Association between retirement status, savings and geriatric depression in China

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จุฬาลงกรณ์มหาวิทยาลัย
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ความสัมพันธ์ระหว่างสภาวะเกษียณ การออม และภาวะซึมเศร้าของผู้สูงอายุในประเทศจีน

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ประเทศจีนได้ประสบปัญหากับสังคมผู้สูงอายุและนโยบายการเกษียณในวัยหนุ่มสาว ซึ่งทำให้ปัญหาด้านสุขภาพจิตของผู้เกษียณอายุเป็นหนึ่งในปัญหาสำคัญ มีการศึกษาส่วนน้อยเท่านั้นที่ได้ศึกษาเกี่ยวกับความสัมพันธ์ระหว่าง การเกษียณอายุ การออมและภาวะซึมเศร้าของผู้สูงอายุในประเทศจีน การศึกษานี้ใช้ข้อมูลจาก CHARLS ปี 2558 ในการศึกษาความสัมพันธ์ระหว่าง สถานะการเกษียณอายุ การออมและภาวะซึมเศร้าในผู้สูงอายุที่มีอายุ 45 ปีขึ้นไป โดยควบคุมปัจจัยอื่น ๆ เช่นสถานะทางสังคมและเศรษฐกิจ สถานะสุขภาพกาย หนี้สินและประกันสุขภาพ การศึกษานี้ใช้โมเดลโลจิสติกส์ และ OLS regression ผลการศึกษาพบว่าไม่มีความสัมพันธ์อย่างมีนัยยะสำคัญระหว่าง การเกษียณอายุ และการทำงานหลังการเกษียณอายุ ต่อภาวะซึมเศร้า อย่างไรก็ตามพนักงานที่เพิ่งเกษียณอายุและไม่ได้ทำงานหลังเกษียณมีโอกาสน้อยที่จะได้รับผลกระทบจากภาวะซึมเศร้า เงินฝากออมทรัพย์มีความสัมพันธ์กับภาวะซึมเศร้าของผู้สูงอายุ เนื่องจากผู้สูงอายุที่มีเงินออมสูงขึ้นมีโอกาสที่จะเกิดภาวะซึมเศร้าน้อยลง ตัวแปรควบคุมอื่น ๆ เช่น เพศ การศึกษาการมีส่วนร่วมทางสังคม ที่อยู่อาศัย โรคเรื้อรังและหนี้สินมีความสัมพันธ์กับภาวะซึมเศร้าอย่างมีนัยสำคัญ การศึกษานี้แสดงให้เห็นว่า นอกจากนโยบายส่งเสริมสุขภาพของผู้สูงอายุแล้ว รัฐบาลควรส่งเสริมเรื่องการออม การมีส่วนร่วมทางสังคม และการจัดการที่อยู่อาศัยของผู้สูงอายุด้วย

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Against the background of an aging population and a mandatory retirement policy at relatively young ages in China, mental health problems of the retired elderly have attracted more and more attention. Yet, only a few studies have looked at the association between retirement status, savings and geriatric depression in China. Using data from the CHARLS (China Health and Retirement Longitudinal Study) 2015 Wave, this thesis aims to find the association between retirement status, savings and geriatric depression of those aged 45 and above, controlling for other factors such as socioeconomic status, risky health behavior, physical health status, debt, and health insurance. Logistic and OLS regression models were estimated. This thesis contributes to the literature by taking into account whether retired people are still working or not, investigating the relationship between savings and depression, and examining possible interaction effects between retirement status and savings.

The results show that there is no significant relationship between retirement and depression. Working after retirement, similarly, does not have relationship with depression. However, recently retired employees who did not work after retirement are less likely to suffer from depression. Savings are found to have a significant association with geriatric depression. The elderly with higher savings has a lower probability of suffering from depression. Control variables like gender, education, marital status, social participation, living arrangement, chronic disease and debt have a significant relationship with depression.

In line with the active aging framework, these findings show that policies and programmes should not only promote physical health, but also savings (security), living arrangement and social participation.

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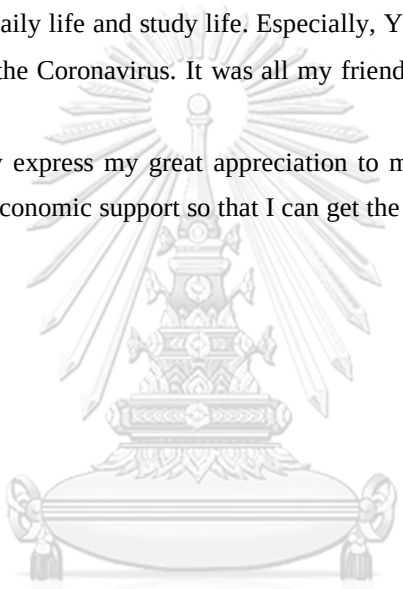

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CHAPTER I

INTRODUCTION

1.1 Motivation

Depression is a common but severe mood disorder in which symptoms affect feelings, thoughts, motivation, and the ability to cope with daily activities and functions (APA, 2013). In both developed and developing countries, depression is an important public health problem. By 2017, according to the WHO, there were 322 million people (4.4% of the total population) suffering from depression worldwide. Depression is essentially a recurrent disease, usually lasting from a few months to a few years, with a normal period in between (Thornicroft & Sartorius, 1993). Those affected may self-injure or commit suicide. Fifteen percent of the most severe cases of depression end their lives by suicide (WHO, 2017). As measured by Years Lived with Disability (YLDs), the World Health Organization predicted depression is expected to be the leading cause of disability by 2020 (WHO, 2001). Fifteen years later, the global disability attributed to depression has increased by 45 % rendering them the leading cause of years lived with disability (Meffert, Neylan, Chambers, & Verdeli, 2016). Asia not only has the largest population but also the largest number of cases of depression. Nearly half of those people who has depression lived in the WHO South-East Asia Region and WHO Western Pacific Region. The rate is 27% and 21% respectively of the total estimated number of people living with depression. The total number of depressed people in Asia is about twice as high as in North America or Europe (WHO, 2017). The prevalence of depression will continue to increase. It had been analyzed that prevalence had increased by 18.4% from 2005 to 2015 (Vos et al., 2016).

In 2015, WHO data showed that more than 50 million people in China suffered from depression. Because of its large population, China has more depressed people than any other Asian countries except India. 4.2% of the Chinese population and 4.5% of

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the Indian population suffered from depression in 2015 (WHO, 2017). But by 2019, more than 90 million Chinese (7% of the Chinese population) were suffering from depression, according to the China Mental Health Survey (CMHS). Only four years, the number of depressed people were almost doubled. China is facing an increasing number of people suffering from depression due to the rapid development of economy and social change in the past 30 years which brings pressure and stress to Chinese citizens (Y. Huang et al., 2019).

At the same time, China has an aging population. It makes the situation even worse because older people have a high risk to have depression (Tang & Wang, 2005). Research had shown that among all age groups in China, the elderly over the age of 50 is the most likely to have depression and about 37% of the elderly in China has depression (Y. Huang et al., 2019). This is confirmed by the results of a survey of retired elderly people in Beijing, China found that the incidence of depression among retired elderly people was 38.4% (Wei & Jing, 2014).

Retirement and economic status (income and savings) are the main factors affecting depression in old age (Dave, Rashad, & Spasojevic, 2006; Wei & Jing, 2014; Xu, 2012; W. Zhang, 2002). Using 2012 data from 32 elderly patients with severe depression in Jinan central hospital, after three months of intervention treatment, Xu (2012) found that retirement is one of the main factors leading to depression in the elderly. Retirement at normal retirement age led to a 4%-6% rise in mental illness and a 6%-9% decline in mental health, while the negative effects were reduced when a person was married or continued to work in their spare time (Dave et al., 2006). Another study analyzed the determinants of depression among all the elderly in Shanghai, China and confirmed that retirement leads to depression among the elderly. The main reason given is that there are not many jobs available for the elderly, with only 7.5% of Shanghai's elderly returning to work after retirement (W. Zhang, 2002). Wei & Jing (2014) argued that retirement may cause depression because retirement leads to a change of social status. The retirees used to have stable incomes and good

social status. But after retirement, their income and social status can change greatly (Wei & Jing, 2014). Economic status (income) is an important factor affecting the prevalence of depression in the elderly. With a good economic status, the elderly will not worry about difficulties in life, and they can get better medical services when they get sick, can participate in more activities they like because rich life contents are conducive to mental health (Wang, 2015). One form of economic status for retirees is savings. Some scholars had concluded that low savings will lead to a decline in the living standard of retired elderly people, worsening the mental health of retirees (Schofield et al., 2011).A study using 1993 Multi-dimensional Longitudinal Study on Aging in Beijing also found that socioeconomic factors have a significant impact on depression and age and gender had less impact on depression than income (Meng & Tang, 2000).

However, a study using 2012 China Family Panel Studies (CFPS) data found that there is a significantly positive relationship between retirement and mental health meaning retirement can lead to an increase in mental health (Deng & He, 2016). Another study using four wave data from the Survey of Health, Ageing, and Retirement in Europe (SHARE) noticed that due to the pension system may subside relatively quickly following retirement there is a negative association between retirement and mental health in long term meaning retirement causes the deterioration in mental health, but retirement does not affect mental health in the short-run (Gabriel Heller-Sahlgren, 2017). Lee and Smith (2009) using 2006 baseline wave of the Korean Longitudinal Study of Aging, a large longitudinal survey of the Korean population aged 45, however, found that retirement by itself does not cause depression and that there is a positive relationship between good financial position and depression. All of those studies do not consider the effect of interaction terms (savings*retirement status). However, in China, retirement often represents a decrease in income and a change in economic conditions (Wei & Jing, 2014). Savings of retired and not retired may different. One possibility is that retired people would have

more savings and possibly lower probability to suffer from depression. And not retired people have more savings, the probability of having depression is likely to be higher. Another possibility is that if people have a lot of savings, whether they retire or not, the probability of depression will be low. But under the condition of retirement, the relationship may be more pronounced. Thus, adding an interaction term of retirement and savings can better reflect the relationship between the model and the variables (Cuntong, 2016).

Some studies using data from the China Health and Retirement Longitudinal Study (CHARLS) have drawn multiple conclusions about the determinants of mental health. One study specifically looked at those retired but still working using Propensity Score Matching, and found that working after retirement significantly improves the mental health of the young elderly (aged 60-65), but does not affect the overall health of the old elderly (> 65) (Q. Huang & Yu, 2019). Huang and Yu (2019), however, did not consider retirement savings in their study. Good financial status including savings has a negative correlation of depression (proxied by CES-D 10) and it means that having good financial status is an effective way to reduce the probability of depression in the elderly (Xia, 2018). However, Xia's article did not add the public housing fund into savings variable and also did not consider retirement and the interaction term between retirement status and savings. Most of literatures using retirement status as independent variable and the data from CHARLS did not consider people who still work after retirement and people retired and not work or looked at retirement and savings (Q. Huang & Yu, 2019; Song Li, 2017; Tianwen Li, 2016; Xia, 2018). Thus, the existing researches cannot clearly show the association between retirement status, savings and depression.

Many other factors can affect depression such as socioeconomic status, risky health behavior, physical health (Cuntong, 2016; Guo et al., 2017; Lei, Sun, Strauss, Zhang, & Zhao, 2014; Meng & Tang, 2000; Xia, 2018). Gender differences are particularly striking, and females having consistently been found to have higher depression scores

(Lei et al., 2014; Xia, 2018; xiuli Li, Runlian He, & Hongmei Yu, 2015). There is a cause and effect relationship between risky health behavior like smoking and depression in which smoking increases the risk of symptoms of depression (Boden, Fergusson, & Horwood, 2010; Fergusson, Goodwin, & Horwood, 2003). Physical health and depression are closely related, and impaired physical health is an important risk factor for depression in the elderly (Akhtar-Danesh & Landeen, 2007; Nan et al., 2012).

The commonly used depression scales in both English and Chinese are: Beck Depression Inventory (BDI), Hamilton Depression Scale (HAMD), Center for Epidemiological Studies Depression Scale (CES-D) and Patient Health Questionnaire Depression Module (PHQ), but most studies employ CES-D 10 because in China, CES-D and its simplified version are widely used to evaluate depression in communities, rural areas or other populations (Niu & Li, 2010).

This thesis aims to find out what the association of retirement status and savings on depression (proxied by CES-D) of the Chinese elderly is, controlling for other factors. As savings may affect the relationship between retirement and depression, an interaction term between retirement and savings is added.

Retirement means an individual's voluntary or involuntary withdrawal from the labor market. There are four kinds of retirement types in China, including normal retirement, early retirement, internal retirement and receding position procedure (L. Zhang, 2015). However, no distinction between the four types is made in this study due to data limitations. CHARLS 2015 data of three groups of people aged 45and above are used, (1) people not retired and not retired, (2) people retired and not working, and (3) people retired and working. This thesis contributes to the literature in four ways. First, it examines the association between retirement status and depression using regression analysis, taking into account whether people are still working or not. Second, it looks at the relationship between savings, retirement status and depression. Third, it investigates interaction effects between retirement status and savings. Fourth, in

contrast to previous papers, this thesis uses data from the latest CHARLS 2015 wave published in 2019.

1.2 Research objective

The main research objective of this study is to explore the association between retirement status, savings and geriatric depression in China.

The specific research objectives of this study are:

1. To analyze the relationship between different retirement status (depending on whether people are working after retirement or not) and depression.
2. To examine the association between savings and depression.
3. To explore the association of an interaction effect of retirement status and savings with depression.

Depression is proxied by CES-D. As CES-D not only has a well-defined cut-off point but also continuous scores, the depression variable is treated as a binary variable and alternatively as a continuous variable.

1.3 Scope

This study is using China Health and Retirement Longitudinal Study (CHARLS) 2015 Wave data, which can represent the overall elderly in China and includes 21,095 observations of over 45 years old, to explore the association between retirement status, savings and geriatric depression in China. The survey data were collected in 2015. After data collation and input, the data were published parts by parts every year. It was not including all data or information unit 20th June, 2019. The population of this study included Chinese over 45 years old who were working in formal organizations. There are 10,622 people working in formal organizations. Farmers or self-employed people do not need to sign formal labor contracts, leaving the labor market or not is out of control by relevant department and retirement police. Thus, it is hard to judge or predict when they will drop out of the Labor market. Therefore, this study excluded this group from the population.

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1.4 Hypotheses

The hypotheses for this study are:

(1) Retirement has a positive relationship with depression (proxied by CES-D 10) meaning that retirement can lead to a higher CES-D score and more depressive symptoms. Thus, retirement may cause the depression because the suddenly change of social status and income (Wei & Jing, 2014).

(2) Retired (but working after formal retirement) has a negative association with depression in the elderly that means working results in lower CES-D 10 score and reduce the incidence of depression among the elderly.

(3) There is a negative association between savings and depression (CES-D 10) meaning that the more money older people save, the less likely they are to suffer from depression. Because if retirees have enough savings, they will not worry about the difficulties of life and spend more time on some activities which is good for their mental health (Wang, 2015).

The interaction term between savings and retirement will have a negative association with depression because retired people would have more savings and possibly lower probability to suffer from depression.

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1.5 Benefits

As people's life expectancy increases and more and more people join the retirement population, China's pension fund is facing great pressure, and delaying retirement can effectively relieve the financial pressure (S. Liu & Lang, 2017). Currently, the Chinese government is considering implementing the policy of gradually delaying retirement to cope with the aging population and the pension shortage, but the delayed retirement cannot be at the expense of the health of the elderly population (Q. Huang & Yu, 2019). This study explores the relationship between retirement status, savings and depression so that the conclusions of this study provide some evidence for the mental health consequences of retirement / working after retirement. In addition, if

people know the association between savings and geriatric depression. This could remind older people to adopt rational spending and saving habits.

There are many factors can affect depression and this study includes many variables as control variables. Though this study, elderly can know which factor may improve mental health and which one may result in worse mental health. The elderly themselves or the government can take the conclusions of this study as a reference to prevent or reduce geriatric depression.

CHAPTER Ⅱ

BACKGROUND

2.1 Basic information of China and aging population in China

People's Republic of China (China for short), founded on October 1, 1949, is located in east Asia. The capital of China is Beijing and China is a multi-ethnic country with the Han nationality as the main body and composed of 56 ethnic groups. China has 23 provinces, 5 autonomous regions, 4 municipalities directly under the central government and 2 special administrative regions. China is a developing country with the largest population in the world and the world's second largest economy, and continues to be the largest contributor to world economic growth (NBSC, 2016).

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China has entered an aging society, according to the national bureau of statistics. In 2018, China's elderly population aged 60 and above reached 249 million, accounting for 17.9% of the total population. The number of people aged 65 and above reached 167 million, accounting for 11.9%. And according to the world population prospects (WPP 2019) released by the United Nations population division in 2019, it is predicted that the size of China's elderly population will reach a peak in 2055-2060 in this century. The number of people aged 60 and over reached 488 million, and the number of people aged 65 and over reached 398 million. The current to 2060 will be the fastest aging period. The specific forecast data are as follows: in 2020, China's

degree of aging (proportion of the population aged 65 and above) is 12.0%, ranking 57th in all countries in the world, about 1.2 percentage points higher than the upper middle-income countries. In 2035, China's degree of aging will be 20.7%, ranking 44th in the world, about 4 percentage points lower than the average level of developed countries and 3 percentage points higher than that of upper middle-income countries, which was in line with the United States (21.2 %) and Norway (21.8 %).In 2050, China's aging level reached 26.1%, ranking 33rd in the world, which is in line with the average level of developed countries (26.9%) (UN, 2019). The aging trend of China's population is irreversible. Thus, as the number of the elderly increase increases, geriatric depression will be a big problem in the future. Because people over 50 are more likely to suffer from depression (Y. Huang et al., 2019). And recurrence rates are higher of people over 45 years of age (Thornicroft & Sartorius, 1993).

2.2 Retirement policy

The Chinese retirement system was established in the 1950s to cover government employees and workers in government-run enterprises. In the 1950s, because the government nationalized nearly all private businesses and self-employment was nearly eliminated, the retirement system effectively covered all workers before the economic reform. Chinese retirement policy is mandatory policy and the retirement ages have not changed since the retirement system's inception in the 1950s, meaning that workers must retire when they reach retirement age (X. Lei, L. Tan, & Y. J. U. M. Zhao, China Center for Economic Research, Peking University, Peking, 2011b). Thus, self-employment and farmers are unlikely to enforce retirement policies. This study drops people who is farmer or self-employed.

China has some of the world's youngest not only compared with deployed countries such as USA, South Korea, and Japan, and similar retirement age with Western Europe but also some developing countries (Lei et al., 2011b). The official retirement age is: age 60 for men, age 50 for blue-collar women, and age 55 for white-collar

women. However, there are some exceptions. For those who are engaged in underground work, high-temperature work, high-altitude work, especially heavy manual labor or other work harmful to health, the retirement age shall be 55 for male and 45 for female. Where the employee is disabled due to illness or non-work-related disability and is certified by the hospital and confirmed by the labor appraisal committee to be completely incapacitated, the retirement age shall be 50 years old for the male and 45 years old for the female (Tianwen Li, 2016).

In addition to normal retirement, there is also an internal retirement and early retirement in China. Early retirement refers to the behavior of the civil servant, the worker of the public institution or the enterprise worker who does not reach the retirement age but withdraws from the work place and receives the pension. China has not defined the concept of early retirement, but has stipulated the conditions for the implementation of early retirement policy. Thus, according to the civil servant Law, there are conditions of early retirement policy: normal workers who have worked for 20 years but the legal retirement age is still five years away; Or the institution staff or civil servants who already have worked around 30 years, they can voluntarily apply for early retirement upon approval; In a state-owned enterprise, a male employee whose age is 50, a female employee whose age is 45, or a female employee who has worked for 25 years or more, may leave his/her post in advance with the approval of the organization if he/she wishes to do so (L. Zhang, 2015)..

Internal retirement began in the late 1990s, as China was reforming its state-owned enterprises, a large number of state-owned enterprises failed. In an effort to ease the burden of state-owned enterprises in the process of transformation, the state council issued rules that state employees who are less than five years away from retirement can apply for internal retirement (L. Zhang, 2015). The condition of internal retirement policy is: internal retirement workers are surplus workers of the enterprise (surplus workers mean that the enterprise who because of production and operation difficulties cannot produce and unable to find positions for the workers); less than five

years before retirement; voluntary Application by employees; approval by business leaders; record of labor department. Besides, internal retirement is a modification of the labor contract. This means that the employer and the employee need to change the labor contract together, such as the term of labor, labor remuneration and related benefits. When the internal retired worker that reaches normal retirement age, the enterprise must deal with normal emeritus formalities for the worker. Internal retirement is not only the product of policy adjustment of state-owned enterprises but also the unique management mode of Chinese enterprises (L. Zhang, 2015).
Overall, according to retirement policy, no matter enterprise or authority institution, men's normal retirement age is 60 on, and early retirement age is 55 or 50 years old. The normal retirement age for women is 55 if they are white-collar, 50 if they are not, and 45 if they retire early.

2.3 Pension insurance system

China's pension insurance system began in the early 1950s with the 'Labor Insurance Regulation' and the 'Regulations on The Retirement of State Employees' promulgated by the state (T. Liu & Sun, 2016). China's pension insurance policy has its own special features because it has two separate systems, one for urban residents and one for rural residents. In the urban areas of China, for most of the period before 1978, the pension system was a unified arrangement for state-owned enterprises, urban collective enterprises, government departments and public institutions. Since 1978, the retirement system has made a distinction between the pension insurance for enterprise employees and the pension insurance for organs and public institutions (Yuan, 2001). In recent years, some places have experimented with an old-age insurance system for rural residents, but the number of people covered is very small, and the pension has nothing to do with employment history. According to population type, currently there are four kinds of pension insurance systems in China:(1) Urban Enterprise Pension System (UEPS), (2) New Rural Pension Scheme (NRPS), (3)

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Urban Residents Pension Scheme, (4) Civil Service Pension. Among all of the pension scheme, UEPS and URPS and Civil Service Pension are related to this study, about the pension insurance system for retirees (Lijun & Dongtao, 2016).

UEPS is the most developed covering 60% of the urban workers and it is also a kind of pension insurance that pays jointly by the worker and the enterprise. The pay scale is: the enterprise pays 20% of the worker's total wage, worker individual undertakes 8%. If the worker and the enterprise pay on time and pay around 15 years, when the worker arrived legal age and dealt with emeritus formalities to be able to get pension every month. The amount of money received each month is adjusted according to China's policy. The worker that the pension insurance, after death, his/her family will have additional money (Funeral expenses and one-time pension). Civil service pension has the same pay scale and rules with UEPS. However, Civil service pension will give more pension than UEPS (Pozen, 2013).

China's pension system can also be divided by level. There are four levels of pension insurance in China. The first level is the basic pension insurance, the second level is the enterprise supplementary pension insurance, the third level is the individual savings pension insurance, the fourth level is the commercial pension insurance. Basic pension is paid by 1% of individual average salary and provincial average income every year, and the payment term is at least 15 years. The pension in payment is linked to a mixed index of wages and prices, which has been around 10% in recent years (Whitehouse & Queisser, 2007). Different classification methods cause that China's pension insurance is two-tier. Thus, UEPS or Civil Service Pension is the combination of basic pension and enterprise supplementary pension insurance (Lijun & Dongtao, 2016).

CHAPTER Ⅲ

LITERATURE REVIEW

In this chapter the literature that deals with the association between retirement, savings and depression is explored. All of the studies reviewed are empirical studies. Ordinary least squares (OLS), logistic regression and regression discontinuity design (RDD) are the three models mostly used in current research on retirement and mental health. The reason for results of empirical studies differ greatly maybe because of the differences in data and the methods. For example, when comparing the impact of retirement on mental health between the two groups of people in Canada who were retired and those who were not, different results were obtained by using different methods: the likelihood of depression was reduced because retirement had a significantly positive effect on depression by using OLS regression; If the fixed panel effect model is used, it is concluded that retirement has a positive effect on mental health, but the result is not significant (Latif, 2013). Some studies have found that the accuracy of the Logit is higher than the OLS (Pohlman & Leitner, 2003; Stone & Rasp, 1991). A study based on data from the Michigan Health Retirement Study (HRS) suggested that there is a strong endogeneity between retirement and mental health (Kerkhofs & Lindeboom, 1997). Using RDD can effectively avoid endogeneity and get a stable result. However, the applicable conditions of the model are extremely harsh. That is the sample size into the model is required to be large enough, nearly 100 million or more, and many sample survey data obviously cannot meet this requirement (Cuntong, 2016).

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The literature review is composed of three parts. The first part is the measures used including BDI, HAMD, CES-D and PHQ while due to many survey data use CES-D 10 or CES-D 20 in China this study will review more about the CES-D 10 and CES-D 20. The first part mainly reviews the internal consistency and stability of these measurements and the reasons for using or not using the measurement. The second

part is the variables for what? including dependent variable, independent variables and control variables in the literature and related findings about the variables in different countries or using different data or methods. The last part is the most important part which illustrates the gap between this study and other studies.

3.1 The measures of depression

3.1.1 HAMD and BDI

Hamilton Depression Scale (HAMD) was compiled by Hamilton in 1960, mainly including cognitive disorder, sleep disorder, anxiety/somatization, weight change, despair and other dimensions. HAMD was used to evaluate the condition of the subjects at that time or in the last week, and the depression status of the subjects was estimated according to the total score (Bech Per et al., 1981).

Currently, there are few articles on the reliability and validity evaluation of the Chinese version of HAMD. A study in the 1990s showed that the Cronbach coefficient of the HAMD was > 0.7, test-retest reliability of the HAMD was 0.95. HAMD also had good internal consistency, the scale's convergent validity, criterion validity and discriminant validity. In China, HAMD is widely used by clinicians to evaluate patients' depression (Zhang D, Shu L, & Shen YC, 1993).

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Beck Depression Inventory (BDI) was compiled by Beck, an American scholar, in 1961. The scale consists of 21 items. The higher the score, the more severe the depression. The subjects evaluated themselves for each item based on the situation for nearly a week (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961).

The research on BDI showed that the Cronbach coefficient of the scale was greater than 0.85 and the split-half reliability was 0.88, showing good internal consistency. BDI is commonly used in China to assess the depression status of clinical patients (Zhang YX, Wang Y, & Qian MY, 1990; Zheng YP & Lin K‐M, 1991).

HAMD and BDI are mostly used clinically. They all have good internal consistency and stability. However, the users of HADM are doctors, while the users of BDI are patients themselves.

3.1.2 CES-D and PHQ

Center for Epidemiological Studies Depression Scale (CES-D) was developed by Radolff at the National Institutes of Mental Health in 1977 and is now widely used for preliminary screening for depressive symptoms. CES-D should not be used for clinical purposes or to monitor changes in severity during treatment, but only for epidemiological investigations (Radloff, 1977).There are many studies on the reliability and validity of CES-D, and the results show that CES-D has high internal consistency, reliability and stability, good reliability and is better in the high-risk population of suicide (Chin, Choi, Chan, & Wong, 2015; Fong et al., 2016; Yang, Jia, & Qin, 2015; Zhang Jie, Sun Weiwei, Kong Yuanyuan, & Wang Cuntong, 2012; Y. Zhang et al., 2015).

Table 1 The reliability of CES-D20 in Chinese adults

Authors	Year	Reliability
Chin	2015	Internal consistency(w)=0.86 Test-retest reliability=0.91
Fong	2016	Cronbach coefficient=0.85 Test-retest reliability=0.64
Zhang	2015	Cronbach coefficient=0.94 (Suicidal attempter) Cronbach coefficient=0.90 (normal people)
Yang	2015	Cronbach coefficient=0.9 Correlation coefficient= 0.39 ~ 0.89
Zhang	2012	Cronbach coefficient=0.74 Correlation coefficient=0.59

There were 20 items in CES-D. A survey called China Family Panel Studies (CFPS) using CES-D 20 to investigate depression among Chinese citizens. In the application, it was found that CES-D20 had such problems as too long response time, high emotional load of subjects and sensitive item content, so CES-D10 appeared in the simplified scale. CES-D10 includes 10 items and the cutoff point of CES-D 10 is 10 which means if the score is higher than 10 people may have depressive symptoms (Kohout, Berkman, Evans, & Cornoni-Huntley, 1993). The researcher evaluated the reliability and validity of CES-D 10 in a large sample population, and found that the Cronbach of the simplified scale was all greater than 0.8, and the correlation coefficient between the deleted scale and the original scale was greater than 0.95, which was highly compatible with the original scale. The study also showed that the aggregate validity and discriminant validity of the simplified scale were better (He J, Chen ZY, & Guo F, 2013; Zhang BS & Li J, 2011). Different versions of CES-D scale have higher reliability and validity. In consideration of the compliance of the research object, the accuracy of the research results and the investigation cost, the simplified version can be used for evaluating the depression of general population. Thus, CES-D 10 is widely used to evaluate depression in communities and rural areas of China. For example, a survey called CHARLS using the CES-D 10 to investigate depression in urban and rural areas. However, there are still some problems of CES-D 10 such as limited research objects, and incomplete validity evaluation (Niu & Li, 2010).

Compiled by Professor Robort Spitzer in the 1990s, PHQ is a nine-item screening scale commonly used in clinical depression diagnosis and general population surveys. PHQ -9 has good internal consistency and stability (Kroenke, Spitzer, & Williams, 2001). In most studies, researchers usually use a simplified version of PHQ. However, the internal consistency and stability of the simplified version of PHQ are low, which may be too little related to the items of the scale (Yu, Stewart, Wong, & Lam, 2011; Zhao JB, Li M, & Xiao R, 2013).

3. 2 Previous studies on the factors that affect mental health

3.2.1 Retirement status and mental health

Some studies showed that retirement can improve the mental health. When an RDD was used to estimate the health impact of retirement in the UK, 2009, it was found that retirement improved the mental health of the elderly because retirement removes work-related stress and increases time for leisure activities, but had no effect on their physical health. But the author also pointed out that this was only a short-term health effect, not suitable for medium or long-term studies (Johnston & Lee, 2009). While some studies found that retirement can lead to a decline in the mental health. A study using the panel data of 11 European countries from 2010 to 2011 and instrumental variable methods to deal with endogeneity found retirement has a statistically significant negative relationship with mental health in the long-term health meaning retirement causes worse mental health (Gabriel Heller-Sahlgren, 2012).

Similar with studies in other countries, some Chinese researchers also found that retirement helps promote the mental health of the elderly in China. Deng and He (2016) using RDD and data from CFPS, treated retirement as a binary variable and noticed that there is a positive relationship between retirement and mental health meaning retirement can lead to an increase in mental health, but retirement does not affect physical health. Because the retirees thought retirement reduces stress and increases life satisfaction. By using the same data and RDD, Liu, S. and X. Lang (2017) found that retirement results in better women's physical and mental health. This is because the authors found that the main mechanism by which retirement affects women's health is exercise. Since retirement, Chinese women have been exercising more, which has led to significant improvements in women's self-reported health and mental health.

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On the contrary, Cuntong's (2016) article on the health effects of retirement on the elderly, using data from the 2010 China General Social Survey (CGSS) and three models (OLS, Tobit, Probit) treated retirement as a binary variable and shown that the retirement leads to a decrease in the mental health among Chinese citizens. Using multiple regression and data from 344 elderly people from Hubei province, China who had retired, Wang (2015) also found that there was a negative effect on mental health meaning retirement results in worse mental health and the mental health of the retirees was poor. Lei (2011) using 1% National Population Sampling Survey data in 2005 in China and the RDD found that retirement has a significant negative effect on men's mental health meaning retirement reduces the mental health of male, retirement has no effect on women. Xu (2012) using the data from Jinan hospital and logit found retirement causes worse mental health of the elderly because when retired people lose their jobs, the focus of their lives will change, and their colleagues will become estranged from each other. As a result, they will feel disappointed with their old age, which will lead to greater psychological pressure. With the same reasons, Huang (2015) found that retirement can lead to a decline in the health of older people.

Studies using CHARLS data and retirement as a binary variable also found there are different relationship between retirement status and mental health. A study using fuzzy regression discontinuity design (FRD) found that there is a negative relationship between retirement and mental health. Retirement can reduce the mental health of male because retirement cannot change their behaviors (smoking and drinking) which leads to the decline of mental health (Tianwen Li, 2016). While by using the same data and method another study found that retirement has no effect on health. Li song (2017) noticed that retirement did not have a significant impact on the mental health of both men and women. Huang and Yu (2019) considered the different retirement status (working after retirement) using logit regression and Propensity Score Matching found that although working after retirement can improve the daily

activities of elderly over 65 years old meaning that the physical health can be improved by working after retirement and working after retirement can improve the mental health of the elderly under 65, the mental health of elderly over 65 dropped dramatically. Thus, working after retirement does not affect health of the elderly over 65 years old on the whole.

Table 2 Relationship between mental health and retirement

Author	Year	Method	Sign	Result
Studies in other countries				
Johnston & Lee	2009	RDD	+	Retirement improved the mental health of the elderly
Gabriel Heller-Sahlgren	2012	IV	-	Retirement causes worse mental health
Studies in China				
Deng & He	2016	RDD	+	Retirement can lead to an increase in mental health.
Liu, S. & X. Lang	2017	RDD	+	Retirement results in better women's physical and mental health
Cuntong	2016	OLS, Tobit, Probit	-	Retirement leads to a decrease in the mental health.
Wang	2015	Multiple regression	-	Retirement results in worse mental health.
Lei	2011	RDD	-	Retirement reduces the mental health of male

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Xu	2012	Logit regression	-	Retirement causes worse mental health of the elderly.
Huang	2015	Logit regression	-	Retirement can lead to a decline in the health of older people.
Studies using CHARLS				
Tianwen Li	2016	FRD	-	Retirement can reduce the mental health of male.
Li song	2017	FRD	/	retirement did not have a significant impact on the mental health of both men and women.
Huang and Yu	2019	Logit regression and Propensity Score Matching	/	retirement can improve the mental health of the elderly under 65, while no effect on the elderly over 65.

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3.2.2 Savings and mental health

There have been many studies that have looked at the relationship between income or economic status and depression (Meng & Tang, 2000; Tan Ping & Zhang Ze-dan, 2013; Wang, 2015). However, there are few Chinese studies looked at the relationship between savings and depression. Xia (2018) used retirement savings including cash and deposit found there is a significant relationship between savings and depression.

A study in USA using the Panel Study of Income Dynamics (PSID) and the Health and Retirement Study (HRS) found that mental health problems have a large and significant negative effect on retirement savings. Specifically, mental health is

associated with decreasing retirement savings as by as much as 67 percentage points (Bogan & Fertig, 2018). Similarly, other study in USA using HRS also found that mental health causes the decrease of retirement savings (Bogan & Fertig, 2013).

One study in China using multivariate ordered logistic regressions and data from a survey conducted in China in 2015 found that people with enough savings were 0.36 times less likely to have mental health problems than those people with financial problem meaning savings result in a better mental health (D. Chen, Petrie, Tang, & Wu, 2018). Many studies also have found a negative relationship between economic status and depression meaning people with good economic status has the lower score and lower probability of depression (H. Huang, 2015; Meng & Tang, 2000; Xia, 2018; Xu, 2012). Meng and Tang (2000) also found that one reason rural elderly people are more likely to suffer from depression than their urban counterparts is because of poor economic conditions.

Xia (2018) using CHARLS treated savings as a continuous variable found that there is a significantly negative relationship between savings and depression which means the more the elderly saves, the healthier and lower CES-D10 score they are. Compared with the old elderly (>75), savings has a greater impact on the probability of depression in the young elderly (60~74 years old), and increasing savings and pension by 1% can reduce the probability of depression by 0.8 percentage points. It may be related to the young elderly's strong self-care ability, high expectation of consumption and strong demand for materials. However, the old elderly always receives more financial support from their children after the decline of self-care ability, so the impact of savings on depression is no longer significant (Xia, 2018).

Table 3 Relationship between savings and mental health or depression

Author	Year	Sign	Result
Bogan & Fertig	2018	-	Mental health is associated with decreasing retirement savings.
Bogan & Fertig	2013	-	Mental health causes the decrease of retirement savings.

D.Chen et al	2018	+	Savings result in a better mental health.
Many studies	2000-2018	-	Good economic status has the lower score and lower probability of depression.
Xia	2018	-	The more the elderly saves, the healthier and lower CES-D10 score they are.

3.2.3 Socioeconomic status

Many studies have found that socioeconomic factors are related with physical health and mental. A study using Tobit and OLS found that there was a significant relationship between socioeconomic factors and physical health. For example, People's health declines as they get older; Men have lower health status than women; The health status of the married people was better than that of the non-married; The higher the education level is, the better the health condition is.; The higher the income or pension of the individual, the better the individual's health (Cuntong, 2016).

A study using logistic regression also found that there was a significant relationship between socioeconomic factors and mental health. For example, the risk of depression increases with age increases.; Women are more likely to suffer from depression than men; The lower the level of education, the more likely to suffer from depression (Hu, 2018). Similarly, Meng and Tang (2000) using logistic regression found also that income, sex and age were the main factors affecting depressive symptoms and scores of depressive symptoms tended to rise among farmers, women and the elderly.

Age

Age is included in almost every article on the relationship between retirement and mental health and usually treated as a continuous variable. According to the results of one study, the detection rate of depression gradually increases as the elderly age growing, mainly because the incidence of physical diseases will increase, which increases the risk of depression (Hu, 2018). Similarly, Meng and Tang found (2000)

the older people get, the more likely they are to suffer from depression. The higher prevalence of depression in older adults may also be due to a variety of illnesses and mental stress (Tan Ping & Zhang Ze-dan, 2013).

Gender

Similar to age, gender is included in almost every article about retirement and mental health and treated as a binary variable. Using different data and method may cause different results. Deng and He (2016) using RDD and data from CFPS found that retirement had a significant positive effect on men's mental health meaning retirement results in an improvement of men's mental health because their life satisfaction increased after retirement, leading to better mental health. Different from Deng's results, a study using 1% National Population Sampling Survey data in 2005 in China and the RDD found that mandatory retirement had a significant negative effect on men's mental health and no effect on women. Voluntary retirement had no effect on the health of either men or women (X. Lei, L. Tan, & Y. Zhao, 2011a). By analyzing the detection rate and characteristics of depression among the elderly in 7 provinces and cities in China, Hu (2018) using logistic regression found that the detection rate of depression among the elderly in women was higher than that among men which means women have a higher risk of depression than men. Similarly, a study using CHARLS also found that women have a higher risk (Fen Zhang, Guanying Huang, & Weiqiang Zhuang, 2014).

Education

Most studies not using CHARLS treated education as a binary variable. Tan Ping and Ze-dan (2013) using logistic regression and data from a random survey of people over 60 years of age found that the lower the level of literacy, the higher the rate of depression detection, and that the rate of depression increased by about 4 percent for

every level of literacy. Another study also showed a higher rate of depression in the less educated elderly (Park Joon Hyuk, Kim Ki Woong, & Myoung-Heeet., 2012). Some studies using CHARLS treated education as a binary variable and found that the people with higher the educational level have a better mental health, but the result is not significant (Song Li, 2017; Tianwen Li, 2016). While another study using CHARLS also found that there is no significant relationship between education and mental health but different question about education and treated the years of education as a continuous variable (Q. Huang & Yu, 2019).

Marital status

A study using data from Xianning Central Hospital in China,2015 found that marriage has an important impact on the mental health of the elderly, and the mental health of the elderly without a spouse is relatively poor. The reason is that spouse can accompany each other in their daily life and encourage and support each other in times of difficulty (Wang, 2015).

Most studies which use CHARLS usually treated marital status as a binary variable and saw divorced, separated, never married and widowed as unmarried, otherwise married (Q. Huang & Yu, 2019; Song Li, 2017; Tianwen Li, 2016). However, one study treated marital status as ordered variable including married, unmarried, widowed and divorced and found that women who are widowed or divorced have higher depressive symptoms (Guo et al., 2017).

Debt

A study found a positive association between debt and depression score which means the more debt people have, the more likely people have depression (Reading, Richard, Reynolds, & Shirley, 2001). Similarly, a study using data from the UK Household Panel Survey found that debt has a positive relationship with mental health (Brown,

Taylor, & Price, 2005). Huang and Yu (2019) treated debt as a continuous variable using CHARLS found that the elderly with higher debt levels are more likely to have depression.

Pension

The size of the pension can affect the severity of depression (X. Chen, Wang, & Busch, 2019). Chen (2019) using CFPS found due to pension enrollment, the symptoms of depression were largely reduced. Some studies using CHARLS treated pension as a continuous variable (Q. Huang & Yu, 2019; Xia, 2018). Xia (2018) using the logarithm of pension found that pensions were associated with a lower risk of depression, but not statistically significant. While a study still using CHARLS saw pension as a binary variable and found that the result is that pension is one of the factors that can affect depression in the elderly, and those who without pensions are more likely to suffer from depression (Y.-H. Zhang, Li, Liu, & Peng, 2013).

3.2.4 Physical health status

Chronic diseases

Many studies at home and abroad have found that chronic diseases are closely related to depression (Akhtar-Danesh & Landeen, 2007; Nan et al., 2012; xiuli Li et al., 2015). A study in China using data from Taiyuan (a city of China) random survey found that the incidence of geriatric depression was higher in the elderly with chronic physical diseases. This is related to the pain caused by chronic disease itself and the long course of the disease, recurrent attacks and another associated disease (xiuli Li et al., 2015).

Usually, there are 14 kinds of chronic diseases: Hypertension/ Dyslipidemia/ Diabetes or high blood sugar/ Cancer or malignant tumor/ Chronic lung diseases, such as chronic bronchitis, emphysema/ Liver disease/ Heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems/ Stroke/ Kidney disease/

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Stomach or other digestive disease/ Emotional, nervous, or psychiatric problems/ Memory-related disease/ Arthritis or rheumatism/ Asthma. Most studies using CHARLS will treat chronic disease researcher as a binary variable and will give a value of 1 or 0, if the answer is one of the 14 kinds of chronic diseases (Q. Huang & Yu, 2019; Song Li, 2017; Tianwen Li, 2016; Xia, 2018). They found that the elderly who has the chronic disease is more likely to suffer from depression (Q. Huang & Yu, 2019; Xia, 2018).

ADL

The better the elderly's ability of daily activities, the lower the incidence of depression (xiuli Li et al., 2015). The elderly with ADL impairment will reduce their activities due to the weakness of the body and their confidence in self-care activities, which will lead to depression in the elderly (Kamin, Berzelak, & Ule, 2012).
There are 13 questions about ADL involving walking 100 meters, standing up after sitting for a long time, climbing stairs, squatting, stretching arms up, lifting weights of 5kg, picking up coins, dressing, bathing, eating, getting out of bed, going to the toilet, and controlling defecation and urination. Xia (2018) using all the questions about ADL in CHARLS treated ADL as continuous variable found that elderly with lower ADL score were more likely to have depression. Li (2017) using 8 questions about ADL in CHARLS saw ADL as binary variable found that the coefficient of ADL is positive but the regression result is not significant. Huang and Yu (2019) using 6 questions about ADL in CHARLS found that working after retirement has a positive impact on ADL that means working after retirement can improve the daily activities of the elderly.

3.2.5 Behaviors

Smoking and drinking

A study using data from 1992–2012 waves of the Health and Retirement Study in USA found that there was association between smoking, drinking and depression and people who smoke and drink were more likely to develop depression (An & Xiang, 2015). However, in China, Liu and Lang (2017) using CFPS also found that there is no significantly relationship between drinking, smoking and depression.

Most of the studies using CHARLS treated smoking or drinking as a binary variable. For example, a study using CHARLS treated smoking and drinking as binary variable and found mental health had no significant effect on smoking or drinking (Song Li, 2017).

Social participation

Usually, individual will be considered having social participation if the individual did any of these activities in the last month: 1. Interacted with friends /2. Played Ma-jong, played chess, played cards, or went to community club/ 3. Provided help to family, friends, or neighbors who do not live with you/ 4. Went to a sport, social, or other kind of club/ 5. Took part in a community-related organization/ 6. Done voluntary or charity work/ 7. Cared for a sick or disabled adult who does not live with you/ 8. Attended an educational or training course/ 9. Stock investment/ 10. Used the Internet/ 11. Other. Some studies using CHARLS as a binary variable found that the health benefits of retirement are represented by social participation and social participation can improve the mental health (Chunhong Su & Song Li, 2019; Song Li, 2017). Another study which did not use CHALS also found that the occurrence of depression was significantly associated with less social (Tan Ping & Zhang Ze-dan, 2013).

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3.2.6 Others and mental health

Living arrangement

Even the literature on the effects of living arrangements on the health of the elderly has not been consistent. A study in Spain using data from ‘Envejecer en Leganés’

(Ageing in Leganés) argued that older people who live with their children get more care from their children, thereby improving physical and mental health and reducing mortality (Zunzunegui, F.Beland, & A.Otero, 2001). On the one hand, children's migrant work will reduce their parents' health and life satisfaction. On the other hand, living with children can also cause inter-generational tension due to increased frequency of seeing each other, which is bad for the health of the elderly (Lian, Li, & Huang, 2015). Living arrangements affect the health of the elderly mainly because living with their children can affect the health of parents who may be physically, mentally and financially cared for by their children (Z. Shi, 2015).

One study using CHARLS treated living arrangement as a binary variable and found that living with a daughter is indeed better for older people's mental health (Qi Xu, 2018).

Medical insurance

There are eleven kinds of medical insurance in China: Urban employee medical insurance (yi-bao)/ Urban resident medical insurance/ New cooperative medical insurance (he-zuo-yi-liao)/ Urban and rural resident medical insurance/ Government medical insurance/ Medical aid/ Private medical insurance: purchased by work unit/ Private medical insurance: purchased by individual/ Urban non-employed persons's health insurance/ Other medical insurance -specify. Some studies using CHARLS treated medical insurance as a binary variable. If individual has one of any kinds of those medical insurance, the individual is considered to be insured (Q. Huang & Yu, 2019; Song Li, 2017). Many studies not using CHARLS but also saw medical insurance as a binary variable and found that medical insurance is one of the major factors affecting depression in the elderly. The reason is that the elderly are mostly ill and without health insurance makes it difficult and often fraught (Tan Ping & Zhang Ze-dan, 2013; Xueying Yang, Yongcheng Li, Shuhui Wang, & Tongyu Wu, 2007).

3.3 Gap

Most Chinese studies focused on the effects of retirement on physical or mental health. There are limited articles to consider the association between retirement status and geriatric depression especially considering all kinds of retirement status (people retired, people retired and working and not retired people). There are many studies exploring the relationship between economic status, but limited papers examine the relationship between retirement savings and geriatric depression.

This study will fill in the gaps and looks at the relationship between savings, retirement status and geriatric depression. In addition, existing researches did not take the interaction between savings and retirement into account. And the most important thing is that the existing research did not use the latest CHARLS data. This means that their results do not reflect the latest situation effectively.

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CHAPTER Ⅳ

CONCEPTUAL FRAMEWORK

To find out the association between retirement status, savings and depression among the elderly in China. This thesis uses depression as dependent variable and savings, retirement status as independent variables to explore the relationship between them. Retirement status includes retired (working), retired (not working) and retired. Huang and Yu (2019) found that there is a positive relationship between working after retirement and mental health, because working after retirement can improve the mental health of the elderly. Xia (2018) found that there are is a significant negative relationship between savings and depression because the more people savings the less likely they suffer from depression. Control variables include socioeconomic status, behavior and physical status, debt, and living arrangement. Socioeconomic status refers to age, gender, marital status, debt, pension and education. Many studies found that there is an association between depression and socioeconomic status (Q. Huang & Yu, 2019; Lei et al., 2014; Song Li, 2017; Tianwen Li, 2016; Xia, 2018). For example, women have higher levels of depressive symptoms than men; Higher levels of schooling and per capita expenditure associated with less depressive symptoms; The elderly without spouse or unmarried elderly experienced more depressive symptoms than did married (B. Zhang & Li, 2011). Smoking, drinking and social participation are included in the behavior. For example, social participation is positively associated with depression, because social can improve the mental health of retired men (Chunhong Su & Song Li, 2019). Physical status means ALD and chronic diseases. There is a negative relationship between depression and ADL and chronic diseases, because chronic diseases and low ADL score are more likely to have depression (Xia, 2018). The interaction term is savings and retirement status. As the literature review shows that many studies use those variables as explanatory variables

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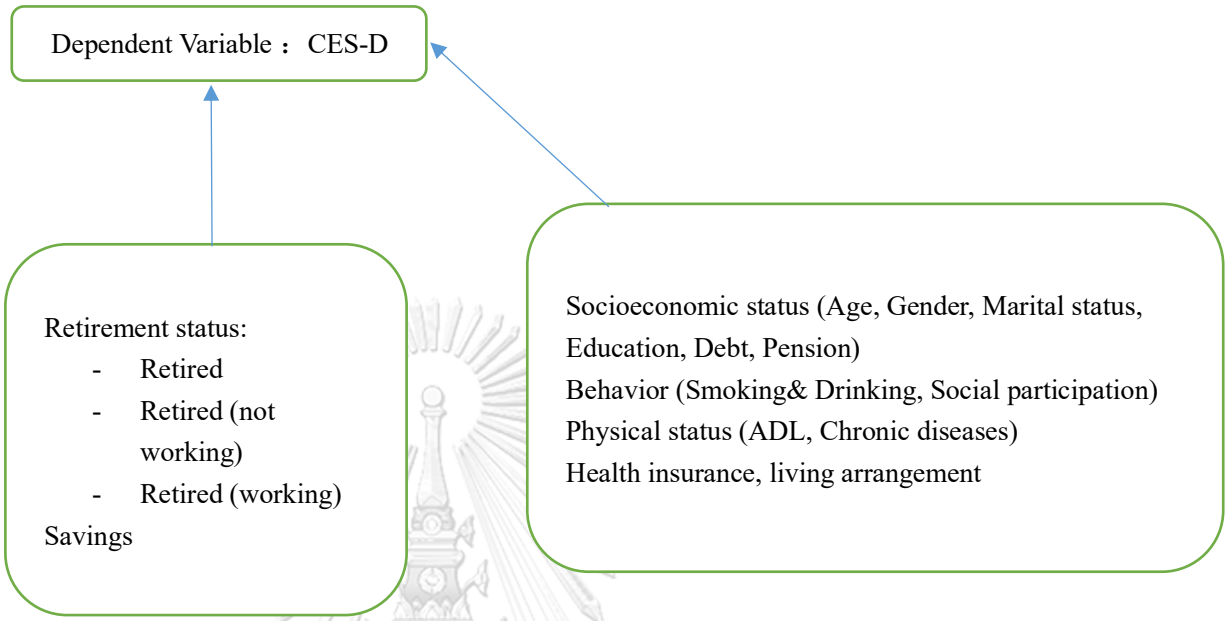
and the results of their studies also illustrate those variables have an effect on the elderly's health.



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CHAPTER Ⅴ

METHOLOGY

This part mainly introduces the source of data and explain how dependent variable and independent variables were operationalized and the intuition of the expectation independent variables in detail.

5.1 Data

This study is based on the data of the China Health and Retirement Longitudinal Study (CHARLS), which was conducted by randomly selected people over 45 years old. The purpose of this Study is to collect a set of high-quality microscopic data representing the families and individuals of China's middle-aged and older people over 45 years old, and use it to analyze the aging population (Zhao, Hu, Smith, Strauss, & Yang, 2014; Zhao et al., 2013). In 2011, the project conducted a national baseline survey, which included 450 villages and residences in 150 counties and districts, and successfully interviewed the elderly in 10,257 households, fully representing the elderly population in China (data and relevant information are available at http://charls.ccer.edu.cn). In 2015, a follow-up survey was conducted. Currently, there are 21,095 samples, including 10,025 males and 11,044 females. This study selects CHARLS database 'Demographic Background' and 'Individual Income' 'Health Status and Functioning' 'Health Care and Insurance' 'Work Retirement and Pension' and 'Family Information' six modules of relevant data, and includes middle-aged and elderly. However, CHARLS respondents are over the age of 45 and older adults, in the sample of a few observations under the age of 45 belong to abnormal and the health level of the population over 80 years old has little variation. This study drops people who is younger than 45 years old or more than 80 years old to avoid measurement bias.

CHARLS 2015 wave includes 21,095 samples. After dropping missing values, outliers, people who doesn't work for a formal organization (agricultural job, self-

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employed, individual firm and unpaid family business), there are total 10,622 matched samples.

5.1.1 Dependent variable

The dependent variable is depression. The depression level indicator is calculated by The Center for Epidemiological Studies-Depression Scale (CES-D10). The CES-D10 scale is widely used in the determination of depressive symptoms in epidemiology and has a high reliability and validity (Andresen, Malmgren, Carter, & Patrick, 1994). The questionnaire includes 10 items which refer to how people have felt and behaved during the last week, assigning a depression state from low to high, and then summarizing the 10 questions score to get a depression level indicator with a range of 0 to 30 points.

The higher the CES-D 10 score, the more severe the depressive symptoms, the worse the mental health condition. Lei (2014) had reported a standard validation exercise using the CHARLS data and found that the Chronbach's α is 0.815, which indicates a reasonable level of internal consistency. And CES-D 10 contained such questions and 5 and 8 are positive questions and others are negative questions as shown in Table 1.

Table 4 Questions of CES-D 10

Question	Type/Value
1: I was bothered by things that don't usually bother me.	Negative statement
Rarely or none of the time (< 1 day)	0
Some or a little of the time (1−2 days)	1
Occasionally or a moderate amount of the time (3−4 days)	2
Most or all of the time (5−7 days)	3
2: I had trouble keeping my mind on what I was doing.	Negative statement
Rarely or none of the time (< 1 day)	0
Some or a little of the time (1−2 days)	1
Occasionally or a moderate amount of the time (3−4 days)	2
Most or all of the time (5−7 days)	3
3: I felt depressed.	Negative statement

Rarely or none of the time (< 1 day)	0
Some or a little of the time (1−2 days)	1
Occasionally or a moderate amount of the time (3−4 days)	2
Most or all of the time (5−7 days)	3
4: I felt everything I did was an effort.	Negative statement
Rarely or none of the time (< 1 day)	0
Some or a little of the time (1−2 days)	1
Occasionally or a moderate amount of the time (3−4 days)	2
Most or all of the time (5−7 days)	3
5: I felt hopeful about the future.	Positive statement
Rarely or none of the time (< 1 day)	3
Some or a little of the time (1−2 days)	2
Occasionally or a moderate amount of the time (3−4 days)	1
Most or all of the time (5−7 days)	0
6: I felt fearful.	Negative statement
Rarely or none of the time (< 1 day)	0
Some or a little of the time (1−2 days)	1
Occasionally or a moderate amount of the time (3−4 days)	2
Most or all of the time (5−7 days)	3
7: My sleep was restless.	Negative statement
Rarely or none of the time (< 1 day)	0
Some or a little of the time (1−2 days)	1
Occasionally or a moderate amount of the time (3−4 days)	2
Most or all of the time (5−7 days)	3
8: I was happy.	Positive statement
Rarely or none of the time (< 1 day)	3
Some or a little of the time (1−2 days)	2
Occasionally or a moderate amount of the time (3−4 days)	1
Most or all of the time (5−7 days)	0
9: I felt lonely.	Negative statement
Rarely or none of the time (< 1 day)	0
Some or a little of the time (1−2 days)	1
Occasionally or a moderate amount of the time (3−4 days)	2
Most or all of the time (5−7 days)	3
10: I could not get ‘going’.	Negative statement

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Rarely or none of the time (< 1 day)	0
Some or a little of the time (1−2 days)	1
Occasionally or a moderate amount of the time (3−4 days)	2
Most or all of the time (5−7 days)	3

Using the metric suggested by Radloff (1977), the four answers are assigned values of 0,1,2 and 3 respectively for negative statements, while the positive statements are the opposite. The scores correspond to the severity of depression respectively. Finally, the scores of ten questions are added as the total CES-D score of individuals. Therefore, the score of the individual in the paper ranges from 0 to 30. A score of 10 and above is a cutoff point for high depressive symptoms (Andresen et al., 1994). When the total score is ≥10 means the individual has depressive symptom. Having depression set to 1, otherwise set to 0.

5.1.2 Independent variables

The independent variables are retirement status, savings and some control variables.

5.1.2.1 Retirement status

In general, retirement means an individual's voluntary or involuntary withdrawal from the Labor market. Some of them may be due to the regulation and have to retire from the job, or the technical level they have mastered is not suitable for the job they are engaged in, or the individual wants to spend more time on leisure. And retirees can do any job. There are four types of retirement: early retirement, internal retirement, receding position procedures and normal retirement (Table 5). However, due to data limitations no distinction between the four types is made in this study and except for normal retirement, the sample number of other different retirement types is not enough. Thus, no matter which way people retire, they are considered retired. Working means not reaching the age or length of service to still work in the same position. In this thesis, working or retirement refers to the workers in the government departments, institutions, enterprises, excluding farmers and self-employed.

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Table 5 4 Types of retirement

Type of retirement	Description
Normal retirement	Retirement refers to a worker who reaches a retirement age. No consent or application is required. The work unit can enforce retirement procedures and give pensions. Source: Retirement of revolutionaries in China: Public policies, social norms, private interests
Early retirement	Early retirement refers to the behavior of the civil servant, the worker of the public institution or the enterprise worker who does not reach the retirement age but withdraws from the work place and receives the pension. Early retirement is proposed by employees and retired wages are exempt from tax. Source: The impact of retirement on health: Evidence from China
Internal retirement	In the 1990s, Chinese state-owned enterprises had a large number of surplus workers, and the internal retirement was a special way to settle these surplus employees. The internal withdrawal refers to the consultation between the enterprise and the employee according to the relevant policy, so that the worker can quit production or leave the job, and then go through the retirement procedure when the legal retirement age is reached. The internal retirement is usually proposed by the enterprise and the salary during the internal retirement period has to pay tax. Source: The impact of retirement on health: Evidence from China
Receding Position Procedure	"Receding Position Procedure " refers to the worker's complete loss of the ability to work due to illness or disability. But worker's age, years of service or number of years for individual payment did not achieve emeritus condition. After the hospital certificate, the confirmation by the labor appraisal committee and the approval by the organization, the staff can withdraw from the production. The organization shall, in accordance with the relevant provisions of the state, provide the workers with certain material help and be compensated for and recuperate. Or it is already to retire age, but the worker with insufficient years of service. Source: CHARLS questionnaire

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There are three variables about retirement status. The first variable about retirement status is retired or not. According to the literature, this study will treat retired as a binary variable using the question ‘Have you completed retirement procedures (including early retirement) or internal retirement (Note: Retirement from government departments, enterprises and institutions, not including retirement in the sense of getting agricultural insurance)?’ The answer is Yes with a value of 1, which means retired. The answer is No with a value of 0, means not retired.

Based on one study using CHRALS noticed that retirement can reduce the mental health of male because retirement cannot change their behaviors (smoking and drinking) which leads to the decline of mental health (Tianwen Li, 2016). Heller-Sahlgren (2012) also found that retirement leads to a decrease in the mental health. Thus, the expected sign between depression and retired (not working) is positive meaning retired people has a higher CES-D10 score (higher depressive symptoms). Normally, most senior citizens who retire from formal organizations do not continue to work after retirement. However, as China is in a specific stage of development and economic system transformation, many retirees work after retirement. People who work after retirement can be divided into two categories: one is to enjoy pension benefits are still engaged in employment activities. This is mainly due to the irregular retirement system in the transition process, allowing them to enjoy pension benefits too early in the prime of their life, while China’s continued economic growth and strong labor market have created conditions for them to continue to work after retirement. Another one is that the elderly without pensions continue to engage in employment activities. Mainly because there is no pension so that retirees do not have enough money to meet basic living needs, so they need to go out to work (Cheng, 2014). Based on this, the second variable about retirement status is retired but still working. There are only one article using CHARLS and considering working after retirement (Q. Huang & Yu, 2019). Following this article, working after retirement is assigned a value of 1 for working, otherwise setting a value of 0. The third variable is

retired and not working. If retiree did not work after retirement giving a value of 1, otherwise 0.

The expected sign between depression and retired (working) maybe negative meaning retired and working results in lower CES-D 10 score. On the contrary, the expected sign between depression and retired (not working) maybe positive meaning retired and not working results in higher CES-D 10 score. Because Huang and Yu (2019) article found that working after retirement significantly improves the mental health of the young elderly (> 65), but does not affect the overall health of the old elderly because although the physical health of the elderly over 65 may increase, the mental health can decline rapidly.

5.1.2.2 Savings

Different from Xia's (2018) article, this study not only includes the cash in the elderly's home and the deposit in financial institution but also includes public housing fund. Generally, having certain cash and deposit can be regarded as retirement savings. However, due to the scope of this thesis is people who work for formal organization that means those people have pension and public housing fund after retirement (Q. Liu, 2003). Thus, this study includes cash, deposit, public housing fund as retirement savings.

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Elderly Chinese like to keep their cash at home. While some older Chinese like to keep their money in financial institution to earn interests instead of keeping it at home. Thus, the amount of cash at home and amount of deposit are part of the savings (Xia, 2018).

According to the Housing Provident Fund Management Ordinance 1999, public housing fund is a long-term housing deposit used by state organs, state-owned enterprises, enterprises with foreign investment, enterprises in cities and towns, institutions, social organizations to help employees buy houses. Public housing fund is the individual housing savings fund that the worker stores up according to the

regulation is used at housing consumption expenditure. Public housing fund is composed by two parts, one part is saved by the work unit that the worker is working for, another part is saved by worker themselves. Both work unit and worker need to pay the money every month until the worker retire. Employees can use the money in this account when they buy a house. If the money is not used, it will be given to the employee when they retire. If the retirees received the money, it can regard as a kind of saving (Q. Liu, 2003). This is the question about public housing fund in the questionnaire: What is the total amount of money in your public housing fund? Those three variables are all numerical variables.

Following Xia's article, this study will consider savings as a continuous variable and use the logarithm of savings to make sure that savings will have a normal distribution. The excepted sign is negative between savings and depression which means the more money older people save, the less likely they are to suffer from depression. Because if retirees have enough savings, they will not worry about the difficulties of life and spend more time on some activities which is good for their mental health (Wang, 2015)

5.1.3 Control variables

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The control variables mainly include socioeconomic status, physical health status and behavior.

Socioeconomic status includes age, sex, marital status, debt, pension and education. Behaviors include smoking and drinking and social participation. Physical health status refers to ADL and chronic diseases in this paper. Others include medical insurance and living arrangement.

5.1.3.1 Socioeconomic status

Age

Biologically, aging is associated with a decline in physical function. Most studies found that there is a positive relationship between age and depression meaning as age

increases, the probability of depression also increases (Cuntong, 2016; Hu, 2018; H. Huang, 2015; Meng & Tang, 2000). Therefore, this study includes age as a control variable and considers as a binary variable. The excepted sign is positive because older people get, the more likely they are to get a high score.

Gender

Lei's (2011) study concluded that retirement affects men's and women's mental health to different degrees. And most articles treated gender as a binary variable in the literature review. Therefore, gender variables were included as the control variables. Men were assigned a value of 1 and women were assigned a value of 0. The excepted sign is negative. Retired men are less likely to suffer from depression than women because their life satisfaction increased after retirement, leading to better mental health (Deng & He, 2016).

Marital status

The impact of marriage on health is mainly reflected in mental health. Studies believe that marriage is conducive to physical and mental stability and organic unity, and can improve the quality of life and promote physical and mental happiness (Koball, Moiduddin, Henderson, Goesling, & Besculides, 2010). This study will treat education as a binary variable like the articles done in the literature review and classify married, cohabitated and married but not living with spouse as married while separated, divorced, widowed and never married as unmarried states. The value assigned to married states is 1, otherwise 0. The excepted sign is negative meaning people with spouse has a lower CES-D 10 score because spouse can accompany each other in their daily life and encourage and support each other in times of difficulty (Wang, 2015).

Education

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Following the way most articles in the literature review that use CHARLS data were done. This study divides the education level into middle school below (including illiterate, did not finish primary school, Sishu/home school and elementary school), middle school and above(including middle school, high school, vocational school, two-/three-year college/associate degree, four-year college/bachelor's degree, master's degree and doctoral degree/Ph.D.). Middle school below were assigned a value of 0 and middle school and above were assigned a value of 1. The excepted sign is negative because higher education can promote people's mental health and reduce the incidence of depression (Xia, 2018).

Debt

The excepted sign is a positive because there is a positive association between debt and depression score which means the more debt people have, the more likely people have depression (Reading et al., 2001). According to previous studies, debt has a negative impact on depression (Brown et al., 2005; Reading et al., 2001). Debt is also a continuous variable or a binary variable in previous studies. This study considers debt as a continuous variable but includes more questions about debt. The questions in the questionnaire include the total amount of loan (not including loans for house), the amount of credit card balance and the total amount of money individual still owe to other families, individuals or organizations (excluding loans, credit card balances, etc.).

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Pension

The pension means the monthly money that the retirees can receive according to the national policy (B. Shi, 2001).Some studies using CHARLS treated pension as a continuous variable while another study also using CHALS treated pension as a binary variable. Using the same question as pervious study, this study will consider pensions as a continuous variable. The excepted sign is negative because pension is

one of the factors that can affect depression in the elderly, and those who has more pensions are less likely to suffer from depression and have a lower CES-D 10 score (Y.-H. Zhang et al., 2013).

5.1.3.2 Behaviors

Smoking and drinking

Smoking and drinking may also influence depression (Baoping Yan et al., 2014). People who smoke and drink were more likely to develop depression (An & Xiang, 2015)

This study included smoking and drinking as a control variable. However, this study will treat smoking and drinking as one variable which is different from the other articles treated smoking and drinking as two variables. This study will use the questions about the smoking as follows: 1. 'Have you ever chewed tobacco, smoked a pipe, smoked self-rolled cigarettes, or smoked cigarettes/cigars?'. The answers are '1. Yes 2. No'. 2. 'Do you still have the habit or have you totally quit?'. The answers are '1. Still have 2. Quit and 3. Never smoked'. The third question is the same as the second and the third question is from the respondents who didn't answer the question or smoked in the previous wave.

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The questions about drinking are 'Did you ever drink alcoholic beverages in the past? How often?' There are three answers (I never had a drink, I used to drink less than once a month and I used to drink more than once a month). One dummy variable is used to indicate whether the respondents drink or smoked. If the interviewees drink and smoke, the value is 0; otherwise, it is 1. The excepted sign is negative meaning people who not smoking and not drinking has a lower score.

Social participation

There is a significant relationship between social participation and depression. The excepted sign is negative because social participation can reduce the occurrence of

depression and lead to a lower score (Tan Ping & Zhang Ze-dan, 2013). This study will treat social participation like all the other studies using CHARLS (Chunhong Su & Song Li, 2019). If the answer is one of those one (1. Interacted with friends /2. Played Ma-jong, played chess, played cards, or went to community club/ 3. Provided help to family, friends, or neighbors who do not live with you/ 4. Went to a sport, social, or other kind of club/ 5. Took part in a community-related organization/ 6. Done voluntary or charity work/ 7. Cared for a sick or disabled adult who does not live with you/ 8. Attended an educational or training course/ 9. Stock investment/ 10. Used the Internet/ 11. Other), giving a value of 1, otherwise 0.

5.1.3.3 Physical health status

ADL

ADL is associated with depression (Kamin et al., 2012; xiuli Li et al., 2015). Huang and Yu (2019) using CHARLS treated ADL as continuous variables. And Huang and Yu only used 6 questions about ADL which includes dressing, bathing, eating, getting up and getting out of bed, going to the toilet, and controlling defecation and urination. The choices are 'no difficulty, difficult but still do it, difficult and need help, cannot do it'. The choices are rated as 3, 2, 1 and 0 respectively.

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The scores of the six questions were added into the ADL score. Zero represents the complete inability of the elderly to take care of themselves. The higher the ADL score is, the stronger the daily activities of the elderly are and the healthier they are. According to this, this study will do the same thing for ADL. The excepted sign is negative because elderly with higher ADL score were less likely to have depression.

Chronic disease

Many study using CHARLS found that there is a significant relationship between chronic disease and depression (Q. Huang & Yu, 2019; Xia, 2018).There are 14 kinds of chronic diseases in the CHARLS questionnaire: Hypertension/ Dyslipidemia/

Diabetes or high blood sugar/ Cancer or malignant tumor/ Chronic lung diseases, such as chronic bronchitis, emphysema/ Liver disease/ Heart attack, coronary heart disease, angina, congestive heart failure, or other heart problems/ Stroke/ Kidney disease/ Stomach or other digestive disease/ Emotional, nervous, or psychiatric problems/ Memory-related disease/ Arthritis or rheumatism/ Asthma. Based on previous studies, participants with one of the 14 conditions were considered to have a chronic disease giving a value of 1, otherwise 0. The excepted sign is positive because older people with chronic diseases are more likely to suffer from depression (Xia, 2018).

5.1.3.4 Others

Medical insurance

Some studies found that health insurance is one of the factors affecting depression in the elderly (Q. Huang & Yu, 2019; Tan Ping & Zhang Ze-dan, 2013; Xueying Yang et al., 2007). There are eleven kinds of medical insurance in China: Urban employee medical insurance (yi-bao)/ Urban resident medical insurance/ New cooperative medical insurance (he-zuo-yi-liao)/ Urban and rural resident medical insurance/ Government medical insurance/ Medical aid/ Private medical insurance: purchased by work unit/ Private medical insurance: purchased by individual/ Urban non-employed person's health insurance/ Other medical insurance -specify. Like the articles using CHARLS considered medical insurance as a binary variable. If the answer is any kind of medical insurance were defined as having insurance giving a value of 1, otherwise 0. The excepted sign is negative because retirees with health insurance are less likely to suffer from depression.

Living arrangement

Living arrangements mean who the elderly live with. Living arrangement affects the health of older people. Following Qi Xu's article, if the answers are 'Spouse/ My parents or parents in law/ Children/ My Siblings/ My spouse's siblings', giving a value of 0 otherwise 1. Older adults who live with children have better physical and

mental health (Xiaofang Dong & Liu, 2018). Thus, the excepted sign is positive relationship between living alone and depression.

5.2 Model

Since the dependent variable can be treated as both binary variable and continuous variable, the model in this article will use a logit and OLS. CES-D score is a continuous variable when the method is OLS. While CES-D score is a binary variable when the method is logit.

The model specification is (Verbeek, 2008)

$y_i^* = x_i'\beta + \varepsilon_i$ (Logit)

where $y_i^*$is a binary variable, x_i is a vector of observable characteristics, β is coefficient, ε_i is an error term. Observed is the binary variable, y_i, and

y_i = 1 if the person suffers from depression

= 0 if the person does not suffer from depression.

$y_i = \beta_1 x_{i1} + \beta_2 x_{i2} + \beta_3 x_{i3}' + \varepsilon_i$ (OLS)

where $y_i$is a continuous variable, x_{i1} is retirement status, β_1 is coefficient of retirement status, x_{i2} is savings, β_2 is coefficient of savings, x_{i3}' is control variables, β_3 is coefficient of control variables, ε_i is an error term.

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As multicollinearity among independent variables might be a problem, diagnostic tests were conducted such as the Variance Inflation Factors (VIF) and correlation coefficient. The results show that VIF is not greater than 5, and similarly, the correlation coefficient is not greater than 0.5. However, there may be multicollinearity between retirement status, age, and savings. Retirement status is related to savings because most people will have less income after retirement (Wei & Jing, 2014). Retirement is related to age, because retirement policy is mandatory in China, people must retire when they reach the age. Whether or not they work after retirement also depends on their age, with younger retirees more likely to work (Cheng, 2014). According to the life cycle hypothesis, savings are related to age as people dis-save

after retirement. On the other hand, older people are more likely to save so they can leave bequests to their children (Deaton, 1997).

The Breusch-Pagan test for heteroskedasticity and the problem have solved after using robust standard errors.

Table 6 Independent variables and control variables

Independent variable	**Description**	**Expected sign**	**Reference**
Retirement status			
Retired	=1retired,0 otherwise dummy variable	+, Retirement results in higher CES-D10 score	Heller-Sahlgren, G. (2012). Work 'til you drop: short- and longer-term health effects of retirement in Europe.
Retired_ working	=1 retired but working,0 otherwise dummy variable	-, Retired and working results in the lower CES-D10 score	Huang gan,yu Dan (2019). Does Postponing Retirement Affect Health? -- based on the study of the reversion
Retired_ not working	=1 retired and not working,0 otherwise dummy variable	+, Retired and not working results in the higher CES-D10 score	
Savings	amount of money continuous variables	-, The more money retirees have, the less likely they are to suffer from depression	Xia, Y. (2018). The influence of economic welfare on depression in urban and rural elderly in China.

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Interaction term	Log savings* retirement	-, retired people would have more savings and possibly lower probability to suffer from depression	
Control variables			
Socioeconomic status （SES）			
Age	Continuous variable and different age group for subsample analysis: 45-55; 55-65; 65- 75; 75 and above	+, as age increases, the probability of depression also increases	Hu, Y. (2018). Prevalence of Depression in Chinese Elderly Persons and Associated Factors
Gender	=1 male, 0 female; dummy variable	-/, Women have higher levels of depressive symptoms than men. Gender had no effect on depression.	Deng and He (2016). The Effects of Retirement on Physical and Mental Health Outcomes in Males: Based on the Empirical Evidences of Regression Discontinuity Design. Lei et al (2014). Depressive symptoms and SES among the mid-aged and elderly in China: Evidence from the China Health and Retirement Longitudinal Study national baseline.
Marital status	=1 married, 0 unmarried; dummy variable	-, people with spouse has lower score	Guo et al (2017). Depression among Chinese older adults: a perspective from Hukou and health inequities.
Education	=1 high school and above,0 middle school and below; dummy variable	-, higher education can promote people's mental health and reduce the incidence of depression	Park Joon Hyuk, Kim Ki Woong and K. Myoung-Heeet. (2012) A nationwide survey on the prevalence and risk factors of late life depression in South Korea

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Pension	=1have pension, 0 otherwise; dummy variable	-, old people are less likely to suffer from depression with pension	Fen Zhang, Guanying Huang, & Weiqiang Zhuang. (2014). Analysis on the present situation of depression among the elderly in some communities of Haizhu District, Guangzhou.
Debt	=total amount of loan, credit card balance and money that respondents owe to other families; continuous variable	+, Older people in debt always have poor mental health	Reading, Richard, Reynolds and Shirley (2001). Debt, social disadvantage and maternal depression.
Behavior			
Smoking & Drinking	=0 smoking & drinking, 1 not smoking or drinking	-, drinking alcohol and smoking increases the risk of depression	An, R. and X. Xiang (2015). Smoking, heavy drinking, and depression among US middle-aged and older adults
Social_ participation	=1 not regularly ,0 regularly; dummy variable	-, social can reduce the occurrence of depression	Chunhong Su and Song Li (2019). Lifestyle and time use: The Effect of Retirement on health
Physical status			
ADL	continuous variables	-, People with higher ADL score were less likely to have depression	Kamin, T., N. Berzelak and M. Ule (2012). The influence of education on differences in depressive symptoms between men and women in Slovenia

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Chronic diseases	=0 no ,1 yes (have chronic disease); dummy variable	+, People with chronic diseases are more likely to suffer from depression than normal people	Nan et al (2012). Depressive symptoms in people with chronic physical conditions: prevalence and risk factors in a Hong Kong community sample.
Medical insurance	=0 no ,1yes (have health insurance); dummy variable	-, Retirees without health insurance are more likely to go to work and suffer from depression	Huang gan, yu Dan. Does Postponing Retirement Affect Health? -- based on the study of the reversion 209,25(02):76-85.
living arrangement	= 1 living alone, 0 living with others	+, living with a daughter can improve older people's mental health	Xu qi. (2018). The impact of living arrangement on depression of the elderly in China -- an empirical study based on CHARLS tracking survey data.

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CHAPTER VI

RESULTS

6.1 Summary statistics

The dependent variable in this study is depression. The sample size is 10,622. Due to this study will use two model (logit and OLS), depression will be treated as a binary variable in the logistic model and a continuous variable in the OLS model. This chapter will show the statistical description of the dependent variable, the independent variables and the control variables

6.1.1 Descriptive statistics of dependent variable

As the table 7 shows that there are more people without depressive symptoms, accounting for 66% of the total population. Only 3,567 people whose CES-D 10 score are greater than 10. The number of people with scores under 10 is twice as the people with scores over 10. The ratio of people without depression to those with depression is about 7:3.

Table 7 Depression as a binary variable

CES_ Dummy	Freq.	Percent
0	7,055	66.42
1	3,567	33.58
Total	10,622	100.00

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The table 8 shows many information. Firstly, the number of retirees is far lower than that of non-retirees, 490 and 10,132 respectively. Similarly, the number of people with depressive symptoms is less than those without depressive symptoms, 3,567 and 7,055 respectively. Secondly, not retired people without depressive symptoms are the largest group among all the groups accounting for 63% of the full samples.

Table 8 Cross tabulation: Depression and Retired

	Retired		
CES_ Dummy	0	1	Total
0	6,678	377	7,055
1	3,454	113	3,567
Total	10,132	490	10,622

The table 9 illustrates the mean score of CES-D 10 among different retirement status. The CES-D score of not retired people is 7.76 which is the highest average score among all kinds of retirement status. The scores of the other three groups were not far apart but lower than the average score of full samples. The score of most people concentrated on those between 0 and 15 which accounts for 87% of the total population and the average score is around 7.49. Chi-square test results show that CES-D is independent of each variable.

Table 9 Depression as a continuous variable

	Full samples Mean	Retired Mean	Not retired Mean	Retired working Mean	Retired not working Mean
CES_ Score	7.49	5.90	7.76	5.56	5.79
Chi2	Pr = 0.000	(1) =25.49		(1) = 13.96	(1) = 62.21

6.1.2 Descriptive statistics of independent variables and control variables

Table 10 Descriptive statistics of control variables

Variable (Mean)	Number	Full samples	Retired	Not retired	Retired working	Retired not working
ln savings	10,622	7.035	7.9	6.93	7.95	7.93
Age	10,622	59.36	64.7	60	60.4	60
Gender	10,622	0.49	0.52	0.47	0.57	0.51
Marital status	10,622	0.88	0.879	0.876	0.94	0.86
Education	10,622	0.35	0.63	0.32	0.33	0.31
Smoking &drinking	10,622	0.83	0.87	0.84	0.79	0.87
Social participation	10,622	0.55	0.68	0.54	0.71	0.64
ADL	10,622	16.97	17.15	16.89	17.85	17.2
Medical insurance	10,622	0.92	0.93	0.92	0.92	0.92
Living arrangement	10,622	0.13	0.09	0.122	0.12	0.122
Chronic disease	10,622	0.99	0.94	0.9	0.99	0.99
ln Pension	10,622	0.73	4.36	0.55	3.76	4.64
ln Debt	10,622	1.79	0.70	1.7	1.33	0.54

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The average saving of full samples is 18,620 RMB (ln saving =7). The not retired people save the least on average. Maybe it's because they're working and don't have to worry about money, so they have less savings. For those who have retired including working and not working, the gap of savings is not much, around 7.9 and higher than average savings of full samples. The average debt of the population is 21956 RMB (ln debt = 1.79). Not retired people are the most indebted but the debt is lower than average savings of full samples. People who don't work after retirement have least debt, which could also be the reason to explain why they don't work. The average score of ADL is 16.97 meaning that most of the samples can take care of themselves. People who are working after retirement have the highest score and better physical health which maybe the reason why they choose to work. Similarly, people who is not working after retirement maybe because they have a higher pension than other group and the gap of different kinds of retirement is huge.

The average age of the samples is around 59 and the age group between 55 and 65 years old has the largest number of people. Thus, the age of all kinds of retirement status is over 60 and retired people have a relatively high age. Because the age of samples is relatively high from 45 to 80 so that most of the people in the sample have health insurance and chronic diseases and each group has similar mean. Maybe there are more men who work after retirement, but not too much. In fact, the proportion of men and women is similar no matter in which group. Most of the people in the data are married, about 88%. People who are working after retirement have the highest proportion and the other groups have the similar married proportion. Similarly, most people have a high education level taking up 65% of the total population. Among the retired population, there are more highly educated people. The average educational attainment of the other groups is similar.

Most of the people in the sample did not smoke or drink alcohol and other groups also have the same situation. The people who is regularly having social participation and non-regular has the similar proportion in the samples and people who are working

after retirement have the largest proportion of social participation compared with other groups. Around 87% of the elderly is living with other and most of retired people are living with others around 90%.

6.2 Regression results

6.2.1 Full sample regression results

There are four regressions in this part. The first two regressions are OLS and Logit without interaction term and the last two are also OLS and Logit but including interaction term.

Table 11 Regression result of retirement

	OLS CES_ Score	Logit CES_ Dummy	Logit CES_ Score	Logit CES_ Dummy
Retired	-0.158	-0.0555	-0.906	-0.213
	(0.281)	(0.161)	(1.002)	(0.467)
ln_ savings	-0.194***	-0.0703***	-0.198***	-0.0710***
	(0.0298)	(0.0160)	(0.0308)	(0.0165)
Age	-0.00480	-0.00529	-0.00469	-0.00527
	(0.00952)	(0.00418)	(0.00952)	(0.00419)
Gender	-1.246***	-0.477***	-1.245***	-0.476***
	(0.154)	(0.0682)	(0.154)	(0.0682)
Marital _status	-0.885***	-0.161*	-0.886***	-0.161*
	(0.263)	(0.0969)	(0.263)	(0.0969)
Education	-1.310***	-0.511***	-1.307***	-0.510***
	(0.161)	(0.0693)	(0.161)	(0.0694)
Smoking & drinking	-0.0380	-0.0111	-0.0355	-0.0106
	(0.187)	(0.0862)	(0.187)	(0.0862)
Social participation	-0.546***	-0.151***	-0.545***	-0.151***
	(0.145)	(0.0572)	(0.145)	(0.0572)
ADL	-0.720***	-0.211***	-0.720***	-0.211***
	(0.0358)	(0.0146)	(0.0359)	(0.0146)
Medical insurance	-0.107	-0.0548	-0.104	-0.0540
	(0.248)	(0.107)	(0.248)	(0.106)
Living arrangement	1.439***	0.457***	1.437***	0.457***
	(0.313)	(0.0986)	(0.313)	(0.0986)
Chronic disease	2.018***	1.219***	2.017***	1.219***
	(0.432)	(0.360)	(0.432)	(0.360)
ln_ pension	-0.101***	-0.0265	-0.102***	-0.0266
	(0.0299)	(0.0176)	(0.0300)	(0.0176)
ln_ debt	0.178***	0.0514***	0.178***	0.0515***
	(0.0203)	(0.00708)	(0.0203)	(0.00707)
Interaction			0.0863	0.0189
			(0.109)	(0.0569)
_cons	21.70***	2.974***	21.72***	2.978***
	(1.078)	(0.560)	(1.079)	(0.561)
N	10622	10622	10622	10622
adj. R^2	0.172	0.1022	0.172	0.1022

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

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Considering retired or not and using the OLS, the results (Table 11) show that savings, gender, marital status, education, social participation, ADL, living arrangement, chronic disease and debt have a significantly statistic relationship between depression. While using logit, the results show that pension becomes not statistically associated with depression and remaining factors keep the same relationship. Adding an interaction item does not make any difference.

Table 12 Regression results of working after retirement

	OLS CES_ Score	Logit CES_ Dummy
Retired_ working	-0.353	-0.369
	(0.248)	(0.449)
retired_ notworking	-0.138	-0.0880
	(0.140)	(0.274)
ln_ savings	-0.0676***	-0.190***
	(0.0154)	(0.0285)
Age	-0.00545	-0.00685
	(0.00404)	(0.00948)
Gender	-0.475***	-1.234***
	(0.0677)	(0.153)
Marital _status	-0.165*	-0.877***
	(0.0965)	(0.261)
Education	-0.506***	-1.311***
	(0.0715)	(0.163)
Smoking & drinking	-0.00650	-0.0339
	(0.0861)	(0.187)
Social participation	-0.141**	-0.535***
	(0.0568)	(0.144)
ADL	-0.212***	-0.723***
	(0.0145)	(0.0357)
Medical insurance	-0.0583	-0.103
	(0.106)	(0.245)
Living arrangement	0.442***	1.428***
	(0.0981)	(0.310)
Chronic disease	1.238***	2.038***
	(0.360)	(0.428)
ln_ pension	-0.0170	-0.0945***
	(0.0162)	(0.0304)
ln_ debt	0.0513***	0.177***
	(0.00704)	(0.0202)
_cons	2.960***	21.81***
	(0.552)	(1.071)
N	10,622	10,622
R^2	0.1729	0.1026

t statistics in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.$

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Considering people retired and not working, and people retired and working, and using OLS or logit, the results illustrate that except retired_ working, retired_ not working, age, smoking and drinking, medical insurance the others factors are significant and pension has a significant relationship only when it in the logit regression.

6.2.2 Sub-sample regression results

6.2.2.1 Sub-sample analyses of age

Based on the scope of this study and the literatures, there are three age groups: 45 to 54, 55 to 64, and 65 to 80 and this study redo the same analysis but using different age group.

Table 13 Sub-sample regression of different age groups for retirement (OLS)

Age	45-54 CES_ Score	55 - 64 CES_ Score	65 - 80 CES_ Score
Retired	-0.990	0.348	-0.197
	(-1.25)	(0.74)	(-0.46)
ln_ savings	-0.248***	-0.230***	-0.138***
	(-5.69)	(-5.69)	(-3.29)
Gender	-1.492***	-1.554***	-1.326***
	(-6.00)	(-7.10)	(-5.95)
Marital_ status	-2.515***	-1.141***	-0.365
	(-5.03)	(-3.03)	(-1.14)
Education	-1.137***	-1.135***	-0.819***
	(-5.22)	(-5.25)	(-2.98)
Smoking & drinking	0.189	-0.106	-0.154
	(0.59)	(-0.38)	(-0.49)
Social participation	-0.742***	-0.457**	-0.472**
	(-3.46)	(-2.38)	(-2.26)
ADL	-1.037***	-0.755***	-0.546***
	(-16.69)	(-17.07)	(-16.00)
Medical insurance	0.446	-0.0571	-0.345
	(1.11)	(-0.16)	(-0.94)
Living arrangement	1.313***	1.643***	1.656***
	(3.56)	(4.52)	(4.69)
Chronic disease	1.444*	1.711	5.199**
	(1.78)	(1.58)	(2.45)
ln_ pension	0.000578	-0.198***	-0.181***
	(0.01)	(-4.29)	(-4.48)
ln_ debt	0.181***	0.172***	0.230***
	(8.39)	(6.66)	(5.20)
_cons	28.95***	23.10***	14.91***
	(19.00)	(16.07)	(6.63)
N	3070	4020	3532

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R^2	0.198	0.172	0.156

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As the table 13 shows that savings, gender, education, social participation, ADL, living arrangement and debt are the factors can affect depression among all age group by using OLS. Marital status can influence depression if the people over 45 years old and under 65 years old. Pension has a significant relationship with depression when people is greater than 55 years old because 55 is the normal retirement age. Chronic disease has a significant relationship with depression in 45-54 and 65-80 age groups.

Table 14 Sub-sample regression of different age groups for retirement (Logit)

Age	45- 54 CES_ Dummy	55 - 64 CES_ Dummy	65 - 80 CES_ Dummy
Retired	-0.137	0.263	-0.175
	(-0.39)	(1.32)	(-1.00)
ln_ savings	-0.103***	-0.0954***	-0.0430***
	(-5.74)	(-6.13)	(-2.76)
Gender	-0.557***	-0.531***	-0.440***
	(-5.25)	(-6.16)	(-5.35)
Marital_ status	-0.576***	-0.202	-0.0540
	(-3.00)	(-1.47)	(-0.47)
Education	-0.425***	-0.407***	-0.261**
	(-4.77)	(-4.73)	(-2.43)
Smoking & drinking	0.0887	-0.136	-0.0116
	(0.62)	(-1.19)	(-0.10)
Social participation	-0.211**	-0.147**	-0.0982
	(-2.44)	(-2.01)	(-1.28)
ADL	-0.320***	-0.200***	-0.157***
	(-9.69)	(-11.11)	(-11.95)
Medical insurance	0.127	-0.115	0.0231
	(0.77)	(-0.86)	(0.17)
Living arrangement	0.356**	0.468***	0.464***
	(2.44)	(3.54)	(3.70)
Chronic disease	0.896**	0.855	1.551
	(1.98)	(1.62)	(1.42)
ln_ pension	-0.0216	-0.0819***	-0.0625***
	(-0.49)	(-3.79)	(-3.76)
ln_ debt	0.0449***	0.0487***	0.0672***
	(5.22)	(5.15)	(4.25)
_cons	5.406***	3.284***	1.041
	(6.83)	(5.10)	(0.92)

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N	3070	4020	3532
R^2	0.1098	0.0997	0.0891

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The logit regression results show that savings, gender, education, ADL, living arrangement and debt have a significant relationship with depression among all age groups. When people over 54 years old, pension appears the influence of depression. While when people under 64 years old, social participation shows statistically association with depression. Chronic disease can affect the depression only when people under 54 years old.

Table 15 Sub-sample regression of different age groups for working after retirement (OLS)

	45-54 CES_ Score	55-64 CES_ Score	65-80 CES_ Score
Retired_ working	-1.126	0.579	-0.445
	(-1.35)	(0.84)	(-0.45)
Retired _notworking	-1.378	-0.265	-0.552
	(-1.49)	(-0.64)	(-1.58)
ln_ savings	-0.248***	-0.230***	-0.132***
	(-5.57)	(-5.62)	(-3.09)
Gender	-1.516***	-1.565***	-1.331***
	(-6.09)	(-7.13)	(-5.97)
Marital _status	-2.540***	-1.150***	-0.378
	(-5.08)	(-3.06)	(-1.18)
Education	-1.111***	-1.120***	-0.759***
	(-5.08)	(-5.14)	(-2.73)
Smoking & drinking	0.183	-0.102	-0.155
	(0.57)	(-0.36)	(-0.49)
Social participation	-0.746***	-0.456**	-0.469**
	(-3.48)	(-2.37)	(-2.25)
ADL	-1.040***	-0.755***	-0.545***
	(-16.72)	(-17.05)	(-15.96)
Medical insurance	0.467	-0.0608	-0.367
	(1.16)	(-0.17)	(-1.00)
Living arrangement	1.325***	1.643***	1.652***
	(3.59)	(4.52)	(4.68)
Chronic disease	1.418*	1.742	5.258**
	(1.75)	(1.61)	(2.48)
ln_ pension	-0.00277	-0.183***	-0.157***

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	(-0.03)	(-3.69)	(-3.64)
ln_ debt	0.183***	0.171***	0.227***
	(8.46)	(6.61)	(5.14)
_cons	29.03***	23.09***	14.85***
	(19.03)	(16.05)	(6.60)
N	3070	4020	3532
R^2	0.198	0.172	0.156

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Similar with the regression results for retirement using OLS, as the table 15 shows that savings, gender, education, social participation, ADL, living arrangement and debt are the factors can affect depression among all age group. Marital status can influence depression if the people under 65 years old. Pension has a significant relationship with depression when people is greater than 55 years old. Chronic disease has a significant relationship with depression in >54 and 65-80 age groups.

Table 16 Sub-sample regression of different age groups for working after retirement (Logit)

	45-54 CES_ Dummy	55-64 CES_ Dummy	65-80 CES_ Dummy
Retired _working	-0.00237	-0.0154	-0.226
	(-0.01)	(-0.05)	(-0.52)
Retired _notworking	-0.805*	-0.00525	-0.229
	(-1.73)	(-0.03)	(-1.61)
ln_ savings	-0.104***	-0.0938***	-0.0402**
	(-5.69)	(-5.99)	(-2.55)
Gender	-0.566***	-0.528***	-0.442***
	(-5.32)	(-6.12)	(-5.38)
Marital _status	-0.592***	-0.202	-0.0598
	(-3.08)	(-1.47)	(-0.52)
Education	-0.416***	-0.401***	-0.241**
	(-4.64)	(-4.62)	(-2.22)
Smoking & drinking	0.0885	-0.135	-0.0132
	(0.62)	(-1.18)	(-0.11)
Social participation	-0.214**	-0.145**	-0.0990
	(-2.48)	(-1.99)	(-1.29)
ADL	-0.321***	-0.200***	-0.157***
	(-9.75)	(-11.10)	(-11.92)
Medical insurance	0.132	-0.117	0.0141
	(0.80)	(-0.87)	(0.11)
Living arrangement	0.358**	0.469***	0.464***

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	(2.46)	(3.55)	(3.70)
Chronic disease	0.902**	0.869*	1.566
	(1.99)	(1.65)	(1.43)
ln_ pension	-0.0150	-0.0737***	-0.0543***
	(-0.37)	(-3.21)	(-3.06)
ln_ debt	0.0453***	0.0487***	0.0661***
	(5.26)	(5.14)	(4.19)
_cons	5.442***	3.259***	1.023
	(6.88)	(5.06)	(0.91)
N	3070	4020	3532
R^2	0.1107	0.0993	0.0895

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The logit regression results for working after retirement show that savings, gender, education, ADL, living arrangement and debt have a significant relationship with depression among all age group. People who retired and not working have a significant relationship with depression when people are between 45 and 54 years old. Chronic disease and social participation can affect the depression only when people are under 64 years old. When people are over 54 years old, pension appears the influence of depression.

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6.2.2.2 Sub-sample analyses of gender

Consider that factors affecting depression in men may be different than in women. A sub-sample analysis of gender was performed in this study.

TABLE 17 Sub-sample regression of gender for retirement

	Male CES_ Dummy	Male CES_ Score	Female CES_ Dummy	Female CES_ Score
Retired	-0.0454	0.0820	0.0965	-0.101
	(0.175)	(0.370)	(0.172)	(0.448)
ln_ savings	-0.0813***	-0.194***	-0.0787***	-0.225***
	(0.0143)	(0.0336)	(0.0126)	(0.0356)
Age	0.00416	0.0149	-0.0109	-0.0191
	(0.00464)	(0.0108)	(0.00393)	(0.0112)
Marital status	-0.294**	-1.073***	-0.161	-0.913***
	(0.132)	(0.330)	(0.0985)	(0.283)
Education	-0.363***	-0.990***	-0.437***	-1.372***

	(0.0753)	(0.172)	(0.0753)	(0.209)
Smoking & drinking	-0.0237	0.00991	0.0345	-0.0847
	(0.0737)	(0.170)	(0.300)	(0.861)
Social participation	-0.181***	-0.539***	-0.137**	-0.584***
	(0.0700)	(0.164)	(0.0588)	(0.169)
ADL	-0.158***	-0.609***	-0.220***	-0.737***
	(0.0143)	(0.0345)	(0.0144)	(0.0349)
Medical insurance	0.0191	0.0174	-0.0214	-0.0749
	(0.132)	(0.312)	(0.105)	(0.299)
Living arrangement	0.387***	1.252***	0.442***	1.707***
	(0.122)	(0.303)	(0.0989)	(0.289)
Chronic disease	1.448**	2.593***	0.741*	1.510
	(0.608)	(0.838)	(0.397)	(0.946)
ln_ pension	-0.0308*	-0.115***	-0.0781***	-0.167***
	(0.0172)	(0.0361)	(0.0178)	(0.0434)
ln_ debt	0.0551***	0.159***	0.0427***	0.204***
	(0.00875)	(0.0214)	(0.00776)	(0.0227)
_cons	0.929	16.72***	3.969***	23.79***
	(0.760)	(1.363)	(0.643)	(1.669)
N	4970	4970	5652	5652
R^2	0.0720	0.133	0.0873	0.157

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The Table 17 illustrates that savings, education, social participation, ADL, living arrangement, pension and debt are associated with depression no matter male or female. On the contrary, retirement, smoking and drinking and medical insurance do not have relationship with depression. Chronic diseases and marriage have a greater impact on depression in men, but less on depression in women.

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TABLE 18 Sub-sample regression of gender for working after retirement

	Male CES_ Dummy	Male CES_ Score	Female CES_ Dummy	Female CES_ Score
Retired _working	-0.203	0.268	0.0915	-0.715
	(0.293)	(0.578)	(0.285)	(0.758)
Retired _notworking	-0.00370	0.0577	-0.202	-0.691
	(0.151)	(0.327)	(0.151)	(0.383)
ln_ savings	-0.0812***	-0.194***	-0.0774***	-0.221***
	(0.0143)	(0.0336)	(0.0126)	(0.0357)
Age	0.00404	0.0149	-0.0101**	-0.0168
	(0.00467)	(0.0109)	(0.00396)	(0.0112)
Marital status	-0.293**	-1.074***	-0.165*	-0.929***
	(0.132)	(0.330)	(0.0986)	(0.283)

Education	-0.362***	-0.994***	-0.422***	-1.307***
	(0.0756)	(0.173)	(0.0761)	(0.211)
Smoking & drinking	-0.0244	0.0108	0.0304	-0.0941
	(0.0737)	(0.170)	(0.301)	(0.860)
Social participation	-0.181***	-0.539***	-0.137**	-0.584***
	(0.0699)	(0.164)	(0.0588)	(0.169)
ADL	-0.157***	-0.609***	-0.219***	-0.735***
	(0.0143)	(0.0345)	(0.0144)	(0.0349)
Medical insurance	0.0185	0.0192	-0.0252	-0.0797
	(0.132)	(0.312)	(0.105)	(0.299)
Living arrangement	0.387***	1.252***	0.440***	1.698***
	(0.122)	(0.303)	(0.0989)	(0.289)
Chronic disease	1.448**	2.596***	0.758*	1.600*
	(0.608)	(0.838)	(0.396)	(0.947)
ln_ pension	-0.0302*	-0.118***	-0.0655***	-0.129***
	(0.0183)	(0.0384)	(0.0190)	(0.0467)
ln_ debt	0.0551***	0.159***	0.0426***	0.204***
	(0.00875)	(0.0214)	(0.00776)	(0.0227)
_cons	0.933	16.72***	3.898***	23.53***
	(0.760)	(1.365)	(0.644)	(1.674)
N	4970	4970	5652	5652
R^2	0.0721	0.133	0.0875	0.157

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

The Table 18 shows that savings, marital status, education, social participation, ADL, living arrangement, pension and debt are associated with depression no matter male or female. Chronic diseases are more strongly associated with depression in men.

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Chapter VII

DISCUSSION OF RESULTS

7.1 Discussion

7.1.1 Retirement

The results show that retirement can reduce the CES-D 10 score but not significant. Similarly, in different age groups or different gender groups, retirement had no effect on depression by using OLS. However, there is a negative relationship between retired and not working and depression if people is under 54 by using logit. The sign is different from the expected positive sign. Retirees are less likely to suffer from depression is the same results with other studies (Deng & He, 2016; Johnston & Lee, 2009; S. Liu & Lang, 2017). Retirement is associated with a lower risk of depression, probably due to reduced work stress and increased life satisfaction after retirement (Deng & He, 2016; S. Liu & Lang, 2017). This reason can also be used to explain this study. As people retire at 45 to 54, not working at this age reduces the stress of working. Retirees have more time to exercise or do things they enjoy but didn't have time for before.

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The results from Table 12 demonstrate that whether retirees working after retirement does not affect depression which is different from the results of Huang and Yu (2019). Their study noticed that working after retirement can improve mental health of the elderly under 65 years old. Maybe because of this study uses different wave of CHARLS and different methods leads to have different conclusions. In addition, whether to work after retirement is a multi-factor decision, related to age, gender, physical health, savings and other factors.

7.1.2 Savings

The result of savings is the same as the hypothesis and expected sign in full sample group, different age group or different gender group no matter using OLS or Logit. This means the more money older people save, the less likely they are to suffer from

depression in all age group. This result is similar to the study using CHARLS and exploring the association between savings and depression (Xia, 2018).The reason is that if retirees have enough savings, they will not worry about the difficulties of life and spend more time on some activities which is good for their mental health and reduce the incidence of depression.

7.1.3 Control variables

The results of gender, marital status, education, debt, and pension are the same as the expected sign and as the results in the literature review.

The regression results show that there is no relationship between age and depression which is different from others studies using CHARLS. Xia (2019) found that as age increases, the elderly may get higher CES-D10 score and higher the probability of having depression. The possible reason is that with the rise of age, the body function of the elderly decreases, and their own ability to recover also decreases.

There is significantly negative relationship between male and depression meaning that male may have a lower CES-D10 score and lower probability than female. Females have more pressure in daily life than male, because in traditional Chinese culture, women have always been responsible for housework and child care, leading to women not only have to work but also to take care of the family (S. Liu & Lang, 2017).

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Similar with other studies in the literature, marital status has a negative association with depression. Married seniors have a lower CES-D10 score and lower probability of suffering from depression. Because spouse can accompany each other in their daily life and encourage and support each other in times of difficulty that leads to a good mental health of the elderly (Wang, 2015).

Older people with higher education are less likely to suffer from depression. The elderly with high education, when they feel that their mental state is not good, they will go to see a doctor or adjust themselves on time such as doing exercise, social and so on to relieve the bad mood. This can greatly reduce the incidence of depression.

Elderly with more pension per month has a lower CES-D10 score. The reason is similar to savings. On the contrary, debt has a positive relationship with depression in all age groups meaning that the higher the debt, the higher the CES-D10 score. The reason is the opposite of savings.

However, considering the effect of age, gender and types of retirement, marital status will not have a significant relationship with depression when the elderly is under 65 years old by using OLS, under 55 years old by using logit, the elderly is female by using logit. While pension will not have an impact on depression until people is over 55 years old because people can't get a pension until they retire and over 55 is normal retirement age.

As expected, both ADL and chronic disease have a significant association with depression. Elderly with chronic diseases or low ADL score are more likely to have depression. This is related to the characteristics of chronic diseases. Because the chronic disease itself causes a lot of pain and concomitant diseases to the patient and the chronic disease course is long and the attack is repeated. At the same time, chronic diseases can impair the elderly's physical functioning, reduce their ability to care for themselves, and then cause the increase of the risk of depression (xiuli Li et al., 2015). Usually, the elderly with low ADL score will reduce their activities due to the weakness of the body and their confidence in self-care activities, which will lead to depression in the elderly (Kamin et al., 2012).

There is no statistically significant relationship between depression and smoking and drinking by using OLS or logit in any full sample or sub-sample group. However, there is a statistically significant relationship between depression and social participation by using OLS in any age group and gender group meaning that social participation is a very important factor. The regression result of social participation is the same as expected. Elderly can promote mental health and reduce the probability of depression by participating in social activities. Social activities are an important way for the elderly to maintain their mental health. Through different types of activities,

they can obtain various kinds of information, communicate ideas and support each other, so as to resist the decline of physiological functions and the weakening of social roles of the elderly (Li., 2019).

Similar to the situation of smoking and drinking, the regression results show that there is no statistically significant relationship between medical insurance and depression by using OLS or logit in full sample groups and any age groups.

Living arrangement is significantly associated with depression not only in full sample group but also in any age groups or gender groups. Elderly who is living alone is at risk for suffering from depression. Because old people living alone often feel lonely and without company. These negative emotions can cause or exacerbate depression. The literature also shows that elderly living with their children can get more care from their children, thereby improving mental health (Zunzunegui, F.Beland, & A.Otero, 2001).

7.2 Limitations

There are 5 kinds of limitations in this study:

(1) The sample size of different types of retirement such as internal retirement and early retirement is insufficient to analyze the influence of each types of retirement on depression in the elderly. Industry which the respondents are/were working in is not considered, because there are very few people who answer this question, and the sample size is not enough.

(2) The selection bias exists in this thesis. Because self-employed or farmers do not need contracts to work, it is hard to judge when they will enter or leave the labor market. In the selection of the population, self-employed and farmers will be excluded and this thesis only focus on workers or retirees in formal organizations.

(3) This study has endogeneity bias. The reason of retirement can be caused by depression or retirement leads to depression. Retirement and depression affect and cause each other. Thus, endogeneity bias exists in this thesis.

(4) The factors that affect depression are multidimensional except the variables included in this study. For example, genetic factors and so on. Therefore, this study only as a reference does not fully represent the factors that affect the geriatric depression.

(5) There were fewer people in the data who answered which year they would retire, so the sample size was not enough to conduct long-term retirement and short-term retirement analysis.

Based on the limitations of this study, future research should pay more attention to the association between different types of retirement and geriatric depression or explore the association between voluntary retirement, compulsory retirement and geriatric depression.

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CHAPTER Ⅷ

CONCLUSIONS AND RECOMMENDATIONS

8.1 Conclusions

This study explores the association between retirement status, savings and geriatric depression in People's Republic of China. The data comes from the China Health and Retirement Longitudinal Study (CHARLS), conducted by Peking university. A total of 10,622 samples were used in this study. Binary logit regression and OLS were used to analyze the data.

The conclusion from the descriptive statistics is: The ratio of people without depression to those with depression is about 7:3 if CES-D 10 is a binary variable and the scores are concentrated between 0 and 15 and the average CES-D 10 is 7.47 if CES-D 10 is a continuous variable. The results are basically consistent with the data in the existing literature (Xia, 2018; Xiaolan Wu, Jin Li, & Lili Wang, 2010). The average saving is 18,620 RMB. However, those with less than 5,000 RMB make up about 58% of the total. In terms of demographic characteristics, women make up 51% of the total sample. Marriage people accounts for 88% of the total sample. Middle school and above education accounts for 65%.

The conclusion from the full sample regression is that there is no statistically significant relationship between all kinds of retirement status and depression by using OLS or Logit. There is a significant relationship between savings, gender, education, debt, ADL, living arrangement and depression.

The conclusion from the sub-sample sample regression is that people retired and not working is significantly associated with depression by using logit when people is under 54 years old. There is a significant relationship between savings, gender, education, debt, ADL, living arrangement and depression in all age group by using both OLS and logit. The effect of marital status on depression is not significant if the

age of elderly is over 65 by using logit. Pension shows a significant relationship with depression only when people is over 55 years old. There is a significant association between savings, education, social participation, ADL, living arrangement, pension, debt and depression in all gender group. However, only debt and social participation are associated with depression in the different retirement groups.

8.2 Recommendation

The previous analysis has shown that savings, social participation, ADL and living arrangement are associated with the geriatric depression deeply. This aligns well with the active ageing framework, whose main connotation is ‘health, participation and security’. ‘Health’ refers to the physical, mental and social well-being of the elderly (Kalache & Gatti, 2003).

Based on the factors associated with depression, this study will make recommendations to health, participation and security respectively.

First of all, the findings underline the importance of interventions to increase retirement savings and perhaps retirement planning overall to ensure financial security in later life. In addition, the results suggest that interventions aimed at preventing problems with ADL after retirement should be encouraged. Although this study did not investigate the determinants of ADL, these interventions might include to increase the investment in infrastructure, provide the space for morning exercise and square dancing, timely repair and update the fitness facilities, and mobilize the enthusiasm of the elderly to exercise so that the elderly will not only be healthier, but they will also be more social participation. ‘Participation’ refers to taking an active part in family, social, economic and cultural activities in various ways according to the individual's will and specialties after retirement and continuing to make contributions to social development when the elderly are physically able (Kalache & Gatti, 2003). The findings show that social participation and living arrangement are associated with geriatric depression. Hence, interventions to encourage participation should be

promoted. The government may need to build cultural and entertainment platforms for the elderly, such as activity centers for the elderly and chess and card rooms, to meet their daily activities, and carry out various types of cultural entertainment activities. The community can regularly organize some cultural activities in line with the customs of the village, such as opera parties, folk knowledge lecture hall and other activities, to enrich the cultural life of the elderly in the countryside. Finally, the government should call on social volunteers, love groups to visit the elderly left behind, for them to send warmth and comfort.

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APPENDIX

Test results

Variable	VIF	1/VIF
martial_st~s	1.43	0.699844
age	1.37	0.727753
living_a	1.34	0.743644
gender	1.33	0.749588
ln_pension	1.27	0.784716
edu	1.26	0.792756
s_d	1.24	0.806289
ln_savings	1.16	0.861143
retired	1.14	0.880324
ln_debt	1.11	0.898169
ADL	1.10	0.910784
social	1.07	0.935126
insurance	1.01	0.991914
chronic_di~e	1.01	0.993770
Mean VIF	1.20	

Variable	VIF	1/VIF
ln_pension	1.46	0.684730
martial_st~s	1.43	0.700023
age	1.39	0.717038
retired_no~g	1.37	0.730753
living_a	1.35	0.743389
gender	1.33	0.749175
edu	1.28	0.783060
s_d	1.24	0.806267
ln_savings	1.16	0.861613
ln_debt	1.11	0.898388
ADL	1.10	0.910587
social	1.07	0.935420
retired_wo~g	1.06	0.946556
insurance	1.01	0.991873
chronic_di~e	1.01	0.993468
Mean VIF	1.22	

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