Theoretical and Applied Economics
Volume XXXI (2024), No. 4(641), Winter, pp. 153-164

The effect of population ageing on savings: a time series analysis for Türkiye

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Abstract. *Despite the theoretical debate on its impact on economic growth, saving is a key macroeconomic variable. This issue has received even more attention since the emergence of endogenous growth models, which argued that by holding technology constant, economic growth would be determined by a country's population growth rate and national saving rate. Later growth models have continued to include savings among the variables affecting economic growth. At this point, demographic change becomes important because household savings, which is an important component of national savings, will be directly affected by the ageing of the population. This relationship came to the fore in the mid-20th century with the emergence of two closely related theories linking the age of individuals to their saving and consumption behaviour: the life cycle hypothesis and the permanent income hypothesis. Both hypotheses assume that individuals seek to maximise their utility through a consumption profile consistent with their lifetime earnings. In Turkey, there has been a significant decline in fertility and mortality rates in recent years. Considering the rapid demographic transition that the country is going through, this study investigates the impact of population ageing on the overall saving volume. According to the findings obtained from the econometric analysis based on the Autoregressive distributed lag (ARDL) model, which includes a series of control variables such as income, interest rate and inflation as well as the amount of the elderly population, the aging of the population positively affects the volume of savings. Inflation and interest rate also have a positive effect on savings, but it is much weaker. Accordingly, it can be concluded that the life cycle hypothesis is not valid in Turkey.*

Keywords: population ageing, gross saving, life cycle hypothesis, time series analysis, ARDL model.

JEL Classification: C22, E21, J11, J14.

1. Introduction

The world population, which was around two billion a century ago, has increased rapidly due to the relative peaceful political atmosphere after World War II and has now reached eight billion. Although the global population growth rate has been generally decreasing since the early 1960s, life expectancy has been gradually increasing worldwide due to the decrease in population growth on the one hand and medical development and widespread use of health services on the other. Until 200 years ago, life expectancy was less than 30 years; today it is over 70 years. Increasing life expectancy and declining birth rates are leading to aging populations worldwide. As a result, the global population is experiencing a demographic shift towards an inverted pyramid. According to the United Nations' estimations, the world's total dependency ratio, which measures the ratio of non-working young (0-14) and elderly (65+) to working-age adults (15-64), decreased from 75.2% in 1965 to 52.5% in 2015 (Witkowska and Kompa, 2024). These significant global demographic changes have serious economic implications. The multifaceted effects of the increasing proportion of the elderly population on production, savings, financial markets and the social security system are the subject of intense theoretical and empirical debate in the literature. The fact that demographic change has not only economic but also social and political consequences increases the interest of governments in the issue.

Demographic changes present a significant policy challenge for industrialized nations. There's a widespread agreement among economists that population aging will hinder output growth and limit increases in economic well-being in most industrialized countries over the next few decades. While increasing capital-labor ratios, productivity gains, and higher labor force participation rates can mitigate the impact on per capita income, an older population can lead to lower levels of employment and output. (Faruqee and Mühleisen, 2003). Economists, who have been concerned about the misery and chaos of a growing population for longer than A. Smith and T. Malthus, are now worried about the problems of ageing caused by a stagnating or even declining population.

Although the ageing of the population is mostly seen as a problem faced by developed countries such as some Western European countries and Japan (Futagami and Nakajima, 2001), some developing countries such as Türkiye, whose population growth rate has started to stagnate, are also facing a similar situation. In the last half century, the population growth rate in Türkiye has decreased from 2.4 per cent to 1.3 per cent (TurkStat, 2022). This makes the country vulnerable in terms of both the labour market and sustainable growth. In this respect, it is important to investigate the economic, social and political effects of population ageing in order to determine appropriate policies and measures to predict and control these effects. The present study aims to make a contribution to this field by empirically investigating the impact of population ageing on the propensity to save in Türkiye.

2. Related Literature

Increasing life expectancy and declining fertility, especially in developed economies, accelerate the ageing of society (Kim and Lee, 2008). The new endogenous growth theory pioneered by Romer (1986), Lucas (1988), and others addresses this important issue

theoretically. Within this framework, the returns on investment in a broad spectrum of capital goods, including human capital, do not necessarily decline as economies develop. The theoretical framework suggests that firms' investments in research and development (R&D) or individual investments in both human and physical capital can produce positive growth effects. In an endogenous growth model, the economic consequences of population aging are associated not only with changes in savings and the labor force but also with changes in human capital and R&D investments. (Fougére and Mérette, 1999).

The neoclassical approach posits that the labor force growth rate equals the population growth rate. As Choudhry and Elhorst (2010) highlight, this assumption may hold true in the long run when both the population size and age distribution remain stable, but it becomes less applicable during periods of demographic transition, characterized by declining mortality and fertility rates.

The 'life-cycle' hypothesis (LCH) is a prominent economic theory that explains how individuals allocate their consumption and savings over their lifetimes. Developed by Modigliani and Brumberg (1954), the LCH posits that individuals plan their consumption and savings decisions to maximize their lifetime utility. The theory is grounded in the assumption that individuals have rational expectations and seek to smooth their consumption patterns over their lifespan. Modigliani and Ando (1957), and Ando and Modigliani (1963) also claim that economic individuals actively save while working but start to stop saving (or become negative savers) at retirement age (roughly 65 years and beyond). Therefore, there is a negative relationship between them, as ageing has a negative impact on the level of national saving. Many empirical studies have found evidence in favour of this hypothesis (Kim and Kim, 2006). The LCH acknowledges that consumption needs and income fluctuate with age. Young people often have higher consumption needs than income, primarily due to education and housing expenses. In middle adulthood, higher incomes allow individuals to save more. Finally, declining income during retirement necessitates spending down the savings accumulated in middle age.

The LCH depends on a number of key assumptions as follows:

- *Rationality*: Individuals are rational and make informed decisions about their consumption and savings.
- *Intertemporal Utility Maximization*: Individuals aim to maximize their lifetime utility by balancing consumption across different periods.
- *Perfect Capital Markets*: Individuals have access to perfect capital markets, allowing them to borrow and lend freely at a constant interest rate.
- *Lifetime Income and Consumption*: Individuals have a known lifetime income stream and plan their consumption accordingly.

On the other hand, the LCH has several important implications for economic behavior:

- *Consumption Smoothing*: Individuals strive to smooth their consumption patterns over their lifetimes, avoiding large fluctuations in spending.
- *Savings Behavior*: The LCH explains why individuals save during their working years and dissave during retirement.
- *Interest Rate Effects*: Changes in interest rates can affect individuals' consumption and savings decisions. Higher interest rates can encourage saving and discourage borrowing, while lower interest rates can have the opposite effect.

- *Economic Growth*: The LCH can be linked to economic growth through its impact on aggregate savings and investment. Higher savings rates can lead to increased investment and economic expansion.

Empirical studies have provided mixed support for the LCH. While some studies have found evidence consistent with the LCH's predictions, others have identified deviations. Factors such as liquidity constraints, uncertainty about future income, and behavioral biases can influence consumption and savings decisions, potentially leading to deviations from the LCH's assumptions. Studies such as Alessie et al. (1999) and Palumbo (1999) show that, due to a number of uncertainty factors about the future, retirees do not give up saving and cut consumption as much as suggested. Alessie et al. (1999) used Dutch data to show that the elderly do not give up saving to the extent predicted by the life cycle theory due to precautionary savings, bequest motives and uncertain health problems. Hence, these factors will cause savings to decline more slowly in old age than the theory predicts. In this case, only a weak negative or economically insignificant relationship between ageing and saving would emerge.

The permanent income hypothesis suggests that individuals aim to spread their consumption evenly over their lifetime, avoiding reductions in consumption due to lower retirement income. This implies that individuals consume only the portion of their income that is sustainable throughout their lifetime. Similar to the life cycle model, adults will save during their peak earning years.

The potential economic consequences of population aging have been examined in numerous studies. Some studies have employed general equilibrium models with overlapping generations to investigate the impact of aging on national savings (see Auerbach and Kotlikoff, 1987; Auerbach et al., 1989; Miles, 1999; Hviding and Merette, 1998). The findings from these studies suggest that population aging will result in a significant decline in national savings rates and real output per capita in the coming decades (Fougére and Mérette, 1999).

Population aging can influence economic growth through its impact on savings. As people live longer, the proportion of retirees with savings relative to workers saving for retirement will increase, leading to a decline in the aggregate savings rate. A decrease in the savings rate can slow down economic growth due to a reduction in capital accumulation (Futagami and Nakajima, 2001). In contrast to this perspective, Pecchenino and Pollard (1997) argue that economic growth can be achieved more easily with increasing life expectancy.

3. Method and Model

The econometric analysis involves a cointegration (bounds) test based on the ARDL model and long-short coefficient estimates. The ARDL bounds test, developed by Pesaran and Shin (1999) and Pesaran et al. (2001), is a widely employed cointegration testing method in time series regressions because it can be used to investigate relationships between variables with the same or different degrees of integration and has several other benefits.

The linear ARDL(p,q) model for a bivariate case (Y and X) can be written as follows:

$$\Delta Y_t = \mu + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + \sum_{j=0}^{q} \delta_j \Delta X_{t-j} + \beta_1 Y_{t-1} + \beta_2 X_{t-1} + \varepsilon_t$$

To test whether a cointegration relationship exists between the variables, we can use a modified F-test, Wald test, or t-test. If cointegration is confirmed, the next step is to estimate the long-run relationship between the variables using the following equation:

$$Y_t = \eta + \sum_{i=1}^{p} \theta_i Y_{t-i} + \sum_{j=1}^{q} \beta_j X_{t-j} + u_t$$

Finally, the existence of a short-run relationship between the variables is also analysed through the following error correction model:

$$\Delta Y_t = \omega + \sum_{i=1}^{p} \alpha_i \Delta Y_{t-i} + \sum_{j=1}^{p} \delta_j \Delta X_{t-j} + \varphi ECM_{t-1} + \upsilon_t$$

The difference terms in the ARDL equation are error correction components and reflect the short-run relationship. Lagged-level terms represent the long-run relationship. Therefore, in the first stage of the analysis, the above ARDL model is estimated by the ECM method and the null hypothesis that $\beta_0 = \beta_1 = \cdots = \beta_k = 0$ is tested against the alternative hypothesis that $\beta_0 \neq \beta_1 \neq \cdots \neq \beta_k \neq 0$ by Wald test. This stage, where the cointegration relationship between variables is investigated, is called the 'bounds test' in the literature. An F value large enough to reject the null hypothesis means that the variables are cointegrated.

In the econometric analysis, the amount of gross savings (*LGS*) is used as the dependent variable and the population aged 65 and over (*LAGE*) is used as the independent variable. Of course, savings in an economy cannot be affected only by a certain variable and excluding important variables in a regression equation would lead to inefficient coefficient estimators. Therefore, a number of control variables are also included in the equation. These variables consist of inflation rate (*INF*), interest rate (*INT*), per capita income (*LY*) and total population (*LPOP*).

An increase in the inflation rate will lead to a decrease in disposable income and purchasing power in the short run, thus limiting the possibility of saving. On the other hand, an increase in the interest rate will increase the cost of holding money and thus encourage saving. An increase in income leads to more money remaining from the expenditures made for consumption, thus increasing the possibility of saving. Even if there is no change in economic indicators in a society, the total amount of savings may increase over time simply because the population increases. Accordingly, a priori, inflation can be expected to have a negative effect on savings, while interest rates, income and population have a positive effect.

The sample used in the analysis covers the period 1974-2021 and consists of annual data. All data are compiled from the World Bank's electronic database (WDI). All series except inflation and interest rates are logarithmically transformed.

4. Findings

As the first step in time series analyses, the standard practice is to investigate the stationarity properties of the series. This is because it is possible for the characteristics of a series (mean, variance, covariance) to change over time and the regression relationship between series that change in this way is likely to cause misleading inferences. For this reason, the stationarity of the series was investigated with the Extended Dickey-Fuller (ADF) test developed by Said and Dickey (1984) and the KPSS test proposed by Kwiatkowski et al. (1992) and the results are presented in Table 1. While the ADF test tests the null hypothesis that the series is non-stationary, the null hypothesis in the KPSS test states that the series is stationary.

According to both test results, all variables except population (*LPOP*) are integrated at first order, I(1). Population series is I(2) according to ADF test and I(1) according to KPSS test. Structural breaks, which are common in time series, make it difficult for traditional tests such as ADF to reject the null hypothesis. For this reason, the test Perron (1989), which takes into account one structural break, was applied and it was concluded that the population series is I(0).

Table 1. *Unit-root tests results*

	ADF					KPSS			
	Level		Difference			Level		Difference	
	C	C + T	C	C + T		C	C + T	C	C + T
LGS	-2.5868 (0.1028) -1.6505	-2.1086 (0.5265) -1.5577	-2.5947 (0.1015) -1.6760	-4.5785 (< 0.01) -1.7006		0.8816 4.6111	0.1951 1.4703	0.3508 -1.5938	0.1439 -1.6667
INT	-1.3589 (0.5940) 7.7012	-1.7567 (0.7096) 7.6762	-8.2907 (< 0.01) 7.6600	-8.5127 (< 0.01) 7.6961		0.2118 9.3260	0.1912 9.3902	0.2531 7.6051	0.0977 7.6621
INF	-1.7581 (0.3962) 8.3325	-2.3678 (0.3909) 8.3539	-7.2424 (< 0.01) 8.4143	-7.2300 (< 0.01) 8.4868		0.3927 9.6338	0.1549 9.4434	0.1501 8.3170	0.1060 8.3919
LY	0.6884 (0.9907) -5.0498	-2.0452 (0.5620) -5.0733	-6.4220 (< 0.01) -5.0198	-6.5448 (< 0.01) -4.9700		0.8907 -0.7359	0.1864 -4.1051	0.1602 -5.1212	0.0511 -5.0644
LPOP	-0.6120 (0.8564) -16.3656	-2.7576 (0.2208) -16.5000	-2.1221 (0.2375) -16.4467	-0.7933 (0.9576) -16.3537		0.9060 -1.6956	0.2212 -6.4153	0.7327 -9.9517	0.1424 -11.1120
LAGE	0.8726 (0.9942) -10.9478	-3.0820 (0.1229) -11.0852	-2.5445 (0.1221) -11.0140	-2.7626 (0.2181) -10.9568		0.9090 -0.3047	0.1371 -4.8017	0.1840 -7.8092	0.0698 -7.8454

Note: Lag length in ADF test is determined according to SIC. C and T denote specifications with constant and trend terms respectively. Critical values for KPSS test: Constant: 0.7390 (1%); 0.4630 (5%); 0.3470 (10%); Constant + trend: 0.2160 (1%); 0.1460 (5%); 0.1190 (10%), bandwidth is determined according to Newey-West method. The Δ sign indicates the first difference of the series. Values in parentheses indicate p-values, and those at the bottom indicate the SIC value.

The results of the ARDL bounds test applied to investigate the existence of a long-run relationship between the variables and the coefficient estimates of the appropriate specification according to the minimum SBC value are given in Tables 2 and 3, respectively. As seen in Table 2, the value of the calculated test statistic is quite high and indicates the existence of a significant cointegration relationship.

Table 2. *Results of ARDL bounds test*

Dependent variable	Independent variables	F-stat	Critical values	I(0)	I(1)
LGS	*INT, INF, LY, LPOP, LAGE*	20.9030	%10 %5 %1	3.012 3.532 4.715	4.147 4.800 6.293

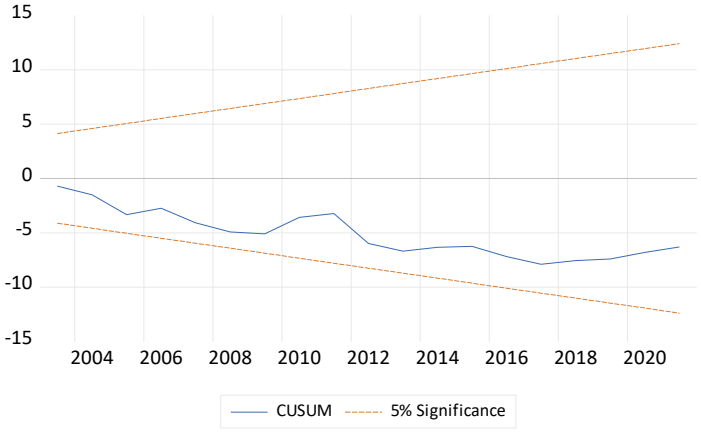
According to the estimates given in Table 3, the increase in the elderly population in Türkiye has a positive and statistically significant effect on the amount of savings. Other variables do not have a significant effect at the 5% level. Although inflation and interest rates have a significant effect at the 10% level, the coefficient of the inflation rate has a positive sign contrary to expectations.

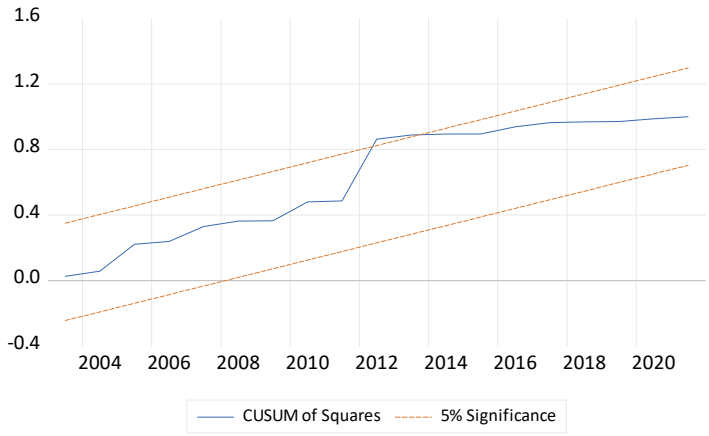
It is observed that the estimated model does not contain any problem in terms of linear regression model assumptions and the error correction term has the expected sign and is significant. The CUSUM and CUSUM_Square graphs in Figure 1 show that the coefficients are stable.

Table 3. *Estimates of long-run relationship*

Variable	Coefficient	St. error	t-stat	p-value
LY	8.4509	7.8656	1.0744	0.2961
LPOP	17.6894	31.6310	0.5592	0.5825
LAGE	33.3110	9.2531	3.5999	< 0.01
INF	0.0439	0.0246	1.7761	0.0917
INT	0.0314	0.0162	1.9340	0.0681
ECM	-0.2237	0.0178	-12.5866	< 0.01
B-G	2.2168	p-value	0.1538	
B-P-G	0.7310	p-value	0.7665	
RESET	0.1576	p-value	0.6961	
J-B	1.0692	p-value	0.5859	

Figure 1. *Graphs of CUSUM and CUSUM_Square*





If the series are cointegrated, the ordinary least squares estimate of the cointegrated vector (static ordinary least squares - SOLS) is consistent and converges at a faster rate than the standard. A major drawback of SOLS is that the estimates typically have a non-Gaussian asymptotic distribution, exhibit asymptotic bias, asymmetry, and are influenced by non-scalar nuisance parameters. Given that conventional testing procedures are not valid unless significantly modified, SOLS is generally not recommended if inference on the cointegrated vector is desired (Montalvo, 1995; IHS, 2017). To overcome this limitation of SOLS, various methods have been developed to estimate the coefficients of the relationship between cointegrated variables. The best known ones are Fully Modified OLS (FMOLS) proposed by Phillips and Hansen (1990), Canonical Co-integration Regression (CCR) proposed by Park (1992) and Dynamic OLS (DOLS) proposed by Stock and Watson (1993) (Karagöz and Özkubat, 2022).

The analysed relationship is estimated by all three methods and the results are presented in Table 4. It is noteworthy that the cointegrated regression estimates differ significantly from the ARDL long-run estimates. According to all three methods, population variables have a significant and positive effect on the savings stock. The effect of total population is higher than that of the elderly population. Again, according to all three methods, interest and inflation rates do not have a significant effect on savings. In fact, the coefficients of these variables are quite small in absolute value.

Contrary to expectations, the effect of income level on saving is negatively signalled and significant at the 10% level according to the estimates obtained by FMOLS and CCR methods. However, when the results of the DOLS method, which has the smallest sum of error squares and the highest explanatory power among the three methods, are considered, it can be accepted that the per capita income level has a highly significant and positive effect on saving.

Table 4. *Cointegrated regression estimates*

	FMOLS	DOLS	CCR
Sabit	-462.9209 (0.0192)	-707.3993 (< 0.01)	-491.1937 (< 0.01)
LY	-6.0802 (0.0702)	9.1555 (< 0.01)	-6.6746 (0.0723)
LPOP	51.2368 (0.0185)	77.1766 (< 0.01)	56.0344 (< 0.01)
LAGE	16.1303 (< 0.01)	15.1844 (< 0.01)	15.1695 (< 0.01)
INT	0.0038 (0.5273)	0.0029 (0.4307)	0.0019 (0.7508)
INF	-0.0067 (0.1054)	0.0011 (0.8014)	-0.0076 (0.1105)
Trend	-0.3734 (0.1167)	-0.7106 (< 0.01)	-0.3898 (0.0618)
R^2	0.9843	0.9999	0.9226
SSE	3.8265	0.0293	4.2303

Note: Values in parentheses are p values. SCC denotes the sum of squared errors. *Trend* denotes the linear time trend term.

5. Discussion

The results obtained from the analyses indicate that the increase in the elderly population has a positive effect on the savings stock in Türkiye. Accordingly, it is concluded that the life cycle hypothesis, which predicts that the opportunity and tendency to save will weaken in old age as in youth, is not valid in Türkiye. In fact, it is also possible to find this result normal.

Since macro data are used in the study, the result reflects the general tendency of the society. As predicted by the life cycle hypothesis, it can be thought that the opportunity to save will decrease in old age, or it can be thought that the non-expenditure income of the elderly population, who have already met many needs that require large expenditures such as automobiles, housing, education and therefore high savings effort, and who have voluntarily or involuntarily given up spending on many goods and services they previously consumed for physical and psychological reasons, has increased. In this case, it can be said that old age does not necessarily mean low income and low savings opportunities. An analysis to be conducted by using micro-level data may make it possible to reach more informative findings on this issue.

In this study, a single specification is used with an average economic regression approach without resorting to alternative model forms. Considering the fact that the regression equation is sensitive to its content, different specifications may yield different findings. This may also explain the weak and insignificant coefficients of factors such as inflation and interest rates, which are expected to be highly influential on the propensity to consume and save.

On the other hand, it may not be a generally valid phenomenon that the propensity to save decreases in parallel with the decrease in the opportunity to save in old age and retirement age. It is possible that spending behaviour patterns, which may vary from country to

country due to cultural and social influences, may be determinative in this regard. It can be said that people in Türkiye continue to save in their old age both as a continuation of their individual lifestyles and due to inheritance concerns. In this respect, the aging - saving relationship in Türkiye may differ from many other country examples and theoretical considerations.

6. Conclusion

Despite the ongoing theoretical debate about its impact on economic growth, saving remains a crucial macroeconomic variable. This issue has gained even more prominence since the emergence of the Solow growth model (1956), which argued that, with technology held constant, economic growth would be determined by a country's population growth rate and national savings rate. Subsequent growth models have continued to incorporate savings as one of the variables influencing economic growth.

Demographic shifts are becoming increasingly significant, particularly as they directly impact household savings. The aging population will have a substantial effect on national savings, a trend that gained attention in the mid-20th century. Two influential theories, the life cycle (Modigliani and Ando, 1957; Ando and Modigliani, 1963) and permanent income (Friedman, 1957) hypotheses, emerged during this time, both positing a connection between age, saving, and consumption patterns. These theories suggest that individuals strive to optimize their financial well-being by aligning their spending habits with their anticipated lifetime income (Zuanazzi and Fochezatto, 2020).

In this study, which investigates the effect of the increasing proportion of elderly population on the volume of savings in Türkiye as a developing country, the time series analysis methods used reveal that the increase in the elderly population has a positive effect on the savings stock. However, taking into account the effect of income on savings, increasing or at least maintaining the purchasing power of the retired population in particular and the elderly population in general is important for the sustainability of the aforementioned saving effect. The importance of preserving the positive effect of the saving tendency of the elderly population cannot be ignored in Türkiye, where the inadequacy of the savings rate and investments is often complained about.

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