Silver Transition's Impact on Shandong's Consumption Structure

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Abstract: The gradual intensification of population aging in China is manifested in substantial structural shifts in consumption expenditure patterns. Taking Shandong Province as an example, this paper examines the characteristics of population aging in the province, using data on the elderly population from 2010-2023. The impact of aging on the composition of consumption expenditures is quantitatively studied through the Pearson correlation coefficient method. It is found that population aging has a statistically significant association with the composition of consumption expenditure. In terms of the composition of consumption expenditure, aging is positively associated with the proportion of expenditure on education, culture, recreation, and health care. This suggests that aging contributes to total consumption expenditure by increasing expenditure on education, recreation, and health care. In addition, the correlation coefficient between aging and the proportion of food, tobacco and alcohol expenditure and housing expenditure is negative, indicating that aging increases will reduce the proportion of food, tobacco and alcohol consumption and housing consumption. Policy recommendations include improving social protection, developing industries focused on older persons, adjusting fertility policies to address the impact of ageing on consumption, and promoting sustainable growth through targeted economic adjustments.

1 INTRODUCTION

China's accelerated aging since 2000, marked by fast-growing elderly populations, coincides with economic restructuring. Examining aging's consumption impacts is crucial for sustainable development and industrial optimization through elderly-focused service expansion.

The composition of consumer spending is an important indicator reflecting the level of economic development and the quality of life of the population. As the proportion of the elderly population increases, the structure of household consumption expenditure is bound to change. On the one hand, the content of consumption of the older population is different from that of the younger population, with higher expenditures on health care and daily care. On the other hand, population ageing may affect household income levels and consumption expectations, indirectly affecting the composition of consumption expenditure.

Although the phenomenon of an expanding aging population is prevalent in most regions, there are significant regional differences in its socio-economic impacts due to different regional development trajectories. Taking Shandong Province as a typical case, this study outlines the characteristics of population aging in the province through longitudinal econometric analysis and explores the impact of aging on the composition of residents' consumption expenditures. The results of the study are important for the innovation of old-age security mechanism and the catalysing of sustainable economic transformation through the strategy of silver-hair economy optimization.

2 LITERATURE REVIEW

About the impact of the increase in the proportion of elderly people on the structure of consumption, the results of some scholars' studies have found that population ageing can enhance the structure of consumption.

Ma empirically evaluated the research hypotheses using provincial balanced panel data from 2003-2021

and obtained the following conclusions: population aging suppresses subsistence consumption, promotes enjoyment consumption, and has a non-significant effect on developmental consumption (Ma, 2024). Through the regression analysis of China's population aging and the composition of consumption expenditure, Ma et al. found that the deepening of population aging not only does not inhibit the upgrading of China's consumption expenditure composition, but also promotes its upgrading (Ma et al., 2023). Xie empirically analysed the data of thirty provinces in China from 2009 to 2020 by using a double fixed-effects model and a panel quantile model and found that the old-age dependency ratio will improve residents' consumption structure (Xie, 2023). Liu and Rao empirically examined the impact of population aging on the level and structure of household consumption using the Tobit model. The results found that demographic changes have a significant impact on rural household consumption (Liu and Rao, 2021). Gu empirically analysed the relationship between changes in household population structure and consumption structure transformation. Population aging achieves consumption upgrading by reducing the demand for food and clothing, increasing the demand for entertainment and healthcare services. At the same time, the increase in healthcare consumption has squeezed out some transportation, communication, and education expenditures (Gu, 2024).

Zhan and Yang examined the consumption patterns among the elderly population. Based on data from the 2012-2020 China Household Tracking Survey, using a stratified cross-classification random effects model, the study finds that the age of the elderly population has an inverted U-shaped relationship with the upgrading of the consumption structure. As age increases, the proportion of development and enjoyment expenditures of the elderly population first increases and then decreases (Zhan and Yang, 2024). Cao empirically examined the impact of population aging on residents' consumption structure using fixed-effects and moderating-effects models. The study results showed that at the national level, population aging significantly inhibits the survival-type consumption of China's residents. It has a significant promotional effect on the development-type and enjoyment-type consumption (Cao, 2023). Wang selected Nantong City, Jiangsu Province, which has the most severe population ageing in China, as a case study. Utilising relevant data from 2012 to 2020, the author employed regression analysis to ascertain that population ageing exerts a significant positive influence on the average living consumption expenditure of all residents, the average consumption propensity of the residents, and the structure of consumption (Wang, 2023). Xu et al. found that population aging significantly promotes the advanced and rationalized industrial structure (Xu et al., 2023).

Some scholars also argued that population aging does not have a significant impact on the composition of consumer spending. Using China's interprovincial panel data for 1989-2004, Li et al. examined the age structure of China's population and finds that China's old-age dependency coefficient does not have a significant effect on the consumption rate of its resident (Li et al., 2008). Through Chinese provincial panel data, Miao examined the impacts and pathways of population ageing on the consumption structure. The findings indicate that population ageing exerts negligible influence on the consumption structure in the eastern region. However, the adverse impacts on the enhancement of the composition of consumption expenditure in the central, western, and northeastern regions are particularly salient (Miao, 2024).

Scholars have examined the interaction between population and consumption from multiple dimensions, but China exhibits clear regional differences in its aging-economy model. Coastal, central, and western regions perform differently in addressing demographic challenges, which is closely related to the different economic development of each region.

3 METHODOLOGY

3.1 Data Source

This paper primarily utilizes population records from 2010-2023 and household expenditure data from 2013-2023 from the Shandong Statistical Yearbook 2024.

3.2 Method Introduction

This paper applies the Pearson correlation coefficient method to study the impact of the increase in the proportion of the elderly population on the composition of consumer expenditures in Shandong Province.

$$r = \frac{\sum_{i=1}^{n}(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}} \tag{1}$$

4 RESULTS AND DISCUSSION

4.1 Ageing in Shandong

In 2023, the total population of Shandong Province has reached 101.23 million people, accounting for 7.18% of the national population, ranking second in the country. It is one of the two provinces with over one hundred million population. In 2023, the population aged sixty-five and above in Shandong Province was 17.61 million, accounting for 9.24% of the national population aged sixty-five and above. Compared with other provinces, Shandong's considerable proportion of elderly people will result in labour shortages and increased government pension costs, which will continue to widen the economic gap between regions.

This analytical perspective reveals that the intensifying gerontic transition constitutes not merely a demographic phenomenon, but rather a multifaceted interdisciplinary challenge spanning economic, social, and institutional dimensions.

Table 1: Percentage of elderly (65+) in China and Shandong, 2010-2023.

Year	National (%)	Shandong (%)
2010	8.9	9.9
2011	9.1	10.0
2012	9.4	10.4
2013	9.7	11.0
2014	10.1	11.6
2015	10.5	12.2
2016	10.8	13.2
2017	11.4	14.0
2018	11.9	15.0
2019	12.6	15.8
2020	13.5	15.1
2021	14.2	15.9
2022	14.9	16.7
2023	15.4	17.4

Table 1 reveals Shandong's accelerated demographic aging trajectory, with the population cohort ≥ 65 years surging from 9.9% (2010) to 17.4% (2023) - exceeding the national average by 1-3 percentage points annually. The aging situation in Shandong Province is more serious than that of the whole country.

4.2 Accelerated Ageing Process

Table 2 delineates a pronounced upward trajectory in Shandong's geriatric demographic metrics. From 2010 to 2023, the number of older adults aged sixty-

five and above in Shandong will increase by about 8.13 million, with an average annual increase of 580000.

Table 2: Population aged 65+ and proportional trends in Shandong Province, 2010–2023.

Year	Population (10⁴ persons)	Proportion (%)
2010	948	9.9
2011	967	10.0
2012	1010	10.4
2013	1072	11.0
2014	1138	11.6
2015	1204	12.2
2016	1316	13.2
2017	1405	14.0
2018	1512	15.0
2019	1597	15.8
2020	1535	15.1
2021	1617	15.9
2022	1697	16.7
2023	1761	17.4

According to the classification criteria for an aging population, a country or region is classified as an aging society when the proportion of people aged 65 and above exceeds 7%, a deeply aging society when it ranges from 14% to 20%, and a super-aging society when it exceeds 20%. In 2017, the number of older adults aged sixty-five and above in Shandong Province reached 13.24 million, accounting for 14.0% of the total population, reaching the standard of a deeply aging society.

Table 3: Age-specific population distribution in Shandong Province, 2010–2023 (%).

Year	0-14 years (%)	15-64 years (%)	65+ years (%)
2010	15.7	74.4	9.9
2011	15.7	74.3	10.0
2012	16.1	73.5	10.4
2013	16.1	72.9	11.0
2014	16.4	72.0	11.6
2015	16.6	71.2	12.2
2016	16.4	70.4	13.2
2017	17.2	68.8	14.0
2018	18.1	66.9	15.0
2019	18.0	66.2	15.8
2020	18.8	66.1	15.1
2021	18.4	65.7	15.9
2022	17.9	65.4	16.7
2023	17.3	65.3	17.4

In table 3, the main working-age population (15-64 years old) shows a gradual shrinking trend (2010-2023), from 74.4% to 65.3%. The decline in the share of the working age population will have a negative impact on the overall economic development. During the liberalization of fertility policy in 2016-2017, there was a brief increase in the adolescent population (0-14 years old), but after 2020 the share of the adolescent population (0-14 years old) declined year by year.

4.3 Impact on Consumption Structure

Household expenditure allocation patterns, fundamentally reflecting the proportional distribution of consumption categories within total domestic outlays, serve as a socioeconomic mirror capturing regional developmental gradients and cultural particularities (Table 4). This paper analyses the data on food (X1), housing (X2), culture, education, and entertainment (X3), healthcare (X4), total expenditure (X), and elderly population ratio (Y).

Table 4: Per Capita consumption expenditure in Shandong Province, 2013-2023.

Year	X (yuan)	X1 (yuan)	X2 (yuan)	X3 (yuan)	X4 (yuan)
2013	11775	3442	2660	1136	902
2014	13329	3932	2826	1303	990
2015	14578	4166	2903	1755	1180
2016	15927	4490	3215	1948	1339
2017	17281	4715	3566	2174	1484
2018	18780	5031	3929	2410	1628
2019	20427	5417	4370	2419	1816
2020	20940	5757	4437	2374	1914
2021	22821	6196	4683	2729	2016
2022	22640	6267	4812	2566	2015
2023	24293	6791	4726	2915	2247

4.4 Pearson Correlation Coefficient Method

The statistical measure of linear association assumes values bounded within the closed interval $[-1, 1]$, where the metric's magnitude corresponds directly to the effect size of the bivariate relationship, with perfect unity indicating deterministic interdependence.

Table 5 shows that the correlation coefficient between aging and consumer expenditure is 0.99, indicating a highly positive correlation. The increase in the aging population can drive consumption expenditures in Shandong Province.

Table 5: Pearson correlation coefficient results

	X	X1, %	X2, %	X3, %	X4, %	Y
X	1					
X1, %	-0.69	1				
X2, %	-0.39	0.16	1			
X3, %	0.48	-0.75	-0.66	1		
X4, %	0.93	-0.79	-0.40	0.64	1	
Y	0.99	-0.74	-0.37	0.53	0.93	1

From the perspective of consumption structure, aging is positively correlated with the proportion of education, entertainment, and healthcare expenditures. The driving effect of aging on total consumption expenditure is achieved through increasing education, entertainment, and healthcare expenditures. In addition, the correlation coefficient between aging and spending on food, tobacco, alcohol, and housing is negative, indicating that an increase in aging will reduce the proportion of food, tobacco, alcohol, and housing consumption.

5 CONCLUSION

First, governments should combat aging challenges through pension system upgrades and healthcare subsidies for chronic treatments. Developing accredited care facilities with mobile health platforms and caregiver training can effectively enhance elderly support systems while reducing family burdens. This will increase the demand and confidence of older people to consume.

Secondly, older people will demand more health and wellness products, and related industries will have development opportunities. Older people have higher purchasing power, and their demand for tourism, culture, leisure, and other fields will also increase. Therefore, the authorities concerned can actively promote the development of the relevant industries, which will not only meet the needs of the elderly but also create more employment opportunities and promote economic growth.

Finally, there is a need to adjust the demographic structure. In response to the low birth rate in Shandong Province, the author is encouraging childbearing by improving the maternity leave system and the insurance system, strengthening financial support, and so on, enhancing the level of eugenics services in terms of lowering the cost of education,

perfecting the system of maternal and child health services, improving women's status and rights, and alleviating the burdens of the family to increase the willingness of families to bear children.

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