefore, we do not reject the null hypotheses that the model is correctly specified. The stability of the model is evidenced by the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ), proposed by Brown *et al.* (1975), as indicated in Figure 8 and Figure 9 respectively. Since the residuals plot does not fall outside the 5 percent significant boundaries, we fail to reject the null hypothesis of perfect parameter stability, and hence conclude that the estimates are stable over the period. In addition, the coefficients of the model are estimated. The results of the estimated coefficients are reported in Figure 10. Despite a slight instability in some parameters, overall results suggest no statistically significant changes in parameters. Since our model exhibits all the desirable properties of OLS, we conclude that the model is reliable for economic analysis and forecasting.

Table 10
Autocorrelation and Partial Autocorrelation

Autocorrelation	*Partial Correlation*		*AC*	*PAC*	*Q-Stat*	*Prob**
. | . |	. | . |	1	0.019	0.019	0.0107	0.918
.** | . |	.** | . |	2	-0.252	-0.253	1.9433	0.378
. * | . |	. * | . |	3	-0.082	-0.076	2.1586	0.540
.** | . |	*** | . |	4	-0.269	-0.355	4.5471	0.337
. |* . |	. | . |	5	0.086	0.049	4.8053	0.440
. | . |	.** | . |	6	0.007	-0.219	4.8073	0.569
. | . |	. |* . |	7	0.065	0.082	4.9706	0.664
. * | . |	.** | . |	8	-0.086	-0.320	5.2724	0.728
.** | . |	. * | . |	9	-0.206	-0.150	7.0896	0.628
. |**. |	. |* . |	10	0.318	0.173	11.680	0.307
. |* . |	. | . |	11	0.134	0.052	12.553	0.324
. * | . |	. * | . |	12	-0.108	-0.098	13.157	0.358
. | . |	. | . |	13	-0.009	-0.006	13.161	0.435
. | . |	. |* . |	14	-0.060	0.109	13.376	0.497
. * | . |	. * | . |	15	-0.071	-0.090	13.707	0.548
. | . |	. | . |	16	0.015	0.031	13.723	0.619
. | . |	. * | . |	17	0.004	-0.153	13.724	0.687
. | . |	. | . |	18	-0.046	-0.018	13.916	0.735
. | . |	. | . |	19	-0.028	-0.002	13.996	0.784
. | . |	. * | . |	20	-0.002	-0.140	13.996	0.831
. | . |	. * | . |	21	0.073	-0.104	14.767	0.834
. | . |	. | . |	22	0.018	-0.019	14.826	0.870
. | . |	. * | . |	23	-0.064	-0.106	15.834	0.862
. | . |	. | . |	24	0.043	-0.064	16.517	0.869

H_0: There is no serial correlation in the residuals;
Ha: There is serial correlation in the residuals

Note: No serial correlation in the model because none of the lag is found to be significant at 1 percent level.

Source: Authors Computations

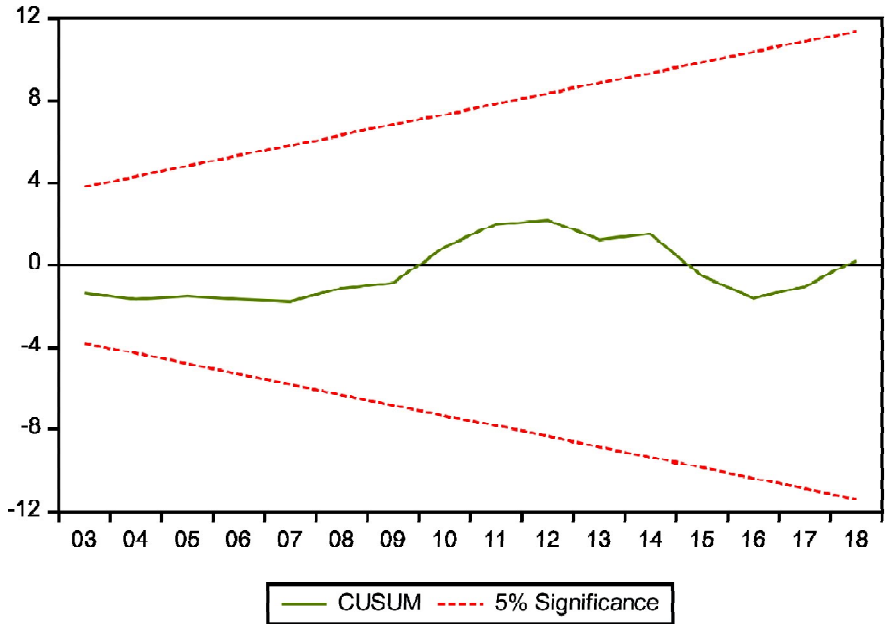

Figure 8: Stability Test: Plot of Cumulative Sum of Recursive Residuals

Source: Authors' Estimates

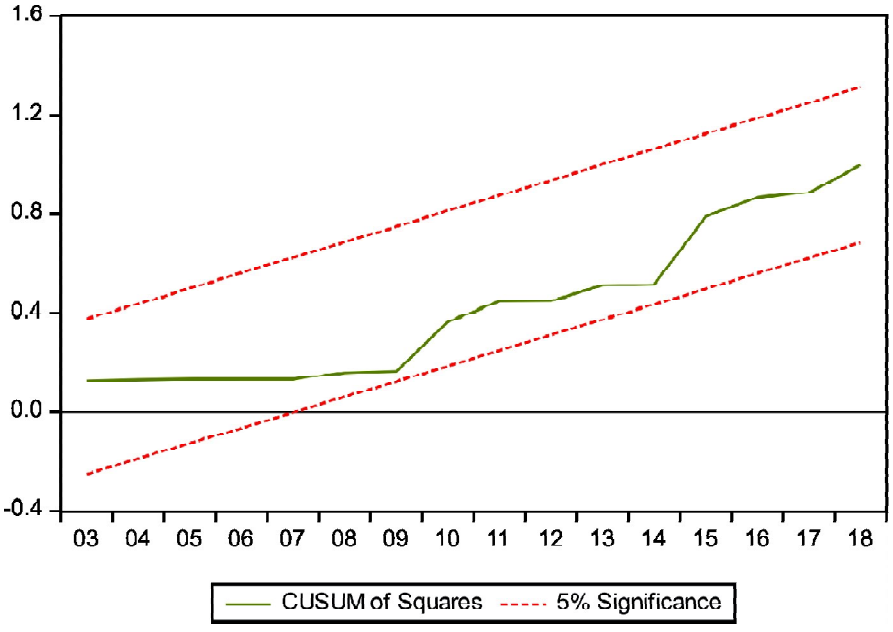

Figure 9: Stability Test: Plot of Cumulative Sum of Squares of Recursive Residuals

Source: Authors' Estimates

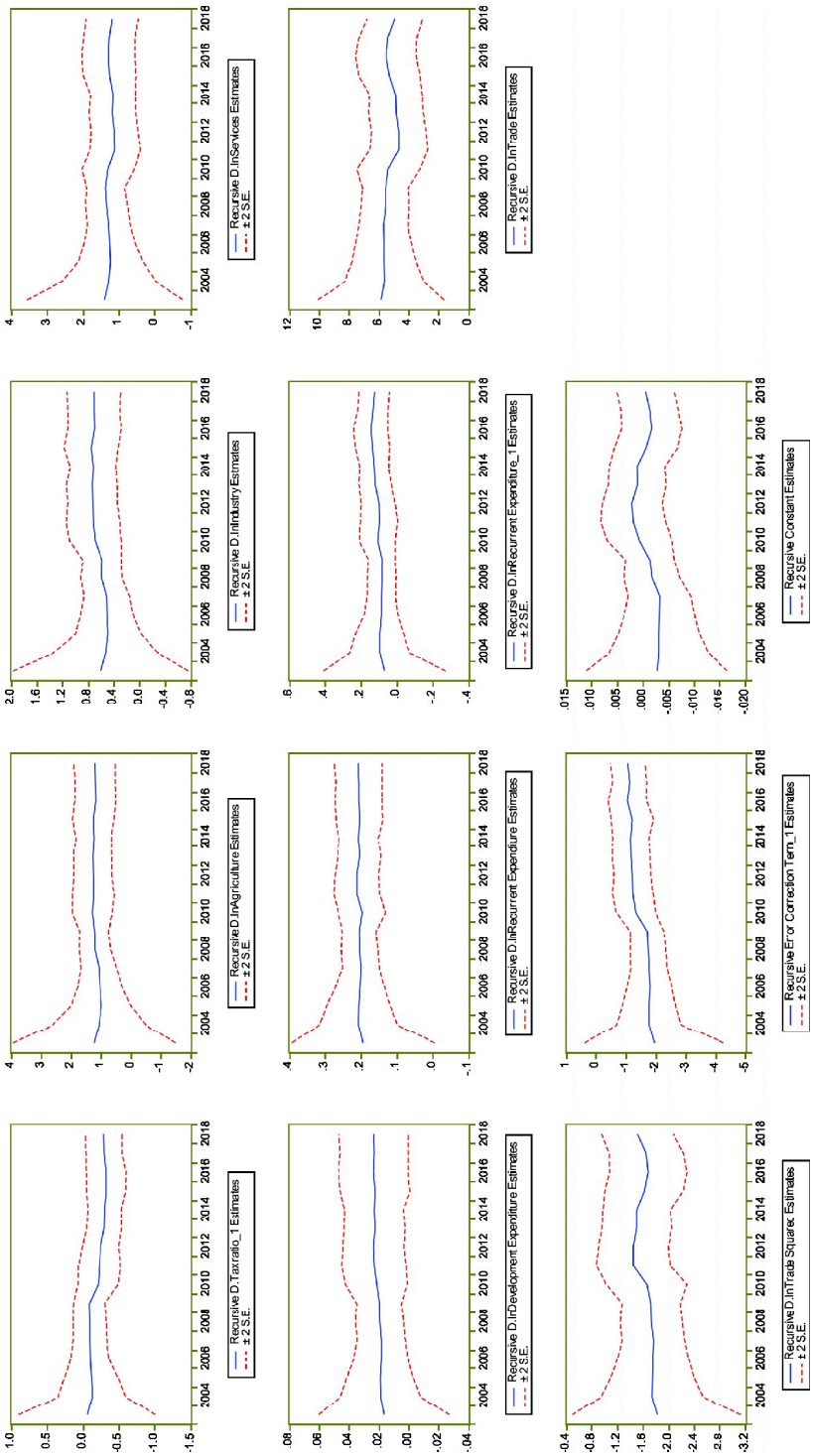

Figure 10: Recursive Estimates of the Estimated Coefficients

Authors' estimates

6. Conclusions and Policy Implications

Tax revenue performance in Tanzania has improved in recent years, but the progress has been slow and in fact, it falls behind when compared to some other sub-Saharan countries, despite the fact that reliance on domestic revenue mobilization has been emerged as a key priority because of the significant decline in donor support. This paper examines the effect of the growth of main sectors of the economy and public expenditure on tax revenue performance using the auto regressive distributed lag (ARDL) methods. The results from the analysis show that in both the short-run and long-run, the ratio of tax revenue-to-GDP is influenced by industrial and services sectors, recurrent and development public expenditures, and trade openness. The agricultural sector exhibits a negative short-run and long-run relationship with the growth of tax-to-GDP ratio. Moreover, the empirical results demonstrate the significant negative effects of further trade openness or liberalization on tax revenue performance.

The positive effects of all main sectors of the economy namely, agricultural, industrial, and services sectors on the tax revenue performance is interesting. First, agriculture accounts for about two-thirds of total labour force but contributes less than one-third share in GDP. Moreover, agriculture is rated the hardest to tax of all hard to tax sectors mainly because of the small and spatial spread of the activity, absence of standard account keeping and the practice of payments not routed through the bank. However, despite all these impediments, the tax revenue effect of agriculture is substantial in both short-run and long run. The policy implication here is that an improvement of agricultural productivity, formalization, and linking agricultural production to value-added agro-processing in the industrial sector will widen the tax base, leading to even more tax revenue performance. However, it should be noted that, although taxing agriculture is central to the development and efficiency improvement of the tax system, there is a need for within-sector retention of resources raised from the sector for infrastructure, productivity improvement, and economic efficiency, which in turn, might raise tax revenue performance. Second, the share of the services sector in GDP is more than agriculture, and indeed is increasing despite the fact that the overall economy is still considered agrarian. Third, the country tends to transform from a largely agricultural economy to a more diversified, dynamic, and market-based economy. Further improvement of factor productivity in these sectors would broaden the tax base, which in turn increases tax revenue collections albeit with increasing an efficient system of tax collection. The fact that the industrial sector is usually assumed to be easier to tax, Tanzania is capable of generating substantially more tax revenue.

The other potential variables that are involved in this paper are development and recurrent public expenditures. The positive effects of both recurrent and development expenditures could be reinforced through the prudent use of funds. Similarly, international trade tends to be an important source of tax revenues in Tanzania. Trade facilitation and removing trade barriers are inclined to strengthen international trade taxes, import VAT, corporate taxes, and total tax revenue. However, trade policies should be designed and implemented with care because the relationship between trade liberalisation and total tax revenue is ambiguous. Further trade liberalization is likely to reduce international trade taxes, and subsequently total tax revenue because international trade taxes constitute a large share of total tax revenue.

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