The Effects of Population Ageing on the Public Pension System in Pakistan

Muhammad Wahab
Content Writer: Institute of Management Sciences,
PhD Scholar, COMSATS Institute of Information Technology, Islamabad
Owais Mufti
Assistant Professor, Institute of Management Sciences, Peshawar
Muhammad Aamir Khan
Assistant Professor, COMSATS Institute of Information Technology, Islamabad

Abstract
Academic and political debates across the globe have greatly voiced the challenge of undefined costs resulting from the defined-benefit pension system. The most important cause, which resulted in the cash crunch of defined-benefit pension payments, stemmed from the rise in the old-age dependency ratio and increase in the average life expectancy. According to United Nations population projections (2015), in Pakistan, the old-age dependency ratio [i.e., 61+/20-60] is expected to lift from 12.6 percent to 21.7 percent of the total population by 2050. The life expectancy, which is expected years of life at birth given current death rates, has also been lifted from 54 in 1970 to 66 in 2015. These changes in population structures will have far-reaching economic and social implications and is very alarming. Although, in Pakistan, population ageing is still at its nascent stage, but will result in many challenges ahead. The results of current study also confirm that there is long-run as well as short-run association of both government pension expenditures and general provident funds with increase in average life expectancy, old-age dependency ratio and total population of the country. Therefore, the intended incremental contributions of the study for policy makers are very much clear based on the results presented.
Keywords: Government pension expenditures, general provident fund, average life expectancy, old-age dependency ratio, pay-as-you go pension system

Governments around the world adopt different types of pension systems to ensure the financial security of older people. Today, the most commonly adopted of these is the defined-benefit pension system, which is maintained on an unfunded basis through payroll taxes. However, with recent unprecedented global demographic changes and for solid theoretical reasons, the current defined-benefit pension system is expected to become unsustainable in many countries. As the population of older people grows, the need to evaluate pension and social security schemes becomes more pressing. In developed countries, this issue maintains a distinct position, as they have already experienced the demographic shift toward an ageing population. Developing countries, however, are in the initial phase of this demographic transition. Policymakers are concerned about the growing trend toward an ageing population and its impact on society and the economy.

Like many other countries, Pakistan has an ageing population. Pakistan is on the list of fifteen countries in the world, including seven developing countries, which have more than 10 million older people. Pakistan's aggregate fertility rate, which is the average number of children born per woman, has fallen from 6.6 in 1970 to 3.72 in 2015. The infant mortality rate (infant deaths per 1,000 live births) has also fallen from 135 in 1970 to 70 in 2015. On the other hand, the average life expectancy has increased from 54 in 1970 to 66 in 2015. Similarly, the old-age dependency ratio (i.e., 61+/20-60), is also expected to increase from 12.6 percent in 2015 to 21.7 percent of the total population by 2050 in Pakistan (United Nations, 2015).

Thus, this study aims to examine the relationship between demographic change (i.e., the increase in average life expectancy and changes in the old-age dependency ratio) and unfunded pension liabilities in the form of government pension expenditure (GPE) and the general provident fund (GPF). The study is important because, in the case of Pakistan, the effect of an ageing population has been less clearly defined until now. This is because it was commonly believed that a large proportion of Pakistan's population was made up of young people. Contrary to this common belief, the preliminary trend analysis (Figure 1) shows that there is a strong relationship between increasing average life expectancy over time and fiscal balance, a large part of which is affected by the country's public pension expenditure.

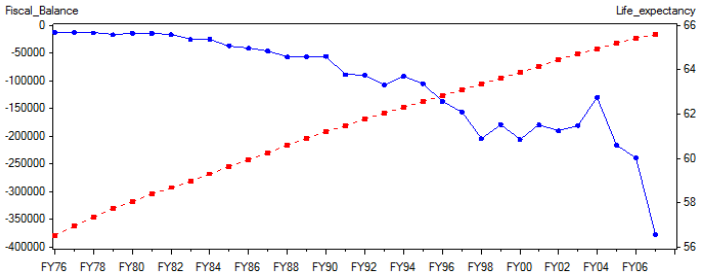

Figure 1. Relationship between fiscal balance and life expectancy in Pakistan (1976–2006).

In addition, the study has important methodological and practical implications. On the methodological side, the study contributes to the literature through the use of new variables (i.e., GPE and GPF). From a practical perspective, the results of this study will be of interest to policymakers who need to consider demographic factors in their current attempts to reform the pension system in Pakistan.

Following this introduction, which has set out the background of the research problem to be addressed, a critical review of the literature is presented. After an interpretation and synthesis of the previous literature on the subject, the research methodology is presented in detail. Finally,

the study concludes by discussing the key findings and limitations and setting out some policy recommendations.

Literature Review

All pension systems aim to support individuals who are unable to earn a living in later life. The existing pension system for public-sector employees in Pakistan was introduced in 1954, embracing a pension-cum-gratuity-cum-general provident fund. This meets pillars 1 and 2 of the World Bank's pension systems. Pillar 1 incorporates defined-benefit pensions and gratuities, which are commonly financed through payroll taxes. No contributions are made by employees; therefore, the pensions are preserved on an unfunded or on a pay-as-you-go (PAYG) basis (Arif and Ahmed, 2010). Pillar 2 involves obligatory contributions from government employees in the form of either a GPF or a contributory provident fund (CPF). A key issue that reinforces the analysis of the current study is the need to understand the sustainability of the publicly managed PAYG pension system, which is dominant in most public-sector organizations in Pakistan, in the light of the rising old-age dependency ratio and average life expectancy.

Demographic trends around the world

In 1970 almost 47.59 percent of the world's population was younger than 20 and only 7.55 percent was older than 60. The remaining 44.85 percent was aged between 20 and 60. However, the falling fertility rate (Figure 2) and rising life expectancy had led to the global population of young people (aged 20 or under) falling from 47.59 percent in 1970 to 34 percent in 2015. The age cohort of 60 and older has increased from 7.55 percent in 1970 to 11.4 percent in 2015, while the population aged between 20 and 60 now represents 54.5 percent of the total population (United Nations, 2015). According to the United Nations world population prospects (2015), the old-age dependency ratio (i.e., 65+/15-64) is likely to reach 25.6 percent of the world's population by 2050, compared with 8.4 percent in 1950. However, the rate and timing of population ageing may vary between countries. It is evident from the results of many studies (e.g., Hagemann & Nicoletti, 1989; Erb, Harvey & Viskanta, 1997) that the cost of fringe benefits, including pension plans, are increasing because of the rapid growth of the older population. In contrast, there has been a decrease in the younger population, whose taxes support the pension plans.

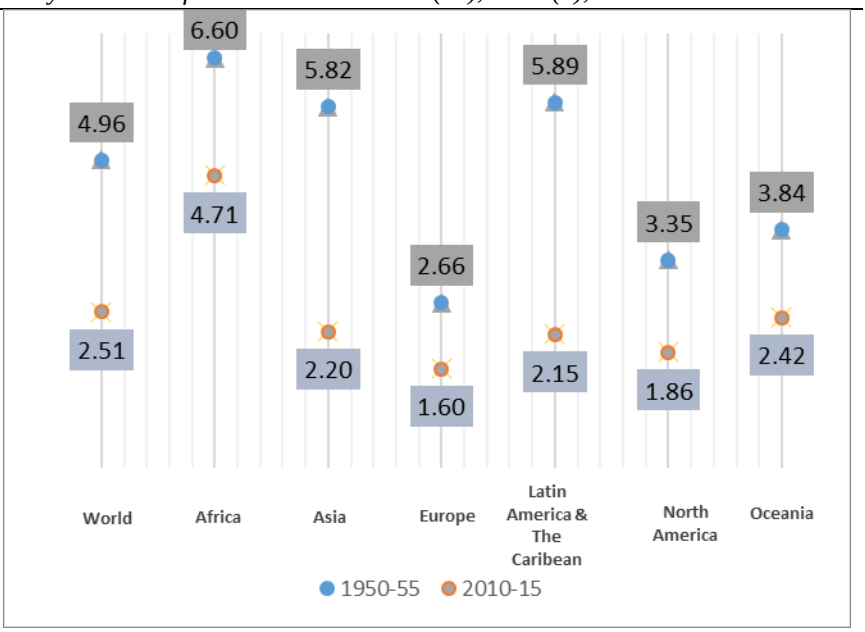

Figure 2. Decline in fertility rates between the period 1950–1955 and the period 2010–2015 (calculations based on United Nations (2015) data).

While fertility rates and mortality rates have continued to fall, the average life expectancy has been increasing, which has led to an increase in the average retirement period (see, hypothesis 1). At the same time, due to global demographic change, the old-age dependency ratio is also continuing to rise (see, hypothesis 2). Henceforth, to be able to provide pension benefits to the growing number of retirees, higher payroll taxes are required. However, the unbalanced changes in the demographic composition will cause a significant contraction of the labor force that can be taxed to support the pension plans. As a result, the large implied pension unfunded liabilities, together with the widening funding gap, are making the current publicly managed PAYG pension system unsustainable in many countries. If policymakers do not put in place the necessary measures to overcome the challenges created by an ageing population, it is likely that the current PAYG pension system will become insolvent soon (World Bank, 1994; James, 1995). Therefore, considering above discussion, the following hypotheses can be tested:

H_1: There is a link between the increase in average life expectancy and government unfunded pension liabilities (i.e., GPE & GPF).

H_2: There is a link between the increase in the old-age dependency ratio and government unfunded pension liabilities (i.e., GPE & GPF).

Economic effects of ageing

It is evident that over the years, Pakistan has failed to collect the level of revenue that is required to finance its budgetary expenses. Along with the limited revenues, a persistent fiscal deficit is exacerbated due to the rise in expenditure. In such a situation, a government can finance its budgetary expenses and developmental efforts either by borrowing (creating internal or external debt) or through taxation, which, if pushed beyond the carrying capacity, may lead to several other economic consequences. In accordance with the Ricardian equivalence hypothesis, a public deficit is not very different from tax increases, because the deficit must ultimately be repaid through taxation.

The revised estimates for total salaries and pension expenditures in the budget for fiscal year 2016–17 shows that these costs came to around 452 billion Pakistani rupees, including total pension payments of 245 billion rupees. As part of public expenditure reforms due to increases in average life expectancy, the International Monetary Fund (IMF) has recommended an increase in the retirement age as a remedy for increasing pension costs. This is one way to reduce pension expenditure and make better use of the expertise of senior employees. Before this suggestion, the Pakistan Ministry of Finance submitted a proposal (in the 2012–13 financial year) to the Prime Minister's secretariat for raising the retirement age to 63. It was suggested that this step would narrow the fiscal deficit to half a percentage of GDP (Maken, 2013). Moreover, given that early retirement puts additional pressure on expenditure by increasing the old-age dependency ratio, increasing the retirement age may prove to be a more effective remedial option (Turner, 2009). This may be a better option from a financial point of view, as increasing the retirement age would increase the total number of taxpayers while simultaneously reducing the number of retirees (Berkel & Börsch-Supan, 2004).

However, these suggested reforms may not provide a permanent solution to the above-mentioned problem; they may simply delay the looming crises for a few more years. The logic behind this is that compared with new entrants, employees nearing retirement age draw higher salaries due to years of increments and pay rises. Similarly, levels of pension benefits are much lower than the prospective salary that an individual would be receiving as they near the age of superannuation. At the same time, a large proportion of the population is made up of young people, and prevailing underemployment rates will increase further because people will be working for longer before they retire, freeing up fewer jobs for younger people. In addition, every year many new graduates enter the Pakistani job market, which exacerbates the problem of unemployment. In general, it is believed that the government needs to create a minimum of 125,000 jobs every year, which can be achieved only if the growth of GDP increases from its current rate of 4.5 percent to at least 7 percent annually (Monnoo, 2015). Given the high rate of unemployment and the growing population in Pakistan, increasing the

retirement age as a method of reducing pension expenditure does not seem to be the best option. Therefore, the following hypothesis will be tested:

H_3: There is a link between population growth in Pakistan and government unfunded pension liabilities (i.e., GPE & GPF).

Similarly, to meet the intense hike in budgetary loads, if authorities adopt the policies of increasing the payroll or raising income taxes, the summative incomes and the accrual of physical capital in the economy will reduce significantly (Feldstein, 1974). Ultimately, this decrease in real wages will hinder Pakistan's economic growth. On the other hand, if the target growth rate for GDP is not achieved over the coming decades then the pension burden will become even heavier, as the current pension system is very generous and characterized *ex ante* by the expectation that the growth rate will be sustained in the future.

Moreover, if pension expenditures are financed by debt at a time when the growth rate is falling, the shortfall will lead to a significant possibility of bankruptcy. A large shortfall in the government's accounting statements will create the problem of a high cost of refinancing the liability. Thus, it is kind of warning to keep a generous PAYG pension system in the mean of notable increase in an old-age dependency ratio (Figure 3). Calculations based on the United Nations (2015) data, the median age of the total population also shows a significant upward trend (Figure 4).

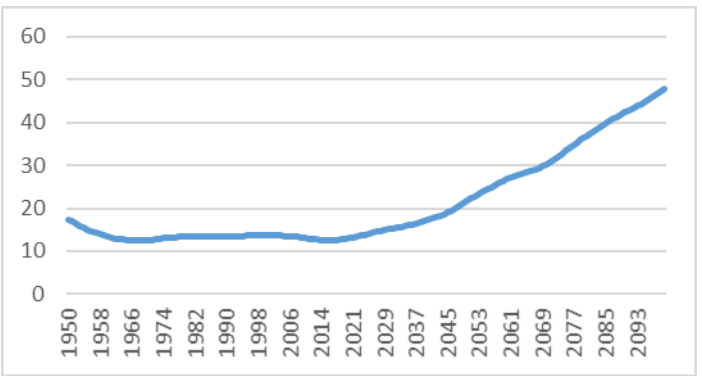

Figure 3. Old-age dependency (61+/20-60) ratio in Pakistan

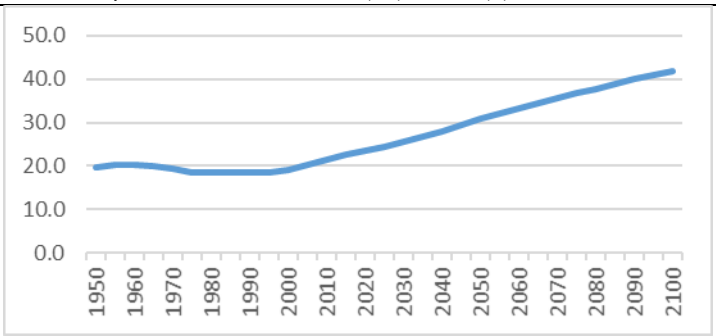

Figure 4. Median age of total population in Pakistan

According to life-cycle theory, saving behavior differs among different age groups. Therefore, as life expectancy increases, so does the tendency to save more, both on macro (Bloom, Canning & Graham, 2003) and micro (Hurd, McFadden & Gan, 1998) economic levels. However, in a study using a panel of macroeconomic data, Bloom, Canning, Mansfield & Moore (2007) show that an increase in average life expectancy increases the level of aggregate savings only in countries with universal benefit coverage or social pensions; no effect was found in countries with PAYG pension systems and high replacement rates. Therefore, keeping in view the dominant unfunded PAYG pension system in Pakistan, these alarming findings turn our attention to empirically estimate the varying degree of risk arising from the changes in Pakistan's demographic structure.

Size of private sector pension investments

The size of private sector pension providers varies across countries. Compared with OECD area, the non-OECD countries has limited presence of the private pension providers' investments (Figure 5). The ratio of invested assets to GDP in case of OECD countries ranges from 0.6% in Greece to 205.9% in Denmark. Whereas, in case of non-OECD countries it ranges from 0.1% in Albania and Pakistan to 96.8% in South Africa (OECD, 2016). Moreover, Figure 5 shows the contribution of private pension investment by type of financing vehicle in the selected OECD and non-OECD countries. In Pakistan, a very large part of the population has no pension provisioning and mostly depend on the joint family system in their old age. However, some private sector employees are covered by funded pensions. Therefore, suggestions have been made to promote privately managed pension funds.

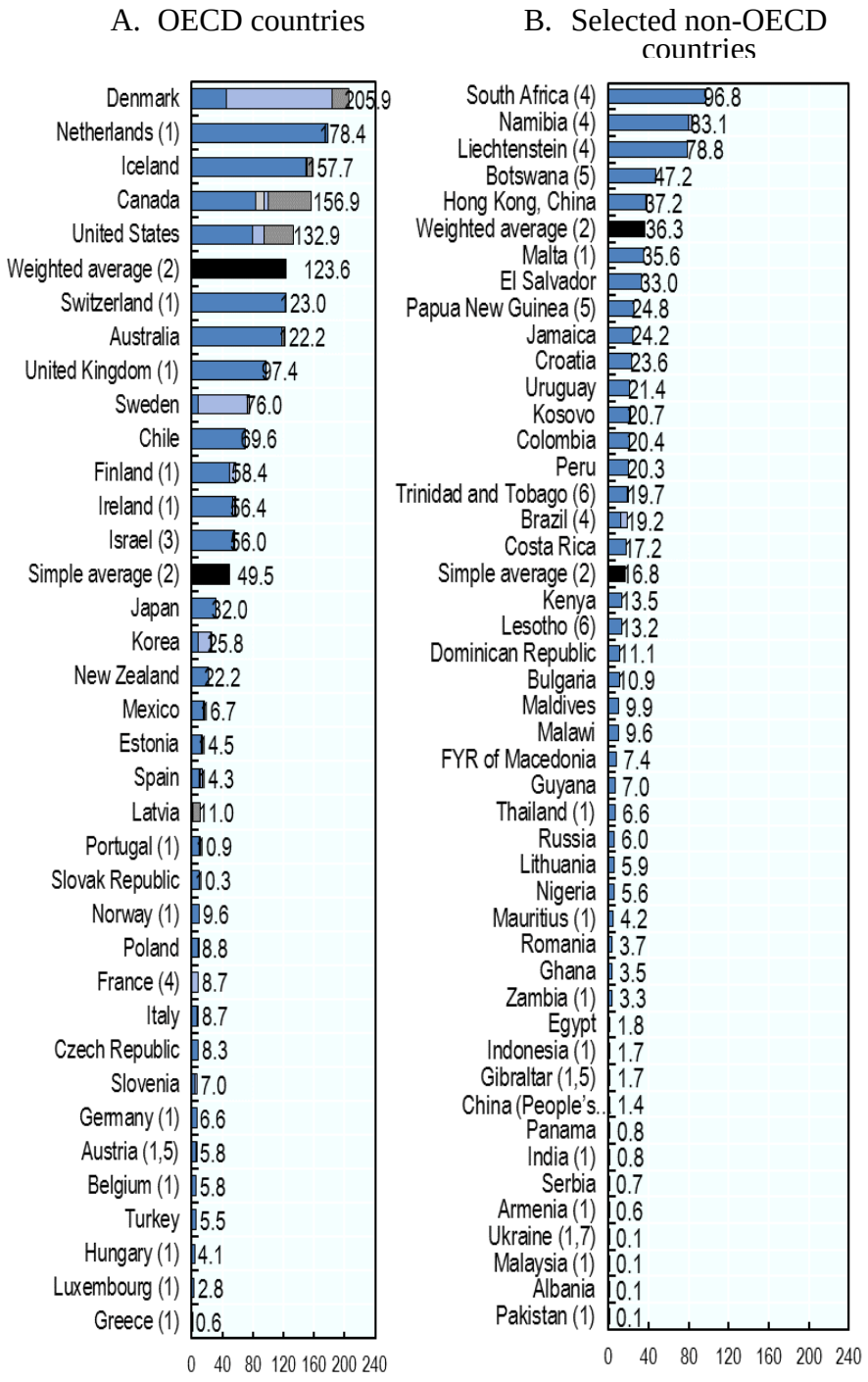

Figure 5: Size of private pension investments worldwide, 2015
Source: OECD Global Pension Statitics

Research Methodology

After delineating the previous literature, the current study found that there is a great deal of confusion about the measurement processes. Most of the previous studies (Geanakoplos, Magill & Quinzii, 2004; Davis & Li, 2003; Brooks, 2002; Poterba, 2001; Erb et al. 1997; Bakshi & Chen 1994, and many other) have examined the relationship between the trends of the demographic variables with the real returns of equity which is inappropriate from the econometrics point of view. One main issue pertaining to such relation is the dynamics of variables. The demographic trends are relatively less volatile as compared to the movements of financial assets i.e., equity prices. The regression tests if applied in this case, where one variable is less volatile while other is more, results in the high standard errors and insignificant results (Ratanabanchuen, 2013). This may lead to erroneous conclusions. For instance, studies performed by Poterba (2001) and Yoo (1994a) reflected insignificant relationship between the working people of prime-age and annual equity returns. Therefore, keeping in view the mentioned problem, this study has utilized the amount of annual government pension expenditures (GPE) and general provident fund (GPF) as dependent variables which have not been previously used in any study and therefore accounts for the positioning of the current study.

Also, demographic variables have been defined and conceptualized in many ways by different researchers. Mostly, the proxies used for demographic variables comprise of middle-aged to young ratio (Geanakoplos *et al*., 2004), proportion of the prime working-age people (Poterba 2001; Yoo, 1994), median age of population (Bakshi & Chen 1994; Erb *et al*. 1996; Davis & Li, 2003), old-age dependency ratio (Poterba, 2001), and average age population (Erb *et al.*, 1996). However, to fulfill the objectives of current study we have used two different demographic variables including, average life expectancy *(Ln_LE)* and old-age dependency ratio *(Oldage_Dep).* For the calculation of old age dependency ratio, we have considered age 60 rather than 65 which is mostly used in the previous studies. The reason for using age 60 is that the retirement age in Pakistan is 60 years. The data for demographic variables were retrieved from the United Nations, Department of Economic and Social Affairs, Population Division (2015), World Population Prospects: The 2015 Revision, DVD Edition. The data on GPE was retrieved from the books of appropriate accounts of finance division available at Directorate of Archives and Libraries of Pakistan.

Explanation of Statistical Models: For the analyses, we have used the following models;

$$GPE_t = \beta_0 + \beta_1 LnLE_t + \beta_2 LnPop_t + \varepsilon_t \quad \text{.....(1)}$$

$$GPE_t = \beta_0 + \beta_1 Oldage\_Dep_t + \beta_2 LnPop_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots (2)$$

Here GPE_t is government pension expenditures, $LnLE_t$ is log of average life expectancy, $LnPop_t$ is log of population and $Oldage\_Dep_t$ is old-age dependency ratio.

$$LnGPF_t = \beta_0 + \beta_1 LnLE_t + \beta_2 LnPop_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Here $LnGPF_t$ is log of general provident fund.

$$LnGPF_t = \beta_0 + \beta_1 Oldage\_Dep_t + \beta_2 LnPop_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots (4)$$

To see the long run relationship between the variables, co-integration analysis has been implemented. As we know that mostly time series data show a systematic pattern and have a trend over the time. In such case we cannot apply co-integration test directly. Therefore, before applying appropriate co-integration technique, the stationarity of variables has been checked through Augmented Dickey Fuller (ADF) test. From the ADF test it was found that all variables are not stationary at same level and the order of integration is different so we have used ARDL technique for co-integration.

The specific form of models in each case are given as follows:

$$LnGPE_t = \alpha_0 + \sum_{i=0}^{l} \alpha_i LnLE_{t-i} + \sum_{i=0}^{m} \alpha_i LnPop_{t-i} + \sum_{i=1}^{n} \beta_i LnGPE_{t-i} + \mu_t$$

$$LnGPE_t = \alpha_0 + \sum_{i=0}^{l} \alpha_i Oldage\_Dep_{t-i} + \sum_{i=0}^{m} \alpha_i LnPop_{t-i} + \sum_{i=1}^{n} \beta_i GPE_{t-i} + \mu_t$$

$$LnGPF_t = \alpha_0 + \sum_{i=0}^{l} \alpha_i LnLE_{t-i} + \sum_{i=0}^{m} \alpha_i LnPop_{t-i} + \sum_{i=1}^{n} \beta_i LnGPF_{t-i} + \mu_t$$

$$LnGPF_t = \alpha_0 + \sum_{i=0}^{l} \alpha_i Oldage\_Dep_{t-i} + \sum_{i=0}^{m} \alpha_i LnPop_{t-i} + \sum_{i=1}^{n} \beta_i GPF_{t-i} + \mu_t$$

Here l, m and n are the numbers of lags of explanatory and dependent variable(s), respectively. For selection of lags of variables to be included in the model, we applied lag selection test. For lag selection, different criterions are used, including, Akaike information criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ).

After checking the long run relationship, we have analysed the short run dynamics and convergence towards the long run equilibrium through Error Correction Model (ECM). The ECM for all four equations are given as:

$$\Delta LnGPE_t = \alpha_0 + \sum_{i=0}^{l} \alpha_i \Delta LnLE_{t-i} + \sum_{i=0}^{m} \alpha_i \Delta LnPop_{t-i} + \sum_{i=1}^{n} \beta_i \Delta LnGPE_{t-i} + \pi \hat{e}_{t-1} + \mu_t$$

$$\Delta LnGPE_t = \alpha_0 + \sum_{i=0}^{l} \alpha_i \Delta Oldage\_Dep_{t-i} + \sum_{i=0}^{m} \alpha_i \Delta LnPop_{t-i} + \sum_{i=1}^{n} \beta_i \Delta LnGPE_{t-i} + \pi \hat{e}_{t-1} + \mu_t$$

$$\Delta LnGPF_t = \alpha_0 + \sum_{i=0}^{l} \alpha_i \Delta LnLE_{t-i} + \sum_{i=0}^{m} \alpha_i \Delta LnPop_{t-i} + \sum_{i=1}^{n} \beta_i \Delta LnGPF_{t-i} + \pi \hat{e}_{t-1} + \mu_t$$

$$\Delta LnGPF_t = \alpha_0 + \sum_{i=0}^{l} \alpha_i \Delta OAGEDEP_{t-i} + \sum_{i=0}^{m} \alpha_i \Delta LnPop_{t-i} + \sum_{i=1}^{n} \beta_i \Delta Y_{t-i} + \pi \hat{e}_{t-1} + \mu_t$$

In the above models π is error correction coefficient or adjustment coefficient which indicates that how much adjustment toward equilibrium point took place or at which speed the error is adjusted and long run equilibrium is achieved.

Results and Discussion

Stationarity of Variables: The results of ADF test (Table 1) indicated that the log of government pension expenditure (Ln_GPE), log of general provident fund (Ln_GPF) and log of average life expectancy

(Ln_LE) were non-stationary at level but were stationary at first difference and the order of integration is one [I(1)]. Both, old-age dependency ratio (Oldage_Dep) and log of total population (Ln_Pop) were stationary at level but Oldage_Dep was stationary when we only included intercept term while Ln_Pop was stationary when we included trend and intercept, both.

Table 1. *Stationarity of Variables*

Variable	Level			First Difference	Order of Integration
	Non	*intercept*	*Trend with intercept*	*Non*	
Ln_GPE	*3.23943*	*-0.89616*	*-3.099939*	*-5.142048**	*I(1)*
Ln_GPF	*4.7150*	*0.1648*	*-2.9874*	*-3.6021**	*I(1)*
Ln_LE	*2.5409*	*-0.2490*	*-2.8235*	*-3.7209**	*I(1)*
Oldage_Dep	*-1.1147*	*-2.7659****			*I(0)*
Ln_Pop	*1.6159*	*-2.0799*	*-4.9857**		*I(0)*

, **, * significant at 10%, 5%, 1%, levels, respectively.*

Cointegration

Government Pension Expenditures, Life Expectancy and Population: After testing the stationarity of variables in next step appropriate lags of variables were selected by using different criterion i.e. Akaike information criterion (AIC), Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ). The results of all three criterion suggested that four lags of each variable has to be included in the model (Table 2).

Table 2. *Lag Selection Test (Log of GPE, Log of Life Expectancy & Log of Population)*

No. of Lag	AIC	SC	HQ
0	-9.534070	-9.400754	-9.488049
1	-23.26405	-22.73079	-23.07997
2	-28.26890	-27.33569	-27.94675
3	-31.77079	-30.43764	-31.31059
4	-33.55544*	-31.82234*	-32.95717*

** Indicate No. of lags to be selected*

In our study, all the variables are stationary at different level and the order of integration is different; therefore, to see the long run relationship we used ARDL co-integration technique. The F-statistic and chi-square values of Wald test confirmed that results are significant, therefore we could say that the coefficient are not equal to zero confirming long run relationship among variables (Table 3). Here the null hypothesis was GPE(-1)= Ln_LE(-1)= Ln_Pop(-1)=0.

Table 3. *Wald Coefficient Test (Ln_GPE, Ln_LE & Ln_Pop)*

Test Statistic	Value	df	Probability
F-statistic	9.083567	(3, 18)	0.0007***

Chi-square	27.25070	3	0.0000***

, **, * significant at 10%, 5%, 1%, levels, respectively.*

After confirming the long run relationship, ECM is implemented to see the short run relationship among variables and speed of adjustment. From the results of the ECM, it is clear that the ECT is negative as well as significant which means that there is significant short run relationship among variables (Table 4). The negative coefficient of ECT is an indication of short term relationship of government pension expenditures with average life expectancy and population and this also show convergence towards long run equilibrium.

Table 4. Error Correction Model (ECM) of Ln_GPE, Ln_LE & Ln_Pop

Variable	Coefficient*	T-Statistic	P-Value
Error Correction Term (ECT)	-1.112524 *(0.288431)*	-3.857159	0.0011
R-Square (Adjusted)	0.597615		
F-statistics	4.655834		*0.001313*
No. of Observations (After Adjustment)	*34*		

** Standard error is given in Parentheses*

Dependent Variable is difference of log of Government Pension Expenditure

Government Pension Expenditure, Old-Age Dependency Ratio and Population: In the above model, we have used average life expectancy as measure for ageing. Other variable which could be used as measure of ageing is old-age dependency ratio. We used old-age dependency above 60 years because in Pakistan the retirement age is 60 and employees usually are entitled to pension benefits at the age of 60 which is also called as superannuation. From the stationarity results (Table 1) it is confirmed that all variables are stationary at different levels and the order of integration is different, therefore, ARDL technique has been implemented. For justified selection of variables lags, we also conducted the lag selection test and the results are reported in Table 5. All three criterion suggested to include 4 lags of each variable.

Table 5. *Lag Selection Test (Log of GPE, Old-Age Dependency Ratio & Log of Total Population)*

No. of Lag	AIC	SC	HQ
0	0.487660	0.620976	0.533681
1	-15.10929	-14.57603	-14.92521
2	-19.10319	-18.16998	-18.78104
3	-21.13683	-19.80367	-20.67662
4	-22.24423*	-20.51113*	-21.64596*

** Indicate No. of lags to be selected*

The chi-square and F-statistic values of Wald test confirms the long run relationship between old-age dependency ratio and GPE (Table 6).

Table 6. *Wald Coefficient Test*

Test Statistic	Value	Df	Probability
F-statistic	3.480064	(3, 18)	0.0376**
Chi-square	10.44019	3	0.0152**

, **, * significant at 10%, 5%, 1%, levels, respectively.*

To see the short-term relationship of GPE with old-age dependency ratio ECM technique has been used. The sign of ECT coefficient is also significant and negative indicating short run relationship and convergence towards the long run equilibrium point (Table 7).

Table 7. *Error Correction Model (ECM)*

Variable	Coefficient*	T-Statistic	P-Value
Error Correction Term (ECT)	*-1.0241 (0.3304)*	*-3.0987*	*0.0059*
R-Square (Adjusted)	*0.512904*		
F-statistics	3.591963		0.005840
No. of Observations (After Adjustment)	*34*		

** Standard error is given in Parentheses*
Dependent Variable is difference of log of GPE D(Ln_GPE)

General Provident Fund, Life Expectancy and Population: As mentioned above that pension system in Pakistan comprises of pension-cum-gratuity-cum-general provident fund, therefore, for robust check we have used general provident fund (GPF) as a proxy for pension liabilities. To see the long run relationship among general provident fund (Ln_GPF), average life expectancy (Ln_LE) and population (Ln_Pop), we used ARDL approach of co-integration technique as ADF test indicated mix of I(0) and I(1). For appropriate lags selection, different lag selection tests were also used. All three criterion confirm that 4 lags of each variable has to be included in the model (Table 8).

Table 8

Lag Selection Test (Log of GPF, Log of Life Expectancy & Log of Population)

No. of Lag	AIC	SC	
0	*-10.51508*	*-10.38312*	
1	*-24.96279*	*-24.43495*	
2	*-31.26172*	*-30.33801*	
3	*-34.30029*	*-32.98069*	

4	*-35.75940**	*-34.04392**	-

** Indicate No. of lags to be selected*

After running regression, Wald coefficient test is used to see whether coefficients of long run variables are zero or not. The values of F-statistic and chi-square statistics confirmed that results are significant (Table 9). Hence, there exists long run relationship between GPF and life expectancy.

Table 9. *Wald Coefficient Test (Ln_GPF, Ln_LE & Ln_Pop)*

Test Statistic	Value	df	Probability
F-statistic	*2.705598*	*(3, 19)*	*0.0742**
Chi-square	*8.116795*	*3*	*0.0437***

, **, * significant at 10%, 5%, 1%, levels, respectively.*

To see the short run relationship and speed of adjustment/convergence to long run equilibrium ECM is used and the results are given in Table 10. The value of ECT term is negative and significant at 10 percent significance level. Hence, confirm the short run relationship and convergence towards long run.

Table 10. Error Correction Model (ECM) of Ln_GPF, Ln_LE & Ln_Pop

Variable	Coefficient*	T-Statistic	P-Value
Error Correction Term (ECT)	*-0.029960 (0.016175)*	*-1.852289*	*0.0788*
R-Square (Adjusted)	*0.744635*		
F-statistics	*4.486104*		*0.001384*
No. of Observations (After Adjustment)	*34*		

** Standard error is given in Parentheses*
Dependent Variable is difference of log of General Provident Fund

General Provident Fund, Old-Age Dependency Ratio and Population: Along with average life expectancy, another variable which could be used as a measure of ageing is an old-age dependency ratio. To see the long run relationship of GPF with old-age dependency ratio and total population, we conducted co-integration analyses. From Table 1 it is confirmed that all variables are stationary at different levels, therefore, ARDL technique has been implemented. Moreover, all three criterion of lag selection test suggested to include 4 lags of each variable (Table 11).

Table 11. *Lag Selection Test (Log of GPF, Old-Age Dependency Ratio & Log of Total Population)*

No. of Lag	AIC	SC	HQ
0	*-0.404574*	*-0.272615*	*-0.358517*
1	*-17.55364*	*-17.02580*	*-17.36941*
2	*-21.00757*	*-20.08385*	*-20.68517*
3	*-22.74431*	*-21.42471*	*-22.28373*

4	*-24.06814**	*-22.35266**	*-23.46939**

** Indicate No. of lags to be selected*

The chi-square and F-statistic values of Wald test confirmed the long run relationship between GPF and old age dependency ration (Table 12). Moreover, the results of ECM indicate although insignificant result, but convergence towards long run equilibrium as the sign of ECT is negative (Table 13).

Table 12. *Wald Coefficient Test*

Test Statistic	Value	Df	Probability
F-statistic	*7.064427*	*(3, 19)*	*0.0022***
Chi-square	*21.19328*	*3*	*0.0001****

, **, * significant at 10%, 5%, 1%, levels, respectively.*

Table 13. *Error Correction Model (ECM)*

Variable	Coefficient*	T-Statistic	P-Value
Error Correction Term (ECT)	*-0.020799 (0.022050)*	*-0.943236*	*0.3568*
R-Square (Adjusted)	*0.539425*		
F-statistics	*1.801845*		*0.114550*
No. of Observations (After Adjustment)	*34*		

** Standard error is given in Parentheses*
Dependent Variable is difference of log of GPF D(Ln_GPF)

Conclusion

It is a matter of common perception and belief that senior citizens have an unconditional right to income security. However, with unprecedented recent changes in global demographics, risk management by the institutions responsible for pensions has once again come to the forefront. It is true that institutions dealing with pensions in developing countries have not been exposed to the same level of risk as developed countries, primarily because young people make up a larger proportion of the total population in developing countries. From a review of the literature, it is evident that the existing defined-benefit pension system is not a viable solution in the long term. The results of the current study also make clear that increases in the old-age-dependency ratio and in average life expectancy will increase public pension expenditure in the long run. Putting this into the context of market dynamics in Pakistan, the situation worsens since in Pakistan pensions are paid to retirees until the end of their life. Moreover, when a male pensioner dies, these payments can be transferred to his widow, his unmarried daughter, his son under the age of 21 or even his widowed daughter if she is dependent on him. Besides this, pension payments are doubled after a decade or, in some cases, 15 years of retirement. Moreover, due to cultural constraints

in Pakistan, women's rate of participation in the labor force is low, which reduces the number of working-age contributors further and increases the pension burden. Therefore, the phenomenon of the ageing population is making it increasingly important to address the issues of retirement security, as there are inherent risks in all forms in the defined-benefit pension system.

Limitations and Future Research Directions

Given that Pakistan operates a defined-benefit pension system in most of its public-sector organizations, the finding that pension expenditure has increased with increases in average life expectancy and the old-age dependency ratio may be *a priori*. For the validation of these empirical findings, one should consider other proxies of demographic variables. For example, one important proxy for demographic variables is the average age (Erb et al., 1996) of the population. This can be used in future research. This may show an insignificant association with unfunded pension liabilities or GPEs, because in addition to the increase in the old-age dependency ratio, the population of working age group has also increased. It is only the age group below 18 that has been decreasing. Therefore, this can be considered as a potential area for future research. At the same time, it is important to consider the growing unemployment rate as a separate variable in the analysis. This is because an increase in the population of working age (i.e., 18 to 60) will compensate for the increasing impact of the old-age dependency ratio only if employment in Pakistan increases at the same rate. The increase in public pension expenditure is subject to many other variables, which cannot be ignored; the case seems to be more complex than has been accounted for. Therefore, to avoid oversimplification, it is important to consider other pertinent variables that may affect the level of pension expenditure, or at least statistically control for their effect.

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