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The Impact of Population Aging from the Perspective of New Productive Forces: Empirical Evidence from 30 Provinces in China

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Abstract: The new quality productive forces are the important means to promote the high quality of Chinese economic development, which is driven by the innovation of science and technology, the layout of new industries and the development of regional links. In the context of China's aging, it is significant to research the influence of the aging population on the NQHP. Based on the data of 30 Chinese provinces between 2010 and 2022, this paper discusses the influence of population aging on NQF in China. The paper found that population aging hurts new quality productivity. The effect of population aging on NQF has the feature of regional heterogeneity, and the biggest negative influence on NQF is the eastern area, and the second is the northeastern area. In the middle and west area, the aging of the population has no negative influence on the new quality productive forces, and it has an obvious positive influence. By means of the intermediary mechanism, we find that the aging population can inhibit the growth of NQF by decreasing the proportion of TPL.

Keywords: population aging, two-way fixed-effect model, new quality productivity.

1. Introduction

In September 2023, during his visit to Heilongjiang Province, General Secretary Xi Jigging pointed out that it is necessary to combine the resources of science and technology, to develop the strategic new industries and the future industries, and to speed up the formation of new quality productivity. On Sept. 7, 2023, General Secretary Xi Jigging stressed the importance of actively developing the new and emerging industries, including new energy, new materials, advanced manufacturing, electronics, and other industries, to speed up the formation of new quality productivity, and boost the momentum of new development[1]. In January 2024, the Political Bureau of the Central Committee conducted its eleventh collective study on advancing high-quality development solidly, clearly stating that developing new quality productivity is an inherent requirement and an important focal point for promoting high-quality development. The paper gives a comprehensive and systematic account of the importance of QFT, and gives a clear direction and direction for its development [2]. According to China's high quality economy, scientific and technological innovation, new industrial layout, regional linkage, and the national innovation target [3], Xi Jigging proposed a new quality productive force for China to realize China's modernization and even to revive the Chinese nation.

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New quality productivity refers to the ability to improve production efficiency and product quality through innovation and technological progress. It is usually affected by factors such as scientific and technological innovation ability and high-level innovative talents and is closely related to the young labor force. However, the data from the seventh national census showed that the population aged 65 and above accounted for 13.5% of the total population, up 4.63 percentage points from the sixth national census data. China's aging population showed an irreversible trend. With the aging of the population, the proportion of young people in the labor market will gradually decrease, which will lead to challenges in the growth of new quality productivity. In addition, an aging population may also affect consumption patterns and cause great pressure on the social security system, thus having adverse effects on new-quality productivity.

In this paper, the effect of population aging on new productivity is investigated by using the two-directional fixed-effect model and the mediation effect model, which is based on the data of 30 Chinese provinces between 2010 and 2022. In this paper, the influence of population aging on new productive forces is analyzed. It is concluded that the aging of the population has a negative effect on the new quality productivity. The impact of population aging on NQQF shows regional heterogeneity, which has a negative influence on NQQF and NQQF. Additionally, this paper proves through a mediating effect mechanism that population aging has a negative impact on new quality productivity by influencing the proportion of tertiary industry employment.

2. Literature review

Currently, the primary contradiction in our society is the growing demand for a better life among the people and the unbalanced and insufficient development. The central task of our Party is to comprehensively advance the great rejuvenation of the Chinese nation through Chinese-style modernization [4]. To address this "primary contradiction" and complete this "central task," we must further liberate and develop productive forces and guide new economic development practices with new productive force theories. Therefore, in the new era and new journey, accelerating the formation of new quality productive forces has become the key factor in liberating and developing productive forces, attracting high attention from the government, enterprises, academic circles, and other sectors of society. Domestic scholars have studied the new quality productive force problem from dimensions such as concepts, measurement, and influencing factors.

As the qualitative transition of the development of productive forces, new quality productive forces is the source of high-quality development. Wang Sitai and Wang Zhenyu pointed out that the proposal of new quality productivity depends on the objective practice situation of China's economic governance[5].Ling Xiaoxiong et al. explained the concept of new quality productivity [6] from three aspects of "time and space, structure and science and technology[6]".From the empirical point of view, there are some primary measures for developing NQF..Lu etc in science and technology productivity, green productivity and digital productivity three level index as the foundation, build the new quality productivity index evaluation system, using the method of improved entropy right-TOPSIS index empowerment, and with the national provincial data, strive to reveal the total level of new quality productivity and structure, regional differences and the status quo of [7].In terms of influencing factors, Peng Xu shu proposed disruptive innovation to leading technology system change is the formation of new quality productivity technology premise, cultivate and develop new quality productivity from disruptive technology innovation, high quality innovation, industrial layout optimization, realize the new factors of production key circulation key focus on [8].Li Ruiqin et al. proposed that to promote high-level opening up through system-based opening-up is a major judgment made by the CPC Central Committee in the new era in order to cope with the complex changes in the domestic and foreign economic environment, and to boost the development of new quality productive forces [9].Jiao Yong and Qi Meixia discuss the development of digital economy

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enabling new quality productivity from five aspects: theoretical logic, dynamic mechanism, expression form and realization path[10].

It can be seen from the above analysis that the research of NQF has been carried out in depth, but there is little literature about NQF from the point of view of the aging population[11].On the other hand, some scholars think that there is a positive economic benefit from the ageing of the population. Meng Lingguo and Wang Qing studied the promoting role of the realization of the second demographic dividend on economic development from three levels of human capital, savings and investment, and system innovation. On the other hand, population aging will have a negative impact on economic growth [12].Li Zhongqiu et al. analyzed the negative effect of China's aging population on economic growth from an empirical perspective [13]. Regarding the degree of openness, Xu Jiexiang and Bing Enguang studied the influence of population aging on FDI. The results showed that the aging of the population and the FDI influx had an obvious inverse U-shaped relation, and the spatial and temporal heterogeneity, and the expansion of the aging population, which impeded the inflow of FDI into [14] .Industrial structure, expecially the agricultural structure, Tingting Li et al.point that as the aging of the rural population deepens, the proportion of food crops planted will further increase, while the proportion of cash crops planted will decrease; agricultural mechanization will promote the further increase of the proportion of food crops planted while the proportion of cash crops planted will decrease in the deepening of the aging of rural population; the aging of the rural population has a more significant impact on the structure of agricultural planting in the eastern region and does not have a significant impact on the central and western provinces[15].

To sum up, the existing literature discusses the problem of new quality productivity from different perspectives, among which there are many insights and insights

Step study has established a solid foundation for the study. But objectively speaking, the relation between the aging of the population and the new quality productivity has not been discussed systematically. Based on the above analysis, it is found that the aging of the population affects the growth of economy, the distribution of income, the level of consumption, and the structure of industry. On this basis, we will explore the impact of the aging mechanism on the new quality productivity. using 2010-2022 China 30 provincial sample panel data, through the empirical test of the population aging of the direct effect and mediation transmission effect, to optimize the population age structure, alleviate the aging problem, accelerate the development of new quality productivity to provide a certain theoretical reference.

3. Data definition and model setup

3.1. Variable selection and data source

3.1.1. The variable to be explained

New Quality Productivity. Referring to Lu Jiang et al., calculate the new quality productivity level (NQP) of each province from three aspects: technological productivity, green productivity, and digital productivity.

3.1.2. Core explanatory variable

The level of population aging is measured using the proportion of the elderly population.

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3.1.3. Control variable selection

Based on related research, this paper will use per capita disposable income (yuan), regional openness, percentage of secondary industry, education level (human capital), and Environmental Regulation as control variables.

This paper uses data from 30 provinces in China (excluding Hong Kong, Macao, Taiwan, and Tibet) sourced from the Wind database and the China Statistical Yearbook. The variable descriptions are shown in Table 1.

Table 1: Variable description

Variable type	Variable name	Specific indicators	Symbol
The variable to be explained.	New productive forces	Calculate the three aspects of technological productivity, green productivity, and digital productivity	NQP
Core explanation Variable	Elderly population proportion	Number of persons over 65 years of age/total population	COG
Control variable	Per capita disposable income	(Per capita total income - total labor productivity * total employment) / 12	PCDI
	Region openness level	Total imports and exports/Gross Regional Product	OPEN
	The proportion of the second industry in GDP	Secondary industry value added/regional gross domestic product	ASI
	Educational level (human capital)	Number of Regular Colleges/Total Population at End of Year.	HUC
	Environmental Regulation	Investing in the Control of Industrial Pollution/Added Value	AER

3.2. Model settings

This paper establishes the following benchmark regression model to analyze the impact of population aging on new productivity.

$$NQP_{it}=\beta_0+\beta_1 COG_{it}+\sum_{i=2}^{n}\beta_1 X_{it}+\tau_t+\mu_i+\varepsilon_{it}$$

The following is the translation of the given text: "The following is the establishment of a mediating effect model:"

$$NQP_{it}=\beta_0+ aCOG_{it}+\sum_{i=2}^{n}\beta_1 X_{it}+\tau_t+\mu_i+\varepsilon_{it}$$

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$$NQP_{it}=\beta_0+a'COG_{it}+bPTI_{it}+\sum_{i=2}^{n}\beta_1 X_{it}+\tau_t+\mu_i+\varepsilon_{it}$$

Among them, i represents provinces, t represents time, COG is the proportion of the elderly population, represents the random error term, PTI_{it} represents the mediating variable, which is the proportion of employees in the tertiary sector to the total population.The above formula is used to test the mediating effect.

4. Experimental results

4.1. Benchmark regression analysis

Table 2: descriptive statistics

Variable symbol	Variable name	sample capacity	mean	standard error	least value	crest value
NQP	New quality productivity	390	0.1989	0.1772	0.0268	0.8768
COG	The proportion of the elderly population	390	0.1101	0.0277	0.0547	0.2001
PCDI	Per capita disposable income	390	24617.96	12637.91	7226	79610
OPEN	Region openness level	390	0.2765	0.2906	0.0076	1.4638
ASI	The proportion of the second industry in GDP	390	40.9848	8.1812	15.8735	61.9603
HUCAER	Educational level (human capital)	390	0.0207	0.0058	0.0080	0.0436
ER	Environmental Regulation	390	0.0026	0.0027	0.0000	0.0245

Using a two-way fixed effects regression model, we regressed the new productivity indicator and found that population aging has a significant negative effect on new productivity. The analysis of the proportion of the elderly population is shown in the following table.

Table 3 indicates that older people have a significant negative effect on new quality productivity. Along with the aging, people's cognition ability is dropping, the knowledge structure is obsolete, the innovation motivation is not enough, resulting in the lack of innovative capability. This inhibits technological innovation and the application of new technologies in the economy, hinders technological advancement and industrial structure upgrading, and ultimately weakens the driving force for economic growth.

Table 3: Baseline regression results

	NQP
COG	-0.7674***
	(0.2727)
PCDI	4.08****10^{-6}
	(1.21*)10^{-6}

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Table 3: (continued).

OPEN	-0.1248*** (0.0366)
ASI	-0.0003 (0.0010)
HUCA	2.3208* (2.0321)
ER	-0.4288 (1.4067)
Constants	0.2007*** (0.0759)
Time/individual effect	Yes
N	390
R^2	0.0015

4.2. Heterogeneity analysis

This paper divides 30 provinces (excluding Hong Kong, Macao, Taiwan, and Tibet) into the eastern, central, western, and northeastern regions (see Table 4) to examine the heterogeneous impact of population aging on the level of new productivity. As shown in the table, population aging hurts the development of new productivity in the eastern and northeastern regions, while it has a positive impact on the development of new productivity in the western and central regions. Moreover, the inhibitory effect of population aging on the development of new productivity in the eastern region is significantly higher than in the northeastern region, while the promoting effect of population aging on the development of new productivity in the western region is slightly higher than in the central region. Through comparative analysis, the eastern region has a higher level of economic development and aging than the central and western regions, indicating that the inhibitory effect of population aging on the development of new productivity is limited by various factors and exhibits a threshold effect. Its full manifestation requires time, and it is not obvious in the early stages, such as the negative effect of population aging on the level of new productivity in the northeastern region is not significant, while in central and western regions, population aging has a positive impact on the development level of new qualitative productivity. However, as the economy continues to develop and the level of aging deepens, this negative effect will gradually become significant, such as the significant negative impact of population aging on the development of new productivity in the eastern region[16].

Table 4: Region division

	Eastern region	The western region	Central region	Northeast region
Province	Beijing, Tianjin, Hebei, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan.	Shanxi, Anhui, Jiangxi, Henan, Hubei, Hunan.	Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang	Liaoning, Jilin, Heilongjiang.

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Table 5: Regional heterogeneity

	(1) Eastern region	(2) The western region	(3) Central region	(4) Northeast region
COG	-1.0908***	1.4699***	3.5403*	-0.2372
	(0.3651)	(0.2443)	(2.0930)	(0.3372)
PCDI	$-1.27 * 10^{-6}$	-7.19****10^{-6}	0.0001***	8.63***10^{-6}
	(1.99*10^{-6})	(1.94*10^{-6})	(0.0000)	(3.10*)10^{-6}
OPEN	-0.1521***	0.0122	0.2008	-0.1692
	(0.0437)	(0.0445)	(0.4338)	(0.1103)
ASI	-0.0062**	-0.0041***	0.0114***	-0.0006
	(0.0025)	(0.0006)	(0.0035)	(-0.0006)
HUCA	-5.1307	2.6484*8	14.0846*	14.8197***
	(4.7587)	(1.0592)	(7.6357)	(3.1287)
ER	6.0940**	-1.3946**	18.5012**	-2.2234
	(2.6459)	(0.5956)	(8.2054)	(2.5160)
Constants	0.8858***	0.1672***	-1.5958***	-0.1781
	(0.2055)	(0.0397)	(0.3911)	(0.1031)
Time/individual effect	Yes	Yes	Yes	Yes
N	130	143	78	39
R^2	0.1030	0.6668	0.0377	0.1058

4.3. Intermediary mechanism verification

In this paper, the employment ratio of the third sector is chosen as the intermediate variable. Along with the adjustment and optimization of Chinese economy structure, the third industry has become the main power to increase the economy and attract employment. Due to the increase of population ageing, the reduction in the size of labour supply, that is, the proportion of the working age population decreases, and the share of the third sector in the total workforce decreases, we can draw a conclusion that the decline in the share of the employment in the tertiary sector will hamper the creation of new high-quality productivity [13].

Table 6 shows that population aging hinders the development of new productivity by reducing the proportion of third-industry employment (PTI).

Table 6: Intermediary mechanism verification

	NQP	NQP
COG	-0.7674***	-0.8537***
	(0.2727)	(0.2672)
PTI		-0.3152**
		(0.1230)
PCDI	4.08****10^{-6}	3.09****10^{-6}
	(1.21*)10^{-6}	(1.16*)10^{-6}
OPEN	-0.1248***	-0.1131***
	(0.0366)	(0.0358)
ASI	-0.0003	0.0015
	(0.0010)	(0.0009)

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Table 6: (continued).

HUCA	2.3208* (2.0321)	0.6965 (2.0352)
ER	-0.4288 (1.4067)	0.4531 (1.1927)
Constants	0.2007*** (0.0759)	0.2752*** (0.0868)
Time/individual effect	Yes	Yes
N	390	390
R^2	0.0015	0.0527

5. Conclusion and Recommendations

5.1. Conclusion

This paper analyzes the mechanism of population aging on new productivity by using panel data from 30 provinces in China from 2010 to 2022, combined with a two-way fixed effects model and an intermediary effect mechanism. The study finds that: (1)Population aging has caused harm to new productivity: By analyzing the proportion of elderly people, it can be seen that population aging hinders technological innovation and industrial structure upgrading, weakens the driving force of economic growth and impedes the improvement of new productivity level. (2)The effect of population aging on new productivity shows regional heterogeneity, that is to say, in the eastern region, it has obvious negative effects on the development level of new productivity, but this effect is not significant; in the central and western regions, it does not damage the development of new productivity, but has a significant positive role; compared with the continuous growth of economy and acceleration of aging, the negative impact of population aging on the development of new productivity is becoming more and more significant. (3)Through the intermediary effect mechanism verified, population aging damages new productivity by affecting the proportion of tertiary sector employment, i.e. population aging reduces the number of tertiary sector employment persons as a percentage of total employment persons, thereby inhibiting the development of new productivity.

5.2. Recommendations

Careful adjustment of birth policy and encouragement of birth: Encouraging birth is the basic measure to deal with the ageing of the population. Carrying out the policy of having three children and supporting measures will help to improve the Chinese population structure, to carry out the national strategy to deal with the aging of the population, and to preserve the superiority of human resources in China.

Strengthen human capital and leverage the role of human resources: Human capital is the source of technological innovation and economic growth. Therefore, we should increase investment in human capital, improve the quality of labor supply, seize the last window period of the demographic dividend, accelerate education system reform, improve the skills and basic occupational qualities of China's labor force, and in response to the accelerating trend of aging, we should increase investment in preschool and basic education, improve the general employment skills and basic professional ethics of the workforce, and improve the level of labor productivity.

In the northeastern region, it is essential to promote the "silver economy," fully tapping into the demand of the elderly population for eldercare products, stimulating market vitality in the eldercare industry, and fostering the development of consumer service sectors. Moreover, the focus should be

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on improving independent innovation capabilities, increasing the conversion rate of technological innovation outcomes, and increasing investment in original research to boost overall innovation levels. In the central and western regions, while vigorously developing the eldercare industry, greater investment in human capital is also needed to improve educational quality, thereby increasing the stock of human capital in these areas. Given relatively weaker independent innovation capabilities, it is crucial to leverage regional resource advantages, align with current economic conditions and technological innovation capacities, and vigorously develop distinctive advantageous industries. This approach will facilitate the transformation of regional characteristic innovation achievements and enhance the development level of new quality productivity. Additionally, strengthening regional exchanges and cooperation is vital which can elevate the overall national level of scientific and technological innovation.

Actively exploit and utilize the elder's human resources and lower the age entry barriers for the tertiary industry. On one hand, adjust labor employment policies timely. With increased life expectancy and average years of education, consider extending retirement ages and implementing flexible retirement systems to transform "population quantity" into "population quality." On the other hand, strengthen training and support for the elder's re-employment, establish the concepts of "being useful in old age" and "supporting oneself in old age," enhance elder education, improve seniors' employ ability, increase their competitiveness in the job market, tap into their potential and strengths, thereby alleviating the issue of idle elderly labor, improving labor utilization efficiency, and raising the development level of new quality productivity.

References

[1] *"Xi Jigging presided over the symposium on Promoting the All-round revitalization of Northeast China in the New Era, emphasizing firmly grasping the important mission of Northeast China and striving to write a new chapter for the all-round revitalization of Northeast China", People's Daily, September 9, 2023.*

[2] *At the 11th collective study session of the Political Bureau of the CPC Central Committee, Xi Jigging emphasized accelerating the development of new quality productive forces and steadily promoting high-quality development [N]. People's Daily, 2024-02-02 (001).*

[3] *Anglia Engross, Duo Angelia.Focus, difficulties, and key path to accelerate the formation of new quality productive forces in the new era [J / OL].Contemporary economic management, 1-10 [2024-05-20].HTTP://kns.cnki.net/kcms/detail/13.1356.F.20240319.1706.002.html.*

[4] *Compiled by the Book Writing Group. "One Hundred Questions on Studying the Report of the 19th National Congress of the Communist Party of China." Beijing: Party Building Reading Materials Publishing House, 2017:8.*

[5] *Wang Shitai, Wang Zhenyu.— Take Adam Smith, Liszt, Schulz, and Marx as the main line of investigation [J / OL].Journal of Hubei Normal University (Philosophy and Social Sciences edition), 1-9 [2024-05-20].HTTP://kns.cnki.net/kcms/detail/42.1890.C.20240514.0952.002.html.*

[6] *Ling Xiao Xiong, Xie Heyuan, Tuo Anglia, and so on.The triple dimension of new productivity: spatial-temporal, structural, and technology [J].Journal of Xinjiang Normal University (Philosophy and Social Sciences edition), 2024,45 (01): 67-76. DOI:10.14100/j.cnki.65-1039/g4.20231101.001.*

[7] *Lu Jiang, Guo Ziang, Wang Yuping.Development level, regional difference, and improvement path of new quality productivity [J / OL].Journal of Chongqing University (Social Science Edition), 1-16 [2024-05-20].HTTP://kns.cnki.net/kcms/detail/50.1023.c.20240306.1451.002.html.*

[8] *Peng Xushu.The formation logic, development path, and key focus point of new quality productive forces [J].Economic Horizontal, 2024, (03): 23-30. DOI:10.16528/j.cnki.22-1054/f.202403023.*

[9] *Li Ruiqin, Wang Chaoqun, Chen Lili.Boosting the development of new quality productive forces through institutional opening: Theoretical mechanism and policy Suggestions [J].International Trade, 2024, (03): 5-14. DOI:10.14114/j.cnki. trade.2024.03.002.*

[10] *Jiao Yong, Qi Meixia.The digital economy enables the development of new quality productivity [J]. Economic and Management Review, 2024,40 (03): 17-30. DOI:10.13962/j.cnki.37-1486/f.2024.03.002.*

[11] *Zhang, Jiaqi and Youxue He. "Research on the impact of population aging on the development of digital economy." Academic Journal of Business & Management (2022): n. pag.*

[12] *Meng Lingguo, Wang Qing.Study on Lewis Turning Point, Secondary Demographic Dividend and Sustained Economic Growth [J].Economic Theory and Economic Management, 2013, (06): 44-53.*

DOI: 10.54254/2754-1169/90/20241943

[13] *Li Zhongqiu, Ma Wenwu, Li Mengfan.Economic effects of population aging in China — evidence from provincial panel data [J].Population and Development, 2017,23 (06): 26-35 + 45.*

[14] *Xu Jiexiang, Bing Enguang.Population aging and foreign direct Investment: Impact Mechanism and Empirical Analysis — Empirical study based on provincial panel data in China [J].Journal of Shandong University of Finance and Economics, 2024,36 (02): 50-64 + 95.*

[15] *Li T ,Lu H ,Luo Q , et al. The Impact of Rural Population Aging on Agricultural Cropping Structure: Evidence from China's Provinces [J]. Agriculture, 2024, 14 (4):*

[16] *Zhang, Mingzhi, Chao Chen, Xiangyu Zhou, Xinpei Wang, Bowen Wang, Fuying Huan and Jianxu Liu. "The impact of accelerating population aging on service industry development: Evidence from China." PLOS ONE 19 (2024): n. pag.*