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Study on the influence of population structure on economic growth

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Abstract: *The seventh national census shows that China's population is showing a new trend of five modernizations, and changes in population structure will lead to changes in economic activities. The study employs data from 31 provinces and municipalities nationwide, spanning the years 2010 to 2019, as its primary research sample. It delves into the analysis of four key aspects of the population structure: urban and rural distribution, age demographics, employment status, and cultural composition, examining their respective influences on economic growth over this time period. Our analysis reveals that several demographic factors significantly influence China's economic growth. These include the percentage of the urban population, the elderly population ratio, the rate of individuals with college degrees or higher, and the distribution of employment across industries. Specifically, the proportions of the employed population in both the primary and tertiary sectors play crucial roles. The urban population share and the educated population (college degree and above) positively contribute to economic development, while the distribution of employment, with more workers in the tertiary (service) sector, also drives growth. Conversely, the proportion of the elderly population might pose challenges due to potential effects on the labor force and productivity. Economic growth may be hindered by an escalation in the proportion of the employment population within the primary industry. To counteract this, it is suggested to boost urbanization rates, augment investment in education, and facilitate the realignment of the industrial structure.*

Keywords: *population structure; economic growth; aging; urbanization*

1. Introduction

The seventh national population census reveals notable shifts in China's demographic composition. The percentage of individuals aged 60 years and above has surpassed 18.7%, reflecting a growth of 5.44% since 2010, which indicates a heightened level of population aging. We will continue to face the pressure of sustained and stable growth in the elderly population for a long time to come. Approximately 2183.6 million individuals hold university degrees, indicating a substantial enhancement in the overall quality of the population. Over the past decade, China's rural agricultural modernization has progressed to a new phase, concurrently with the steady advancement of its new urbanization process. This has resulted in significant breakthroughs in urban development projects. As of now, approximately 9019.9 million people reside in urban areas, constituting 63.89% of the total population. This figure represents a significant rise of 14.21% compared to the urban population percentage in 2010. Between 2010 and 2020, China's employed population experienced a shift in dynamics, initially rising before subsequently declining. Despite a continued decrease in the number of employed individuals in 2020, the decline was marginal, not exceeding 0.1%, thus indicating a general stability in the employment rate over the period. Scholars have recently taken notice of the novel findings from census data, particularly the extensive debates surrounding the demographic age composition. On one hand, some argue that the escalating population aging could impede economic progress. On the other hand, there are those who posit that this demographic shift presents novel prospects for economic growth.

People are the main body of economic activities, and different population structures represent different quantities and qualities of labor, which determine differences in consumption structure, and economic activities naturally also have differences. The changes in population structure will lead to changes in economic activities, so it is necessary to explore a suitable population structure for economic growth. Chinese scholars mainly focus on a single structure in their research on population structure, lacking comprehensive analysis from multiple perspectives. This article employs a comprehensive

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approach to examine the population structure, incorporating literature review and empirical analysis methods in order to investigate the effects of population dynamics on economic growth.

2. Literature Review

2.1 Research on the Impact of Population Age Structure on Economic Growth

Chinese scholars mainly focus on studying a certain structure of population structure, among which the study on population age structure is the most extensive.Xu (2011) [1] study, a macro econometric model was employed to examine the empirical connection between age growth and labor productivity, revealing an inverted U-shaped correlation. The author argues that China is currently transitioning into a phase where an aging population contributes to enhancing labor productivity, thereby positively influencing economic expansion.Dai (2019) [2] empirically analyzed that aging will promote the development of the tertiary industry and increase GDP levels.Feng (2021) [3] empirically demonstrated that as age progression intensifies, the per capita GDP growth rate is anticipated to diminish, leading to a gradual growth trajectory around the year 2025.

2.2 Related research on the impact of population urban-rural structure on economic growth

Hu (1999) [4] discussed the promoting effect of urbanization on the economy from the perspective that accelerating urbanization construction is conducive to solving the problem of surplus rural labor and accelerating the pace of urbanization is conducive to expanding domestic demand. Long (2010) [5] urbanization plays a crucial role in fueling China's economic progress. An enhancement in the urbanization level is instrumental in stimulating the rise of rural residents' consumption demand, which in turn promotes economic growth. Notably, urbanization exerts a stimulative impact on the economic development across various regions; however, the extent of this effect differs.(Zhu&Huang , 2016) [6]

2.3 Research on the Impact of Population and Cultural Structure on Economic Growth

According to Song (2003) [7],“Enhancing cultural level does not demonstrably contribute to a substantial increase in economic development levels”.Luo(2008) [8]demonstrated a positive relationship between the level of education among individuals in the labor force and the per capita Gross Domestic Product (GDP).Bai (2013) [9] research employed empirical data to uncover how different levels of education impact economic activities. The study notably found that increasing the proportion of people with secondary education and above significantly boosts economic growth.

2.4 Research on the Impact of Population Employment Structure on Economic Growth

Li (1997) [10]delved into the intricate relationship between population dynamics and economic growth, scrutinizing this connection through the lens of labor market scenarios.Ji (2006) [11] argues that there is an indispensable connection between the rapid transformation of industrial structure and economic growth.Zhang (2006) [12]conducted an empirical study to argue that a significant labor surplus is present in the primary sector in Shaanxi Province. Moreover, it was proposed that the enhancement of employment opportunities in the tertiary sector had a pronounced stimulating effect on Shaanxi’s Gross Domestic Product (GDP). Wang (2008) [13]found through empirical research that due to differences in production efficiency among industries, the flow of labor between industries can lead to changes in overall productivity. The shift of the labor force into the secondary and tertiary sectors contributes to the improvement of the employment structure, boosts relative labor productivity, and ultimately drives economic expansion.

3. Indicator Construction and Data Resources

3.1 Indicator Construction

The Per Capita Gross Regional Product (PCGRP) of the 31 provinces and municipalities in China was selected as the primary indicator for our analytical framework.

In addressing the selection of independent variables, this research investigates perspectives concerning urban-rural configuration, demographic composition, cultural dynamics, and occupational

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sector distribution within industry. It subsequently proceeds to identify and analyze the following six surrogate variables.

3.1.1 Population urban-rural structure (UR)

With the advancement of urbanization, there is a potential to stimulate rural consumption demand and expand the rural consumption market, contributing to a larger migration of labor from the primary sector to the secondary and tertiary sectors, which in turn drives economic growth. In this context, the urban population ratio (UR) was chosen as the proxy variable.

3.1.2 Population age structure (DR)

Due to the increasingly prominent issue of aging population in China, it has attracted widespread attention. Therefore, this article chooses the elderly dependency ratio (DR) as the proxy variable.

3.1.3 Population and cultural structure (EDU)

As pivotal players in socio-economic activities, the quality of the workforce has a substantial impact on the rate and magnitude of economic growth. In the context of China's progression towards a novel economic phase, it is forecasted that economic expansion will become increasingly reliant on expenditures aimed at enhancing human capital and technological innovations. Consequently, the population's educational achievement level, particularly for individuals holding a high school diploma or higher (EDU), was selected as the proxy variable.

3.1.4 Industrial Structure

The state of industrial structure functions as a gauge for assessing a country's economic development trajectory and serves as a driving force in guiding the transformation of economic growth patterns.Han and Zhao(2019)[14]introduced the Solow model of population structure variables and the binary economic theory, and concluded that industrial structure changes output through labor transfer, thereby affecting economic growth. Therefore, the scholars selected the proportion of the workforce dedicated to the primary sector (PI), the share active in the secondary sector (SI), and the fraction employed in the tertiary sector (TI) as the central elements for their study.

3.2 Data Sources

The research data utilized in this article predominantly originates from the China Statistical Yearbook (2010-2019).

4. Methodology

4.1 Model Selection

This chapter employs an empirical panel regression model to delve into the effects of population structure shifts on economic growth in China. The analysis is grounded in annual data spanning from 2010 to 2019, sourced from 31 provinces and municipalities across the country.

Construct the following econometric model and design the expression as follows:

$$LnPGDP_{i,t} = \alpha + \beta_1 LnUR_{i,t} + \beta_2 LnDR_{i,t} + \beta_3 LnEDU_{i,t} + \beta_4 LnPI_{i,t} + \beta_5 LnSI_{i,t} + \beta_6 LnTI_{i,t} + \varepsilon_{i,t}$$

In the formula: i represents the research area; T represents the year; α Is the constant term of the model; β_1, β_2, β_3, β_4, β_5, β_6 represents the elasticity of each variable.

4.2 Empirical testing

4.2.1 Unit Root Test

So this section conducts stationarity tests on the panel sequences within the sample. From a quantitative perspective, LLC test and ADF Fisher unit root test are used to gradually detect the sample sequence. The results are shown in Table 1.

At a significance level of 5%, the probability values corresponding to the ADF Fisher test are all below 0.05. To conclude, the null hypothesis of unit roots is rejected for all seven panel variables, as they exhibit statistical significance at the 5% level.

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Table 1 Summary of Unit Root Test Results

variable	Levin,Lin & Chu		ADF-Fisher		conclusion
	statistic	Prob.	statistic	Prob.	
LnPGDP	-22.0502***	0.0000	163.4260***	0.0000	stable
LnUR	-19.9509***	0.0000	135.4510***	0.0000	stable
LnDR	-11.0201***	0.0000	105.5310***	0.0005	stable
LnEDU	-9.0453***	0.0000	108.5400***	0.0002	stable
LnPI	-20.3733***	0.0000	350.7850***	0.0000	stable
LnSI	-16.1891***	0.0000	119.8590***	0.0000	stable
LnTI	-14.4148***	0.0000	87.7820***	0.0173	stable

4.2.2 Hausman Test

The Hausman test on the sample data yields a statistical measure with a probability value below 0.05, indicating that a fixed effects model is suitable. This outcome is advantageous for our analysis.

5. Results

The sample data has been analyzed using a fixed effects model, and the encapsulated regression outcomes are presented in Table 2.

Table 2 Fixed Effects Model Regression Results

Variable	estimation parameter	standard error	t-statistic	P-value
LnUR	1.1858***	0.1183	10.0207	0.0000
LnDR	0.2228***	0.0576	3.8709	0.0001
LnEDU	0.2818***	0.0723	3.9008	0.0001
LnPI	-0.9597***	0.0799	-12.0181	0.0000
LnSI	0.0098	0.0572	0.1718	0.8638
LnTI	0.5258***	0.0658	7.9904	0.0000
Constant term	5.6888***	0.4725	12.0387	0.0000

(Note: The values in parentheses are P-values, where *, **, *** represents a significance level of 5%, 10%, 1%respectively)

Based on the regression outcomes presented in the aforementioned table, the model's coefficient of determination amounts to 0.9620, indicating a high degree of fit. Moreover, the model's F-statistic stands at 271.0495, accompanied by a probability (p-value) for this statistic that is notably low, suggesting strong statistical significance. Therefore, the regression equation of the entire model is significant and ideal. According to the regression results, the model expression is obtained as follows:

$$LnPGDP_{i,t} = 5.6888 + 1.1858LnUR_{i,t} + 0.2228LnDR_{i,t} + 0.2818LnEDU_{i,t} - 0.9597LnPI_{i,t} + 0.0098LnSI_{i,t} + 0.5258LnTI_{i,t}$$

Starting from the significance of estimated parameters, at the 10% significance level, LnSI did not pass the t-test. The statistical significance of the regression coefficients for LnPGDP, LnUR, LnDR, LnEDU, LnPI, and LnTI was confirmed at the 1% level through the t-test, suggesting that factors such as the degree of urbanization, dependency ratio, percentage of the population with secondary education or higher, share of primary employed individuals, and proportion of those in tertiary employment play a crucial role in shaping economic growth across different regions in China.

6. Discussion

6.1 The increase in the proportion of urban population has a significant impact on economic growth

The urban populace witnessed a 1% rise, paralleled by a 1.1858% growth in per capita GDP. This enhancement in urbanization facilitates the aggregation of productive resources within urban centers, promotes the migration of rural dwellers to urban locales, expands avenues for farmers to augment their earnings, and, to a degree, amplifies the consumer demand from individuals with purchasing power; Simultaneously, as the urban populace and industrial sectors expand, the government will escalate its expenditure on public amenities and infrastructure development.

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6.2 The increase in the proportion of elderly population has a promoting effect on economic growth

The proportion of elderly population increased by 1%, and the per capita GDP increased by 0.228%. Although population aging can lead to a decrease in labor supply, it does not necessarily suppress economic growth. As pure consumers, the larger the proportion of elderly people, the more they can increase the consumption of the entire society, and thus the aging population can also have a dividend effect on society. For the elderly, their demand for service and care will increase, and the elderly industry will become a "silver haired industry", with huge potential in the elderly market. The increasing demand for elderly care has led various enterprises to launch services and products related to elderly care, increasing related employment opportunities.

6.3 The Increase in the Proportion of People with High School or above Education also Has a Driving Effect on Economic Growth

The percentage of individuals holding a high school education or higher has risen by 1%, whereas the per capita Gross Domestic Product (GDP) has grown by 0.2818%. The improvement of residents' cultural level is conducive to mastering modern production equipment operation technology, further improving the degree of mechanized production, promoting the improvement of labor productivity, and increasing output. The output ability of workers also improves accordingly, so the improvement of their quality has an output effect on economic growth.

6.4 The Proportion of Employed Population in the Three Major Industries Has Different Impacts on Economic Growth

Boosting the workforce's involvement in primary sector tasks often hinders economic progress, whereas an increase in the tertiary sector's job contributions tends to stimulate economic growth. Specifically, a 1% hike in the primary sector's workforce share leads to a roughly 0.9597% reduction in per capita GDP. Conversely, a similar 1% uptick in the tertiary industry's employment rate correlates with about a 0.5258% increase in per capita GDP. Compared to their counterparts in secondary and tertiary sectors, the proportion of the working-age populace involved in primary sector occupations has notably decreased, possibly indicative of an escalating preference for job prospects within contemporary industries. This transformation in labor trends could be explained by the attractiveness of secondary and tertiary sector roles, prompting a steady transition of workforce from agricultural activities to manufacturing and service sectors.PENEDER M (2003) [15] argued that reallocating input resources from inefficient sectors to more effective ones markedly increases overall productivity in economies and social systems. He viewed the migration of production components as a crucial catalyst for economic growth. The reallocation of labor from foundational industries to more advanced sectors significantly enriches the employment panorama, harmonizes discrepancies in line with industrial design, promotes effective resource allocation, and catalyzes economic growth. The robust link between the expansion of tertiary sector employment and economic growth underscores how bolstering this sector's labor force significantly fortifies the economy. Employment growth in the tertiary industry disproportionately influences economic advancement more so than in other sectors. Consequently, the augmentation in the tertiary industry's workforce serves as a pivotal element propelling comprehensive economic development, Economic growth often experiences a positive association with the expansion of employment within the tertiary sector. Notably, the contribution of this employment growth in the tertiary industry to the overall economy is substantial, echoing the findings of Li (1996)[16]. The impact of a growing share of workers in the secondary sector on stimulating economic development does not show substantial significance.

At a 10% significance level, the variable failed to meet the criteria for statistical significance. The reason may be that in modern society, with the development of large-scale industrial production and technological progress, industrial mechanization upgrading, machines replacing labor, compared to labor input, technological progress has a more significant effect on improving production efficiency, promoting output growth, and promoting economic development. Furthermore, China is currently advancing into a more sophisticated phase of industrialization, witnessing a progressive transformation of its industrial structure. This shift marks a move away from labor-intensive sectors towards those that are increasingly reliant on advanced technology and substantial capital investments. As economies evolve from a focus on growth to achieving higher quality standards, technological innovation and capital investment gain greater significance.

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7. Conclusions and Recommendations

The article draws a conclusion from empirical studies that the urban population ratio, the percentage of individuals with high school education or higher, the elder population share, and the share of the population engaged in the tertiary sector positively influence economic growth. Economic growth may be hindered by a rising proportion of the population engaged in the primary industry, whereas an equivalent increase in the secondary industry's workforce does not notably impact economic growth. The following suggestions are proposed for this:

Firstly, the government should first promote the process of population urbanization, encourage the coordinated development of cities and the rational flow of the population, and reduce barriers to mobility. It should accelerate the reform of household registration management, relax the conditions for settling down, and guide the rural population to integrate into urban areas while addressing the issue of compulsory education for rural children. Additionally, the government should provide social security measures such as unemployment insurance and medical insurance for migrant workers in cities, so that they can better integrate into urban life.

Secondly, relevant departments should vigorously develop the elderly cultural industry to stimulate the demand of the elderly population, change their consumption concepts, and promote economic growth. They should also develop relevant policies to encourage enterprises to develop products specifically for the elderly.

Thirdly, the government should increase education funding, provide higher-quality education, and place greater emphasis on educational equity. Investing in high-quality human resources is essential for driving sustainable economic growth. To achieve this, it is imperative to enhance national investment in education and implement reforms within the education system to ensure its effectiveness and efficiency. Specifically, to boost investment in higher education, the government should prioritize funding for key national laboratories and foster collaboration between universities and industries. This will not only advance research and innovation but also improve employment prospects for graduates. Additionally, promoting lifelong learning initiatives will help upgrade the skills and overall quality of the workforce, ensuring adaptability in a rapidly evolving economy.

Fourthly, the government should promote the adjustment of the population's industrial structure, advance the modernization of agriculture through the improvement and innovation of agricultural equipment, thereby liberating the labor force. It should increase investment in vocational training for rural migrant workers to encourage their participation in production activities in the secondary and tertiary sectors. It should also strive to raise the proportion of the population employed in these sectors, thus contributing to the optimization of the country's labor force industrial structure.

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