The Influence of Aging Population on Labor Cost -- An Analysis from The Perspective of Labor Demand

Mu Li [1, *], Zixuan Zhao [2]

[1] Department of Economics, London School of Economics and Political Science, London, United Kingdom

[2] School of Economics & Management, Northwestern University, Xi'an, China

* Corresponding Author Email: m.li95@lse.ac.uk

Abstract. Globally, the phenomenon of population aging has become a significant trend. This article starts from the view of labor demand and sorts out the impact mechanism of aging population on labor costs. This article summarizes previous research from three aspects: labor productivity, consumption structure and technological advancement, and explores the impact of population aging. Research has found that aging will reduce business productivity due to the degradation of physical functions and the inability of older people to adapt to new technologies. Secondly, aging has also had a significant impact on social consumption structure, especially increasing the level of consumption in medical care. However, this trend has also resulted in a substantial increase in government medical expenditures, which may have a suppressive effect on the overall national income and consumption level of society in the future. Finally, populating aging has also hindered technological progress to a certain extent and slowed down the speed of technological innovation and development. This article provides a reference at the subdivision level for exploring how populating aging influence the cost of labor on the labor demand side.

Keywords: Populating aging; labor market; labor cost.

1. Introduction

Population aging is a hot topic that has attracted much attention and is becoming increasingly prominent in the current social development. According to the United Nations' statistics and forecasts on world population in 2024, in the next century, the percentage of elderly people is expected to increase from 5.82% in 1980 to 23.8%. The global median age will rise from 22.2 years in 1950 to 42.1 years. In addition, the old dependency ratio will consistently increase from 8.4% in 1950 to 15.4% in 2023, and has witnessed an upward trend [1]. Figure 1 shows the proportion of the global population aged more than 65 from 1980 to the present and in the next century. In 1980, there were only 5.82% of the elderly in the world, but by 2100, this proportion will have more than quadrupled. Figure 2 illustrates the global median age from 1950 to 2100. It can see that although this value decreased between 1950 and 1970, it continued to rise to 42.1 years. Finally, in Figure 3, the figure for old-age dependency ratio has been rising steadily since 1950 until it reaches 15.4 in 2023. These facts and forecasts show that population aging has become a global trend.

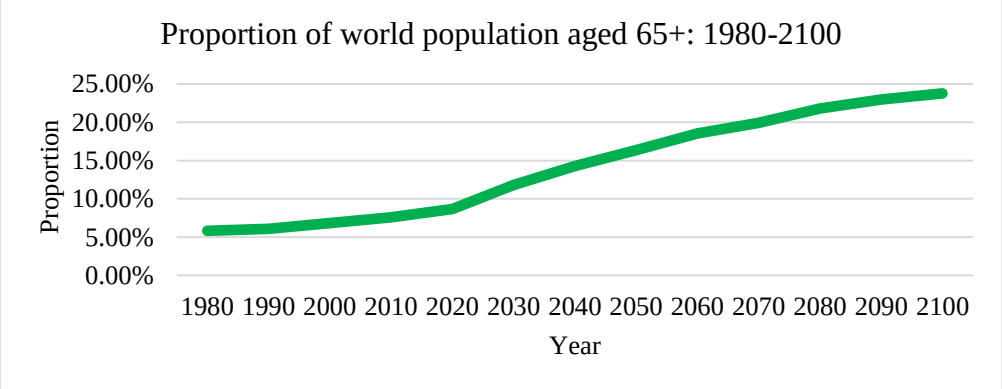


Fig. 1 Proportion of World Populating Aged 65+: 1980-2100

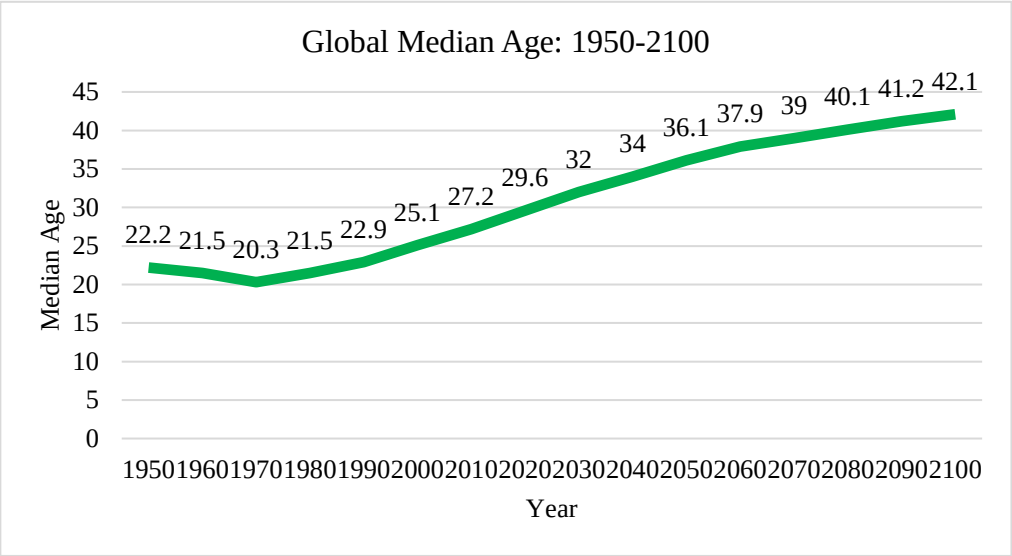


Fig. 2 Global Median Age: 1950-2100

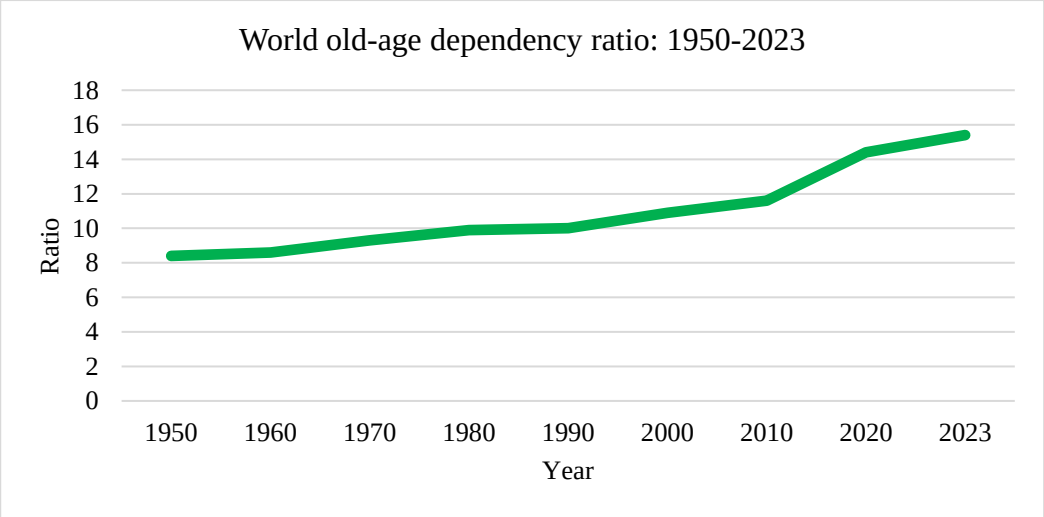


Fig. 3 World old-age dependency ratio: 1950-2023

Data Source: UN, World Population Prospects (2024)

On the other hand, changes in labor costs have long-term effects on consumers, enterprises and the entire economy. Specifically, for enterprises, labor costs account for a large part of production costs, so changes in labor costs largely affect changes in production costs, and thus product prices and market competitiveness. Therefore, under the pressure of increasing labor costs, enterprises will try to save costs in other aspects to reduce total costs; for example, adopting more efficient production lines or adjusting management strategies. From the perspective of the economy, consumer income is positively correlated with total consumption of the economy, which in turn have a significant effect on the overall GDP level and unemployment rate.

This article attempts to explain the causal effect of populating aging on labor costs. Generally speaking, populating aging is followed by a shrink in the working-age population, which has a noticeable impact on labor and socioeconomic development. Therefore, population aging suggests a contraction in potential economic growth, but at the same time, this impact can be mitigated through means such as technological upgrading and human capital investment. Because aging populating mainly affects labor market through labor demand, according to existing literature, this article analyzes from this perspective and sorts out the impact mechanism of population aging on labor costs. It explores the direction and degree of the effect of labor productivity, consumption structure and technological progress, and provides a reference for academic research in this subdivision.

2. The Effect of Populating Aging on Labor Productivity

Neoclassical economist Alfred Marshall believed that in a perfectly competitive market, the price of labor at which labor supply equates labor demand determines wage. By definition, productivity means output per unit of labor per unit of time. Productivity is positively correlated with labor demand. When productivity increases, the demand for labor also increases. The overall productivity of the economy will inevitably be affected by population with more elderly people, but there are currently different views on whether aging will increase or decrease productivity.

Some views believe that increasing degree of aging will lead to a decline in labor productivity. The physical, intellectual, and cognitive capacities of the work force tend to deteriorate as people age, which leads to the aging of the labor force structure. Most of the elderly have significantly less ability to absorb knowledge than young people, so they cannot swiftly adjust to the requirements of updating industrial structures. Through a survey of migrant workers in Dongguan City, it was found that the productivity of workers in labor-intensive industries will decline rapidly after the age of 35 [2]. Some scholars use the predicted aging rate of the United States as an instrumental variable to study the effect of the aging of the US population on economic growth between 1980 and 2010. The study found that a 10% increase in the elderly population (over 60 years old) will reduce GDP per capita by about 5.5%, of which two-thirds is caused by reduced productivity and the remaining one-third is caused by the labor force growing at a slower rate [3].

Those who believe labor productivity would decline because of populating aging argue that it will also force companies to accelerate technological progress and improve total factor productivity. Especially in the context of rising labor costs and the rapid development of artificial intelligence technology, there saw an accelerating trend in the tradeoff for labor needs and the replacement of machines for labor. With the help of data analysis from the International Federation of Robotics (IFR), it can be concluded that countries experiencing faster aging are more likely to adopt automated production to replace labor [4]. This is because the relatively scarce middle-aged labor force makes the employment cost of this type of people higher, and they are more proficient in the manufacturing industry, which is the easiest to be automated. After about 50 years old, the ratio of blue-collar labor to white-collar labor drops significantly. Because the productivity of labor after 50 years old is significantly lower than before, companies tend to use more automated equipment, such as robots to replace manual production.

Lehman believes through research that individual age and labor productivity have an inverted "U" relationship, meaning that as people age, their productivity initially increases and then falls; however, for different industries, the point where productivity reaches its peak is different. For example, in fields of artistic creation and pure physical theory research, the peak of labor productivity occurs around 30 years old, and then it will decline rapidly. Labor working in the field of medical and historical research are expected to reach their peak at 40-50 years old, and then slowly decline. However, some studies have found that the peak age of labor productivity is 40 to 49 years old, and then labor productivity will continue to decline [5].

3. The Effect of Populating Aging on Consumption Structure

Aggregate demand of an economy is positively correlated with the demand for labor. When the economy is booming, consumers and businesses are optimistic about the future, so as consumption and investment grow, the demand for labor also increases, and vice versa.

Overall, academic research on population aging and consumption patterns of inhabitants can be divided into three categories, and has shifted from the early pure population perspective to the overall perspective of social and economic development. First, aging is conducive to consumption growth. The first theory to introduce population age structure into microeconomic research was consumer behavior theory. Modigliani proposed the life cycle hypothesis based on individual consumption behavior, which became the basic theory in this field. He believes that residents will reasonably allocate their consumption at various stages of the life cycle on the basis of their expected income

throughout their lives, while family consumption is closely related to the life stage of family members. Since all families in the whole society are at different stages of the life cycle, it is less likely that the marginal propensity to consume will fluctuate in the long run if there is no major change in the overall population composition of the society. If the proportion of young people and the elderly in society increases, the propensity to consume will increase, and if the proportion of middle-aged people increases, the propensity to consume will decrease. On the basis of the life cycle savings theory, Schultz tested the effect of population age structure on savings rate using panel data from 16 Asian countries and regions using a range of dynamic panel regression models. His research conclusions supported the view of the life cycle theory, but there is weak evidence of the impact of aging on savings rate. Nevertheless, before that, it was generally believed that higher elderly burden coefficient and total burden coefficient were not conducive to the rise in savings rate; in other words, they were conducive to consumption growth [6].

The population age structure significantly affects the consumption structure of urban residents. When all other factors are held constant, the average consumption propensity of urban dwellers increases with the senior population dependence ratio; the child population dependency ratio has no discernible effect on the consumption of urban dwellers [7]. If people pay attention to other factors, the child dependency coefficient has a significant positive impact on the proportion of cultural, educational and entertainment consumption, and the elderly dependency coefficient has a significant positive impact on the proportion of housing and medical care consumption, indicating that Chinese urban children have a strong demand for cultural and entertainment consumption, and the elderly have a strong demand for housing and medical care consumption [8]. Using a fixed effect model and parameter estimation method, Li et al. studied the impact of aging on medical consumption of people of different age groups. The results show that aging induces an increase the medical consumption of the economy, and the impact on the elderly population over 65 years old is the most significant [9].

Second, aging is not conducive to consumption growth. Scholars Modigliani & Cao determined that population aging is a significant factor contributing to China's high savings rate after conducting a quantitative investigation on the relationship between population aging and savings rate using time series data from 1953 to 2000 [10]. Scholars Clark & Spengler conducted a survey in some parts of the United States and found that the government pays three times more for the elderly than for the young population [11]. Generally speaking, unlike young people, the cost of supporting the elderly is pure consumption expenditure. Therefore, if the government spends more on the elderly, it may reduce the future growth rate of national income, thereby affecting residents' consumption. Obviously, it can be concluded that the increase in the elderly dependency ratio is an important reason for the decline in residents' consumption [12].

Third, the impact of aging on consumption is not significant. Contrary to the conclusions of existing literature, Li Wenxing, Xu Changsheng, and Ai Chunrong believe that transformation in the population age structure is not the reason why China’s resident consumption rate is too low. According to their research, resident consumption is negatively impacted by the child dependency coefficient, however this effect is not very strong. The consumption of residents is not significantly affected by changes in the elderly dependency coefficient. Therefore, the low resident consumption rate in China is neither caused by changes in the child dependence coefficient or the senior dependency coefficient [13].

4. The Effect of Populating Aging on Technological Progress

As AI technology continues to develop, labor will be largely replaced by capital in many industries. The rate of return on capital determines the enterprise's demand for capital, which in turn affects the demand for labor. Academically, there are different views on how aging leads to technological progress and the channels through which this occurs.

Often an increase in the elderly population makes it more difficult for a country or region to adapt to innovative activities such as applying new technologies. For example, in theoretical research,

Lancia et al. developed a three-period generation overlap model, explaining that the extension of life expectancy in an aging society makes younger employees tend to favor the application of new technologies, while older employees generally veto the application of new technologies [14]. Based on the endogenous growth theory, Han Zhibin studied and demonstrated the "income distribution" path of population aging affecting technological progress. He used the expanded two-period generation overlap model and the expanded endogenous growth model to discover the degree of population aging and pension income distribution. The level of technological advancement is significantly impacted negatively by the improvement of the level; in other words, population aging has an impact on technological advancement through the "income distribution" path, and higher-level technological advancement is more negatively impacted by the "income distribution" path [15].

In terms of empirical research, many scholars try to start from considering shifts in the age distribution of the population and use certain representative data indicators to conduct empirical research, trying to find evidence of the impact of aging on national or local technological progress from the existing data. For example, Feyrer found that there is an "inverted U"-shaped relationship between age and total factor productivity, with TFP growth rate peaking between the ages of 40 and 49 [5]. Similarly, Werding found an “inverted U”-shaped correlation between TFP levels and age structure [16]. The above-mentioned scholars used the production function to calculate total factor productivity (TFP) and attribute the increase in output that is not input to technological progress. However, under this method, the selection of the production function and the share of capital are unreasonably underestimated and endogenous. The emergence of problems are pain points that are difficult to solve [17].

At the theoretical level, some literature analysis points out that population aging will increase the government's pension burden, or will affect the technological progress of the country or region. Gonzales-Eiras et al. constructed a generation overlap model and found that population aging’s effects on economic growth can be decomposed into direct effects and indirect effects [18]. When the government only adjusts tax rates and government expenditures, but does not extend the retirement age (indirect effect), rising social security costs will crowd out government public investment; when the government adjusts the retirement age at the same time (direct effect), social security expenditures and government public investments. The proportion of investment in GDP is rising, and the effect of social security expenditure crowding out

government public investment does not exist. However, since many countries have implemented measures, such as extending the retirement age and changing retirement conditions in recent years, the simultaneous adjustment of retirement age is more convincing.

Although many scholars agree that the increasing burden of elderly care will hinder technological progress, they wonder whether technological progress will decline in the future. The research results of some scholars also indicate a small probability that aging will have a very large negative impact on future technological progress. Izmirlioglu constructed a multi-sector economic growth model including population factors, used U.S. data to standardize the model variables, and obtained the result: Although the population age structure will age in the future, technological progress will continue, and the percentage of R&D workers will keep rising [19]. Zhai Zhenwu et al. maintain that in the context of population aging, as long as the absolute size of working-age population is large and the proportion of R&D personnel in the labor force is small, population aging is not going to affect the overall R&D level, and the increased burden of elderly care caused by aging will not necessarily have an impact on the overall R&D level. Investment in R&D funds produces a squeezing effect [20].

5. Conclusion

Currently, aging has become a very common and high-profile phenomenon, attracting attention around the world. Labor costs have a significant impact on consumers, businesses and the economy as a whole. Although there are currently a large number of independent literature reviews and studies on aging and labor costs, discussion of the precise impact of aging on labor expenses is comparatively

lacking. In view of the close connection between the two, it is particularly important to conduct a relevant literature review. This article starts from the main factors that affect labor demand - productivity, consumption structure and technological progress, and explores how aging affects these factors, thereby shifting the demand curve and leading to changes in wages, which are the main component of labor costs. First, aging will reduce productivity due to the degradation of the elderly's physical functions and their inability to adapt to new technologies. It will also encourage companies to adopt more advanced technologies to improve productivity. Secondly, aging can mainly increase medical and health consumption, but it will greatly increase government expenditures, which may lead to a downswing in national income and consumption in the future. Finally, from the perspective of technological progress, the elderly finds it more difficult to adjust to new technologies. This, coupled with the increase in government spending, is likely to slow down technological progress. Reviewing the literature, there are still areas worth exploring. Changes in wages are also determined by labor supply. Aging will also lead to changes in some factors that affect labor supply, which will in turn affect labor supply, such as the working-age population, government policies, education and skills, but no literature or research on this type has been found. This aspect of labor supply deserves more study in the foreseeable future.

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

References

[1] UN, World Population Prospects (2024) – processed by Our World in Data. Old-age dependency ratio,age old – UN WPP. United Nations, World Population Prospects, 2024.

[2] Zhang Z. The age difference in labor productivity and the lewis turning point. China Rural Economy, 2011, (08): 12-21+32.

[3] Maestas N, Mullen K J, Powell D. The effect of population aging on economic growth, the labor force, and productivity. American Economic Journal: Macroeconomics, 2023, 15(2): 306-332.

[4] Acemoglu D, Restrepo P. The effect of aging on economic growth in the age of automation. American Economic Review, 2017, 107(5): 174-179.

[5] Feyrer J. Demographics and productivity.The Review of Economics and Statistics, 2017, 89 (1): 100-109.

[6] Leff, N. H. Dependency rates and savings rates. The American Economic Review, 1969, 59(5): 886-896.

[7] Wang Y. Research on the impact of population aging on the consumption behavior of Chinese urban residents. Chinese Journal of Population Science, 2011, (01): 64-73+112.

[8] Huang Y F, Zhang C, Tian S D. Influence mechanism of population age structure and housing price on household consumption of urban residents. Population Research, 2019, 43(04): 17-35.

[9] Li L, Du T, Hu Y. The effect of population aging on healthcare expenditure from a healthcare demand perspective among different age groups: evidence from Beijing City in the People's Republic of China. Risk Management and Healthcare Policy, 2020, 1403-1412.

[10] Modigliani F, Cao S L. The Chinese saving puzzle and the life-cycle hypothesis. Journal of economic literature, 2002, 42(1): 145-170.

[11] Clark R L, Spengler J J. The economics of individual and population aging. CUP Archive, 1980.

[12] Mao Z G, Sun W, Hong T. Comparative analysis of the relationship between the age structure of Chinese population and residents' consumption. Population Research, 2013, 37(03): 82-92.

[13] Li W X, Xu C S, Ai C. Age structure and household consumption of Chinese:1989-2004. Economic Research Journal, 2008, (07): 118-129.

[14] Lancia F. Prarolo G. Life expectancy, human capital accumulation, technological adoption and the process of economic growth.Labour Markets and Demographic Change. 2009, 169-189.

[15] Han Z B. Research on the path of "income distribution" of population aging affecting technological progress. Reform of Economic System, 2022, (05): 186-194.

[16] Werding M. Aging and productivity growth:are there macro-level cohort effects of human capital?. CESIFO Working Paper. 2018, 2207.

[17] Ilmakunnas P, Maliranta M, Vainiomaki J. The roles of employer and employee characteristics for plant productivity. Journal of Productivity Analysis, 2004, 21 (3): 249-276.

[18] Gonzales-Eiras M. Niepelt D. Aging, government budgets, retirement, and growth. European Economic Review, 2012, 56 (1): 97-115.

[19] Izmirlioglu Y. The impact of population ageing on technological progress and tfp growth, with application to united states:1950-2050. MPRA Paper, 2019, 24687.

[20] Zhai Z W, Jin G G, Zhang Y Y. Will an aging population hinder technological innovation? Dongyue Tribune, 2021, 42(11): 24-35+191.