Doctoral Dissertation

An empirical analysis of the effect on China's household labor supply, income and expenditure

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Introduction

This paper describes the factors affecting Chinese families from three aspects: national policies, non-labor income and obesity, which quantitatively analyses and solves the identification problems encountered in the research.

For the first aspect, China's national policy has always been known for its efficiency, especially the policies formulated by the central government. Before the implementation of relevant policies, some provinces will be selected as pilot areas, which is convenient for economic research. Since the beginning of the 21st century, the Chinese government has implemented a series of policies on medical treatment, education, and childbirth to regulate the economic and social development. This article analyzes the impact of the reform of China's endowment insurance system on family consumption. The aim of the reform of the endowment insurance system is to smoothly and effectively solve the problems left over from the era of planned economy. Today, endowment insurance is not only the responsibility of enterprises, but also becomes the responsibility of the society. The focus of this paper is whether people will join the endowment insurance system through this reform, in other words, whether the reform is effective and whether the reform will have an impact on family consumption.

For the second aspect, the impact of non-labor income on labor supply is an important and meaningful research topic. An important source of non-labor income is the national welfare policy, which aims to ensure the minimum living needs of the poor However, the government allowances reduce labor supply. Due to the complexity of the welfare system and social situation, there has been no accurate conclusion on this in econometric

researches and families can obtain non-labor income from the welfare system. Based on the characteristics of China's minimum living standard allowance, this paper quantitatively analyzes the impact of non-labor income on labor supply.

Last but not least, it has been confirmed in many previous studies (e.g., Jens Agerstrom and Dan-Olof Rooth 2011; KS O'Brien and JD Latner 2012) that obesity can bring disadvantages to people in employment. Based on the previous studies, this paper further analyzes the impact of obesity on people's income. The number and proportion of overweight and obese people in China are increasing year by year. China has become the country with the largest number of obese people. Apart from physical diseases, obesity also brings adverse effects on social connections, marriage, and employment.

Therefore, it is important to analyze the labor supply and expenditure of Chinese families in Chinese social development nowadays. According to the seventh national census, China's current population is 1.41 billion, of which more than 260 million are over the age of 60 and 264 million are under the age of 14. In 2020, the population growth rate is 1.45‰, and the population growth rate shows a downward trend year by year.[1] China is facing a difficult population problem, that is, China has entered a society with aging population and too Few Children. At the same time, China is also undergoing the transformation of industrial structure. The demographic dividend has provided strong support for China's rapid development in the past 20 years. The consequent problem is that the decline of population growth rate will lead to the reduction of labor force gradually. Thus, the Chinese government is trying to transform China's production mode from labor-intensive to high-

[1] Data source: the seventh census report of the National Bureau of statistics of China

tech.

Endowment insurance, non-labor income and obesity are three important aspects for families. Which also have a significant effect on labor supply and consumption. So this paper analyzes the cause effect on family labor supply and consumption in the hope that it would provide some help for policymaking.

Acknowledgment

Just as a child cannot be raised without the care of his parents, I am able to complete my studies because of the help of my parents, professors, and friends. I am very grateful to them for caring on me in Japan.

First of all, I want to thank my parents. I come from an ordinary family in Fujian Province, China. My parents are ordinary office workers. They took out most of their meager salary to support my study abroad. Compared with China, prices in Japan are expensive. But my parents still try their best to make me have a comfortable life in Japan. Because of their selfless dedication, I can complete my studies.

The professors at Yokohama National University（YNU）have been very helpful. Since I entered YNU in 2017, I have received the help of many professors. Professor Omori, Professor Akiyama, Professor Kobayashi and Professor Liu not only gave me a lot of academic guidance, but also gave me great support in my life. When I finished my doctoral thesis, Professor Omori was correcting my thesis late at night. Without the help of my professors, I would never have finished my studies.

During the three-year study of doctor, the support of Takayama International Education Foundation enabled me to complete my doctoral thesis with peace of mind. There are many friends who have given me a lot of help. I can't list all the names here. I sincerely thank them and wish them all the best.

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1 Introduction

In 2000, the Chinese government prepared to reform social endowment insurance and change the enterprise-based endowment insurance system of China into social compulsory endowment insurance. In December 2000, the State Council of China announced the "Notice on Improving the Social Insurance System". According to this notice, social endowment insurance premium for each individual would be transferred to an individual exclusive account and social insurance fund, abuse of the social insurance fund would be prohibited, and the insurance premium in the personal account could only be applied to the retirement allowance. If an insured person dies, the amount remaining in his or her individual account could be inherited. The Chinese government first carried out the pilot program of social insurance reform in Liaoning province.

1.1Main Policy of the Social Endowment Insurance

The main policies of the reform are as follows:

(1) Employees of all enterprises (including foreign and private companies) are obligated to participate in the social endowment insurance. The insurance premium is 28% of the basic wages. Employees pay 8% of their basic wages while the companies will pay 20% of their basic wages.

(2) The local government and the central government will provide subsidies to urge the unemployed and freelancers to participate in the social endowment insurance.

(3) The local government, the central government, and welfare institutions will provide subsidies to urge the rural residents to participate in the social endowment insurance.

The main purpose of these policies is to create a social endowment insurance system that could cover all Chinese people.

1.2 Types of the Social Endowment Insurance

There are mainly three kinds of social endowment insurance after the reform of the social endowment insurance.

(1) Staff basic endowment insurance: All corporate staff members must have staff basic endowment insurance. The insurance premium comprises 8% of the basic wage paid by employees and 20% of it paid by companies, which is 28% of the basic wage in total. The individual's burden goes to the individual exclusive account while the company's burden goes to the social insurance fund. After the staffs retire, they will receive the pension every month.

$$\text{Pension} = \text{basic pension} + \text{individual account pension}$$

The basic pension is paid from the social insurance fund and is determined by the social average wage in the retirement year and the weighted average wage of the individual and the number of years of payment.

$$\text{Basic pension} = 0.5(\text{social average wage} + \text{the weighted average wage of}$$

the individual) ×years of payment×1%

The individual account pension is paid from the individual exclusive account. If the individual exclusive account runs out and the insured person is alive, the social insurance fund will pay it instead. If an insured person dies before the individual exclusive account runs out, the amount left in the individual exclusive account could be inherited.

Individual account pension = the amount in individual exclusive account ÷ calculation month

The calculation month vary with the age of retirement. (e.g., if the retirement age is 60 years old, the calculation month will be 139; if the retirement age is 65 years, calculation month will be 101; and if the retirement age is 70 years old, calculation month will be 56).

(2) Urban residents' social endowment insurance: The unemployed and self-employed and freelancers who live in towns can participate in urban residents' social endowment insurance. The insurance premium is divided into 12 levels from 100 *yuan* to 2000 *yuan* every year. The urban residents choose their level and pay the insurance premium. The amount of payment is deposited in the individual exclusive account. The central government will grant the same number of subsidies to insured persons who live in the central and western areas of China and grant the subsidies as 50% of the premiums to those who live in the eastern region. Local governments will grant subsidies of more than 30 *yuan* annually according to their finances to insured persons. All subsidiaries shall be transferred to the individual exclusive account along with personal premiums. When the insured person exceeds 60 years old, they begin to receive the pension.

Pension=basic pension + individual account pension

The local government determines the basic pension according to finance and socioeconomic conditions. The local government provides the basic allowance. The amount in the individual exclusive account when an insured person is 60 years old divides 139 is the amount of individual account pension every month. If the individual exclusive account runs out and the insured person is alive, the local government will pay instead. If an insured person dies before the individual exclusive account runs out, the amount left in the individual exclusive account could be inherited.

(3) New rural area residents' endowment insurance: Rural area residents could participate in the new rural area resident's endowment insurance. The insurance premium is divided into five levels, i.e. 100 yuan, 200 yuan, 300 yuan, 400 yuan, and 500 *yuan* each year. Individuals choose from them and pay the insurance premium. All the amount of payment is deposited in the individual exclusive account. The central government will grant the same number of subsidies to insured persons who live in the central and western areas of China and grant the subsidies as 50% of the premiums to those who live in the eastern region. Local governments will grant subsidies of more than 30 *yuan* annually according to their finances to insured persons. The Rural Committee also actively grants subsidies according to the situation. When the insured person exceeds 60 years old, they begin to receive the pension. The method of calculating the pension and payment is the same as the urban resident's social endowment insurance.

1.3 The Result of the Reform

In 2005, five years after the practice of Liaoning province, the central government launched the national reform of social endowment insurance.

The local government strictly supervises the social endowment insurance fund and grants subsidies actively according to the situation.

The central government and the local governments have issued various policies to complete the social endowment insurance system, hence the management and operation of the social endowment insurance fund have become more strict.

There are mainly two changes in the reform of the social endowment insurance in 2005. One is that social endowment insurance has become compulsory and normalized while the other is that the central government and local governments have started assistance subsidies in social endowment insurance.

(Figure 1.1)

Figure 1.1 indicates the changing trend of the proportion of endowment insurance in the working population after the reform of China's endowment insurance system. As for China that has the world's largest population, the importance of social endowment insurance could not be emphasized more. But to what extent does the reform of the social endowment insurance affect the welfare of the people? And how does social endowment insurance affect the distribution, consumption, and savings of families? Hence this study aims to confirm the effect and influence of the reform of the China social endowment insurance in 2005.

2 Literature

Modigliani and Brumberg (1954) proposed the life cycle theory in which people live in two periods, i.e., the young saving period and old consumption

period. Everyone acts to maximize the utility in the two periods. There is an alternative relationship between social endowment insurance and savings and compulsory social endowment insurance affects household savings.

Y Zhigang and S Zheng (2000) developed the OLG model and proved that the social endowment insurance system affects consumption. They also proposed that the decrease in the labor force in the future would affect consumption and savings.

Y Zhigang (2001) analyzed the Chinese macroeconomy and stated it was difficult to guarantee life after retirement due to the low interest rate of the current social insurance account. This also lowered the willingness to participate in social endowment insurance.

Liu Jun (2004) analyzed the proportion of China's social insurance (including medical insurance) to income through an econometric model and thought the optimum ratio is 15%. Qiu Chang Rong, Zhang Li Guang, and Guo Yan (2004) rated China's social endowment insurance system through the metric model and found that there is a serious problem in the management of the social endowment insurance fund and the distribution between generations before the reform. Tackling this problem is one of the fundamental reasons for reform.

Peng Haoran and Shen Shuguang (2007) analyzed the relationship between income and social endowment insurance. The theoretical model indicates that there is a strong positive correlation between the endowment social insurance and the income when a person has a low income, and the correlation becomes low when the income becomes high.

Ning Yu and Qinghua Shi (2010) have proven through OLG models that

there is an alternative relationship between social endowment insurance and the ownership of the house and land. It has been proven that the willingness of those who have a house or land to participate in the social endowment insurance is lower than the person without the ownership.

Liu Ao (2011) explained the cause and history of the China social endowment insurance reform and the scale and the present state of insurance in detail. He also pointed out the problem and the direction of reform at each stage.

Previous research has not analyzed the DID model when confirming the effect of China's social insurance reform. Therefore, this paper examines the effect of the reform of the social endowment insurance, especially the change of the insurance premium before and after reform. In addition, based on the data of the stable period of social insurance, the fixed effect model is applied to verify the relationship between household income and social endowment insurance premium.

3 Regression method

The basic regression equation of this paper is：

$$\text{Insurance}_{it} = \alpha + \beta X_{jt} + \delta_1 Z_{it} + \delta_2 M_{jt} + T_t + F_j + \varepsilon_{ijt}$$

Insurance is the average monthly premium paid by each family. X denotes a dummy variable of whether the province has implemented the endowment insurance reform. Z and M represent the observable control variables of families and provinces respectively. T represents the effect of time. F represents the effect of the region. T and F denote unobservant variables. Subscripts i, j, and t represent the samples family, province, and

time respectively.

3.1 Identification Problems

Similar to previous policy evaluation studies, the main identification problem in this paper lies in the omitted variables, which are the effect of time and that of the region. In different years, the situation of economic development is different. After China joined the WTO in 2001, China's economy has a huge growth rate every year. The data of 2004 and 2005 applied in this paper are during the period of rapid economic growth in China. China's economic growth has been driving the growth of China's per capita income. China's per capita income in 2005 was significantly higher than that in 2004. If we only compare the regional differences before and after the time when the policy was implemented, the impact of time will be eliminated. Hence the final impact includes the policy effect and the time effect, which we are concerned about.

(Figure 1.2)

Another essential omitted variable is regional impact. The experimental group applied in this paper is Liaoning province located in northeast China, which has focused on the development of the heavy industry since the 1950s. Compared with other provinces, Liaoning province has perfect infrastructure and a large population. However, since the beginning of the 21st century, China's economic center has moved to the south. The phenomenon of population loss has gradually appeared in Liaoning province. The control group of this paper is Hubei, Wuhan, Beijing, and other 8 provinces. The characteristics of economic development in each province are different. If we only compare the provinces that implemented the policy and those that did not implement the policy, we could not eliminate the differences caused by

the self-development factors of different provinces.

3.2 Identification Strategy

The best way to tackle the bias caused by omitted time effect and regional effect is Difference-In-Difference (DID) model. Comparing the impact before and after the implementation of the policy in the same province could eliminate the impact of the regional effect. Comparing the impact of different provinces during the same period could eliminate the impact of the time effect.

Moreover, several special national conditions of China make it convenient to conduct DID model analysis:

(1) The rationality of the selection of the experimental area of the policy. To better observe the effect of the policy, the Chinese government will not select some special provinces. Although Liaoning province has its characteristics, its overall economic development and social structure are similar to most other provinces. Its factors like per capita income and per capita consumption are different from other provinces, but they conform to a common trend. This will be explained in detail later in this paper. In this paper, Liaoning province is chosen as the experimental group, which will not lead to errors in the results.

(2) China's registered residence system restricts population mobility. China has a strict registered residence system. If residents want to change the location of their registered permanent residence, they usually need to have a fixed house in the place where they move in. The endowment insurance for urban residents needs to be handled by the applicant at the place where the registered permanent residence is located. It is difficult for Chinese residents to change their registered permanent residence. When the welfare of the

policy is limited and the registration of household relocation is inconvenient, people will not choose to migrate due to the policy. Therefore, compared with the country with a more liberal registered residence system, the DID model could be applied to avoid errors in the result of population movement in China.

(3) There is a short interval between the publication and implementation of China's policies, which could effectively prevent the samples from responding in advance. People's early response makes it difficult to accurately measure the effect of the policy.

4 Data

The data applied in this study are from the Chinese Household Survey (UHS) conducted by the China National Statistics Bureau, which covers 9 provinces in China. The sample of the survey is the family living in China's urban area. The survey includes household income (e.g. wages and investment income), consumption, savings, taxes, and insurance premium, family members' occupations, and household property.

UHS is held every year. One family is surveyed for three consecutive years and one-third of samples are changed every year. Since two-thirds of the samples in two consecutive years will be panel data, this study will focus on two-thirds of these samples and avoid the bias inherent in a home.

4.1 Selection of Observations

There are three types of social endowment insurance in China, but the types in which people could participate depend on the family register and occupation. The samples are divided by occupation to measure the effect of the basic staff endowment insurance and the urban resident's social

endowment insurance. However, there are no samples of rural residents in UHS.

The insurance premium of the staff basic endowment insurance depends on the wage. Using staff family samples could show whether the reform made the social endowment insurance system normalization and compulsion.

The insurance premium of the urban resident's social endowment insurance is decided by the individual, using the unemployed, self-employed person, and freelance family data the effect of the assistance and subsidies could be understood.

The data in 2004, 2005, 2008, and 2009 were used. In 2000, the Liaoning province took the first, and since 2005, China all provinces started the reform of the social endowment insurance. Using 2004 and 2005 data, we could see the effect of the reform of social endowment insurance. In addition, the scope of the social endowment insurance almost covered all adult people after three years in 2008. Social endowment insurance has stabilized. Using the data in 2008 and 2009, we could see the relationship between household income and social endowment insurance premium.

The number of samples in 2004 and 2005 is 32811, among which 8394 are unemployed, self-employed, or freelance families. In this home, some people participate in the urban resident's social endowment. There is 24308 staff family. Some people participate in the staff basic endowment insurance in this home.

The number of samples in 2008 and 2009 is 18166, among which 9419 families were continuously surveyed in 2008 and 2009. The number of staff

families is 5739, and the number of unemployed, self-employed, or freelance families is 3218.

4.2 Common Trends

DID model could be applied when the experimental group and conditional group have a common trend. We take the average insurance premium from 2002 to 2009 to check the common trends between the experimental group and the conditional group.

(Figure 1.3)

Figure 1.3 shows the average insurance premium in the experimental group and conditional group, implying the common trends and the difference in the year of reform.

Apart from the insurance premium, we also check that whether there are common trends in family's incoming, consumption, saving, and investment.

(Figure 1.4)

In Figure 1.4, the experimental group and the condition group present an obvious common trend.

4 Empirical equations

We applied the data in 2004 and 2005 to make DID model for testing the effect of the reform of social endowment insurance and used the data in 2008 and 2009 to check the relationship between household income and social endowment insurance premium.

4.1 The effect of the reform

Herein, we analyze the effects of policy using the data between 2004 and 2005. The DID model is made by using the difference of time and the difference of the execution region. The empirical equation is expressed as:

$$\text{Insurance}_{it} = \alpha + \beta(T_t \times D_j) + \delta_1 Z_{it} + \delta_2 M_{jt} + \gamma_1 T_t + \gamma_2 D_j + \varepsilon_{ijt}$$

Insurance_{it} denotes the amount of social endowment insurance premium paid by the family i at the year t. T is a year dummy variable.

$$T = \begin{cases} 1 & 2004\text{（before the reform）} \\ 0 & 2005\text{（after the reform）} \end{cases}$$

D denotes a local dummy variable. Since the Liaoning province had taken the reform in 2000, the reform in 2005 Liaoning province became a control group.

$$D = \begin{cases} 1 & \text{others province（experimental group）} \\ 0 & \text{Liaoning province（conditional group）} \end{cases}$$

M_{it} and Z_{it} are control variables (family size, income, and price) when family i in time t. β represents the effect of the reform of social endowment insurance. The results of the regression are shown in the table below.

(Table 1.1)

As indicated in Table 1.1, the amount of social endowment insurance premium increases by about 128 *yuan* after the reform. In general, the reform promoted social endowment insurance and the insurance premium

increased.

The type of social endowment insurance which individuals participate in is different, which depends on the occupation of the individual. By limiting the samples, the normalization and compulsion after the reform could be tested and the effect of subsidies could be checked.

(Table 1.2)

(Table 1.3)

The samples applied in Table 1.2 are the staff families, some of whom participate in the staff basic endowment insurance. The effect shown in Table 1.2 represents the normalization and compulsion of the social endowment insurance.

The samples applied in Table 1.3 are the unemployed, self-employed, and freelance families. In other words, some families participate in the urban resident's social endowment insurance. The effect shown in Table 1.3 indicates the effect of government policy and subsidies.

Social endowment insurance reform not only affects the social endowment insurance premium, household expenditure but also changes.

$$Y_{it} = \lambda + \lambda_1 T_t + \lambda_2 D_j + \gamma(T_t \cdot D_j) + \phi_1 M_{jt} + \phi_2 Z_{it} + e_{ijt}$$

Y_{it} denotes the family's expenditure content consumption, savings, savings insurance, bonds, and investment in the family at the time t.

(Table 1.4)

In Table 1.4, it is the only investment that has a significant influence from the reform of the social endowment insurance. After the reform of the social endowment insurance, people's demand for safe property increased, which exerted a negative effect on the investment. Meanwhile, it does not have a significant impact on consumption, hence the reform of the social endowment insurance could not lower the home utility level. The main reason lies in that the percentage of the social endowment insurance premium to the total income of the family is quite low.

4.2 Relationship between Income and Premiums

More than 60% of adult people participate in social endowment insurance, hence social endowment insurance has reached a stable period. The estimation equation of the social allowance for the aged and the retirement rate of the household income is expressed as:

$$\text{Insurance}_{it} = \alpha + \beta Ln(Income_{it}) + \delta X_{it} + u_i + \varepsilon_{it}$$

Insurance_{it} denotes the amount of social endowment insurance premium that family I pay at the time t. Income_{it} is the income of the family I at the time t. X_{it} represents the control variables when the family I at the time t. u is a family fixed effect. The fixed effect model is applied to estimate the β which represents the relationship between household income and social endowment insurance premium.

$$\Delta\text{Insurance}_i = \gamma + \beta \Delta Ln(Income_i) + \delta \Delta X_i + e_i$$

$\Delta\text{Insurance}_i$ is the difference of social endowment insurance premium between 2008 and 2009. ΔIncome_i denotes the difference in income between 2008 and 2009. ΔX_i represents the difference of control variables between 2008 and 2009.

(Table 1.5)

Table 1.5 comprises the data from the unemployed, self-employed, and freelance families because premiums of the staff basic endowment insurance are determined by wages, and the unemployed, self-employed, and freelance families could freely select the level of premiums. In this section, only the data of the unemployed, self-employed, and freelance families are applied. As shown in Figure 1.5, when the income increases by one percentage, the social endowment insurance premium increase by about 1.29 *yuan*.

The upper limit of the insurance premium of the urban resident's social endowment is 2000 yuan, hence there is an upper limit for pension after retirement. The security of the life that the wealthy layer gets from the social endowment insurance system is limited. The relationship between the social endowment insurance premium and income depends on income. According to income, the samples is divided into four groups and the regression function is as follows:

$$\Delta Insurance_i = \alpha + \sum \beta_j \Delta(income_i \times D_j) + \lambda \Delta X_i + e_i$$

D_j is a quadrature dummy variable. Income is divided into four levels using quadrilateral dummy variables. In other words, the family belonging to the first rank is the poorest while the family belonging to the fourth rank is the wealthiest.

$$D_j = \begin{cases} 1 & \text{The family belong to the j quadrature} \\ 0 & \text{Others} \end{cases}$$

$Income_i \times D_j$ is a quadrature dummy variable multiply income. Herein, four parameters from β1 to β4 are the effects of household income of each wealthy class on social endowment insurance premium. Families belonging to zone D1 are the richest while those belonging to zone D4 are the poorest.

(Table 1.6)

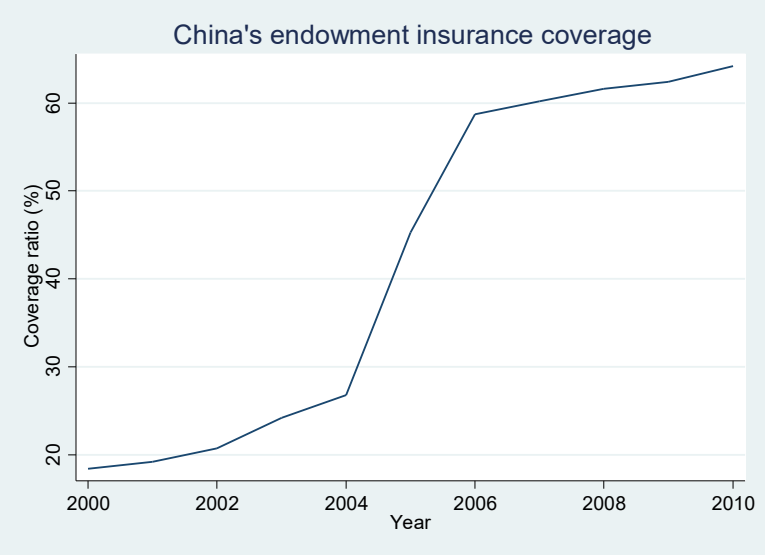
As indicated in Table 6, the effect of family income on social endowment insurance premium varies with income. Even if the income of a poor family increases, it does not have a significant impact on the social endowment insurance premium because consumption increases first when the income of poor households increases. As for middle-income households, when income increases, social endowment insurance premium increases significantly. However, the impact of this income tends to be lower in higher-income families.

5 Conclusions

Through the analysis using the DID model, it was proven that the effect of the reform of the endowment insurance was remarkable. After the reform, an increase in social endowment insurance premium occurred. Insurance premiums have increased, but consumption and savings have not declined. In addition, it was verified that people's living security after retirement has been guaranteed and no evidence could prove that the social endowment insurance adds to families' burden.

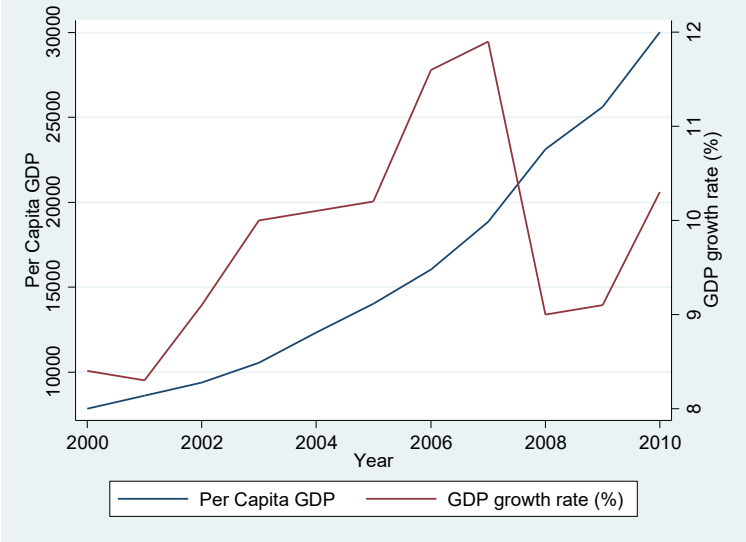
Furthermore, the effect of social insurance was found to differ according to individual income. It was proven that for middle-income and high-income families, the social endowment insurance premium is closely related to family income.

Figure 1.1 China's endowment insurance coverage



Data source: Insurance yearbook of
China Banking and Insurance Regulatory Commission

Figure 1.2 China per capita GDP and GDP growth rate



Data source: Statistical Yearbook of
the National Bureau of statistics of China

Figure 1.3 Per capita endowment insurance premium of experimental group and control group

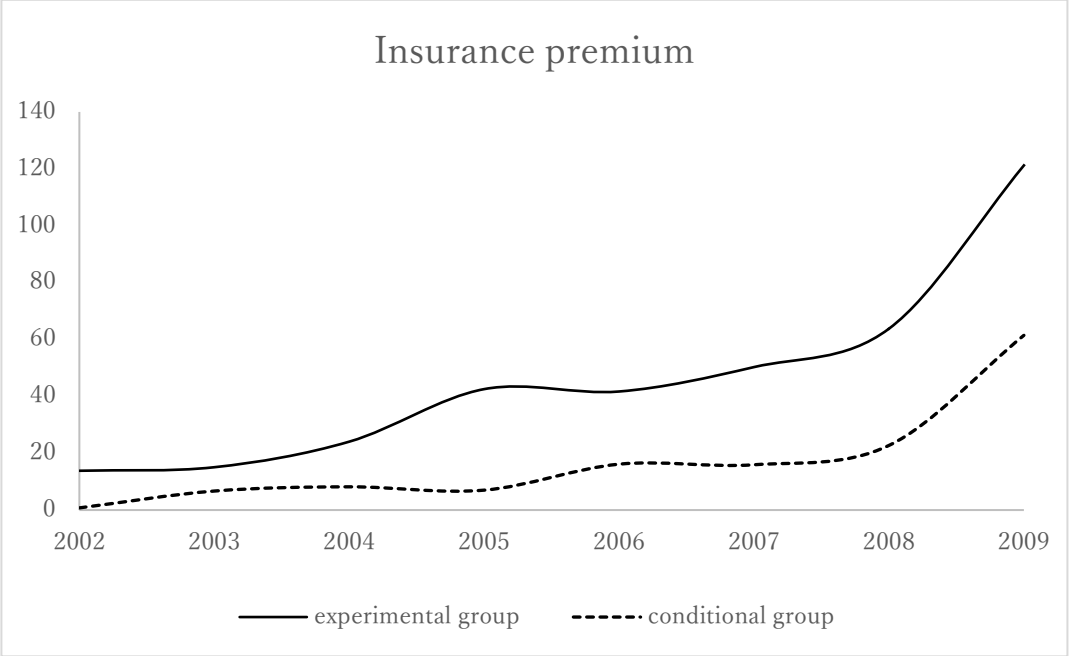
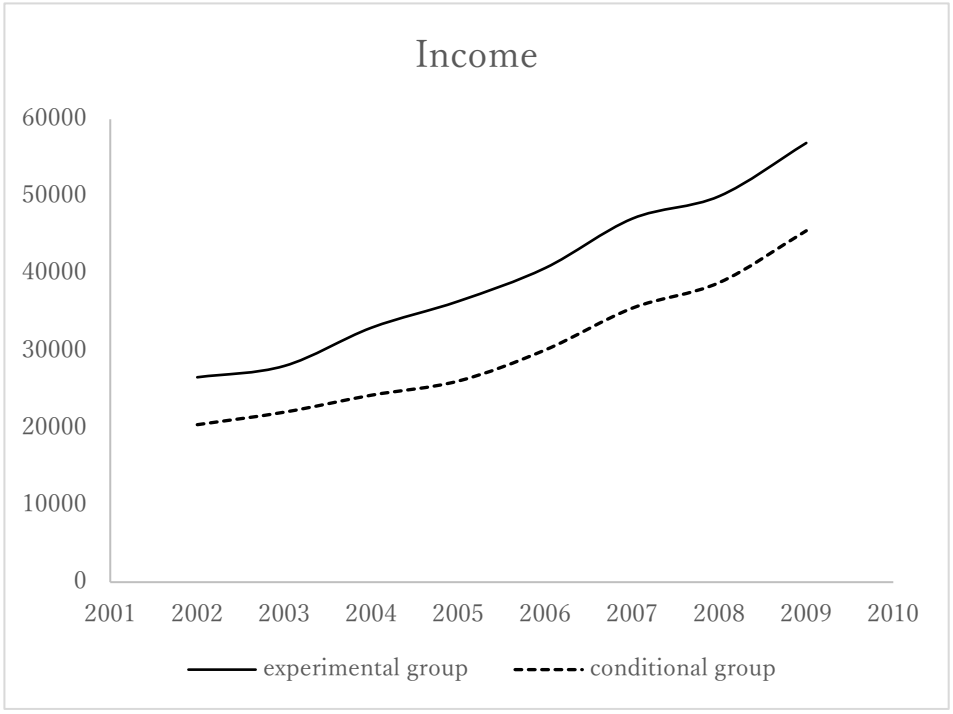
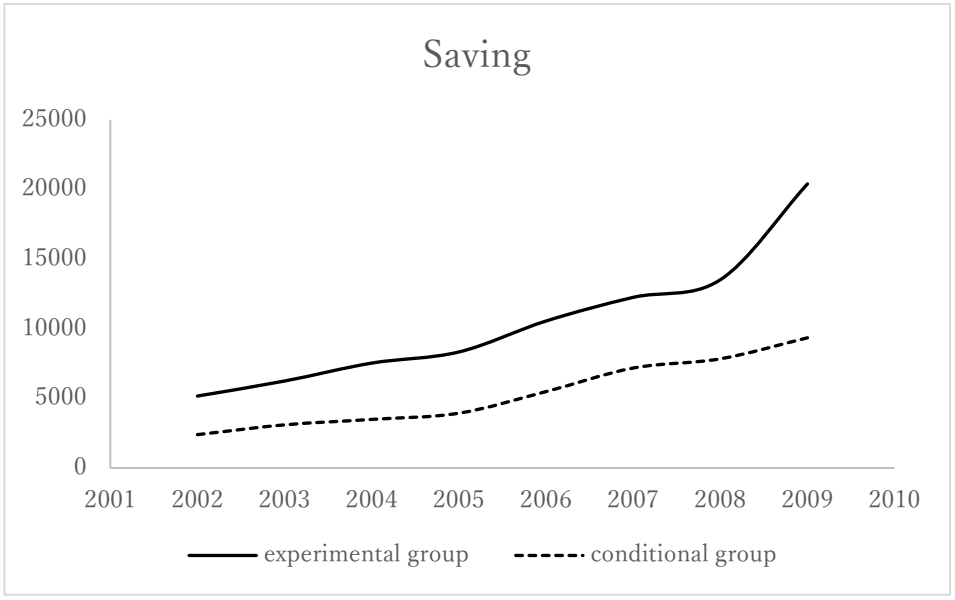
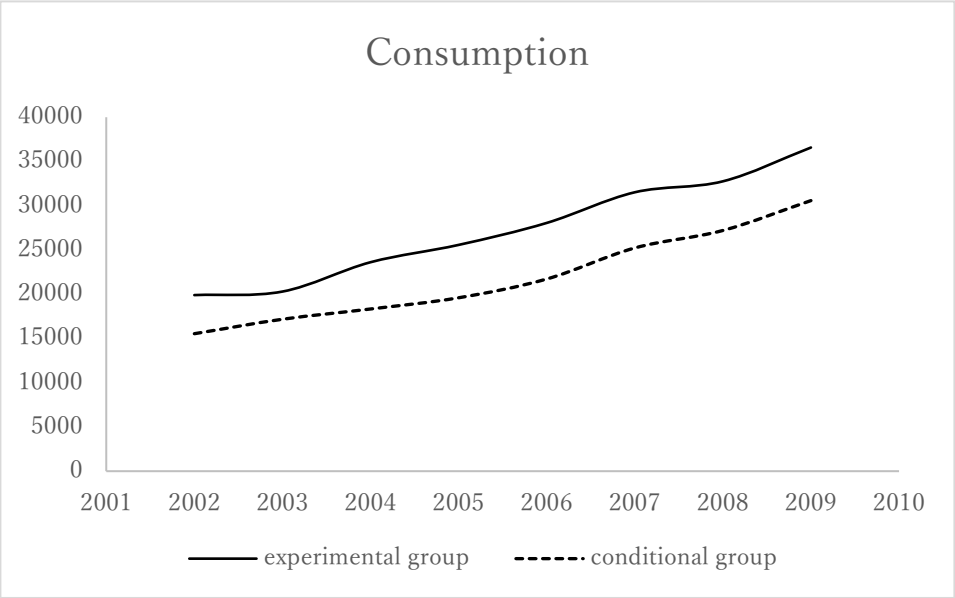


Figure 1.4 Common trends in household income and expenditure






Consumption
40000
35000
30000
25000
20000
15000
10000
5000
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
experimental group
conditional group

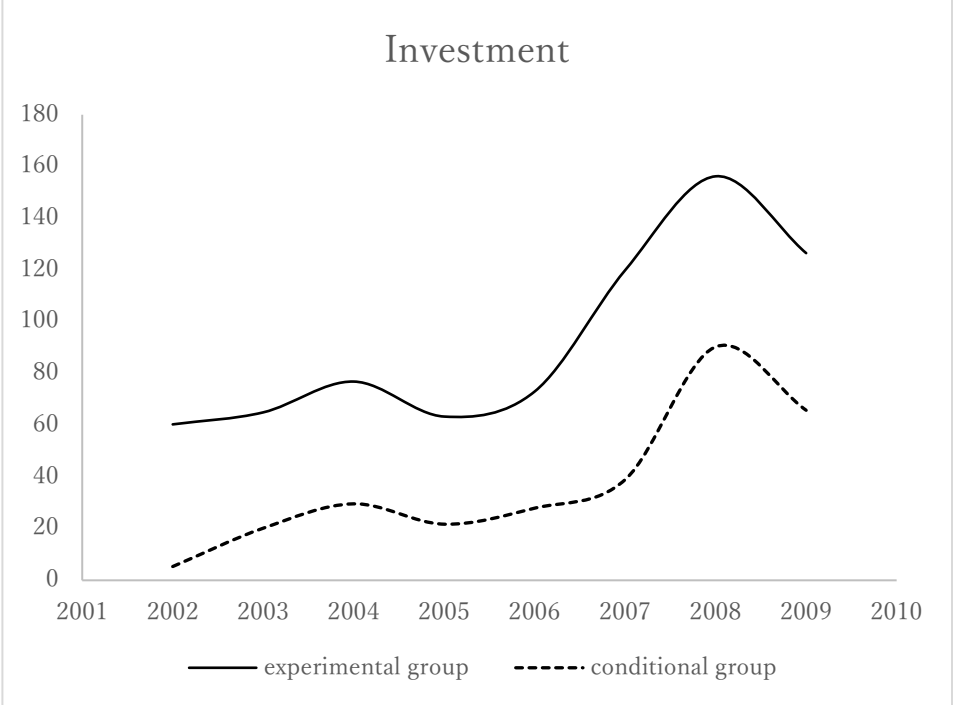

Investment
180
160
140
120
100
80
60
40
20
0
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
experimental group
conditional group

Table 1.1 Regression result of DID model

Outcome var.	Insurance	S. Err	|t|	P>|t|
Before				
Condition	792.897			
Experiment	896.432			
Diff (T-C)	103.535	32.219	3.21	0.001***
After				
Condition	774.907			
Experiment	1006.96			
Diff (T-C)	232.056	31.466	7.37	0.000***
Diff-in-Diff	128.521	45.035	2.85	0.004***

*** p<0.01 ** p<0.05 * p<0.1

Table 1.2 Regression result of DID mode with non-self-employed families

Outcome var.	Insurance	S. Err	|t|	P>|t|
Before				
Condition	1058.950			
Experiment	1083.744			
Diff (T-C)	24.794	40.245	0.62	0.538
After				
Condition	1061.302			
Experiment	1243.284			
Diff (T-C)	181.982	40.874	4.45	0.000***
Diff-in-Diff	157.188	57.362	2.74	0.006***

*** p<0.01 ** p<0.05 * p<0.1

Table 1.3 Regression result of DID mode with self-employed families

Outcome var.	Insurance	S. Err	|t|	P>|t|
Before				
Condition	714.378			
Experiment	758.338			
Diff (T-C)	43.960	53.938	0.82	0.415
After				
Condition	677.386			
Experiment	900.820			
Diff (T-C)	223.434	40.874	4.45	0.000***
Diff-in-Diff	179.474	74.100	2.42	0.015**

*** p<0.01 ** p<0.05 * p<0.1

Table 1.4 Regression result of DID mode in different dependent variables

VARIABLES	(1) consumption	(2) saving	(3) saving_insurance	(4) bond	(5) investment
T	252.2	-296.9	-10.99	-40.85	172.0**
	(430.0)	(372.8)	(56.30)	(109.7)	(81.97)
D	355.6	574.3**	111.3**	-10.34	4.425
	(333.7)	(289.3)	(43.69)	(85.11)	(63.61)
DID	-156.5	-329.5	-72.31	-41.82	-203.2**
	(464.6)	(402.8)	(60.83)	(118.5)	(88.57)
income	0.553***	0.406***	0.0159***	0.0160***	0.00503***
	(0.00335)	(0.00291)	(0.000439)	(0.000855)	(0.000639)
family_member	1,131***	-954.7***	-25.45*	-55.91**	-12.96
	(102.7)	(89.06)	(13.45)	(26.20)	(19.58)
Constant	1,681***	-3,603***	-136.6**	-174.4	-54.99
	(427.6)	(370.7)	(55.98)	(109.1)	(81.51)
Observations	32,810	32,810	32,810	32,810	32,810
R-squared	0.468	0.379	0.040	0.011	0.002

*** p<0.01 ** p<0.05 * p<0.1

Table 1.5 The relationship between income and endowment insurance premium

Insurance	coef.	Std. Err	|t|	P>|t|
Ln(Income)	1.28512	0.210	6.11	0.000
Investment	-0.00008	0.005	0.02	0.998
Saving	-0.00418	0.002	1.88	0.060
Family size	-0.00231	0.234	0.01	0.999
Price	-0.01249	0.007	1.57	0.161
_cons	1030.553	82.245	12.53	0.000
Num of samples	4244			
Regional fixed effect	YES			

Table 1.6 The relationship between income and endowment insurance premium in families of different income classes

Insurance	coef.	Std. Err	|t|	P>|t|
β1	0.00615	0.007	0.81	0.415
β2	0.01105	0.004	2.24	0.025
β3	0.01684	0.004	4.80	0.000
β4	0.01211	0.002	5.55	0.000
Num of samples	4244			
Regional fixed effect	YES			

Chapter 2: The Impact of Non-labor Income on Labor Supply——The Evidence of China's Minimum Living Standard Allowance

1 Introduction

Do more allowances mean less labor supply? Low-income families will get non-labor income through welfare policies, which will cause them to provide less labor supply. It is an essential topic to prove to what extent the non-labor income affects the labor supply of the family. Due to the selection bias and the complex welfare policies of various countries, it is difficult to confirm the impact of non-labor income on labor supply.

China's Minimum Living Standard Allowance system (MLSA) stipulates that families whose income is below the baseline could receive a fixed allowance. Thus, the final total household income is the sum of the original income and allowances rather than a fixed income. Low-income families are more likely to receive the allowances.

The welfare policy causes the nonconvex of the budget constraint line and the discontinuity of the labor supply, hence the families who receive allowances and those who do not could not be directly compared. Figure 2.1 presents some consumption sets that will not be selected below the nonconvex budget constraint line.

(Figure 2.1)

Families that could receive allowances from the welfare system will have

some characteristics. Income is closely related to labor supply, education, work experience and is affected by some unobservable factors like a family situation and labor willingness (Adam Thomas and Isabel Sawhill, 2005). These factors also affect whether families could receive allowances. As for the selection of the families that receive allowances, the low-income families are chosen. When these families are applied as sample for analysis, the unobservable error terms that affect whether families could get allowances also affect their labor supply. Such a selection bias will lead to a wrong regression result.

Moreover, a region may have multiple welfare systems meanwhile, which makes it impossible to confirm whether the reduction of labor supply is due to cash benefits or other benefits (Robert Moffitt, 2002).

This paper chooses China's special welfare policies and adopts a Heckman model to investigate the impact of non-labor income obtained from welfare policy on family labor supply. In the theoretical model of this paper, this paper regards non-labor income as an endogenous variable. Non-labor income obtained from welfare policy is determined by family labor supply, wages, and government policies, which are independent variables in the model. In previous studies (e.g. Pierre-Andre Chiappori 1992; Jianli Wang and Pu Gong, 2012), non-labor income was regarded as an exogenous variable unrelated to other variables.

With the progress of society, developed countries like the United States, Japan, and Europe established social security systems in the 20th century. The social security system, which helps the weak and cares for the poor, is a symbol of human civilization to some extent. Meanwhile, the social security system has played an essential role in maintaining social stability.

The social security system could be roughly divided into two types, the first being social insurance. People who pay insurance premiums at ordinary times could receive insurance money to maintain their basic living conditions when an insurance accident occurs. Social insurance guarantees the livelihood of most people. Measures must be taken to deal with predictable risks. More importantly, when some unpredictable risks occur (e.g., illness and work injury), people's basic living standards are guaranteed.

The second type of social security is social relief. When it is difficult for people to maintain a basic living or social insurance could not fully guarantee the basic living after a risk occurs, social relief is the bottom line to guarantee people's right to survive. Social relief is a system of caring for the weak after human society has developed to reach a certain stage.

There are many types of social assistance. Apart from directly giving money to the poor to maintain their basic lives, there are jobs for the unemployed and free medical treatment for the poor.[2] This gives the poor a chance to survive and creates opportunities for the "sluggards". The poor could receive social assistance without hard work. With the improvement of the welfare system, there are more and more such people.

Giving more money to the poor causes them to provide less labor under the same conditions. Some people who do not need to receive allowances will also deliberately reduce their labor supply and income to obtain benefits. This makes the welfare system, which was designed to provide the poor with a minimum living guarantee, become a problem that adds to a heavy burden to society.

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[2] Aid to Families with Dependent Children (AFDC), Earned Income Tax Credit (EITC) and so on project in the United States, benefits such as family care, tax breaks, employment guidance are provided in addition to cash benefits.

The research on the influence of non-labor income on labor supply has always been a hot research topic, e.g., whether the impact of non-labor income on labor supply exists and to what extent it affects labor supply, and how much labor supply will be reduced when the allowance is increased. However, it is difficult to accurately analyze the results due to some social factors.

In inland provinces of China, the amount of the minimum living standard allowance could meet the basic household expenditure. Nationally, income from the minimum living standard allowance accounts for more than 20% of the total household expenditure.[3] For poor families, the minimum living standard allowance is indeed a good source of income. This paper applies some of China's unique national conditions to tackle the problem in this topic.

2 Main difficulties in previous studies

Two social problems have puzzled scholars who study this issue. First, the impact of population mobility. The movement of populations could be affected by welfare policies (James Midgley, 2004). Situations in different regions in the same country differ. The allowance and welfare policies formulated by the two regions are different. If one area increases the level of welfare relief, recipients of welfare in other areas will be motivated to flow to areas with a high level of welfare relief. If welfare recipients flood into areas where the level of welfare relief is improved, social pressure will be increased. These welfare recipients will enter the labor market while entering high-welfare areas to receive high-welfare relief.

(Figure 2.2)

[3] Data source: statistical yearbook of China Provincial Bureau of Statistics

Welfare recipients reduce labor supply due to two factors, the first being the effect of non-labor income on labor supply that is concerned about. The benefits received by welfare recipients increase, hence recipients actively reduce their labor supply. Another factor is that new laborers attracted by high welfare have entered the labor market. The total labor supply curve will change when the number of laborers in the market changes. The new equilibrium wage will affect all laborers in this labor market. Figure 2.2 presents that when new laborers enter the labor market, the total labor supply curve shifts to the right and the new equilibrium point corresponds to a lower wage level than before. For every worker, lower market wage causes laborers to reduce their labor supply.

However, the impact of population mobility could not be clearly distinguished due to welfare improvement from the effect of non-labor income on labor supply that is concerned about. Population movement has caused a severe problem for the analysis of the effect of non-labor income on labor supply, which exists in many previous studies.[4]

The second problem that makes it difficult to analyze the topic lies in the complex welfare system. In some areas with well-developed welfare systems, their welfare variety is diverse. The same welfare recipients could enjoy multiple welfare policies. Apart from direct cash subsidies, social relief has many preferential policies for the poor in terms of medical care, education, and employment. When the system changes, multiple policies tend to be adjusted. In face of many welfare systems, families could choose the right welfare according to their needs. (Richard Blundell, Monica Costa Dias, Costas Meghir, and Jonathan M. Shaw, 2013) Despite that such a system

[4] Thomas Aronsson and James R. Walker (1997) and David Neumark and Elizabeth Powers (1998) compared the changes of labor supply of the sample before and after the rise of relief funds. These studies did not exclude the impact of population mobility. This makes the regression results may be biased.

guarantees the basic living standards of the poor, it makes it difficult to measure the effect of non-labor income on the labor supply of certain social welfare.

3 China’s minimum living standard allowance system

In 1997, the Chinese Central Government decided to establish the Minimum Living Standard Allowance system (MLSA). In the same year, China promulgated a law to implement the system. At the end of 1999, most provinces and cities in China established MLSA.

Local governments set minimum living standard baseline based on local conditions. If the total income of a certain family is below the minimum living standard baseline, the local government will allocate allowances to each adult in the family every month. The payment amount of the allowances is determined by the local government according to local conditions.

MLSA is characterized by the following aspects:

First, families whose monthly income is below the minimum standard baseline could only receive allowances in the area of household registration. Due to China's household registration system, it is difficult to change the location of household registration. Such a system could avoid the problems caused by the movement of low-income groups due to different welfare policies in different regions.

Second, provide allowances in cash. Before 2015, households could only receive cash allowances and there were no preferential policies in terms of employment, medical and education. A single cash allowance could effectively eliminate the influence of other welfare policies on the

presumption.

Third, recipients in the same area receive the same amount of allowances. The local government decides the minimum living standard and allowances based on local conditions. For recipients living in the same place, if their income is below the minimum living standard baseline, they could receive the same amount of the allowance. The amount received is not related to income.

Fourth, each province could adjust the amount of the allowance according to its actual conditions. Since the establishment of the system, each province has adjusted the number of allowances. Due to the restriction of household registration, the recipients after adjusting the allowances are the same as the people who could receive the allowances.

Fifth, when each province adjusts the number of allowances, the time when the policy is announced is close (usually 1 to 2 months) to the time when it is implemented. Therefore, the increase in the minimum living relief could be regarded as an accidental random event for labor suppliers. Since the people who receive the minimum living relief could not respond in advance, the accuracy of the response to the change in the amount of the minimum living allowance when the change in labor supply time is analyzed is guaranteed.

Sixth, MLSA does not specify the maximum time for receiving it. Different from the welfare system of other countries, even a healthy and normal worker could receive allowances if his family income is below the baseline. MLSA does not stipulate the maximum number of years to receive the allowance.

Seventh, the minimum living standard baseline varies from year to year. The government will determine the baseline every year according to local conditions (e.g., price index, and average wage), the number of people who apply for subsidies, and their family conditions. Families whose total income is below the baseline could receive the allowance. The baseline set by local governments differs every year.

Eighth, there is a certain degree of supervision over family income. To prevent families from falsely reporting their income to receive the allowances, local governments should monitor the income. This includes requiring employers to issue wage certificates and relevant certificates of the neighborhood committee and conducting an actual household investigation. This effectively avoids the high-income families who receive the allowance.

As of 2017, there were 7.415 million households in urban areas in China, and 12.61 million people could receive the minimum living allowance. The allowance per capita could receive 540.6 *yuan* per month. In rural areas, there were 22.493 million households, and 40.452 million people could receive the minimum living allowance. Each person could receive 358.3 yuan per month on average. This indicates that there is still a huge population in China who receive minimum living allowances. It is of huge significance to study the welfare dependence phenomenon caused by the minimum living standard allowance.[5]

4 Literature

As early as the 1970s, academia began to explore the impact of non-labor income on labor supply through the theoretical model. Orley Ashenfelter and

[5] The data comes from the 2019 statistical yearbook of China National Bureau of statistics.

James Heckman (1974) established a theoretical model. Families obtain utility through consumption and leisure and earn income by sacrificing leisure time to work. By maximizing the household utility function under a budget constraint, it was concluded that the increase of non-labor income would reduce the labor supply, which was demonstrated with a regression model. In this model, non-labor income was regarded as an exogenous variable not affected by family consumption and labor supply. The specific welfare system is not involved in many theoretical models, hence the source of non-labor income is unknown. It is also applied to regard non-labor income as an exogenous variable in some later theoretical models.

Pierre-Andre Chiappori (1992) developed a collective model different from traditional economics. In the traditional economic model, each family is regarded as an entirety, has a utility function, and obtains the optimal labor supply after maximizing its utility function. In the collective model developed by Pierre-Andre Chiappori, the family consists of members, each of whom has its utility function. As an altruistic "agent", the family will reasonably distribute non-labor income among family members. When the non-labor income and tax change, all members of the family will adjust their own consumption set.

Afterward, in some theoretical analyses, the static model was changed into a dynamic model. A family long-term utility function was established to obtain a discounted total utility through consumption in different periods and leisure during different periods. In the future, families will probably receive a certain amount of non-labor income. When maximizing their utility, households will first allocate reasonable non-labor income during each period through savings and loans. Afterward, the family will provide the labor supply during each period according to the non-labor income allocated. The increase of non-labor income will also affect the consumption and labor

supply during each period (W. Henry Chiu and Louis Eeckhoudt 2010). If the future non-labor income is not a definite value but a random variable, the variance and expectation of non-labor income will affect the labor supply and consumption of families during each period (Jianli Wang and Pu Gong 2012). A considerable number of theoretical studies have explained that non-labor income will affect labor supply. In their model, non-labor income is not determined by the internal factors of the model but an exogenous variable independent of other variables.

Similarly, many empirical analyses focus on the impact of non-labor income on labor supply. James Heckman (1979) proposed that attention should be paid to selection bias when econometric models are applied to analyze the wage. When studying the impact of various variables on wages, we could only observe the wages of people who are working but do not know the wages that people who are unwilling to work could get if they work. Only when the actual wage is higher than what people expect they should get at least will they start working. The actual wage depends on many factors like the sample's education, experience, and physical condition. A sample is willing to work means that he will get a relatively high salary. Using only working people as samples for regression analysis will cause selection bias because the sample willing to work has some particularity, which makes them have a high wage compared with the sample not working. Such a selection bias will cause an overestimation of the impact on wages because the samples applied in this paper tend to have some factors that make their wages higher.

Prior to the above analyses, the research on the impact of non-labor income on labor supply ignored the problem of selection biases. John F. Cogan (1980) considered women's motivation to enter the labor market when analyzing the labor supply and wages of married women. Whether married

women enter the labor market will be affected by many factors like family. Similarly, David E. Sahn and Harold Alderman (1988) also applied the Heckman model when analyzing the labor market, considering that the people will participate in the labor market under certain preconditions.

To confirm the impact of non-labor income on labor supply, James Allison and Peter Boulter (1983) experimented with rats on the effects of wages and non-labor income on labor. Rats could get a certain amount of water (similar to wages) by treading on water tankers, and they could get it without labor (similar to non-labor income). By adjusting the "wage" and "non-labor income" of rats, the author observed the time of rats stepping on the water wheel every day (similar to labor supply). Through this experiment, the obvious backward bending of the labor supply curve and the negative impact of non-labor income on labor supply is observed. These papers mainly focus on the impact of some factors like salary, education, race, age and gender on labor supply and still regard non-labor income as an exogenous variable.

James Heckman (1990) and Christopher Winship and Robert D. Mare (1992) pointed out that there are selection biases not only in the study of whether to enter the labor market but also in many problems faced by selection. For example, there is a phenomenon of selection bias in the study of the school entrance, punishment of criminals, choice of occupation, and other related problems.

In the 1990s, the welfare system of various countries developed rapidly. Poor families could get various benefits from various welfare programs, including cash benefits, i.e. non-labor income. The impact of welfare on labor supply and the impact of non-labor income obtained through welfare projects on labor supply have gradually become the main research objects.

At the beginning of the analysis of the welfare system, many scholars did not pay attention to the non-labor income brought by the welfare system and did not consider the selection bias in the regression equation. David M. Blau and Philip K. Robins (1986) applied the Logit model when analyzing labor's Employment Opportunities Pilot Projects (EOPP) and confirmed that EOPP will affect the labor supply of families and women are more likely to be affected.

Robert Moffitt and Barbara Wolfe (1990) analyzed the impact of the Medicaid program (AFDC) system in the United States on the probability of employment participation. Wei Yin Hu (1999) analyzed the impact of Temporary Assistance for Need Families (TANF), food stamps, and the earned income tax credit on family labor supply. This paper points out that different families will choose different benefits. Meanwhile, it makes a distinction between families who choose different welfare and analyzes it.

Bruce D. Meyer and Dan T. Rosenbaum (2001) and Bruce D. Meyer (2002) pointed out that low-income families are more likely to receive such benefits when analyzing the impact of the Earned Income Tax Credit (EITC) on employment and family labor supply in the United States. If whether families receive welfare or not is directly compared, selection bias will occur.

In the follow-up research, scholars paid more attention to the impact of non-labor income and tax changes on labor supply in welfare projects and selection bias. Lennart Flood, Jorgen Hansen, and Roger Wahlberg (2004) and Nada Eissa, Henrik Jacobsen Kleven, and Claus Thustup Kreiner (2004) analyzed the impact of tax relief on labor supply under different tax systems. These two papers pointed out that families who receive benefits are different from those who do not. The Heckman model was applied to tackle the selection bias. In the United States at that time, there were many welfare

programs. Apart from the preferential tax system, many welfare projects like life relief, medical assistance, and employment guidance could also be selected by families. In such a multi-welfare system, it is difficult to analyze the impact of specific welfare.

In face of such a society with a complex welfare system, many scholars began to apply the impact of welfare policy changes to prove the impact of welfare and non-labor income on labor supply. Thomas Aronsson and James R. Walker (1997) applied the fixed effect model to analyze the changes in family labor supply when the tax welfare policy changes. David Neumark and Elizabeth Powers (1998) applied DID model to analyze the impact of changes in non-labor income brought by welfare policy on family labor supply by comparing the areas where the policy had not changed. Maria Laura Alzua (2010) also applied DID model to analyze the impact of three different policies on labor supply in Latin America: Mexico's Progresa, Nicaragua's Red de Protección Social (RPS) and Honduras' Programa de Asignación Familiar (PRAF). The paper proposes that the welfare system exerts no significant impact on the overall labor supply in a region, but the family substantially reduces the labor supply after people receive the subsidy.

Using a fixed effect model to analyze non-labor income often faces a serious problem. The government formulates welfare policies so that families could enjoy welfare when they meet certain conditions. In the model where households obtain utility through consumption and leisure, the budget constraint line becomes nonconvex, which will cause some consumption sets to be not selected when families maximize their utility. When the amount of relief changes, the optimal solution will jump. i.e. with the increase of non-labor income, labor supply time is not continuous. Labor supply is no differentiability when the allowance changes, hence the fixed effect model could not be applied to measure the change of labor supply.

The level of welfare will affect population mobility. The reasons for changing welfare policies in a region tend to be related to the labor market. As described in section 2, population mobility will affect changes in the labor market. It is difficult to distinguish between the impact of changes in the labor market and that of allowances. The conclusion drawn through the fixed effect model and the DID model is a mixed effect. The mobility of the population and the non-randomness of policy will make the fixed effect model and DID model unable to accurately calculate the impact on labor supply. Francesco agostinelli, Emilio Borghesan, and Giuseppe Sorrenti (2020) also pointed out the limitations of using DID model.

This paper applies the Heckman model to analyze the impact of MLSA on labor supply for the first time. China's welfare system is different from that of other countries — China's poor families could choose only MLSA. Thus, a single welfare system could effectively avoid the selection of samples in different welfare items, thus resulting in selection bias again. The allowances are only cash. With other non-cash benefits excluded, the impact of non-labor income on labor supply could be better analyzed. The number of allowances is not related to family factors. Families could only choose whether they meet the standard to receive the allowances and could not decide the amount. Such a system is more in line with the application conditions of the Heckman model.

5 Theoretical analyses

Many related studies have analyzed the reasons why allowances will affect a family's labor supply in detail (e.g., Timothy J. Bartik 1998 and Olivier Bargain 2011). By establishing the family utility function, this paper analyzes the choice of maximizing family utility under different circumstances. According to MLSA, in this model, whether a family could receive allowances

depends on their total income when they apply for MLSA.

Previous studies (e.g., Yang-Ming Chang, et al. 2012 and Francisco J. Gomes 2005) adopted the life cycle model to explain the impact of non-labor income on labor supply. People distribute non-labor income reasonably to each period and maximize the utility function during each period to obtain the optimal labor supply. Meanwhile, people's utility is obtained from leisure and consumption. People will sacrifice their leisure (i.e., to work) to get labor income and use the total income for consumption. Each family will choose an appropriate amount of leisure when maximizing the utility and use the remaining time to work and earn income to consume.

Leisure is a superior commodity, i.e., the more income, the more demand. If low-income families are given some extra income — minimum living standard allowance, leisure consumption will increase. Under the premise that the total disposable time of the family is fixed, the increase of leisure consumption means the decrease of labor supply time. This is the main reason for the impact of non-labor income on labor supply.

In this paper, the method of maximizing household utility is adopted to analyze how each household will change the labor supply after they receive the minimum living standard allowance. By referring to the previous research, it is assumed that the utility of the family comes from general consumption and leisure time. It is assumed that the utility function in period t satisfies the following inequation:

$$\begin{aligned} \partial U/\partial c_t > 0 \qquad & \partial U/\partial l_t > 0 \\ \partial^2 U/\partial {c_t}^2 < 0 \qquad & \partial^2 U/\partial c{l_t}^2 < 0 \end{aligned}$$

Herein, c represents the general consumption of the family while l denotes the leisure time of the family. To better show the impact of non-labor

income on labor supply, this paper uses CES-type utility to assume the utility function as:

$$u = U(c_t, l_t) = (\alpha c_t^{\sigma} + \beta l_t^{\sigma})^{\frac{1}{\sigma}}$$

Herein, u is the utility that the family could obtain. It is assumed that the family budget constraint is:

$$pc_t + wl_t = wH + Y \quad l_t \leq H \; ; \begin{cases} Y = Y^* & if\ pc_{t-1} > M \\ Y = Y^* + S & otherwise \end{cases}$$

The family's total monthly income (the sum of wage income w(H-l) and non-labor income Y) is below the minimum standard baseline M, the government grants the family allowances S, where w is the wage level and H denotes the disposable time of the family. The disposable time of the family is spent on labor and leisure. p represents the price index.

From the budget constraint line, the characteristics of MLSA are observed. The allowance amount s is a fixed value, which shifts part of the budget constraint line upward. Figure 2.3 presents the possible consumption set under budget constraints.

(Figure 2.3)

Under the budget constraint, the utility could be maximized to get the optimal consumption and leisure time. In the first case, household income is above the baseline and will not receive subsidies from the government.

$$l_t = (wH + Y)\left(p\left(\frac{\beta p}{\alpha w}\right)^{\frac{1}{1-\sigma}} + w\right)^{-1}$$

$$c_t = (wH + Y)\left(w\left(\frac{\alpha w}{\beta p}\right)^{\frac{1}{1-\sigma}} + p\right)^{-1}$$

The two formulas satisfy the following inequations:

$$H - l_1 > \frac{M - Y}{w}$$
$$u(c_1, l_1) > u\left(M, \left(H - \frac{M - Y}{w}\right)\right)$$

This means that the utility of the family at this optimal consumption set is greater than that of any consumption set that could receive allowances. Families provide more labor than they could get allowances.

In the second case, a corner solution appears due to the discontinuity of the budget constraint line. The optimal consumption set is at the breakpoint of the budget constraint line. The labor supply allows the family to just get the allowances.

$$l_2 = H - \frac{M - Y}{W}$$
$$c_2 = \frac{M + S}{P}$$

The two formulas satisfy the following inequations:

$$H - l_1 > \frac{M - Y}{w}$$
$$u(c_1, l_1) < u\left(M, \left(H - \frac{M - Y}{w}\right)\right)$$

This means that the utility of the family getting from the optimal consumption set is greater than any consumption set that could not get

allowances.

In the third case, the family will receive the allowances provided by the government. At this time, the family provides the labor supply, which keeps the total income below the baseline. It is observed that after the government increases the allowances S, the consumption of leisure time will increase and the labor supply will decrease.

$$l_3 = (wH + Y)\left(p\left(\frac{\beta p}{\alpha w}\right)^{\frac{1}{1-\sigma}} + w\right)^{-1}$$

$$c_3 = (wH + Y)\left(w\left(\frac{\alpha w}{\beta p}\right)^{\frac{1}{1-\sigma}} + p\right)^{-1}$$

The two formulas satisfy the following inequations:

$$0 < H - l_3 < \frac{M - Y}{w}$$

$$u(c_3, l_3) > u\left(\frac{Y}{P}, H\right)$$

This means that the utility obtained from the optimal consumption set is greater than that when there is no labor supply.

In the fourth case, the available time is limited, hence another corner solution appears. The optimal consumption set is located at the end of the budget constraint line, i.e., when the leisure consumption is the largest. Families will use all their time as leisure time without providing the labor supply.

$$l_4 = H$$

$$c_4 = \frac{Y}{P}$$

The two formulas satisfy the following inequations:

$$l_3 > H$$
$$u(c_3, l_3) < u\left(\frac{Y}{P}, H\right)$$

This presents that the utility of this corner solution is greater than any other consumption set.

Families will choose the best consumption set according to their situation. Figure 2.4 presents the optimal consumption set in four cases.

(Figure 2.4)

It is observed from the model that the increase of non-labor income will change the optimal household consumption set. When the amount of allowances increases, the labor supply of families will decrease.

As indicated by the model, low-income families could get allowances. Some factors tend to be related to income and labor supply meanwhile. If the sample data for analysis is directly used, selection bias will occur. This paper will explain the problems encountered in regression in detail in the next section.

6 Regression analysis

The quantitative analysis of the impact on labor supply has always been a complex research topic. The quantitative analysis of the impact is difficult due to the existence of many interfering factors. Some people who depend on allowances will move from low-relief areas to high-relief ones, which will

change the local labor market and affect the analysis of labor supply. The complex social welfare systems in some countries have also added trouble to the calculation of the impact on labor supply.

Due to the particularity of China's household registration system and the minimum living standard allowance, the application of Chinese data in this study could effectively avoid the impact of population migration and complex welfare. But there are still some problems in regression analysis.

The basic regression equation is as expressed as:

$$L_{it} = \alpha + \beta Y_{it} + \delta(w_{it}/p_{jt}) + F_j + u_{it} \qquad (1)$$

L_{it} represents the average working hours per month for sample i living in year t; Y_{it} denotes the amount of the non-labor income that could be received each month by the sample in year t; P is the price index; F denotes the fixed effect of the region; u represents the error term.

6.1 Identification problem

This paper mainly encountered the problem of selection bias, which will be introduced later in detail. Families whose income is below the baseline could receive the minimum living standard allowances. When using the change of non-labor income brought by the minimum living standard allowances, we could only observe the impact of non-labor income of low-income families on labor supply. If only a simple regression analysis is conducted, selection bias will occur.

In the basic regression equation, β presents the number of hours that the monthly labor supply decreases when the sample's monthly non-labor income increases by 1%. For simplicity, a same model is used to represent

equation (1).

$$L_{it} = X_{it}B + \beta Y_{it} + u_{it} \quad (2)$$

X represents other control variables. Vector B contains the influence of each control variable on labor supply. β represents the impact of non-labor income on labor supply. If the expected value of the error term was zero, the following formula could be used:

$$E(L_{it}|X_{it}, Y_{it}) = X_{it}B + \beta Y_{it} + E(u_{it}|X_{it}, Y_{it}) = X_{it}B + \beta Y_{it}$$

D=1 is used to indicate the family receiving the allowances. we could only observe the changes in the labor supply of families who receive allowances, hence the changes in the labor supply of families who do not receive allowances if they receive allowances could not be known. The regression equation is expressed as:

$$E(L_{it}|X_{it}, Y_{it}, D_i = 1) = X_{it}B + \beta Y_{it} + E(u_{it}|X_{it}, Y_{it}, D_i = 1)$$

According to MLSA, whether a family could receive the allowances is determined by the actual wage, non-labor income, and the minimum living standard baseline M set by the local government.

$$\begin{cases} Y_t = Y_t^* & if\ w_t L_t + Y_t^* > m_t \\ Y_t = Y_t^* + S_t & otherwise \end{cases}$$

We could know whether families could get relief in a functional relationship between Y and m. The function of whether family can receive the allowance is assumed as follows:

$$D_{it} = f(I_{it-1}, m_{jt-1}, v_{it-1}) \quad (3)$$

v represents the error term in the subsidy equation and m is the

minimum living standard basic line. I_{it-1} ($\equiv w_t L_t + Y_t^*$)denotes the amount of the total income in last period. When the simple regression equation continues to be used this time, it will be found that:

$$E(L_{it}|X_{it}, Y_{it}, D_{it}) = E\left(L_{it}\middle|X_{it}, Y_{it}, I_{it-1}, m_{jt-1}, v_{it-1}\right) = X_{it}B + \beta Y_{it} +$$

$$E\left(u_{it}\middle|X_{it}, Y_{it}, I_{it-1}, m_{jt-1}, v_{it-1}\right) \quad (4)$$

Equations (2) and (3) represent the labor supply equation and the selection equation respectively. Therefore, there is usually a strong correlation between v and u. Family situation (e.g., the health status of family members, the number of people to support, and living conditions) and willingness to work affect income (Adam Thomas and Isabel Sawhill, 2005). Meanwhile, the government will also take these two points into account when granting allowances. These two factors from the database could not be observed. Hence, when v and u are related. When OLS is used to conduct an analysis, selection bias will occur.

6.2 Identification strategy

This paper applies the Heckman model to tackle the problem of selection bias. Hypothesis v and u obey joint normal distribution. The correlation coefficient between the two error terms is ρ. The variances of the two variables are σ1 andσ2. Specifically:

$$(u, v) \sim \begin{pmatrix} \sigma_1^2 & \rho\sigma_2\sigma_1 \\ \rho\sigma_1\sigma_2 & \sigma_2^2 \end{pmatrix}$$

Moreover, the local government determines the minimum living standard baseline according to the local financial situation, per capita income, and other factors. The baseline will not directly affect the labor supply of

households. The family labor supply is not related to the minimum living standard baseline set by the government. Suppose I_{it-1}, m_{jt-1} and u_{it} are not related. Therefore, Equation (4) could be reduced to:

$$E\left(L_{it}\middle|X_{it}, Y_{it}, I_{it-1}, m_{jt-1}, v_{it-1}\right) = X_{it}B + \beta Y_{it} + E(u_{it}|v_{it})$$
$$= X_{it}B + \beta Y_{it} + \rho v_{it}$$

The term that causes bias is the inverse mills ratio (IMR). The following equation could be obtained.

$$E\left(L_{it}\middle|X_{it}, Y_{it}, I_{it-1}, m_{jt-1}, v_{it-1}\right) = X_{it}B + \beta Y_{it} + \rho\lambda(I_{it-1}, m_{jt})$$

Herein:

$$\lambda\left(I_{it-1}, m_{jt}\right)$$

Then the Probit model could be used to estimate the value of IMR. The equation that assumes whether the minimum living standard allowance is available is expressed as:

$$D_{it}^{*} = \gamma_1 I_{it-1} + \gamma_2 m_{jt-1} + v_{it-1}$$

$$D_{it} = 1 \; if \;\; D_{it}^{*} > 0$$

Through the maximum likelihood method, $\hat{v}_{it}$, the estimated quantity of v_{it}, could be calculated.

$$\hat{v}_{it} = \begin{cases} E\left(v_{it}\middle|v_{it} > -\gamma_1 I_{it-1} - \gamma_2 m_{jt}\right) = \varphi(z\gamma)/\Phi(z\gamma) & if\ D_{it} = 1 \\ E\left(v_{it}\middle|v_{it} < -\gamma_1 I_{it-1} - \gamma_2 m_{jt}\right) = -\varphi(z\gamma)/(1 - \Phi(z\gamma)) & if\ D_{it} = 0 \end{cases}$$

Herein, φ and Φ are the density function and distribution function of standard normal distribution. The final regression model could be obtained:

$$L_{it} = \alpha + \beta Ln(Y_{it}) + \delta_1(w_{it}/p_{jt}) + \theta x_{it} + F_j + \rho\widehat{v_i} + u_{ijt+1} \quad (5)$$

Observed from Equation (5), β is the impact of non-labor income on labor supply. When the monthly non-labor income of the family increases by 1%, the monthly labor supply of the family will change β. x represents some other control variables.

6.3 Data

The database applied in this study is China Family Panel Studies (CFPS) provided by the Chinese Social Science Research Center of Peking University, which has three levels of data, i.e., individuals, families, and communities. It contains data from 2010 for 16,000 households, covering data on basic household conditions, labor, income, consumption, and expenditure. In particular, it contains key information like the amount of minimum living standard allowances received by each family member and working hours. Some regional data like population and price index come from the National Bureau of Statistics of China.

This paper applies panel data between 2012 and 2014. Observations aged over 55 years old and under 25 are excluded to prevent the impact of not joining the labor market or exiting it due to age issues, thus ensuring the accuracy of regression analysis. Similarly, the sample applied does not include people who have lost working ability.

In the data applied in this study, 3,292 families received minimum living standard allowances in 2012 and 2014, among which 2,276 families received more allowances in 2014. Among the families that received the allowances in

2014, allowances accounted for 28.5% of the total household income. The allowance accounted for 16.31% of the total household expenditure. It is observed that in these families, the allowances accounts for a large proportion of family income and expenditure. Changes in the amount of the minimum living standard allowance will inevitably affect the economic activities of the family.

7 Regression results

The number of allowances received through MLSA is fixed. Family income could only determine whether they could receive the allowances, but it is not related to their amount. This paper applies the Probit model to conduct a regression analysis on the probability of families who obtain allowances. Table 2.1 presents the results of the regression.

(Table 2.1)

As indicated by the results, the family's income in the previous year and the minimum living baseline are substantially related to whether the family could receive the allowances. For every 1% increase in the family's income in the previous year, the probability of receiving the allowances decreased by 0.78%. The purpose of establishing MLSA is to ensure the basic life of poor families. In principle, only families whose income is below the minimum living baseline could receive the allowances. Therefore, it is more difficult for high-income families to obtain allowances, which does not violate the original intention of MLSA.

There is a significant positive correlation between the amount of the minimum living baseline and the probability of receiving the allowances. When the government sets a higher standard, the number of families whose

income is below the baseline is increasing and the chances of receiving allowances increase.

This paper compares the results of the OLS and Heckman models. Table 2.2 presents the results of two different techniques. As indicated by the results, there is a problem of selection bias in the study of the impact of non-labor income on labor supply.

(Table 2.2)

According to the regression results, the increase in the amount of the minimum living standard allowance has brought a decrease in labor supply. The amount increases by one percentage and those families who receive the minimum living standard allowance will reduce their labor supply by 0.291 hours a month.

Due to the lack of elasticity of labor supply in China (Yanan Li 2016), labor supply is less affected by non-labor income. The main forms of work in China are civil servants, employees of public institutions, employees of state-owned or collective enterprises, employees of joint-stock or mixed-ownership enterprises, employees of private enterprises, private owners, farmers, and freelancers. People who do the first five jobs need to commute regularly. Despite that they could adjust over time, most of the labor supply time is difficult to change. In addition, China had a working population of 811 million in 2019, of which 220 million (private owners, farmers, and freelancers) could flexibly adjust their labor supply, accounting for 27.16% of the working population.[6] The structure of China's labor market makes labor supply less affected by non-labor income.

[6] Data source: the seventh census report of the National Bureau of statistics of China

Due to different forms of employment in China, the requirements for labor suppliers also differ. Most of those who have formal jobs have labor contracts with their employers. Such groups of people have specific regulations on the working hours each day, and it is difficult for them to adjust their time of labor supply. After the minimum living standard allowance increases, they will be able to reduce their labor supply.

(Table 2.3)

For private owners, farmers, and freelancers, their labor supply is more flexible. When the minimum living standard allowance increases, they could adjust it more flexibly. The results in Table 2.3 imply that the effect is bigger on flexible employees than that on formal employees.

8 Conclusions

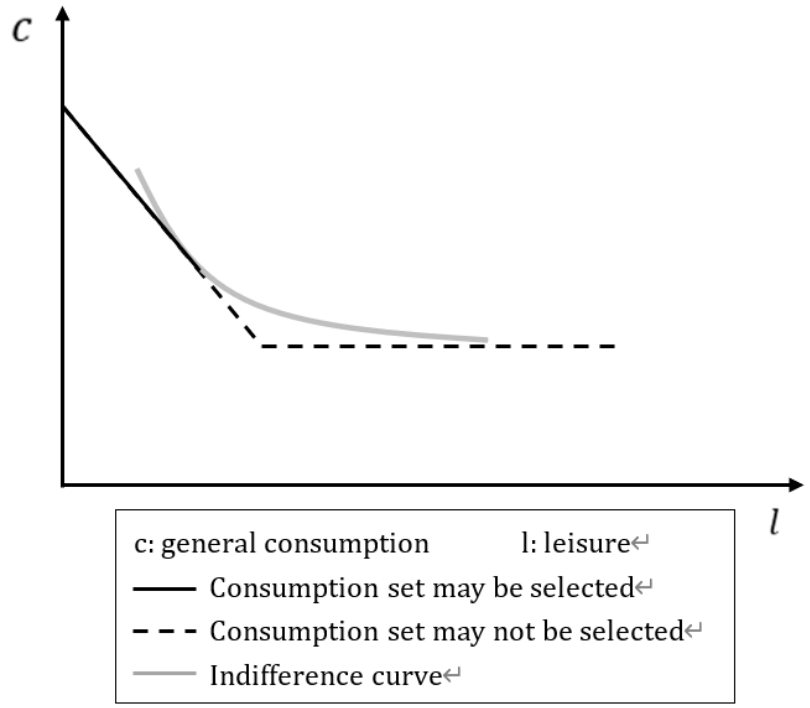
As indicated by the regression results, China's minimum living standard allowance has indeed caused a decrease in labor supply. There are two main forms of employment in China, one being a regular employee who has signed a contract and the other being an informal employee who has not signed any labor contract. There are obvious differences between formal employees and flexible employees. Flexible employees could adjust their labor supply time more conveniently. After flexible employees receive the minimum living standard allowances, they will substantially reduce their labor supply time. The impact of the minimum living standard allowances on the labor supply of formal employees is insignificant.

The data applied in this paper has a long interval among different years, which may cause errors. However, a two-year interval must be applied due to limited data, hence the family situation of some samples may change during

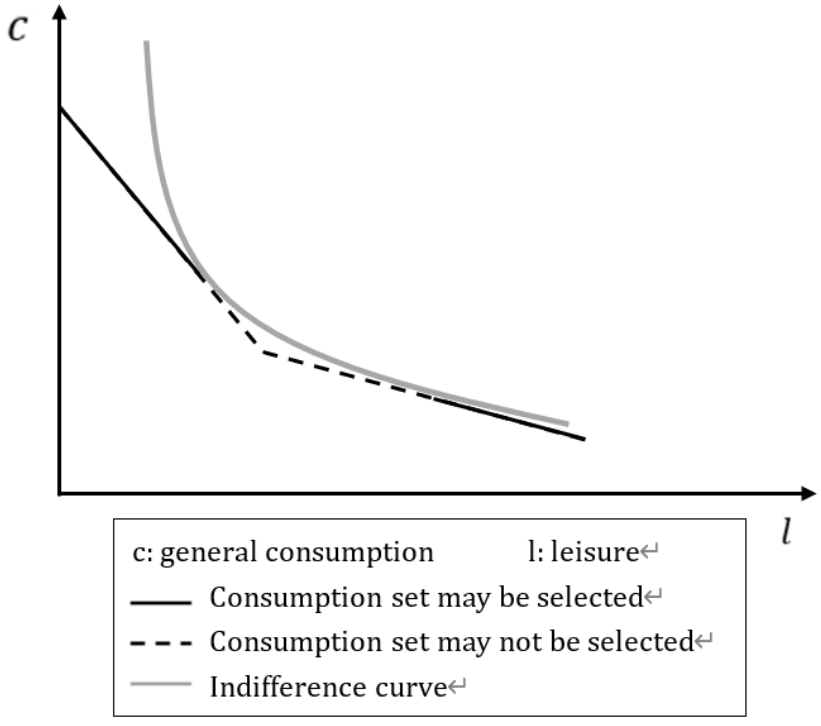
this period and there is no need to receive relief. Selecting the samples that have received an allowance for two years will cause another selection bias. If a shorter time interval could be applied, the impact of the change in the amount of the minimum living standard allowance on the supply of labor could be estimated more accurately.

Dynamic analysis is the main development direction of welfare research. The income of the previous period will affect whether the allowances can be received in this period, and the income of this period will also affect whether the allowances can be obtained in the next period. The choice of family is dynamic, and the selection bias is also dynamic. Using the structure model, dynamic consideration of family is a reasonable method. However, China lacks long-term panel data, dynamic analysis still faces difficulties.

Figure 2.1 The impact of common subsidies on the budget constraint line.

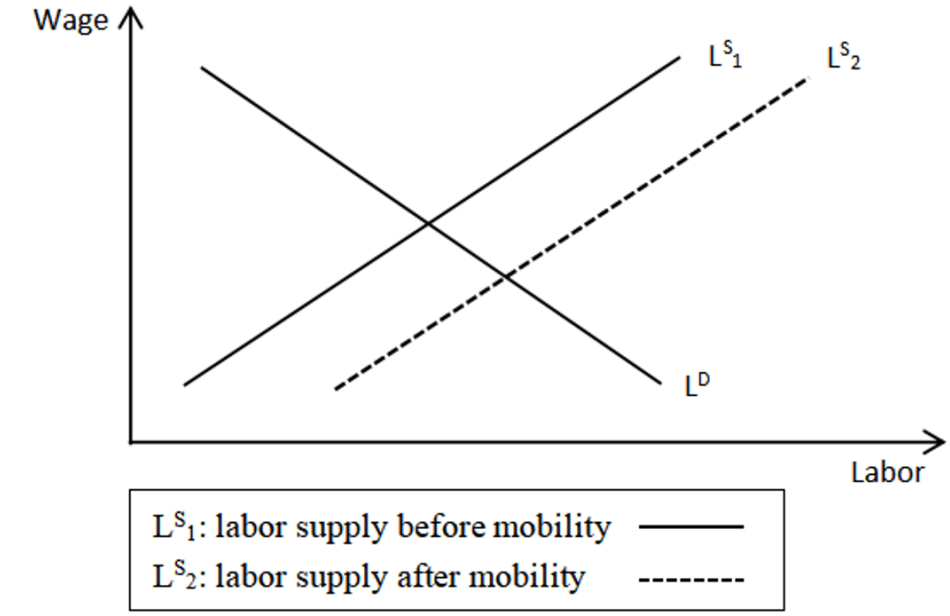


Welfare system for maintaining minimum income

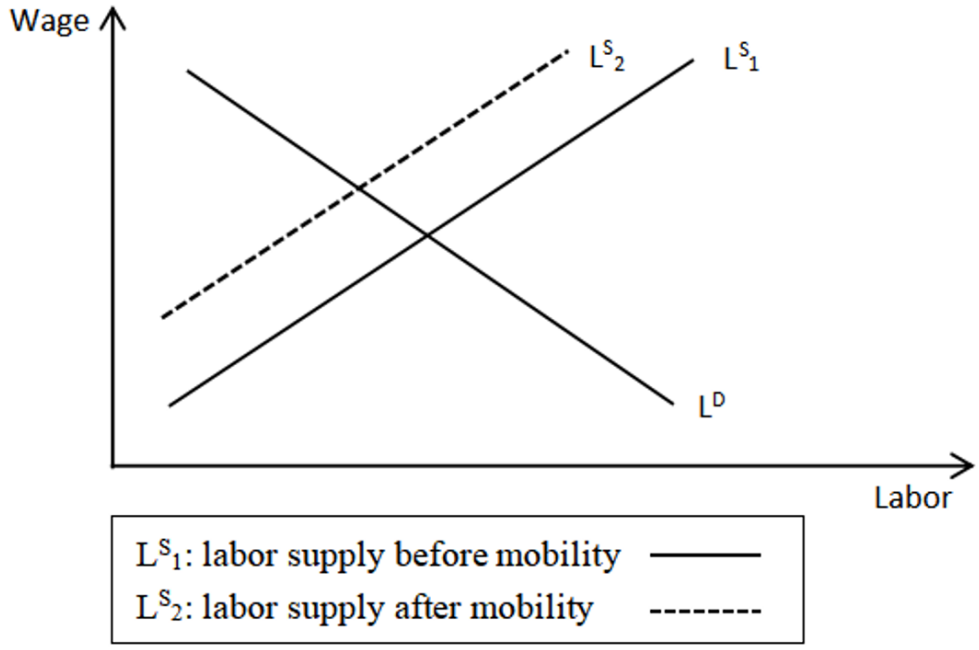


Welfare system for tax relief

Figure 2.2 The impact of population mobility on the labor market



Areas of population inflow



Areas of population outflow

Figure 2.3 The constraint line under the minimum living allowance system

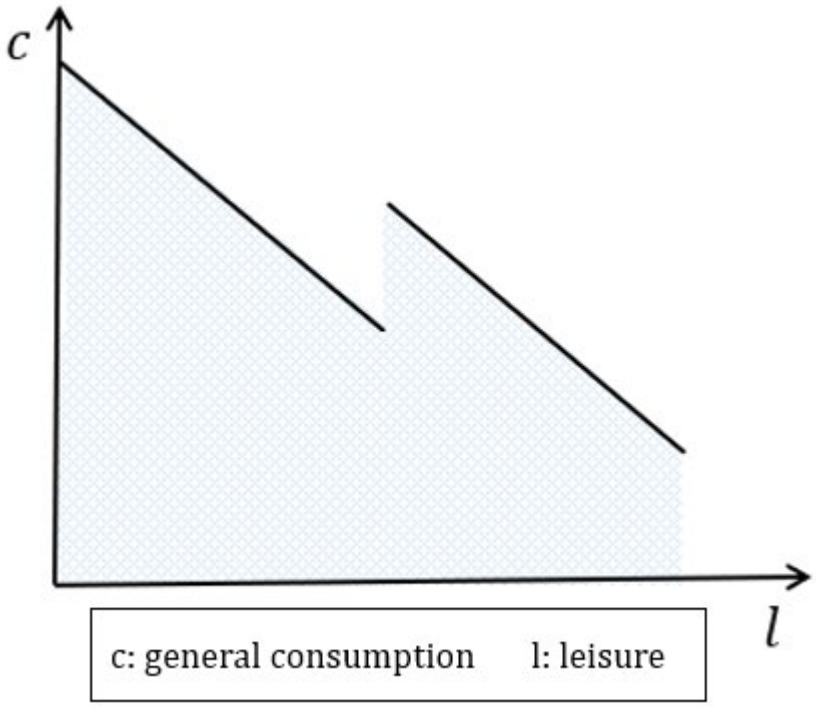


Figure 2.4 Four optimal consumption sets

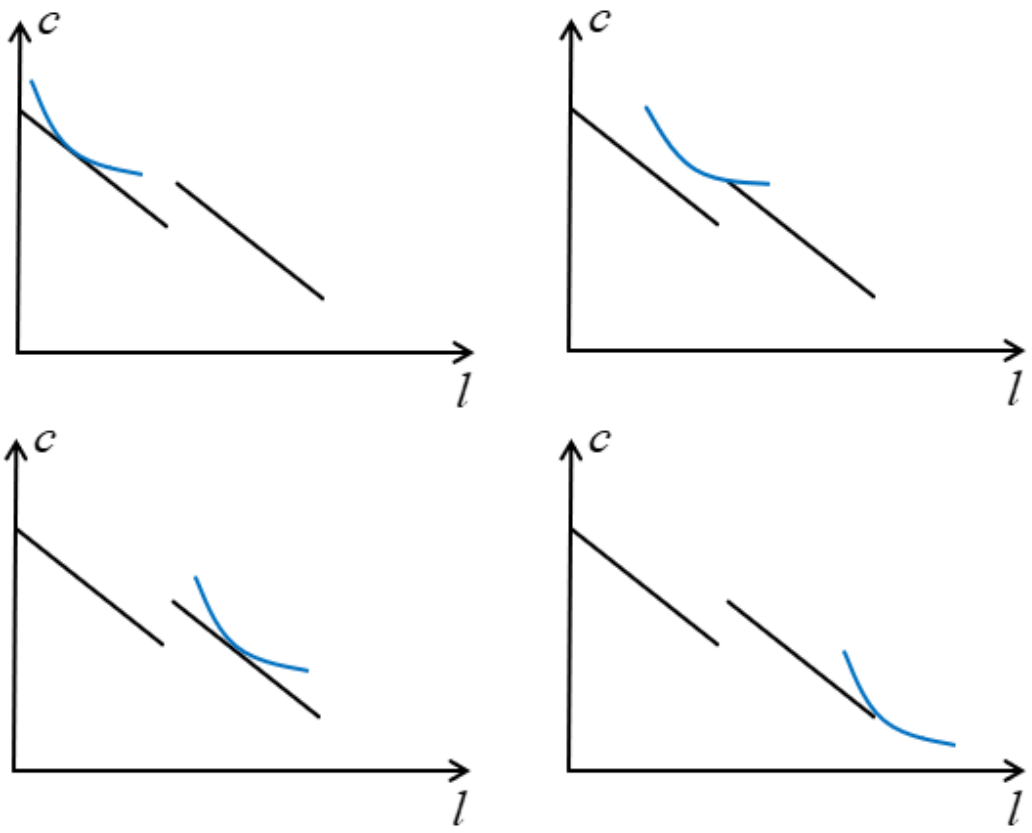


Table 2.1 Probit model of the probability of families obtaining allowances

D	coef.	Std.Err	t	P	[95% Conf.	Interval]
Ln(Last year income)	-0.6812	0.3021	-2.25	0.036	-1.5154	-0.0512
Ln(base line)	0.4137	0.2003	2.07	0.019	0.0513	0.6141
Num of obs	12714					
Regional effect	yes					

Table 2.2 Regression results of OLS and Heckman models

Labor Supply	OLS	Heckman Selection Model
	(1)	(2)
Ln(no-labor income)	-0.473***	-0.288***
	(0.201)	(0.109)
Family size	-6.782***	-5.31**
	(1.242)	(2.434)
Real Wage	0.184***	0.245***
	(0.041)	(0.023)
Ln(Last year income)	13.257***	6.314***
	(2.41)	(1.68)
Marital status	14.322***	12.324***
	(3.32)	(3.27)
Health	24.213***	13.321***
	(3.57)	(5.09)
Num of obs	12714	1987
Regional fixed effect	YES	YES

* p-value<0.1 ** p-value<0.05 *** p-value<0.01

Table 2.3 Regression results of Heckman model in different forms of employment

Labor Supply	Formal employees (1)	Flexible employees (2)
Ln(no-labor supply)	-0.207** (0.111)	-0.431*** (0.199)
Family size	-3.782*** (1.012)	-5.99** (2.434)
Real wage	19.143*** (4.231)	23.215*** (5.596)
Last year income	4.523** (2.248)	8.954*** (3.012)
Marital status	18.482*** (5.32)	12.44*** (3.87)
Health	20.23*** (3.57)	12.43*** (5.09)
Num of obs	1523	4642
Regional fixed effect	YES	YES

* p-value<0.1 ** p-value<0.05 *** p-value<0.01

Chapter 3: Obesity and Poverty— Regression Analysis of the Effect of BMI on Income

1 Introduction

Will obesity affect people's income? Previous studies have proved that there is a correlation between obesity and income, but none of them has successfully proved the impact of obesity on income. Statistics indicate that in 2016, more than 1.9 billion adults were overweight, of whom more than 650 million were obese. The overweight rate of adults was 39%, the obesity rate was 13%, and the average annual growth rate in the last 20 years was 0.8%.[7] It is necessary to investigate the impact of obesity on people's social life. This paper applies Chinese household survey data to demonstrate whether obese people are prone to low income. This section will introduce some data and reasons for obesity in China.

1.1 Status of Obesity in China

The number of obese people in China has surpassed that in the United States, making China the country with the largest number of obese people in the world. The degree of obesity is expressed by Body Mass Index (BMI) value. As defined by World Health Organization (WHO), overweight is a BMI between 25 to 30 while obesity is a BMI greater than 30. In China, the number of obese people is about 85 million, and overweight and obesity rates are 34.3%

[7] Data source: World Health Organization (WHO) https://www.who.int/zh/news-room/fact-sheets/detail/obesity-and-overweight

and 16.4% respectively. One-tenth of children under 6 years old are overweight or obese, whose rates of overweight and obesity are 6.8% and 3.6% respectively. Among adolescents aged 6 to 17 years old, nearly one in five are overweight or obese and their rates of overweight and obesity are 11.1% and 7.9% respectively.[8]

Obesity in China presents obvious regional differences. The obesity rate in northern China is substantially higher than that in southern China. As indicated by the obesity rate in various provinces of China in Figure 3.1, the average BMI of Tianjin (25.4) is the highest while that of Hainan (22.2) is the lowest; the overweight rate of Beijing (40.9%) is the highest while that of Guangxi is the lowest (14.6%); the obesity rate is the highest in Tianjin (12.2%) while the lowest in Hainan (1.3%).[9] Figure 3.2 and figure 3.3 show the distribution of obesity rate and overweight rate in China.

(Figure 3.1)

(Figure 3.2)

The main reasons for this phenomenon are as follows. First, the different eating habits in southern and northern China cause different obesity rates (Haiyan Shi, et al. 2013). It is cold in winter in northern China where people generally eat high-calorie food while people in southern China have lighter eating habits of which the food contains fewer calories (Guansheng Ma, et al., 2008). The difference in eating habits is the main reason for the different

[8] Data source: Chinese Center for Disease Control and Prevention (CCDCP) https://www.chinacdc.cn/

[9] Data source: Zhang L, Wang Z, Wang X, et al. Prevalence of overweight and obesity in China: results from a cross-sectional study of 441 thousand adults, 2012–2015[J]. Obesity research & clinical practice, 2020, 14(2): 119-126.

obesity rates between south and north China (Ni Guo-hua, Zhang Jing, and Zheng Feng-tian, 2013) and (Xiaofei Zhang et al. 2014).

(Figure 3.3)

Second, the difference of genes between north and south China is another essential cause for the different obesity rates. Gene differences determine the obesity rate at the basic level. Studies have proven that there are significant differences in Impaired Glucose Tolerance (IGT) between southern and northern populations in China (Hongding Xiang, 2004). In addition, there are remarkable differences in some genes related to cardiovascular disease between the south and the north. It is believed that these genes are directly related to obesity (Weihong Wang, 2008). However, China has experienced several large-scale population migrations, hence there are large migrant cities in the south and north of China like Beijing in the north, Shanghai in the south, and Guangdong in the south. The influencing factor of ethnic differences has been weakened. But in some ethnic minority areas, the difference in obesity rate is still obvious (Yarong Yuan, 2011; Yueping Yu et al., 2013).

The risk of obesity among adolescents has increased substantially. The number of obese children and adolescents aged 6~17 has tripled in 10 years to 53 million.[10] In China, between 2002 and 2007, the growth rate of obesity in urban children was 160% while that in rural children was 400%. Obese children have accounted for 10% of the total number of children and are increasing at a rate of 8% each year.[11]

[10] Data source: The fourth survey report on nutrition and health status of Chinese Residents

[11] Data source: Sina News (2007)

The reason why teenagers are obese lies in their parents. In Chinese families, teenagers and infants live with their parents whose diet is directly decided by their parents' eating habits. When parents' diet contains large amounts of high-calorie fried or salty foods, their children will also eat such foods in their daily life (Jingyu Chen et al. 2021; Haoxiang Shan, 2015). Moreover, parents' attitudes towards health also affect children's attitudes (Peter Dolton and Mimi Xiao, 2015). In terms of family education, parents pay attention to children's knowledge learning but ignore their exercise time. Nowadays, lack of exercise has become the norm among Chinese students who face heavy academic pressure from primary school to high school. Lack of exercise is also an essential reason for adolescent obesity (Jiayi Liu, 2015). Heavy learning pressure makes students anxious, thus increasing the risk of obesity among teenagers (Tan Feng-zhu et al., 2007).

1.2 Main Causes of Obesity in China

In China, many factors could cause obesity. According to the results of previous research, the main reasons are unhealthy eating habits (Jingyu Chen et al., 2021; Yinghua Zhang and Qiuying Zhang, 2011), lack of exercise (Liya Huang, 2011), lack of sleep (Xun Wen and Shiquan Xu, 2009; Yi Hong et al., 2011), irregular work and rest (Liya Huang, 2011), excessive pressure (Qiwu Liu et al., 2004), etc.

First, unhealthy eating habits are the main cause of obesity. The per capita annual direct grain consumption was 247.18kg in 1978 and then increased rapidly with the improvement of production capacity. In 1990, it reached 262.11kg and remained at the level of about 260kg for a long time.[12]

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http://www.age06.com/Age06Public/SPEAuditing/PostPreview.aspx?view&ContentId=545109

[12] Data source: FENG Zhi-ming, SHI Deng-feng “Chinese Food Consumption and

260kg basically reached the saturation level of grain consumption of Chinese residents (Feng Zhi-ming and Shi Deng-feng, 2006). Nowadays, hunger caused by poverty barely occurs in China. There are still differences in income in China, but the most basic problem of food and clothing has been tackled. Moreover, China's food prices are quite low. Since 2013, China's Engel coefficient has been below 32%.[13] The problem of emaciation caused by insufficient nutritional intake due to poverty and the inability to afford food has been tackled. However, food affects people's weight in another way, i.e., eating habits could cause obesity. The daily diet contains too many carbohydrates, fried foods, high-calorie foods, which will increase the risk of obesity (Yinghua Zhang and Qiuying Zhang, 2011). Meanwhile, many problems in the basic daily diet of the family will affect health. Eating too much meat and fat, using too much oil and salt when cooking food, eating too much staple food, daily excessive drinking, and other reasons will lead to obesity (Jingyu Chen et al., 2021).

Second, lack of exercise is one of the direct causes of obesity in China. In 2019, the average exercise time of Chinese people was 31 minutes a week.[14] Exercise could not only directly help lose weight but also effectively improve the basic metabolism ability. Higher basal metabolic capacity means that people could consume more calories every day and keep a better figure (Shaw K A, Gennat H C, and O'Rourke P et al., 2006; Bouchard C, Depres J P, and Tremblay A., 1993). There are two main reasons for the lack of exercise, the first being poor awareness of sports and lack of subjective exercise and the second being lack of sports time due to busy study and work.

Third, lack of sleep and stress caused by work is one of the main causes

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Nourishment in the Latest 20 Years" resources science 2006 ,1007 - 7588 01 - 0002 - 07

[13] Data source: Statistical yearbook of the National Bureau of statistics of China

[14] Data source: Statistical yearbook of the National Bureau of statistics of China

of obesity in China. According to the statistics in 2018, the average sleep time of Chinese people years was 6.8 hours[15], especially those office workers whose working place is far away from where they live. The average commuting time of Chinese people was 72 minutes a day. In Beijing, the commuting time per capita was 94 minutes and people with a commuting time of more than 120 minutes accounted for 27%. The commuting time per capita in super large cities with a population of more than 10 million (Beijing, Shanghai, Guangzhou, and Shenzhen) exceeded 70 minutes per day.[16] Meanwhile, the stress encountered at work could cause obesity (Yin Cao, 2014). Previous studies have proven that facing pressure or frustration for a long time could easily induce obesity (Qiwu Liu et al., 2004; Angelina R. Sutin and Antonio Terracciano, 2012). Table 3.1 shows the commuting time of major cities in China.

(Table 3.1)

Income no longer directly affects obesity, which will be proven in this paper later. With the development of the economy and the improvement of per capita income, income will have a positive, negative, or no impact on obesity (Nathalie Mathieu-Bolh, 2020) and (Mohd Masood and Daniel D Reidpath, 2015). China's Gini coefficient has been steadily declining and grain consumption has reached a saturation level. Income will no longer affect the weight of Chinese people through the nutritional intake (Feng Zhi-ming and Shi Deng-feng, 2006). Although certain previous studies have confirmed no impact of income on obesity in China, this paper will later verify that income has no impact on obesity in China through an econometric model.

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[15] Data source: Statistical yearbook of the National Bureau of statistics of China

[16] Data source: Commute monitoring report of major cities in China in 2021 by China Academy of Urban Planning and Design

1.3 Reasons for the Impact of Obesity on Income

Previous studies have concluded that obesity will affect people's income in some ways. This paper will discuss the possible ways in China in detail in this section.

First, it is more difficult for obese people to find jobs than normal-weight people. Obese people have obvious disadvantages in the interview, the evaluation of leadership, and starting salary, which has been proven by many economists through economic experiments (Jens Agerstrom and Dan Olof root, 2011; KS O'Brien and JD Latner, 2012). The author will discuss their experiments in the next section. It is difficult for obese people to find jobs, which means that wage income will be directly affected.

Second, obese people look less attractive, especially women whose appearance evaluation is more likely to be affected by obesity (Raymundo M. Campos-Vazquez and Eva Gonzalez, 2020). Obese people are likely to be isolated in teamwork because it is difficult for other team members to accept them (Malgorzata Obara-Golębiowska, 2016), hence they have a significant impact on society.

Third, obesity will affect health and work efficiency. Thousands of articles have confirmed that obesity could induce various diseases. The large physical form of obese people affects their movement, hence obese people have lower work efficiency, which means that their wages are lower than the general population.

Fourth, obese people will be discriminated against at work. Extremely obese people are inefficient and could be defined as "physically or mentally

damaged".[17] Some overweight and slightly obese people are considered to be prone to absenteeism and inefficiency, despite that there is no evidence to prove this (Karen M. Kramer, 1994). Due to these stereotypes, overweight and obese people will be treated differently from normal-weight people in terms of salary and other aspects (Jennifer L. Pomeranz and Rebecca M. Puhl, 2013).

Fifth, obese people tend to be introverted, who are more resistant to communicate with others. Obese people are more likely to have negative emotions after being ridiculed. Some previous studies have confirmed this view through surveys and interviews (Malgorzata Obara-Golębiowska, 2016).

It is known that obesity does affect people's income in some ways, but the author prefers to quantitatively calculate the specific impact of obesity on income. In the third section, this paper explains the measurement methods in detail.

1.4 Research Significance

In the 21st century, the obesity rate is soaring all over the world. Developed countries and most developing countries are facing the problem of obesity. Most European and American countries have fallen into the abyss of universal obesity (Finkelstein E A, Strombonne K L and Popkin B M, 2010), hence the research on obesity started earlier in European and American countries. In the last decade, the topic of the impact of obesity on social life has attracted particular attention in academia. China is also facing a soaring obesity rate, but there is little research on the impact of obesity on social life

[17] According to the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 in the USA, obese people can be defined as "physical or mental damage" after meeting certain conditions.

in the context of Chinese society. Therefore, this paper applies China survey data to analyze the impact of obesity on income to fill this research gap.

Most studies are limited to the correlation between income and obesity (which will be introduced in the next section). This paper quantitatively analyzes the specific impact of obesity on income. The conclusion of this paper could better reveal the impact of obesity on people's social life, and the analysis method could be applied to the study of obesity-related effects.

The impact of obesity is analyzed in this paper to better tackle the problem of obesity. When obesity has become a common social phenomenon, the government needs to promulgate corresponding policies to tackle it (Guohua Ni et al.). Understanding the impact of obesity is also conducive to policymaking.

2 Literature Review

The investigation on the relationship between obesity and work, income, and social status began with some legal and sociological studies. Since the 20th century, scholars have begun to pay attention to obese people. Karen M. Kramer and Arlene B. Mayerson (1994) pointed out that obesity could be identified as "physical or mental damage" under the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990. But most obese people face wage discrimination for no reason. Due to the stereotype of obesity, obese people are generally considered to be inefficient and more likely to be absent from work and get sick compared with normal-weight employees. The author believes that when there is no evidence to prove that obese people are incompetent when they receive unequal treatment of wages, they should apply for compensation. Meanwhile, the author calls on more scholars to pay attention to the relevant benefits of obese people. This began the discussion

of factors related to obesity, work, and income. Jennifer L. Pomeranz and Rebecca M. Puhl (2013) and Margaret m dement, Jere D Haas, and Christine m Olson (2014) believe that the unfair treatment and treatment of obese people have not been tackled today but have become a more common phenomenon. These two articles pointed out that relevant laws should be established to protect obese people. Thus, it is still necessary to study obesity.

The research on the impact of obesity on income and employment is not limited to the legal level. More scholars want to use data to prove the existence of the impact of obesity on social life.

Certain early papers have drawn some conclusions through survey data, pointing out that obese people have lower appearance evaluations than normal-weight people and will encounter more difficulties in job searching. Rebecca Puhl and Kelly D. Brownell (2001) inquired about nearly 2000 people in three different directions, namely education, health care, and employment. The results indicated that 28% of teachers said obesity was a person's worst thing and 24% of nurses said obese people were more reluctant to communicate with them. Meanwhile, the article points out that doctors' attitudes towards obese patients will be different from those towards normal-weight patients. Some doctors believe that patients' diseases stem from their inability to control their bodies, despite that there is no obvious evidence to prove this. Deborah Carr and Michael A. Friedman (2005) proved that obese people are more likely to receive unfair treatment. Applying the survey data of 4242 samples in the United States between 1995 and 1996, the author proves that obese people are more likely to receive clan discrimination, employment discrimination, and worse interpersonal relationships.

In the subsequent research, it was found that obesity will not only bring

difficulties in income and employment to individuals but also make them experience more risk of obesity after being treated unfairly or discriminated against at work. Angelina R. Sutin and Antonio Terraciano (2012) argued through the panel data of 6157 participants that obese people will become more prone to obesity after encountering discrimination. Ma l Gorzata Obara-Go le Biowska (2016) surveyed 420 women and found that the most common psychophysiological consequences of discrimination are emotional problems, lack of motivation, and overeating due to stress. Obesity, income, employment, and other factors attach importance to interaction, thus making it difficult to analyze the real impact of obesity.

To tackle the problem of the impact of related factors, scholars have conducted some economic experiments to analyze the impact of obesity on employment and income. Jens Agerstrom and Dan Olof root (2011) explained that obese people are in a disadvantageous position when searching for jobs through the screening of resumes on the recruitment website by employers of American enterprises. Employers upload the real resume except for the weight on the recruitment website, and the enterprise decides whether to invite the sample offline interview. The author observed through the experiment that when the BMI of the sample is higher than 30, the probability of obtaining the interview opportunity will be substantially reduced. KS O'Brien, JD Latner, D Ebneter, and JA Hunter (2012) presented interviewees photos of women before (BMI: 38 ~ 41) and after (BMI: 22 ~ 24) weight loss surgery. Afterward, respondents were asked how they rated the appearance, leadership, and starting salary of the women in the photos. Through this comparison, the author found that BMI plays an essential role in the evaluation of women. Stuart William Flint and his group (2016) put volunteers (107 men and 74 women) into jobs suitable for their situation. After some time, the results of the experiment indicated that obese people were less likely to get a positive evaluation of job suitability than normal-

weight people. In addition, obese people who are actively employed are more vulnerable to discrimination than those who are not. Meanwhile, obese women are more vulnerable to discrimination than obese men.

Apart from designing economic experiments, many scholars are actively applying survey data to analyze the relationship between obesity and income. Youfa Wang and Qi Zhang (2006) obtained the relationship between family income and BMI applying the data from 1971 to 2001. There was no correlation among most people but a significant negative correlation between BMI and income among white women.

Maximilian D. Schmeiser (2012) applied the 1979 U.S. household survey data and took the tax relief system as an instrumental variable to explore the impact of income on BMI. The results indicate that for every $1000 increase in income, BMI will increase by 0.2. Melissa Neuman, Ichiro Kawachi, Steven Gortmaker, and SV Subramanian (2013), and Jason E. murasko (2013) confirmed the negative correlation between income and BMI by applying the fixed effect model. Meanwhile, BMI is affected by the average BMI of residence. The authors believe that residents will actively change their body shape due to the attitude of their neighbors.

When exploring the correlation between BMI and income in different years, obesity, and income might show a positive, uncorrelated, or even negative correlation trend. Data from earlier years indicated a positive correlation between BMI and income. Afterward, data indicate that the correlation between BMI and income is not significant. Data from later years show a negative correlation trend.

Jolliffe, Dean (2013) indicated that in the sample data of the United States between 2003 and 2006, the correlation between income and BMI was

not remarkable. R. Alexander Bentley, Paul Ormerod, and Damian J. ruck (2018) proved through data before 1990 in the United States that there was no remarkable correlation between income and BMI. However, there was a negative correlation trend after 1990, and the correlation reached its peak in 2015. Many studies have pointed out that this is due to the improvement of nutritional status in the process of increasing income, which presents a positive correlation trend (Kate E Pickett and Shona Kelly, et al. 2005). However, as for the high-income group, the higher the income, the more attention people will pay to their body shape. High income means that people can eat healthier food and spend more time managing their bodies. Therefore, income and BMI show a negative correlation trend (Jason E. Murasko 2013).

Many scholars began to analyze the relationship between obesity and socio-economic development. Jaume Garci (2009) found that the higher the per capita GDP, the lower the average BMI of countries in Europe. Mohd Masood, Daniel D Reidpath (2015), and Hannah Ameye and Johan Swinnen (2019) argued that national income and BMI indicated an n-type trend, i.e. with the increase of per capita income, the average BMI increases first and then decreases. Some studies have shown that the gap between the rich and the poor and obesity in a country shows a positive correlation trend. (Kate e Pickett 2005) and (Dejun Su 2011). There is a negative correlation between the degree of globalization and obesity (Yevgeniy Goryakin 2015).

In terms of the research on BMI and income, different from the previous correlation analysis, this paper explores whether obesity will have an impact on income. Due to the interference of mutual causality and other related factors, most of the previous studies did not conduct further research beyond the analysis of correlation. This paper will use some models to eliminate these interferences and verify the real impact of BMI on income despite that it has been confirmed in some economic experiments that obesity will bring

adverse effects on employment and social evaluation. However, there is a lack of research on the impact of obesity on real income. Compared with the experimental data, this paper applies real survey data to demonstrate the impact of obesity on income.

3 Regression Analysis

This paper aims to explore the impact of obesity on income.[18] The basic regression equation is as follows:

$$\ln(\text{Income}_i) = \alpha + \beta \text{BMI}_i + \gamma X_i + \mu_i + \varepsilon_i$$

Income represents the average total monthly income while X is the observable control variables of observation i (e.g., labor supply, schooling, age, length of service, gender, and family size). μ represents the effect that could not be observed in observation i, such as disposable time, working environment, etc.

3.1 Identification Problem

In this paper, the problem of omitted variables lies in the identification. Two essential variables which could not be observed, i.e., disposable time and work environment, have an essential impact on obesity and income.

Everyone has 24 hours a day, but the available time is different. Apart from the necessary sleep time, time to take care of family members, time for housework, and commuting time, etc., the remaining time is disposable. According to traditional economic theoretical models (e.g., y James J.

[18] Obesity affects income by affecting wages. At the same time, obesity will also affect bonuses, various allowance, and non-labor income. Therefore, the total income is used as the dependent variable.

Heckman 1979 and Pierre Andre Chiappori 1988), the utility of consumers comes from consumption and leisure. When consumers maximize their utility function, they will determine a reasonable leisure consumption time, hence the optimal labor supply is also determined. Therefore, people's disposable income affects their income. Lack of exercise and sleep is one of the essential reasons for obesity in China, which has been introduced in detail in the first section of this chapter. Disposable time also determines the consumption of leisure time, e.g., the time for exercise and additional sleep time. The length of consumers' disposable time remains unknown; hence it will be a bias to omit this variable.

The working environment is also an essential factor that affects people's income and obesity. The working environment includes the physical working environment, i.e., indoor work, outdoor work, high-temperature work, low-temperature work, work in a special time, and the abstract working environment like the relationship with colleagues and leaders. McHugh M D and Ma C. (2014) argued that the working environment is significantly correlated with wages. People who work in special circumstances will get higher wages while a poor working environment will make people more anxious. Stansfeld S and Candy B (2006) pointed out that the physical working environment will affect people's mood and mental state. People's specific working environment could not be obtained through the survey data. The working environment has an impact on income and obesity.

There might be potential reciprocal causality problems in this research. The topic discussed in this paper is the impact of obesity on income, but there might be a reverse impact of income on obesity. Nathalie Mathieu-Bolh and Ronald Wendner (2020) established a theoretical model to confirm that income has a positive impact on obesity, in which people's utility comes from foods with different calorie contents. Low-income families prefer high-

calorie foods. A high income could ensure adequate food so that people will not lose weight due to lack of nutrition. Meanwhile, other papers (e.g., Jason E. Murasko 2013) point out that in high-income families, income will exert a negative impact on obesity because high-income families could afford healthier food. High-income people pay more attention to a healthy life than low-income people. In China, there is no perfect econometric analysis to verify whether Chinese people's income will have an impact on obesity. If there is an impact of income on obesity, a simple regression analysis could only conclude that there is a correlation between obesity and income not that obesity reduces the income of the sample.

3.2 Identification Strategy

In this paper, the instrumental variable method is applied to tackle the problem of omitted variables and possible potential reciprocal causality. This paper takes the average BMI of the parents of observation as an instrumental variable.

First, parents' obesity will cause children's obesity. An essential factor in obesity is genes (Heather W. Brown and Jennifer Roberts 2012). Even if the daily exercise time, rest time, eating habits, and other factors of the two samples are the same, the final degree of obesity will differ. Genes play a decisive role in energy conversion and absorption. Parents often have a gene prone to obesity, which will be passed to their children and make them prone to obesity (Margaret M Demment, Jere D Haas, and Christine M Olson 2014).

In addition, parents decide their children's eating habits (Scott W. Powers, et al. 2006). In Chinese families, it is most common for parents to cook every day, hence parents' eating habits determine their children's eating habits. A reasonable diet will keep the family's BMI within a normal range. If

a family's diet contains many carbohydrates or takes in much salt through diet, the family will have a high probability of obesity. Moreover, the eating habits formed in adolescence largely determine the eating habits in adulthood. The sample will also maintain similar eating habits with his or her parents after adulthood. Therefore, the BMI index of parents will affect the BMI index of children (Jingyu Chen, et al. 2021).

The BMI of the observation's parents will not affect the observation's income by affecting the observation's parents' income. If parents' BMI affects observation's income in other ways, the regression model will fail. The income difference between the sample parents is small, which does not affect the difference between obesity and the sample income. (Atkinson A, Trinder C, Maynard A, et al. 1993) discussed in detail how parents' income affects children's income in their book.

This paper avoids this problem by limiting observation's age. The sample applied in this paper are those aged between 35 and 45 years old in 2015, i.e. the year of birth is between 1970 and 1980. China has carried out economic reform since the late 1970s. These observations were born during the period of the market economy. The income of these observations is affected by various market factors, including the impact of obesity on income. However, the parents of these observations were born before 1960, who began to work during the period of China's planned economy when wages were determined by regions and substantially affected by the market. There was no significant variance in the income of observations' parents, hence the impact of the income of observations' parents could be ignored. The differences in observations' income and obesity are not caused by their parents. Herein, the only way for the BMI of the parents of the observations to affect observations' income is by affecting their BMI index, not through the correlation between parents' BMI and income.

This paper applies the China Health and Retirement Longitudinal Study (CHRLS) database to test the dispersion of workers' income during the period of China's planned economy. CHRLS surveyed retired people in 2014 and asked them about their life experiences. The average income before retirement of 595 samples applied in this paper is 1,130, the standard deviation is 1,629, and the mode is 1,000 *yuan*. During the planned economy period, the income of most people was between 500 and 2,500 *yuan*, accounting for 78% of the sample. As indicated by the data, there is no significant difference in income during the planned economy period. Figure 3.5 shows the distribution of income.

(Figure 3.4)

This paper applies the unexpected income of the observation as an instrumental variable to verify whether there is reverse causality. The unexpected income refers to the income obtained through the lottery, state compensation, and inheritance. The amount of this unexpected income is huge, and people could turn one-time unexpected income into permanent income through various portfolios.

The lottery has complete randomness and is not affected by any external factors, but the winning observation will get a high income. The lottery has an extremely significant impact on total income. Similarly, heritage is random and could not be predicted. Heritage does not directly affect the BMI index of the sample. State compensation refers to the compensation provided by the government to the sample due to its expropriation of houses, land, and other properties. The Chinese government has been committed to infrastructure construction for nearly 20 years. The compensation for land expropriated due to the construction of railways, highways, airports, and other public facilities is usually higher than the market value. Therefore, state

compensation also has an essential impact on the income of people. Similarly, the population compensated by the state could be regarded as random and is not directly correlated with the BMI of the sample. This paper applies these random unexpected incomes to investigate whether the change of total income will affect the change of observation's BMI index.

3.3 Data

This paper applies the survey data in the China Health and Nutrition Survey (CHNS) database jointly established by the Chinese Center for disease prevention and control and the University of North Carolina in 2015. About 20000 people in nine provinces of China were randomly surveyed. CHNS contains panel data from seven surveys since 1989 of detailed personal height, weight, various diseases, and other health information. Meanwhile, it contains detailed work information like income and working hours. As a household survey, CHNS contains information about all family members in a family. Therefore, applying CHNS could not only obtain various information of observation but also easily match the observation and his or her parents.

This paper selects observations aged between 35 and 45 years old. During this period, human metabolism slows down, and obesity will appear substantially. As for most of the surveyed population, the parents of the observation have a higher probability of survival when he or she is 35 to 45 years old. If the selected sample is too old, the probability of death of the observation's parents will increase. Then the selected samples have longevity and health genes, which will cause a selection bias. Similarly, if the selected sample is too young, problems will also be caused. When a too young observation is selected, his or her parents will also enter the period of market economy in their prime of life. If the income variance of the parents of the observations is too large, it is impossible to ensure that the obesity index and

income of the sample are not affected by the income of the parents.

In this paper, the people with disabilities and chronic diseases are excluded because these diseases could substantially affect obesity and work efficiency. Although various diseases in the sample could be observed through the data, the labor supply and physical condition of these people are special and the impact of obesity on income also differ from other groups.

The number of observations selected in this paper is 7,721, among which 2,214 were overweight and 575 were obese. The distribution and average wage of obese people are presented in the figure below.

(Figure 3.5)

4 Regression Results

Table 3.2 presents the results of OLS, 2SLS method, and reduced form. Notably, the effect of obesity on income is substantially positive when applying OLS. Applying the IV 2SLS method, it could be found that at the first stage, the BMI of the observation's parents has a significantly positive impact on the BMI. Parents who are obese will make their children obese. At the second stage, the BMI of the observations has a significantly negative impact on income.

(Table 3.2)

When the BMI index increases by 1, the income will decrease substantially by 0.626%. If the BMI of the observation's parents increased by 1, the sample's income will decrease by 0.267%.

To verify whether there is a reverse causal relationship, this paper

applies the IV to detect the impact of income on obesity. The basic regression equation is expressed as:

$$BMI_i = \alpha + \beta \ln(Income_i) + \gamma X_i + \mu_i + \varepsilon_i$$

Two-stage least-squares regression is expressed as:

$$\ln(Income_i) = a_1 + b_1 M + c_1 X_i + e_i$$

$$BMI_i = a_2 + b_2 \ln(\widehat{Income}_i) + c_2 X_i + \epsilon_i$$

$\ln(\widehat{Income}_i)$ represents the estimated logarithmic income while M denotes the average monthly unexpected income of observation i.

(Table 3.3)

Notably, unexpected income has a significant impact on total income at the first stage but does not at the second stage. This regression result presents that there is no reciprocal causality problem in this paper. The results presented in Table 3.2 are the real impact of obesity on income.

Considering men and women might be affected by obesity differently, this paper divides them into two groups according to gender for regression analysis.

(Table 3.4)

The results in Table 3.3 indicate that the impact of obesity on income is more obvious in the male group. For every unit of BMI increase, men's income decreases by an average of 5.9% while women's income decreases by an average of 2.96%.

Apart from income, obesity also makes it more difficult for the samples to get promotions. Afterward, this paper applies the same method to detect the impact of obesity on promotion. There is a strong correlation between promotion and age, hence the age of the samples applied in this paper is between 42 and 45 years old to ensure that the impact of age could be eliminated. The observations who get promotions are difficult to be promoted again in a short time, hence the dependent variable applied in this paper is the number of promotions before the survey. Promotion represents the total number of promotions.

(Table 3.5)

As shown in Table 3.4, obesity also substantially reduces the chances of promotion. For men, BMI increases by 1 unit and the average number of promotions before the age of 42 to 45 decreases by 0.2. Women reduce by 0.15.

5 Outlook

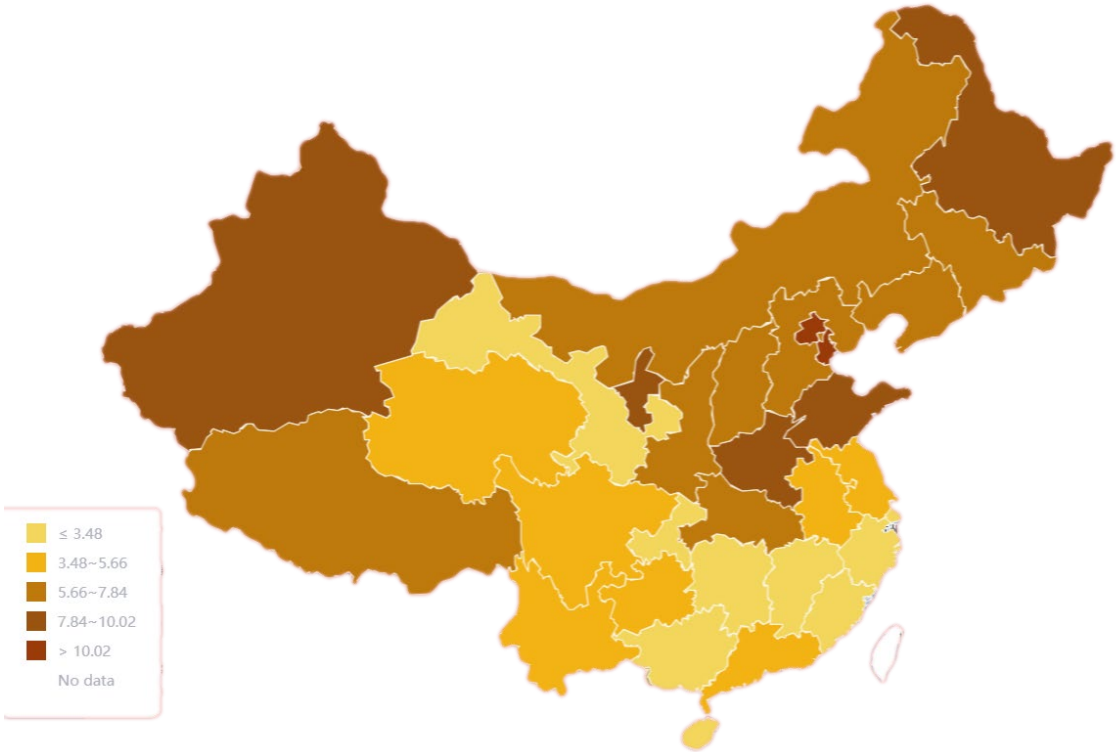
This paper analyzes the impact of obesity on income in China, i.e., an obese person has a lower income than other workers. Compared with other previous studies, this paper applies two instrumental variables and China's special national conditions to tackle the problem of omitted variables.

This paper also confirms that the income of men and women is affected by obesity to different degrees, which provides new research directions. First, there is still a lack of theoretical research to prove why men are more seriously affected, through which channels obesity will the income of men and women be affected, and whether men and women will be treated differently due to obesity in matters like promotion and bonus. These topics

are worthy of further discussion and research.

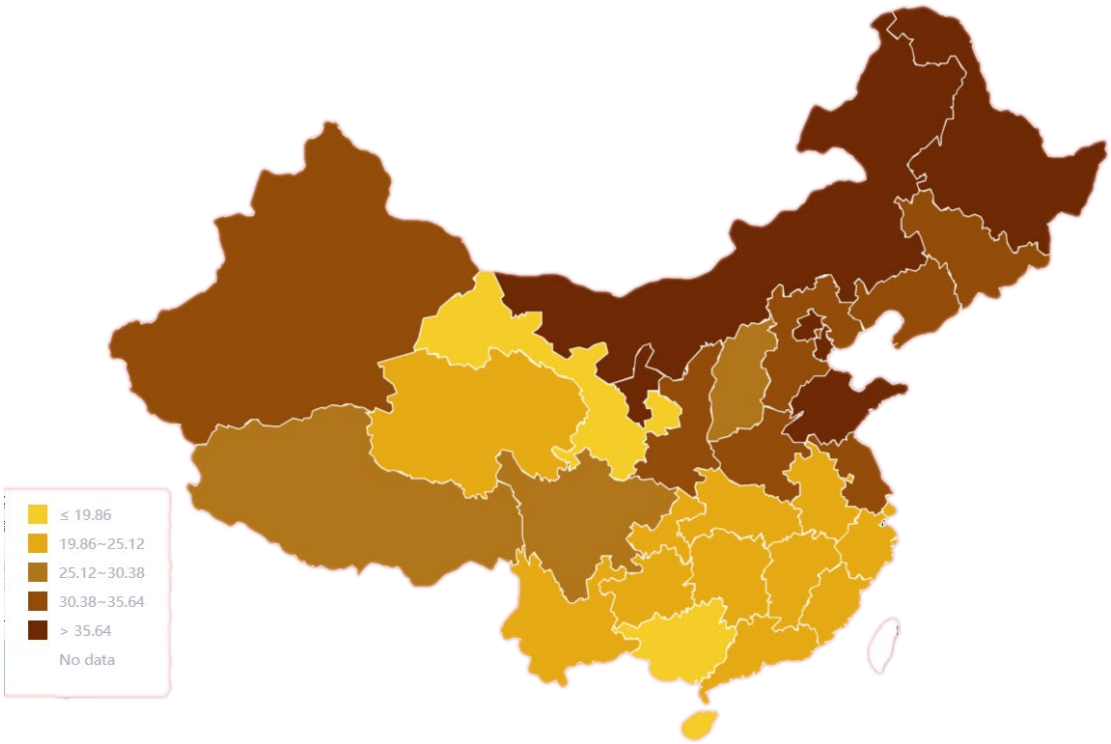
Influence of obesity differ in different age. If there are enough observations, the impact of obesity at different ages on income can be tested. Similarly, the impact of obesity on promotion will change over time. The same subject can use long panel data and duration model to analyze the impact of obesity on promotion.

Figure 3.1 Geographical variation of the obesity rate among Chinese adults.[19]



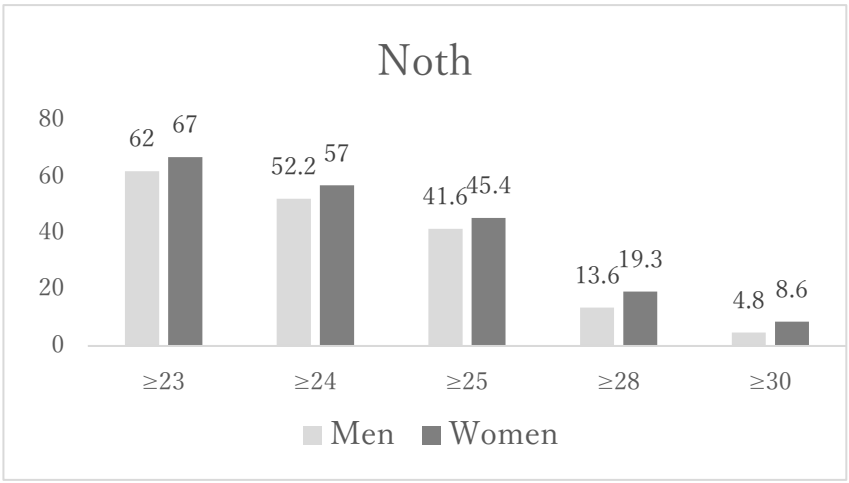
[19] Data source: Data source: Zhang L, Wang Z, Wang X, et al. Prevalence of overweight and obesity in China: results from a cross-sectional study of 441 thousand adults, 2012–2015[J]. Obesity research & clinical practice, 2020, 14(2): 119-126.

Figure 3.2 Geographical variation of the overweight rate among Chinese adults.[20]

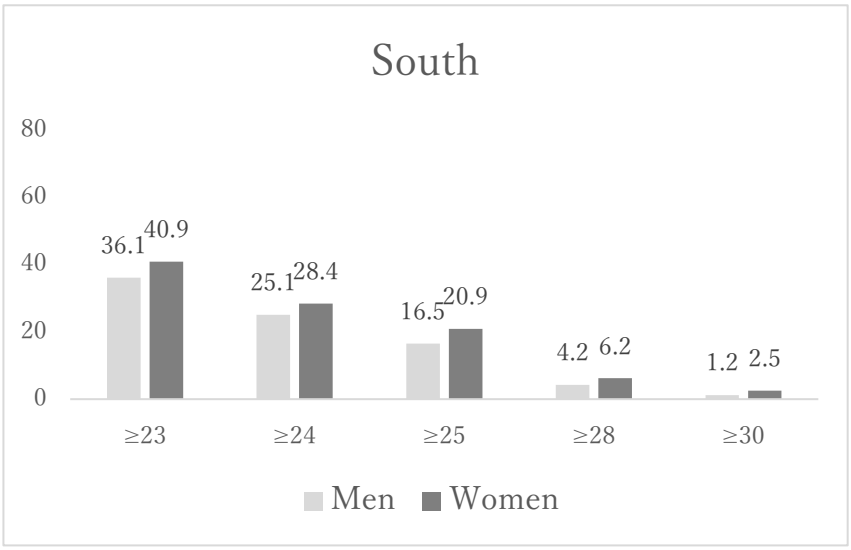


[20] Data source: Data source: Zhang L, Wang Z, Wang X, et al. Prevalence of overweight and obesity in China: results from a cross-sectional study of 441 thousand adults, 2012–2015[J]. Obesity research & clinical practice, 2020, 14(2): 119-126.

Figure 3.3 Proportion of obese people in North and South China.[21]



Proportion of people in the total number of people with weight in each stage in the North China.



Proportion of people in the total number of people with weight in each stage in the South China.

[21] Data source: Reynolds K, Gu D, Whelton P K, et al. Prevalence and risk factors of overweight and obesity in China[J]. Obesity, 2007, 15(1): 10-18.

Figure 3.4 Distribution of income in the period of planned economy.

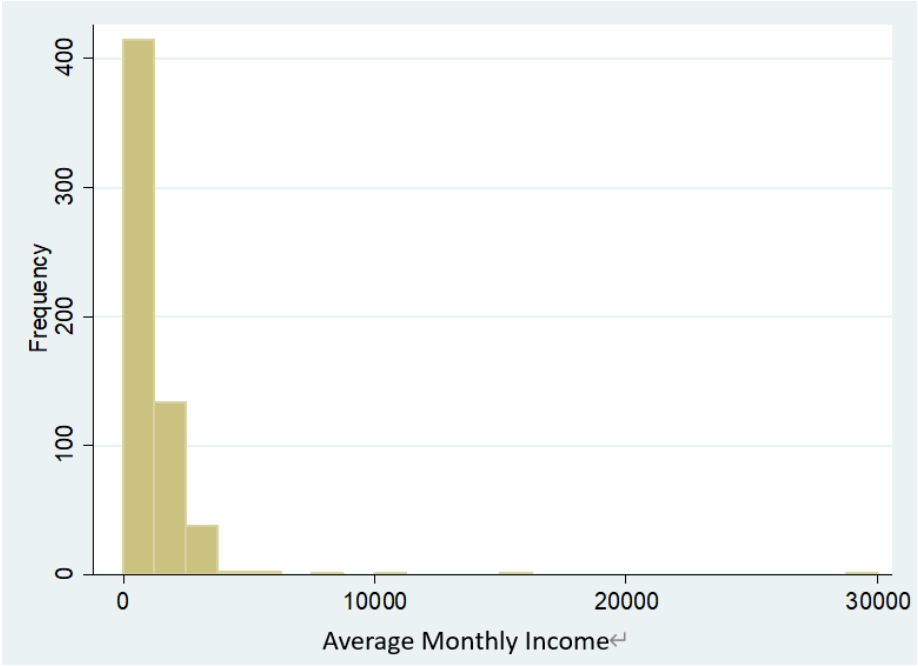


Figure 3.5 Scatter diagram of income and BMI.

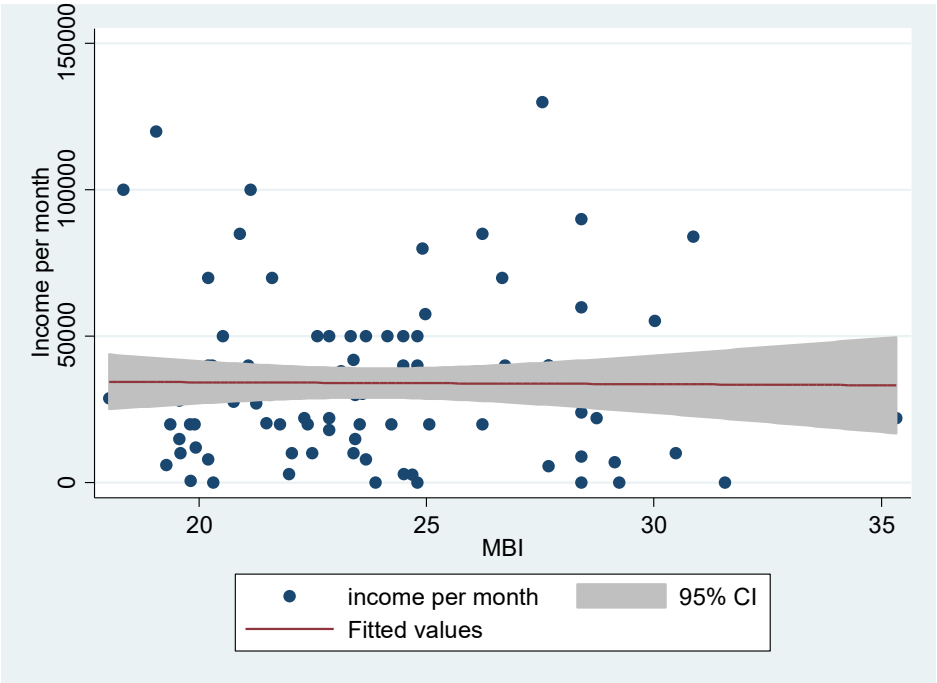


Table 3.1 Commuting time in major cities in China.[22]

City	Average Commute Time	Proportion of people commuting for more than 120 minutes
Beijing	94	27
Shanghai	80	17
Chongqing	80	17
Tianjin	78	15
Wuhan	78	14
Chengdu	78	13
Qingdao	78	14
Guangzhou	76	13
Nanjing	76	13
Dalian	76	13
Shenzhen	72	12
Shenyang	72	12
Zhengzhou	72	10
Hangzhou	70	11
Xi'an	68	8

[22] Data source: Commute monitoring report of major cities in China in 2021 by China Academy of Urban Planning and Design

Table 3.2 The results of OLS, 2SLS method, and reduced form.

	OLS	2SLS		Reduce Formce
Ln(Income)		1stage	2stage	
BMI	0.01832***		-0.62621***	
	(0.0043)		(0.2334)	
Parents BMI		0.30979***		-0.15131***
		(0.0136)		(0.0536)
Age	0.00920***	0.09353***	0.01934***	0.01834***
	(0.0016)	(0.0046)	(0.0024)	(0.0019)
Gender	0.26018***	1.75859***	0.29429***	0.27513***
	(0.0341)	(0.0928)	(0.0471)	(0.0349)
Work hours per month	-0.00121	-0.00131	-0.00155	-0.00306
	(0.0008)	(0.3844)	(0.3239)	(0.0054)
Num of obs	4388	3821	3821	3821
Regional fixed effect	YES	YES	YES	YES

3.3 Table reciprocal causation test.

	OLS	2SLS		Reduce Formce
BMI		1stage	2stage	
Ln(Income)	0.21595***		-0.02791	
	(0.0517)		(0.0488)	
Ln(Unexpected income)		0.74529***		0.044481
		(0.2107)		(0.0269)
Age	0.07023***	0.01834***	0.04485***	0.09471***
	(0.0053)	(0.0019)	(0.0058)	(0.0135)
Gender	1.7777***	0.2751***	0.37325***	2.21689***
	(0.1148)	(0.0349)	(0.1061)	(0.2434)
Work hours per month	-0.00015	-0.00157	-0.01022***	-0.00461
	(0.0028)	(0.1543)	(0.0027)	(0.0078)
Num of obs	4388	3683	3683	3683
Regional fixed effect	YES	YES	YES	YES

Table 3.4 The effects of obesity on men and women, respectively.

	Male	Female
Ln(Income)	(1)	(2)
BMI	-0.51902***	-0.23960***
	(0.0201)	(0.00328)
Age	0.01587***	0.03471***
	(0.0027)	(0.0060)
Work hours per month	-0.0014	-0.00103
	(0.0010)	(0.0021)
Num of obs	2704	1117
Regional fixed effect	YES	YES

Table 3.5 The impact of obesity on promotion.

	Male	Female
Promotion	(1)	(2)
BMI	-0.20142***	-0.15277***
	(0.0573)	(0.04565)
Work hours per month	0.04442**	0.02216*
	(0.0202)	(0.0138)
Num of obs	841	287
Regional fixed effect	YES	YES

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