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Research on the Impact of Population Aging on Regional Economic Development

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Abstract: *Against the backdrop of the increasingly evident global trend of population aging, China, as the most populous country in the world, faces a particularly prominent issue of population aging. Studying the impact of population aging on regional economic development is of great significance for formulating targeted population policies and economic development strategies. This paper theoretically analyzes the impact mechanisms of population aging on the labor market, consumption structure, social security, and technological innovation. Subsequently, it empirically examines the impact of population aging on regional economic development by constructing a regional economic development model incorporating aging factors and applying it to different economic regions of China. The findings reveal that population aging has a negative impact on regional economic development, but the effects on different regions in China show significant differences. Therefore, each region should formulate appropriate policy measures according to its actual situation when responding to the challenges of population aging. This is necessary to guard against potential risks and make full use of the opportunities brought by population aging.*

Keywords: *Population aging; Regional economy; Economic development*

1. Introduction

As the global population structure evolves, population aging has become a universal challenge for countries worldwide. In China, with its large and rapidly growing elderly population, the aging issue is particularly pronounced. Since 1999, the proportion of China's elderly population has exceeded 10%, marking the country's entry into an aging society. By the end of 2020, the number of people aged 60 and above reached 185 million, accounting for 18.7% of the total population, highlighting the severity of the aging problem. The impact of population aging on society is multifaceted; it changes the labor force structure, adjusts the consumption structure, increases social security expenditure, and affects innovation and technological development, thus having a broad impact on economic development. Therefore, the impact of population aging on economic development has become a focus of attention for academics and policymakers.

Scholars have examined the impact of population aging on economic development from various perspectives. For instance, Lyu Liangting (2022) analyzed the impact of population aging on high-quality economic development and found that population aging not only directly affects high-quality economic development but also indirectly hinders it by obstructing industrial upgrading [1]. Lu Wenjian (2022) pointed out that the impact of population aging on high-quality economic development is complex. Population aging not only directly affects high-quality economic development but also indirectly affects it by influencing human capital [2]. Gao Zehao (2023) pointed out that China faces the challenge of rapid aging and a large base of elderly population. The country has entered an aging society before achieving sufficient prosperity, indicating that the impact of aging differs across different stages of economic development [3]. Song Jiaying and Gao Chuansheng (2023) analyzed the impact of population aging and pension expenditure on high-quality economic development and found that population aging inhibits high-quality economic development, while pension expenditure promotes it [4]. Yang Jianren et al.'s research indicates that there are mediating effects of effective labor input, consumption expenditure, and urbanization between population aging and economic growth. Population aging inhibits economic growth by reducing effective labor input, residents' consumption levels, and the urbanization rate [5]. Xie Shangyong (2022) found that demographic changes and public fiscal expenditure have complex effects in different regions, subsequently impacting regional

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economies differently [6].

Research on the impact of population aging on economic development can better reveal the relationship between aging and economic growth, deepen understanding of economic growth, labor markets, productivity, and consumption behaviors, identify new growth points and development opportunities, promote the upgrading and transformation of economic structures, and facilitate sustainable economic development. Given China's vast territory and the differences in economic, social, and cultural backgrounds among regions, as well as varying levels of aging, the impact of population aging on regional economic development is also diverse. Therefore, this paper focuses on the impact of population aging on different regional economies, analyzing its influence from both theoretical and empirical perspectives, and providing a theoretical basis and policy recommendations for promoting the sustainable development of regional economies.

2. Theoretical Analysis

2.1. Population Aging Leads to a Reduction in Labor Supply Affecting Economic Development

One of the impacts of population aging on economic development is the reduction in labor supply. As the proportion of elderly people increases, the labor market faces the challenge of shrinking. The growing elderly population means fewer young people entering the labor market, resulting in a decrease in overall labor supply. This directly affects enterprises' labor demand and production capacity.

In a contracting labor market, enterprises may encounter difficulties in recruitment and labor shortages. Insufficient labor constrains enterprise expansion and development, impacting national economic growth. The lack of sufficient labor will restrict the expansion and development of enterprises, thereby affecting the economic development of the country. Additionally, productivity may decline due to a lack of fresh talent, as the elderly are often unable to match the young in terms of technology or innovation.

2.2. Population Aging Changes Consumer Demand Affecting Economic Development

Another significant impact of population aging on economic development is the change in consumption demand. As the aging population grows, the consumption patterns of the elderly also undergo significant changes. Elderly people typically have higher savings rates and lower consumption propensities, focusing more on stable income and asset preservation and appreciation. This leads to changes in consumption structures, affecting the economy in various ways.

Firstly, the consumption demand of the elderly population gradually shifts towards health, medical care, and elderly care services. This shift not only highlights the urgent need for medical care and elderly care services but also heralds the prosperity of related industries. This development trend will effectively promote economic growth, create more employment opportunities, and contribute to social harmony and progress.

Secondly, the consumption demand of the elderly population positively impacts the tourism industry. With an increasing number of retirees, they have more time and resources for travel. The tourism demand of the elderly population will drive the development of the tourism industry, promoting the prosperity of related industries.

However, the changes in consumption demand caused by population aging also pose challenges. The lower consumption propensity of the elderly may lead to a decrease in overall consumption levels, potentially restraining economic growth. Additionally, the shift in consumption demand towards specific sectors may reduce demand in other industries, impacting the economic structure.

2.3. Population Aging Increases Social Security Expenditure Affecting Economic Development

As the degree of population aging continues to intensify, social security expenditure will face tremendous fiscal pressure. With the increase in the elderly population, the government needs to pay more pensions to meet their living needs. This will lead to an increase in government fiscal deficits, thereby having a negative impact on economic stability. The government may need to take measures such as increasing taxes or reducing other expenditures to cope with the rising pension costs, posing challenges to the fiscal system and impacting economic development.

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Simultaneously, population aging increases the burden of other social welfare expenditures. The government needs to enhance its care and support for the elderly population. Elderly people often require more social welfare support, such as housing subsidies, and long-term care. This further increases the financial burden on the government, negatively affecting economic development.

2.4. Population Aging Stimulates Innovation and Technological Development Affecting Economic Development

Another impact of population aging on economic development is the incentivization of innovation and technological development. As the proportion of elderly people increases, their needs and problems become more complex and diverse. This presents opportunities and challenges for innovation and technological development in areas such as medical care, elderly care services, and intelligent devices. This will encourage enterprises to increase research and development investments in related fields, promoting innovation in the medical technology, intelligent device, and elderly care service sectors. These innovations are beneficial for improving the efficiency and quality of medical services, while reducing the pressure on medical resources; they help improve the convenience and safety of the elderly population, providing certain employment opportunities and business opportunities for related industries; they help improve the quality of life for the elderly, enhance happiness index; and they help the development of various industries, bringing new growth points to the economy and promoting economic development.

3. Empirical Analysis

3.1. Variable Selection and Data Sources

This study selected the regional economic development index, calculated through the entropy method, as the dependent variable. The proportion of the population aged 65 and above was used as the explanatory variable, with the old-age dependency ratio as an alternative variable. Control variables included the level of fiscal expenditure, the growth rate of fixed assets, the area of urban roads per capita, and the level of per capita urban consumption expenditure.

The data used in this study were panel data from 31 provinces, municipalities, and autonomous regions in China (excluding Hong Kong, Macau, and Taiwan) from 2011 to 2022. All data were obtained from the National Bureau of Statistics website and the China Statistical Yearbook.

3.2. Calculation of Regional Economic Development Index

Table 1: Regional Economic Development Index Evaluation Indicator System.

First-Level Indicator	Second-Level Indicator
Innovation Dimension	Full-time equivalent of R&D personnel in enterprises above designated size
	R&D funds of enterprises above designated size
	Technical market transaction value
	Number of patent applications received
	Number of students in ordinary higher education institutions
Coordination Dimension	Industrial structure index
	Urban-rural income gap
	Urbanization rate
Green Dimension	Green coverage rate of built-up areas
	Forest coverage rate
	Per capita park green space area
	Fiscal expenditure on environmental protection
Openness Dimension	Import and export volume
	Number of foreign-invested enterprises
Sharing Dimension	Per capita public library collection
	Number of health personnel
	Number of medical and health institutions
	Per capita education expenditure
	Per capita disposable income of residents

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The calculation of the regional economic development index comprehensively considered five aspects: innovation, coordination, green development, openness, and sharing, as first-level evaluation indicators. These were further refined to construct second-level evaluation indicators to comprehensively assess the status of regional economic development. The constructed regional economic development index evaluation indicator system is shown in Table 1. Among them, the urban-rural income gap indicator is a reverse indicator, and the remaining indicators are all positive indicators. According to the evaluation indicator system, the regional economic development index for each region in each year can be calculated using the entropy method.

3.3. Regression Model Construction

This study chose to establish a panel multiple regression model, which can simultaneously consider both cross-sectional and longitudinal data, and can better control the fixed effects of time and individuals, thus reducing the impact of omitted variables and improving the accuracy and robustness of the model.

$$EDL_{it} = \beta_0 + \beta_1 OLD_{it} + \beta_2 GOV_{it} + \beta_3 FAGR_{it} + \beta_4 LNRPR_{it} + \beta_5 LNPCC_{it} + \mu_{it} \quad (1)$$

In the above equation, EDL represents the regional economic development index, OLD represents the degree of population aging, GOV represents the level of fiscal expenditure, FAGR represents the growth rate of fixed assets, RPR represents the area of urban roads per capita, and PCC represents the level of per capita urban consumption expenditure. β_0 represents the constant term, and β_i represents the regression coefficients of each variable. To eliminate the influence of different dimensions, logarithmic processing was performed on the area of urban roads per capita and the level of per capita urban consumption expenditure.

3.4. Stationarity Test

To prevent spurious regression, this study used the ADF test to test the stationarity of each variable. The test results are shown in Table 2.

Table 2: Correlation Analysis Results.

Variables	ADF Test	p-value	Result
EDL	136.7109	0.0000	Stationary
OLD	78.8829	0.0728	Stationary
GOV	122.9242	0.0000	Stationary
FAGR	121.3564	0.0000	Stationary
LNRPR	175.2550	0.0000	Stationary
LNPCC	175.8207	0.0000	Stationary

The results of the stationarity test show that the P-values of regional economic development level, population aging, fiscal expenditure level, fixed asset growth rate, area of urban roads per capita, and per capita urban consumption expenditure in the ADF test are all less than 0.1, passing the stationarity test. This indicates that all variables are stationary sequences and regression analysis can be conducted.

3.5. Regression Analysis

Before performing regression analysis, it is necessary to determine the model effect. The Hausman test was used to judge whether a random or fixed effect model should be chosen. According to the Hausman test results, the P-value was 0.0070, which was less than 0.1, indicating that a fixed effect model should be used in this study. This study used a fixed effect model with both time and region fixed to analyze the selected variables. The fixed effect model can control the potential variables of time and region, reducing their interference with the research results, making the model results more accurate and reliable. The regression results are shown in Table 3.

From the results of the fixed effect regression, the goodness of fit of the model is 0.664, meaning that the selected factors explain 66.4% of the regional economic development index. Additionally, the model passed the F-test at the 1% level, indicating that the overall regression effect is good.

The regression coefficient between population aging and the regional economic development index is -0.528, and it passed the T-test. This suggests a negative correlation between population aging and regional economic development. For every unit increase in population aging, the regional economic

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development index will decrease by 0.528 units. This verifies the previous theoretical analysis, as population aging can lead to a decrease in the labor force, potentially causing labor market tension and constraining the growth of productivity and innovation. The consumption structure of the elderly population typically favors spending on services and medical care rather than products and services that directly promote economic growth, potentially reducing investment and expenditure in other fields. Additionally, the government needs to allocate more funds for pensions, medical care, and other social welfare expenditures, reducing the funds available for investment and development. However, population aging may also incentivize innovation and technological development to address the needs of an aging society, which may have a positive impact on economic development.

Table 3: Correlation Analysis Results.

Variable	Regression Result
OLD	-0.528** (0.210)
GOV	0.254*** (0.063)
FAGR	0.025 (0.022)
LNRPR	-0.084*** (0.015)
LNPCC	0.005 (0.034)
_cons	0.257 (0.320)
R-squared	0.664
F-statistics	40.10***

Note: ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

There is a significant positive correlation between the level of fiscal expenditure and the regional economic development index, with a regression coefficient of 0.254, and it passed the T-test. This means that for every unit increase in the level of fiscal expenditure, the regional economic development index will increase by 0.254 units, indicating that increasing public fiscal expenditure can promote the level of regional economic development. This aligns with expectations, as increasing public fiscal expenditure typically stimulates infrastructure construction and public services, thus promoting economic growth.

The regression coefficient between the area of urban roads per capita and the regional economic development index is -0.084, and it passed the T-test, indicating a negative correlation between per capita urban road area and regional economic development. For every unit increase in the area of urban roads per capita, the regional economic development index will decrease by 0.084 units, suggesting that the area of urban roads per capita has an inhibitory effect on the level of regional economic development. This indicates that inefficient or unreasonable planning in resource allocation may have a negative impact on regional economic development.

The regression coefficients of the growth rate of fixed assets and the level of per capita urban consumption expenditure did not pass the T-test, indicating that these two factors have no significant impact on the level of regional economic development.

3.6. Robustness Test

This study replaced the proportion of the population aged 65 and above with the old-age dependency ratio (EDR) as the explanatory variable for robustness regression analysis. The results of the robustness regression analysis are shown in Table 4.

Through robustness regression analysis, it was found that the old-age dependency ratio has a negative correlation with the regional economic development index, with a regression coefficient of -0.224，and passed the T-test verification. This indicates that for every unit increase in the old-age dependency ratio, the regional economic development index will decrease by 0.224 units, suggesting that the old-age dependency ratio has an inhibitory effect on the level of regional economic development. This conclusion is consistent with the results of the previous regression analysis, further confirming the robustness of the regression results.

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Table 4: Correlation Analysis Results.

Variable	Regression Result
EDR	-0.224* (0.130)
GOV	0.241*** (0.063)
FAGR	0.022 (0.022)
LNRPR	-0.084*** (0.015)
LNPCC	0.019 (0.034)
_cons	0.108 (0.312)
R-squared	0.660
F-statistics	39.49***
N	372

Note: ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

3.7. Heterogeneity Analysis

China's vast territory and differences in economic, cultural, and population structures among regions result in varied impacts of population aging on regional economic development. To explore this issue more comprehensively, this study divided the 31 provinces into four different regions: the eastern, central, western, and northeastern regions. The eastern region includes ten provincial administrative regions: Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan. The central region includes six provincial administrative regions: Shanxi, Anhui, Jiangxi, Henan, Hubei, and Hunan. The western region includes twelve provincial administrative regions: Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Tibet, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang. The northeastern region includes three provincial administrative regions: Liaoning, Jilin, and Heilongjiang. This division not only considers geographical factors but also combines the characteristics of economic development in each region. By doing so, we aim to more accurately reveal the different impacts of population aging on regional economic development, and provide decision-making support for promoting the coordinated development of regional economies.

The same fixed effect model with both time and region fixed was used for regression analysis. The results of the heterogeneity regression analysis for each region are shown in Table 5.

Table 5: Correlation Analysis Results.

Variable	Eastern Region	Central Region	Western Region	Northeastern Region
OLD	-1.642*** (0.459)	0.024 (0.355)	0.676*** (0.127)	-0.188 (0.192)
GOV	1.073*** (0.284)	0.205 (0.144)	0.031 (0.025)	-0.048 (0.030)
FAGR	0.058 (0.077)	-0.076** (0.029)	0.004 (0.010)	0.006 (0.008)
LNRPR	-0.020 (0.041)	-0.062** (0.025)	-0.006 (0.007)	0.026* (0.015)
LNPCC	-0.280** (0.116)	0.232*** (0.046)	0.072*** (0.015)	0.004 (0.027)
_cons	2.875** (1.112)	-1.858*** (0.473)	-0.640*** (0.136)	0.032 (0.260)
R-squared	0.781	0.962	0.871	0.971
F-statistics	20.94***	78.39***	48.98***	35.45***
N	120	72	144	36

Note: ***, **, and * denote significance levels of 1%, 5%, and 10%, respectively.

The results of the regression analysis for each region show that each regression passed the F-test at the 1% level, indicating that the overall regression effect is good for each region.

The regression coefficient between population aging and the regional economic development index

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in the eastern region is -1.642, and it passed the T-test. This suggests a negative correlation between population aging and the regional economic development index in the eastern region. For every unit increase in population aging in the eastern region, the regional economic development index will decrease by 1.642 units, indicating that population aging has an inhibitory effect on the regional economic development in the eastern region. This is because the eastern region is relatively developed economically, with a more diversified economic structure and a longer average life expectancy. The aging population may lead to a shortage of labor, limiting the growth of productivity and innovation, reducing the flexibility of the labor market, and causing a decline in per capita productivity. Additionally, the increased expenditure on pensions and medical care and other social welfare increases the burden on the public finance system, reducing investment and development in other fields such as innovation and science and technology, and potentially reducing innovation and enterprise vitality, thus negatively impacting economic development. At the same time, the consumption structure of the elderly population typically tends to focus more on service consumption such as medical care and leisure tourism rather than products and services that directly promote economic growth. This change in consumption structure may slow down the pace of economic development.

The regression coefficient between population aging and the regional economic development index in the central region is 0.024, but it did not pass the T-test. The same applies to the northeastern region. This indicates that the correlation between population aging and the regional economic development index in the central and northeastern regions is weak, meaning that population aging has no significant impact on regional economic development in these regions. This is because the central and northeastern regions have relatively low levels of economic development and relatively traditional industrial structures. Population aging has a less significant impact on economic development in these regions. In these regions, due to long-term population outflow, the labor market is more capable of dealing with employment and labor supply issues for the elderly population, thus the impact of population aging on the labor market is relatively small, and it will not have a significant impact on regional economic development. An increasing elderly population does not necessarily exert pressure on the labor market, and there may not be sufficient consumption power to drive economic growth.

The regression coefficient between population aging and the regional economic development index in the western region is 0.676, and it passed the T-test. This suggests a positive correlation between population aging and the regional economic development index in the western region. For every unit increase in population aging in the western region, the regional economic development index will increase by 0.676 units, indicating that population aging has a positive effect on the regional economic development in the western region. This may be because the western region has abundant natural resources and ecological environment. With the aging population, the demand for elderly care, nursing, and health tourism and other related industries increases. This may promote the development of emerging industries such as the elderly care industry, medical and health care, and ecological tourism, driving regional economic development. At the same time, the western region plays an important role in the national “Belt and Road” strategy. Its geographical location and unique regional advantages provide development opportunities for elderly care services, medical services export, and cross-border tourism. This may attract more investment and resources to the region, promoting economic development.

4. Conclusion

This study combines theoretical analysis and empirical testing methods to explore in depth the impact of population aging on regional economic development. Based on clarifying the impact path of population aging on regional economic development, this paper constructs an econometric model and analyzes the following research conclusions:

(1) Population aging has a significant negative impact on regional economic development. The aging trend leads to a decrease in labor market supply, potentially causing rising labor costs and affecting the operational costs and competitiveness of enterprises. Simultaneously, the growing elderly population increases the burden on the social security system, exerting pressure on public finance.

(2) The impact of population aging on regional economic development varies significantly across different regions. In regions with higher levels of economic development, with more diversified economic structures and longer average life expectancies, the impact of population aging on economic development is relatively greater. However, in regions with lower levels of economic development, with relatively single industrial structures, the impact of population aging on economic development

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may be less significant.

(3) The impact of population aging on regional economic development is not entirely negative. Population aging brings not only challenges but also opportunities for transformation and upgrading. Population aging may promote the adjustment and upgrading of regional economic structures, encouraging economic development towards higher quality and sustainability. Population aging may also bring new business opportunities, such as the elderly care service industry and health industry, injecting new vitality into regional economic development.

Therefore, when formulating population policies and economic development strategies, it is essential to thoroughly consider the different impacts of population aging on various economic regions for the government to ensure that policies and strategies are more targeted and effective.

Firstly, the government should provide policy support and encourage young families to have children through incentives to stabilize the population structure. It should implement flexible retirement policies to encourage elderly people to continue participating in the labor market and alleviate labor shortages. The government should invest funds and resources to strengthen the construction of community elderly care facilities and improve service levels to meet the elderly care needs and reduce family burdens.

Secondly, the government needs to further improve the social security system, enhance legal assistance for the elderly, and resolutely safeguard their legitimate rights and interests. It should encourage social capital to participate in the construction of elderly care institutions, expand elderly care service supply, and improve service levels and coverage. It should formulate preferential tax policies to encourage enterprises to establish enterprise pension systems and increase pension contributions to ensure the basic quality of life for the elderly.

Finally, local governments should formulate policies and measures targeted at the local economic situation and the degree of aging to provide new impetus for regional economic development and promote the sustainable, healthy, and sustainable development of regional economies.

References

[1] Lyu Liangting. Research on the impact of population aging on high-quality economic development. [D]. Hunan University, 2022.
[2] Lu Wenjian. The impact of population aging on high-quality economic development in China [D]. Minzu University of China, 2022.
[3] Gao Zehao. Research on the impact of population aging in China on economic growth [J]. Modern Marketing (Late Edition), 2023(02):5-7.
[4] Song Jiaying, Gao Chuansheng. Population aging, pension expenditure, and high-quality economic development [J]. Journal of Jinan University (Philosophy and Social Sciences Edition), 2023, 45(02):98-114.
[5] Yang Jianren, He Fangjian, Chen Tao. Empirical analysis of the impact of population aging on economic growth [J]. Statistics and Decision, 2023, 39(02):125-129.
[6] Xie Shangyong. Population aging, fiscal expenditure, and high-quality economic development [D]. Huaibei Normal University, 2023.