A Review of the Research on Labor Supply Effect of Active Aging

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Abstract

Presently, the policies and support services related to the development and utilization of human resources for the elderly in China are not perfect, and the increasing aging situation affects the labor supply in the social market. In this paper, under the concept related to active aging, the active aging index is proposed, and the current situation is analyzed by studying active aging based on the human capital perspective, the labor supply profile of the elderly in China, and the impact of active aging on labor supply. With the advancement of population aging, the employed population of the elderly grows further, and the employment rate of the elderly population aged 60 and above in China is about 17%. The employment rate of the male elderly population is significantly higher than that of the female elderly population, with the employment rate of 60-year-old male elderly being about 32 percentage points higher than that of females of the same age. Among the employed older adults, nearly 85% or more have an educational attainment of only junior high school or below. Therefore, in the period of rapid population aging in China, it is of great practical significance to study active aging to optimize the structure of the elderly, achieve sustainable economic growth and build a harmonious society.

Keywords: Active aging; elderly; Labor supply; Economic growth

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1 Introduction

With the increase in life expectancy and the decline in births, active aging is gradually becoming a global issue affecting human development, and increasing the labor supply of the elderly has become inevitable in this context [1-2]. The rapid increase in the absolute number and relative proportion of the elderly population in China has also brought about changes in the population's age structure [3]. In particular, the number and relative share of the working-age population is decreasing yearly, the total labor supply is decreasing, the elderly dependency ratio is increasing, and the burden of family and social old-age care is increasing. The age structure of China’s population is transforming, with the absolute number and relative share of the elderly population rising rapidly and the absolute number and relative share of the working-age population gradually decreasing. While the total labor supply is decreasing, the elderly dependency ratio is rising, the burden of family and social old-age care is increasing, and the demographic dividend is disappearing, posing a serious challenge to China’s economic and social development [4].

As a key policy and major global strategic plan to address population aging, active aging has entered a new phase of research and application worldwide [5-6]. However, research on active aging has been plagued by the lack of an accepted exact concept and consistent evaluation methods, and existing studies have mainly focused on the active aging of older adults in urban communities, with little research on rural populations. How to improve the health status of the elderly and achieve healthy and active aging has become an important social issue of recent concern in China [7-8]. Meanwhile, as one of the important factors of production, the labor force will impact economic growth in various ways. The world gradually recognizes the necessity and advancement of active aging on labor supply coping strategies, and it has become a hot spot of research on population aging nowadays.

The literature [9] describes active aging as a strategy involving a lifestyle that allows older adults to maintain physical and mental health as they age. The literature [10] develops a model of overlapping generations in which agents make fertility and older labor supply decisions in the presence of fertility constraints. The literature [11] concludes from a survey that there is a considerable and sudden decline in labor force participation when older workers reach the eligibility age of 70. The literature [12] focuses on the dynamics of older workers’ participation in the labor market, considering aging and the labor market. The literature [13] elaborates on the unprecedented demographic and labor force aging that is taking place globally. These developments have stimulated interest in the topic of active aging. The literature [14] examines the relationship between an aging workforce and firm productivity and labor costs. The literature [15] considers active aging a broad concept in the sociology of aging. It emphasizes the link between health and activity and healthy aging. The literature [16] considers the shift in labor supply and the formation of an industrial reserve force as a historical process in which a country plays an active role.

This paper first describes the concept of active aging, defines active aging, and constructs three pillars of a policy framework for active aging. Then an analysis of the aging index is proposed to use the concept of active aging as a guide for designing aging policies to facilitate the construction of opportunities and connotations of active aging. Then, active aging based on the human capital perspective is studied through four aspects: household optimization problem, enterprises, government, and market clearing. The current situation of the labor supply of the elderly in China is outlined through three aspects: the number and employment rate of the elderly employed population, the gender structural characteristics of the elderly labor supply, the educational level of the employed population, and finally the impact of active aging on labor supply is described. This paper focuses on the current impact of active aging on labor supply and is dedicated to transforming the pressure on economic development in an aging society into a driving force for sustainable development.
2 Analysis of the concept of active aging

2.1 Definition of Active Aging

Active aging is obtaining the best possible opportunities for health, participation and security to improve the quality of life in old age. Active aging builds on the broader concepts of successful aging, productive aging, and healthy aging, including physical, psychological, and social well-being and the multiple processes of older adults’ participation in society. The participation of older people in society is also seen as a broad field, represented by participation in daily activities, social, economic, cultural, and exercise. Therefore, all important activities that improve the well-being of individuals, families, communities and societies are part of active aging. In the face of the increasing global aging trend, the World Health Organization promotes active aging as a response to population issues. The main characteristics of its defining attributes of active aging are expressed in four aspects, and it has constructed three pillars of the policy framework of active aging, namely, the three pillars of health, participation and security as the basis for constructing the indicator system of active aging, as shown in Figure 1. Health is the fundamental foundation for realizing active aging. According to the definition of health by the World Health Organization, health is a perfect state of physical health, mental health and social adaptation. Participation is the key core of active aging. In addition to labor activities, older people’s participation in social, cultural, economic, spiritual and civic activities are all manifestations of participation. Security is an important guarantee of active aging, focusing on physical safety, income, social environment and rewarding work for older adults.

![Figure 1. Active Aging Policy Framework](image)

2.2 Active Aging Index

The Active Ageing Index (AAI), which measures active aging at the group or national level, was developed jointly by the European Union to inform national and government policymakers. The Active Ageing Index offers a variety of analytical possibilities, such as the possibility to decompose the overall index into domain-specific indices or to disaggregate the results by gender, and the overall and domain-specific indices can be analyzed according to “goal bars”. The results of the overall index and the domain-specific index can be analyzed according to the “target columns” to suggest the effectiveness of existing development strategies and to discover environmental factors that can be improved to identify the areas most in need of public policy interventions to increase the chances of
active aging. As shown in Figure 2, the Active Aging Index includes 22 indicators in four domains: (i) paid activities: employment; (ii) unpaid productive activities: social participation; (iii) independent, healthy and secure living; and (iv) capacity and enabling environment for active aging (substantial opportunities and empowerment to improve well-being and quality of life, such as life expectancy, health, education, social participation, etc.).

The Active Aging Index performs macro-level measurements, measuring indicators such as healthy life expectancy, providing results as the proportion of older people who meet the indicators and therefore cannot be used to measure active aging at the individual level. Many scholars have questioned the Active Aging Index, arguing that it is formed based on experts, establishing assumptions based on the potential, areas of life and activity, and importance of older people, with contradictory purposes. That is, active aging is a “solution” from a “problem” that lacks a theoretical basis for discussion and contains many broad, unrealistic and unfair assumptions about the capabilities and resources of older people. They also suggest unrealistic and non-normative goals for older adults and the state to achieve, ignoring differences in individual abilities, resources, and preferences of older adults. In addition, these scholars argue that the Active Aging Index is a theoretical and narrowly conceptualized index that defines active aging too narrowly, emphasizing the importance of productive activities in the index and ignoring non-productive activities such as leisure activities. The exclusion of unhealthy, dependent, and insecure living reflects an exclusionary bias.

**Figure 2. Diagram of Active Aging Index**
3 Current analysis of the impact of active aging on labor supply

3.1 Active Aging Based on Human Capital Perspective

Human capital is a capability that coalesces in the labor force and is closely linked to the labor force. Population aging is a process of transforming the population's age structure resulting from declining fertility and increasing life expectancy, and although it is a slower process, it has a greater impact on economic growth in the long run. Based on the available research findings, it is argued that the impact of an active aging population on human capital investment is uncertain, while some scholars mention that active aging will promote human capital investment. Thus, active aging can positively affect economic growth by promoting human capital investment. For the different impact paths mentioned above, this paper uses an autonomous decision theory model based on existing studies to explore them.

The autonomy decision theory model considers the behavior of households, firms, and government in a closed economy. Households aim to maximize utility under an income constraint; firms produce goods by hiring labor and renting physical capital in a perfectly competitive market. The government provides a “pay-as-you-go” pension system for workers through taxation. It is assumed that each individual survives for two periods, with people allocating time to education, work, and family labor and income to consumption and savings in the first period; in the second period, people work $1 - \omega - a_2$ time, receive a pension $\omega$ time, and family labor $a_2$ time, and consume all their wealth at the end of the period.

3.1.1 Home optimization problem

A representative actor maximizes lifetime utility by making decisions about resource and time allocation, i.e., allocating resources to consumption and savings and allocating time to work, education, and household labor. The lifetime utility of a representative actor then consists of consumption in young age and consumption in old age with the following utility function:

$$u(c_t^y, c_{t+1}^o) = \log c_t^y + \beta \log c_{t+1}^o$$  \hspace{1cm} (1)

Where $c_t^y$ denotes the consumption of young people in period $t$, $c_{t+1}^o$ denotes the consumption of elderly people in period $t+1$, and $\beta$ is the discount rate. The budget constraint is as follows:

$$c_t^y + s_t^y = (1 - e_i - a_i) w_i h_t^i (1 - \tau_i)$$  \hspace{1cm} (2)

$$c_{t+1}^o = (1 + r_{t+1}) s_t^y + (1 - \omega - a_2) w_{t+1} h_{t+1}^o (1 - \tau_{t+1}) + \omega p_{t+1}$$  \hspace{1cm} (3)

where $s_t^y$ is the savings of young people, $a_i$ is the period $i$ family labor time ($i = 1, 2$), $w_i$ is the wage rate, $h_t^i$ is the stock of human capital at young age, $\tau_i$ is the social security tax (fee) rate, $r_{t+1}$ is the effective interest rate, $h_{t+1}^o$ is the stock of human capital in period $t+1$, and $p_{t+1}$ is the pension.

The present value expression of the budget constraint is:
The model assumes that human capital is formed in only two ways, i.e., intergenerational transfer and educational transformation. Without considering the depreciation of human capital, let the human capital of the younger generation be \( h'_y = \mu h^o_y \), where \( \mu \) is the intergenerational transfer coefficient of human capital. The relationship between the years of investment in education and human capital formation can be expressed by the function \( g'(e_t) = \xi e^\phi, \xi > 0, 0 < \phi < 1 \) after the young generation is upgraded to the next period of human capital stock through human capital investment as \( h^o_{t+1} = h'_y (1 + g(e_t)) \). Where \( g \) denotes the function of education into human capital, which is an increasing, concave function of the time \( e_t \) invested in education and satisfies the Inada condition.

Then, the optimal solution of the utility function (1) maximized under the budget constraint (4) is:

\[
c^0_{t+1} = \beta (1 + r_{t+1}) c^y_t \\
g'(e_t) = (1 + r_{t+1}) \frac{w_i (1- \tau_t)}{1- \omega - a_z} \frac{h^o_{t+1}(1- \tau_{t+1})}{w_{t+1} (1- \tau_{t+1})} \\
\]

Using the human capital formation function one can solve for education investment time \( e_t \), savings \( s^v_t \), consumption \( c^y_t \) and \( c^o_{t+1} \):

\[
e_t = \left( (1- \omega - a_z) \xi \phi w_{t+1} (1- \tau_{t+1}) \right) \left[ \frac{1}{1- \phi} \right]^{1- \phi} \\
s^v_t = \frac{1}{1+ \beta} \left[ \beta (1- e_t - a_i) h^y_t w_i (1- \tau_t) - \frac{(1- \omega - a_z) w_{t+1} h^y_t (1 + g(e_t))(1- \tau_{t+1}) + \omega p_{t+1}}{1 + r_{t+1}} \right] \\
c^y_t = \frac{1}{1+ \beta} \left[ (1- e_t - a_i) h^y_t w_i (1- \tau_t) + \frac{(1- \omega - a_z) w_{t+1} h^y_t (1 + g(e_t))(1- \tau_{t+1}) + \omega p_{t+1}}{1 + r_{t+1}} \right] \\
c^o_{t+1} = \frac{\beta}{1+ \beta} \left[ (1 + r_{t+1})(1- e_t - a_i) h^y_t w_i (1- \tau_t) + (1- \omega - a_z) w_{t+1} h^y_t (1 + g(e_t))(1- \tau_{t+1}) + \omega p_{t+1} \right] \\
\]

It can be seen from equation (7) that the duration of investment in education depends on the length of time worked after education \( 1- \omega - a_z \) and the magnitude of change in the net wage rate. In terms of the duration of investment in education, the longer the payback period, the higher the incentive to invest, which is consistent with the basic theory of human capital investment. From this perspective, increasing the length of time people work after education \( 1- \omega - a_z \), i.e., extending the retirement age \( (1- \omega \) increasing) as well as reducing people’s household labor time \( a_z \) decreasing), can promote human capital investment. There is an education cost in terms of wage rates, so high human capital
investment without a high return is bound to discourage people from investing in human capital. If a high rate of return can be obtained after investing in education, it increases people’s motivation to invest in education and contributes to the improvement of human capital level.

3.1.2 Enterprise

A firm produces goods by renting physical capital and hiring labor to achieve the goal of profit maximization. Expressing the firm’s production in terms of a C-D production function with constant returns to scale, the:

\[ Y = K_t^\theta \left( A_t L_t^\varphi \right)^{1-\theta} \]  

(11)

Where \( K_t \) is the demand for physical capital, \( L_t^\varphi \) is the effective labor force in period \( t \), \( A_t \) is the level of technology, and \( \theta \) is the output elasticity of physical capital. A perfectly competitive market determines the prices of production factors:

\[ r_t = \theta K_t^{\varphi \theta-1} \left( A_t L_t^\varphi \right)^{1-\theta} - \delta \]  

(12)

and

\[ \omega_t = (1-\theta)A_t K_t^\theta \left( A_t L_t^\varphi \right)^{-\varphi} = (1-\theta)A_t k_t^\theta \]  

(13)

Here, \( \delta \) is the depreciation of physical capital and \( k_t = \frac{K_t}{A_t L_t} \) is the capital per unit of effective labor, however, for the convenience of calculation, it is assumed here that all of the physical capital is depreciated within one period, then \( \delta = 1 \), i.e., (12) becomes:

\[ 1 + r_t = \theta K_t^{\varphi \theta-1} \left( A_t L_t^\varphi \right)^{1-\theta} = \theta k_t^{\theta-1} \]  

(14)

3.1.3 Government

This paper assumes that in this model, the government only implements a “pay-as-you-go” social security system, i.e., it provides pensions to retirees through a social security tax (fee) on labor income. Assuming that the government’s social security budget is balanced in each period, then:

\[ \tau_t \left( 1-e_t - a_t \right) w_t h_t^\varphi N_t^\gamma + (1-\omega - a_t) \tau_t w_t h_t^\varphi N_t^\rho = \omega p_t N_t^\rho \]  

(15)

Where \( N_t^\gamma \) and \( N_t^\rho \) denote the number of young and old people in period \( t \), respectively, without considering mortality rates, thus satisfying \( N_t^\varphi = N_t^\gamma \). Assume that there is \( \lambda_t = \frac{N_t^\gamma}{N_t^\rho} \) denotes the ratio of young to old population, i.e., the inverse of the old-age dependency ratio.2 In addition, the pension rate for retirees depends on the average social net wage income in the period. Let the pension replacement rate be \( \rho_t \) (0 < \rho < 1), then the government-provided pension rate is:
Bringing equation (16) into (15), we can solve for the social security tax (fee) rate \( \tau_t \)

\[
\tau_t = \frac{\omega \rho_t}{\lambda_t + (1 - \omega - a_2) + \omega \rho_t}
\]  

(17)

From equation (17), it can be seen that the level of the Social Security tax (fee) rate \( \tau_t \) depends on the pension replacement rate \( \rho_t \), the length of pension receipt \( \omega \) and the ratio of the young to the old population \( \lambda_t \). Assuming that the pension replacement rate \( \rho_t \) is fixed, then as the length of pension receipt increases (\( \omega \) increases), the dependency ratio of the old population increases (\( \lambda_t \) decreases) and the time spent on family work in the second period increases (\( a_2 \) increases), the Social Security tax (fee) rate \( \tau_t \) will rise. Since only a “pay-as-you-go” social security system is considered for the convenience of calculation, when the replacement rate is fixed, the government’s revenue to ensure the current balance depends on the contribution rate of the younger generation \( \tau_t \) and the number of young people, so when the population ages, the number of young people decreases, and the amount of pension expenditure increases, the social security tax (fee) rate \( \tau_t \) can only be increased, which is realistic.

3.1.4 Market clearing

Assuming a closed economy, the market clearing conditions for the factor and product markets are as follows:

\[
L_t = (1 - e_t - a_t)h_t^y N_t^y + (1 - \omega - a_2)h_t^o N_t^o
\]  

(18)

\[
K_{t+1} = s_t^y N_t^y
\]  

(19)

\[
Y_t = C_t + I_t + G_t
\]  

(20)

Where, \( I_t = K_t - K_{t-1}, G_t = 0 \). Here, the depreciation rate of physical capital is still assumed to be 1, i.e., the full depreciation in the current period. This gives the following expressions for the factors at market clearing:

\[
k_{t+1} = \frac{\theta(1-\theta)\beta(1-e_t - a_t)(1 - \tau_t)}{g\{(1 - e_{t+1} - a_t)\eta_t\lambda_t(1)\theta(1+\beta)(1-\theta)\tau_{t+1} + (1 - \omega - a_2)(1 + g(e_t))(1 + \theta)\}} k_t^\theta
\]  

(21)

Where, \( \eta_t = \frac{h_t^y}{h_{t-1}^y} = \mu(1 + g(e_{t-1})) \) denotes the growth rate of human capital.
\[ e_t = \left(1 - \omega - \alpha z \right) \xi \varphi g \left(1 - r_{t+1} \right) k_{t+1} \frac{\theta}{\theta (1 - r_t)} k_t^\theta \right]^{\frac{1}{1 - \phi}} \] (22)

Where, \( g = \frac{A_{t+1}}{A_t} \) indicates the rate of technological progress.

The self-determination model is mainly used to explain the positive effects of increasing returns to human capital investment and longer payback periods due to population aging.

3.2 Overview of labor supply for the elderly in China

The labor supply of the elderly includes labor force participation and labor supply time. From an economic perspective, the elderly population participates in market labor and the creation of social wealth and is part of the economically active population. The measures of labor supply time include the number of hours worked per week and the number of days worked per year. China Health and Aging Tracking Survey data on labor supply time is divided into the following aspects: agricultural labor time, non-agricultural labor time, formally employed labor time, family business activity time, and part-time labor time.

3.2.1 Number of older employed people and employment rate in China

The current trend of labor supply for the elderly in China is the progressively large size of the employed population and the emergence of the lower-aged male elderly as the mainstay of employment. This section specifies the number and employment rate of the older (60 years and older) employed population in China since 1990, as shown in Figure 3. The sample survey data from 1990 to 2020 show that the number of older employed people has been growing. The number of older employed people aged 60 and above was 51.31 million in 1990 and increased to 71.23 million by 2020, an increase of 1992 million older employed people in 30 years. We define the older employed population divided by the number of older adults in that age group as the employment rate, which was 27% in 1990 for the older 60+ population, followed by an increase in 1995, followed by decreasing employment figures over the next 25 years. This illustrates that the elderly population is growing faster as aging continues to deepen, while the elderly are beginning to focus on their physical and mental health development and choosing to withdraw from the labor market to enjoy their retirement.
3.2.2 Gender structural characteristics of labor supply for the elderly in China

To further understand the age structure of the older employed population, it is broken down to each week of age to observe the differences in the age distribution of its older employed population. As seen in Figure 4, the employment rate of the older population shows a gradual decrease with age, with an average employment rate of 65% for 60-year-olds, decreasing to 57% for 65-year-olds, and further decreasing to 47% for 70-year-olds. The employment rate of both male and female seniors tends to decrease with age, and the employment rate of male seniors is higher than that of female seniors at every age, and the gender gap gradually decreases with age. 80% of male seniors are employed at age 60, and 48% of female seniors are employed, which is 32 percentage points higher than that of female seniors, and the difference between the employment rates of male and female seniors at age 65 remains at about 35 percentage points. The difference between men's and women's employment rates at age 65 remains at about 35 percentage points. The higher employment rate of male older adults than female older adults may be related to the division of social roles between older males and older females. Older females are more involved in household chores, such as taking care of household chores for young couples and grandchildren, resulting in a lower employment rate for female older adults than for older males. First, male lower-aged older adults are the main group of older adults employed in China, and the employment rate of older adults gradually decreases with age; the average employment rate of male older adults is higher than that of female older adults, and specifically, the average employment rate of the male older adult population at each older age stage is higher than that of female older adults.
3.2.3 Educational attainment of China’s older employed population

The difference in the educational status of the elderly population with different characteristics is one of the factors affecting the employment of the elderly. In recent years, the gender gap and age gap, as well as the urban-rural gap in the educational level of the elderly population, have been narrowing, which is greatly related to the benign development of education and the promotion of active aging in China after the founding of the country. Over time, the illiteracy rate of China’s older working population will gradually decline, and the gender, age, and urban-rural gaps in illiteracy rates will continue to narrow. However, the education level of China’s older employed population is still low, and most of the older people’s education level is only concentrated in junior high school or below.

As can be seen from Figure 5, according to the educational level distribution of China’s elderly employed population (60-70 years old) made by 2020 data, more than 85% of the elderly employed population have an educational level of junior high school or below, among which 18.9% of the elderly employed population have not attended school, 57.9% have received primary education, and 28.1% have received junior high school education. The most educated older employed people in China only stay at the elementary school level.
3.3 **Impact of Active Aging on Labor Supply**

Under active aging, health is particularly important for older people. A healthy physical condition not only prolongs life expectancy but also reduces disease and pain, enhances psychological satisfaction, and allows for greater participation in the labor force, wealth creation for family and society, and the realization of life values. Empirical studies of health influencing the labor supply behavior of the elderly have always occupied a more important position in the field of labor economics and health economics. Many scholars have explored the relationship between the health status of the elderly and labor supply decisions accordingly, mainly focusing on the effects of health on labor force participation, labor time, labor productivity and income. Existing studies have found that better health leads to higher labor force participation and increased labor supply time, and the positive correlation between them may be due to better health leading to more labor force supply, or it may be that more labor force supply leads to increased income followed by increased health status due to increased purchasable medical and health products, or there may be an intertwined effect between them.

In the above empirical evidence of theories related to active aging based on the human capital perspective, we also know that human capital is one of the important factors affecting economic growth. Human capital is a capability that coalesces in the labor force and is closely related to the labor supply. Therefore, when the population's age structure changes, there are different effects on economic growth due to the different stock of human capital. Under active aging, the capital stock per capita will increase on the one hand, and on the other hand, the savings rate of the older population will also increase.

4 **Conclusion**

When China enters an actively aging society, it inevitably affects the quantity and structure of the labor force. During active aging, the elderly labor force decreases and employment pressure is reduced, which promotes human capital investment in labor supply to a certain extent. Through research and analysis, the number of elderly employed people over 60 will have reached 71.23 million by 2020, an increase of 1992 million in 30 years. In terms of the gender structural characteristics of the labor supply of the elderly in China, in 2020, the employment rate of the elderly aged 60 was 80%
for males and 48% for females, and the employment rate of the elderly males was higher than that of females. In addition, more than 85% of China’s older employed population has an education level of junior high school or below, and 18.9% have not attended school. Active aging leads to a decrease in the labor supply of the elderly, a rise in the wage level, and an increase in the return on investment in human capital for labor supply, and this signal feedback is beneficial to promote labor supply in the whole society. With longer life expectancy, active aging of the population leads to a longer payback period of human capital, which is conducive to higher investment in human capital.

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References