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## How does health affect the labor supply of urban mid-aged and elderly workers in China? Empirical evidence from CHNS data

**Liqiong Zhang, Song Tian and Rong Chen**

### Abstract

This study analysis the impact of health condition on labor supply of urban middle-aged and elderly workers in China to provide the basis for the implementation of the retirement age and "Healthy China" policy. Labor supply model and labor participation model with the help of CHNS were used to this study. The annual working hours of unhealthy men and women will be reduced by 557 and 897 hours, and participant rate will decrease by 9.01% and 10.77%; Men and women working hours were reduced by 86 and 51 hours, and participant rate decline by 4.49% and 2.35% with age. The higher income and education level of male middle-aged and elderly workers, the higher the probability of withdrawing from the labor market. Gender differences in health is inevitable in the process of public policies formation, with the emphasis on aging problems for men and health issues for women.

**Keywords:** Health, middle-aged and elderly wokers, labor supply, gender differences

### Introduction

As an important factor of social and economic input, the labor supply is an important condition for the sustained growth of the economy, which determines the economic efficiency of a country directly. In recent years, the falling birth rate and increasing life expectancy accelerated the pace of China's population aging, which has been the major social problem in China. It is showed in the *Statistical Communique on National Economic and Social Development in 2017* that, by the end of 2017, there are 240 million people over 60 years old, accounting for 17.3% of the total population, and 158 million people over 65 years old, accounting for 11.4%. Compared with the sixth national census in 2010, the proportion of population over 60 years old increased by 4.04 percentage while the proportion of the people at the age of 65 and over increased by 2.53 percentage. The increase exceeded that of the year from 2000 to 2010. The question of whether the change of population structure can promote the development of Chinese economy has triggered a great controversy in all walks of life.

It is no doubt that aging population gives a heavier burden to social pension system, and actually how much burden social pension system bear mainly depends on the exact retirement age of elders. There is a saying goes that "An elder is the treasure heaven gives to the whole family". Middle-aged and elderly labors are trained with professional skills, rich working experience and extensive social relations, which all are the indispensable assets for the development of a country's economy and society. The urging issue for leaders is that whether these elder "burdens" can be converted into treasure or not. It is necessary for decision-makers to help those elderly labors who are willing to continue working, through which it is possible to ensure the labor forces needed for social development, reduce increasing public spending, and then maintain the validity of labor market, by the means of adjusting current policies, including retirement age, pension system, medical care and other relative ones.

Therefore, a further study on the labor supply of middle-aged workers, including their working hours and participation rate, is the premise of coping with social risks. The factor of health status is an inevitable issue in studying labor supply. It is undeniable that health condition as a part of human capitals<sup>[1]</sup> is closely related to labor supply of one society<sup>[2]</sup> that it mainly influences the performance of workers and their working skills for one job.

Among all labors, middle-aged and elderly labors particularly are more likely to be affected by health status. With aging, middle-aged and elderly labors' deteriorating physical condition is the most important reason for their withdrawal from the labor market, and leads them to retire accordingly [3]. It is found that labors with poor physical conditions inclined to retire early [4], and this finding are well-acknowledged by scholars in other countries. Riphahn [5] found that the probability of workers between the age of 40 and 59 in Germany withdrawing from the labor market has increased by 200% because of health issues. Jiménez-Martín and others [6] gave the finding that the probability that workers between the age of 50 to 60 in Spain willing to continue working will decline as health condition deteriorate. It is particular in the group of low-income manual workers that affected by some chronic diseases, middle-aged workers do reduce their working hours and participation rate, which caused a 45% reduction in income [7]. Although health condition is in a loose co-directional relationship with the participation rate of middle-aged and elderly labors [8], however factors like age, gender, income, educational background and policy are all playing their roles in the complex process of health status impacting the situation of labor supply. When physical status seriously affected the basic ability of a worker, one is confronted with the phenomenon of a meager income and awkward opportunities to work. At this time, once there is a sustainable economic source for living consumption, the worker will leave the labor market and thus the labor supply will be cut off [9]. Otherwise, there might be precautionary labor supply pattern caused by the uncertainty of health status, which means the impact of health issues on workers will conversely increase the labor supply workers provide as their insurance to cope with the future risks of health issues [10]. For instance, the patterns of labor supply of middle-aged and elderly workers are very different in urban and rural area of China. Due to the practice effect of the rural pension system and the medical insurance system is not very satisfactory, in terms of elders in rural areas, they choose to work ceaselessly for livelihoods a lot, even in poor health [11]. Unlike rural elders, it is very common that urban elders living with a better pension system retired earlier that most female workers choose to retire at the age of 45 and males are more common to retire at the age of 50 and 55 [12]. In all, most studies in recent years pay attention to the elders in developed countries. Due to the limited data, there are few studies focusing on elders' labor supply in China, among which most focus on the influence of health status on labor supply of elders in rural areas instead of those seniors in urban regions. This paper focused on the urban workers in retirement age and made an in-depth analysis on the impact of health condition on labor supply of urban elders by applying the cross-section survey data of CHNS in 2000, 2004, 2009 and 2011. It mainly concentrated on the influence of health issues on labor supply of senior worker in urban China, which aims to provide evidence and data for the implementation of "Healthy China" policy and for the adjustment of a scientific, reasonable and operational policy about retirement age by studying the participation rate and working hours of urban worker, in order to alleviate the impact of the accelerated aging on Chinese society.

## Methods

The analysis of labor supply model will be more convincing when given the promise of data reliability and this paper applies both the labor supply model and the labor participation model with the reliable data in this essay.

### Labor Supply Model

In labor supply models, the explained variable is working hour. When workers choose to leave labor market, that means zero labor supply hour. Working hour is the limited explained variable, and also is typical one of left-ended variables. Therefore, it is reasonable that Tobit structure model is applied to estimate working hour in this paper. The model is designed as follows:

$$\begin{aligned} LH^* &= \beta_0 + \beta_1 \text{age} + \beta_2 (\text{age} - c)^2 + \beta_3 \text{health} + Z'\gamma + u \quad (1) \\ LH &= LH^*, \text{ if } LH^* > 0; \text{ otherwise, } LH = 0 \end{aligned}$$

$LH$  refers to potential labor hour, which is the latent variable. When it can be observed as  $LH=LH^*$ , it's greater than 0. Otherwise,  $LH$  is 0. The word "age" means the age of workers, and  $C$  is a positive number. Considering the "accelerated depreciation" phenomenon of healthy stock, the potential labor hour is a quadratic non-linear function of age. "Health" refers to the health variable and  $Z'$  is a vector representing other factors influencing labor supply. " $U$ " is a random disturbance of model.

### Labor Participation Model

In labor participation models, the explained variable is labor participation decision that if workers decided to continue their work instead of leaving labor market, then it can be observed as one, otherwise it's 0. The model designed is as follows:

$$\text{Prob}(LP = 1) = \Phi(\alpha_0 + \alpha_1 \text{age} + \alpha_2 (\text{age} - c)^2 + \alpha_3 \text{health} + Z'\gamma + \varepsilon) \quad (2)$$

" $LP=1$ " means leaving labor market and " $\varepsilon$ " is the random disturbance of this model.

### Solution to Endogenous Issues

It has been illustrated in many studies that health factors can cause endogenous problems. Health problems reduce labor supply hours, which, meanwhile, is also possible to give rise to health problems. Therefore, it is necessary to take into consideration of endogenous problems of health variable. In other words, endogenous tests is the prerequisites of Tobit model regression and Probit model regression. If there are endogenous problems, then it is better to estimate with instrumental variable method. The simplified model is shown below.

$$\text{health} = \pi_0 + \pi_1 \text{instrument} + \pi_2 \text{age} + z'\theta + v \quad (3)$$

"Instrument" means hypothetically there is at least one exogenous variable, which is irrelevant with the random disturbances of model (1) and model (2). Meanwhile, instrument and health variable are closely related. If the existing endogenous problems in health variables is already confirmed, then the estimation method of IV-Tobit should be applied in labor supply models and the IV-Probit method in labor participation models.

### Data Source

Data in this paper all come from the five-phase survey data of CHNS in years of 200, 2004, 2006, 2009 and 2011. Although there are the same samples in different years, all samples and data selected here can still be considered as random considering the quantity of sample data. This paper mainly analyzed the middle-aged elders in urban regions, therefore only those lived in cities were kept as samples. Studies found that it is more common that labors in cities retired earlier, that most female labors retired at the age of 45 and males mainly retired between the age of 50 and 55. Labors over 70 years old are unwilling to work<sup>[13]</sup>. Thus, the author kept the male samples between the age of 55 and 70 and the female sample between the age of 45 and 70, for the information of their health conditions and labor supply hours is still complete.

### Variable Selection

#### Labor Supply Hours and Labor Participation Decision

This paper takes the annual labor supply hours of these samples as measure to test labor hours, and "Labor" here indicates works with payment, excluding works like housework. The average daily working hour, the average weekly working hour and the average annual working hour are all given in the data here, then the labor supply hours of individuals can be shown in this equation.  $LH = hours \times weeks \times months \times 4$ . The labor participation decision here is dummy variable, which equals to 1 when labors choose to stay in labor market, otherwise it is 0.

#### Health Measurement

Learned from previous studies of Yao Xianguo and Lei Xiaoyan<sup>[14]</sup>, this paper applies the body mass index (BMI) as proxy variable to health measurement. The criteria for Chinese is that  $BMI < 18.5$  referring lean,  $BMI > 23.9$  meaning overweight, and BMI between 18.5-23.9 meaning normal. Therefore, it can be said that it is considered unhealthy when BMI is below 18.5 or over 23.9, and the value of BMI should be 1. BMI between 18.5 and 23.9 is considered healthy, so that it equals to 0. Given to the endogenous problems of health variables, the author chooses weight and height as the instrumental variables of BMI.

#### Other Variables

The author also investigated other variables, including age, education background and personal net income, except for the variables above. Age refers to the actual age of every individual, and the education background is the years an individual receives formal education. Individual's annual net income is the proxy variable for personal income. Units of measure are uniformly converted into thousand RMB. With the consideration of the impact of different regions and research date on labor supply, this paper applies a series of regional virtual variables and time virtual variables for measurement, and also uses the variables of weight and height considering the possibility that there may exist endogenous problems in health variables. All the data and the definition of variables have been fully explained in table 1.

### Results

#### Descriptive Analysis

The average age of male samples is 61.62 years old, and the females' is 56.48 years old. In terms of labor participation rate, the rate of men is 6% higher than that of women. Given

to the greater gap between age groups of female samples, the labor participation rate of women is probably overestimated, and, in terms of the working hour, the average working hour of men is 114-hour higher than that of women. In addition, men are better in terms of health condition, and the average years of education of men is 1.71 years longer than those of women.

According to the age groups in the table 2 above, the average labor participation rates and average labor hours of both men and women are decreasing during aging. The average *LP* rate and *LH* of both men over 60 years old and women over 55 years old are lower than the overall average level, which shows that the retirement age system impacts greatly on the labor supply hours of individuals. The health levels of both men and women are all lower than the overall average level with obvious changes. The unhealthy rate of females between the age of 50 and 55 (excluding the age of 55) is 51%, and the rate of women between 55 and 60 (excluding 60 years old) years old is 57%, which is 6 percentage higher than that of the previous group of women. The unhealthy ratio of men between the age of 55 and 60 (excluding 60 years old) is 51%, and that of men between the age of 60 and 65 increases to 54%. While, health conditions of males between the age of 60 and 70 remain stable.

#### Statistical results

It is necessary to test the endogenous problems of health variables before model estimation in order to choose a suitable estimation method. According to certain theories in statistics, whether there is endogenous problem in health variables depends on the dependency of error terms in equation (1) and equation (2). Specifically, if we set  $u = \delta v + e$ , among which the  $e$  and  $v$  are irrelevant and they both contain zero-means. Then the necessary and sufficient condition of the irrelevance is  $\delta = 0$ . The simplest way is to do t-test by taking  $v$  as explained variable into the labor supply model and labor participation model. If the condition  $\delta = 0$  can be rejected at a small level of significance, then  $v$  and  $u$  are related, indicating the health variable is endogenous. Otherwise, endogenous problem of health does not exist. With that hypothesis, the author conducted an endogenous test. It turns out that, in labor supply models, the  $\delta$  of men is -319.30 and the  $\delta$  of women equals to 111.71. The value of both groups are significant at the confidence level of 5%, so the author rejected the previous hypothesis of  $\delta = 0$  and ensured that there are endogenous problems in health variables. Thus, the estimation method of IV-Tobit is applied. In labor participation models, the author did the same test and then applied the method of IV-Tobit, because of the existing endogenous problems of health variable in both males' and females' groups. Weight and height are set as instrumental variables, concluding that the results are unstable with height as instrumental variable. So this paper chose to take weight as instrumental variable and applied a AR test, with which it turns out that the instrumental test of weight is stronger than that of height, because the strong and stable instrumental variables are required when applied to test the endogenous problems, otherwise, weak IV will make even larger deviation and larger difference in test level. The regression results are shown respectively in table 3 and table 4 as follows.

### Labor Supply Model Estimation

Table 3 gives the estimated coefficients and marginal effects of the labor supply model. In terms of marginal effect, there are significant gender differences in the impact of health, age and income variables on working hours. In the control of other variables unchanging, (1) the working hours of unhealthy male workers is less than healthy worker by about 557 hours, while unhealthy female workers provide 897-hour less than those healthy people. (2) With each one-year increase in age, the average annual working hour of male workers decreases by about 86 hours, and that of female workers decreases by about 51 hours. (3) By every 1000-yuan increase in income, the annual working hour of male workers increases by an average of 10 hours, while that of women increases by an average of 8 hours. In addition, it should be noticed that the marginal effect of age passed the significance test of 1%, while the marginal effect of health variable of males just passed the test of 5%.

### Labor Participation Model Estimation

Table 4 gives the estimated coefficients and marginal effects of the labor participation model. In terms of the marginal effect, (1) the probability of unhealthy male workers remaining in labor market is lower than those healthy workers by 9.01%, and that of unhealthy female workers is lower by 10.77% than those healthy women. (2) With the increase of age, the possibility of middle-aged and elderly male workers who choose to remaining in labor market decreases by 4.49%, and that of female worker decreases by 2.35%. (3) By every 1000-yuan increase in income, the possibility of male workers remaining in labor market increases by 0.85%, and that of women increases by 0.73%.

### Discussion

The above statistics give the influence of health status, which is affected by age, education background and income, of middle-aged and elder worker in urban China on labor supply. The major finding will enrich the studies about the influence of health issues on labor supply in China. The major findings can be concluded as the follows.

Firstly, the statutory retirement age is strongly binding. According to the data obtained, the average labor participation rate and working hour of men and women respectively over 60 years and 55 years old are lower than the overall average. This is basically the same with the age of 60-year-old male and 55-year-old female retired in the 1970s China. But at the same time, statutory retirement age nowadays is no longer applicable to current society. Although statistical results show that men between 55 and 60 years old and women between 50 and 55 years old are in poorer health status than before, but health fluctuations are common phenomenon due to various factors before retirement. The fluctuations at this time does not mean that the senior workers are with serious health problems, which can also be proved from the rebound of workers' health conditions after retirement. On the contrary, in recent decades, with the improvement of living standards and the medical treatments, the life span of Chinese people has increased to 75 years due to the improvement of average health condition. The statutory retirement age policy that cannot keep pace with the times not only wastes social resources and human resources, but also brings economic and mental stress to workers and damage their health

conditions, which will only give negative impact<sup>[15]</sup>. Thus, the adjustment of retirement age is indispensable.

Secondly, health status does have an impact on the labor supply of urban middle-aged and elder workers, and has obvious gender difference. Zhang Chuanchuan concluded that workers especially in urban areas are more likely to reduce their part of labor supply because of deteriorating health status<sup>[16]</sup>. This paper also provided evidence for this conclusion that poor health status will increase the probability of middle-aged and elder workers withdrawing from the labor market and reduce the time of labor supply, and there is a strong difference between genders. Compared with healthy men, the probability of unhealthy ones remaining in labor market is 9.01% lower than that of healthy men, and the probability of unhealthy women are 10.77% lower than that of healthy ones. It is clear that the labor participation rate of women is so much lower than that of men due to health issues, which can be said that women are more sensitive to health status than men. This can also be reflected in the reduction of labor supply. Health has a greater impact on females' labor supply, and the increase in stock of female human resources will increase the labor supply. Gender differences are more pronounced on health than on age. Similar to health factors, the increase in age also inhibits the rate and time of labor participation that the working hour of urban men and women will respectively decrease by about 86 and 51 hours along with the ages of urban middle-aged and elder workers increase by one year. Meanwhile males are more sensitive to aging that for the increase of age by one year, the probability of male middle-aged workers remaining in labor market will fall by 4.49%, and women will fall by 2.35%. Ageing has a greater impact on the labor supply of men. Compared with women, the reduction of male's working hour is more likely due to aging.

Therefore, though health status and aging give negative effect on labor supply, the phenomenon of women and men are very different that the stock of health of middle-aged male workers is decreasing with aging, and the decline of physical functions forces them to change their labor supply or cut off their labor participation. Meanwhile, for middle-aged female workers, the declined physical function and the risk of illness caused by aging affect the reduction of labor supply. This is also very common in America that the annual working hour of women between 45 to 64 years old is decreased by up to 51% because of illness, such as arthritis<sup>[17]</sup>. This difference between men and women is classically described by western scholars as "it is riskier for men to die, but it is more likely for women to get sick"<sup>[18]</sup>. This conclusion also provides basis for the adjustment of China's retirement age policy. Given the significant gender differences in health conditions, the implementation of men and women at the same age still needs further consideration. Last of all, besides, income and years of education will also affect labor supply. It has been confirmed by previous studies that wage and other financial income like pension, estates and other wealth all give negative effect on the rate of labor participation which can be promoted by a better income expectations<sup>[19]</sup>. The findings support these ideas. Under conditions of keeping other factors unchanged, income growth can encourage workers to provide more working hours and increase the probability of middle-aged and elder workers remaining in labor market, especially for men. For every 1,000 yuan increase in income, the

probability that male middle-aged workers will remain in the labor market will increase by 0.85%, while women will increase by 0.73%. In addition, regarding the impact of years of education on labor supply, some studies suggested that the shorter workers been educated, the earlier they stop working. While the probability of people with longer years of education are more likely to keep working at a full time job [20]. However, according to the statistics been collected in this paper, the influence of education background on labor supply is not quite prominent that it only works in middle-aged male workers and increases their probability of leaving the labor market under the control of other conditions. Therefore, during adjusting the retirement age, it is necessary to rely on a new pension system with old-age pension and wage incentive effects.

**Conclusion**

Based on the pool data of health survey in the years of 2000, 2004, 2006, 2009, and 2011, this paper made an in-depth analysis on the impact of health status on the labor supply

and the labor participation decision male workers between the age of 55 and 70 and female workers between 45 and 70 years old applying IV-Tobit and IV-Probit estimation. The major findings can be concluded as follows. Health status has a significant codirectional effect on the labor supply of urban middle-aged workers that physical weakness reduced the working hour of labors, and lowered the participation rate. Labor supply of female workers particularly is more sensitive to health status. Secondly, age is also one factor affecting labor supply that labor supply and participation rate both declined because of aging, and men are more sensitive to age instead of health status compared with women. In addition, individuals with higher income are more willingly to stay working, meanwhile, middle-aged male workers with higher educational background are more likely to leave labor market. In all, it could be concluded that the decrease of labor supply of male workers is mainly because of age, while that of female workers are more because of health issues.

**Table 1:** Definition of Variables and Descriptive Analysis

Name of Variables	Definition	Gender	Average Value	Minimum	Maximum	Standard Deviation
LP	Labor Participation	M	0.30	0	1	0.46
		F	0.24	0	1	0.42
LH	Labor Hour	M	567.18	0	5040	970.55
		F	453.29	0	5376	906.19
Age	Age (Years old)	M	61.62	55	70	4.34
		F	56.48	45	70	6.89
Health	Health Condition	M	0.52	0	1	0.50
		F	0.55	0	1	0.50
Education	Years of Education	M	9.57	0	20	5.19
		F	7.86	0	21	5.13
Income	Personal Income (Thousands of RMB)	M	15.25	0	276.01	18.01
		F	10.66	0	432.01	16.07
Height	Height(Meter)	M	1.67	1.40	1.86	0.06
		F	1.56	1.0	1.80	0.63
Weight	Weight (Kg)	M	66.60	34.20	166.70	11.73
		F	59.25	24.70	140.50	9.99
Province	Regional Variable	M	36.17	11	55	11.12
		F	36.54	11	55	10.89
Year	Time Variable(Years)	M	2007.46	2000	2011	3.66
		F	2007.05	2000	2011	3.76

**Table 2:** The Labor Supply and Health Condition of Different Age Groups

Age Groups		[45-50]	[50-55]	[55-60]	[60-65]	[65-70]
Male	Labor participation rate	--	--	0.52	0.19	0.07
	Labor hour	--	--	1003.51	357.99	130.87
	Health condition	--	--	0.51	0.54	0.53
Female	Labor participation rate	0.51	0.31	0.16	0.07	0.04
	Labor hour	1022.14	582.67	279.29	139.69	50.93
	Health condition	0.52	0.51	0.57	0.59	0.58

**Table 3:** Regression Results of Labor Supply Model

	Male Group		Female Group	
	IV-Tobit	Marginal effects	IV-Tobit	Marginal effects
Age	-313.5645*** (20.3532)	-86.0076*** (5.5698)	-211.7036*** (9.5298)	-50.5311*** (2.2350)
(Age-C) <sup>2</sup>	2.6572 (3.8639)	-0.7288 (1.0606)	1.8522 (1.2253)	0.4421 (0.2930)
Health	-557.1302*** (229.5771)	-152.8152** (62.9367)	-897.3789*** (180.314)	-214.1935*** (42.9814)
Education	-10.4497 (12.6479)	-2.8663 (3.4684)	8.6478 (10.8391)	2.0641 (2.5876)
Income	35.3978*** (3.2395)	9.7093*** (0.8825)	31.8234*** (2.7850)	7.5959*** (0.6604)
Cons	-30288.34 (35296.59)		8131.5620 (27755.10)	
Year	Yes		Yes	
Province	Yes		Yes	
Likelihood	-6469.3832		-10655.6310	
AR Test	600.89***		1516.80***	

**Note:** In male groups, c=60; otherwise c=55. The values in parentheses are stable standard deviation. \*p<0.1, \*\*p<0.5, \*\*\*p<0.01.

**Table 4:** The Regression Results of Labor Participation Model

	Male Group		Female Group	
	IV-Probit	Marginal effects	IV-Probit	Marginal effects
Age	-0.1776*** (0.0108)	-0.0460*** (0.0022)	-0.0993*** (0.0042)	-0.0239*** (0.0008)
(Age-C) <sup>2</sup>	0.0041** (0.0021)	0.0011** (0.0005)	0.0019*** (0.0006)	0.0004*** (0.0001)
Health	-0.3477*** (0.1213)	-0.0901*** (0.0315)	-0.4478*** (0.0830)	-0.1077*** (0.0200)
Education	-0.0178** (0.0071)	-0.0046** (0.0018)	-0.0077 (0.0053)	-0.0018 (0.0013)
Income	0.0328*** (0.0026)	0.0085*** (0.0006)	0.0303*** (0.0020)	0.0073*** (0.0005)
Cons	10.3535 (19.0788)		19.2181 (13.2972)	
Year	Yes		Yes	
Province	Yes		Yes	
Likelihood	-2176.0838		-4126.8154	
Wald Test	6.21 [0.0127]		16.53 [0.0000]	

**Note:** c=60 in male groups, while in female groups, c=55. Values in parentheses are stable standard deviation that \*p<0.1, \*\*p<0.5, \*\*\*p<0.01; numbers in square brackets are the P values of Wald exogenous chi-square test.

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