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Impact of Demographic Transition on Economic Growth of Pakistan

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Abstract
Demographic transition is a crucial determinant of long-term economic growth because changes in population structure influence labor supply, productivity, savings, and investment. This study examines the impact of demographic transition on economic growth in Pakistan using annual time-series data from 1988 to 2023. A comprehensive Demographic Index (DI) is constructed through Principal Component Analysis (PCA) by incorporating population growth rate, fertility rate, life expectancy, dependency ratio, working-age population, population aged 65 and above, and inverse population density. The Autoregressive Distributed Lag (ARDL) approach is employed to analyze both short-run and long-run relationships between demographic transition and economic growth, while labor force participation, education expenditure, health expenditure, foreign direct investment, and inflation are included as control variables. The empirical findings confirm the existence of a long-run relationship among the variables. The results reveal that the demographic index has a negative and significant effect on economic growth, indicating that Pakistan has not

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yet fully transformed its demographic changes into a demographic dividend. Conversely, education expenditure, health expenditure, foreign direct investment, and labor force participation positively contribute to economic growth, whereas inflation exerts a negative effect. The error correction term is negative and statistically significant, confirming the stability of the long-run equilibrium relationship. The study concludes that demographic transition alone cannot guarantee economic growth unless supported by effective policies aimed at human capital development, employment generation, and investment promotion. Therefore, Pakistan should focus on improving education and healthcare services, creating productive employment opportunities, and strengthening investment-friendly policies to convert its demographic potential into sustainable economic growth.

Keywords: Demographic Transition, Economic Growth, Principal Component Analysis

Background of the Study

Economic growth is an important goal of all developing countries, with a direct impact on living standards, jobs and national development (Dragoi 2020; Cristea et al., 2021) . Demographic transition is one of the most significant but lesser-known factors of economic growth. Demographic transition is a transition towards lower fertility and mortality levels which brings about structural change of the population, especially in terms of the proportion of the working-age population. This demographic shift offers an opportunity and a challenge for economic development, contingent upon a country's ability to harness its demographic structure (Warf 2026; Bazaluk 2025; Stolnitz 2017; Bongaarts & Hodgson 2022).

In this respect, demographic transition in developing countries can produce a demographic dividend that results from an increase in the size of the working age population compared to the dependent population, which can lead to better economic growth, savings, investment, and productivity. Consequently, this age re-structuring may help boost economic performance in three ways: increasing the labor supply, raising household savings, and better capital accumulation (Cruz & Ahmed 2018). The achievement of this dividend, however, is by no means automatic and hinges critically on the availability of sufficient employment, quality education, and accessible health care services. If these supporting conditions are fragile, then the growing workforce could be out of or underemployed jobs, either of which will ultimately lead to less productivity and more economic pressure, so less economic growth. In this context, the demographic transition could, instead of being a blessing, become a burden.

A demographic conditionality is well reflected in the empirical literature. For example, the demographic dynamics have been found to have a significant impact on economic growth in Pakistan, but their positive impact is subject to complementarity with economic and institutional policies (Zahid et al., 2025). Likewise, Ahmed and Ahmed (2024) state that demographic transition has positive impacts on growth provided it has adequate human capital development and labour market absorptive capacity. Cruz

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and Ahmed (2018) also show at the global level that, under the right investment conditions in education, health and employment, demographic change can generate a poverty reduction and boost economic growth. Hence it is clear that the impact of demographic transition in developing countries is very conditional and depends on policy frameworks to leverage population changes into sustainable economic growth.

This is especially pertinent in the case of Pakistan where it has a huge and growing population. At present, Pakistan is one of the most populous countries in the world with a population of more than 240 million, being the 5th largest human capital base in the world (World Bank, 2025). The country has undergone a gradual demographic transition where the proportion of working age group (15-64 years) population now accounts for almost 60-64% of total population, still high proportion of the youth and comparatively low proportion of elderly (UNFPA Pakistan, 2022; World Bank, 2025). Furthermore, there has been a gradual decrease in fertility with a total fertility rate of approximately 3.3 births per woman (World Bank, 2025). Although these demographic benefits exist, Pakistan has still not been able to tap into its expanding pool of labour and is burdened with severe difficulties in terms of job creation, declining industrial productivity and persistent skill mismatches in the labour market.

Meanwhile, the economy of Pakistan is not doing particularly well considering the level of the population. It is around USD 1500 - 1700 per capita GDP, which is low when compared to the regional countries, and also is very low in terms of productivity (World Bank, 2025). Furthermore, GDP growth has been somewhat weak and volatile in recent years, averaging between 2–3%, mainly due to macroeconomic instability, inflationary pressures and external debt constraints (IMF, 2025). Inflation has also been on a high level, frequently above 20% in the peak periods and double digits (State Bank of Pakistan, 2024-2025) which has hurt real incomes and purchasing power. Further, youth unemployment is still a structural issue which hampers the country to tap into its vast working-age population. These indicators all point to a significant gap between Pakistan's demographic needs and its economic performance and underscore the importance of policies that emphasize education, skill development, job creation and investment promotion to turn the demographic potential into sustainable economic growth.

Based on this background the empirical literature has mixed findings on the impact of demographic change on economic growth. On the other hand, several studies have suggested that a positive relationship between demographic transition and economic growth – if countries can leverage the demographic dividend by investing in human capital, labor market efficiency and productivity – is driven by this transition.Demographic transition is argued to have a positive impact on economic growth, as countries make improvements in human capital, labour market efficiency and investment. Theoretically and empirically, a larger share of the working-age population is associated with improved productivity, saving and capital accumulation, leading to improved economic performance in the long run (Galor, 2005; Becker et al., 1990). Furthermore, recent cross-country evidence shows that favorable age structures combine with the right policies such as expansion of education and labor market absorption, with substantial increases to economic growth (Crombach & Smits, 2021;

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Gupta & Chander, 2024). Furthermore, according to the results of the analysis of foreign direct investment and trade openness carried out in global panels, demographic structure plays a significant role in shaping the outcomes of economic growth across countries, particularly in these regards (Srdelic & Dávila-Fernández, 2025).

Other researchers, however, suggest that demographic trends could turn out to be negative or neutral for economic growth, in countries with low levels of structural change and limited ability to absorb new entrants to the labor force, such as developing economies. When job creation and skill formation are lagging behind this rapid population growth, it can lead to higher unemployment, pressure on public resources and lower per capita income in such environments. In recent years, there is evidence that without proper institutional quality, education and health investments fail to produce economic results and can even reduce the growth performance due to demographic growth (Ali & Rehman, 2024; Cruz & Ahmed, 2018). The effects of demographical changes on economic growth are thus highly conditional, relying on human capital formation, macroeconomic stability and productive absorption of the larger labor force in the economies.

Statement of Problem

Pakistan is in a critical demographic phase of transition, marked by an increase in working age population, decrease in fertility and mortality rates, in theory, the demographic dividend, and its positive impact on economic growth by increasing the labor force, savings, and productivity. Yet, in the face of these positive demographic trends, Pakistan has failed to achieve sustained economic growth and structural concerns such as low GDP growth, unemployment (especially in the youth) and human capital development, inflationary pressures and limited investment inflows remain. This is an important empirical question, does demographic transition in Pakistan help in economic growth or structural and institutional factors are dampening the potential gains of demographic transition. Some literature supports the positive role of demographic change when bolstered by strong education, health and labor market conditions (Becker et al., 1990; Galor, 2005), while others suggest that it may have negative or negligible impacts in developing countries with weak labor markets and institutions (Afzal, 2009; Zahid et al., 2025). Hence the main issue of this study is, in Pakistan the effect of demography transition on economic growth is still ambiguous and need empirical evidence and analysis with advanced econometric tools and a comprehensive demographic index.

Objective of the Study

Primary aim of this study is to empirically test the effect of demographic transition on the economic growth of Pakistan by developing a comprehensive demographic index and conducting its short and long term impact through advanced econometric methodologies.

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Significance of the Study

The study is important because it gives an empirical and detailed study of the linkage of demographic transition and economic development in a country that is going through rapid demographic transition such as Pakistan. The study provides a more comprehensive and reliable picture of the effect of demographic factors on economic performance by building an extensive demographic index and using advanced econometric methods. The findings are significant for policy makers as they will help determine if Pakistan is having a demographic dividend or burden because of structural issues like unemployment, less human capital development, and less investment inflow. Moreover, the country specific evidence in the study can be used to design effective policies in Pakistan that would relate to population planning, education, health, labour market reforms and investment promotion to realise sustainable economic growth from demographic potential.

This research paper has five chapters. The introduction is found in the first chapter, and it contains the background of this study, a problem statement, objectives and the significance of this study. The theoretical and empirical literature relevant to the study of demographic transition and economic growth is summarized in Chapter 2 in great detail, with a particular focus on the results of past research and the gaps this study fills. The data and methodology applied in the study is explained in Chapter 3 including the development of the demographic index using Principal Component Analysis (PCA) and the econometric techniques used such as the ARDL approach. The empirical findings and discussion are discussed in Chapter 4 and comprise descriptive statistics, correlation analysis, unit root tests and the short-term and long-term ARDL estimates. Finally, Chapter 5 provides the conclusion of the study along with policy recommendations based on the empirical findings.

Literature Review

The cause and effect relationship between demographic transition and economic growth is a key prior research question in development economics. Demographic transition is the change in fertility rates which is changing high fertility and high mortality rates to low fertility and low mortality rates and such transition slowly alters the age structure, dependency ratio, labor supply, savings behavioral patterns, and human capital formation of a country. In developing nations, such as Pakistan, where a high number of young people is joining the labor market, it is commonly referred to as a transition that may or may not result in a Demographic dividend, or may widen the unemployment, poverty, and strain on services offered by the government. Literature on this subject can be split into two broad strands which are: theoretical literature which establishes the channels by which demographic change has an effect on growth and empirical literature that test such associations on cross-country and within Pakistan.

Theoretical Literature Review

The theoretical relationship between demographic transition and economic growth has received wide coverage in the literature of economics, demography, and development.

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Demographic transition is a permanent transition of a regime in which fertility is high and relatively high mortality is high to one in which fertility is low and fairly low mortality is low and changes the age distribution of a population, affecting economic performance in terms of labor supply, dependency burden, savings, human capital and structural change. Demographic transition in economic theory is not perceived as a populous phenomenon but as a core process, as a result of which societies can pass the road to low-income stagnation and to stable economic development. This change gains crucial significance in the case of developing nations like Pakistan where the huge and rising youth population offers it not only a chance to grow faster, but also a threat in the form of economic strain unless meaningfully utilized. According to the literature, the economic importance of demographic transition does not necessarily consist of the population size; it comprises the composition, productivity, and the age-structure shifts (Ranganathan et al., 2015; Cervellati and Sunde, 2019).

The Malthusian view is one of the earliest theoretical approaches that have connected population change and economic outcomes; and in doing so, it has largely viewed population growth as a limiting factor in development. Thomas Malthus stated that population is normally increasing at a rate that is greater than the rate of increase of subsistence, which generates pressure on food supply, wages, employment and the use of the state resources. In this context, high population growth rates can lower income per capita and keep the economies in low productivity status. Even though strict Malthusian argument has in latter development theory been disputed, it still can help to understand why high fertility and high growth rates can become an impediment of growth in low-income countries. This view applies to the situation with Pakistan since the continued rise in population can increase the strain on education, labour, housing, health and facilities, and reduce the ability of the economy to enhance productivity and living standards. Therefore, as a Malthusian perspective demographic transition can only be considered economically efficient when fertility starts to fall and dependency pressures start to be held back (Galor and Weil, 1999, 2012; Ranganathan et al., 2015).

A more contemporary suggestion is born out of neoclassical growth theory, and more specifically, the Solow model of growth which considers economic growth as a factor of labor, capital and technological advancements. In this line of thinking, demographic transition has an impact on growth based on the labor force and capital-labor ratio. The labor force increases over time as the number of survivors who live longer lives in spite of declining mortality. Subsequently, as the fertility rate decreases, the ratio of working-age population to the dependents increases, which can increase the output and national income. Nonetheless, the neoclassical theory also highlights the point that the increase of the labor force alone is not sufficient to achieve the growth of the per capita income. When labor increases at a higher rate than capital accumulation, then capital per worker decreases, productivity declines and there is a low rate of growth. This is commonly known as capital dilution. Thus, neoclassical arguments suggest that demographic transition can be used to support the growth of an economy only when the working-age population is augmented by an adequate investment in the physical capital, infrastructure, industrial growth and technology. In

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the case of Pakistan, this especially applies since a vast amount of youth would only binge the growth rates when the economy has the capacity to generate useful jobs and increase investment rates (Barro, 1991; Ranganathan et al., 2015).

An alternative useful theoretical perspective of demographic transition and economic growth is the human capital approach. This viewpoint, which is related to Becker, Schultz, and Lucas, states that the development of an economy is not predominantly based on the amount of labor but the quality of such labor. With the less fertility, greater investment is more likely to be made by the household towards education, nutrition, and health of the children. This phenomenon of replacing many children with better educated and healthier children is a manifestation of the so called quantity-quality trade-off developed by development economists. The demographic transition in this context enhances the growth in the long run by making the future workers more productive, particularly by better human capital formation. This theory is very important to countries like Pakistan, where the levels of educational attainment and productivity at the workstations are a major issue of development. This suggests that the real economic benefits of demographic transition of greater working-age population does not automatically attend on the greater numbers of population, but rather on the quality to which that population is made skilled, healthy and employable. Unless Pakistan can enhance the quality of education and health performance in the transition, the demographic opportunity is not likely to be translated into a sustainable economic development (Becker et al., 1990; Galor, 2005).

The life-cycle hypothesis is closely related to human capital theory since it describes how demographic transition can impact on economic growth by altering the behavior of savings and investment. Life-cycle model which was developed by Modigliani and Brumberg indicates that people consume and save differently at various ages. The dependent consumers are usually the children and the older adults, income earners and savers are working age adults. In case demographic transition reduces the fertility rate and increases the proportion of individuals of working age in the population, there are higher chances of an increase in the aggregate rate of savings since a larger fraction of the population is working and earning. Increased savings can subsequently generate domestic investment, capital formation and long run economic growth. This theoretical direction is particularly significant in developing economies as it makes the change of age-structure directly related to the macroeconomic performance. The applicability of this theory in Pakistan is that, as the number of working-age people rises, then the level of household and country savings may be enhanced, as long as the employment and income production are high. Nevertheless, when there is the growth of labor forces with unemployment or low wages, the channel of saving can be weak even in favorable demographic environment (Ranganathan et al., 2015; UNFPA Pakistan, 2022).

An influential theory in recent development literature is the theory of the demographic dividend that postulates that demographic transition can have created a momentary, yet strong window of opportunity in economic growth. According to this theory, when the fertility is decreasing and the mortality was already reduced, the population structure will shift in a manner that the working-age proportion of the population will

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be high and the dependency ratio will decrease. This develops conducive growth opportunities in a number of intertwined avenues. To begin with, more individuals of working age also lead to an increase in the labor force and the level of production. Second, reduced child dependency enables the family and government to pay lesser on the basic dependency needs and invest more in productive investment. Third, low fertility tends to enhance women in the capacity to engage in education and paid labor, hence expanding effective labor force. Fourth, the reduced dependency cost (burden) allows more expenditure results in education and health per child, enhancing future productivity. The demographic dividend theory particularly applies to the Pakistan case due to the fact that the nation is commonly known to undergo a high youth bulge and open demographic opportunity. The theory however clearly focuses on the fact that the dividend is not automatic as well. It needs good public policy, especially in education, health, family planning, skills development and job creation. The absence of such institutional support, a demographic dividend will be easily transformed into a demographic burden, characterized by unemployment, poverty, and social pressure (UNFPA Pakistan, 2022; UNFPA Pakistan, 2017).

The other theory that is of great relevance is the Unified Growth Theory which in most part is related to Galor which tries to describe how the long run growth can occur out of stagnation by incorporating the demographic behavior, technological change, and human capital accumulation. This theory posits that high fertility and low productivity in the early period of development is a rational reaction to economic factors and is more successful in the agrarian economy, where direct economic value is taken by the size of the family and the child labor as the factors of direct production. Nevertheless, with the growth of technological achievements and growth in the returns to education, there is some change in which the families are not focused on the number of children but focused on the quality of children. This change results in a decrease of fertility rate, increased investment of education which ultimately results into increased productivity and economic growth. Unified Growth Theory is especially applicable to the case of Pakistan since the theory can be used to understand the reasons why demographic transition should be considered as a part of a larger process of modernization, comprising urbanization, education, change in the labor market, and structural transformation. It also gives the reasons as to why growth in the economy and decline in fertility tend to be reinforcing rather than isolated. Demographic transition is both a cause and a consequence of development in this perspective, and the effects of its growth are heightened in the presence of technological and institutional advancement (Galor, 2005; Cervellati & Sunde, 2019).

Female education and female involvement in the labor force are also accorded significant focus in theoretical literature in terms of them being a channel through which demographic transition impacts growth. Theorists of development in general tend to relate falling fertility with education, independence, and economic empowerment of women. With declining fertility women are likely to have less time in repeated child bearing and unpaid care work and thus it is more possible to experience further schooling, skills acquisition and also enter the workforce. This would boost economic growth due to labor force participation, household income and

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productivity. Furthermore, female education in itself has also been linked with reduced fertility, better child health and more investment in human capital, further justifying the demographic transition process. This avenue is particularly important to Pakistan since among the largest constraints towards the complete realization of demographic benefits is the low rate of women being utilized in the labor market. According to the theoretical literature, however, the demographic transition in Pakistan cannot be solely explained without referring to the gender aspect of growth, fertility decline, and change in the labor force (Ranganathan et al., 2015; UNFPA Pakistan, 2022).

Combined, the theoretical literature depicts demographic transition as a multidimensional process with tremendous consequences on economic growth. Demographic transition acts through a mixture of changes in labor supply, a decline in dependency ratios, an increase in savings, higher levels of human capital, enhanced female participation, and structural transformation as opposed to working through just one channel to influence growth. Nonetheless, the theories also always note that demographic transition is conditional in its growth impacts. It is not a sufficient condition to follow prosperity, rather, it opens the prospect of quicker growth that has to be materialized by help of supportive institutions and development policies. The above theoretical understandings are especially relevant in the context of Pakistan where the nation is undergoing a demographic transition where a huge working age population can be either a source of economic pressure or a powerful development driver. Thus, the theoretical background clearly underpins the thesis statement that demographic transition must be viewed as one of the leading factors of long-run economic performance in Pakistan, in particular, when analyzed within the context of education, employment, gender inclusion, and investment dynamics (UNFPA Pakistan, 2017; Ranganathan et al., 2015).

Empirical Literature

Empirical research on demographic transition and economic growth has grown dramatically in recent years, especially since 2015, as the researcher community has started to consider more closely how age structure, fertility decline, labour force structure, and dependency ratios instead of the traditional variables explained the long-term development outcome. Previous empirical literature tended to focus on the general impact of population growth on economic performance, however, more contemporary research revealed that the composition of the population is more crucial than the size. Demographic transition, in this context, can be thought of as a process that influences economic growth in a number of channels that are interdependent, such as supply of labor, human capital, savings behavior, urbanization, as well as the participation of female workforce in the labor force. In the context of developing nations like Pakistan, these problems are of particular concern due to the fact that the nation currently faces a massive youth bulge, and a trend to switch towards the aging demographic, which may bring about or cause a demographic dividend in case of ineffective management, or lead to economic stressors (Ranganathan et al., 2015).

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Among the significant research works in this field, we have the work by Ranganathan et al. (2015) who studied the association between demographic transition and the level of development of various countries and discovered that demographic shifts are at the center of economic transition. Their analysis has suggested that falling fertility and mortality are linked with age structure change which may enhance productivity and growth with the help of effective institutions and social investment. Their contribution is of value especially in the sense that they shifted the discussion beyond the cultural issue of too much population to the issue of actually using an issue of the age structure of a population as a factor in development. The fact applies to the case of Pakistan since not the number of people in the country is significant to its growth, but the number of healthy, educated, and economically active ones.

Within the Pakistan context, one of the most specialized empirical analyses to be undertaken, subsequent to 2015 was the one by Khan et al., (2016) who studied the association between the changing demographics and the economic growth via annual time-series data on Pakistan. Using econometric estimates like the adoption of Johansen cointegration and the variance decomposition, study reported a statistically significant long run relationship between the demographic variables and economic growth. Their results revealed that demographic variables affect the growth curve of Pakistan, especially the age structure and the labour force structure. This paper is valuable in that it offered a provisional country-specific empirical evidence implying that demographic variables must be viewed as primary sources of explaining the process of Pakistan as opposed to merely reflecting on the population in the background.

The other significant line of empirical literature has concerned the contribution of human capital and age structure to growth. As an example, Ahmad and Khan (2018) investigated the role of demographic variables and human capital in developing countries and discovered that disaggregated demographic variables, in particular, working-age population and dependency ratios, are more effective in explaining growth than aggregate population growth. According to their research, only age structure that is favorable and comes with increases in education and labor productivity can lead to growth. The observation is particularly pertinent to Pakistan where a substantial proportion of the populace falls within the young age move, although issues regarding teaching quality, lack of ability, and low production of labor are expressed.

Recent research has also grown more advanced in terms of methodology, as well as yielded more subtle results on Pakistan. To illustrate, Ahmed and Ahmed (2024) re-examined the connection between demographic transition and economic progress in Pakistan through Time-Varying Vector Autoregressive (TVP- VAR) model. Taking 1972-2020 annual data, they revealed that the impact of demographic transition on the Pakistani economy is not linear over the years. The relationship is, instead, different at various macroeconomic times implying that demographic transition may have a greater or lesser influence on in relation to the labor market, policy and economic stability. This paper is significant in the sense that it proves that demographic variables are not independent; their influence on growth is conditioned by the wide-

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scale structural preconditions. To Pakistan this implies that the same demographic pattern can yield varying economic results in various policy settings.

Park and Shin (2026) studied how population aging plays with the silver dividend and economic growth and discovered that aging tends to slow down the economic growth because it reduces the labor force productivity (TFP) and labor force growth. Though, the paper also states that some of these adverse impacts are mitigable provided that the aged, women, and other underutilized categories of the population are kept in the labor force longer. According to their idea of the silver dividend, even the aging societies can be used to drive economic growth by extending working years and promoting improved policies of productivity. This work is applicable to Pakistan since, as the country is still young, it demonstrates the need to plan the long-run consequences of economic transition, which is demographic (Park & Shin, 2026).

The other recent addition is the work done by Mudassar and Yiridoe (2024), who investigated the impact of longevity on economic growth in Pakistan and adjusted the changes in demographic transition. Through the ARDL bounds testing approach, they found out that increasing life expectancy can be meaningfully applied to the growth of the economy, but with greater meaning when the same is put in the greater context of demographic transition. They believe that long-term growth can be supported through health and survival rates that increase labor productivity and human capital accumulation. This is exceptionally applicable to the case of Pakistan since fertility decline is not the sole factor that leads to demographic transition, mortality reduction and increased health outcomes also contribute to the same.

The empirical data has also attributed demographic transition to be associated with urbanization and structural change which are among the main ways, through which population change influences growth. In this aspect, Khan and Sarwar (2024) studied the nexus between agglomeration, urbanization, and economic prosperity in Pakistan through an ARDL method. Their findings reveal that urban concentration and agglomeration economies have the potential to be a positive factor to the prosperity of a region in the long-run, but rapid urban growth in a location without the infrastructure necessary to enforce these gains may also undermine it in the short-term. This article can be used in research on demographic transition since many studies conclude that the labor demands of an increasing number of individuals of working age tend to be conditional on whether employees were absorbed into productive metropolitan activities. It is particularly an important channel in Pakistan where demographic change is becoming a process closely related to migration and urban growth.

Zahid et al., (2025) are a highly timely and relevant empirical addition since it allows examining demographic trends and economic development in Pakistan based on annual data between 1972 and 2023 and on the basis of the Autoregressive Distributed Lag (ARDL) model. They find that demographic factors which are population density, labor force to working-age population ratio, and the overall dependency ratio are negatively correlated with the GDP per capita growth in the long-run, when the growth is not backed by productive economic structures. Meanwhile, they discovered that education, gross domestic savings and life

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expectancy are beneficial to growth. This work has a great significance as it directly helps to argue that there are positive and negative aspects to demographic transition in Pakistan. It strengthens the point that demographic transition can only be economically fruitful when it is enhanced by education, mobilization of savings and efficiency of labor markets.

Cruz and Ahmed (2018) make a valuable contribution to the existing body of literature on the subject of demographic transition since they focus on understanding the impact of the population age structure changes on economic growth and poverty in countries. With data size of 180 countries in the year 1950-2010, the authors observed that an increasing proportion of the work age population has a considerable positive impact on the growth of GDP per capita besides reducing poverty. Their analysis demonstrates that economic gains of demographic change are largely comprised by the fact that a decrease in child dependency decreases the dependency burden in households and governments and permits more resources to be used in productive areas like education, health, savings and investment. The research also implies that the demographic transition has the potential of generating demographic dividend in situations where the labor force increases in respect to dependents, these benefits are not automatic and require enabling policies like creating jobs, building human capital, and efficiency in the labor market. The results of the research are highly applicable to Pakistan due to the fact that the nation is presently facing a surge in the number of young people as well as working-age, and this may be turned into a source of economic growth and poverty alleviation in case these phenomena are dealt with in an appropriate manner with the help of proper social and economic policies (Cruz & Ahmed, 2018).

Besides Pakistan-related research, empirical evidence regarding demographic transition in developing and South Asian economies is wide-ranging and also indicates the presence of a conditional association between demographic transition and growth. Readings on developing nations always indicate that decreasing fertility, decreasing dependency, and increasing working transactions can help to grow by increasing workforce participation, saving and productivity. Nevertheless, when the countries are characterized by high unemployment among young people, poor educational systems, and low female participation in the labor force, these gains become much lower. Such a comparative evidence can be used in Pakistan since it demonstrates that demographic transition in the country can not be examined in a vacuum; this transition must be judged relative to the experience of other countries that have managed to obtain or missed the demographic dividend.

A critical examination based on the empirical literature demonstrates that there is a number of unanimous conclusions of the literature. To begin with, the majority of studies find that demographic factors of fertility, life expectancy, age structure, dependency ratio and labor force structure have significant effects on economic growth which are statistically significant. Second, there has been growing literature focus on how the working-age population, as opposed to the quantity of population, matters. Third, according to the literature, it is the most significant transmission mechanisms through which human capital, savings, and absorption of labor markets

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are transmitted; through which demographic transition can influence growth. Fourth, the recent evidence indicates that demographic transition and growth in Pakistan are not necessarily automatic and universally positive, but time-varying and policy-dependent. Lastly, it is strongly indicated by the existing empirical literature that Pakistan has still a potential demographic opportunity although this opportunity is still conditional to a successful investment in education, employment generating opportunities, health sector, and structural change.

In general, evidence in the existing empirical literature backs the idea that demographic transition can moderate but significantly affect economic growth in Pakistan. Although an increasing working population age, reduced dependency rate, and increased life expectancy can give good conditions to allocate growth, these are benefits that are not assured. Devoid of quality teaching, productive work, inclusion of female workforce, adequate saving and investment, demographic transition might on the contrary produce unemployment, low labor productivity and social pressure. Hence, the empirical data implies that the demographic transition in Pakistan is to be discussed as the strategic development issue, but not as the population trend only.

Research Gap

Although certain literature is increasing on the demographic transition and economic growth, there are various gaps especially in the Pakistani context. To begin with, the majority of international researchers, including Cruz and Ahmed (2018) or Park and Shin (2026), employ cross-country data, and this factor restricts the relevance of their results to Pakistan because it has a different demographic, economic, and institutional setting. County-specific articles, such as the ones by Khan et al. (2019), Ahmed and Khan (2018) also deal less with the description of demographic transition in general, i.e., the age structure, the share of working-age population, fertility, and the life expectancy, and more with the extent of population growth or dependency.. Second, there are numerous Pakistan-specific studies based on more old data or that were too old to be used according to current demographic and economic transformations i.e. increasing urbanization rates, the older generation youths labor strains as well as altering fertility rates. The period investigated by Khan et al. (2019) (1990-2017) might not be connected to the real demographic and economic conditions at present. Third, most research does not unmistakably study how demographic transition influences economic growth, including labor force participation, human capital formation, savings, and productivity (Cruz and Ahmed, 2018; Chen et al, 2026). Also, as research materials such as Park and Shin (2026) and Chen et al. (2026) have indicated the problem of aging populations, little research has focused on the policy implications of demographic transition to a nation such as Pakistan which is presently in a situation where it experiences a high population of youths..

Contribution of the Study

This research contributes to the literature in a number of ways. First, it makes a conceptual addition focusing on demographic transition instead of growth in population, the impact of age structure, working-age population, fertility decline, and

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life expectancy on economic growth (Khan et al., 2019; Cruz & Ahmed, 2018). Second, it makes an empirical contribution since it encompasses more recent and country-specific data on Pakistan which reflects the recent demographic patterns and economic developments, while former studies did not (Afza 2009; Ahmed and Khan, 2018). Third, the study offers analytical contributions since it correlates demographic transition with growth using explicit avenues including labor force participation, human capital accumulation, dependency burden and savings behavior. The method enhances appreciation of the effect of demographic changes on economic performance and their causes. Fourth, it offers policy-relevant implications, especially on Pakistan, of the effectiveness of investment in education, job creation, and entry into the workforce as a means of the country leveraging the present demographic dividend and planning against the issue of aging (Park and Shin, 2026; Chen et al., 2026). All in all this research fills the gaps in the literature as it includes a very elaborate, recent, and context-pathological analysis of demographic transition and its economic consequences as it relates to Pakistan.

Research Methodology

The methodology used to explore the effect of demographic transition on economic growth in Pakistan is explained in this chapter. It covers the theoretical background, sources of data, descriptions of the variables, specification of the model, the construction of the demographic index using Principal Component Analysis (PCA) and the econometric methods used for the study. The chapter also provides explanation on testing stationarity, cointegration, short run and long run relationships among variables. The methodology aims to support the availability of strong empirical evidence on the role of demographic transition in economic growth in Pakistan.

Model of Study

In line with the demographic transition and economic growth literature, the model of economic growth is assumed to be mediated by demographic transition, labor force participation, inflation, health expenditure, education expenditure and foreign direct investment. The functional form of the model is written as:

$$Y_t = \alpha_0 + \alpha_2 DI_t + \alpha_3 LF_t + \alpha_4 INF_t + \alpha_5 HE_t + \alpha_6 EE_t + \alpha_7 FDI_t + \epsilon_t$$

Table 1: Variables of Study

Variables	Proxy		Symbol	Data source
Economic Growth	GDP per capita growth (annual %)		Y	WDI
Demographic Index	Poulation Growth Rate Fertility Rate	PG FR	DI	

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	Life Expextancy at birth	LE	
	Dependency ratio	DR	
	Working Age Population (15 - 64)	LPD	
	Population Age 65 +	AP	
	Inverse Population Density	IPD	
Health Expenditure	Current health expenditure (% of GDP)		HE
Education Expenditure	Expenditure on tertiary education (% of government expenditure on education)		ED
Inflation	Inflation, consumer prices (annual %)		INF
Labor Force	Labor force participation rate for ages 15-24, total (%) (national estimate)		LF
FDI	Foreign direct investment, net inflows (% of GDP)		FDI

Construction of Demographic Index

Demographic transition is a multi-dimensional process, and cannot be captured by a single variable. For this reason in this work the author has created the composite Demographic Index (DI) by Principal Component Analysis (PCA).

PCA is a method that compresses a set of correlated variables that measure different aspects of a subject into a smaller number of linear combinations, called principal components, that also capture as much information in the original variables as possible.

The general PCA model is:

$$PCi = a1X1 + a2X2 + a3X3 + \cdots + anXn$$

Where:
PCi = Principal Component
ai = Eigenvector weights
Xi = standardized demographic variables.

To build the Demographic Index PC1, which captures the greatest between-group variation in demographic variables, is used.

$$DI = \sum_{i=1}^{n} w_i z_i$$

Where:
DI = Demographic Index
wi = PCA weights from PC1
Zi = Standardized demographic variables

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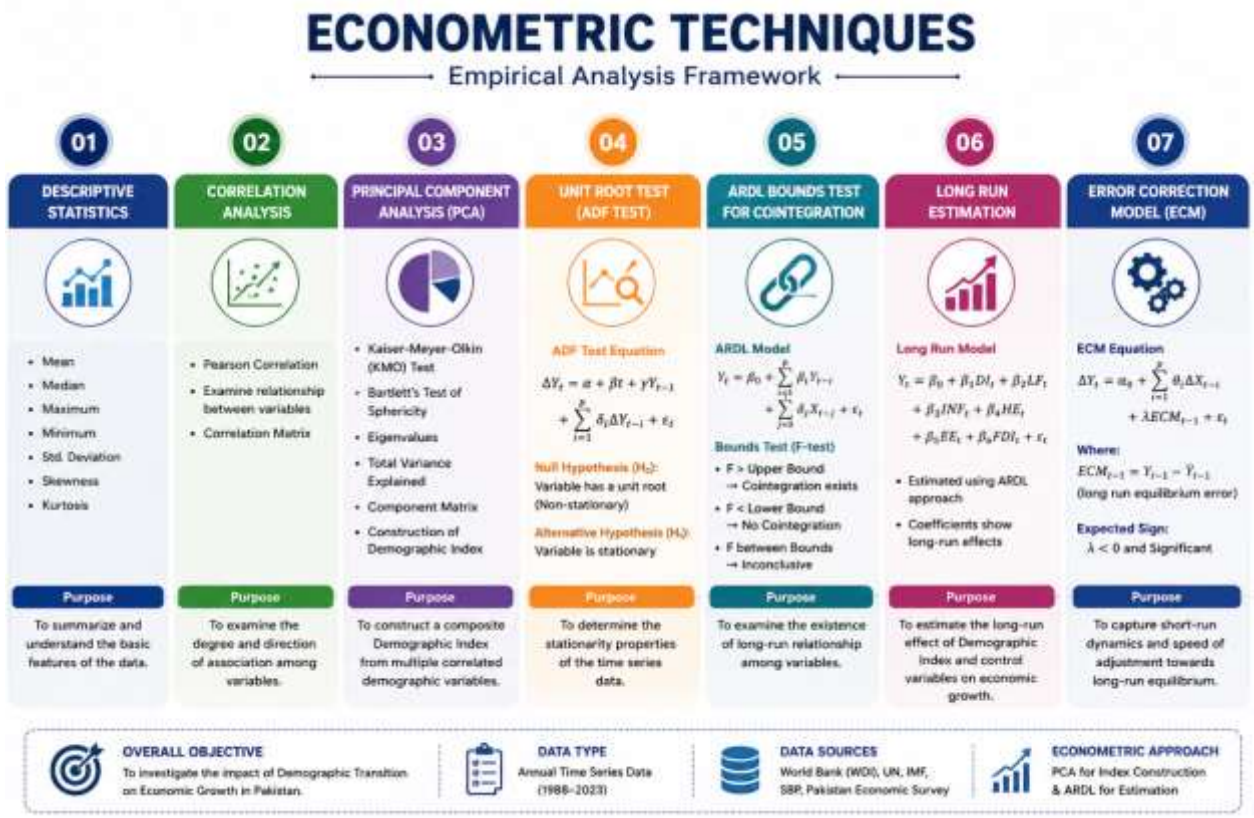
Figure 1. Econometric Techniques



Data Analysis

This chapter discusses the empirical analysis of the study "Impact of Demographic Transition on Economic Growth in Pakistan. The major aim of this chapter is to analyse the relationship between demographic transition and economic growth through the suitable econometric methods. This analysis starts with descriptive statistics to give an overview of the characteristics and distribution of variables selected. The trends and patterns of demographic and economic indicators over the period of study are then illustrated using graphical analysis. To check for reliability of the results, the stationarity properties of the data are examined by using the unit root tests. Once the order of integration is determined, an appropriate econometric method is used to estimate the long-run and short-run relationships between the variables. The results of the empirical study are interpreted and discussed within the framework of the theory and previous literature. The chapter thus makes a comprehensive evaluation of the impact of demographic transition on economic development of Pakistan and suggests useful suggestions supported through evidence for policy making and economic planning in Pakistan.

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Table 2: Descriptive Statistics

	Y	LF	INF	HE	EE	FDI	DI
Mean	1.60	40.96	9.65	2.47	16.86	0.91	45.84
Median	1.50	40.63	9.50	2.41	14.43	0.70	38.66
Std. Dev.	2.066	2.05	5.59	0.22	4.52	0.64	31.44
Skewness	-0.089	-0.08	1.62	0.68	1.24	2.14	0.32
Kurtosis	2.542	3.10	7.08	3.07	4.56	6.92	1.713
Observations	36	36	36	36	36	36	36

The descriptive statistics show that the economy of Pakistan grew on the average by 1.60% during the period under study while the average labour force participation rate was 40.96% which was relatively stable. The inflation was 9.65% with a very large standard deviation of 5.59, indicating that there were significant fluctuations. Health expenditure has relatively low mean of 2.47 and education expenditure had moderate mean of 16.86 with little variation across time. Foreign direct investment had an average of 0.91% as investment of foreign capital was restricted, and there was considerable variation in the demographic index, which had a mean value of 45.84, reflecting significant demographic changes over the time period. The skewness values indicate that most of the variables are skewed to the right, in particular inflation and FDI, suggesting that the proportion of extreme values is greater, whereas the variables of economic growth and labor force are more or less symmetrical. In addition, the values of kurtosis suggest that both inflation and FDI are highly leptokurtic, which means that there can be a lot of volatility and outlier values. The descriptive results indicate that there are significant differences in demographic and macroeconomic indicators and this implies that further econometric analysis is warranted for analyzing impacts of the demography changes on economic growth in Pakistan.

After descriptive statistics analysis, the next step is to create the Demographic Index (DI) by the Principal Component Analysis (PCA) technique. PCA is a multivariate statistical technique which uses multiple demographic indicators to create a composite index based on the principal components that account for the greatest variation in the data. The aims of using PCA is to reduce the number of dimensions in the demographic variables but not to lose most of the important information about the demographic transition. The weights given to each principal component based on the variance explained by that component, allows PCA to create a comprehensive demographic index that gives a good idea of the overall demographic conditions of Pakistan. This index is then used in the econometric analysis to explore the relationship between demographic transition and economic development, and to offer a more reliable way of measuring the demographic transition than using individual demographic variables in isolation.

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Table 3: Correlation Matrix

	AP	DR	FR	IPD	LE	PG	WAP
AP	1.00	-0.86	-0.78	-0.81	-0.84	-0.55	0.87
DR	-0.86	1.00	0.97	0.97	-0.98	0.86	-1.00
FR	-0.78	0.97	1.00	1.00	-0.99	0.95	-0.97
IPD	-0.81	0.97	1.00	1.00	-1.00	0.93	-0.96
LE	-0.84	0.98	0.99	1.00	-1.00	-0.91	0.98
PG	-0.55	0.86	0.95	0.93	-0.91	1.00	-0.85
WAP	0.87	-1.00	-0.97	-0.96	0.98	-0.85	1.00

It is important to consider the inter-correlation of the demographic variables used to construct the Demographic Index before running the Principal Component Analysis (PCA) because the variables should be sufficiently inter-related. The correlation matrix in Table 3 shows a high correlation between the variables, which meets the important condition for PCA. The results indicate that there is a strong positive correlation between dependency ratio (DR), fertility rate (FR) and inverse population density (IPD) ranging from 0.97 to 1.00. The same goes for indicators of life expectancy (LE), which is strongly negatively correlated with DR (-0.98), FR (-0.99) and IPD (-1.00), which shows the inverse relationship between demographic development and these indicators. There is strong positive correlation between life expectancy (0.98) and working age population (WAP); strong negative correlation between working age population (WAP) and DR (-1.00) and FR (-0.97); AP (0.87) is also strongly positively correlated with WAP. Like population growth (PG), most of the variables show large correlations, most notably with FR (0.95), IPD (0.93) and LE (-0.91). In general, the positive and negative correlations are high, which indicates that the demographic indicators contain the same information, and they are able to be reduced in dimensionality using PCA. Thus, all variables selected were kept and the Demographic Index was calculated which reflects the underlying demographic transition in Pakistan.

Table 4: Principal Component Analysis

Variable	PC 1	PC 2	PC 3	PC 4	PC 5	PC 6	PC 7
Z_AP	-0.333	0.753	-0.384	-0.415	0.008	-0.039	0.000
Z_DR	0.39	-	-	0.00	-	0.20	0.70

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	0	0.092	0.545	3	0.097	4	1
Z_FR	0.391	0.172	0.036	-0.069	0.716	0.503	-0.214
Z_IPD	0.391	0.108	0.402	-0.430	0.208	-0.590	0.312
Z_LE	-0.393	-0.011	-0.159	0.488	0.610	-0.363	0.281
Z_PG	0.355	0.609	0.205	0.629	-0.249	-0.051	0.019
Z_WAP	-0.389	-0.111	0.570	-0.059	-0.019	0.470	0.535

The strong correlations among the demographic variables are confirmed and the common variation is extracted by Principal Component Analysis (PCA) and used to create a composite Demographic Index (DI). The factor loadings of the seven demographic variables on the principal components are shown in Table 4. The results show that the first principle component (PC1) accounts for the most amount of variance in the data and is thus adopted for the building of the demographic index. PC1 loadings are positive for Dependency Ratio (DR) (0.390), Fertility Rate (FR) (0.391), Inverse Population Density (IPD) (0.391), and Population Growth Rate (PG) (0.355); and negative for Population Aged 65 and Above (AP) (-0.333), Life Expectancy (LE) (-0.393), and Working-Age Population (WAP) (-0.389). The loadings indicate that higher fertility, dependency, population growth, and population density are correlated with earlier phases of demographic transition, while higher life expectancy, larger working age population, and an aging population are correlated with more advanced phases of demographic transition. The scores of pc1 are combined to make up the Demographic Index (DI) as it reflects the greatest common information from all the demographic indicators. Therefore, the index developed is a complete indicator of demographic transition in Pakistan and is used in the following econometric analysis to analyze the effect of demographic transition on economic growth.

Table 5: Unit Root test

Variables	ADF Test		Results
	Level	First Difference	
Y	-4.53*		
DI	-2.09	-3.35***	

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EE	-2.50	-8.75*
FDI	-3.13**	
INF	-2.91***	
HE	-1.19	-4.65*
LF	-3.64*	

shows 1%, ** shows 5%, *** shows 10% level of Significance

To estimate the econometric model, the stationarity properties of the variables are tested with Augmented Dickey-Fuller (ADF) unit root test. As is seen in the results given in the tabular form of table 5, all the variables have mixed order of integration. The economic growth (Y), foreign direct investment (FDI), inflation (INF) and labor force participation (LF) are found to be stationary at level as their ADF test statistics are significant at conventional levels. The education expenditure (EE) and health expenditure (HE) variables, on the other hand, are I(1) processes despite being non-stationary at level. The education expenditure (EE) and health expenditure (HE) variables, instead, are I(1) processes and non-stationary at level. In particular, the ADF first difference statistics of -3.35, -8.75 and -4.65 do not allow the unit root hypothesis to be accepted. The results indicate the use of ARDL approach for the study of long run and short run relationship between demographic transition and economic growth in the context of Pakistan because none of the variables is of order 2 and combination of I(0) and I(1) variables in the dataset.

Table 6: ARDL Bound Test

			Null Hypothesis: No levels relationship	
F-Bounds Test				
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.062901	10%	1.75	2.87
K	6	5%	2.04	3.24
		2.5%	2.32	3.59
		1%	2.66	4.05

			Null Hypothesis: No levels relationship	
t-Bounds Test				
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-6.560080	10%	-1.62	-3.7
		5%	-1.95	-4.04
		2.5%	-2.24	-4.34
		1%	-2.58	-4.67

The order of integration of the variables is identified and then the ARDL Bounds Test is applied to investigate the presence of long-run relationship between economic

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growth and explanatory variables. The results shown in Table 6 show that the calculated value of F is 5.0629 and the upper critical bound value of F for the 1% level of significance is 4.05, thus it is agreed that the F value calculated exceeds the upper critical bound value of F. This helps to reject the null hypothesis of no levels relationship and establishes that there is a cointegration between the variables. Likewise, the t-Bounds Test confirms this, because the calculated t-statistic is (-6.5601) which is less than the upper t-bound critical value of (-4.67) at the 1% significance level. The stability of the F-Bounds and t-Bounds tests results are supportive of a stable long-run equilibrium relationship between economic growth, demographic transition, labour force participation, inflation, health expenditure, education expenditure and foreign direct investment in Pakistan. Hence, the study moves to estimating long run and short run ARDL coefficients to see the strength and direction of these relationships.

It is important to note that the short run ARDL estimates contained in Table 7 are for the short term effects of demographic transition and other macroeconomic variables on economic growth in Pakistan. The results show that the error correction term is negative and statistically significant which validates that a stable long-run equilibrium exists among the variables. The coefficient values indicate the relationship between the changes in demographic and economic variables to that of economic growth in the short run.

Table 7: ARDL Short Run

ARDL Error Correction Regression
Dependent Variable: D(Y)

ECM Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DI)	-0.589903	0.265674	-2.220403	0.0365
D(HE)	1.225455	3.165986	0.387069	0.7024
D(INF)	-0.282440	0.155929	-1.811334	0.0952
D(LF)	1.470497	0.197008	7.464157	0.0000
D(FDI)	3.954304	0.680653	5.809571	0.0003
D(EE)	0.219013	0.064626	3.388915	0.0080
CointEq(-1)*	-0.847402	0.129182	-6.560080	0.0000

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	43	0

The coefficient of the Demographic Index (DI) is -0.5899 with a significant value of 5% indicating that for each one unit increase of the demographic index, the economic growth will decrease by about 0.59 units in the short run. This negative correlation implies that the country is still undergoing the transition costs which are linked to the demographic transition of the country. While the economy may benefit from an expanding working-age population, rapid population changes can put pressure on public services, jobs and infrastructure before the economy has had the chance to take advantage of the larger working-age population. The increasing size of the labour force could outgrow the ability of the economy to create productive employment, thus limiting growth in the short run. The same results were obtained by Afzal (2009) who has suggested that rapid demographic shifts can be one of the factors which can restrict the economic growth of Pakistan in the initial period and Ahmed and Ahmed (2024) who have concluded that the impact of demographic shifts can differ across the different phases of economic development.

Besides the demographic pressures, macroeconomic stability is also a key determinant of the short-run economic performance. The coefficient of inflation is -0.2824 and it is significant at 10% level ($p = 0.0952$), which means that rise in inflation has detrimental effect on the economic growth in short run. The estimated impact, specifically, is that an increase in inflation by one unit will cause a decrease in economic growth by 0.28 unit. The economic uncertainty and high inflation dampen purchasing power, investing, and production costs can all slow economic activity. Higher inflation in developing countries like Pakistan can adversely affect the welfare of the household as well as stifle sustainable growth. The result confirms Nadeem et al. (2025) and Khalil et al. (2026) who found macroeconomic instability as a big impediment to economic growth.

Labor force involvement in the economy can mitigate some of these negative effects of inflation, but growth will be harmed. The coefficient of labour force participation is 1.4705 and is highly significant at 1 per cent level implying that for every increase of one unit in labour force participation, the economic growth increases by 1.47 units in the short run. This positive link is a reminder of the importance of labor supply for production and economic activity. An increase in the size of the workforce leads to more people to work, better productivity and greater output. The outcome is consistent with the concept of a demographic dividend, which states that economic development is bound to pick up when working-age population grows. The same results were obtained by Ahmad and Khan (2018), where they concluded that human capital development and the expansion of the labor force have a significant impact on the economic growth of developing countries.

In addition to the domestic labour market dynamics, foreign capital inflows are also a significant contributor to economic growth. The coefficient of the foreign direct investment is positive and statistically significant. This means that an additional unit of FDI leads to an increase in economic growth of around 3.95 units in the short run.

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FDI contributes to economic growth through inflow of capital, transfer of technology, know-how and jobs. In Pakistan foreign investment plays its role in boosting industrial development and improving the productivity of the sector, thus facilitating economic activities. This is in line with Nadeem et al. (2025) who asserts that investment is key to economic development.

Likewise, long-run growth is driven by more than just physical investment; it is also dependent on investment in human capital. With a coefficient of 0.2190, education expenditure is statistically significant at the 1% level and the increased spending on education is expected to have a positive impact on economic growth in the short run. A $1 increment in education spending leads to an increase in economic growth of about $0.22. Education boosts the skills of the workforce, improves labour productivity and the capacity for innovation, all of which contribute to economic growth. An increased investment in education also helps to maximize the use of countries' demographic dividend, by producing a more skilled and productive workforce. This finding is consistent with the conclusions of Ahmad and Khan (2018) that human capital development has a positive effect on the economic growth.

Table 8 shows the long run ARDL estimates of the effect of demographic transition and other macro-economic variables on economic growth of Pakistan. The findings suggest that the demographic index, inflation, expenditure on education, expenditure on health, participation of the labor force, and foreign direct investment have a significant impact on the economic growth in the long run. The estimated coefficients are evidence of the size and sign of these effects

Table 8: Long run ARDL

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DI	-0.023580	0.011125	-2.119525	0.0417
EE	0.395079	0.144823	2.728020	0.0233
FDI	2.460277	1.077222	2.283908	0.0483
HE	0.483214	0.176429	2.738861	0.0099
INF	-0.158815	0.091796	-1.730089	0.0946
LF	0.420938	0.123546	3.407149	0.0078

The long run ARDL results show that demographic transition and macroeconomic variables are significant factors affecting economic growth in Pakistan. The

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coefficient of the Demographic Index (DI) is -0.0236, which is statistically significant at the 5 percent level, meaning that a one-unit increase in the demographic index decreases economic growth by about 0.024 units in the long run. This negative relationship indicates that the transformation of the demographic changes into a demographic dividend is still not complete in Pakistan. It is not only that the demographic transition generally leads to a rise in the working-age population, but it is also that employment opportunities, labor productivity, and human capital development are insufficient, which means that the economy does not reap the benefits of the transitions. This means that the demographic dividend may not be sufficient to offset this potential, and growth may be reduced. This finding aligns with Afzal (2009) and Zahid et al. (2025), that demographic changes have a negative impact on the economic performance if there are no constructive economic policies and institutional frameworks.

The results suggest that investments in human capital can have a significant effect on economic growth, even though demographic transition had a negative effect. The coefficient of Education Expenditure (EE) is 0.3951; statistically significant at the 5 percent level and it means that a unit increase in education expenditure will increase economic growth by about 0.40 units in the long run. This positive impact calls attention to the need for education for human capital formation, labor productivity, innovation and economy's ability to embrace new technologies. Improved educational opportunities also help people to have more productive economic engagements. The results are consistent with the human capital theory by Becker et al. (1990) and Ahmad and Khan (2018), who pointed out that education has a positive impact on economic growth.

Likewise, economic growth is found to be positively and statistically significantly related to Health Expenditure (HE). The estimated coefficient of 0.4832 means that investment in health will generally lead to a 0.48 increase in economic growth in the long run. Better health care will contribute to longer life expectancy, lower disease burden and higher productivity of the labor force, which will make human capital more productive. A more productive and healthy workforce can contribute to the economic activities more effectively. Thus, human capital development is a prerequisite to sustained economic growth, and the positive effect of health expenditure strengthens the case for this. The outcome aligns with that of Becker et al. (1990), and Mudasser and Yiridoe (2024) who also found a positive association between health-related gains and economic expansion in the case of Pakistan.

Foreign Direct Investment (FDI) is also an important tool for encouraging long-run economic growth, apart from the human capital factors. The coefficient of FDI is 2.4603 which is statistically significant at 5 percent level means a one unit rise in FDI leads to an increase in economic growth by about 2.46 units. This is a significant positive impact, which suggests that foreign investment is a driver of economic growth, not just in terms of capital investment, technology transfer, management know-how, but also employment creation. In addition, FDI provides a boost to productive capacity and integration with international markets, leading to industrial development and economic growth. The discovery is consistent with Barro's growth

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theory (1991) that investment is one of the main factors affecting the long-run performance of the economy.

On the other hand, the negative effects of inflation in the long run are felt in economic growth. The coefficient of Inflation (INF) is -0.1588 and significant at 10 percent; this suggests that every inflation unit decrease in the economy by about 0.16 units. High inflation leads to economic uncertainty, de-incentivizes domestic and foreign investment, lowers purchasing power and raises production costs. Sustained inflation can also cause realignment of resources and adversely affect economic efficiency, which can delay the growth process. The negative coefficient therefore highlights the importance of maintaining macroeconomic stability to achieve sustainable economic growth. The result is consistent with that of Barro (1991), who states that stable macroeconomic environment is a crucial precondition for economic development.

Last but not least, the positive significant effect of LF on economic growth is revealed. The estimated coefficient of 0.4209 suggests that an additional 1% increase in the labour force participation would lead to an increase of about 0.42 in the long-run economic growth. The achievement of this outcome highlights the significance of a healthy and productive workforce to support increased production capacity and economic efficiency. The larger labor force allows the economy to benefit from demographic transition by increasing output and productivity to create a ‘demographic dividend'. This discovery adds to the list of policy interventions, especially for raising labour force participation, which have the potential to substantially improve Pakistan's long-term growth potential, especially among women and youth. This finding is in line with the findings of Ahmad and Khan (2018) and the United Nations Population Fund (2022) who highlight the importance of a growing labour force for the materialisation of the advantages of demographic transition.

Conclusion

The demographic transition and its impact on economic growth of Pakistan has been analysed through descriptive statistics, Principal Component Analysis (PCA), Unit Root Tests and ARDL Method. Long run relationship between the selected explanatory variables and economic growth was validated with the findings. The short run findings showed that the demographic index and inflation had a negative relationship with economic growth while the foreign direct investment, the labor force participation and the expenditure on education had a positive relationship with the economic performance. The large error correction term was another piece of evidence that the long-run equilibrium relationship between the variables was stable.

The long-run estimates showed that demographic index has a negative and significant impact on growth of the economy that means Pakistan is not yet able to translate the demographic transition into a ‘demographic dividend'. However, education expenditure, health expenditure, labour force participation and foreign direct investment were positively and significantly influencing economic growth, thus underscoring the significance of human capital development, productive labour and foreign direct investment. It was observed that inflation adversely affects the growth of the economy, making macroeconomic stability important. The overall findings

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indicate that demographic transition does not necessarily lead to economic development; rather, the impact of demographic transition can rely on the nation's capacity to invest in education and health, to generate employment opportunities, to attract foreign investment and to ensure a stable economic climate. Hence, policy interventions are needed to effectively leverage the demographic shifts for sustainable economic growth and development in Pakistan.

Recommendation of Study

The empirical results of this study have led to several policy recommendations to make demographic transition more effective in contributing to economic growth in Pakistan. As the demographic index is negative and significant towards economic growth, the policymaker should pay attention to changing the growing population into an economic asset through effective population planning, skill development programs and employment generation programs. All these would allow the growing working age population to play a more active role in achieving economic growth and realize the demographic dividend of Pakistan. In addition, the positive and significant impact of education spending on economic growth underscores the importance of human capital development. The government, therefore, should: enhance educational investments; improve educational institutions; increase the number of vocational and technical training institutions; and strengthen educational curriculum in line with the needs of the labour market for increased productivity and innovations in the labour market. Likewise, the positive effects of health spending highlight the need for increased spending on health infrastructure and public health services to boost labor productivity, improve human capital and promote long-term economic growth.

Furthermore, the positive impact of foreign direct investment (FDI) on economic growth suggests that Pakistan needs to devise policies to increase foreign investments by enhancing political and economic stability, institutional quality, improving business regulations and upgrading infrastructure. Higher level of FDI inflows can help transfer technology, accumulate capital, create jobs and foster industrial growth and sustainable economic growth. Further, the positive contribution of the increase in labour force participation highlights an urgent need to generate more employment opportunities, especially for young people and women, to make the best use of the increasing working-age population in the country. Last but not least, inflation negatively affects economic growth and hence the policy makers should restore macroeconomic stability by putting in place appropriate monetary and fiscal policies to control inflationary pressures. A stable economic climate will facilitate investment, protect purchasing power and provide conducive environment to achieve sustainable economic development in Pakistan.