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Population Expansion and Public Expenditures in Pakistan

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Abstract

With population expansion, governments need to allocate scarce resources for better access to public service. Pakistan, according to population and housing census 2023, is growing with a population growth rate of 2.55 which is highest in the South Asian region. At the same time, the distribution of public expenditures presents a challenge because current expenditures significantly outweigh development expenditures, and the growth of expenditures does not correspond to the growth in tax revenues. The combination of unprecedented population growth and subsequent increase in public expenditures pose a daunting challenge for economy of Pakistan. This research aims to explore this issue. In this study, the relationship between population growth and public expenditures in Pakistan is explored using annual time series data (1976 to 2022) and employing Autoregressive Distributed Lag Model (ARDL). This study finds that a 1% increase in population corresponds to a 1.57% rise in total expenditure. When analysis is disaggregated for current and development expenditures, it is observed that a 1% increase in population leads to a 2.6% increase in current expenditures, while there is no significant relationship of population with development expenditures. Findings of this study suggest that population growth in Pakistan impose a financial burden primarily through increased short-term recurring expenditures, rather than contributing to long-term economic progress through development expenditures. This study also points out that public finance policies and population planning efforts must be made in tandem with financial planning to allocate scarce resources in a judicious manner.

Keywords: Public Expenditures, Population Growth; Development Expenditures; Current Expenditures; Population and Economy; Pakistan.

1. Introduction

As populations increase, funds must be allocated for education, health, law enforcement, and other public services. Inadequate revenue growth compared to expenditure might result in (budget) deficits. Increasing population also needs substantial expansion in roads, water systems, and public transportation along with other public services. If lower-income inhabitants drive population growth, this could impact revenue growth as municipalities may experience a decline in property tax and other tax revenues. Malthus argued that if population growth was unchecked, it could surpass economic growth, leading to significant problems for society (Malthus and Gilbert, 1993). Although technological advancements have helped alleviate some of these issues, the relationship between population growth and economic progress remains complex. On the positive side, an increase in population often leads to a larger workforce, which can boost economic productivity and thus growth. This growth in the labor force enhances human capital as more individuals acquire skills and education, thereby improving overall economic efficiency. Additionally, a larger population can result in increased tax revenues, as there are more working individuals contributing to public finances. Furthermore, an expanded workforce can lead to a reduction in labor costs due to an increase in labor supply and higher competition among workers (Bloom et al., 2011).

However, population growth can also present several economic challenges. Higher fertility rates can strain public resources, particularly in health and education sectors, as governments need to invest more to accommodate the growing number of young people (Lee, 2003). Additionally, higher birth rates may prompt some women to leave the workforce, which can reduce female labor force participation and limit economic growth potential (Goldin, 2014). Furthermore, an aging population, characterized by increased longevity and lower birth rates, places additional pressure on pension systems and public health expenditures, as there are more elderly individuals requiring financial support and healthcare (Gruber & Wise, 1999).

Understanding the relationship between population growth and public finance is crucial for countries like Pakistan where high population growth can present major challenges to economic development. Pakistan is the 5th largest country in the world in terms of population with a population growth rate of 2.55% per annum (PBS, 2023). With a high fiscal deficit, growing local and external debt and average ten-year annual GDP growth rate of 4.2%, Pakistan faces a significant public finance challenge. Therefore, this paper examines the impact of population expansion on public finance growth in Pakistan. It explores how increasing population affects total, current and development expenditures in Pakistan. This study expands the framework of Wagner's law which suggests that as countries become wealthier, government spending naturally increases (Henrekson, 1993). We add population and other control variables in the Wagner's law equation based on the quantitative studies. Using Autoregressive Distributed Lag Model on the annual data from 1976 to 2022, we show that there is a 1.57% increase in total expenditures for every 1% increase in population. A 1% increase in population causes a 2.6% increase in current expenditures, but there is no significant relationship of population expansion with development expenditures when we examine current and development expenditures separately.

The rest of the paper is organized as follows: Section 2 presents the review of literature, Section 3 provides theoretical framework for the study, Section 4 explains the econometric model and methodology for the study, Section 5 presents the results and Section 6 concludes the study.

2. Literature review

The debate on population and resources dates back to existing human history. Malthus presented one of the critical views in this area. The Malthusian theory of population has been the focus of extensive debate and examination by social scientists and economists alike. Malthus hypothesized that the population growth rate would surpass the rate of food production, resulting in famine, disease, and other associated issues that would help restrict the population size (Cain, 1951).

The correlation between population growth and government spending is complex and multifold. One strand of this literature suggests that a high population growth rate can have various negative consequences (Easterlin, 1967). These include putting strain on limited natural resources, decreasing the formation of private and public capital, and redirecting resources towards maintaining existing capital rather than increasing it per worker. Gabler (1971) investigated the relationship between a city's population size, public expenditures, and employment in the public sector. Gabler utilizes the 1967 Census of US Government's data to reassess the correlation between population size and per capita expenditures. This study emphasizes that populated cities generally have more significant expenditures. As the population grows in the urban areas, it necessitates an increase in public expenditures. The relationship between population growth and government expenditures can have different patterns, considering the heterogeneous characteristics of the countries. The effects of a growing population on expenditures could differ based on a nation's particular circumstances and level of advancement. In underdeveloped nations, such as less developed countries (LDCs), it has been observed that areas with high population density show rapid economic expansion. This, in turn, can result in higher government income and expenditure (Gobin, 1992).

Another strand of literature presents the determinants of public expenditure from the perspective of Wagner's Law. Wagner's Law is used as a theoretical foundation to study the relationship between economic expansion and the provision of public services. Wagner's Law states that as an economy expands, the proportion of national income allocated to public expenditure will also rise to accommodate the growing needs for public services like education, healthcare, and social security. Moreover, urbanization and population growth require increased public expenditure, especially for law enforcement and administration. The demand for public goods, such as education and health, is primarily driven by income, and demand for these public goods is elastic (Chang, Liu, and Caudill 2004).

Shelton (2007) uses Wagner's Law and emphasizes that variations in the preferences or characteristics of a population, such as age, income, or cultural background, can considerably influence how governments distribute resources. The study postulates that decentralization can be viewed as an outcome of addressing resource distribution in a heterogeneous population. When the population possesses divergent preferences, it becomes challenging for a centralized government to

distribute resources efficiently. Decentralization can be a helpful means to meet these diverse needs, but decentralization does not necessarily reduce total government spending.

The accuracy of Wagner's Law is examined in East Asian Economies by Kumar and Cao (2020). Their research focuses on the connection between population structure, government expenditures, and economic growth. This research includes the dependency ratio as a crucial factor in the conventional analysis of Wagner's Law. A higher dependency ratio requires increased government expenditure on age-related services such as pensions and healthcare. The relationship between government expenditure and economic growth becomes significantly more robust when the dependency ratio is included in the analysis. This implies that changes in the dependency ratio can substantially impact the allocation of government funds. As the dependency ratio increases, the governments in the East Asian economies may experience increasing pressure to allocate additional resources toward social security, healthcare, and other services. Therefore, increasing taxes, borrowing, or redistributing funds from other sectors potentially affects economic expansion and fiscal stability.

Karceski and Kiser (2020) validate Wagner's Law while examining the relationship between government spending and economic growth. Expanding economies and increasing populations need a more significant provision of government services, which further requires a state's ability to increase taxes. Citizens initially may tolerate the policy towards higher taxes, but with time, they develop opposition, leading to restrictions on government spending. Moreover, states can temporarily reduce tax constraints by engaging in borrowing. However, this is not favorable in the long run and requires more favorable alternatives. When debts become overwhelming,[1] governments must reduce their spending. Therefore, although there is an increase in population and a need for more public services, the state's spending is constrained by the careful equilibrium between the provision of public goods and the availability of public funds.

Wagner's law has been argued in some studies that increased per capita income can support the law because it increases total and capital government expenditure (Akanbi 2014). However, there is vast empirical evidence that shows that the different types of spending cannot be easily generalized; instead, the different elements of spending exhibit different degrees of correlation with population growth, and its implications can vary depending on country to country, some studies pointing to the fact that population growth may be inversely related to government expenditure (Akanbi, 2014).

Florio and Colautti (2005) criticize Wagner's Law stating that although it may be valid initially, it ignores rising taxation's important influence and consequences. Abundant resources may boost the population. However, resource depletion slows growth to equilibrium. Pigou's *"excess burden"* of taxation limits governmental spending. The negative impact of government tax on the economic activity outweighs the gains from it which leads to a reduction in public spending. Furthermore, this implies that unchecked government expenditure growth is unsustainable and that policymakers

[1] Pakistan is in debt trap and the debt in pakistan is ever growing (GoP, 2024). Furthermore, currently the total debt of Pakistan in the year 2023 is 62,881 billion PKR and the Public debt to GDP ratio is 75 percent (GoP, 2024).

must weigh public service costs against revenue, thereby instilling a sense of concern about fiscal responsibility in the audience.

In the context of Pakistan, Hussain, Iqbal, and Siddiqi (2010) analyze the economic growth, government expenditure, population patterns, and exports. The analysis provides evidence in favor of Wagner's Law, meaning that an increase in population exerts pressure on public services and infrastructure. Rapid population growth increases the need for vital services such as healthcare, education, housing, transportation, and other critical amenities. To accommodate the increase in population, the government allocation must be revised upwards. Their study asserts that changes in population size and structure significantly impact a country's economic performance. Irrespective of economic growth, population increase can substantially impact government spending. Furthermore, the researchers recommend that Governments should consider demographic patterns while formulating economic strategies to align spending with the demands of the growing population.

Another strand of debate in the literature is about population size and economies of scale; for example Alesina (2003) shows several benefits that may enable more densely populated countries to support smaller governments. Firstly, countries with larger populations can use economies of scale related to providing public goods. However, Krieger and Meierrieks (2020) report that prior research on this subject has yielded conflicting findings. Some contend that larger populations result in economies of scale, leading to smaller governments. Conversely, others propose that larger populations incur higher costs due to increased heterogeneity, necessitating larger governments to address the associated challenges effectively. This research argues that the elements that support the expansion of governments in response to population growth, such as higher costs due to diversity, overcrowding, crime, and conflict, are more significant than the potential benefits of economies of scale. In conclusion, developing countries undergoing rapid population growth should not anticipate a reduction in the size of their government; in fact, increasing government size is proportionate to the growing population. Another factor that leads to a rise in government expenditure is the increasing population that requires services and facilities that the government should provide. (Szirmai 2015).

Dao (1995) argued that the impact of population on government spending trends needs to follow a universal approach as the population can impact government expenditures nonlinearly. Smaller, less developed countries, particularly those with populations below 20 million, frequently demonstrate distinct expenditure patterns compared to larger, more developed nations. This emphasizes the importance of examining the relationship between population and expenditures in particular developmental and demographic circumstances. The research study argues for a more sophisticated and contextual comprehension of how population dynamics, such as size, density, and developmental stage, influence government spending priorities and patterns. Similarly, Getzen (1992) examines the relationship between changing population demographics, specifically the aging population, and their influence on public expenditure on healthcare. A changing demographic profile such as age can increase healthcare spending, and effectively tackling the escalating healthcare expenses requires a comprehensive strategy embedded with technological progress and economic growth to necessitate this changing attribute of the population.

On the county level Breunig and Rocaboy (2008) use a dataset of French municipalities to determine the trends of government expenditures. Their study shows that when the population of smaller municipalities grows, there is an initial decrease in per-capita public expenditures. This indicates that the benefits of sharing taxes outweigh the costs of increasing population. When municipalities experience growth in size of population, this pattern is reversed, and per-capita expenditures start to increase, suggesting that the costs of a growing population outweigh the advantages of shared expenses.

Herrera (2007) does not directly investigate the correlation between population and public spending but offers valuable insights about them. This research work primarily analyzes the impact of government expenditure on economic growth, with a specific focus on public spending efficiency. However, it recognizes that population growth can significantly burden public services, leading to increased demand for public services and perhaps affecting the overall effectiveness of public spending. Furthermore, policymakers should take population patterns into account when allocating resources and planning for future public service supply. This is particularly relevant for developing countries experiencing rapid population growth, as the burden on healthcare, education, and infrastructure can be substantial.

Drew, Miyazaki, and A. Kortt (2023) examined the relationship between local government revenue and population growth. It disputes policymakers' assertion that population expansion leads to an increase in local government revenues, as earlier studies neglect the revenue side of this relationship. Their research argues that increased population through births exceeding deaths may not immediately impact revenue generation.

Researchers have also focused on the impact of an aging population on public expenditures. The demographic profile of countries like Japan has significantly changed in recent decades due to a rise in life expectancy, a decline in fertility rates, and an increase in the proportion of the older population. Hence, government expenditures on healthcare and pensions are increasing (Oliver, 2015). Similarly, Ridho, Razzaq, and Kusnadi (2019) and Pilehvari, You, and Lin (2023) find that when life expectancy increases, people spend more years in retirement, which requires higher pension payments. Furthermore, Pilehvari, You, and Lin (2023), found that governments have adopted diverse policy solutions to tackle the fiscal challenges of an aging population. These solutions comprise raising the retirement age and modifying pension schemes. However, the efficacy of these approaches is still a subject of continuous debate.

Another aspect covered in the literature is population growth and investment, derived from the neo-classical theory of the Solow growth model. In African countries, an increase in population has led to a direct and beneficial relationship contrary to a decline in investment due to increasing population. As populations expand, governments may encounter rising demands to allocate resources toward public infrastructure and services to accommodate the larger population, hence increasing investment. A conducive investment environment to attract private and foreign investments is essential for long-term economic growth. Nevertheless, uncontrolled population growth may result in unsustainable strain on public infrastructure and services (Asongu, 2013). More populated communities typically possess a more extensive tax base and higher per capita wealth,

affording them much better financial capability for public investment. Moreover, an increased and more heterogeneous population generates a requirement for public services and facilities, bringing in a higher level of investment (Hansen, 1965).

3. Theoretical Framework

The basic idea of Wagner's law can be expressed in the following functional form.

$$G = f(Y) \quad \text{---------- (1)}$$

The above expression explains the relationship between government expenditures (G) and national income (Y) in its simplest form.

There have been several modifications in the functional form of this relationship, and some researchers have incorporated growth accounting techniques to check this relationship see, for example; Jibir and Aluthge, 2019). This functional form was modified by including variables like population, dependency ratio, and per capita population in different studies see interalia; Kumar and Cao 2020; Chang, Liu, and Caudill 2004; Durevall and Henrekson 2011).

$$G = \alpha + \beta Y \quad \text{---------- (2)}$$

Equation 2 is the most common formulation to observe this relationship and is widely used in research, both in past and recent studies, with the inclusion of control variables (e.g.; Shelton 2007; Mann 1980; Islam 2001; Chow, Cotsomitis, and Kwan 2002; Goff 1998). Those specifications that overlooked the population variable in the above equation generally show a more considerable increase in the demand for public expenditures than those that include it (Durevall and Henrekson 2011). A modified version of equation 2 thus includes population as a critical variable.

$$G = \alpha + \beta Y + \gamma P \quad \text{---------- (3)}$$

It is important to note that the above equation is a long-run relationship between Government expenditures, National income, and population (P). This implies that this equation holds on average over a given time-period. For this relationship (Wagner's law) to hold, the national income must determine the government expenditures. We include a set of control variables in the above equation so that the determination of this relationship includes all relevant variables, and no significant information is neglected. The final form of the equation that is estimated in this study is as follows;

$$G = \alpha + \beta Y + \gamma P + \delta_i(Control.Variables) + \mu \quad \text{---------- (4)}$$

The above equation specifies Wagner's law as an econometric relationship, including population, control variables, and an error term. A time series specification for the above model can be written as follows:

$$G_t = \alpha + \beta Y_t + \gamma P_t + \delta_i(Control.Variables)_t + \mu_t \quad \text{---------- (5)}$$

According to Wagner's law β >0, the sign and magnitude of γ can differ, as Wagner's law is driven by demographic and country profile (Shelton, 2007). As this is a long-run relationship, any displacement or shock can have a persistent effect. A lag value of the dependent variable is included in this model to include such effects.

$$G_t = \alpha + \alpha_1 G_{t-1} + \beta Y_t + \gamma P_t + \delta_i(Control.Variables)_t + \mu_t \quad \text{---------- (6)}$$

4. Econometric Model, Data and Methodology

We build our model .by drawing upon the commonly used econometric models in literature for testing the extended version of Wagner's Law. Since we are interested in the elasticity of public expenditures with respect to the growth in population, we use the log-log formulation of Pryor (1969) (see Paparas, Richter and Konstakis 2019 for details). In *Equation 6*, we incorporate. the logarithm of the main independent variables and add control variables informed by prior research in this field. These control variables include real total government revenues, the real effective exchange rate, trade openness, the inflation rate, and the unemployment rate. To facilitate interpretation, variables measured in levels are transformed into their logarithmic forms, while variables expressed as ratios remain in their original forms. Our primary ARDL(p,q) model is presented in Equation 7, and a detailed description of the variables follows in the subsequent section.

$$logReal\ Expenditures_t = \alpha_1 + \sum_{k=1}^{p} \beta_k logReal\ Expenditures_{t-k} + \sum_{j=0}^{q1} \beta_{j+1}\ logReal\ GDP_{t-j} + \sum_{j=0}^{q2} \beta_{j+1}\ logPopulation_{t-j} + \sum_{j=0}^{q3} \beta_{j+1}\ logReal\ Revenues_{t-j} + \sum_{j=0}^{q4} \beta_{j+1}\ Real\ Effective\ Exchange\ Rate_{t-j} + \sum_{j=0}^{q5} \beta_{j+1}\ Trade\ Openness_{t-j} + \sum_{j=0}^{q6} \beta_{j+1}\ Inflation_{t-j} + \sum_{j=0}^{q7} \beta_{j+1}\ Unemployment_{t-j} + \epsilon_t \text{ ---------- (7)}$$

Variables and Data Sources

In this study, we use data from 1976 to 2022 using various local and international data sources. In this section, we will explain the variables used, methodology for their calculations and their sources.

1. ***Population***: Population represents total population of Pakistan in millions. World Development Indicators provide data for population starting from 1960, however, the population estimates for the census years do not tally with the official reports of Pakistan Bureau of Statistics. Therefore, we used several local sources to compile the data for population. We use the Pakistan Bureau of Statistics publication 50 Years of Pakistan Economy for the year 1981, the publication of Ministry of Finance, Economic Survey 2000-01 for the years 1990-1999, and Economic Survey 2022-23 for observations from 2000 to 2022. The missing values for the years 1976-1979 and 1982-1989 were generated using linear interpolation. The correlation between the newly generated series and the one from WDI is 0.99.

2. ***Real GDP***: Real GDP is GDP of Pakistan in billion Pakistan Rupees at 2010 prices. Nominal GDP was taken from World Development Indicators and converted to Real GDP at 2010 using CPI.

3. ***Real Expenditures (Total, Current and Development)***: Total Expenditures is the sum of current and development expenditures in billion Pakistan Rupees at 2010 prices. Current and Development expenditures are also measured using the same methodology. We compiled data for total expenditures from the following local sources: 50 Years of Pakistan Economy for years 1976 to 1990, Economic Survey 2000-01 for years 1992 to 1998, Economic Survey 2006-07 for 2000 to 2003, Economic Survey 2011-12 for years 2004 to 2008, Economic Survey 2015-16 for years 2009 to 2016, Economic Survey 2018-19 for years 2017 and 2018, and Economic Survey 2022-23 for years 2019-2022. The series was rebased to the constant prices of 2010 using CPI.

4. ***Real Total Revenues as percentage of GDP***: Real total revenues include both tax and non-tax revenues of Pakistan. Data for total revenues was compiled using the same methodology as explained above for real total expenditures. We used 50 Years of Pakistan Economy publication for years 1976 to 1997, Economic Survey 2007-08 for years 1999 to 2006, Economic Survey 2011-12 for years 2007 to 2011, Economic Survey 2018-19 for years 2012 to 2018, and Economic Survey 2022-23 for years 2019 to 2022. The resulting series was rebased to the prices of 2010 using CPI and divided by real GDP to calculate real total revenues as percentage of GDP.

5. ***Real Effective Exchange Rate***: Nominal exchange rate is the weighted average of Pakistani Rupees in relation to the basket of other major currencies. The real effective exchange rate is a nominal effective exchange rate index adjusted for prices. We use Real Effective Exchange Rates at 2010 prices from World Development Indicators.

6. ***Trade Openness***: We use the sum of imports and exports as percentage of GDP as the proxy for trade openness. Data for this series is taken from World Development Indicators.

7. ***Inflation***: Inflation is calculated as an annual change in CPI at 2010 prices. We used SBP Handbook of Statistics 2005 for the years 1976 to 1990, Economic Survey 2003-04 for the years 1991 to 2000, and Economic Survey 2022-23 for years 2001 to 2023. We used splicing method to rebase the CPI values at 2010.

8. ***Unemployment rate***: Data for unemployment rates was taken from 50 Years of Pakistan Economy for the years 1980, 1981, 1983, 1985-1988, Economic Survey 2000-01 for years 1990 to 1999, and Economic Survey 2022-23 from years 2000-2015, 2018, 2019, 2021. Data for the years 1976-1979, 1982, 1984, 1989, 2016, 2017, 2020 and 2022 were estimated using linear interpolation.

Table 1 presents the descriptive statistics for the variables used in this study, covering a span of 47 years from 1976 to 2022. During this period, the total population of Pakistan grew from 71 million in 1976 to 229 million in 2022. Concurrently, total public expenditures surged from 492 billion PKR in 1976 to over 5 trillion PKR in 2022. Additionally, the real GDP expanded significantly from 2 trillion PKR in 1976 to over 25 trillion PKR in 2022. These figures indicate a positive trend over time, suggesting potential non-stationarity in the series analyzed.

Table 1: Descriptive Statistics

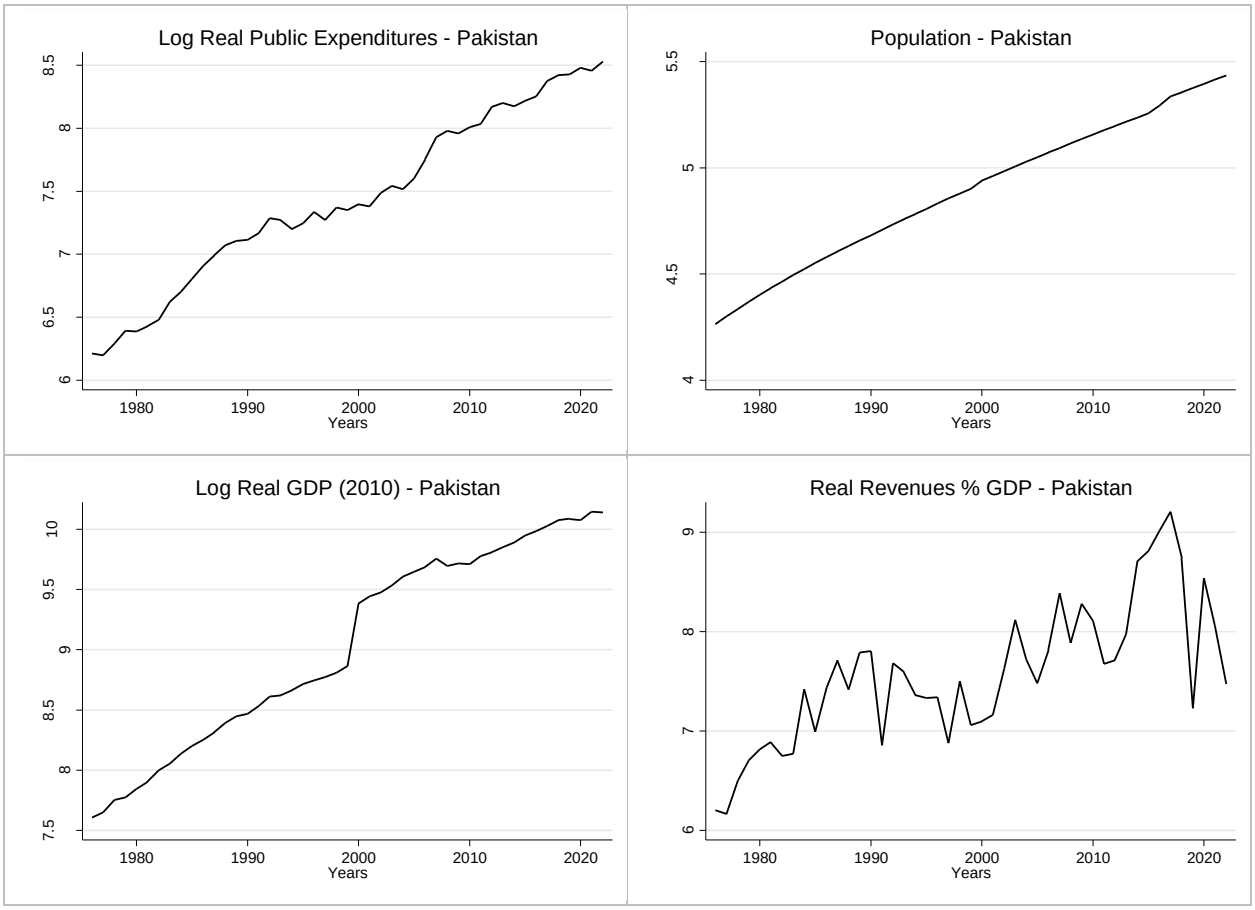
Variable	Obs	Mean	Std. Dev.	Min	Max
Population (Million)	47	140.31	46.20	71.04	229.22
Real GDP (Billion PKR)	47	11,277.87	7,843.79	2,009.67	25,486.81
Real Expenditures (Billion PKR)	47	2,112.19	1,369.26	492.31	5,062.58
Real Current Expenditures (Billion PKR)	47	1,697.31	1,175.82	281.81	4,387.12
Real Development Expenditures (Billion PKR)	47	413.69	225.64	190.63	1,079.23
Real Total Revenues % GDP	47	7.57	0.70	6.16	9.21

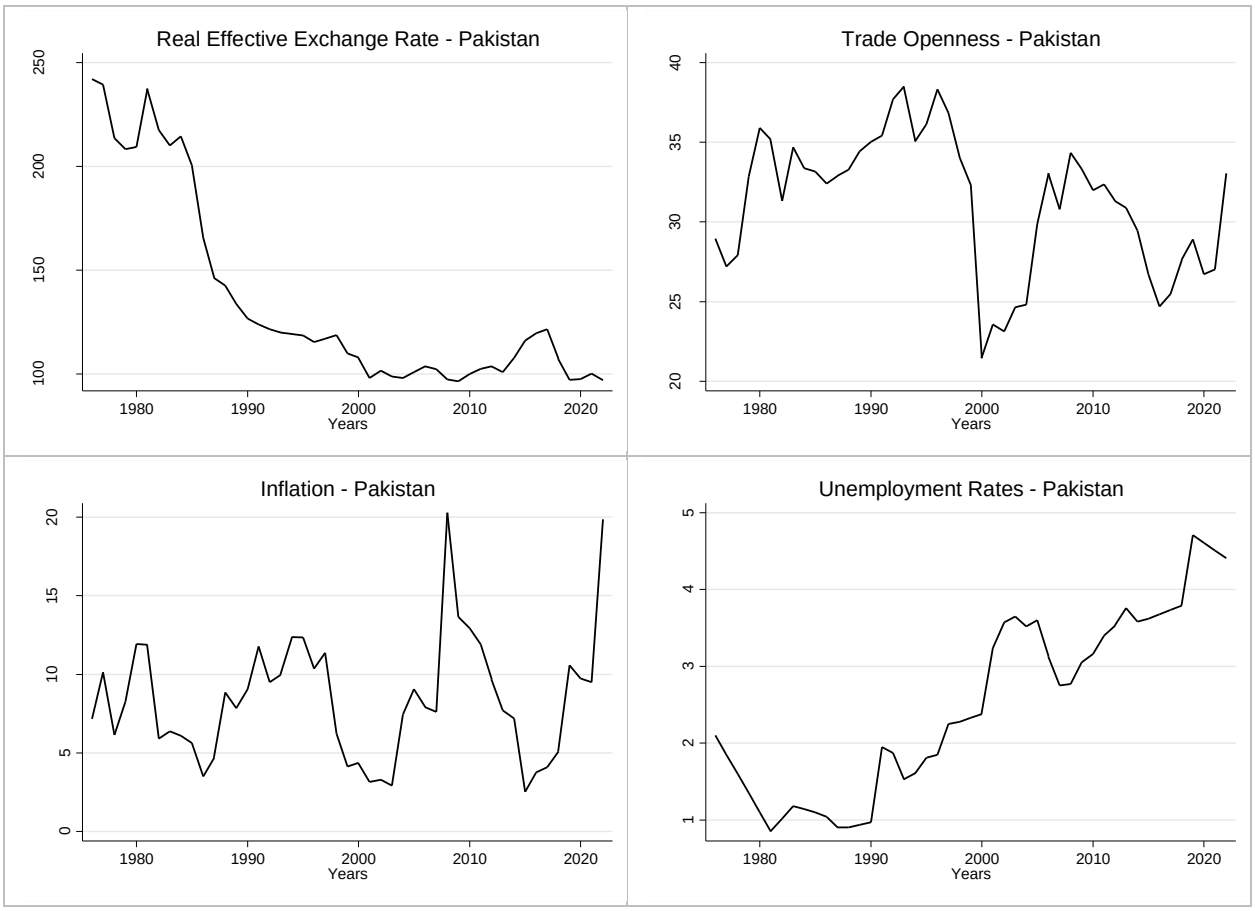
Real Effective Exchange Rate	47	135.08	46.86	96.49	242.10
Trade Openness	47	31.24	4.30	21.46	38.50
Inflation	47	8.42	3.93	2.53	20.29
Unemployment rate	47	2.50	1.19	0.85	4.71

Methodology

Since we are dealing with a single country time series data and most annual macroeconomic series have a time trend, we visualize the data to observe obvious time trends. Figure 1 shows that most of the variables have a strong time trend hence we must test for the non-stationarity of these variables.

Figure 1





We have employed the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test to test for the stationarity of the variables. The KPSS test has the null hypothesis of stationarity. The results, presented in Table 2, indicate the unit root tests' outcomes at levels I(0) and first differences I(1). Our findings reveal that the variables are either stationary at levels or become stationary after first differencing. Consequently, we cannot apply Ordinary Least Squares (OLS) or the Johansen Cointegration methodology for estimation of the coefficients.

Given the mixed integration order of our series I(0) and I(1), we adopted the Autoregressive Distributed Lag (ARDL) model developed by Pesaran, Shin and Smith (2001) for estimation. The analysis was conducted using Stata 14.2 for diagnostics, data management, visualization, and estimations. The lag structure for the ARDL model was determined based on the Bayesian Information Criterion (BIC).

Table 2: Test Statistics of KPSS Stationarity Test: Ho = Variable is Stationary.

	Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test	
	I(0)	I(1)
Log Population	0.487***	0.145
Log Real GDP	0.453***	0.070
Log Real Expenditures	0.177***	0.096
Log Real Current Expenditures	0.32***	0.056
Log Real Development Expenditures	0.227***	0.073
Real Total Revenues % GDP	0.096	0.04
Real Effective Exchange Rate	0.521***	0.060
Trade Openness	0.115	0.064
Inflation	0.064	0.054
Unemployment rate	0.181***	0.067

Note: Lag order = 1, * = 5%, ** = 2.25%, *** = 1%

5. Estimation Results

The results of the ARDL estimations are presented in Table 3. We begin with Model 1, where total expenditures are modeled as a function of population, GDP, real revenues as a percentage of GDP, real effective exchange rates, and trade openness. In Model 2, we add the inflation variable to Model 1, and in Model 3, we add the unemployment rate to Model 2.

In all three models, we find that a one percent increase in population leads to more than a 1.4% increase in total real expenditures. Specifically, in the most comprehensive model (Model 3), a 1% increase in population results in a 1.57% increase in total expenditures. The coefficients for population are significant at the 1% level across all models. Using the current population growth rate of 2.55%, our results indicate that total expenditures are increasing by more than 4%.

Regarding Wagner's Law, our results do not support it, as we find no significant correlation between GDP growth and total expenditures. However, we do find positive correlations between total real expenditures and real revenues as a percentage of GDP, real effective exchange rates, and trade openness. Conversely, we do not find significant correlations between total expenditures and inflation or unemployment rates.

Post-estimation diagnostics suggest that Models 1, 2, and 3 are free from autocorrelation and heteroskedasticity. The Pesaran, Shin, and Smith (2001) Bound test results show that the F-values are greater than the upper bound of the 5% critical values, allowing us to reject the null hypothesis of "no levels relationship."

Table 3: Population and Total Expenditures. Long run ARDL estimates. Dependent variable: Log Real Total Expenditures

	Model 1	Model 2	Model 3
Lag structure	1 0 0 0 2 0	1 0 0 0 2 0 0	1 0 0 0 2 0 0 0
Log Population	1.537***	1.457***	1.573***
Log Real GDP	0.267	0.341	0.342
Real Revenues % GDP	0.124***	0.108***	0.094*
Real Effective Exchange Rates	0.002*	0.002*	0.002*
Trade Openness	0.021***	0.027***	0.025***
Inflation Rate		-0.006	-0.006
Unemployment Rate			-0.029
ECM(-1)	-0.440***	-0.412***	-0.425***
Autocorrelation Breusch-Godfrey LM Test: P-value	0.527	0.301	0.339
Heteroskedasticity White Test: P-value	0.429	0.429	0.429
Pesaran/Shin/Smith (2001) ARDL Bounds F-Test	4.812	4.185	3.618
Bound F-Test Critical Values at 5%	2.62 – 3.79	2.45 – 3.61	2.32 – 3.50

Next, we estimate the same models for Current expenditures (Table 4) and Development expenditures (Table 5). Table 4 shows that one percent increase in population leads to a 2% increase in current expenditures in both Models 1 and Model 2. In Model 3, when we add unemployment rate in the model, the elasticity of current expenditures with respect to population increases to 2.6%. We find that unemployment is negatively correlated with current expenditures. This could be explained by the reasoning that economic slowdown leads to increase in unemployment and puts pressure on the government to reduce current expenditure. Table 5 shows that there is no significant relationship between population and development expenditures. These results indicate that the fiscal burden of increasing population in Pakistan is reflected in increasing the recurring short-term expenditures and not in impacting the long-term development expenditures towards the development of all types of infrastructure to support the growing population in the country.

Table 4: Population and Current Expenditures. Long run ARDL estimates. Dependent variable: Log Real Current Expenditure

	Model 1	Model 2	Model 3
Lag structure	1 0 0 0 2 2	1 0 0 0 2 2 0	1 0 0 0 2 0 0 3
Log Population	1.99***	1.99***	2.604***
Log Real GDP	0.128	0.141	0.185
Real Revenues % GDP	0.08**	0.077*	0.018
Real Effective Exchange Rates	0.0001	0.0002	0.0007
Trade Openness	0.022***	0.023**	0.006
Inflation Rate		-0.001	0.004
Unemployment Rate			-0.208***
ECM(-1)	-0.523***	-0.516***	-0.658***
Autocorrelation Breusch-Godfrey LM Test: P-value	0.376	0.347	0.05
Heteroskedasticity White Test: P-value	0.429	0.429	0.429
Pesaran/Shin/Smith (2001) ARDL Bounds F-Test	5.188	4.327	4.579
Bound F-Test Critical Values at 5%	2.62 – 3.79	2.45 – 3.61	2.32 – 3.50

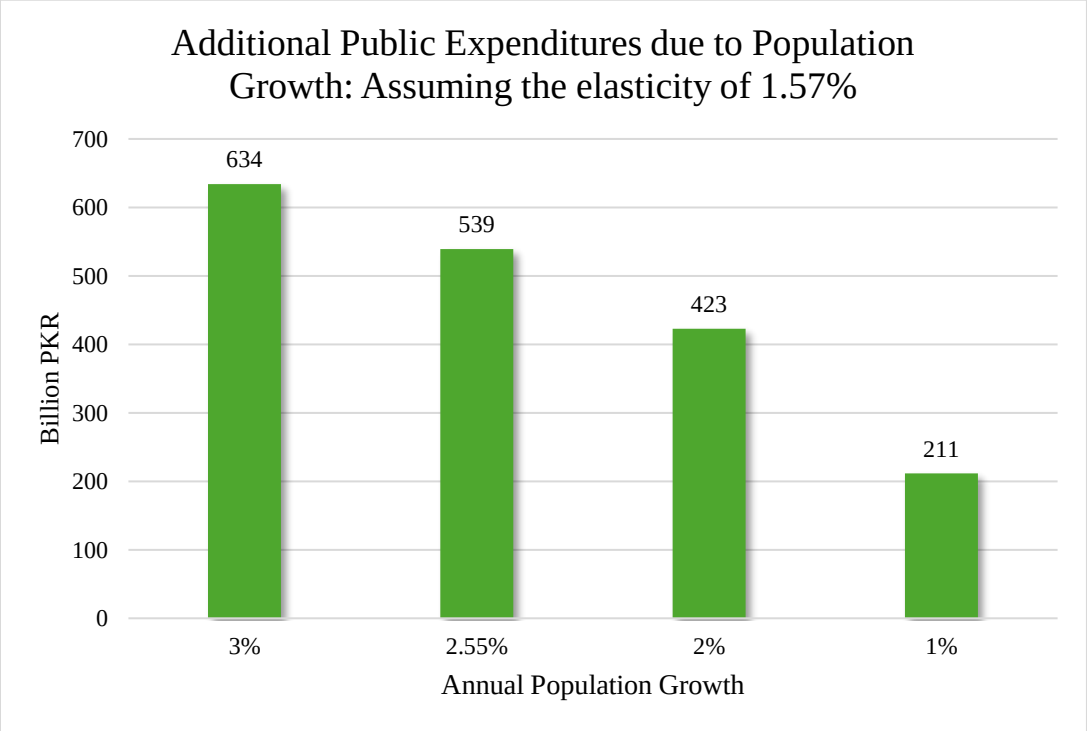
Table 5: Population and Development Expenditures. Long run ARDL estimates. Dependent variable: Log Real Development Expenditure

	Model 1	Model 2	Model 3
Lag structure	1 0 0 0 0 0	1 0 0 0 0 0 0	1 0 0 1 0 0 0 3
Log Population	-1.170	-1.200	-1.412
Log Real GDP	1.137**	1.168**	0.900*
Real Revenues % GDP	0.413***	0.404***	0.498***
Real Effective Exchange Rates	0.007***	0.007***	0.004*
Trade Openness	0.038**	0.041*	0.068***
Inflation Rate		-0.003	-0.038*

Unemployment Rate			0.217
ECM(-1)	-0.431***	-0.427***	-0.519***
Autocorrelation Breusch-Godfrey LM Test: P-value	0.936	0.980	0.827
Heteroskedasticity White Test: P-value	0.594	0.515	0.429
Pesaran/Shin/Smith (2001) ARDL Bounds F-Test	4.06	3.683	3.810
Bound F-Test Critical Values at 5%	2.62 – 3.79	2.45 – 3.61	2.32 – 3.50

Based on the estimated elasticities of expenditures with respect to population growth in Table 3, we can project the expected increase in annual public expenditures attributable to population expansion in Figure 1. With a growth rate of 2.55%, the model indicates that an additional Rs. 539 billion will be required each year. This amounts to Rs. 5.4 trillion in additional expenditures by 2034. If the population growth rate is reduced to 2%, the required additional annual expenditures would decrease to Rs. 423 billion, and further reducing the growth rate to 1% would lower the required additional expenditures to Rs. 211 billion annually.

Figure 1: Impact of Population Growth on Total Expenditures at Various Population Growth Rates



The additional burden on public sector expenditures due to population changes may be attributed to the dependency ratio. Table 6 presents the results of three supplementary models that incorporate various dependency variables. In Model 1, we include the percentage of the population below 15 years of age. In Model 2, we consider the percentage of the population between 15 and 65 years of age. In Model 3, we add the percentage of the population over 65 years of age.

Our results indicate that the population under 15 years and the working-age population have a negative but relatively minor effect on total expenditures. However, the proportion of the population over 65 years shows a strong positive correlation with total expenditures. Notably, in Model 3, the coefficient of the total population becomes insignificant, suggesting that the impact of population on total expenditures may be driven primarily by the aging population in Pakistan. To examine the impact of dependency independent of the population variable, we re-estimated the models in Table 6 after excluding the population variable (see Table A1 in Appendix). Our results show that working and young dependency is no longer a significant predictor of total expenditure. However, old dependency is still a positive and significant predictor of total public expenditures.

Table 6: Effect of Dependency: Long run ARDL estimates: Dependent variable: Log Real Total Expenditures

	Model 4 Young Dependency	Model 5 Working Age	Model 6 Old Dependency
Lag structure	1 1 1 0 0 0 0 0 0	1 1 1 0 0 0 0 0 0	1 0 1 0 0 0 0 0 2
Log Population	1.424***	1.561***	0.727
Population (<15 % Total)	-0.070***		
Population (15-65 % Total)		-0.072***	
Population (>65 % Total)			0.626***
Log Real GDP	0.037	-0.006	0.408**
Real Revenues % GDP	0.016	0.014	0.021
Real Effective Exchange Rates	-0.003***	-0.003***	-0.002***
Trade Openness	0.013**	0.012*	0.018***
Inflation Rate	-0.004	-0.003	-0.011**
Unemployment Rate	-0.024	-0.026	-0.154***
ECM(-1)	-0.669***	-0.682***	-0.610***
Autocorrelation Breusch-Godfrey LM Test: P-value	0.734	0.741	0.333
Heteroskedasticity White Test: P-value	0.431	0.431	0.429
Pesaran/Shin/Smith (2001) ARDL Bounds F-Test	5.393	5.464	4.887
Bound F-Test Critical Values at 5%	2.22 – 3.39	2.22 – 3.39	2.22 – 3.39

6. Conclusions and Policy Directions

Pakistan is the fifth most populous country globally, experiencing a notable annual population growth rate of 2.55percent. With an average GDP growth rate of just over 4% over the past decade and a rising fiscal deficit, a key policy issue is how to finance the needs of both current and future generations. To address this, it is crucial to first determine whether current expenditures are linked to population growth. In this paper, we examined how population growth affects public spending in Pakistan, focusing on total, current, and development expenditures. This study highlights the critical need for Pakistan to develop a comprehensive fiscal strategy that balances the immediate demands of a growing population with the long-term goals of sustainable development. By understanding the relationship between population growth and public spending, policymakers can better address the challenges of fiscal management and ensure that both current and future generations benefit from effective and equitable resource allocation. Analyzing data from 1976 to 2022, we found that as the population grows, public spending also increases. Specifically, population growth has a significant impact on current expenditures but does not notably affect development expenditures. Additionally, an aging population leads to higher public spending in Pakistan. Our estimates indicate that with a 2.55% annual population growth rate, Pakistan will need an extra Rs. 539 billion annually to meet its population's needs.

The study reveals a clear relationship between population growth and increased public spending. As the population expands, current expenditures, including those on public services and welfare, rise significantly. This trend underscores the growing burden on government resources to meet the needs of a larger population. Current expenditures typically cover essential services such as healthcare, education, and social welfare, all of which are directly influenced by demographic changes. Interestingly, the study also finds that population growth does not significantly impact development expenditures. These expenditures, which include investments in infrastructure, research, and long-term projects aimed at economic growth, are not adjusted proportionally to population increases. This limited impact on development spending suggests a potential misalignment that could hinder the country's ability to invest in future-oriented projects crucial for sustainable development. Additionally, the analysis highlights that an aging population substantially increases public spending. This demographic shift leads to higher costs for healthcare and pensions, placing further strain on public finances. As the elderly population grows, the demand for health services and social support intensifies, challenging the fiscal sustainability of the country.

Based on our findings, we recommend the following policies:

1. Implement measures to slow population growth to ease the financial strain on the economy.
2. Ensure that development expenditures are adjusted to keep pace with population growth, to address the needs of future generations.
3. Current expenditures are found to be negatively and significantly related to the unemployment rate, while development expenditures show no significant relationship. This suggests that increasing current expenditures, without a proportional increase in development expenditures, may exacerbate unemployment by increasing dependence on large family sizes, requiring additional financing through social safety net programs. In the short term, expanding social safety nets could provide immediate relief to affected households. However, for sustainable economic growth and reduced dependency in the long run, it is recommended that the

government prioritize an increase in development expenditures. This would stimulate job creation, improve infrastructure, and ultimately reduce the need for extensive welfare support.

4. Focus on improving the efficiency of public spending to make the most out of available resources and reduce waste.

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Appendix

Table A1: Effect of Dependency (without Log Population). Long run ARDL estimates: Dependent variable: Log Real Total Expenditures

	Model 4 Young Dependency	Model 5 Working Age	Model 6 Old Dependency
Lag structure	2 0 0 1 1 0 1 0	2 0 0 1 1 0 1 0	1 2 0 0 0 2 0 0
Population (<15 % Total)	-0.089		
Population (15-65 % Total)		-0.093	
Population (>65 % Total)			0.918***
Log Real GDP	0.953**	1.010**	0.442***
Real Revenues % GDP	-0.041	-0.046	0.069**
Real Effective Exchange Rates	0.001	0.001	-0.003***
Trade Openness	0.070***	0.075***	0.027***
Inflation Rate	-0.051**	-0.054**	-0.009**
Unemployment Rate	-0.083	-0.082	-0.038
ECM(-1)	-0.234***	-0.218***	-0.708***
Autocorrelation Breusch-Godfrey LM Test: P-value	0.338	0.351	0.132
Heteroskedasticity White Test: P-value	0.429	0.429	0.429
Pesaran/Shin/Smith (2001) ARDL Bounds F-Test	3.651	3.587	5.922
Bound F-Test Critical Values at 5%	2.32 – 3.50	2.32 – 3.50	2.32 – 3.50