Analysis of the Current Status of Healthy Working Life Expectancy in Shandong Province

Jiahui Zhao*, Yuxin Wang, Feixiao Ren, Zihan Yin

School of Insurance, Shandong University of Finance and Economics, Jinan, China, 2.50014

Author's email:Jiahui Zhao,15153468708@163.com;Yuxin Wang,moycfe@163.com;Feixiao Ren,cgajtz@163.com;Zihan Yin,ltxuyo@163.com

*Corresponding to:Jiahui Zhao,School of Insurance, Shandong University of Finance and Economics, Jinan, China, 250014 ,15153468708@163.com

Abstract

This paper focuses on the "Healthy China" strategy and the background of the gradual retirement policy, and conducts research on the healthy working life expectancy in Shandong Province in response to the deepening of the aging population, the increase in residents' medical expenses, the younger onset of diseases, and the compression of working time due to the increase in average years of education. The aim is to explore the construction of a life-cycle solution for aging, verify the feasibility of delayed retirement, and provide policy recommendations. The research uses data from the 2018-2020 Shandong Province Health Big Data of Northern Health Medical Big Data Technology Co., Ltd, taking 606,163 employees of listed companies in Shandong Province as samples. A model including five states: healthy retirement, healthy work, unhealthy retirement, unhealthy work, and death is constructed based on the Markov process. The health status is determined by chronic disease expenses, hospitalization expenses, and major disease indicators, and the healthy working life expectancy is measured by combining transition probabilities and actuarial theory. The statistical results show that there are significant differences in the healthy working life expectancy among different groups: from the perspective of gender and age, the

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The authors declare that there is no conflict of interest.

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healthy working life expectancy of women under 25 is higher than that of men, but men surpass women after the age of 36. The sum of age and healthy working life expectancy of women aged 51-65 and men aged 56-65 exceeds the original legal retirement age, indicating the potential for delayed retirement. From the perspective of regions, employees in Heze City have the longest healthy working life expectancy and healthy life expectancy in Shandong Province, while those in Linyi City have the shortest. From the perspective of enterprise characteristics, employees in state-owned enterprises, medium-capital-density enterprises, medium-sized enterprises, and non-heavy-polluting enterprises have better healthy working life expectancy and healthy life expectancy. From the perspective of employee income, the healthy working life expectancy decreases with the increase in income, and low-income employees have the best healthy working life expectancy. From the perspective of industries, the first and third industries are better than the second industry, with the real estate industry having the longest healthy working life expectancy and the construction and information internet industries having the shortest. The research conclusion points out that the delayed retirement policy is in line with the current situation of the labor force and elderly care, and although it may squeeze the employment opportunities of young people in the short term, it can stimulate economic growth and increase employment opportunities in the long term. It is suggested that when implementing the delayed retirement policy, the differences in healthy working life expectancy among different groups should be fully considered, and differentiated strategies should be formulated in combination with enterprise characteristics and individual employee characteristics to support the construction of "Healthy China" and "Digital China".

Keywords: Delayed Retirement, Healthy Work Life, Healthy China

1. Introduction

1.1Research background

1.1.1 With the deepening of aging and the increasing burden on residents' medical expenses, Healthy China faces new challenges

The continuous improvement of national health is a prerequisite for extending working life and delaying retirement. For instance, in developed countries like Japan, where the average life expectancy is among the highest in the world at 84.5 years, the legal retirement age is set at 64 years, reflecting the significant improvement in the health of workers. The Outline of the Healthy China 2030 Plan, issued by the Central Committee of the Communist Party of China and The State Council, points out that promoting the construction of a Healthy China is an important foundation for building a moderately prosperous society in all respects and basically achieving socialist modernization. With the rapid economic development, technological changes, globalization and other factors have made industry competition more intense, people's work pressure has gradually increased, and there has been a trend of diseases affecting younger people, as shown in Table 1, the expenditure on health care of the national residents is constantly increasing, and the proportion of consumption is constantly rising. In addition, although the premature mortality rate of major chronic diseases in China has dropped from 18.5% in 2015 to 15.0% in 2023, the proportion is still relatively high and the problem of chronic diseases advancing is still prominent. The ongoing development of Healthy China encounters a multitude of fresh challenges. Meanwhile, the current policy of gradually raising the retirement age places greater emphasis on individuals' physical well-being. To guarantee the smooth execution of this policy, both the state and enterprises must explore effective measures solutions to improve work efficiency and enhance enterprise effectiveness.

Main data on national income and expenditure in 2024

Table 1

Indicators	Absolute quantity (yuan)	Growth over the previous year (%)(real growth rate in parentheses)
(1) Per capita disposable income of all residents By place of permanent residence:	41314	5.3 (5.1)

Urban residents	54188	4.6 (4.4)
Rural residents	23119	6.6 (6.3)
By source of income:		
Wage income	23327	5.8
Net operating income	6908	5.6
Net income from property	3435	2.2
Net transfer income	7644	5.3
(2) Median per capita disposable income of national residents	34707	5.1
By place of permanent residence:		
Urban residents	49302	4.6
Rural residents	19605	4.6
(3)National per capita consumption expenditure	28227	5.3 (5.1)
By place of permanent residence:		
Urban residents	34557	4.7 (4.5)
Rural residents	19280	6.1 (5.8)
By consumption category:		
Food, tobacco and alcohol	8411	5.4
Clothing	1521	2.8
Living	6263	2.8
Household goods and services	1547	1.4
Transportation and communication	3976	8.9
Education Culture Entertainment	3189	9.8
Healthcare	2547	3.6
Other supplies and services	773	10.8

1.1.2 The average years of education in China are increasing, the time of participation in work is moving backward, and overall working hours are shortening

With economic development and the improvement of education level, the average duration of education per person in China has been increasing. According to the 2022 National Education Development Statistical Bulletin, the total number of students enrolled in all forms of higher education reached 46.55 million, marking an increase of 2.25 million from the previous year. According to the latest statistics, the gross enrollment rate of higher education in 2022 reached 59.6%, marking an increase of 1.8% from the previous year. As shown in Figure 1, According to recent reports, the average years of education for the working-age population in China have significantly increased, reaching 11.05 years in 2023, up from just over 8 years in 1982. The average years of education for the new labor force in China has increased to 14 years, and the population receiving higher education has reached

250 million. The increase in education time has compressed working hours, and the shortening of average working years has led to problems such as reduced utilization of human capital and insufficient personal pension reserves. To promote the development and utilization of human resources and alleviate the current severe aging problem, it is inevitable to implement the policy of delaying retirement in line with the trend of the transformation from the demographic dividend to the human resource dividend. Furthermore, the rise in average years of education fuels technological innovation, enabling the digital empowerment of the workforce and sparking fresh perspectives on fostering a healthy human capital.

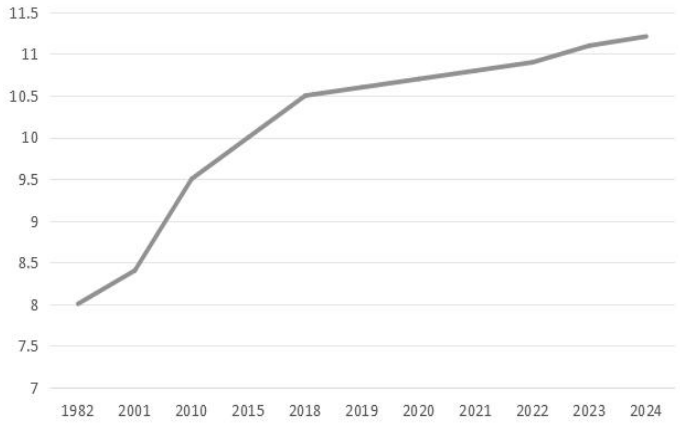

Figure 1 Average years of education in china

1.2 Study objectives

1.2.1 To analyze the influencing mechanism of healthy working life expectancy and provide scientific support for the optimization of enterprise health management and the formulation of regional health human capital policies.

Based on the data of the 2018-2020 Shandong Province Health Big Data of Northern Health Medical Big Data Technology Co., Ltd, and taking 606,163 on-the-job employees of listed companies in Shandong Province as the research sample, combined with the Markov state transition model and actuarial theory, systematically identify the action paths and influencing mechanisms of individual characteristics (gender, age, income level), enterprise attributes (ownership nature, enterprise scale, capital density, environmental protection level), industry type, and regional differences on healthy working life expectancy, and clarify the key driving factors (such as working environment conditions, labor intensity levels, accessibility of health protection resources, etc.) and core constraints for the significant differences in healthy working life expectancy among different groups. On the one hand, it provides

empirical support for enterprises to build differentiated employee health management systems (such as precise health monitoring plans and occupational health risk intervention measures for employees of different income levels and industry types) and optimize labor protection mechanisms; on the other hand, it provides scientific references for different cities in Shandong Province to formulate health human capital cultivation strategies for different groups and fields, as well as to refine regional health empowerment policies that are in line with the "Healthy China" strategy, ultimately contributing to the coordinated improvement of labor force health levels and employment quality.

1.2.2 Explore life-cycle solutions to the aging problem and contribute to the construction of a healthy China

The implementation of delayed retirement policies is a critical response to the escalating aging crisis, serving as an interim solution to mitigate the adverse societal effects of profound aging, given the inadequate social pension reserves. But as aging becomes the main trend, in order to reduce the negative impact of aging in the long term and even turn the aging trend into a new driving force for social development, it is necessary to formulate macro plans from the perspective of the entire life cycle of individuals. The team takes "health" as the core of the life-cycle response plan to explore how to improve the health level of society and ultimately aims to empower the driving force of social development with health, providing a life-cycle supporting plan for the implementation of the delayed retirement approach and opening up new paths for the construction of a healthy China.

1.2.3 Verify the feasibility of delayed retirement and provide policy recommendations for the flexible and gradual implementation of the delayed retirement approach

The newly issued "Measures of The State Council on the Gradual Increase of the Legal Retirement Age" initiates work related to the increase of the legal retirement age, however, the policy framework and supporting measures for encouraging elderly participation remain incomplete. Conforming to the strategic direction of building a healthy China and further strengthening research on aging policies is the only way to help the silver economy achieve demand-oriented high-quality development, effectively solve real social problems, and meet the real needs of delaying retirement. Therefore, the team will start with the digital

transformation of the employing enterprises, establish the relationship between employee health and enterprise benefits, verify the feasibility of the gradual delayed retirement policy and provide feasible suggestions for its flexible implementation.

2. Overview of Research on the same topic at home and abroad

2.1 Domestic research review

Against the backdrop of China's launch of a flexible and gradual delayed retirement age program, the scientific advancement of the delayed retirement policy has put forward higher requirements for the improvement of workers' healthy working life expectancy and the accumulation of healthy human capital. Domestic scholars have conducted a series of targeted studies on the correlation between healthy working life expectancy, healthy human capital and delayed retirement, laying the foundation for policy practice and theoretical deepening. From the perspective of the compatibility research between healthy working life expectancy and the delayed retirement age, some domestic scholars have earlier clarified the core supporting role of healthy working life expectancy in the formulation of the delayed retirement policy, suggesting that the calculation of the delayed retirement age cannot be divorced from the actual healthy working life expectancy of workers, and should be based on healthy working life expectancy as an important basis to ensure that the policy is in line with the actual labor market, This view emphasizes the necessity of the health dimension in policy design (Tan et al., 2016). In response to the differences in healthy working life among different groups, some domestic scholars have conducted further research and pointed out that there is significant occupational type heterogeneity in healthy working life - different occupations have different labor intensities, working environments, and health risks, resulting in significant differences in healthy working life among workers. Based on this, they proposed that differentiated flexible retirement systems should be established instead of a uniform retirement standard for all occupations, to achieve a balance between fairness and feasibility of the delayed retirement policy by adapting to the characteristics of healthy working life of different occupational groups (Zhao Huijun and Liu Xizhen, 2017).

2.2 Review of foreign studies

The policy of delaying retirement has been implemented in many countries, and some scholars have studied its feasibility and incentive system. Governments that attempt to

postpone the legal retirement age should increase the degree of intergenerational redistribution of pension systems to make the reform easier to implement (Lacomba and Lagos, 2010). In Italy, economic incentives were used to induce workers to choose to delay retirement, but the findings showed that incentive bonuses had a negative effect on the willingness to delay retirement (Ferrari and Irene, 2019). Scholars from multiple countries conducted statistical analyses of healthy working life expectancy (HWLE), and England's statistics showed that although life expectancy increased, the projected HWLE growth slowed and did not meet the policy target. Improving population health benefits, reducing inequality, increasing job opportunities, etc. are conducive to maintaining the upward trajectory of HWLE in both male and female populations (Bucknall et al.,2022). Educational attainment, occupational class, and income disparities have resulted in variations in healthy working lives, rendering the "one-size-fits-all" approach to delaying retirement inadequate in addressing socioeconomic inequalities (Solovieva, 2024).

3. Measurement and statistics of healthy working life expectancy

3.1 Definition of concepts

3.1.1 Healthy life expectancy

The average life expectancy refers to the number of years a group of individuals born in the same year is expected to live, based on current age and gender-specific mortality rates, while healthy life expectancy indicates the number of years a person can expect to live in good health.

3.1.2 Healthy working life expectancy

For a group of people born in the same year, the number of years from the start of work to the end of employment at a certain age-gender mortality and employment rate level is called working life. The working life of a person in a healthy state is called healthy working life. Healthy working life is the remaining healthy working life of an employed person in the observed year.

3.2 Calculation of healthy working life expectancy

3.2.1 Data preparation

This project will use the 2018-2020 Shandong Province Health Big Data of Northern Health Medical Big Data Technology Co., Ltd. to calculate the remaining health work life.

The survey subjects will be the employees of listed companies in a certain province. Key information missing and non-continuous tracking samples will be deleted, and the final sample size will be determined to be 606,163.

3.2.2 Status discrimination

At present, the criteria for defining health are not uniform. This project takes into full account the objectivity, comparability, and availability of data indicators, utilizing information on chronic disease outpatient visits (hereinafter referred to as "outpatient chronic diseases"), inpatient stays, and serious illnesses to ascertain the health status of employees. The specific determination methods are as follows: (1) Based on whether outpatient chronic disease expenses occurred in the current year, employees who incurred outpatient chronic disease expenses were classified as unhealthy, while those who did not incur such expenses were considered healthy.(2) Employees who had incurred hospitalization expenses were deemed unhealthy, whereas those who had not were deemed healthy, based on their hospitalization expense history.(3) If an employee has a serious illness in the current year (serious illness = out-of-pocket expenses/contribution base), if the serious illness indicator value is greater than 10%, the employee is judged as having a serious illness in the current year and is judged as unhealthy; otherwise, it is judged as healthy.

The retirement status is determined based on the retirement time of the employee. If the survey year is greater than the retirement year, it is judged as retired; otherwise, it is judged as working.

The death status is determined based on the date of death. If the year of investigation is greater than the year of death, it is determined to be dead; otherwise, it is determined to be alive.

Form a status matrix based on the above status determination method. First, multiply the four states of healthy, unhealthy, retired, and working in pairs to form the four states of healthy retirement, healthy working, unhealthy retirement, and unhealthy working. Next, replace the status of the deceased employee in the data with death based on whether the employee is dead or not. Ultimately, five statuses are formed: healthy retirement (status 1, coded as 1), healthy work (status 2, coded as 2), unhealthy retirement (status 3, coded as 3), unhealthy work (status 4, coded as 4), and death (status 5, coded as 5), among which status 1,

status 3, and status 5 are absorbed statuses.

3.2.3 Model construction

A Markov process is a random process consisting of a fixed number of states, with transition possibilities between different states and the property of memorylessness. Based on this, this paper constructs a Markov process that includes five states: healthy retirement, healthy employment, unhealthy retirement, unhealthy employment, and death.

In this paper, the transition probability x_{ijt}^{p} , $i=2,4, j=1,2,3,4,5$ represents the probability of transitioning from state i at age (x) to state j at age $(x+t)$. x_{ijt}^{p} satisfies the discrete-time Markov property, meaning that the transition probability x_{ijt}^{p} is uniquely determined by the state i at age (x) , and is independent of the states prior to age (x) . The transition probabilities for different groups in various states at age (x) to other states at age $(x+t)$ form the transition probability matrix $P(x+t)$.

$$P(x+t)=\begin{bmatrix} x_{11t}^{p} & x_{12t}^{p} & x_{13t}^{p} & x_{14t}^{p} & x_{15t}^{p} \\ x_{21t}^{p} & x_{22t}^{p} & x_{23t}^{p} & x_{24t}^{p} & x_{25t}^{p} \\ x_{31t}^{p} & x_{32t}^{p} & x_{33t}^{p} & x_{34t}^{p} & x_{35t}^{p} \\ x_{41t}^{p} & x_{42t}^{p} & x_{43t}^{p} & x_{44t}^{p} & x_{45t}^{p} \\ x_{51t}^{p} & x_{52t}^{p} & x_{53t}^{p} & x_{54t}^{p} & x_{55t}^{p} \end{bmatrix} \quad (1)$$

The sum of each row of the matrix is 1. The first, third, and fifth rows become unit rows because state 1 (healthy retirement), state 3 (unhealthy retirement), and state 5 (death) are absorbing states.

The transition intensity $r^{ij}(x)$, $i=2,4, j=1,2,3,4,5$ represents the intensity of transitioning from state i to state j at age (x) . The transition intensities between different states form the transition intensity matrix $R(x)$. If there are only two states and the transition is unidirectional, the relationship between the transition probability and the transition intensity is:

$$\frac{d_t p_x}{dt}=p_{xt}r(x+t)\Rightarrow p_{xt}=\exp\left[\int_0^t r(x+s)ds\right] \quad (2)$$

If multiple states are involved, it is necessary to consider all possible paths from the initial state to the target state, which can be represented in matrix form as:

$$\frac{dP(x+t)}{dt} = P_{xt}R(x+t) \Rightarrow P_{xt} = \exp\left[\int_0^t R(x+s)ds\right] \quad (3)$$

Where, when $R(x+s) = R(x) = R$ is constant, $\mathrm{p}(x,t) = \exp(tR)$, and the transition probability follows an exponential distribution that depends solely on the time interval and is independent of the initial age (x) . In this case, the Markov process is said to be time-homogeneous.

The expression for the transition probability under the assumption of time-homogeneity in a Markov process implies that, regardless of age, the health changes over an equal period of time in the future are the same. This assumption is, in most cases, inconsistent with reality. Based on the non-homogeneous nature of transition intensities varying with age, and to ensure the computational manageability, this paper adopts the approach of piecewise constant transition intensities, as referenced in "Have We Lived Long and Stayed Healthy? — Validation Based on a State-Transition Probability Model" (Cui Xiaodong et al., 2022)[3]. It is assumed that the transition intensity $R(x+s)$ remains constant within a year, with different transition intensities for different years:

$$P(x,t) = \exp\left[\int_0^1 R_1(x+s)ds + \int_1^2 R_2(x+s)ds + \ldots + \int_{t-1}^t R_t(x+s)ds\right] \quad (4)$$

Based on the above transition probabilities, the expressions for the working life expectancy and healthy working life expectancy are derived using actuarial theory. The future working life expectancy for a population starting at age (x) in state i is given by $LE = \sum_{t=1}^{T-x} x_{it}^s$, where x_{it}^s represents the probability that individuals in the population at age (x) are still working at age $(x+t)$. The value of $x_{it}^s = x_{i2t}^p + x_{i4t}^p$, where x_{i2t}^p and x_{i4t}^p are the corresponding values in $P(x+t)$. T is the maximum working age. Since the population at age (x) consists of individuals in different initial states, the expected working life expectancy is the weighted average of the expected working life expectancies under each state. Let the weight be the row vector $W_x = \begin{pmatrix} x_2^w & x_4^w & 0 \end{pmatrix}$, which represents the proportion of individuals

in states 2 and 4 in the population at age (x). The working probabilities for states 2 and 4 are written as the column vector $S_{xt} = \begin{pmatrix} S_{xt}^2 & S_{xt}^4 & 0 \end{pmatrix}$. Thus, the expected working life expectancy for the population at age (x) is:

$$LE = \sum_{t=1}^{T-x} w_{x+t-1} x_t^S \quad (5)$$

By replacing the survival vector x_{1t}^p with the health vector x_{it}^s, the healthy working life expectancy is obtained as follows:

$$LE = \sum_{t=1}^{T-x} w_{x+t-1} x_{1t}^p \quad (6)$$

Where W_{x+t-1} represents the proportion of individuals in different states at the same age, and x_{1t}^p and x_{it}^s are determined based on the corresponding column vectors of the transition matrix $P(x+t)$.

3.3 Statistical results on remaining healthy working life

3.3.1 Measurement results

The results of healthy working life, calculated by age and gender, are shown in Figure 3. The study indicates that the health working life expectancy of Chinese employees decreases with age, with notable gender differences. Female employees under 25 have a higher health working life expectancy than their male counterparts, but this trend reverses in subsequent age groups, particularly between 36 and 45, where male employees exhibit a significantly higher health working life expectancy. This is consistent with findings from a study on Chinese workers, which reported that male health working life expectancy averages 8.06 years, while females average 5.77 years. Among them, female employees in the 51-65 age group and male employees in the 56-65 age group have the potential to delay retirement if the sum of their existing age and healthy working life expectancy is higher than the original legal retirement age (60 for men and 55 for women).

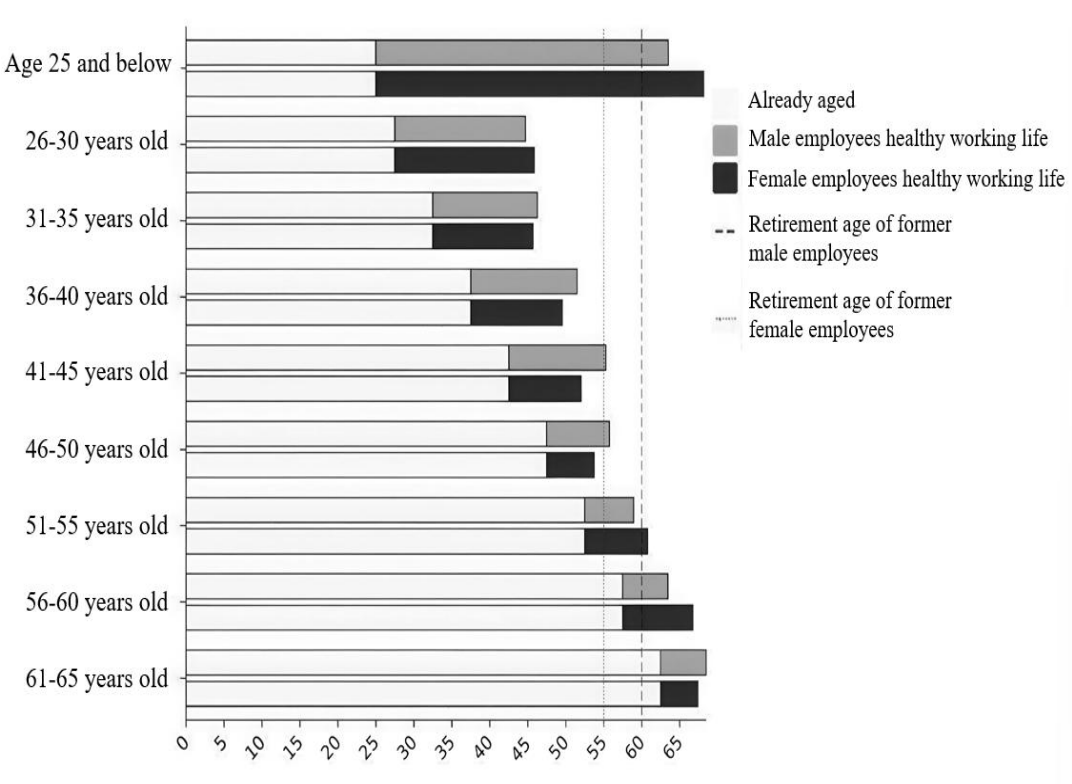

Figure 2 Healthy working life expectancy by gender and age group

3.3.2 Healthy remaining life at work and healthy remaining life of employees in different categories

In different categories, the health work remaining life and health remaining life of enterprise employees may vary. This paper, after counting healthy working life by gender and age group, further classified statistics based on seven conditions: region, company nature, employee income, capital density, enterprise size, industry differences, and environmental protection level, to explore the differences in healthy working life and healthy life of enterprise employees.

(1) Regional classification

This paper obtained the results shown in Table 2 by processing and analyzing data on healthy working life expectancy and healthy life expectancy of enterprise employees in 16 municipal regions of Shandong Province.

Healthy remaining working life and healthy remaining life (years) of employees in shandong province

Table 2

Region	Average healthy working life expectancy	Average healthy remaining life

Region	Average healthy working life expectancy	Average healthy remaining life
Dongying	52.9108	53.5260
Linyi	49.2565	49.7350
Weihai	50.6041	51.1754
Texas	49.8763	50.3677
Sunshine	52.0532	52.7627
Tai 'an	51.0826	51.8455
Jinan	52.5804	53.0957
Jining	51.7468	52.3443
Zibo	51.2992	52.0660
Binzhou	52.0868	52.6202
Weifang	51.4619	52.3378
Yantai	53.4929	54.0753
Heze	56.8019	60.3425
Qingdao	51.7968	52.5502
Zaozhuang	49.4026	49.9120
Liaocheng	49.5816	50.0323

As shown in Table 2, the average healthy working life expectancy of employees in 16 cities of Shandong Province is 51.52 years, and the average healthy life expectancy is 53.26 years. Among them, Heze City had the longest healthy working life expectancy and healthy life expectancy, at 56.80 years and 60.34 years respectively, while Linyi City had the shortest healthy working life expectancy and healthy life expectancy, at 49.26 years and 49.74 years respectively.

(2) Nature of the company

Due to the different corporate contexts, employees' healthy working life and healthy life can vary. This paper categorizes companies into three types: state-owned enterprises, private enterprises, and foreign-funded enterprises, and explores the differences in healthy working life and health life of employees in these three types of companies.

Employee healthy working life and healthy remaining life (years) under different company natures

Table 3

Company nature	Average healthy working life expectancy	Average healthy remaining life

State-owned enterprises	51.7923	52.2943
Private enterprises	51.3522	52.1371
Foreign-funded enterprises	51.3322	51.8756

According to Table 3, state-owned enterprises have the longest remaining healthy working life and remaining healthy life, reaching 51.79 years and 52.29 years respectively. Foreign-funded enterprises had the shortest healthy working life expectancy and healthy life expectancy, at 51.33 and 51.88 years respectively. And in all three cases, there was little difference between healthy working life and healthy life. The average healthy working life expectancy was 51.49 years and the average healthy life expectancy was 52.10 years under the three company natures.

(3) Employee income

This paper classifies employee income into three income scenarios: low employee income, medium employee income, and high employee income, and explores the differences in employee healthy working life and healthy life under these three income scenarios. The results are presented in Table 4.

Healthy working life expectancy and healthy life expectancy (years) at different incomes

Table 4

Employee income	Average healthy working life expectancy	Average healthy remaining life
Low income	52.5863	53.5005
Middle income	51.3133	52.0983
High income	50.4517	50.7864

As shown in Table 4, low-income employees have the longest healthy working life expectancy and healthy working life expectancy, at 52.59 years and 53.50 years, respectively. High-income employees had the shortest healthy working life expectancy and healthy working life expectancy at 50.45 years and 50.79 years respectively. And there was a decrease in healthy working life expectancy and healthy working life expectancy as income increased.

(4) Capital density

This paper classifies enterprises into three scenarios: low capital density enterprises, medium capital density enterprises, and high capital density enterprises, and explores the

healthy working life and healthy remaining life of enterprises under the three capital density scenarios. The results are shown in Table 5.

Employee healthy working life and healthy life (years) under different capital densities of the enterprise

Table 5

Enterprise capital density	Average healthy working life expectancy	Average healthy remaining life
High capital density	51.3387	52.1726
Medium capital density	51.8710	52.3588
Low capital density	51.2981	52.0176

It can be seen from Table 5 that the healthy working life expectancy and healthy life expectancy of medium capital density enterprises are the longest, which are 51.87 years and 52.36 years respectively. Low capital density enterprises had the shortest healthy working life and healthy life, at 51.30 years and 52.02 years respectively. At the three different capital densities, there was little difference in healthy working life and remaining life, with an average of 51.50 years for healthy working life and 52.18 years for remaining life in all three cases.

(5) Industry differences

Healthy working life and healthy life (years) of employees in different industries

Table 6

Industry names	Average healthy working life expectancy	Average healthy remaining life
Agriculture,forestry,animal husbandry and fisheries	54.407	54.892
Mining	51.652	51.895
Manufacturing	52.036	52.335
Supply industry	51.924	52.190
Construction	50.754	51.139
Wholesale and retail trade	51.361	52.085
Transportation and postal services	51.992	52.368
Information and Internet industry	50.735	51.333
Financial industry	53.371	53.613
Real estate	56.257	56.555

As can be seen from Table 6, the average healthy working life expectancy and healthy life expectancy in the primary and tertiary industries are significantly higher than those in the secondary industry. This may suggest that factors such as labor intensity and working environment can affect employees' healthy working life expectancy and health life expectancy. Among the observed industries, the real estate sector had the longest average healthy working life expectancy and healthy life expectancy, at 56.257 years and 56.555 years, respectively. The construction and information Internet industries had the shortest average healthy working life expectancy.

(6) Business size

Healthy working life expectancy and healthy life expectancy (years) of employees in enterprises of different sizes

Table 7

Business size	Average healthy working life expectancy	Average healthy remaining life
Small businesses	51.559	52.10393
Medium-sized enterprises	51.782	52.31281
Large enterprises	51.137	52.13298

According to Table 7, among the three sizes of enterprises, medium-sized enterprises had the longest average healthy working life expectancy and healthy life expectancy, reaching 51.782 years and 52.31281 years respectively. Although the average healthy working life expectancy and healthy life expectancy vary among the three sizes of enterprises, the differences between them are not significant, which may suggest that the size of enterprises has little impact on the healthy working life expectancy and healthy life expectancy of employees.

(7) Environmental protection level

Healthy working life expectancy and healthy life expectancy (years) of employees in enterprises with different levels of environmental protection

Table 8

Business nature	Average healthy working life expectancy	Average healthy remaining life
Non-heavily polluting	51.67936	52.41686

enterprises Heavily polluting enterprises	51.10872	51.67274

Classify enterprises into two categories based on the degree of environmental protection: non-heavily polluting and heavily polluting. According to Table 8, the average healthy working life expectancy and healthy life expectancy of employees in non-heavily polluting enterprises are both greater than those in heavily polluting enterprises. This may be because the working environment directly affects the health status of employees, and employees in heavily polluting enterprises are exposed to more harmful environments to their health, so their healthy working life expectancy and healthy life expectancy are relatively shorter.

4. Conclusions

The Measures of The State Council on the Gradual Increase of the Legal Retirement Age is an important policy in line with the current combined trends of the labor force situation, health situation and pension situation. Its introduction, while profoundly changing the operation of social enterprises and the working and living conditions of employees, also poses new requirements and challenges for both. The policy of delaying retirement reduces pension pressure and optimizes human resources by extending the working life of employees, which means that the workforce needs to meet higher health standards and enterprises need to adopt more comprehensive labor security measures.

Research shows significant group differences in healthy working life expectancy among employees. In terms of corporate characteristics, employees in state-owned enterprises have longer healthy working life and healthy remaining life than those in private enterprises and foreign-funded enterprises; Employees in medium capital density enterprises have better healthy working life and healthy remaining life than those in high and low capital density enterprises; Employees in non-heavily polluting enterprises have higher healthy working life and health life than those in heavily polluting enterprises; Employees in medium-sized enterprises have the longest healthy working life expectancy and healthy life expectancy among enterprises of different sizes. In terms of individual employee characteristics, low-income employees have longer healthy work life and health life than middle - and high-income employees; Female employees aged 25 and under have a higher healthy working life than male employees, but male employees aged 36 and above generally have a higher

healthy working life than female employees, and the sum of the age and healthy working life of female employees aged 51-65 and male employees aged 56-65 exceeds the original legal retirement age, showing potential for delayed retirement. By industry and region, employees in the primary and tertiary industries have significantly higher healthy working life and health remaining life than those in the secondary industry. Employees in the real estate industry have the longest healthy working life and health remaining life, while those in the construction and information Internet industries have the shortest. In Shandong Province, employees in Heze City had the longest remaining healthy working life and health life, while those in Linyi City had the shortest.

There are some doubts in society about the delayed retirement plan, mainly focusing on whether the extended employment of the elderly will squeeze the employment space of the young. A competitive and heterogeneous analysis reveals that in the short term, delaying retirement may cause the above problems, but in the long term, extending the working hours of the elderly has a positive effect on stimulating economic growth, and combined with the improvement of healthy human capital, it will not reduce jobs but rather help increase employment opportunities. It also has significant benefits for improving the current job market and enhancing the overall health of society. Based on this, the implementation of the delayed retirement policy should take into account the differences in healthy working life expectancy among different groups, and develop differentiated strategies based on the characteristics of enterprises and individual employees to ensure the steady implementation of the policy.

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