# The Impact of Population Aging on Local Fiscal Sustainability in China

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**Abstract.** Under the new normal of demographic development, China is facing severe population aging. In 2022, China already has 280 million elderly people over 60 years old, constituting close to one-fifth of the nation's entire population, of which the size of the elderly group aged 65 and above exceeds 210 million. The pattern of deep aging has intensified the structural pressure on social welfare expenditure. This demographic shift has intensified pressures on social welfare expenditures, particularly in healthcare and pension systems, posing significant challenges to fiscal sustainability. This study analyses the impact of population ageing trends on the long-term stability of local finances in China. This research examines how population aging trends affect the long-term fiscal sustainability of China's local authorities, employing a comprehensive evaluation framework and panel data from 31 provinces (2008–2020). Using entropy weight methods and fixed-effects models, the analysis reveals that aging significantly undermines fiscal sustainability, with a regression coefficient of -0.359 for the elderly population ratio. Additionally, industrial structure and urbanization exacerbate fiscal pressures, while technological investments demonstrate a positive mitigating effect. The findings highlight the urgency of policy reforms to address aging-related fiscal risks, offering insights for achieving long-term fiscal balance amid demographic transitions.

## 1 Introduction

Under the new normal of demographic development, China's population dynamics are characterized by prominent trends such as aging, declining birth rates, and regional population divergence. Data show that as of 31 December 2022, the elderly demographic's proportion in China has climbed to a significantly high level. Notably, there are 280 million people aged 60 and above in China, making up close to 20% of the country's population. The size of the group aged 65 years or older reaches 210.3 million, accounting for about 14.9 per cent of the country's total population. The 65-and-over demographic in China reaches 210.3 million, representing approximately 15% of the country's inhabitants. According to international standards, China has already entered a phase of severe population aging.

The intensifying aging problem has directly triggered structural changes in social welfare expenditures. Demand for social welfare spending in health care, medical services, and elderly care is expected to increase substantially. Given that elderly care services possess

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quasi-public good attributes, their supply cannot be effectively allocated solely through market mechanisms. Consequently, public finance plays a pivotal role in addressing population aging, serving as a critical pillar for the elderly care security system.

Meanwhile, deepening population aging will exert profound impacts across various socioeconomic dimensions, ultimately manifesting as challenges to local fiscal sustainability. Against the backdrop of economic downturn, market entities have grown pessimistic about future economic prospects, leading to widespread "wait-and-see" sentiment. In an aging society, increased family burdens for elderly care may prompt households to raise savings rates at the expense of investment and consumption. This could result in reduced corporate production and sales, slower local economic growth, and weakened tax revenue expansion—all exacerbating fiscal sustainability risks.

Simultaneously, rigid fiscal expenditure demands continue to grow due to population aging and other factors. As fiscal revenue-expenditure imbalances become more acute, local governments face tremendous fiscal pressure and inherent incentives to adopt distorted fiscal behaviors. This is evidenced by the rising proportion of non-tax revenue in fiscal income, where some local governments resort to administrative fees, penalty income, and other non-tax measures to bridge fiscal gaps. Moreover, local government debt has been expanding as a financing tool. Both the increasing reliance on non-tax revenue and debt accumulation seriously threatens fiscal sustainability. Additionally, growing elderly care and medical expenditures may crowd out other types of fiscal spending, adversely affecting long-term local development.

In conclusion, under the new demographic normal, population aging has become a critical factor influencing China's socioeconomic development. Understanding the mechanisms through which aging affects local fiscal sustainability has emerged as a vital issue for China's economic and social progress. Based on this, this paper expounds the influence of aging on local finance.

## 2 Literature review

Some scholars systematically researched urban pension insurance contribution levels across three dimensions-the lenses of anti-poverty effects, wage replacement adequacy, and system sustainability, revealing the current double imbalance in China's urban pension treatment [1]. Some scholars have analysed the effects from modifications in individual healthcare expenditure growth and demographic composition's impact on the long-term viability of the Employees' Essential Health Insurance Reserve in Shanghai caused by factors other than demographic variables [2]. Huan Wang's research team used a population transfer matrix to systematically assess the effects of policy adjustments on the financial robustness of China's urban workers' retirement security system [3]. Some scholars investigated ramifications of demographic transition for government finance sustainability and its nonlinear characteristics under different levels of health care resources [4]. Some scholars examine Korean data and find that fiscal sustainability can be maintained through the cointegration of taxes and expenditures, despite the fact that social welfare expenditures continue to grow in response to low fertility aging [5]. Some scholars find that population aging had a significantly differentiated impact on fiscal sustainability in 14 European countries over the 1970-2014 period - countries not experiencing fiscal crisis maintained fiscal solvency by boosting their Marginal Primary Surplus (MRPS), while crisis countries experienced a deterioration in MRPS due to aging exacerbated pension and healthcare expenditures and ineffective policy regulation The MRPS has continued to deteriorate in crisis countries as aging has increased pension and healthcare spending and policy regulation has failed [6]. Some scholars proposed a dual pension model consisting of a "young-age pension" and an "old-age pension," designed to improve population structure by aligning with household life-cycle cash flows [7]. Some scholars analyze the performance of the Cuban pension system in terms of its financial actuarial sustainability and impact on the population over the period from 2006 to 2021 [8]. Based on the framework of the unified urban-rural pension insurance system, some scholars measured the trend of fund revenues and expenditures under different substitution rate scenarios, and found that the low substitution rate scenario could maintain fund balance until 2040, the medium substitution rate scenario would last only until 2030, and the high substitution rate scenario would incur deficits in 2025 and ultimately lose financial sustainability in 2035 [9]. Some scholars have quantitatively analysed the impact of population ageing on fiscal sustainability in China through the intergenerational accounting method, and found that ageing will lead to an increase in the average tax load per person of up to 55.9 per cent in the future through the weakening of the tax base and the expansion of expenditures, and have put forward a proposal for the optimization of the fiscal system that involves “increasing revenues, saving expenditures and adjusting the structure” [10].

## 3 Research design

As mentioned above, the relationship between population aging and local fiscal sustainability has been hotly debated by researchers, however, the existing literature on fiscal sustainability is mostly based on static or single indicators and lacks a more comprehensive and systematic interpretation and measurement. This study employs China's provincial panel data from 2008 to 2023 to establish a two-way fixed-effects model for empirically analyzing how demographic aging affects local government fiscal stability, with a view to providing theoretical basis and policy reference for addressing the challenges of aging and achieving long-term fiscal balance.

### 3.1 Measurement and evaluation of local fiscal sustainability

With reference to Liu et al. this paper constructs a local fiscal sustainability indicator system from three aspects of sustainable fiscal development, balanced fiscal revenues and expenditures [11,12], and controllable fiscal risks, covering 10 sub-indicators and 22 measurement indicators, as shown in Table 1. Through entropy weight methodology, this research quantitatively analyzes fiscal sustainability for China's 31 provincial administrations over the 2008-2023 period.

**Table 1.** Index system of local financial sustainability.

| Aspect indicators | Sub-indicators | Underlying indicators | Measurement indicators | Indicator characteristics |
|---|---|---|---|---|
| Fiscal development Sustained level | economic development | Growth intensity | GDP per capita | + |
| | | Growth capacity | Gross regional product index | + |
| | Resource Environment | Resource Consumption | Per Capita Daily Domestic Water Consumption | - |
| | Social Security | Standard of living | Engel's coefficient | - |
| | | Income Gap | Gini coefficient measured based on lighting data | - |
| | | Education Security | Education Expenditure/General Budget Expenditure | + |
| | | Employment Security | Social Security and Employment | + |

| | | | | |
|---|---|---|---|---|
| | | | Expenditure/General Public Budget Expenditure | |
| | | Healthcare Security | Healthcare Expenditure/General Budget Expenditure | + |
| | Geographic Coordination | Inter-provincial Coordination | GDP per capita per region/GDP per capita per country | + |
| Fiscal Balance Rate of Expenditures | Fiscal Expenditures | Expenditures Growth | General Public Budget Expenditures/Previous Year's General Budget Expenditures | + |
| | | Rate of Expenditures | Level of Expenditures General Budget Expenditures/Population | + |
| | | Expenditures Structure | General Public Service Expenditures/General Budget Expenditures | + |
| | | | Expenditures on People's Livelihoods/General Budget Expenditures | + |
| | Fiscal Income | Income Growth | General Public Budget Income/Previous Year's General Budget Revenue | + |
| | | Rate of Revenues | Revenue level General budget revenue/total population | + |
| | | Revenue structure | Tax revenue/general budget revenue | + |
| | | | (corporate income tax + personal income tax)/general budget revenue | + |
| | Income and Expenditure Balance | Fiscal Pressure | General Budget Expenditure/General Budget Revenue | - |
| | | Income and Expenditure Gap | (General Budget Revenue-General Budget Expenditure)/GDP | - |
| Fiscal Risks Controllable | Debt Risks | Deficit Dependency | (General Budget Expenditure - General Budget Revenue)/General Budget Expenditure | - |
| | Social Stability Risks | Social Security Burden | Elderly People Dependency Ratio | - |
| | Management Risks | Government Intervention | General Budget Expenditure/Regional GDP | - |

### 3.2 Research model and results

This paper uses the inter-provincial panel data of 31 Chinese provinces and municipalities spanning 2008 to 2020to carry out empirical tests on the theoretical hypotheses and constructs the following panel regression model.

$$sustain_{it} = \alpha_0 + \alpha_1 old_{it} + \delta X_{it} + U_i + \varepsilon_{it} \quad (1)$$

where i and t stand for the provinces and cities and the year, respectively; the explanatory variable sustains stands for the results of the computation of the local financial sustainability in the previous section; the core explanatory variable old stands for the index of aging; and X stands for the other control variables affecting the sustainability of local finances. Based on the outcomes of the F-test and Hausman test, the study employs a fixed-effects model to examine the association between population aging and regional fiscal sustainability The research data in this study were sourced from three authoritative channels: the National Bureau of Statistics of China's official website, the China Statistical Yearbook, and the China Stock Market & Accounting Research Database (CSMAR) . Table 2 is the variable definition. Table 3 is descriptive statistics.

**Table 2.** Variable definition.

| Variable Type | Variable Name | Variable Symbol/Unit | Variable Meaning |
|---|---|---|---|
| Explained variable | Local financial sustainability | Sustain | obtained by using entropy weight method to calculate the composite index |
| Core explanatory variable | Population aging rate | Old（%） | the proportion of the population over 65 years old to the total population in the region |
| | Old-age dependency ratio | Fyb（%） | the ratio of the elderly portion of the non-working-age population to the number of the working-age population in the region |
| Control variable | Value added of industrial structure | Ec（%） | value added of tertiary industry/region GDP |
| | Expenditure on science and technology | Kj（%） | Expenditure on science and technology/general budget expenditure |
| | Level of education | Jy | Number of students enrolled in general higher education institutions |
| | Urbanization rate | urban | Urban population/year-end resident population |

**Table 3.** Descriptive statistics.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| VARIABLES | N | mean | sd | min | max |
| id | 496 | 16 | 8.953 | 1 | 31 |
| year | 496 | 2,016 | 4.614 | 2,008 | 2,023 |
| sustain | 496 | 0.357 | 0.130 | 0.0900 | 0.828 |
| old | 496 | 0.109 | 0.0311 | 0.0482 | 0.211 |
| fyb | 496 | 15.19 | 4.755 | 6.700 | 30.60 |
| ec | 496 | 0.489 | 0.0928 | 0.298 | 0.848 |
| kj | 496 | 0.0209 | 0.0153 | 0.00303 | 0.0720 |
| jy | 496 | 89.25 | 58.59 | 2.940 | 295.6 |
| urban | 496 | 0.578 | 0.138 | 0.219 | 0.896 |
| Score | 496 | 0.345 | 0.117 | 0.162 | 0.757 |
| lnfyb | 496 | 2.674 | 0.304 | 1.902 | 3.421 |

The applicability of the data model and variables was initially judged before the base regression. The covariance test, smoothness analysis and panel data cointegration test were conducted using variance inflation factor VIF, using IPS test, LLC test and ADF-Fisher test, Pedroni test and Westerlund test respectively. The empirical results indicate that no significant multicollinearity issues exist among the key explanatory variables in the model.

**Table 4.** Benchmark regression results.

| | (1) | (2) |
|---|---|---|
| | Fiscal sustainability composite index | Fiscal sustainability composite index |
| old | | -0.359*** |
| | | (0.131) |
| ec | -0.253*** | -0.212*** |
| | (0.053) | (0.054) |
| kj | 1.055*** | 0.987*** |
| | (0.238) | (0.238) |
| jy | 0.000 | 0.000 |
| | (0.000) | (0.000) |
| urban | -0.252*** | -0.273*** |
| | (0.067) | (0.067) |
| constant term | 0.536*** | 0.564*** |
| | (0.041) | (0.042) |
| fixed time | YES | YES |
| Stationary individual | YES | YES |
| N | 496.000 | 496.000 |
| r2 | 0.322 | 0.333 |

Standard errors in parentheses * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4 displays the baseline regression outcomes, where the composite index of regional fiscal sustainability (Sustain) serves as the primary explanatory variable in the empirical analysis. Both model (1) and model (2) control for time and individual fixed effects, with a sample capacity of 496, and $R^2$ of 0.322 and 0.333, respectively, which makes the model fit satisfactory. The regression analysis reveals a statistically significant negative association between the population aging rate and regional fiscal sustainability ($\beta = -0.359$, $p<0.01$). This finding suggests that an increase in the elderly population proportion is associated with deteriorating fiscal conditions at the regional level.

The empirical findings robustly demonstrate that population aging exerts adverse effects on fiscal expenditure pressures, particularly regarding long-term obligations in pension and healthcare systems. Regarding industrial structure (ec), the analysis reveals consistently negative coefficients (-0.253 and -0.212 across both specifications), significant at the 99% confidence level. This suggests that greater dominance of the tertiary sector may paradoxically undermine fiscal sustainability, potentially attributable to either volatile tax revenues or inadequate fiscal contributions from service industries. Conversely, science and technology expenditures (kj) emerge as a strong positive determinant, with coefficients of 1.055 and 0.987 (both significant at $p<0.01$), indicating that increased investment in this area significantly enhances fiscal sustainability. This indicates that science and technology inputs play an important role in improving fiscal quality, which may enhance fiscal revenue elasticity and sustainability by promoting industrial upgrading and high-quality economic development. The urbanization rate (urban) variable shows a significant negative correlation, with coefficients of -0.252 and -0.273 in the two models, both significant at the 1% level of significance. This finding may be different from expectations and may reflect the fact that the current phase of urbanization is characterized by large infrastructure investment and public service expenditures, which increase the fiscal burden in the short term.

To more comprehensively examine demographic influences on regional fiscal sustainability, model (2) incorporates the natural logarithm of the dependency burden of the aging population (lnfyb) as a substitute for the demographic burden factor in model (1), which originally omitted this dimension. This key indicator quantifies the economic pressure exerted by senior citizens relative to the labor-force population. The logarithmic transformation serves two purposes: first, it reduces the impact of outliers in the data; second, it more effectively captures the variable's marginal effects in the regression analysis.

**Table 5.** Robustness check.

| | (1) | (2) |
|---|---|---|
| | Fiscal sustainability composite index | Fiscal sustainability composite index |
| lnfyb | | $-0.040^{***}$ |
| | | (0.014) |
| ec | $-0.253^{***}$ | $-0.221^{***}$ |
| | (0.053) | (0.054) |
| kj | $1.055^{***}$ | $0.992^{***}$ |
| | (0.238) | (0.237) |
| jy | 0.000 | 0.000 |
| | (0.000) | (0.000) |
| urban | $-0.252^{***}$ | $-0.267^{***}$ |
| | (0.067) | (0.067) |
| constant term | $0.536^{***}$ | $0.633^{***}$ |
| | (0.041) | (0.054) |
| fixed time | YES | YES |
| stationary individual | YES | YES |
| N | 496.000 | 496.000 |
| r2 | 0.322 | 0.334 |

Standard errors in parentheses* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The results of the empirical analysis show (Table 5) that the logarithm of the the dependency ratio concerning the elderly population (lnfyb) is significantly negatively correlated with fiscal sustainability ( $\beta$ =-0.040, p<0.01). This finding implies that the level of fiscal sustainability is relatively lower in areas where the burden of dependency on the elderly population is higher. The result remains robust after controlling for fixed effects and other variables, further validating the structural impact mechanism of ageing of the population on fiscal pressures, especially in terms of pension and health care security, which bring long-term expenditure rigidity. In addition, industrial structure (ec) remains significantly negatively correlated, with coefficients of -0.253 and -0.221 in the two models, suggesting that a rise in the share of the service sector may put pressure on local finances in the short run, for reasons that may include inefficient tax collection, an unstable tax base, or a shift of the labor force to low-productivity sectors. The positive impact of science and technology expenditure (kj) remains robust and significant (coefficients of 1.055 and 0.992, respectively), reflecting the positive contribution of science and technology inputs to fiscal sustainability, which may lead to fiscal health by improving the quality of the economy and the ability of fiscal revenues. The urbanization rate also shows a significant negative impact in both models (with coefficients ranging from about -0.25 to -0.27), indicating that although the urbanization process promotes the agglomeration of economic factors and population, at the current stage of development, its elevated demand for infrastructure development and public services may at the same time exacerbate the pressure on fiscal expenditures.

## 4 Conclusion

The empirical results of this study reveal a statistically significant inverse relationship between population aging and regional fiscal sustainability. The increase in the proportion of the elderly population will exacerbate the pressure of fiscal expenditure, especially the rigid expenditure in the areas of pensions and medical care, leading to a rising risk of fiscal imbalance. In addition, factors such as industrial structure, science and technology expenditures, and urbanization rate also have varying degrees of impact on fiscal sustainability, of which science and technology inputs can improve the quality of finances, but the urbanization process may increase the fiscal burden in the short term.

In order to cope with the financial challenges brought about by population aging, the following measures can be taken: first, optimize the pension and medical insurance system, explore diversified financing mechanisms, specifically the gradual and steady implementation of the policy of delaying the retirement age, and at the same time, introduce a market-oriented pension model and foster social capital to participate in the pension service industry, such as building pension communities, providing personalized pension services, etc., so as to alleviate the financial burden. Second, enhancing expenditures on scientific and technological development should be prioritized, set up a special scientific research fund to support the development of emerging industries, promote the upgrading of traditional industries to intelligent and green, improve productivity and economic efficiency, and enhance the elasticity of fiscal revenues; third, improve the supporting policies for urbanization, rationally plan the layout of cities, optimize the allocation of public service resources, and make use of big data and other technologies to enhance the efficiency of public service management, so as to avoid excessive growth in fiscal expenditures due to blind expansion; and finally Strengthen financial supervision and performance evaluation to ensure that every financial fund is used on the knife's edge, enhance fund utilization efficiency and adopt a coordinated approach to mitigate fiscal pressures induced by demographic aging.

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