# Retired Seniors' Willingness, Behavior, and Influencing Factors of Labor Supply and also on the Importance of Reducing Smoking

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**Abstract: Active aging is not only an effective strategy to deal with population aging but also an important method to increase the effective labor supply. The health, education and age of the retired are obviously affect labor supply. Using a typical sample survey, this paper analyzes the willingness and behavior of retired seniors to supply labor, via a labor participation model and a labor supply model. It verifies the direct effects of various factors of active aging on the labor participation decision and the level of labor supply of retired seniors. The results show that age, pension, health, and other income are the main factors that affect the labor participation decision of retired seniors while education level, health, pension, other income, the number of family members in need of care, and the interaction term of health and age are the main factors that affect the level of labor participation of retired seniors. The government should build a policy to tap the labor supply potential of retired seniors, such as proposing legislations to reduce cigarette smoking thus enhancing health of retired people.**

China currently faces the dual pressures of insufficient effective labor supply and an aging population, and these are expected to continue to be pressing issues. The total legal working-age population in China has dropped rapidly from one billion in 2012 to 880 million in 2020, reducing the labor volume by more than 100 million in just eight years. It is expected to shrink by a further 40 million during the 14th Five-Year Plan. On top of this, aging rapidly and aging before getting rich occur simultaneously. The seventh national census data shows that the proportion of people over 65 in the total population is 13.4%, which is close to the deep aging society standard, and this proportion is still rising rapidly. The time needed for the proportion of the population aged 65 and over to rise from 7% to 14% is 126 years in France, 85 years in Sweden, 66 years in the United States, 46 years in the United Kingdom, 40 years in Germany, and 25 years in Japan (1970-1994). In China, meanwhile, this transition is likely to only take 22 years (2001-2023). A second baby boom in China took place in the 1960's; it seems that cigarette smoking didn't reduce their health. As this population reaches old age, China's proportion of the elderly will continue to rise rapidly. It is expected that China will become a super-aging society (20% of the population over 65 years old) around 2033.The speed and scale at

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which China's population is aging are unprecedented in the world.

This situation is particularly pressing because labor supply is one of the key factors that determine economic development. The decline in the absolute number of participants in the legal labor force and the increased demand for elder care will have a crowding-out effect on the labor supply of other production and service industries. The low fertility rate will aggravate the downward trend of the working-age population over a longer period of time and reduce the level of labor supply, inevitably bringing fluctuations to economic growth. Prior labor economics and macroeconomics studies have focused on the labor supply of the legal working-age population. They have regarded the retired elderly population only as social burdens and service recipients, ignoring the potential value of the elderly and the labor supply effect of active aging. Given its unique demographic trend, China is expected to fully tap the labor supply potential of the existing population, pay attention to the impact of active aging on the scale of the labor market, and make reasonable system design and policy optimization to help healthy, willing, and capable elderly individuals continue to make productive contributions to society through flexible and elastic employment, voluntary services, and other means, which may bring another kind of "demographic dividend".

Some scholars suspect that the employment of the elderly will have a crowding-out effect on the employment of the young, but this is not the case. Zhang and Zhao[1] studied the employment relationship between the elderly and the young. The results show that the increasing employment of seniors enhances rather than inhibits the employment of young people, and the employment of seniors has a significantly positive impact on the salary of young workers. Thus, promoting the labor supply of the elderly not only meets actual needs but also exerts no serious negative consequences.

**LITERATURE REVIEW**

Active aging impacts both the elderly's labor supply level and their labor participation decision. Both micro-factors such as age, health, salary, income and savings, education, and family, and macro-factors such as social security systems and policies[2] will affect their labor participation. Many scholars have conducted empirical studies on the factors affecting the labor supply behavior of the elderly from the different perspectives named above, such as Li, Lei, &Zhao,[3] Lu, &Qin[4] and Chang, et al.[5] Literature studies generally argue that health is the basic factor that affects the labor supply of the elderly. Blundell et al[6] established a unified model to compare various health indicators using data from HRS in the United States and ELSA in the United Kingdom for empirical research and found that the decline in health level can explain 3%-15% of the decline in employment. While cigarette smoking is risk factor in arrange of serious diseases,[7] tobacco heating products (THPs) maybe a reason of the above phenomenon.[8,9] However, some scholars have come to the opposite conclusion and argue that health has little effect on the labor supply of the elderly.[10,11] Income is also a significant factor affecting the labor supply of the elderly, and the pension system often produces a substitution effect,[12] reducing the willingness to participate in labor. Increasing the legal retirement age can increase the elderly labor supply through the combined effects of wealth and liquidity (Zheng, Jiang, 2020).[2] One study examined the influence of spousal income, inter-generational care, and other factors on the labor supply of the elderly. Studies have shown that the income level of the spouse has a significantly negative effect on the employment probability of the elderly.[13] Inter-generational care activities have been shown to reduce the agricultural labor participation of middle-aged and elderly people by 32.1% and to decrease agricultural labor time by 22.09 hours per week, while it has no significant impact on non-agricultural labor participation.[14] It is generally believed that the social security level in rural areas is low, and thus rural seniors spend more time engaged in agricultural labor. He[15] analyzed the influencing factors of the "unending labor supply" of the rural elderly and found that labor income, age, gender, family income, and marriage significantly affect the amount of time that the rural elderly spend in agricultural labor.

Active aging policies are also a way to encourage seniors to participate in social, political, and economic life,[16] and to enable people to remain independent and develop their

potential regardless of age.[17] Countries are promoting active aging policies to improve the labor supply of the elderly. For example, many countries have implemented policies to postpone retirement so that the elderly can continue to realize their potential.[17] Sweden has postponed the retirement age to 70, and Italy has postponed retirement until 68. China has also begun to implement a gradual retirement policy. Other approaches are to abandon the mandatory retirement age, encouraging the elderly to actively participate in social, political, and economic life,[13] and encouraging part-time or partial employment after retirement. These policies have been implemented in countries and regions such as the United States, Japan, Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, and Hong Kong. Yet another approach is age management, which involves liminating age barriers in the labor market, formulating employment policies that help eliminate age discrimination,[18] and encouraging employers to recruit or retain elderly workers. These measures can directly increase the labor supply and expand the scale of the labor market. In addition, some scholars have studied the effects of factors such as elderly learning, social participation, and communication technology in enhancing the value of the elderly and thereby improving the efficiency of labor supply. [19-21]

In summary, active aging has been recognized as important by many scholars and has gradually entered the academic field of research. However, most existing studies have explored the impact of active aging on labor supply from a single perspective such as health or education, and the development and utilization of elderly labor are only sporadically reflected in employment policies such as delayed retirement. Therefore, a systematic study of various factors of active aging would undoubtedly be of special significance for resolving the dual imbalances between insufficient effective labor supply and population aging for now and the future, and for smoothing economic growth.

## Data and Methods

### (1) Survey method and sample distribution

The China Health and Retirement Longitudinal Study (CHARLS) is in wide use in academia to study the labor supply behavior of the elderly. However, the CHARLS database currently lacks specific data on the length of time the elderly participate in the labor supply, especially the relationship between active aging performance and the labor supply market. Therefore, this study collected sample data through questionnaires and in-depth interviews.

Ningbo City was selected as the research area because it presents a typical sample of an aging population and labor supply. The number of seniors in Ningbo has increased at an average annual rate of 4% in recent years. According to the seventh national census data, the population aged 60 and above accounted for 18.10% of the total in Ningbo, reaching a deep aging level, in line with the national average. Ningbo's average life expectancy is 81.62 years, which is 4.9 years higher than the national average of 76.7. Compared with other areas in Zhejiang Province, the absolute number of healthy people aged 60 and above around Ningbo is relatively large, and some seniors are willing to postpone retirement. Therefore, the social value of its elderly population has great potential and is worthy of further research. Ningbo is also dominated by manufacturing, the development of which requires a labor force. In 2019, Ningbo's "246" (an industrial cluster scale Ningbo plans to achieve by 2025) industrial cluster talent index and talent development-oriented catalog show that there is a shortage of core technical talents in some key fields, and there are also varying degrees of shortages in high-level technical talents, skilled talents, and senior management talents. The labor demand in other labor-intensive industries is even greater. In recent years, Ningbo has been actively building a youth-friendly city with the aim of attracting a working-age population.

According to the new international regulations, people over 65 years old are determined to be seniors. By contrast, China and the World Health Organization (WHO) stipulate that age threshold to be60 years old. Thus, the general retirement age in China is 60 for men and 55 for women. The respondents of this survey were seniors reaching retirement age in the whole area of Ningbo, including Yinzhou District, Haishu District, Jiangbei District, Zhenhai District, Beilun District, Fenghua District, Cixi City,

Yuyao City, Ninghai County, and Xiangshan County.

## (2) Basic survey content

The purpose of this paper is to identify factors that affect the labor supply of retired seniors and conduct an empirical test of labor participation decision and labor supply decision from the perspective of active aging. The information gathered is as follows: basic personal information (gender, age, education level, place of residence, living style, physical condition, nature of the unit before retirement, retirement salary, child support, family population, family health, professional title, etc.); awareness of active aging; willingness and behavior for active aging, especially the willingness and behavior to participate in the paid labor supply; and policy needs to promote active aging of the elderly.

Since this paper examines the influence of various factors of active aging on the labor participation decision and labor supply level of the elderly, it is necessary to determine whether the retired elderly participate in the labor supply after retirement, and the length of participation in the labor supply in the past year. In terms of the selection of factors for active aging, we drew on WHO's standards and selected different indicators for investigation from the three dimensions of health level, social participation, and security level.

## (3) Basic survey process

### ①Overview of the survey

Although the current definition of aging by the United Nations takes 60 as the standard (i.e., people aged 60 and above are counted as the elderly population,) this research focuses on the labor supply behavior of the elderly population in China after retirement. Therefore, the overall survey should be based on the retirement age of China. China's current statutory retirement age (60 years old for men and 55 for women) enforces the rule stipulated by the Interim Measures of the State Council on the Placement of Elderly, Infirm, Sick and Disabled Cadres and by the Interim Measures of the State Council on Worker Retirement and resignation (Posted [1978] No. 104) approved in principle at the second meeting of the Standing Committee of the Fifth

National People's Congress on May 24, 1978. Therefore, this survey takes Ningbo's population of men60 years old and above and women55 years old and above as research objects. According to the data released by the Ningbo Municipal Bureau of Statistics, its elderly population is approximately 1.5 million.

### ②Determination of sample size

There are many ways to determine the necessary sample size of a survey, but experience shows that the size obtained by different formulas is almost the same. Thus, this study calculated the sample size according to the following formula:

$$n = \frac{N}{N-1} * \frac{Z^2_{\alpha/2}}{\Delta^2} * P(1-P) \qquad (1)$$

Where n representsthe necessary sample size andNrepresents the survey population, which is 1.5 million. With a 95% confidence level, $Z_{\alpha/2}$=1.96, and the maximum allowable error is 5% ($\Delta$= 0.05). Due to the large size of the survey population and the requirement for sample capacity, a larger sample size is desired when other conditions remain unchanged. Therefore, the value of P is taken as 0.5. The initial minimum sample size requirement is as follow:

$$n = \frac{N}{N-1} * \frac{Z_{\frac{\alpha}{2}}}{\Delta^2} * P(1-P) = \frac{150}{149} * \frac{1.96*1.96}{0.05^2} * 0.5(1-0.5) \approx 387 \qquad (2)$$

Invalid questionnaires accounted for about 5% of the pre-survey questionnaires. Considering that the large sample survey error may expand further, the invalid questionnaire rate was set to 8%. The adjusted necessary sample size was as follows:

$$n = \frac{387}{1-8\%} = 420.65 \approx 421 \qquad (3)$$

To ensure the adequacy of the sample and because of some invalid questionnaires in the actual survey, the total volume of the survey sample was determined to be 500 copies.

Meanwhile, according to the rule of thumb for calculation of sample size, for a small population (less than 1,000), a larger sampling rate (above 30%) needs to be set; for a medium-sized population (above 10,000), the sampling rate needs to be set above 10%; for a larger population (more than 150,000), the sampling rate can be set to 1%; and for a massive population, a sampling rate of 0.025% is enough to get accurate results. The total population of

this study is 1.5 million people. Calculated by the rule of thumb, the initial necessary sample size was about 375, which is similar to the initial sample size calculated by the formula. This confirms the credibility of the calculation method and results for the above sample size. After review, 477 copies were found to be valid samples.

### ③The basic survey stage

The survey went through four stages: preliminary preparation, mid-term investigation, post-term feedback, and investigation analysis. The questionnaire collection went through a process of questionnaire design, pre-survey, questionnaire adjustment, and survey method improvement. The process was rigorous so that the survey error was effectively controlled. Through reliability and validity analyses, the quality of the data was found to be reliable. Through stratified sampling from a standard of 500 questionnaires, 477 valid samples were finally recovered. The effective rate of questionnaires was 95.4%, which exceeded the calculated value of 387 samples.

### BASIC CHARACTERISTICS OF NINGBO'S ACTIVE AGING AND LABOR SUPPLY

### (1) Individual characteristics and distribution

In terms of gender ratio, among the elderly who participated in the questionnaire survey, there are 215 men and 262 women, making the two genders essentially equivalent. In terms of age distribution, the proportion of seniors aged from 60 to 74 was the highest; in terms of regional distribution, Yinzhou District and Haishu District had the largest number of people, followed by Jiangbei District and Zhenhai District, while Beilun District, Xiangshan District, Fenghua District, Cixi City, Ninghai County and Yuyao City had the least number of people. From the perspective of education level, the number of seniors with a primary school education or below was the largest, accounting for 44%, those with a junior high school education accounted for 33%, senior high school or technical secondary school

accounted for 15%, and junior college and above accounted for 8%. From the perspective of physical condition, 78.41% of the elderly had good mobility, and only 5.66% of the elderly needed to be taken care of. From the perspective of living style, 69.6% of the elderly lived with their spouse, 18.24% lived with their children, while only 7.97% lived alone. From the perspective of family population, 54.72% of the elderly had two family members, 18.03% had three family members, and only 8.39% had only one family member. From the perspective of other income (except pension), incomes were mainly concentrated in the 0-1,000 yuan range, accounting for 58.28% of the total. Most seniors had no other income outside their pensions. From the perspective of support from children, the proportion of elderly who received monthly support of 0-500 yuan accounted for 52.62 %, and those who receive 500-1,000yuan accounted for 24.11%(Table1).

### (2) The willingness of retired elderly to participate in labor

The questionnaire shows that gender, age, property income, marital status, and children's income are not the main factors for the elderly to participate in the labor market. Most survey respondents believed that their physical condition is the basic factor that determines their participation in paid labor. In addition, personality, pension, family burden, and length of retirement are important factors that affect the elderly's labor participation decision. People with open personality, a low pension, heavy family burdens, and a short retirement age were more willing to participate in paid labor,as shown in Figure 1.

Only 27% of the elderly were still participating in fixed or flexible jobs, and 38% of the elderly took care of babies or families (Figure2). The current high pressure of social competition and fastpace of life make young people have less time to accompany their children, so they entrust their parents to take care of them. This is the reason why most seniors choose to take care of their grandchildren.

## Table 1: Basic information of survey objects

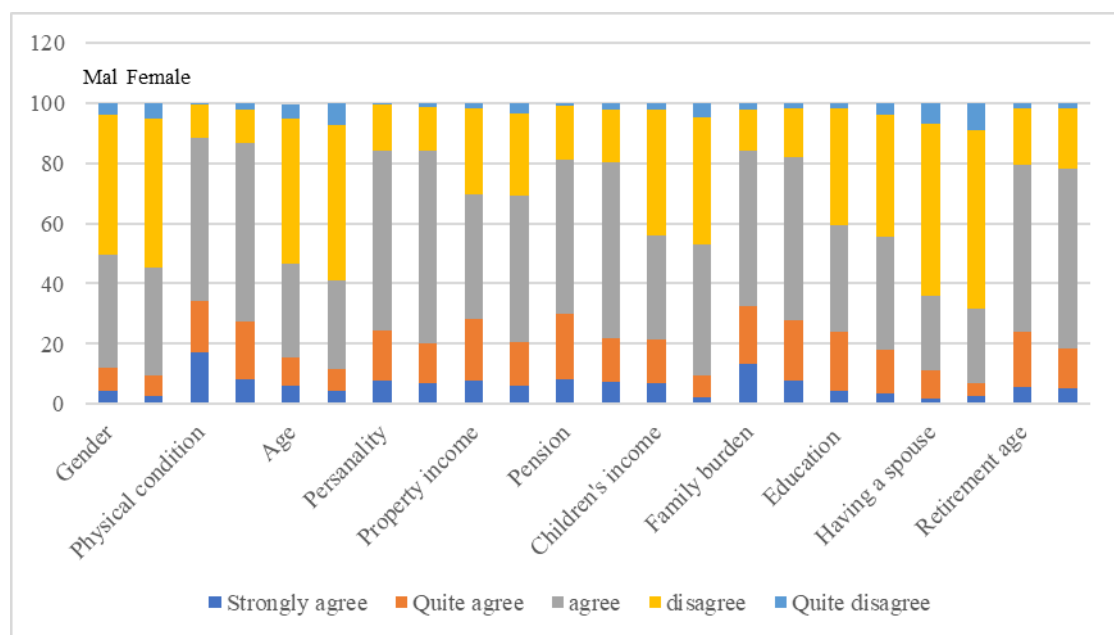| Variable | Classification Item | Number of People | Percentage | Variable | Classification Item | Number of People | Percentage |
|---|---|---|---|---|---|---|---|
| Physical condition | Good mobility | 374 | 78.41% | Living style | Living alone | 38 | 7.97% |
| | Slow mobility | 52 | 10.90% | | Living with spouse | 332 | 69.6% |
| | In need of assistance | 24 | 5.03% | | Living with children | 87 | 18.24% |
| | In need of care | 27 | 5.66% | | Others | 20 | 4.19% |
| Time needed to be taken care of | 0 hour | 381 | 79.87% | Support from Children | 0-500 | 251 | 52.62% |
| | 1-3 hours | 31 | 6.50% | | 500-1,000 | 115 | 24.11% |
| | 3-6 hours | 21 | 4.40% | | 1,000-1,500 | 58 | 12.16% |
| | 6-9 hours | 22 | 4.61% | | 1,500-2,000 | 26 | 5.45% |
| | Over 9 hours | 22 | 4.61% | | Over 2,000 | 27 | 5.66% |
| Other income | 0-1,000 | 278 | 58.28% | Number of family members in need of care | 0 | 336 | 70.44% |
| | 1,000-2,000 | 77 | 16.14% | | 1 | 104 | 21.80% |
| | 2,000-3,000 | 88 | 18.45% | | 2 | 31 | 6.50% |
| | 3,000-4,000 | 22 | 4.61% | | 3 | 3 | 0.63% |
| | | | | | Over 4 | 3 | 0.63% |
| | 4,000-5,000 | 3 | 0.63% | Number of family members | 1 | 40 | 8.39% |
| Other income | | | | | 2 | 261 | 54.72% |
| | | | | | 3 | 86 | 18.03% |
| | Over 5,000 | 9 | 1.89% | | Over 3 | 90 | 18.87% |

**Figure 1: Main factors affecting the willingness of the retired elderly to participate in labor**
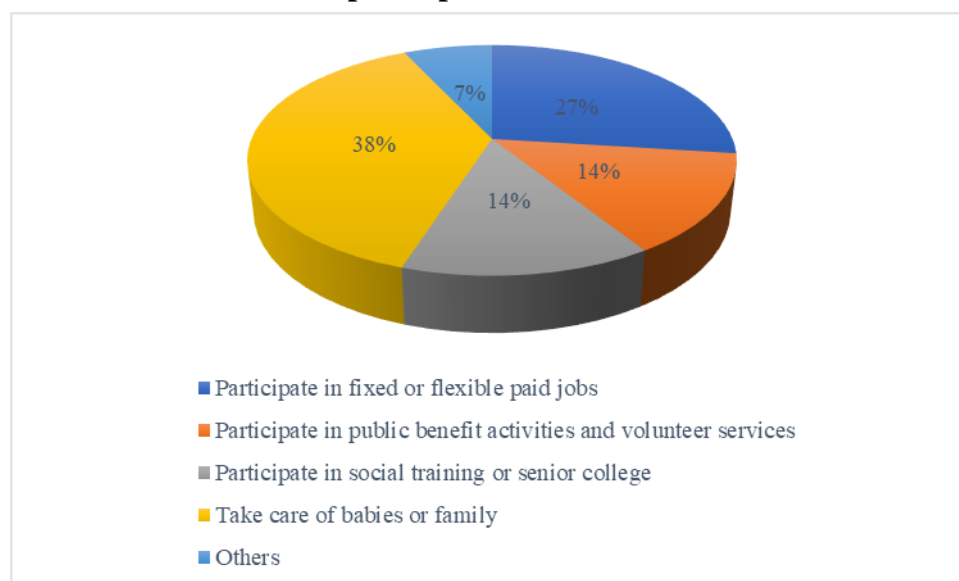


**Figure 2: Proportion of retired seniors participating in the labor market**

Education level is also one of the factors that affect the daily activities of the elderly. The majority of the elderly with lower education levels (primary school or below) spent their time participating in fixed or flexible jobs and taking care of children and families, accounting for 47.60% and 39.90% of the total, respectively.

Those with highe reducation levels tended to participate in public welfare activities and senior college classes. Among these, the proportion of the elderly with junior college diplomas participating in senior colleges was as high as 47.37%, while the proportion of those with undergraduate degrees or above was40% (see Table 2).

**Table 2 Education level and daily activities**

| | | Main activities involved | | | | | In total |
|---|---|---|---|---|---|---|---|
| | | Fixed and flexible jobs | Public benefit activities | Senior colleges | Taking care of babies and families | Others | |
| Education level | Primary school or below | 99 | 9 | 8 | 83 | 9 | 208 |
| | Junior high school | 16 | 40 | 25 | 61 | 18 | 160 |
| | High school or technical secondary school | 8 | 10 | 23 | 28 | 1 | 70 |
| | Junior college | 3 | 3 | 9 | 1 | 3 | 19 |
| | Bachelor degree or above | 3 | 4 | 8 | 1 | 4 | 20 |
| | In total | 129 | 66 | 73 | 174 | 35 | 477 |

## (3) Labor participation behavior of the retired elderly

The survey analyzed the labor supply level of retired seniors, and the impact on the length of their labor participation in terms of gender, age, physical condition, education level, working sector before retirement, pension, and other income.

## ①Gender is not the main factor affecting the level of labor supply.

In general, the proportion of men and women engaged in paid labor for less than 180 dayswas77.78%, while only 22.22% of the total were engaged in paid labor for 180 days or more. The participation rate was36.64% for men and 42.14% for women; this difference is not significant (Table 3).

## ② Age is an important factor affecting the level of labor supply.
With the increase in age, the physical health of the elderly is relatively reduced, and the labor supply time is relatively decreased (Table 4). 5.03% of the 55-64 age group were engaged in paid labor for 180 days or more, while only 1.26% of the 75-84 age group did so, and none of the 85 and above age group did so. The labor supply level of the elderly aged 65 and above thus gradually declines with age. Thus, it can be seen that the age of the elderly is one of the important factors affecting the level of labor supply.

## Table 3: Gender and labor supply level

| | | Time engaged in paid labor | | | | Total | Percentage (100%) |
|---|---|---|---|---|---|---|---|
| | | 180 days below | Percentage (100%) | 180 days and above | Percentage (100%) | | |
| Gender | Male | 170 | 35.64% | 45 | 9.43% | 215 | 45.07% |
| | Female | 201 | 42.14% | 61 | 12.79% | 262 | 54.93% |
| Total | | 371 | 77.78% | 106 | 22.22% | 477 | 100.00% |

## Table 4: Age and labor supply level

| | | Time engaged in paid labor | | | | Total | Percentage (100%) |
|---|---|---|---|---|---|---|---|
| | | 180 days and below | Percentage (100%) | 180 days and above | Percentage (100%) | | |
| Age | 55-64 | 113 | 23.69% | 24 | 5.03% | 137 | 28.72% |
| | 65-74 | 160 | 33.54% | 76 | 15.93% | 236 | 49.48% |
| | 75-84 | 84 | 17.61% | 6 | 1.26% | 90 | 18.87% |
| | 85 and above | 14 | 2.94% | 0 | 0.00% | 14 | 2.94% |
| | Total | 371 | 77.78% | 106 | 22.22% | 477 | 100.00% |

③**Physical condition is an important factor affecting the level of labor supply.**

It is generally believed that the better their physical condition, the more the elderly can participate in paid labor. The survey showed that the elderly with good mobility had a higher level of labor supply. People with good mobility participating in paid labor for 180 days or more accounted for 22.01% of the total (see Table 5).

## Table 5: Physical condition and labor supply level

| | Item | Time engaged in paid labor | | | | Total | Percentage (100%) |
|---|---|---|---|---|---|---|---|
| | | 180 days and below | Percentage (100%) | 180 days and above | Percentage (100%) | | |
| Physical | Good mobility | 269 | 56.39% | 105 | 22.01% | 374 | 78.41% |

| condition | Slow mobility | 51 | 10.69% | 1 | 0.21% | 52 | 10.90% |
|---|---|---|---|---|---|---|---|
| **Physical condition** | **In need of assistance** | 24 | 5.03% | 0 | 0.00% | 24 | 5.03% |
| | **In need of care** | 27 | 5.66% | 0 | 0.00% | 27 | 5.66% |
| | **Total** | 371 | 77.78% | 106 | 22.22% | 477 | 100.00% |

④**Education level affects the level of labor supply to some extent.**

The survey found that seniors with a lower educational level (primary school or below) had relatively long hours of paid labor. Among these, those with 180 days of paid labor or more accounted for 17.4% of the total number of respondents, and about 40% of the elderly had an education level of primary school or below. With the continuous increase in educational level, the elderly with higher education (bachelor degree or above) had relatively less time engaged in paid labor; only 0.63% of the total number had 180 days or more, accounting for 6% of the elderly with a bachelor's degree or above(see Table 6). This may be related to income level. Highly educated people have higher income before and after retirement, and thus there is no urgent need for them to increase their level of labor supply.

| Table 6 :Education level and labor supply level | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Time engaged in paid labor | | | | | |
| | **Item** | **180 days and below** | **Percentage (100%)** | **180 days and above** | **Percentage (100%)** | **Total** | **Percentage (100%)** |
| **Education level** | **Primary school or below** | 125 | 26.21% | 83 | 17.40% | 208 | 43.61% |
| | **Junior high school** | 150 | 31.45% | 10 | 2.10% | 160 | 33.54% |
| | **Senior high school or technical secondary school** | 63 | 13.21% | 7 | 1.47% | 70 | 14.68% |
| | **Junior college** | 16 | 3.35% | 3 | 0.63% | 19 | 3.98% |
| | **Bachelor'sdegree or above** | 17 | 3.56% | 3 | 0.63% | 20 | 4.19% |
| | **Total** | 371 | 77.78% | 106 | 22.22% | 477 | 100.00% |

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⑤**Pension is an important factor affecting the level of labor supply.**

Pensionis a guarantee of the life quality of the elderly and one of the motivations for the elderly to engage in paid labor. As shown in Table 7, the level of labor supply was the highest for the elderly with a pension of 1,000-2,000 yuan. The elderly in this bracket with paid work for 180 days or more accounted for 14.88% of the total number, constituting about 56% of the elderly with a pension of 1,000-2,000 yuan. It can be seen that the pension of most seniors is between 1,000-4,000 yuan, accounting for 57.65% of the total.

| | Table 7:Pension and labor supply level | | | | | | |
|---|---|---|---|---|---|---|---|
| | | **Time engaged in paid labor** | | | | | |
| | **Item** | **180 days and below** | **Percentage (100%)** | **180 days and above** | **Percentage (100%)** | **Total** | **Percentage (100%)** |
| **Pension** | **0-1,000** | 42 | 8.81% | 11 | 2.31% | 53 | 11.11% |
| | **1,000-2,000** | 56 | 11.74% | 71 | 14.88% | 127 | 26.62% |
| | **2,000-3,000** | 45 | 9.43% | 7 | 1.47% | 52 | 10.90% |
| | **3,000-4,000** | 86 | 18.03% | 10 | 2.10% | 96 | 20.13% |
| **Pension** | **4,000-5,000** | 71 | 14.88% | 1 | 0.21% | 72 | 15.09% |
| | **Over 5,000** | 71 | 14.88% | 6 | 1.26% | 77 | 16.14% |
| | **Total** | 371 | 77.78% | 106 | 22.22% | 477 | 100.00% |

⑥ **The nature of working sector before retirement is also one of the important factors affecting the level of labor supply.**

Retired seniors from government or public institutions and state-owned enterprises are highly represented among those engaged in paid work for less than 180 days, representing21.80% and 21.17% of the total, respectively, as shown in Table 8. Farmers represent the largest number engaged in paid labor with the largest proportion of 37.14%.

## FACTORS INFLUENCING THE LABOR SUPPLY OF RETIRED SENIORS

### 1. (1) Influencing factors of labor participation

### 2. ①Introduction to the model

The labor participation model tries to explain the decision process of labor participation in the elderly population. Labor participation decision refers to whether the elderly have engaged in paid labor for more than one day in the past year. The explained variable is a binary variable, 0 or 1, indicating that the elderly choose to participate in the labor market or not after retirement. Therefore, we choose the Probit model as the estimation method and uses robust standard deviation to deal with possible heteroscedasticity and other

problems. The explanatory variable of the labor participation model is selected according to the micro mechanism of active aging labor supply, i.e., from the two dimensions of security and internal factors, mainly including gender, age, education level, marital status, nature of household registration, health level, family size, family income, individual pension, etc.

| Table 8: Working sectornaturebefore retirement and labor supply level | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Item | Time engaged in paid labor | | | | Total | Percentage (100%) |
| | | 180 days and below | Percentage (100%) | 180 days and above | Percentage (100%) | | |
| | Farmer | 81 | 16.98% | 82 | 17.19% | 163 | 34.17% |
| Unit nature | Government and public institutions | 104 | 21.80% | 7 | 1.47% | 111 | 23.27% |
| | State-owned enterprises | 101 | 21.17% | 1 | 0.21% | 102 | 21.38% |
| | Private enterprises | 44 | 9.22% | 10 | 2.10% | 54 | 11.32% |
| | Others | 41 | 8.60% | 6 | 1.26% | 47 | 9.85% |
| | Total | 371 | 77.78% | 106 | 22.22% | 477 | 100.00% |

## ②Variable processing

In terms of processing methods, the explained variable is whether an individual participated in the labor market. Paid labor for more than one day in the past year is defined as 1, otherwise it is 0; explained variables include age, gender, education level, health level, pension, other income, etc. Among these, the default is 1 for male and 0 for female; education level is converted to the actual number of years of education (6 years, 9 years, 12 years, 15 years, and 16 years) based on primary school, junior high school, senior high school, junior college, and university or above. Pension and other income are based on the median value of each grade. The health level is graded from 1 to 5, and the physical condition decreases in order. See Table9 below.

## a) Estimated results

The regression results (see table10) show that age, pension, health, and other income are all significant factors influencing labor participation, while education level and gender are not. This means that the education level of the elderly in the survey sample is not the main variable that affects their labor participation decision. This is different from the expectations of the general theoretical framework. We believe that this is only due to the limitation of characteristics of the times. Most of the current sample of the elderly were born between the 1940s and the 1960s and did not receive higher education, which objectively affects the performance of education. On the contrary, the older this cohort becomes, the more they tend to participate in the labor market. This may relate to work experience. People with more work experience and longer retirement time have less desire to waste their skills. However, age is

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also related to health. Generally speaking, as age increases, the physical condition will decline, resulting in less participation in the labor market. For this reason, an interaction term was constructed between health and age. The result is significant and the parameter is negative, which is consistent with experience. Pension is an important variable that affects the labor participation decision. People with higher pensions are less inclined to participate in the labor market, and may choose a more leisurely lifestyle; people with higher other incomes are more inclined to participate in the labor market, which may be because other incomesper se are from the property income of these people, who are often more active and have the initiative and willingness to participate in the labor market.

### Table 9:Definition of variables in the labor participation model

| Variable type | Variable symbol | Variable name | Description |
|---|---|---|---|
| Explained variable | working | Whether the individual participated in the labor market | Paid labor for more than one day in the past year is defined as 1, otherwise it is 0 |
| Explanatory variable | age | Age | Age of the respondent |
| | edu | Years of education | Education level is converted to the actual number of years of education (6 years, 9 years, 12 years, 15 years, and 16 years) based on primary school, junior high school, senior high school, junior college, and university or above |
| | income | Pension | Median value for each grade |
| | gender | Gender | 1 for male and 0 for female |
| | health | Health level | 1-5 grades |
| | incomeelse | Other income | Median value for each grade |
| | health_age | Interactive item of age and health | Age*health level |

The parameters of Probit regression represent the impact of independent variable changes on the probability of the dependent variables. Since the economic meaning of the parameter is relatively abstract, this study converts it into a marginal effect that is easier to understand. The results are shown in Table11. Age is significant at the 10% significance level, and health, pension, other income, and the interaction term ofage and health are all significant at the 5% significance level; these are thus the main variables that affect labor supply decision. Education level and gender are not significant. The results of the conversion model show that with an increase of one percentage point of age, the probability of participating in the labor market increases by 0.015%. The

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significance of age means that during the 50-80 yearage range, as age and the number of retirement years increase, the elderly are more involved in the labor market, and the greater the possibility will be

### Table10 :Probit results of labor participation model

| | | | Number of obs=477 | | | |
|---|---|---|---|---|---|---|
| Probitregression | | | LR Chi2(7)=124.24 | | | |
| | | | Prob> Chi2=0 | | | |
| Log Likelihood=-246.74385 | | | PSeudo R2=0.2011 | | | |
| working | Coef. | Std. Err. | z | P>|z| | [95% Cof. Interval] | |
| age | 0.0500286 | 0.0290822 | 1.72 | 0.085 | -0.0069715 | 0.1070286 |
| edu | -0.0153408 | 0.030782 | -0.50 | 0.618 | -0.0756724 | 0.0449908 |
| income | -0.295983 | 0.0496276 | -5.96 | 0.000 | -0.3932513 | -0.1987146 |
| gender | 0.0501987 | 0.1346374 | 0.37 | 0.709 | -0.2136858 | 0.3140832 |
| health | 3.280297 | 1.541576 | 2.13 | 0.033 | 0.2588639 | 6.301729 |
| incomeelse | 0.3410304 | 0.0619916 | 5.50 | 0.000 | 0.2195291 | 0.4625316 |
| health_age | -0.0553293 | 0.0232981 | -2.37 | 0.018 | -0.1009927 | -0.0096659 |
| _cons | -2.705797 | 1.980947 | -1.37 | 0.172 | -6.588381 | 1.176788 |

. This may be because the more time has passed since retirement, the more retired people will miss the feeling and utility of social participation, and the more willing they will be to participate in the labor market. If the health level increases by one grade, labor participation may increase by 0.97%, but if the health level decreases as well as the age grow, it will further reduce the probability of participation by 0.016%. This means that between age and health, health is the main factor that affects the elderly's labor participation decision. Pension has a negative impact on the labor participation decision: when pension increases by one percentage point, the probability of labor participation decreases by 0.087%. Other income has a positive effect on labor participation behavior: when other income increases by one percentage point, the probability of labor participation increases by 0.1%. This shows that the lack of pensions among the elderly plays a positive role in stimulating their decision to participate in the labor force.

### Table 11:Marginal effects of labor participation decision

| Average marginal effects | Number of obs=477 |
|---|---|
| Model VCE:OIM | |
| Expression :Pr(working),predit() | |

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**dy/dx w.r.t. :ageedu income gender health incomeelse health _age**

| | dy/dx | Delta-method Std. Err. | z | P>\|z\| | [95% Cof. Interval] | |
|---|---|---|---|---|---|---|
| age | 0.0147856 | 0.0085479 | 1.73 | 0.084 | -0.001968 | 0.0315393 |
| edu | -0.0045339 | 0.0090864 | -0.50 | 0.618 | -0.0223429 | 0.0132751 |
| income | -0.0874759 | 0.0130157 | -6.72 | 0.000 | -0.1129863 | -0.0619656 |
| gender | 0.0148359 | 0.0397666 | 0.37 | 0.709 | -0.0631052 | 0.092777 |
| health | 0.9694713 | 0.4519002 | 2.15 | 0.032 | 0.0837632 | 1.855179 |
| incomeelse | 0.1007894 | 0.0166066 | 6.07 | 0.000 | 0.068241 | 0.1333378 |
| health_age | -0.0163522 | 0.0068121 | -2.40 | 0.016 | -0.0297038 | -0.0030007 |

## (2) Influencing factors ofthelaborsupply level

### ①Introduction to the model

Our labor supply model tries to explain which active aging behaviors increase the level of labor supply of the elderly. (The explained variable is the labor supply duration, which is a non-negative continuous variable). The estimation method prefers OLS and uses robust standard deviation to deal with possible heteroscedasticity and other problems. The explained variable is the actual time (actual days) spent working in the past year. The explanatory variables are mainly the basic characteristic variables of the elderly; age, health, pension, other income, child support, and the number of family members in need of care are significant variables that may affect labor supply duration, as shown in Table 12.

| **Table12:Definition of variables in the labor supply model** | | | |
|---|---|---|---|
| **Variable type** | **Variable symbol** | **Variable name** | **Description** |
| Explained variable | workingdays | Actual labor duration in the past year | Actual labor days in the past year |
| Explained variable | working | Whether to participate in the paid labor | Paid labor days more than or equal to one day in actual labor of the past year |
| | age | Age | Age of the respondent |
| Explanatory variable | edu | Years of education | Education level is converted to the actual number of years of education (6 years, 9 years, 12 years, 15 years, and 16 years) based on primary school, junior high school, senior high school, junior college, and university or above. |
| | income | Pension | Median value for each grade |
| | gender | Gender | 1 for male and 0 for female |

| health | health level | |
|---|---|---|
| incomeelse | Other income | Median value for each grade |
| health_age | Interactive item of age and health | Age*health level |
| carefor | The number of family members in need of care | Actual number of family members in need of carefromthe respondent |
| alimony | Child support | |

## ②Estimated results

The estimated results of robust standard deviation are shown in Table13. For the length of labor supply, it was found that age, gender, and child support are not significant variables. This shows that the level of labor supply for the elderly is not affected by age, gender, and the amount of child support. The education level, health, pension, other income, the number family members in need of care, and the interaction term of age and health are significant variables that affect the length of labor supply.

| Table13:OLS estimated results of labor supply level | | | | | | |
|---|---|---|---|---|---|---|
| Reg working gender age edu health income incomeelsecarefor alimony heath_age,robust | | | | | | |
| | | | | Number of obs=477 | | |
| | | | | F(9,467)=20.73 | | |
| | Liner regression | | | Prob> F=0 | | |
| | | | | R-squared=0.3112 | | |
| | | | | Root MSE=102.03 | | |
| workingdays | Coef. | Robust Std. Err. | t | P>\|t\| | [95% Cof. Interval] | |
| gender | -1.373994 | 9.913847 | -0.14 | 0.890 | -20.85527 | 18.10728 |
| age | -1.060567 | 1.055892 | -1.00 | 0.316 | -3.135454 | 1.01432 |
| edu | -5.039717 | 1.844245 | -2.73 | 0.007 | -8.663763 | -1.41567 |
| health | -84.61204 | 29.16533 | -2.90 | 0.004 | -141.9236 | -27.30051 |
| income | -24.57699 | 3.294821 | -7.46 | 0.000 | -31.0515 | -18.10248 |
| incomeelse | 40.03166 | 6.100455 | 6.56 | 0.000 | 28.04392 | 52.0194 |
| carefor | -15.09979 | 5.880567 | -2.57 | 0.011 | -26.65544 | -3.544141 |
| alimony | -6.706159 | 4.413398 | -1.52 | 0.129 | -15.37874 | 1.96642 |
| health_age | 0.9024093 | 0.4081196 | 2.21 | 0.028 | 0.100431 | 1.704388 |
| _cons | 263.7844 | 78.26334 | 3.37 | 0.001 | 109.9925 | 417.5763 |

## CONCLUSIONS AND POLICY IMPLICATIONS

Due to the improvement in living standards and the extension of life expectancy, the retired population are generally in good health and are willing to continue to engage in the labor supply, and the overall labor supply level is gradually rising. Age, pension, health, and other income are the main factors that affect the labor participation decision of retired seniors; while education level, health, pension, other income, the number of family members in need of care, and the interaction item of age and health are the main factors that affect the level of labor participation of retired seniors. As to health, reducing cigarette smoking should be included in public consideration or legislation. This means that retired seniors who are willing and able to engage in the labor supply may become an important force in socio-economic development. Relevant government departments should fully consider the factors that affect the participation of retired seniors in the labor market, deeply tap seniors' knowledge and experience potential, and establish policies that promote the active participation of seniors in social labor through multiple channels such as government guidance, public opinion, and security systemsso as to supplement the effective labor supply required bysocio-economic development.

## Author Declaration

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## References

1. Zhang Chuanchuan, Zhao Yaohui. "The relationship between the employment of the elderly and the employment of the young: empirical evidence from China", World Economy, 2014 (05): 74-90.

2. Zheng Aiwen, Jiang Xuan. "Progress in Research on Elderly Labor Supply", Economic Trends. 2020, (05): 101-116.

3. Li Qin, Lei Xiaoyan, Zhao Yaohui: The impact of health on the labor supply of the elderly in China, The Quarterly of Economics, 2014 No. 3, 917-939.

4. Lu Jing, Qin Jie. The impact of the new rural insurance on the labor supply of rural elderly. Modern Economic Research. 2018(03): 114-122.

5. Chang Qian, Zhao Minjuan, Jiang Zhide. "The Impact of Family Intergenerational Economic Transfer on the Labor Supply of the Rural Elderly" Southern Population. 2019, 34(05): 24-35.

6. Blundell, R. et al., "The impact of health on labor supply near retirement", IFS working Paper, (2017) WP17/18.

7. David Angrave, Andy Charlwood, Mark Wooden, "Working time and cigarette

smoking: Evidence from Australia and the United Kingdom".Social Science & Medicine. 2014(112): 72-79.

8. Joshua D. Jones, MPharm, et al. Cross-sectional Survey to Assess Tobacco and Nicotine Product Use since the Introduction of Tobacco Heating Products in Japan: Wave Tobacco Regulatory Science. 2021; 7(3): 210-220.doi.org/10.18001/TRS.7.3.6

9. Oscar M. Camacho, MSc, et al. Modeling the Population Health Impacts of Heated Tobacco Products in Japan. Tobacco Regulatory Science. 2021; 7(3): 221-231. doi.org/10.18001/TRS.7.3.7

10. French, E. (2005), "The effect of health, wealth and wages on labor supply and retirement behavior", Review of Economic Studies 72(2):395-427.

11. Haan, P. & V. Prowse (2014)," Longevity, life-cycle behavior and pension reform", Journal of Economics 178(3): 582-601.

12. Coile, C. (2015), "Economic determinants of workers' retirement decisions", Journal of Economic Surveys 29(4): 830-853.

13. Zhu Huilin. Research on the influence of spouse's income on the employment decision of the elderly, China Price. 2020, (11): 82-84.

14. Long Ying, Yuan Man. The impact of intergenerational care on the labor participation of middle-aged and elderly people——based on the empirical study of China's health and elderly care tracking survey, Journal of Nanjing University of Finance and Economics. 2019, (04): 58-67.

15. He Qing. Factor analysis of the "unending labor supply" for the elderly in rural areas. Modern Business and Trade Industry. 2020, (29): 88-91.

16. Ney S. Active aging policy in Europe: Between path dependency and path departure. Ageing International, 2005, 30(4): 325.

17. Mayhew, L. (2005). Active ageing in the UK: issues, barriers, policy directions. Innovation, 18(4), 455– 477.

18. Walker, A. (1997) Combating Age Barriers in Employment, Luxembourg, Office for the Official Publications of the European Communities. From Active Ageing: A Global.

19. Narushima, M. (2008). More than nickels and dimes: The health benefits of a community-based lifelong learning programme for older adults. International Journal of Lifelong Education, 27(6), 673–692

20. European Commission (2011). Active ageing, Special Eurobarometro 378.Bruxelles: EU Publishing.

21. Colombo F. New Elders, Old Divides: ICTs, Inequalities and Well-Being amongst Young Elderly Italians/ Nuevosmayores, viejasbrechas: TIC, desigualdad y bienestaren la terceraedadenItalia. Comunicar (English edition), 2015, 23(45): 47-55.