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An Analysis of the Macroeconomic, Structural, and Institutional Factors Affecting Tax Revenue in Pakistan: Evidence from an ARDL Model

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Abstract

This paper investigates the key macroeconomic, structural, demographic and institutional determinants of Pakistan's tax-to-GDP ratio. The country continues to be financially constrained despite being relatively under-taxed, thus warrants a closer inspection of the tax determinants for the country. This research is followed time series data over the years from 1990 to 2024 was used in the study. The study employed the popular Autoregressive Distributed Lag (ARDL) bounds testing methodology to test for the presence of a long-run relationship and short-run dynamics among the series. The unit root tests indicate mixed levels of integration among the variables thus validating the use of the cointegration bounds test approach in the context. The study made three models to avoid the multicollinearity issues among variable. This allows the study to understand macroeconomic, structural and institutional factors. From the bounds test, the research found that there is a long-run relationship in all models. In the long run, levels of per capita income, level of democracy, inflation, control of corruption, labor force, male labor force and urbanization and have impacting positively on tax-to-GDP ratio. While the agriculture share in GDP, age dependency ratio and income inequality have negative effects. In the short run, the variables display persistent effects with adjustment to the long run. The diagnostic and stability tests indicate efficiency and stability of the models. The findings imply that strengthening the institutional framework, pursuing structural macroeconomic policy initiatives, and expanding the urban formal sector can help improve the country's tax potential in the long run.

JEL Classification: H20; H26; E62; O23; C22.

Keywords: Tax-to-GDP Ratio; Tax Revenue Mobilization; ARDL Bounds Testing; Structural Transformation; Institutional Quality; Pakistan; Fiscal Capacity

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1 Introduction

Pakistan has experienced difficulties in achieving a relatively low tax-to-GDP ratio relative to its fiscal needs. The scenario of Pakistan in comparison to many developing countries show the similar pattern. The ability of government to finance development projects with inadequate domestic resource mobilization hampers cushion the economy against external shocks. It reduces reliance on external borrowing. The problem is becoming more severe, especially over the last decade, since the government has been increasing public spending, running budget deficits, and increasing debt-servicing needs. Strengthening tax capacity is deemed necessary for long-term macroeconomic stability, fiscal independence, and good governance for countries like Pakistan, and thus, the element of importance of identifying the determinants of tax performance. While many studies have investigated the determinants of tax revenue, most Pakistan-specific studies have mainly relied on conventional macroeconomic indicators including income level, inflation, and trade openness. Less emphasis has been placed on the functions of the structural adjustment of the economy, in particular sectoral transformation and urbanization; institutional quality; and demographic factors, which jointly affect tax efficiency and administrative performance. Additionally, less effort has been made to empirically analyze the pace of adjustment of tax revenue in the context of recently developed time series techniques. Notably, empirical Pakistan studies have rarely incorporated the ARDL bounds testing approach and utilized the more updated data. This research paper makes a valuable addition to knowledge in this field in various respectful ways. First, in terms of methodology use, this paper deploys the bounds testing approach to co-integration was developed by (Pesaran et al. 2001). Which has been found to be particularly suitable for time-series variables with small sample sizes and of different levels of integration. Also, the paper develops alternative specifications of the model that allow for estimating the separate impacts of macroeconomic environment, structural factors and institutional and other demographic ones on tax proceeds, which enables in conjunction identification of the distinct pathways through which they actually impact the tax to GDP ratio. The empirical analysis is carried out on an up-to-date dataset, which combines regularly updated annual series from 1990 to 2024. To allow for capturing recent changes in Pakistani macroeconomic and fiscal setting. In addition, by employing the error-correction form of the ARDL model, this paper is able to explore both short-run adjustments and a long-run relationship in one framework affecting the tax-to-GDP ratio. The remainder of the paper is organized as follows. In Section 2, briefly review the theoretical and empirical literature. In Section 3 describe the data and some of the methodological issues. In Section 4 describe the empirical results and tests of model adequacy. In Section 5 we estimate the macroeconomic and institutional determinants of tax efficiency and discuss the policy implications of the results. Section 6 concludes the paper. Section 7 provides the policy recommendations and future perspective.

2 Literature Review

Existing studies that examine the determinants of tax revenues have explored this issue from various perspectives in the broader literature on public economics and development economics. In general, the determinants of tax capacity within a country rest on an interactive set of factors including economic structure, economic conditions and institutional strength. (Fauvelle-Aymar, C. 1999). Based on review of the literature, three major streams of research can be distinguished according to the dimensions of influencing forces on tax performance. Macroeconomic factors the formulation of any empirical analysis of tax performance in a macroeconomic context customarily underscores the importance of certain macroeconomic factors (Ibrahimov, O., Vancsura, L., & Parádi-Dolgos, A. 2025). In particular, income level, inflation and economic openness have been analyzed as significant contributors to tax revenues. There is a consensus view that a higher income has a positive impact on tax revenues due to a higher formalization and modernization process in the economy, which is associated with better administrative systems, higher levels of compliance, and an increased ability of work forces and consumers to produce and consume in compliance with the tax rules (Andrejovska, A., & Pulikova, V. 2018). This is general supported by literature by showing that a rise in GDP per capita leads to higher tax-to-GDP ratios as economies expand and taxation becomes more sustainable and efficient (Hussain, S., & Ilahi, N. (2016). The impact of inflation on tax revenues remains ambivalent (Beer, S., Griffiths, M., & Klemm, A. 2023). While inflation by raising price levels and personal incomes can generate direct increases in tax revenue in the presence of non-indexed tax schedules (Aaron, H. 1976). Extreme or persistent inflation reduces the real value of taxes due to a drag on real economic activity, erosion of assets and weakening of taxpayer incentives to comply. It also delays and distortions in the collection process. This has been explained with support of empirical studies on developing economies by the Olivera Tanzi effect (Anušić, Z., & Švaljek, S. 1996). However, there are mixed results because of conflicting effects of inflation and the influence of weak macroeconomic stability of a country (Tekdemir, N. 2025). Trade liberalization is frequently connected with improving the revenue performance of tax systems (Pupongsak, S. 2010). Greater integration into the world economy results in increased imports and exports (Haberler, G. 1964). Thus, it broader the base and also facilitates increased detection of transactions at border points. For many developing countries, trade taxes provided the bulk of government revenue (Tarschys, D. 1988). For various reasons, however, trade liberalization and the subsequent decline in tariff rates have made such sources less important in recent decades (Sowrov, S. M. 2024). It forcing governments to rely on other revenue sources. Whether trade liberalization enhances overall tax revenue depends on variables affecting the contribution of both the tax system and the economy. Changes in

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the structure of an economy, often a result of Structural Transformation, are also strongly correlated with the performance of a tax system (Campos, N. F., De Grauwe, P., & Ji, Y. 2025). The composition of sectors varies in its contribution to overall efficiency of taxation as well as the size of the formal tax base. As a rule of thumb, large agricultural sectors tend to be correlated with low levels of tax revenues (Şahin, A. Y. 2024). In many developing countries, agriculture due to its politicization, informal nature, dispersed location, and preponderance in rural areas has been relatively untaxed (Khan, M. H. 2001). Consequently, when the share of agriculture in the economy becomes large, the tax base remains underdeveloped (Deng, H. et al. 2023). However, the expansion of the industrial sector is more likely to be associated with an increased strength of tax collection (Challoumis, C. 2024). As industrial activities are carried out by more formalized enterprises (Skorková, Z. 2020). It becomes easier for the government to monitor activities and impose taxes, which can be monitored through business transaction records (Jensen, A. 2022). The expansion of industry will also promote a shift to wage employment, where tax collection can be done through the mechanism of taxes at source (Challoumis, C. 2024). Therefore, the empirical evidence from many studies indicates that an increase in the share of industry in the economy is to be though they are also associated with a rise in the tax-to-GDP ratio (Dahal, A. K. 2020). Modernization of the structure of production through developments in industry is thus another important factor for revenue performance (Soldak, M. O., & Shamileva, L. L. 2018). Urbanization is the second dimension of structural change that gains particular significance (Hussain, M., & Imitiyaz, I. 2018). When large migratory flows are experienced from rural to urban regions. The effectiveness of tax administration is enhanced because of increased compliance. It also higher costs for evasion and greater visibility of taxed activities in urban market centers. Consequently, urban increases are also found to be, in various studies. It is positively correlated with better tax performance in the developing countries (Andersson, P. F. 2018).

2.1 Institutions and Demographics

Aside from economic structure, the quality of institutions and demographic attributes can be important for tax effectiveness (Hussain, S., & Ilahi, N. 2016). Some of the most robust findings involve measures of corruption control (Picur, R. D., & Riahi-Belkaoui, A. 2006). Improvements in this area lead to more effective tax collection, less waste and corruption in tax administration and greater confidence in the state. Tax noncompliance and inefficient state capacity are explicitly linked to corruption in political economy models of fiscal development (Ricciuti, R., Savoia, A., & Sen, K. 2019). Empirical evidence confirms the strong relationship between governance and taxation (Liu, H. et al. 2023). Less corruption equates to higher levels of revenue-GDP ratios (Yohou, H. D. 2023). Similarly, other non-income variables such as political stability can impact the fiscal relationship (Amin, M. 2025). Economies with stable regimes ensure policy which make the economic strength to make it more stable. It often derives benefits of predictable enforcement. It also stimulates investment in institutions (Nunes, S. P. P., & Nunes, R. D. C. 2024). While the mirror image of it is instability can foster informality as well as undermine compliance which shrink the tax revenue capacity (Ackom, E. K., et al. 2025). Empirical work corroborates these results, finding a positive link in developing countries (Gnangnon, S. K. 2022). One further mechanism through which these demographics may have influence on tax revenue is through the size, structure and strength of the tax base (Mamun, A. A., et al.2014). Higher age dependency ratio will pull down on tax revenue (Ruggeri, J., & Zou, Y. 2007). As more people are outside of the formal labor market and non-contributing, reducing the tax base, and increasing pension and other government expenditure (Asher, M. G. 1996). Conversely higher level of labor force participation should buoy up tax revenue (Yıldırım, B., & Kuştepeli, Y. 2023). As labor force size and the tax base in income tax will be expanded and active participation in the formal economy will be promoted (Brückner, M., & Pappa, E. 2012). However, actual effects will depend greatly on the structure of the labor market (Attinasi, M. G., et al. 2016).

2.2 Literature gap

Literature Review Despite the existence of sizeable body of international literature on its various determinants. There are important gaps in the case of Pakistan. The international literature generally focused too much on the traditional macroeconomic growth variables neglecting the combined effects of structural change and institutional quality. Empirical applications for a comprehensive dynamic framework that could adequately capture the short term and long term dynamics of the tax revenue. This study, therefore, seeks to fill the literature gaps by including macroeconomic, structural, institutional and demographics factors in a united ARDL approach and sample data of Pakistan covering the period of 1990 to 2024.

3 Theoretical Framework

The examination of developing country tax performance is based on a number of related theoretical perspectives tax capacity theory, modernization theory, the political economy of taxation and fiscal sociology. All of which have a coherent intellectual logic for motivating the choice of macroeconomic, structural, institutional and demographic variables in this study (Berry, W. D., & Fording, R. C. 1997).

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3.1 Tax Capacity Theory

In the tax capacity theory, the country's capacity is constrained by the economic structure, level of income and administration (Fauvelle-Aymar, C. 1999). In the initial public finance literature, the growth of the GDP per capita facilitates the increase in the size of the tax base, the state of record-keeping efficiency and reduces the burden of the tax administration (Bird, R. M. 2015). Under this circumstance, the GDP per capita will positively influence the tax to GDP ratio (Dahal, A. K. 2020). Following the notion that increase in income will lead the state to have enhanced ability and capacity to tax (Di John, J. 2011). Likewise, sectoral structure is a significant determinant of tax capacity (Karagöz, K. 2013). For example, economies with larger agricultural shares have lower taxable capacity (Leuthold, J. H. 1991). Given that agriculture is characterized by a large informal sector and spread over a wide area. It is also subject to political influence (Charmes, J. 2012). Conversely, modernization of the industrial and urban sectors, owing to their higher formalization and observability (Kwilinski, A. 2018). It is thought to enhance ability to collect taxes. Demographic variables such as labor force participation and dependency ratios impact tax capacity by determining the potential tax base size (Yıldırım, B., & Kuştepeli, Y. 2023). Tax capacity theory therefore expects tax revenues to rise with structural revitalization and income growth (Le, T. M., et al. 2008).

3.2 Modernization Theory

In the perspective of modernization theory, fiscal development is associated with the process of economic and social transition (Chugunov, I., & Makohon, V. 2019). When a country develops from the traditional agriculture-centered economy into a modern, industrial and urban one, the tax base will generally increase (Hungerford, T. L. 2012). It becomes more monetized and more administrable (Dance, G. E. 2007). All these structural transitions should lead to improved tax effort and fiscal performance. Along this line of argument, urbanization and share of industry variables capture the transition toward a more modern economic structure (Oyelaran-Oyeyinka, B., & Lal, K. 2016). From the efficiency point of view, urban concentration is favorable to taxation due to higher population concentrations, better record-keeping and expanded participation in the formal economy (Henderson, J. V. 2003). Conversely, the larger the share of agriculture, the more traditional the structure will be and hence limited the fiscal capacity. Inflation is also relevant in this case because macroeconomic volatility will turn out to be a restraining factor for tax administration and revenue efficiency of developing countries (Edwards, S., & Tabellini, G. 1991). Accordingly, modernization theory provides a sound justification for the inclusion of structural transformation variables in the model (Goorha, P. 2010).

3.3 Political Economy of Taxation

The political economy explains the tax performance as a function of governance quality (Bekana, D. M. 2023). Institutional legitimacy (Saptono, P. B., & Mahmud, G. 2022). and state citizen relations as taxation is not a purely technical-economic activity (Arlen, G. 2022). As the political economy believes, one can expect the control of corruption to have positive effects on tax revenue (Dramane, A. 2022). It will contribute by lessening the leakages, increasing administrative efficiency, and by improving taxpayers' confidence. Lack of corruption leads to reduced tax evasion, administrative inefficiency, and deterioration of revenue (Winter, L. B., & Vozza, D. 2022). Political stability and the function efficiency of the state apparatus promote tax reforms, weaken tax evasion, and maintain the implementation capacity of taxation (Kebede, T. N. 2025). Unstable political climate causes the problem of restrictions in tax reform, weakening implementation, and undermining citizen compliance (Abodher, F. M., et al. 2025). Trade openness can also be viewed from the political economy angle, as it reflects different policy orientations, and global connectivity may lead to increased reshuffles in taxation (Fehling, P. 2023).

3.4 Fiscal Sociology

In a similar to manner, the academic tradition of fiscal sociology emphasizes the social and population distribution on taxation (Mannan, D. K. A., et al. 2023). Though tax systems can be characterized as existing within and responding to larger social structures. The effective capacity of the state to extract resources is determined by demographic composition, labor market participation, and urban rural differences (Qin, H. 2010). Expanding on this perspective, the age-dependency ratio and labor force participation ratios are important indicators because they ensure that a given nation has a larger effective tax base of working taxpayers (Pekarek, S. 2018). While urban and rural differences demonstrate a larger social infrastructure in which to monitor compliance (Andersson, P. F. 2018). Therefore, fiscal sociology suggests those factors that influence revenue performance are those that influence effective tax base of a nation (Martin, I. et al. 2009).

3.5 Synthesis

All in all, the aforesaid theoretical frameworks imply that the tax revenue performance for Pakistan is driven by a complex combination of economic growth, structural change, institutional strength, and population dynamics. The use of ARDL methodology in this paper makes it feasible to analyze these triangular influences in both the short and long run in a theoretically sound manner.

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This approach is designed to allow the study to capture the immediate adjustments as well as the long-term equilibrium relationships. Either it exists between tax revenue and its determinants or not. Economic growth expands the taxable base as well as the structural transformation of the economy (Tosun, M. S., & Abizadeh, S. 2005). Such as shifts from agriculture to industry and services. That alters the efficiency and capacity of tax collection (Grabowski, R. 2011). Institutional quality, including governance and control of corruption. The important point is here it influences the effectiveness of tax administration and compliance (Desta, T. 2022). At the same time, demographic factors like urbanization and age dependency ratios shape the tax base and government expenditure needs (Luo, W. 2023).

4 Methodology

4.1 Theoretical and Econometric Model

The theoretical framework of this study is based on the foundation that tax revenue performance is determined by economic development, institutional quality, structural transformation and demographic characteristics. As per the theory of tax capacity and fiscal performance. The ability of a government to mobilize tax revenue largely depends on the size of the taxable base. It is also based on the efficiency of institutions and structure of economic activities. Demographic composition of the population is one of the core factors of modern dynamics which ensue the fiscal base of a country. One side, literature and theory spark taxable income and consumption increases by economic growth. While on the other side structural transformation from agriculture to industry and services improves tax collection efficiency. This is because these sectors are relatively easier to monitor and regulate. The factors that enhance transparency and encourage tax compliance. Such as strong institutional quality, democratic governance and effective control of corruption. political stability is also in line with these factors. The tax base is also affected by demographic factors. This is including labor force participation, urbanization, and age dependency ratios. It enhances the capacity of the government in tax revenue generation. The tax-to-GDP ratio is used as a proxy for tax revenue performance. It is happily based on these theoretical considerations that several macroeconomic, institutional, structural and demographic variables are included as its potential determinants. The theoretical relationship can be expressed as:

$$TaxToGDP_t = f(GDPpc_t, Agriculture_t, Industry_t, Services_t, Inflation_t, Democracy_t, PoliticalStability_t, ControlOfCorruption_t, LFPR_t, GINI_t, Urbanization_t, ADR_t)$$

here

$TaxToGDP_t$ represents the tax-to-GDP ratio at time t. It is dependent variable. All other variables are independent variables like here $GDPpc_t$ shows GDP per capita. $Agriculture_t$, $Industry_t$, and $Services_t$ represent the sectoral configuration of the country. $Inflation_t$ captures macroeconomic stability, $Democracy_t$, $PoliticalStability_t$. $ControlOfCorruption_t$ represent institutional quality. $LFPR_t$indicates labor force participation rate. $GINI_t$ measures income inequality. $Urbanization_t$ reflects the share of urban population in total population. ADR_t represents the age dependency ratio. To empirically examine this relationship. The study employed the Autoregressive Distributed Lag (ARDL) modeling approach. The ARDL approach is particularly suitable when the variables included in the model are integrated of different orders, specifically I(0) and I(1). Here is very important point is that there should not be integrated of order two any variable (Pesaran, M. 2001). As it facilitates the estimation of both short-run dynamics as well as long-run relationships in one framework. This is the advantages of the ARDL technique. Furthermore, it accomplishes well with relatively small sample sizes and helps discourse potential endogeneity issues among explanatory variables.

The following form of general ARDL model is applied in this study. This can be expressed as.

$$TaxToGDP_t = \alpha_0 + \sum_{j=0}^{q} \beta_j X_{t-j} + \varepsilon_t$$

where shows a vector of explanatory variables. It is including GDP per capita, sectoral composition variables, institutional indicators and demographic factors. To test for the given the existence of a long-run relationship between the variables the ARDL bounds testing methodology is employed. The lag lengths are selected based on information criteria. Such as the Akaike Information Criterion (AIC) to ensure an optimal model specification. This test involves estimating an unrestricted error correction model and computing an F-statistic to examine the joint significance of the lagged level variables. If the computed the value of the F-statistic is larger than the one specified as the upper critic value. Thus, the study can reject the null hypothesis of no cointegration. The study can conclude there is a stable long-run equilibrium relationship among the variables. Once cointegration is confirmed, the long-run coefficients are estimated and the Error Correction Model (ECM) is derived to capture the short-run dynamics of the model. The ECM specification can be written as:

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$$\Delta TaxToGDP_t = \alpha_0 + \sum_{j=0}^{q} \beta_j \Delta X_{t-j} + \lambda ECT_{t-1} + \varepsilon_t$$

where Δ denotes the first difference operator, $_{-1}$is the lagged error correction term obtained from the long-run equation, and represents the speed of adjustment toward the long-run equilibrium. A negative and statistically significant coefficient of the error correction term indicates the stability of the long-run relationship and indicates how quickly deviations from equilibrium are corrected over time. To ensure the reliability and validity of the estimated ARDL model several diagnostic tests are conducted. These tests include serial correlation test, heteroskedasticity test, normality test and functional form specification test. To verify whether the coefficients remain stable over the sample period Stability test is conducted. The estimated parameters are examined through the CUSUM and CUSUM of Squares (CUSUMSQ) tests. Variance inflation factors (VIF) are assessed to detect potential multicollinearity among the explanatory variables. To confirm that the estimated relationships are statistically sound and economically meaningful. These diagnostic and stability tests are important. By ensuring model adequacy and robustness. The empirical results provide more reliable evidence regarding the determinants of tax revenue generation. The selection of appropriate lag lengths is crucial in the ARDL framework. It is based on Akaike Information Criterion (AIC). Lags are selected automatically by STATA software. It captures the dynamic adjustments among the variables over time. The optimal lag structure helps avoid problem of autocorrelation. It also helps to identify the model misspecification. Additionally, this research confirms that all variables are not integrated of order two, given that the bounds testing procedure of the ARDL method is not applicable in the existence of I(2) variables. Therefore, unit root tests such as the Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests are applied prior to model estimation to determine the order of integration of each variable. Furthermore, once the order of integration of the variables is confirmed. To be either I(0) or I(1). The ARDL bounds testing procedure has been used to investigate the presence of long run equilibrium relationship among the variables. The computed F-statistic is compared with the critical bounds values to determine whether cointegration exists between tax revenue performance and its determinants. If the calculated F-statistic surpasses the upper bound critical value. The null hypothesis of no long-run relationship is rejected. This is indicating the presence of cointegration. In this case, the long-run coefficients and the associated error correction model (ECM) are estimated. The error correction term describes the speed of adjustment of the short-run deviations from the long-run equilibrium. A negative coefficient and statistically significant of the error correction term ensures the stability for the long-run relationship.

5 Results and Discussion

5.1 Descriptive statistics

Table 1: ***Descriptive Statistics***

Variable	Obs	Mean	Std. Dev.	Min	Max
year	35	-	-	1990	2024
TaxtoGDP	35	9.923	1.476	8.4	13.7
Log(GDPpc)	35	6.71	.518	5.842	7.358
Agriculture	35	22.777	1.328	19.938	25.387
Industry	35	20.3	1.711	17.159	22.931
Inflation	35	9.566	5.651	2.529	30.768
Level of Democracy	35	.3368	.0759248	.17	.47
Political Stability	35	-1.842	.588	-2.41	1.105
Control of corruption	35	-1.059	.301	-1.865	.802
LFPR_total	35	50.152	1.42	46.56	53.78
MLFPR	35	80.445	2.666	72.897	84.89
FEMLFPR	35	18.478	3.917	11.31	25.23
GINI	35	36.346	4.356	30.6	42.9
Age dependency ratio	35	80.745	7.964	69.393	92.115
Urban population	35	34.471	2.33	30.753	39.173

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Table 1 shows the descriptive statistics of the variables used in the analysis over the period 1990–2024. The tax-to-GDP ratio averages is 9.92 percent. The standard deviation is 1.48. This is indicating moderate variability in tax revenue performance of Pakistan. The ratio ranges from 8.4 percent to 13.7 percent. It is reflecting persistent challenges in domestic revenue generation. The mean of natural logarithm of GDP per capita is 6.71. This shows a steady rising trend in income levels during the period of study. Composition of sectoral dynamics indicates that agriculture accounts for mean value 22.78 percent of GDP. Industry shows the mean value is 20.3 percent of GDP. This is actually highlighting the continued importance of the agrarian sector. This is alongside partial industrial development. Inflation mean is 9.57 percent. It shows considerable instability with maximum 30.77 percent. This is representing macroeconomic uncertainty. Institutional indicators reveal comparatively weak governance conditions. The mean of political stability is −1.84. While the mean value of control of corruption is −1.06. Both the variable is reflecting governance challenges during the study period. The level of democracy shows partial variation with a mean of 0.337. This is signifying gradual but modest democratic development. Labor market factors show that total labor force participation mean value of 50.15 percent. Male participation rate is 80.45 percent. It is considerably higher than female participation 18.48 percent. This is showing significant gender inequalities in economic activity. The age dependency ratio is comparatively high at 80.75. It is implying demographic pressure on the productive population. Income inequality is measured by the Gini coefficient. Its averages value is 36.35. This is representing reasonable inequality. The mean of Urban population is 34.47 percent. It is reflecting gradual but incomplete urban transition of Pakistan. Looking at the overall the descriptive statistics show meaningful variation across macroeconomic, structural, institutional, and demographic factors. This is supporting the suitability of econometric analysis for the dataset for time-series.

5.2 Correlation matrix

Table 2: ***Pairwise Correlation***

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) TaxtoGDP	1.000														
(2) ln_gdppc	0.622	1.000													
(3) Agriculture	-0.148	-0.370	1.000												
(4) Industry	0.548	0.471	0.185	1.000											
(5) Services	0.700	0.760	-0.313	0.841	1.000										
(6) Inflation	0.511	0.147	-0.138	0.416	-0.084	1.000									
(7) lodemo	0.439	0.416	-0.142	0.381	-0.031	0.235	1.000								
(8) PolStab	0.591	0.488	0.439	0.189	0.672	-0.103	0.645	1.000							
(9) corr	0.689	0.704	-0.166	0.623	0.358	-0.144	0.060	0.853	1.000						
(10) lfpr	0.585	0.339	0.138	0.150	0.197	0.190	0.071	0.244	-0.305	1.000					
(11) malfpr	0.566	0.583	0.314	0.138	0.531	-0.446	-0.451	0.665	-0.470	0.819	1.000				
(12) felfpr	0.588	0.452	-0.204	0.322	0.613	-0.011	0.473	0.788	-0.624	0.882	-0.712	1.000			
(13) gini	-0.466	-0.610	0.117	-0.003	-0.239	-0.402	-0.696	0.641	0.267	-0.274	0.629	-0.633	1.000		
(14) Urban	0.677	0.630	-0.220	0.420	0.817	0.283	0.780	0.679	-0.572	0.398	-0.752	0.754	-0.708	1.000	
(15) ADR	-0.725	-0.679	0.342	-0.377	-0.703	0.239	-0.438	-0.652	0.587	-0.367	0.794	-0.638	0.758	-0.748	1.000

Table 2 provides the correlation matrix for the variables consider during the study period. The results show that the tax-to-GDP ratio has a strong positive correlation with services 0.700. It also has significant correlation with urbanization and Control of corruption 0.677 0.689 respectively. This is signifying that spread of the service sector and growing urbanization are related with better tax revenue generation in Pakistan. Improvements in institutional quality also matter significantly. both the variables GDP per capita 0.622 and political stability 0.591 are also indicate a positive and strong association with the tax-to-GDP ratio. This is implying that economic development and stable governance structures may contribute to stronger revenue mobilization. On the other hand, the tax-to-GDP ratio exhibits a negative correlation with the age dependency ratio -0.725 and income inequality measured by the Gini coefficient -0.466. It is indicating that higher demographic dependency and greater inequality may weaken the capacity of government to generate tax revenue. The agriculture sector also shows a weak negative relationship with tax revenue performance -0.148. Which is consistent with the argument

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that agricultural activities are relatively difficult to tax in developing economies. Among the explanatory variables. Some relatively high correlations are observed. Such as between services and industry 0.841 and urbanization and democracy 0.780. This is reflecting the structural transformation and institutional linkages within the economy. However, most correlation coefficients remain below the commonly used multicollinearity threshold. This is indicating that the problem of severe multicollinearity is not expected to be a serious issue in the empirical estimation.

5.3 Unit root results

Table 3: ***Stationarity Test***

	ADF				**PP**				**Final**
Variable	**Level**	**Spec.**	**Δ**	**Spec.**	**Level**	**Spec.**	**Δ**	**Spec.**	**Order**
TaxtoGDP	-3.389***	C	-8.852***	C	-4.381***	C	-9.062	C	**I(0)**
Log (GDPpc)	-0.684	C+T	-4.133**	C	-1.807	C+T	-7.049***	C	**I(1)**
Agriculture	-2.753	C+T	-3.614***	C	-2.144	C+T	-4.214***	C	**I(1)**
Industry	-2.352	C+T	-3.727***	C	-2.303	C+T	-5.878***	C	**I(1)**
Services	-1.172	C+T	-2.625***	C	-1.140	C+T	-5.066***	C	**I(1)**
Inflation	-2.299	C	-3.077***	C	-2.977	C	-5.600***	C	**I(1)**
Level of democracy	-2.567	C	-1.730**	C	-1.558	C	-3.369**	C	**I(1)**
Political Stability	-1.431	C	-3.975***	C	-0.619	C	-4.807***	C	**I(1)**
Control of Corruption	-3.797***	C	-3.827***	C	-2.472***	C	-8.591***	C	**I(0)**
LFPR	-3.237***	C	-4.028*	C	-7.829***	C	-17.413***	C	**I(0)**
MLFPR	-5.001***	C	-6.920***	C	-5.007***	C	-9.257***	C	**I(0)**
FMLFPR	-1.217	C	-2.197**	C	-2.395	C	-13.663***	C	**I(1)**
Gini	-4.860***	C	-2.736*	C	-4.252***	C	-5.354	C	**I(0)**
Urban Population	-0.612	C+T	-4.331***	C	-2.298	C+T	-6.553***	C	**I(1)**
Age Dep. Ratio	-3.364***	C	-0.831	C	-3.430**	C	-0.807	C	**I(0)**

Significance Levels *** $p < 0.01$ ** $p < 0.05$ *$p < 0.10$

Table 3 reports the results of the Augmented Dickey Fuller (ADF) and Phillips Perron (PP) unit root tests is used. To examine the stationarity properties of the variables. Establishing the order of integration is essential for selecting an appropriate econometric methodology. The findings indicate that most variables including TaxtoGDP, log(gdppc), Agriculture, Industry, Services, Inflation, Level of Democracy, Political Stability, FMLFPR, Gini, Urban Population, and Age Dependency Ratio are non-stationary at levels but stationary after first difference. These variables are thus integrated of order one, I (1) In contrast, Control of Corruption, LFPR, and MLFPR are found to be stationary at level. This is implying integration of order zero, I(0). Prominently, none of the variables is integrated of order two, I(2). Which satisfies the key precondition for applying the ARDL bounds testing approach. The presence of a mixed order of integration. As some variables I(0) and others I(1). It provides further justification for using the ARDL framework. As it is specifically designed to handle such cases in small sample time series analysis. In general, the unit root results confirm the econometric suitability of the dataset for ARDL estimation and subsequent cointegration analysis. By incorporating these diverse yet interconnected factors. The ARDL framework provides the detailed analysis of the composition and determinants of Pakistan tax revenue of Pakistan. Subsequently, the empirical results derived from this model can offer meaningful policy insights for improving fiscal capacity. Which is also strengthening revenue mobilization in the country.

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5.4 ARDL bounds test

In this study, the Autoregressive Distributed Lag (ARDL) bounds testing methodology is used to examine. Whether a long-run equilibrium relationship (cointegration) exists between the tax-to-GDP ratio and its key determinants. The ARDL methodology is developed within the framework of time series econometrics. This is particularly suitable for empirical analysis when the variables are integrated of different orders. Specifically, I(0) and I(1), but not I(2). Since the unit root tests conducted earlier in the study indicate that the variables are either stationary at level or become stationary after first differencing. The ARDL bounds testing approach provides an appropriate and reliable framework for investigating long-run relationships among the variables. The fundamental objective of the bounds test is to determine whether the dependent variable and the explanatory variables move together over time. Thus, forming a stable long-run relationship. In the ARDL framework, this is achieved by estimating an unrestricted error correction model. It is also computed an F-statistic to test the joint significance of the lagged level variables. The null hypothesis of the bounds test is that there is no long-run relationship among the variables. While on the other hand, the alternative hypothesis suggests the presence of cointegration. The calculated F-statistics for the three estimated models in this study are 7.584, 15.32 and 21.93 respectively for Model 1,2 and 3. These values are compared with the critical bounds' values. These values are provided in the ARDL bounds testing framework. If the computed F-statistic exceeds the upper critical bound. The null hypothesis that there is no cointegration. It is rejected. This is representing the existence of a long-run association among the variables. In this study, the computed F-statistics for all three models are significantly higher than the upper bound critical values at the 1 percent significance level. It provides strong statistical evidence against the null hypothesis. Null hypothesis is rejected. This means that cointegration exists among the tax-to-GDP ratio and its explanatory variables. This exhibits that despite short-run fluctuations. There is a stable long-run equilibrium relationship over time among variables. This finding is particularly significant. This is because it proposes that macroeconomic variables, structural features of the economy, institutional quality as well as demographic dynamics. This is collectively influencing the long-term performance of tax revenue in Pakistan. Changes in these determinants may lead to temporary deviations in tax revenue performance in the short run. The system ultimately adjusts and converges toward a path of stable long-run equilibrium. Furthermore, the presence of cointegration has important implications for the subsequent stages of empirical analysis. Once a long-run relationship is established through the bounds test. It becomes econometrically valid to estimate the long-run coefficients of the ARDL model as well as the short-run dynamics through an Error Correction Model (ECM). The ECM framework allows the study to capture over the time how quickly short-run deviations from the long-run equilibrium are corrected. The inclusion of the error correction term provides valuable insights into the speed of adjustment. It is through which the tax-to-GDP ratio returns to its equilibrium level following short-run shocks. Generally, the results of the ARDL bounds test confirm the existence of a robust and stable long-run equilibrium association among the tax-to-GDP ratio and its determinants across all model specifications.

5.5 Long-run estimates

Table 4 ARDL Long-Run Estimates

Variables	Model 1	Model 2	Model 3
log(GDPpc)	3.013***	3.726***	3.686***
	[3.13]	[4.37]	[3.64]
Agriculture	−0.1826*	-	−0.1673**
	[−1.69]	-	[-2.04]
Industry	0.2143**	0.1614**	-
	[2.50]	[2.92]	-
Services	-	-	0.25281
	-	-	[1.33]
Inflation	0.0877**	0.1149**	0.1036***
	[2.45]	[2.22]	[3.69]
Level of Democracy	-	-	8.080**

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	-	-	[2.06]
Political Stability$_t$	-	1.5253**	-
	-	[2.70]	-
Control of Corruption	1.4467**	-	1.3514**
	[2.93]	-	[2.32]
LFPR	0.2155**	-	-
	[3.23]	-	-
MLFPR	-	0.2815**	-
	-	[2.85]	-
FMLFPR	-	-	0.1161
	-	-	[1.78]
GINI	-	−0.1882***	−0.14735***
	-	[−4.07]	[−4.91]
Urbanization	.2727**	-	-
	[2.01]	-	-
Age dependency ratio	−.1374	-	-
	[− 1.71]	-	-
Constant	6.3156	-	8.9595
	[0.31]	-	[1.52]
Observations	33	33	33
R^2	0.79	0.81	0.86
Bounds F-stat	7.584	15.32	21.93

Significance Levels *** p < 0.01 ** p < 0.05 *p < 0.10

Table 4 reports the long-run estimates obtained from the ARDL models, which examine the relationship between the tax-to-GDP ratio and its macroeconomic, structural, institutional, and demographic determinants in Pakistan. The results are presented across three different model specifications in order to check the robustness of the estimated relationships. Overall, the findings suggest that economic development, institutional quality, labor market dynamics, and demographic characteristics play an important role in shaping the long-run performance of tax revenue in Pakistan. A key finding across all three models is the positive and highly significant coefficient of GDP per capita. The estimated coefficients of 3.013, 3.726, and 3.686 in Models 1, 2, and 3 respectively are statistically significant at the 1 percent level. This is representing that higher levels of economic development significantly enhance tax revenue generation. This result indicates that as income levels rises. The ability of the government to generate tax revenue also increases. Higher income per capita spreads the tax base via enlarged economic activity. It betters compliance capacity. It also makes greater formalization of the economy. The results are in line with the theoretical connection with economic growth. It would imply stronger fiscal capacity. higher tax collection. The findings of the study show the important role of structural transformation of the economy structure. There is negative coefficient of the agriculture sector in both Model 1 and 3. The values of the models are −0.1826 and −0.1673 respectively. The coefficients of these models are significant at statistical level. This is proposing that a greater share of agriculture in the economy is the reason to decline the tax-to-GDP ratio over the time. The findings of the study echo the structural challenges are in connection with taxing the agricultural sector in developing economies. As in the developing economies the production line is frequently informal, fragmented, and hard to regulate. On the other side, the industrial sector shows a

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significantly positive outcome in Models 1 and 2. The coefficients of models are 0.2143 and 0.1614 respectively. This directs that the share of industry in GDP contributes positively to tax revenue generation. As industrial activities are more formalized and show to be easier to tax. The services sector (contained in Model 3) also gives a positive coefficient 0.2528. However, it is not statistically significant at the usual levels. Despite this, the sign is positive. This implies that service expansion may help to enhance tax revenue performance in the long term. Inflation is positive and statistically significant good to apply to the ratio of tax to GDP derived from all three models, with estimated 0.0877, 0.1149, and 0.1036. This suggests that relatively moderate pattern of price increases can stimulate nominal tax revenues. It may be that the inflation effect is actually the reverse of the Tanzi Olivera effect where inflation boosts nominal income and consumption. It increases the nominal level of tax collections. However, the size of this effect is dependent on the composition and effectiveness of the tax system. Other institutional factors may be also directly responsible for determining tax revenue performance. In Model 3. the level of democracy has a large positive coefficient of 8.080. It is statistically significant. This suggests that democratic governance may strengthen fiscal institutions. It may improve transparency. It can enhance public trust in government. Thus, this promotes tax compliance. Similarly, political stability, included in Model 2, shows a positive and statistically significant coefficient of 1.5253. Political Stability (Public Order) that is covered in Model 2 exhibits a coefficient which is positive and statistically significant. of 1.5253. This indicates that having a stable political environment enables efficient tax management and policy design for long-term. Control of corruption show positive and significant impact on tax revenue generation in Models 1 and 3. Its coefficients of 1.4467 and 1.3514. This imply that the existence of stronger anti-corruption measures and better governance. It improves the effectiveness of revenue collection. It reduces evasion of tax. Labor market variables seem to have a positive impact on tax revenue generation. The overall labor force participation rate (LFPR) in Model 1 presents a statistically positive and significant coefficient. The value of coefficient is 0.2155. This is signifying that higher participation in economic activities and indicating an uptrend in all labor market activities. It shows an expansion in the taxable income structure. As well, the male labor force participation rate (MLFPR) in Model 2 shows a positive and statistically significance value of 0.2815. This implies that the productivity of working age group households in taxable can potentially lift up revenue collection rates. Moreover, the female labor force participation rate (FMLFPR) in Model 3 presents a positive coefficient. However, there is not enough statistical evidence to support this result. Although, a positive sign recommends the strength of female participation in expanding the tax base over time. Further results also reveal the interesting impact of income inequality and demographic factors. The Gini coefficient. It is a measure of income inequality. It has a negative and highly significant coefficient in Models 2 and 3. The estimated values of -0.1882 and -0.1473. This proposes that higher levels of inequality in the economy tend to reduce the level of tax-to-GDP ratio. This may occur because unequal income distribution usually causes to lower level of tax compliance. This is also implied that greater political resistance to the adoption of more progressive tax system. Turning to the Model 1. urbanization has a positive and highly statistically significant coefficient. The value of coefficient is 0.2727. This is indicating that a greater share of urban population generally supports the effective level of tax revenue generation. Urban areas typically have higher levels of economic activity and transmission of transactions. It has more robust tax administration systems and better documentation of transactions. All of which facilitate tax collection. On the other hand, the age dependency ratio shows a negative coefficient in Model 1. It means that more dependents would culminate in the decrease of total effective tax base. Although the coefficient is not statistically significant. The long-run results indicate that economic growth, structural transformation, institutional quality, and demographic dynamics jointly figure the long-term behavior of tax revenue generation in Pakistan overall. The comparatively high R^2 values of 0.79, 0.81, and 0.86. The value of R^2 across the all three models indicate that studied variables account for most of the changes in the tax to GDP ratio. In addition, the bounds F-statistics reported for each model approve that there exists of a stable long-run relationship. This is validating the use of the ARDL framework. These findings suggest that policies measures promo ting economic growth, solid governance, active labor market participation. This is also supporting structural transformation of the economy. That can be important in improving tax revenue performance of Pakistan in the long run. Moreover, the findings also suggest that sustainable enhancement in fiscal capacity may not be achieved through short-term fiscal policies alone. This may call for a package of macroeconomic and institutional reforms. Institutional reforms such as improvement in transparency, reduction in corruption and administrative efficiency may raise the confidence of public to the tax system. It would in turn may trigger voluntary compliance. Institutional reforms underpinned by industrialization, urban development, and formalization of economic activities can expand the taxable base simultaneously. Demographic factors such as labor force participation and population structure also increase the presentation of taxable income leading to augmentation in revenue mobilization. Therefore, a comprehensive policy framework for long-term augmentation in the sustainability of fiscal capacity that integrates economic, institutional, and demographic considerations. It is the key to the development of long term improvements. in fiscal capacity and revenue generation of Pakistan. Consistent macroeconomic stability and vibrant macroeconomic and fiscal policy coordination may further anchor fiscal sustainability.

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5.6 Short-run ECM results

Table 5: ***Short-Run Error Correction Model***

Variables	Model 1	Model 2	Model 3
ΔTaxtoGDP$_{-1}$	0.472**	0.391**	0.438**
	[3.82]	[2.41]	[3.27]
Δlog(GDPpc)	2.753**	2.891**	3.9610***
	[2.59]	[2.80]	[2.85]
Δlog(GDPpc)$_{-1}$	3.075**	2.991**	3.9610***
	[2.63]	[2.83]	[2.85]
ΔAgriculture	−0.0272	-	−.0648
	[−0.19]	-	[−0.18]
ΔIndustry	0.1520	0.1810*	
	[0.73]	[1.81]	
ΔIndustry$_{-1}$	0.2442**	0.3223**	
	[2.343]	[2.81]	
ΔServices	-	-	.2528**
	-	-	[2.33]
ΔInflation	0.0538**	0.095**	.06211***
	[2.39]	[2.76]	[3.54]
ΔLevel of Democracy	-		5.24
	-		[1.35]
ΔPolitical Stability	0.3253	0.2502	
	[0.43]	[0.85]	
ΔControl of Corruption	1.3447*		1.0429
	[1.85]		[1.03]
ΔLFPR	0.344**		
	[2.68]		
ΔLFPR$_{-1}$	0.2457		
	[1.28]		
ΔMLFPR	-	0.1581	
	-	[1.74]	
ΔMLFPR$_{-1}$		0.1834	
		[1.24]	

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Variables	Model 1	Model 2	Model 3
ΔFELFPR	-		.3622***
	-		[3.00]
ΔGINI	-	−0.103	
	-	[−1.24]	
ΔUrbanization	.1347		
	[0.91]		
$\Delta Urbanization_{-1}$	.1705**		
	[2.47]		
ΔAge dependency ratio	−.1867		
	[−1.71]		
ECT(−1)	−0.2785**	−0.2343**	−0.2973**
	[−2.10]	[−2.40]	[−2.91]
Adj. R^2	0.714	0.74	0.81
F-statistic	30.24	22.67	28.78

Significance Levels *** p < 0.01 ** p < 0.05 *p < 0.10

Table 5 provides the short-run dynamics adjustment parameters estimated through the Error Correction Model (ECM). This is obtained from the ARDL framework. The ECM estimates the short-run dynamics of the tax-to-GDP ratio in response to the short-run changes in the determinants of revenue generation. This is also incorporating the error correction term (ECT). It measures the speed at which deviations from short-run disequilibrium to the long-run level. The presence of a statistically significant and negative error correction term confirms the existence of the ARDL bounds test for a long run relationship to the tax-to-GDP ratio. The coefficient of the lagged dependent variable (ΔTaxtoGDP_(t−1)) is positive and statistically significant. The results across all three models are significant. With values of 0.472, 0.391, and 0.438, respectively. This indicates that previous change in the revenue performance affects the current revenue flows. This is reflecting inertia in fiscal performance and corresponding to how persistent changes to the tax-to-GDP ratio are. In the short run, economic growth continues to play a crucial role in determining tax revenue performance. The change in GDP per capita (Δlog(GDPpc)) is positive and statistically significant in all three models. The estimated coefficients suggest that an increase in income per capita leads to an immediate improvement in the tax-to-GDP ratio. This relationship reflects the expansion of the taxable base as economic activity increases. Furthermore, the lagged change of GDP per capita is also significant. This is indicating that the effects of economic growth on tax revenue extend beyond the current period. It is continued to influence revenue performance in subsequent periods. With respect to the sectoral composition of the economy. The results show mixed short-run effects. The agriculture sector does not exhibit a statistically significant short-run impact on the tax-to-GDP ratio. Which may reflect the persistent difficulties associated with taxing agricultural activities in Pakistan. On the opposites side, the industrial sector shows a positive and significant lagged effect in Models 1 and 2. This is indicating that industrial expansion contributes to higher tax revenue with a short time lag. Likewise, the services sector in Model 3 has a positive and statistically significant coefficient. This is suggesting that growth in the services sector can quickly translate into higher tax revenues in the short run. Inflation also appears to influence tax revenue performance in the short run. The coefficients of ΔInflation are positive and statistically significant across all models. This is implying that increases in the price level may temporarily raise nominal tax revenues through higher taxable income and consumption values. This finding suggests that moderate inflation can have a short-run revenue-enhancing effect. Even though such gains may depend on the responsiveness and efficiency of the tax system. Institutional variables exhibit varying short-run effects. While the change in political stability is positive. It is not statistically significant in the short run. This is indicating that improvements in political stability may take longer to influence revenue collection. Also, the control of corruption shows a positive but relatively weak short-run impact. However, the positive sign on the coefficients highlight that reforms in the quality of in governance and institutional quality can contribute to better tax performance in

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the long term. Labor market indicators also determine short-run revenue momentum. In Model 1, the labor force participation rate (LFPR) shows a positive and statistically significant coefficient. This is indicating that greater participation in economic activities increases the short-term tax base. In Model 2, the male labor force participation rate (MLFPR) has a positive effect. Although it is significant. It is also relatively weaker. On the other hand, the female labor force participation rate (FELFPR) in Model 3 is positive and highly significant. It is suggesting that increased female participation in the labor market can contribute meaningfully to tax revenue generation. This is in the short run. The results further show that income inequality and demographic factors have limited short-run effect on tax revenue performance. The coefficient of GINI is negative. It is statistically insignificant in the short run. This is implying that the effects of inequality on tax revenue may occur more strongly in the long run. Likewise, urbanization shows a positive and mostly insignificant contemporary effect. Although its lagged value becomes significant in Model 1. This is suggesting that urban expansion gradually strengthens the capacity for tax collection. The age dependency ratio indicates a negative coefficient. This is representing that a higher share of dependent population may place compression on the productive tax base. A crucial module of the ECM results is the error correction term (ECT_{t−1}). Which is negative and statistically significant across all three models. The estimated coefficients of −0.2785, −0.2343, and −0.2973. This implies that around 23 to 30 percent of the short-run imbalance is corrected each year. This indicates that when tax revenue diverges from its long-run equilibrium level. The adjustment process gradually restores balance over time. The negative and significant ECT coefficients ensure the stability of the long-run relationship between tax revenue and its factors.Finally, the overall performance of the short-run models seems acceptable. The adjusted R^2 values of 0.714, 0.74, and 0.81. It suggests that the models explain a significant share of the short-run variation in the tax-to-GDP ratio. Furthermore, the F-statistics indicate that the models are jointly significant. This is confirming the explanatory influence of the selected variables.

Generally, the short-run results highlight that economic growth, inflation, sectoral dynamics and labor market participation. They are key drivers of short-term changes in tax revenue performance. Although institutional and demographic variables tend to exert stronger effect in the long run. The large error correction process also provides evidence that shocks are continuously driven back to equilibrium. It is ensuring stability in the relationship between tax revenue and its underlying factors. These results point toward that short term revenue generation process is sensitive to instable macroeconomic conditions. It is also affected by sluggish labor market activity. Temporary demand or supply shocks can exert short-term effects on tax revenue. The error correction mechanism confirms the convergence toward the long-run trend. Therefore, maintaining stable macroeconomic policies and promoting complete labor market participation can help strongly. These constraints can be identified as the short-run system of tax revenue responsiveness of Pakistan. This allows the study to tease out long-run structural effects versus short run. dynamic adjustments in tax revenue performance.

Furthermore, these findings highlight the importance of strengthening fiscal institutions to improve the responsiveness of the tax system to economic fluctuations. Reforms towards broader tax base may insulate the tax system from its narrow provenance. Reforms that broaden the tax base and reduce dependence on narrow sources of taxation can further strengthen the resilience of the tax system. Thus, policy measures aimed at improving macroeconomic stability and institutional capacity can catalyze to sustainable growth of tax revenue in Pakistan. In addition to this, strengthening documentation of the economy and reducing informality can further strengthen the efficiency of the tax system. These steps would enhance the ability of the government to mobilize domestic resources. This could also lead to long-term fiscal sustainability. Finally, the consistent economic growth and structural reforms can make better the elasticity of the tax system in long term. This would ultimately reinforce the capacity of the government to finance public expenditures and development projects.

5.7 Diagnostic Tests Results

5.7.1 Diagnostic test for validity of Model 1

1. Variance inflation factor

	VIF	1/VIF
Log(gdppc)	7.696	.129
Urbanpopulation	5.859	.171
Agedependencyratio	4.367	.228
Controlofcorruption	2.787	.359
Industry	2.629	.38
Inflation	2.232	.448

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Agriculture	1.657	.603
lfpr	1.344	.744
Mean VIF	3.57	.

2. Serial Correlation Test

Breuschâ€“Godfrey LM test for autocorrelation chi2	df	Prob>Chi2
2.757	1	0.097

H0: no serial correlation

3. Heteroskedasticity Test

Breuschâ€“Pagan/Cookâ€“Weisberg test for heteroskedasticity

Assumption: Normal error terms

Variable: Fitted values of D.TaxtoGDP

H0: Constant variance

chi2(1) = 0.04

Prob > chi2 = 0.8385

4. Normality Test

Skewness and kurtosis tests for normality

----- Joint test -----

Variable	Obs	Pr(skewness)	Pr(kurtosis)	Adj	chi2(2)	Prob>chi2
ehat	33	0.800	0.708	0.200	0.903	

5. Ramsey Reset Test (Model Specification)

Ramsey RESET test for omitted variables

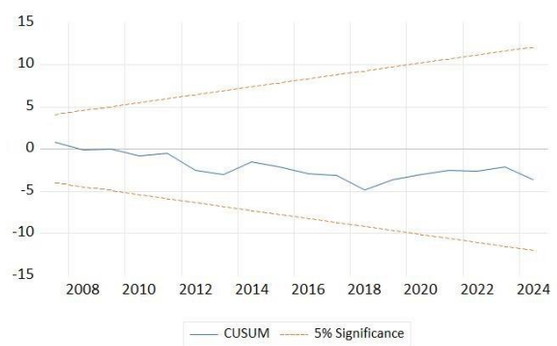
Omitted: Powers of fitted values of D.TaxtoGDP

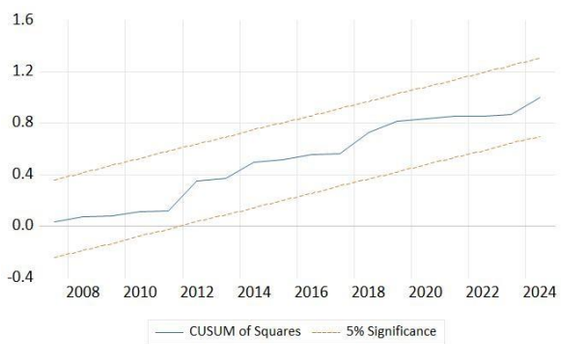
H0: Model has no omitted variables

F(3, 15) = 1.85

Prob > F = 0.1812

6. CUSUM/CUSUMSQ Stability Test





5.7.2 Diagnostic test for validity of Model 2

1. Variance inflation factor

	VIF	1/VIF
log(gdppc)	7.707	.13

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Politicalstability	6.807	.147
gini	5.783	.173
Industry	5.255	.19
mlfpr	3.911	.256
Services	3.862	.259
Inflation	2.77	.361
Mean VIF	5.15	.

2. Serial Correlation Test

Breuschâ€“Godfrey LM test for autocorrelation chi2	df	Prob>Chi2
0.106	1	0.745

H0: no serial correlation

3. Heteroskedasticity Test

Breuschâ€“Pagan/Cookâ€“Weisberg test for heteroskedasticity

Assumption: Normal error terms

Variable: Fitted values of D.TaxtoGDP

H0: Constant variance

chi2(1) = 0.94

Prob > chi2 = 0.3330

4. Normality Test

Skewness and kurtosis tests for normality

----- Joint test -----

Variable	Obs	Pr(skewness)	Pr(kurtosis)	Adj	chi2(2)	Prob>chi2
ehat	33	0.596	0.850		0.320	0.854

5. Ramsey Reset Test (Model Specification)

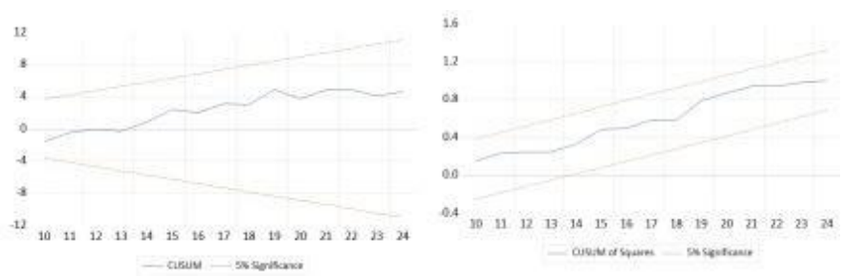
Ramsey RESET test for omitted variables

Omitted: Powers of fitted values of D.TaxtoGDP

H0: Model has no omitted variables

F(3, 20) = 0.65

Prob > F = 0.5947



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6. CUUM/CUSUMSQ Stability Test

5.7.3 Diagnostic test for validity of Model 3

1. Variance inflation factor

	VIF	1/VIF
log(gdppc)	7.076	.083
Services	6.108	.164
gini	4.872	.205
fmlfpr	4.667	.214
Controlofcorruption	3.57	.28
Levelofdemocracy	2.932	.341
Agriculture	1.851	.54
Inflation	1.497	.668
Mean VIF	4.697	.

2. Serial Correlation Test

Breuschâ€“Godfrey LM test for autocorrelation chi2	df	Prob>Chi2
0.313	1	0.576

H0: no serial correlation

3. Heteroskedasticity Test

Breuschâ€“Pagan/Cookâ€“Weisberg test for heteroskedasticity

Assumption: Normal error terms

Variable: Fitted values of D.TaxtoGDP

H0: Constant variance

chi2(1) = 0.00

Prob > chi2 = 0.9606

4. Normality Test

Skewness and kurtosis tests for normality

----- Joint test -----

Variable	Obs	Pr(skewness)	Pr(kurtosis)	Adj	chi2(2)	Prob>chi2
ehat	33	0.533	0.378	1.240	0.538	

5. Ramsey Reset Test (Model Specification)

Ramsey RESET test for omitted variables

Omitted: Powers of fitted values of D.TaxtoGDP

H0: Model has no omitted variables

F(3, 15) = 1.20

Prob > F = 0.3444

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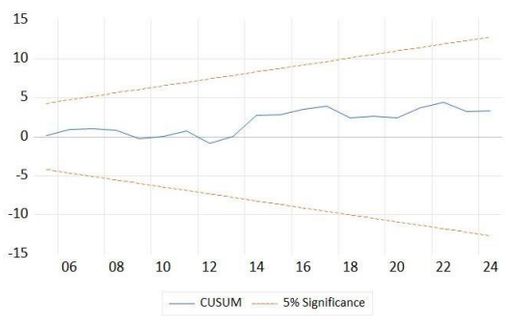

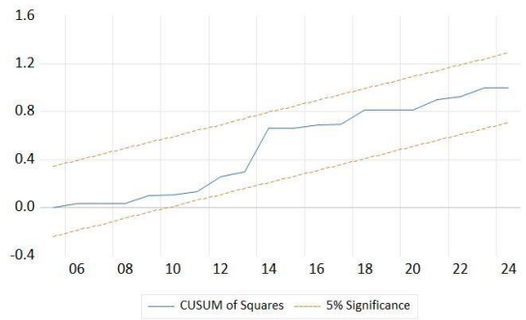

6. CUSUM/CUSUMSQ Stability Test

To confirm the econometric validity and robustness of the estimated ARDL models. A comprehensive set of diagnostic tests was conducted. This is including multicollinearity, serial correlation, heteroskedasticity, normality, and functional form tests. It is found that for all three models show that the estimated specifications are statistically sound.

5.7.4 Multicollinearity (VIF)

The results of Variance Inflation Factor (VIF) propose that there is not a serious multicollinearity concern in any model. In Model 1, the mean VIF is 3.57; in Model 2, 5.15; and in Model 3, 4.70. All values remain well below the conventional threshold of 10. While log(GDP per capita) demonstrations relatively higher VIF values across models. They remain within acceptable limits. Consequently, the explanatory variables do not exhibit harmful linear dependence. The coefficient estimates can be considered reliable.

5.7.5 Serial Correlation

The Breusch Godfrey LM test does not reject the null hypothesis of no serial correlation in all the models. The reported p-values (Model 1: 0.097; Model 2: 0.745; Model 3: 0.576) surpass conventional significance levels. This shows that the residuals are free from autocorrelation. This is confirming that the dynamic specification of the ARDL models is suitable.

5.7.6 Heteroskedasticity

The Breusch Pagan/Cook Weisberg test results indicate homoskedastic residuals. Thiis is across all models. The null hypothesis of constant variance cannot be rejected (Model 1 $p = 0.8385$; Model 2 $p = 0.3330$; Model 3 $p = 0.9606$). This assumes the error variance is constant and that the estimated standard errors are valid for hypothesis testing.

5.7.7 Normality of Residuals

The skewness and kurtosis tests confirm that the residuals are approximately normally distributed in all specifications. The joint test p-values (Model 1: 0.903; Model 2: 0.854; Model 3: 0.538) are well above conventional significance levels. This is ensuring the validity of hypothesis testing. Which indicates that the models do not suffer from serious distributional problems.

5.7.8 Functional Form (Ramsey RESET)

The Ramsey RESET test does not reject the null hypothesis that the model is correctly specified for each of the models (Model 1 $p = 0.1812$; Model 2 $p = 0.5947$; Model 3 $p = 0.3444$). This suggests that there is no evidence of omitted variable bias or functional form misspecification in the estimated ARDL equations. Taken together, the diagnostic tests strongly support the econometric adequacy of the three ARDL models. The absence of serious multicollinearity, autocorrelation, heteroskedasticity, non-normality, and functional form problems. This shows that the estimated coefficients are reliable. It is also suitable for policy interpretation. The models therefore satisfy the standard post-estimation requirements for time-series analysis. It also provides a robust basis for inference regarding the determinants of the tax-to-GDP ratio in Pakistan.

5.7.9 Stability Test (CUSUM and CUSUM of Squares)

To examine the stability of the estimated ARDL coefficients over the sample period. The Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUMSQ) tests are applied. These tests are commonly used in time-series analysis to detect structural instability in the estimated parameters. The results indicate that, for Model 1, Model 2, and Model 3, the plotted CUSUM and CUSUMSQ statistics persist within the 5% critical bounds. This is suggesting that the estimated coefficients are stable throughout the study period. The CUSUM test evaluates the stability of the recursive residuals While the CUSUMSQ test examines the variance stability of the residuals over time. When the cumulative sums stay within the critical boundaries. Cannot reject the null hypothesis of parameter stability. Therefore, the graphical results confirm that no structural breaks or

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parameter instability are present in the estimated ARDL models. This further ensures the reliability of the long-run and short-run estimates derived from the models and strengthens the validity of the empirical findings regarding the determinants of the tax-to-GDP ratio in Pakistan.

6 Conclusion

This study examined the macroeconomic, structural, institutional, and demographic determinants of the tax-to-GDP ratio in Pakistan. The study is conducted over the period 1990–2024. The study used ARDL bounds testing approach. The empirical work found a a stable long-run cointegrating relationship between tax revenue performance and its key drivers. The long run and short run outcomes can be used to advantage when explaining the flow of mobilizing the tax revenue of Pakistan. The findings specify that economic development plays an essential role in increasing the tax capacity. The ever significant and positive coefficient of GDP per capita. This is across all models. supports the hypotheses of tax capacity and modernization.

This is implying that persistent income growth broadens the tax base. It also improves revenue productivity. Structural transformation appears to be another key factor. The effect of agriculture is negative. While the impact from industry, services, and urbanization is positive. This indicates the importance of shifting toward more formal. It is also easily taxable sectors of the economy. The quality of institutions is proven to be equally as relevant. Improvements in control of corruption and political stability having great positive implications for the level of tax performance. This is underscoring the role of governance in promoting compliance and administrative efficiency. Labor market participation particularly female participation has positively affected revenue mobilization. While higher income inequality and demographic dependency exert downward pressure on the tax-to-GDP ratio. The short-run results show that tax indicators are highly persistent. The meaningful speed of adjustment toward long-run equilibrium. It is so because about one-quarter to one-third of the disequilibrium is adjusted per annum. Diagnostic and stability tests approve that the estimated models to be both economically and statistically appropriate. The results suggest that the effort of Pakistan to enhance tax revenue should not be limited to the traditional tax policies reforms. Promoting sustained economic growth, accelerating structural transformation toward industry and urban sectors, strengthening anti-corruption measures, enhancing political and institutional stability. It is broadening the coverage of formal employment. Especially among women are all critical for improving fiscal capacity. While taking income inequality and demographic pressures. It is further ensured long-term revenue mobilization. The study is subject to certain limitations. It includes using aggregate national observations, omitting detailed tax policy variables. Future research might extend the framework by employing the provincial level observations. It can add measures of informality and digitalized tax management. It might also utilize nonlinear and panel approaches for comparative palates. Overall, the evidence established through this research is quite conclusive that tax performance of Pakistan is driven by a multidimensional mix of economic, structural, institutional and demographic fundamentals. It is imperative that these priorities be addressed to fundamentally bring about the systematic enhancement in tax-to-GDP ratio of the country and long-term fiscal stability.

7 Policy Recommendations and Future Perspective

7.1 Policy Recommendations

The empirical evidence also indicates that efforts to strengthen the economy of Pakistan. Tax-to-GDP ratio requires a broad, structural strategy rather than narrow tax rate adjustments. The first imperative for this approach is to maintain policies that keep real incomes on a rising path. Expanding the formal economy through industrialization, services development, and productivity enhancing investment will naturally widen the taxable base. Which will be produced in tandem with growth. Building up incentives and infrastructure for transferring activity out of low-yield agriculture into industry. Newer forms of services are one way to contribute to strengthening revenue capacity. Second, institutional reforms must be prioritized. The positive role of control of corruption and political stability suggests that strengthening tax administration, improving transparency, and reducing discretionary leakages are critical. Digitalization of tax filing, third-party data sharing and risk profiling audit could be the way forward. Risk-based audit systems can improve compliance and reduce enforcement costs. Third, the reforms in the labor market should move in the direction of better integration of the job market and a higher female participation. Instructions toward this end would include strengthening human capital investments, formal employment promotion, and formalization of the labor market. This would lead to growth of the tax base. Meanwhile, investments in social and human capital could slowly mitigate the pressure from the high reliance ratio.

Fourth, urban management and planning should be aligned with fiscal objectives. As urbanization positively supports tax performance, improving property registration systems, municipal taxation capacity, and urban service delivery can help capture the fiscal benefits of Pakistan’s ongoing urban transition. Finally, addressing income inequality is important for long-term revenue sustainability. Broadening the direct tax base, rationalizing exemptions, and strengthening progressive taxation can improve both equity and revenue outcomes. Fourth, urban management and planning must be consistent with fiscal goals. Since urban growth benefits tax performance, enhancing property registration, municipal taxing powers and urban service delivery could ensure Pakistan captures the fiscal spillover effects of the urban transition. Lastly, tackling income inequality is crucial

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for revenue sustainability in the future. Extending the direct tax base, reducing exemptions, and increasing the progressivity of the system could benefit income distribution and revenue enhancement.

7.2 Future Perspective

The tax system in Pakistan will become more reliant on the management of structural and institutional change in the future. Sustained urbanization, digital financial inclusion, and continuing formalization of economic activity will provide further opportunities to strengthen tax capacity. Changes in digital tax administration and the proliferation of electronic documentation systems can play central roles in curbing informality. Future studies could extend from this one by exploring effects of tax policy setting, informality, and digital tax reforms using the measures provided here. Provincial or sector-specific studies might unveil other sources of heterogeneity in the Pakistani tax system. More general, nonlinear or asymmetric ARDL models could also show the existence of potential threshold effects in the relationship among GDP growth, governance indicators and revenue performance. Overall, raising the Pakistani tax-to-GDP ratio will have to be based on further strides in economic modernization, institutional reform and the formalization of the labor market. A concerted reform effort that addresses these underlying structural factors simultaneously will be the most believable course of action to ensure sustained fiscal gains.

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