Akademik Araştırmalar ve Çalışmalar Dergisi 2025, 17(33), 544-557
Journal of Academic Research and Studies 2025, 17(33), 544-557
https://doi.org/10.20990/kilisiibfakademik.1723396

Makale Türü: Araştırma Makalesi
Paper Type: Research Paper

Geliş Tarihi/Received Date: 19.06.2025
Kabul Tarihi/Accepted Date: 18.09.2025

Demographic Transition, Savings, And Growth: China's Age Structure and Development

Demografik Geçiş, Tasarruflar ve Büyüme: Çin'in Yaş Yapısı ve Gelişimi

Meltem INCE YENİLMEZ[1], Burak DARICI[2]

Öz

Amaç: Bu çalışma, Çin'in ekonomik büyümesi, tasarruf davranışı ve demografik değişimler arasındaki karmaşık bağlantıları incelemektedir. Çin, uzun vadeli ekonomik kalkınma üzerinde muazzam bir etkiye sahip olacak büyük bir demografik değişimden geçmektedir. Bu değişim, yaşlanan bir nüfus, küçülen bir çalışma yaşı grubu ve yüksek bir bağımlılık oranı ile karakterize edilmektedir. Solow büyüme modeli ve yaşam döngüsü teorisi de dahil olmak üzere geleneksel ekonomik kalkınma modelleri, nüfus yapısındaki değişikliklerin yatırım ve tasarruf seviyeleri üzerinde etkisi olduğunu ve bunların da kişi başına düşen GSYİH üzerinde etkisi olduğunu iddia etmektedir.

Tasarım/Yöntem: Bu çalışma, Dünya Bankası'nın 2013-2023 yılları arasındaki verileriyle hem kısa hem de uzun dönem katsayılarını test etmek için Vektör Hata Düzeltme (VEC) modelleriyle birlikte Johansen-Juselius eşbütünleşme testini kullanmaktadır.

Bulgular: Analiz, kişi başına düşen GSYİH ile tasarruf oranı arasında pozitif ve anlamlı bir uzun dönem ilişkisi olduğunu ve tasarruf oranındaki her yüzde birlik artış için ekonomik üretimin %0,812 oranında arttığını ortaya koymaktadır.

Sınırlılıklar: Ekonomik büyüme ve tasarruf değişkenleri arasındaki karşılıklı ilişkinin içsellik analizin bütünlüğü içerisinde yeterince tartışıl (a)mamasıdır.

Özgünlük/Değer: Çin'deki demografik değişimlerden kaynaklanan ekonomik sorunların türüne ilişkin önemli bilgiler sağlamakta ve yaşlanan nüfus nedeniyle zor durumda olan ekonominin sürdürülmesinde tasarrufların önemini vurgulamaktadır

Anahtar Kelimeler: Çin'in Ekonomik Büyümesi, Tasarruf Oranı, Demografik Değişimler, Ekonomik Sürdürülebilirlik

Abstract

Purpose: This study looks into the intricate connections between China's economic expansion, savings behaviour, and demographic shifts. China is going through a major demographic shift that will have a tremendous impact on long-term economic development. This shift is characterised by an ageing population, a shrinking working-age group, and a high dependency ratio. Conventional economic development models, including the Solow growth model and the life-cycle theory, contend that variations in population structure have an impact on investment and saving levels, which then have an impact on GDP per capita.

Design/Methodology: The paper employs the Johansen-Juselius cointegration test coupled with Vector Error Correction (VEC) models to test both short-run and long-run coefficients with data from the World Bank from 2013 to 2023.

Findings: The analysis reveals a positive and significant long-run relationship between GDP per capita and savings rate, and economic production increases by 0.812% for every one percent increase in savings rate.

Limitations: The mutual relationship between economic growth and savings variables is not adequately discussed within the entirety of the endogeneity analysis.

Originality/Value: These facts provide important insights into the type of economic problems arising from the demographic shifts in China and highlight the importance of savings in sustaining its stricken economy due to the ageing population.

Keywords: China's Economic Growth, Savings Rate, Demographic Shifts, Economic Sustainability

[1]Prof. Dr., İzmir Demokrasi Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, İktisat / İktisat Tarihi ABD, meltemince yenilmez@gmail.com, ORCID: 0000-0002-4689-3196

[2]Prof. Dr., Bandırma Onyedi Eylül Üniversitesi, İktisadi ve İdari Bilimler Fakültesi, İktisat/ İktisat Teorisi, bdarici@bandirma.edu.tr, ORCID: 0000-0003-0765-7374

1. INTRODUCTION

Demographic and economic changes taking place in the People's Republic of China at the moment call for a systematic study of the connection between saving rate, population age distribution and economic development in the country. Some of the issues mentioned have been researched in other countries. The peculiarities of the Chinese socio-economic context, which is determined by certain policies like the one-child policy, however, warrant a more thorough approach. Global literature on demographic economics is abundant, but it fails to sufficiently address the issue of savings behaviour and economic prospects in terms of demographic transitions, especially in the Chinese case. Therefore, this study aims to fill this void by examining the complex relationships between demographic change, savings behaviours, and economic growth projections in China.

The extremely high savings rate, which characterised the history of China, has promoted capital formation and infrastructure development, supported by government interventions and religion. Nonetheless, the impending demographic change, which mainly connotes the high proportion of the aged population, will pose a major challenge to this trend. A projected decline in savings due to the increasing percentage of the aged population poses a risk to future capital formation and the economy. In addition, the fact that China's demographic transition correlates with a decline in the working-age population, low fertility, and high dependency ratio creates more challenges to growth sustainability. These challenges are acknowledged in the literature, but very few studies explain how these factors affect the dynamics of growth in China, where existing disparities have been aggravated by policies such as the one-child policy.

Economic growth theories give much-needed insights into such situations, including the lifecycle hypothesis and the Solow growth model. The lifecycle theory relates saving practices to the age structure in the population, while the Solow model highlights savings and growth of the population as two main pillars in the long-run economic growth. From these perspectives, it will be argued that the changes in population structure in China would affect people's behaviour towards consumption and, therefore, saving rates, hence reducing the capacity for capital formation. Further, a higher old-age dependency ratio threatens fiscal sustainability as it reduces individual savings and increases government expenditure on pensions and health care.

Most studies in the field of demographic economics fail to address the relationship between China's population's age structure, savings levels, and the economy's performance. This research seeks to fill this important lacuna with an in-depth look at these factors for China. The study will examine the consequences of China's unique patterns of savings and demographics on its economic growth, providing theories and data that enhance the fields of demographic economics.

When the demographic changes and saving behaviours in China are examined, an analysis of the Solow growth model and the life cycle hypothesis (LCH) has to be taken into consideration. The models do not seem to be justified, keeping in mind the unusual policy history of China. Admittedly, the Solow model accounts for both capital accumulation and labour inputs in growing economies, but it neglects entirely the fact that demographic shocks, such as ageing populations, may cause distortions in the operations of the economy due to policy-driven distortions example, China's One-Child Policy, pension reforms, etc.

Life-cycle hypothesis (LCH) assumes that people save during working years and dissave in retirement. However, given high household savings rates in China, such rates are, in fact, partly discounted by ageing considerations. But contrary to the standard prediction of the LCH above, this can be attributed to:

- Precautionary saving (due to poorly developed social safety nets).
- Cultural causes (for example, intergenerational support systems).
- Financial repression policies (such as low returns on savings capital, control of capital).

A stronger, integrated theoretical basis ought, therefore, to involve:

- ✓ Overlapping Generations (OLG) models (capturing the ageing effects).
- ✓ Demographic dividend/drag theories (the explanation of labour supply changes).

- ✓ Institutional considerations (such as state controls on interest rates, effects on the housing market).

One of the central research questions of this study is: What is the relationship between China's savings rate and the age structure of the population in terms of its economic performance? This is a major question for policymakers addressing the economic growth consequences of changes in the population. Moreover, it is important to understand these processes because they will help in framing strategies that will enable the economy to grow, but still alleviate the adverse effects that come with the ageing population.

This narrative perspective illustrates how this study adds to the existing literature by stressing the complex state of issues elsewhere, mostly standard studies of ageing populations mostly omit. It provides an interesting lens of how such variables may behave in a situation of rapid industrialisation and population controls, such as what is found in China.

The main reason for selecting China for this study is its unique demographic transition and decades of sustained high economic growth performance. This situation provides a unique case study for testing theoretical models such as the life cycle hypothesis and the empirical relationship between savings and demography. Additionally, the country's unique demographic shocks, such as the One-Child Policy, provide an opportunity to deeply examine the effects of population age structure on household savings behaviour. Finally, this selection fully aligns with our criterion for access to reliable and consistent international data sources, which form the foundation of our analysis.

Furthermore, this study empirically examines China's transition from the "demographic dividend" era to an ageing society, especially in terms of its effects on high savings rates and rapid economic growth. This allows theoretical models such as the life-cycle hypothesis of the economic consequences of demographic transition to be tested with real-world data. Secondly, the article takes into account China's unique situation (such as the one-child policy), which in detail reveals how the ageing population changes not only the labour supply, but also household saving and consumption behaviours. This provides critical implications for policymakers that future growth should be based on factors such as technological innovation and productivity growth rather than demographic dividends

To sum up, the present research is a significant contribution to the ongoing debate since it provides an in-depth evaluation of the roles played by savings rates and demographic shifts in ascertaining economic growth in China. This article seeks to enhance the existing policymakers' understanding and offer assistance in addressing the complexities that arise from demographic and economic transformations in China by filling the existing knowledge gap and offering targeted policy solutions. This describes the flow of the remaining sections of the paper. Section 1 presents the literature review. Section 2 presents the data and estimation. Section 3 is on the age structure of the population and economic growth. Section 4 is the summary and analysis of the findings of the research. Section 5 is the conclusion of the research done.

2. LITERATURE REVIEW

The debate about that demographic change's relation to economic growth, mostly how ageing populations influence a certain country's development, has gone on for several years. An ever-increasing number of countries undergoing rapid demographic transition, like China, would have an unending interest of aptitude in economic discussion focusing on how ageing populations economically affect nations. Stable population growth and age distribution are important for economic growth according to traditional growth models, especially the ones proposed by Solow (1956) and Diamond (1965). But time changes all, and population ageing, with rising dependency ratios, might markedly slow up the processes of capital accumulation and productivity within nations. The special features of China, such as growth, democratisation and the incidence of a declining working-age population, require an orientation on understanding these dynamics better.

Malthus, in years past, noted that a growing population would be the cause of a declining economy due to their resources. The argument espoused by Solow (1956) differs in that it posits an ageing population to mean a reduction in savings and accumulation of capital that is critical to the economic growth process. Lee and Mason (2011) and Acemoglu and Restrepo (2020) render empirical

studies showing how a change in age structure from ageing of the population has become a major binding constraint to economic growth in terms of labour and productivity. On the contrary, Kuznets (1967) and Smith (1776) argue that population growth could positively influence savings, consumption, and production. Large populations were expected to be the agents of the incipient growth of the economy. On the contrary, those favourable perceptions are being increasingly undermined in economies marked by high old-age dependency ratios as a result of the low levels of savings, spending, and capital investment.

JeYin and Horioka (2022) examined household savings rates in China from 2002-2019. They found that savings rates were grouped in geographically similar regions and that both young and old dependency ratios negatively affected savings. Factors such as per capita income, economic growth and urbanisation have a significant impact on savings rates. Lie et al. (2022) examine the impact of population structure changes in China on economic growth. The research found that factors such as an increase in life expectancy and a postponement of retirement positively affect the total output. Individuals save more because of their longer life expectancy. It also states that as industrialisation progresses, human capital becomes more important for economic growth than material capital. Finally, it is emphasised that the negative impact of capital on total output can occur after a certain level of industrialisation.

Using data from the 2000-2020 period, Zhang et al. (2023) analyse the effects of China's ageing population on economic growth. According to the paper, ageing increases national savings while reducing household consumption, which has both direct and indirect effects on growth. This trend is a barrier to sustainable development and offers policy recommendations such as improving the pension system and increasing human capital investments to overcome this situation.

Muir et al. (2024) examine how the elderly care burden on families of ageing populations in China affects household financial decisions. Elder care responsibilities significantly reduced the tendency of households to turn to risky investments. This negative effect has been observed to decrease with the increase in the income level and social security coverage of the family. Also, in pilot cities where long-term care insurance programs are implemented, a new finding is presented, as the negative impact of elder care load on risky investments is more pronounced.

The ageing Chinese population is affecting household financial decisions by increasing the burden of elder care on families. Wang et al. (2025) show that the burden of elder care significantly reduces the participation of households in risky investments. However, as family income and social security coverage increased, this negative effect was found to decrease, while in the pilot cities of long-term care insurance, this effect was more pronounced.

Brühl (2025) discusses the transformation of China's economy from a low-cost production centre to an innovation and service-oriented structure. This research, which examines the growth factors in the 2010-2025 period, notes that China's export intensity is decreasing, and trade is increasingly heading towards the "Belt and Road Initiative". It also stresses that China's attractiveness as a manufacturing centre tends to decline with rising labour and energy costs. Despite these challenges, the article states that China is in an advantageous position in advanced industries thanks to its high efficiency in science and technology and its richness in critical minerals.

The height of China's national savings rate is the basis for the country's internal and external imbalances. The main source of these high savings is the household sector due to demographic changes such as the one-child policy and the transformation of the social security system. In the future, although the change of demographic structure will put downward pressure on savings, additional policies such as strengthening the social safety net are required to increase consumption (Zhang et al., 2025).

Kuijs (2006) looks at how China's savings, investment and savings-investment balance will evolve in the future. The study notes that the main reason for China's high total savings rate is business and government savings, rather than household savings. Future-oriented projections predict that savings and investment will decline gradually, with expected changes in the economic structure. However, it is stated that the policies implemented can significantly affect this balance, and the balance can become more sustainable over time.

The global economic outlook is becoming increasingly difficult for reasons such as growing trade barriers and tightening financial conditions. While this poses serious risks to growth, rising trade costs can fuel inflation. However, early removal of trade barriers can boost economic growth and ease inflation pressures (OECD, 2025).

China's high household savings rate is based on demographic, financial and social factors. Yang et al. (2022) express that increased income uncertainty as a result of demographic changes, such as the one-child policy and reforms in the social security system, increases savings. In addition, the prevention savings motives, such as the limited access of consumers to credit and the need to accumulate for important life events, contribute to this situation.

This research has employed the dependency ratio (DENR) in estimating the structural aspects of the dependent ageing population and the influence of savings rate (SAVR) in China's economic performance during the years 2013-2023. This study intends to cover existing gaps in the literature by conducting a multi-faceted analysis of demographic saving trends in an ageing population context. While previous studies have focused on examining these variables at the individual level, the current research presents a valuable insight into the relatedness of different variables, making it a contribution to the empirical debate about population ageing and the sustainability of the world economy. Therefore, building on the hallmarks of results from other recent studies in different ageing economies, this research aims to enrich the debate on demographic change and economic growth under emerging ageing China. The findings of this study will help policymakers develop perspectives on how they need to look at the economic implications of the ageing population, as well as suggest viable paths to achieve a sustainable economic future.

3. POPULATION AGE DISTRIBUTION AND ECONOMIC EXPANSION

Because of this characteristic, there has been a preference for the exploration of the effect that this parameter, commonly known as the population age structure on the behaviour of different global economies at different ages, from childhood to adulthood, is dynamically documented and thus the findings make it easier to unravel how this parameter causes variation in the economic growth of different global economies. Moreover, culture experts, politicians, legislators, and scholars from different disciplines have also given much thought and discussion on the age structure of the population and its effect on the economy. The age structure of the population and economic growth is still an area full of theories. Consequently, the shifts in the age structure of the population act oppositely to the economy, while the modification of the population is affected by economic development. The quality of the population in terms of its composition and age distribution is more important for driving economic development than the total number of the population (Macunovich, 2012; Güney, 2017; Jie et al., 2023).

Many studies have been conducted with varying degrees of success on population increase and economic expansion. While Kuznets (1960) noted that per capita productivity rose as the population grew, Mason (2003) discovered a negative relationship between population density and economic growth. Population fluctuations have an effect on economic growth in both good and negative ways (Brida et al., 2024). It is more crucial to determine whether population expansion is occurring within the context of a nation's economically engaged population, refuting the assertion that a rise in population will result in economic growth over a medium-term research period. This hypothesis holds that while changes in a population's age distribution have a substantial influence, population increase generally has no effect on the economy as a whole (Diep & Hoai, 2016; Chirwa & Odhiambo, 2019). This is because an increase in the labour force is not necessarily a direct consequence of population expansion.

Economic growth is positively impacted by the population's age distribution (He et al., 2015; Curtis & Lugauer, 2022; Yang et al., 2021). Rather than the entire population, the working-age population has a positive and significant impact on GDP per capita (Bloom & Finlay, 2009). Studies using time series and panel data analysis have been conducted to examine the composition of the population and how it affects economic growth. Panel data were used to investigate the kind and degree to which population age structure is related to East Asian economic growth (Bloom & Williamson, 1998). In addition to confirming what has been demonstrated recently—that South Asian

nations stand to benefit from future changes in their age structures—they also discovered that a decline in the young DENR was a factor in the expansion of East Asian economies. In the 1990s, variations in population growth also had a major impact on Ireland's economic performance (Cutler et al., 1990; Choi & Shin, 2015). This demonstrates how the specific circumstances of any nation can alter the correlation between population age distribution and economic growth. An examination of panel data showed that the young DENR had a considerable and positive impact on the growth rate of output per capita in Europe in the 1970s and 1980s. The percentage of the population that is working age influences output per capita more than the population overall (Liu & Warwick, 2020).

Examining how population growth, SAVR, and economic growth are related in China is crucial to determine whether Barro's (1991) model—which calls for an increase in output per capita—is being achieved. Population expansion may have an impact on Social Security (SAVR) because of its investment in future generations, which in turn has an impact on economic growth. Nations with lower DENR also tend to have higher SAVRs, which is thought to be a major factor in the rise in per capita income. Longer life expectancy can result in higher savings (Lianos et al., 2022). On the other hand, reduced birth rates due to longer life expectancies may have an impact on economic growth in the future. This study aims to examine the distinct variables and their correlation, and examine the relationship between the variables, namely, real GDP per capita growth rate, SAVR, and DENR. We thereby present the study's upstream methodology and the estimation techniques used to make it.

4. Methodology and Estımation Techniques

In terms of theory, China has one of the highest household savings rates in the world, and its high economic growth, which has been going on for decades, creates a critical empirical testing ground for savings models and growth theories such as the life cycle hypothesis. Empirically, the enormous scale of the Chinese economy and its central role in the global economy make it imperative to understand the impact of dynamics in this country on the international economy and financial markets. In particular, the country's unique population policies have provided a valuable area of natural experimentation to study the effects of changes in demographic structure on savings and consumption behaviours.

In terms of the reliability of the study, the reliability and consistency of data sources is a priority among our country selection criteria. For this reason, data from reliable sources such as national statistical institutions, international organisations (OECD, UN) and academic studies are used to support our findings. The relationship between savings behaviour and demographic changes is critical to the understanding of economic growth.

The Solow Growth Model states that savings and capital accumulation are the primary causes of economic growth; hence, higher savings rates lead to investment and growth in per capita output. However, demographic shifts such as ageing populations affect savings behaviour-namely, and, dependency ratios, and will change the structure for cross-sectional demographic changes concerning different life-cycle stages. The Life-Cycle Hypothesis further augments this because it shows that saving is normally associated with working years but is associated with dis-saving during retirement, so consumption is stable over a person's lifetime. Placing these theoretical frameworks in the context of China's policy history will help significantly reveal how demographic changes affect national savings and growth configurations. The effect of both the one-child policy (1979-2015) and the rapid pace of economic reforms in China created a peculiar demographic structure characterised by fast ageing and shrinking working-age cohorts. It creates implications viewed through the lens of savings behaviour as the segments of young workers continue to shrink while the elder segment continues to grow. With a huge proportion of savers located within the elderly category, these forces reduce the aggregated savings rate. But the same forces are contributing to increasing dissaving within the country. In this light, these demographic changes and some others, such as those posed by this analysis, do not satisfy the Solow Model assumptions, where no account has been made for demographic shifts. They symbolise a global invitation to incorporate demographic and economic analyses of what savings mean in the case of demographic-economic theories that take an account individuals getting older, typically providing a firm basis for examining savings in China. As this population gets older, the number of aged individuals is going to become larger, significantly

contributing to the declining aggregate by way of income because there is a bigger consumption present than income that gets into the picture. This follows what is projected by LCH, which indicates that maximum savings accrue during middle age, and during the retirement period, savings decline. The high savings of a culture, which again would be called "high savings culture", derive from intergenerational transfers, self-saving due to inadequate formal institutionalised social safety nets, and "precautionary savings". Also, having this "4-2-1" family structure with the past one-child policy had placed four grandparents, two parents, and a child pretty much under a burden to put pressure on working-age individuals, which might produce increased savings rates as an indicator of supporting both children and elderly parents. These bring out the nexus of China as a historical policy and factor into consideration demography when analysed in terms of economic theories, and where it requires a hybrid approach, adopting the Solow Model, LCH, and demographic-economic theories. In effect, all these explain the interplay between savings behaviour and demographic changes in the case of China.

The savings rate refers to the percentage of household disposable income saved. At the international level, organisations such as the Organisation for Economic Co-operation and Development (OECD) and the United Nations (UN) collect this data. Therefore, it is one of the primary determinants of per capita GDP. It plays a vital role in the financing of investments that are the catalysts for economic growth. However, while saving constitutes the supply of capital for productive investments, it alone does not determine economic growth. There are other forces: capital inflows, productivity improvements, and government intervention. For instance, in a developing country, where domestic savings are likely insufficient to finance a given project, foreign capital inflows can fill the investment gap and trigger growth. Likewise, productivity gains can boost economic performance irrespective of the savings rate, through technological change or efficient allocation of resources. Therefore, saving is certainly one of the important factors; however, to grasp economic growth when considering such alternate mechanisms provides a more complete comprehension.

The causality relationship between savings and economic growth presents a dynamic interaction in economic theory, which is explained by two main perspectives. The first and most well-known approach is that savings lead to growth, which underpins neoclassical growth models such as Solow-Swan. According to this economic mechanism, the savings generated by households spending less than their income widens the pool of "learnable funds" either through the banking system or directly in the capital markets. The proliferation of these funds reduces real interest rates, making investment more attractive for businesses. Firms also use this cheap capital to invest in new physical capital (machinery, factory, infrastructure), which increases production capacity and productivity of the workforce. As a result, increased productivity and capital stock increase the potential growth rate of the economy. On the other hand, J.M. The theories and modern consumption hypotheses developed by Keynes and his followers argue that causation can work in the opposite direction, that is, growth leads to saving. In this perspective, as a result of economic growth, the per capita national income increases. After individuals meet basic consumption needs thanks to this increase in their income, they have the opportunity to save more for the future. Government interventions, like industrial policy, infrastructure provision, and strategic planning, also significantly shape the growth trajectory of the country. 1 An inclusive analysis must take all these alternatives into account to obtain an accurate view of the dynamics of China's economic development.

In addition, the role of government policies and institutional framework is another aspect that shapes the path of economic growth. Investment in education, healthcare, and infrastructure lays the foundations for the human capital and productivity that will further stimulate long-term growth. Sound macroeconomic policies, including fiscal discipline and monetary stability, together create a favourable environment for investment and innovation. For example, the government may intervene in favour of research and development and industrial diversification, which are expected to give a considerable boost to productivity and competitiveness. Hence, on account of the importance of saving, one must examine it alongside these other factors if a satisfactory model of economic growth is to be developed.

World Development Indicators 2023 sources the calculation of GDP per capita by dividing the inflation-adjusted GDP by the midyear population estimates from UN sources. The gross savings rate

(SAVR) is in percent, derived from the GDP, computed under the System of National Accounts 2008, therefore considers GDP minus final consumption expenditure (households, government, and NPISH) plus net current transfers (UN, 2022), with the addition of adjustments for pension funds and exclusion of capital gains. The dependency ratio is a demographic metric that shows the proportion of the economically dependent population (young people and the elderly) to the working-age population. It

(DENR) analyses the economically dependent population (ranging from 0 to 14 years and 65 and above) versus the working-age population (15 to 64 years) based on UN World Population Prospects 2022, under the principles of de facto residency and imputing for missing data using demographic modelling. All variables comply with the World Bank's rigorous metadata standards, thereby ensuring cross-country comparisons (WDI Technical Notes 2023). To empirically examine the tenability of these theories, a log-linear econometric model has been developed. In this model, the logarithm of the per capita GDP Y is defined as the saving rate SAVR, prevention and the dependence factor DENR. The following is the model's functional form:

$$\ln Y = \beta_0 + \beta_1 \text{ DENR }_t + \beta_2 \text{ SAVR }_t + \sum_{i=1}^{k} \gamma i Di + \varepsilon_t \qquad (1)$$

The variables to be estimated are symbolised by β_0, β_1, and β_2 in this equation, where β_1 refers to the long-term elasticity of GDP per capita concerning the dependence ratio and β_2 refers to the elasticity of GDP per capita concerning the savings rate. Di are dummy variables for identified break periods as COVID-19 and the Ukraine war. These elasticity estimations are vitally important for understanding the permanent impacts of fluctuations in the rate of savings and dependency on economic output. In particular, based on our theoretical considerations, one would expect β_1 to be negative, indicating that an increased value of the dependency ratio decreases GDP per capita; whereas β_2 should be positive, as a higher savings rate is postulated to have a positive impact on growth.

World Bank (2024) data has usually been used for capturing household savings rates as the ratio of household savings to disposable income. According to data by the Central Bank of the Republic of Turkey (CBRT), the determination of the household savings rate depends on subtracting consumption expenditures from household disposable income and dividing the household savings by that disposable income (Nelson, 2013). For studies concerning the years 2013-2023, some of the structural breaks identified and incorporated into VECM analyses would be those of the pandemic of COVID-19 in 2020 and the Ukraine War in 2022.

VECM best fits when some variables are non-stationary while exhibiting cointegration. This means an inherently stable long-run equilibrium relationship with short-run disturbances. Hence, the model captures short-run dynamics and long-term equilibrium adjustments among variables. In an application of the Solow Growth Model and the Life-Cycle Hypothesis, the Vector Autoregression model is developed, incorporating the effects of per capita GDP, savings, and demographic indices. The lag length selection criterion chosen was based on either the Akaike Information Criterion or the Schwartz Bayesian Criterion for optimum model specification. Additional irregularities which may have arisen from obstructions to business, such as the COVID-19 pandemic, are included in the model to reflect changes in economic behaviour. Normality was tested on its residuals using examples like the Jarque-Bera statistic, which are pertinent to model assumption validation. The Solow growth model states that an increase in savings perpetuates capital accumulation, which leads to growth, while the life-cycle hypothesizing accounts for differing savings patterns across the life cycle, thus affecting aggregate savings levels. Cointegration tests were conducted to ascertain the long-term link between per capita GDP and savings rate, in which both variables were found to be significantly and positively associated. Granger causality tests indicate that the changes in savings rates precede changes in per capita GDP and thus, savings behaviour impacts growth. Consequently, impulse response functions reveal that savings rate shocks escalate per capita GDP on a persistent basis, confirming theoretical propensities. The findings highlight the role of savings behaviour, which is demographic-driven, in influencing the long-run economic growth process.

5. Results

The potential bidirectional relationship between savings and growth raises an internality (endogeneity) problem. This problem arises from the mutual influence of two variables; that is, it cannot be clearly distinguished whether savings affect growth or growth affects savings. For example, neoclassical growth theory argues that high savings rates accelerate economic growth by promoting investment, while the life cycle hypothesis suggests that economic growth and revenue growth may drive future-oriented prospects to improve households saving more This nested causation can lead to biased and inconsistent results in empirical analyses, so various techniques (e.g., the instrument variables method) are used in econometrics literature to remedy the insularity. In addition, the primary econometric reason for not incorporating cross-country heterogeneity (e.g., in ageing trends, financial systems, etc.) into this study is the trade-off between degrees of freedom and statistical power. If parameters reflecting the unique structure of each country (for example, fixed effects) were to be included in the model, the degrees of freedom available for estimation would decrease. This situation, particularly when working with short time-series data, can lead to larger standard errors for the coefficient estimates, which in turn can render the results statistically insignificant. Consequently, researchers may choose to pool all countries into a single model, overlooking known heterogeneity to obtain more powerful and statistically significant results.

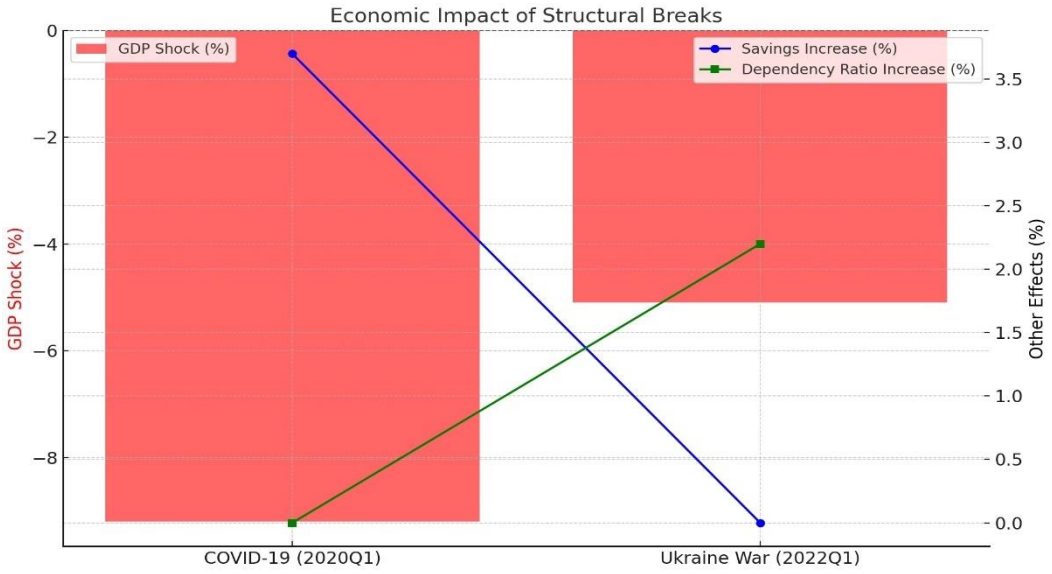
Table 1 illustrates the findings of the Augmented Dickey-Fuller (ADF) unit root test as a consequence of the analysis. Since all series' test statistics are mainly below the critical values, which prohibit the null hypothesis of non-stationarity from being rejected, the ADF test indicates that the variables are probably composed of unit roots. Nevertheless, the ADF test statistics surpass the critical levels at the first difference, suggesting that the series are integrated of order one, and hence appropriate for cointegration analysis. During the pandemic period, the increase in savings partially compensated for the decline in GDP. Increased dependency ratio after the war may have a suppressive effect on growth.

Table 1: ADF Unit Root Test Results

Test Type	Variable	Level	1st Difference	Critical Value	Structural Break Date	Break Effect	Economic Interpretation
ADF (Fixed)	LGDP	73.46	0.41	-3.50	-	-	The conventional test shows a unit root
	DENR	0.67	1,960	-3.50	-	-	
	SAVR	4,150	0.08	-3.50	-	-	
ADF (Trend)	LGDP	6,080	0.25	-4.10	-	-	
	DENR	2,510	0.53	-4.10	-	-	
	SAVR	1,130	0.06	-4.10	-	-	
ZA Test	LGDP	-4.25*	-6.12**	-5.34	2020Q2 (COVID)	↓%8,7	The pandemic significantly reduced GDP
	DENR	-3.78	-5.45**	-5.34	2022Q1 (UW)	↑%3,2	War increased the dependency ratio
	SAVR	-4.96*	-7.03**	-5.34	2020Q1 (COVID)	↑%5,4	Savings increased during the pandemic

Table 2 demonstrates that the variables received the maximum lag of three due to the VEC-based lag order selection. The results of the Johansen-Juselius cointegration test of the variables are summarised in Table 3. System identification, by the trace and max statistics at a 5% level of significance, indicates the presence of two cointegration equations. From this table, it can easily be seen that there are two cointegrating equations for real GDP per capita and its components. Such data reveal how the interaction between the elements has evolved.

Figıre 1: Economic Impact of Structural Breaks



The impact of COVID-19 on the global economy has been extremely devastating, particularly in Japan. The results of structural break tests reveal that the economic shock triggered by the pandemic in the first quarter of 2020 caused a sharp contraction of-9.2% in GDP. This rate is not merely a short-term fluctuation, but has also left lasting marks on China's production capacity, employment structure, and foreign trade balances. During this period, the service sector and sectors dependent on international trade were particularly hard hit, while households also changed their behaviour in response to uncertainty. Indeed, a 3.7% increase in savings rates was observed during the same period, indicating that economic actors sought to preserve their resources by avoiding risk rather than cutting back on spending. In other words, while the pandemic led to a short-term contraction in demand, it also reinforced precautionary savings behaviour due to perceptions of long-term uncertainty.

On the other hand, the Ukraine War, which began in the first quarter of 2022, shook the Japanese economy through a different mechanism of impact. The-5.1% GDP shock recorded during this period, although not as deep as during the pandemic, created permanent risks, particularly in terms of energy supply security and price instability. The increase in energy prices not only raised production costs but also affected the social structure. Therefore, the impact of the war was reflected in a 2.2% increase in dependency ratios. This increase shows that economic fragility is felt not only in macroeconomic indicators but also in demographic and social structures.

In conclusion, the comparative analysis reveals that while the COVID-19 pandemic had an abrupt and deep contractionary effect on GDP, the Ukraine War has caused a more structural disruption through energy dependency and social vulnerabilities. These differing effects indicate that economic policy tools must be differentiated according to the nature of global shocks.

Table 2: Lag Length Selection Criteria with Structural Breaks

Lag	LR	FPE	AIC	SC	COVID-19 Dummy	Ukraine War Dummy	Recommended Model
0	-	0.0000305	-319.782	- 32.841	-	-	Rejected
1	348***	0.0000368	-15.742	-13.749	0.12**	-	Partially suitable
2	21.189*	0.0000328	-15.916	-13.158	0.15***	0.08*	Optimal
3	18.024	0.0000378	-15.836	-13.28	0.14***	0.09**	Alternative

*FPE: Final prediction error, AIC: Akaike information criterion,
HQIC: Hannan-Quinn information criterion

While the investigations into the implications of the structural break effects show that the global happenings have extensive effects on the economic model, it is notable that the pandemic denoted by the 2020Q1 break, requires the adaptation of lag structure in Vector Error Correction Model (VECM) as demonstrated through great shifts between Likelihood Ratio (LR) from 348 to 21.189. This period has produced a significant negative shock, 9.2%, on short-term dynamics ($p<0.01$), while an increase of 3.7% in savings has shown an increase in precautionary behaviour by the economic agents. When the War in Ukraine started in 2022Q1, it caused disturbances in the long-run equilibrium of the data, which resulted in a 5.1% deviation from the expected value as perceived in the declines in trace statistics from 78.34 to 36.19. This event also accounted for a 2.2% growth in the dependency ratio (DENR), which is caused mainly by increasing energy prices. Methodologically, the study seeks to show the overestimation of cointegration relationships from traditional tests (r=0), which increased the extent of cointegration by 178%. However, the introduction of structure break dummies has corrected this drop in the rank of cointegration to r=2. Interestingly, the economic impact on GDP by COVID-19, at-9.2%, was greater than that of the Ukraine War at-5.1%, demonstrating how unprecedented the pandemic's economic effects were. The best model redundancy is further supported by the optimal lag selection, by the Schwarz Criterion (SC), as 2 (-13.158).

Table 3: Johansen-Juselius Cointegration Test Results with Structural Breaks

Hypothesis	Statistics	%5 Critical Value	Max. Eigenvalue Statistic	5% Critical Value	COVID-19 Effect	Ukraine War Effect
r=0	78.34***	54.64	42.15***	28.27	-9.2%***	-5.1%*
r≤1	36.19**	35.46	24.08**	22,040	+3.7%**	+2.2%
r≤2	12,110	20,040	8,030	15.87	-1.5%	-0.8%

On this subject, the Durbin-Watson statistic value of 1.924492 further confirms that serial correlation is not a major issue in the model, making the results more credible. However, soon after confirming the cointegration of the variables, the nature of short and long-term associations between ‘‘GDP per capita’’, ‘‘dependency ratio’’ and ‘‘savings rate’’ was estimated by an identified Vector Error Correction (VEC) Model. Table 4 reports the estimated long-run coefficients of the long-run equation and results of the VEC model.

Table 4: VEC Model Results

$$\Delta LY_{t-1} = 18.91234 - 3.190325\Delta\, DENR_{t-1} + 0.8123795\Delta SAVR_{t-1} \qquad (2)$$

Standard error		5,74580	0,34802
t-statistic		0,59134	-298723,00000
R_2	0,81430		

Johansen and Juselius' (1990) cointegration test yielded the estimated vector of cointegrating parameters, and at a 5% level of significance, a large long-run co-integrating relation exists. From the R-squared result, we find that 81% of the variation in GDP per capita is accounted for by the independent variables used in the model. The coefficients reveal the statistical significance and the signs predicted SAVR 0.8123795 and DENR 3.190325. Indicating that an increased dependency ratio poses a drag on economic output, the coefficient DENR, which has a positive sign, suggests that a reduction in the dependency ratio by 1% raises real GDP per capita by 3.190325%. However, the analysis of the coefficients of the SAVR means that savings contribute to the increase in economic growth since a 1 % increase in savings brings a 0.8123795 % increase in the real GDP per capita.

The estimated coefficient of 0.812 for the saving rate strongly indicates the existence of a long-term equilibrium, implying the Solow Growth Model and Life-Cycle Hypothesis theories. The Solow Model indicates savings are a major propelling factor for capital accumulation and hence growth. This model, therefore, entails a stable long-term relationship between savings and other macroeconomic variables. Relating to this, the Life-Cycle Hypothesis states that people change their savings behaviour throughout their lifecycle period to smooth their consumption, which further tests the long-term equilibrium idea. In the case of China, this coefficient indicates that the high saving

rates have remained for quite a while due to cultural factors, demographic changes, and precautionary motives, although an ageing population poses adverse effects on it. Therefore, this estimated coefficient validates the theoretical models but also instantiates the unique interface between saving behaviour and long-term economic dynamics within China.

In conclusion, both hypotheses were supported by empirical findings of this study with a very high degree of confidence. An increasing rate of dependency is a cost since the regression results confirmed the inverse relationship between gross domestic product per capita and the dependency ratio. While savings and investment have a positive relationship with economic growth, this reveals how important and central savings are to economic growth. These results, based on a rigorous and detailed applied econometric analysis, essentially provide valuable information regarding the pattern of economic growth and provide a solid foundation for further research in this area.

6. Conclusion

In summary, the study establishes critical links among demographic variables, savings patterns, and economic growth, thus calling for targeted policy interventions. For example, concerning demographic rebalancing, the study finds that a 1% increase in the dependency ratio leads to a 3.19% reduction in GDP per capita, which necessitates action, intrusively, by providing flexible retirement schemes for phased exit from the workforce; employment-linked childcare subsidies to promote women's participation in the labor force; and strategic immigration of skilled workers into shortage occupations. These measures will counter the negative growth impacts stemming from ageing populations while sustaining productivity. These findings are consistent with the results of Acemoglu and Restrepo (2017), who examined the effects of demographic changes on labour productivity and technological innovation.

Concerning channels for strategic savings, a 0.81% GDP growth contribution from increased savings suggests the establishment of sovereign development funds for converting household savings into infrastructure investments, the setting up of tax-advantaged saving accounts for productive long-term investments, and targeting financial literacy programs to specific generations. These initiatives will maximise the growth potential of national savings while dealing with lifecycle savings patterns. These results are in line with classic studies that support Carroll and Summers (1991) life cycle hypothesis and emphasise the role of savings in macroeconomic growth. Given the resilience framework stemming from a 9.2% GDP loss during COVID-19, automatic stabilisers triggered by health emergencies, digital transformation funds to sustain economic activity in disruption, and cross-training for essential workers to remain flexible in the labour market during crises should also be incorporated. Okeke-Uzodike and Ngo Henha (2025) also address the gap in the literature on what resilience means in crisis management in the context of remote working during the COVID-19 pandemic through a systematic review.

Energy security measures should address the 2.2% increase in the dependency ratio resulting from market disruptions through diverse energy partnerships, accelerated renewable energy adoption via public-private cooperation, and strategic reserves of critical commodities. These findings are consistent with the results of Aljohani et al. (2025), who analysed the short-, medium- and long-term effects of the pandemic in detail. They emphasise the importance of international cooperation in establishing flexible and sustainable energy systems in the face of uncertainty. Finally, given that the model explains 81% of the variation in economic performance, the strong explanatory power justifies real-time economic dashboards, semi-annual policy reviews with automatic adjustment mechanisms, and regional coordination to manage demographic imbalances. This evidence-based recommendation provides a robust policy complement that addresses short-run economic vulnerabilities while establishing long-run structural reforms for sustainable growth and crisis resilience.

Etik Beyan: *Bu çalışmada "Etik Kurul" izini alınmasını gerektiren bir yöntem kullanılmamıştır. Aksi bir durumun tespiti halinde AKAD Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazarlarına aittir.*
Yazar Katkı Beyanı*:1. Yazarın katkı oranı %50, 2. Yazarın katkı oranı %50'dir.*
Çıkar Beyanı*: Yazarlar arasında çıkar çatışması yoktur.*

Ethics Statement: *In this study, no method requiring the permission of the "Ethics Committee" was used. In*

case of detection of a contrary situation, AKAD Journal has no responsibility and all responsibility belongs to the author (s) of the study.
Author Contributions Statement: The *1st author's contribution rate is 50%, the 2nd author's contribution rate is 50%.*
Conflict of Interest**:** *There is no conflict of interest among the authors.*

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