The Effect of Depression on Labor Participation of Middle-aged and Older Chinese: A Study Based on CHARLS Panel Data

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Abstract

The relationship between physical health and labor participation is well established, but limited research focuses on the impact of mental health on labor supply. This article attempts to study the impact of mental health (depression) on labor participation of middle-aged and older Chinese population. We use China Health and Retirement Longitudinal Study (CHARLS), a nationally representative biennial survey starting from 2011, to conduct our analysis. CHARLS provides information of family composition, health, wealth, labor market outcomes and retirement for Chinese population. It covers Chinese urban and rural residents aged 45 and older and their partners. It contains over 10,000 households, approximately 17,500 individuals in 450 communities. Three waves of data from 2011, 2013 and 2015 yields around 60,000 observations. Based on the rich dataset, we study the effect of depression on labor participation and work hours among the Chinese population over 45 years old. The result of panel data regressions shows that depression has a negative impact on labor participation and work hours for middle-aged and older Chinese. The paper tries to address endogeneity caused by reverse causality using lagged depression status as an instrumental variable. The result remains consistent. By dividing the population by gender and rural status, we find that labor participation of male is negatively affected by depression. Female labor participation is less affected by depression. We also find that working hour of rural male population is affected more negatively by depression than any other group.

Keywords: depression, labor participation, working hours, middle-aged and older population

JEL Classification: I18, J14, J24

1. Introduction

Both physical health and mental health influence the labor force participation among middle-aged and older population. There is abundant research in the effect of health on labor force participation. Some research focus on objective and subjective overall health status. Past research finds that being unhealthy has a negative impact on labor supply. (Haveman et al. 1994; Kalwij and Vermeulen 2008; 蒋选 and 郝磊 2017) Other research focus on specific diseases including cancer, cardiovascular diseases, diabetes, and mental illnesses. (Miah and Wilcox-Gök 2007; Li, Lei and Zhao 2014; Ettner, Frank, and Kessler 1997)

Our society has been increasing aware of the impact of mental health. Why do we study mental health of middle-aged and older population? In 2016, the size of population over 60 years old in China exceeds 231 million, constituting 16.7% of the population.[1] Besides the global trend of aging and decrease in fertility that changes the population structure, China is also experiencing migration of the younger population from rural to urban, these trends decrease the amount of care and emotional support that middle-aged and older people receive from their children.

Middle-aged and older people faces mental problems including depression. Depression is a common mental illness around the world. According to the WHO, there are around 300 million people suffering from depression, which is the number one cause of disability.[2] An estimation from Global Burden of Disease show that of all the DALYs lost in China, DALYs lost from mental illnesses and substance abuse ranks the third, which is higher than diabetes and chronic respiratory diseases.[3] The disease burden of depression can be measured in different ways, the economic cost of treatment, and indirect costs including loss of income and burden on the household. (Culyer and Newhouse 2000) Some of the indirect costs can be accounted by the change in income and labor participation. Although early research establishes the correlation between mental illnesses and income(Bruce, Takeuchi, and Leaf 1991), the causality between mental illnesses, income and labor participation is difficult to establish. This is due to reverse causality. Mental illnesses do affect labor supply, but labor supply shocks such as unemployment may also affect mental health.

Using instrumental variables to isolate the effect of mental illnesses on health is a common approach in the

[1] Source: Ministry of Civil Affairs of the People's Republic of China
[2] http://www.who.int/mediacentre/factsheets/fs369/en/
[3] https://vizhub.healthdata.org/gbd-compare/

literature. Past instrumental variables include death of a close friend, mental health status of the parents, mental health before adulthood, mental health status of three months ago, social support, frequency of exercise, and major stress events. (Ettner, Frank, and Kessler 1997; Hamilton, Merrigan, and Dufresne 1997; Chatterji et al. 2007) In literature, Ettner et al(1997) find that mental illnesses decrease labor participation by 11 percent, and the effect on income is larger than the effect on work hours. Ettner use parent's mental health status and mental health status before 18 as instrumental variable. Following Ettner's method, Mitra et al (2017) use panel data to analyze the effect of four measures of mental health on labor supply. They use the lagged mental health measures as instruments to address the problem of reverse causality. Their research finds that having a mental illness increases the chance of not being employed by 7.3%. Among people who were unemployed, those who suffered from a mental illness were less likely to return to the labor market than those without a mental illness. Frijters et al (2010) uses the death of a close friend as an instrument. They find that when having a mental illness decrease by one standard deviation, the likelihood of labor force participation decreases by 17 percent, and the effect is stronger among women and the elderly. Banerjee et al (2017) finds that mental illnesses are correlated with unemployment, income loss, absence from work, decrease labor supply, and decreased labor efficiency.

Developing countries, including China, lacks awareness of mental illnesses. This is reflected in the academic literature. Take China for example, although there is abundant research in the effect of health on the labor participation of middle age and elderly people, there is little evidence on the relationship between mental health and labor force participation. Lu et al (2009) uses a cross-sectional data to analyze mental health and labor force participation. With the cross-sectional data from CHARLS 2011, Zhu (2017) uses the health status at the age of 15 and the interaction with relatives and friends as instruments. Zhu finds that mental health significantly affects the labor supply of urban middle aged and elderly and the non-agricultural labor supply among rural residents.

Due to insufficient evidence in the effect of depression on labor supply, we aim to use the rich dataset of CHARLS to further explore this relationship. First, as there are more detailed data available, it is time to check the robustness of previous results. Second, the difference styles of labor supply between China's rural and urban sectors may result in different effects. Third, there are some evidence of the different impact of mental illnesses on men and women. This paper aims to use a three wave panel data to address these questions. We use depression tendency in the past as an instrument to current depression tendency to measure its effect on individual labor

supply. We find that depression tendency negatively affects the decision to work and the length of work. Depression tendency has a larger effect to the rural population and male population.

The paper is organized into 5 sections. Section 2 describes the model, the selection of variables and the reason of choosing lagged mental status as an instrument. Section 3 describes the data and main variables. Section 4 presents results from the main regression, including regression of the panel data and regression using the instrument, and the heterogeneity analysis by rural status and gender. Section 5 concludes this paper.

2. Model and Variable Selection

2.1 Model

The paper uses panel data to perform the regression analysis. The econometric model is as follows:

$$Y_{it} = \alpha_i + \beta DEPR_{it} + \delta X_{it} + \epsilon_{it} \qquad (1)$$

In equation 1, Y_{it} is the measure of labor participation force of individual i at time t. There are two measures: a dummy variable of whether the individual is working and a continuous variable of working hours. $DEPR_{it}$ is the measurement of depression. One measure is the score of the CESD-10 questionnaire. The other measure is a dummy variable of whether the individual is depressed. X_{it} includes control variables at the individual level. There are 3 waves in total. Based on the dependent variables and instrumental variables in the analysis, we use panel Probit model, panel Tobit model, IV-Probit model, and IV-Tobit model.

2.2 Variable selection

Labor Participation

We use two measures of labor participation. The first is a dummy variable. 0 indicates the individual is not working at the moment. 1 indicates the individual is working. Work includes agricultural work, employed work, and self-employed. The second measurement is working hours per week. We set the variables to 0 for those who are not in the labor force.

Depression and Mental Illness

In literature, psychiatric symptom index (PSI) and the existence of specific mental illnesses were used as the measurement for mental illnesses. PSI measures the intensity of 29 symptoms and can be categorized into four main factors, including depression, anxiety, anger and cognitive disturbance. (Ilfeld Jr 1976) Ettner et al uses the

appearance of certain psychological condition to measure mental status.(Ettner, Frank, and Kessler 1997) The psychological conditions include depression, anxiety, fear, mania, alcohol and substance abuse and dependency. This paper focuses on the effect of depression on labor supply. We use CESD-10 score from CHARLS data to measure depression. CHARLS measures each individual's mental health using CESD-10 questionnaire. The minimum score is 0 and the maximum score is 30. We follow literature and use a score of 10 as the cutoff point for whether the individual has a depression tendency. (Andresen et al. 1994)

Control Variables

We control for individual characteristics and household characteristics. Individual characteristics include gender, age, education, place of residency, whether the individual suffers from major diseases. These individual characteristics, especially age and education, are related to an individual's performance in the labor market. Household characteristics include marital status (unmarried, married, married but separated, divorced, widowed), number of children and age of children. Marital status and children affects an individual's choice in the labor market and his or her performance.

2.3 The issue of endogeneity and instrumental variable

While the correlation between mental health and employment has been well established, there are limited studies in past years that use instrumental variable to construct a convincing causal relationship (Ettner, Frank, and Kessler 1997; Hamilton, Merrigan, and Dufresne 1997; Marcotte, Wilcox-Gök, and Redmon 2000; Alexandre and French 2001; Chatterji et al. 2007; Ojeda et al. 2010). The key is to find the exogenous factor of mental health that only affects labor market performance through the channel of mental health.

Past research uses mental illness history of the parents (Ettner, Frank, and Kessler 1997; Marcotte, Wilcox-Gök, and Redmon 2000), mental illness during childhood (Ettner, Frank, and Kessler 1997; Chatterji et al. 2007), mental status of three months ago (Hamilton, Merrigan, and Dufresne 1997), religion (Alexandre and French 2001; Chatterji et al. 2007), social support (Hamilton, Merrigan, and Dufresne 1997; Alexandre and French 2001; Ojeda et al. 2010), frequency of exercise and occurrence of stressful events(Hamilton, Merrigan, and Dufresne 1997), and death of a close friend in the past year (Frijters, Johnston, and Shields 2010) as instruments. This paper uses the depression tendency in the previous wave as an instrument of depression tendency in the current wave.

3. Data and descriptive statistics

3.1 Source of data

China Health and Retirement Longitudinal Study (CHARLS) is a representative national longitudinal data in China that is similar to Health and Retirement Survey. CHALRS collects data of population over 45 years old from 450 villages/communities in 150 counties. It collects information on the community/village level, household level and individual level. It provides information on income, labor supply, health status and retirement status. We use data from 2011, 2013 and 2015. For each wave, the sample size is 15,959, 16,270 and 19,182.

3.2 Descriptive data

Table 1 presents summary statistics for the whole population and by gender and residency. We see that the average age of the sample is almost 59 years old. Male consists of 47.2% of the population. 60.7% percent of the population has rural hukou. 87.7% of the population lives with his or her spouse. The average number of children is 2.62, 2.34 and 2.81 for the full sample, urban residents, and rural residents, respectively. We define having at least one disease among cancer, hypertension and diabetes as having a major disease. We see that 35% of the sample is under the influence of major diseases. More female and more urban residents are under the influence of major diseases. The sample is not highly educated. 25.7% of the sample are illiterate. Female are less educated compared to male. Rural residents are less educated compared to urban residents.

CESD-10 is a simple questionnaire for measuring depression tendency. The average CESD-10 score is 8.015. The average score for female is higher than that of male. The average score for rural residents is higher than that of urban residents. In literature, a score of 10 is used as a cutoff point for depression tendency. Around 40% of female population has a tendency for depression. 37.8% of rural population has a tendency for depression.

As for labor supply. 78.2% of the rural population is working, compared to 55.7% in urban population. The average working hours per week for rural population is 32.22 hours, which is higher than the 24.22 hours in urban population. More men are working than women. Men also work longer hours per week compared to women.

Table 1 Summary Statistics

		Gender		Residency	
	Full Sample	Male	Female	Urban	Rural
Proportion	1	0.472	0.528	0.393	0.607
Working (%)	0.694	0.755	0.639	0.557	0.782
	(0.461)	(0.43)	(0.48)	(0.497)	(0.413)
Working Hours per Week	29.08	33.35	25.26	24.22	32.22
	(28.78)	(28.8)	(28.22)	(28.99)	(28.2)
CESD-10 Score	8.015	6.988	8.934	6.981	8.683
	(6.163)	(5.629)	(6.468)	(5.713)	(6.348)
Depression Tendency	0.336	0.265	0.399	0.27	0.378
	(0.472)	(0.442)	(0.49)	(0.444)	(0.485)
Age	58.9 (10.06)	59.63	58.24	58.85	58.93 (10)
		(9.792)	(10.26)	(10.15)	
Living with Spouse	0.877	0.91	0.848	0.88	0.876
	(0.328)	(0.286)	(0.359)	(0.325)	(0.33)
Number of Children	2.626 (1.41)	2.565	2.68	2.344	2.808
		(1.391)	(1.426)	(1.361)	(1.412)
Major Disease	0.35 (0.477)	0.333	0.366	0.385	0.328
		(0.471)	(0.482)	(0.487)	(0.47)
Education					
Illiterate	25.72	11.71	38.26	16.19	31.88
Did not finish elementary school	17.22	17.04	17.39	14.3	19.12
Private education	0.37	0.64	0.12	0.33	0.39
Elementary School	24.62	29.39	20.35	24.33	24.81
Middle School	20.21	25.42	15.54	24.38	17.51
High School	7.56	9.55	5.78	11.6	4.95
Vocational School	2.33	3.37	1.4	4.38	1.01
Technical College	1.24	1.81	0.74	2.75	0.27
Undergraduate and Above	0.73	1.07	0.42	1.74	0.06

Table 2 presents labor supply status by depression tendency, gender and place of residency. Compared with Table 1, the difference of labor supply between place of residency and gender still exists. Male, urban residents and rural residents all exhibit a trend of working less with depression. But for female, the difference is very small. This indicates that depression tendency is not a determining factor for female labor supply.

Table 2 Labor Supply by Depression Tendency

		Full sample	Gender		Place of Residency	
			Male	Female	Urban	Rural
Work status	depression tendency	66.99	72.11	63.94	52.65	73.61
	none	70.55	76.69	63.83	56.79	81
working hours per week	depression tendency	28.71	31.02	24.83	22.07	29.49
	none	28.76	34.19	25.53	25.02	33.87

Figure 1 and Figure 2 show the relationship between work status and working hours per week, respectively. Each figure presents subsample results by gender and residency. We see large fluctuation for CESD-10 score that are over 20. For the population where CESD-10 scores below 20, we see a consistent trend for the full sample, rural male, rural female and urban male that the proportion of people working and the average working hours per week decreases as CESD-10 score increases. For urban female, the trend is not visible.

Figure 1 Work Status by CESD-10 Score

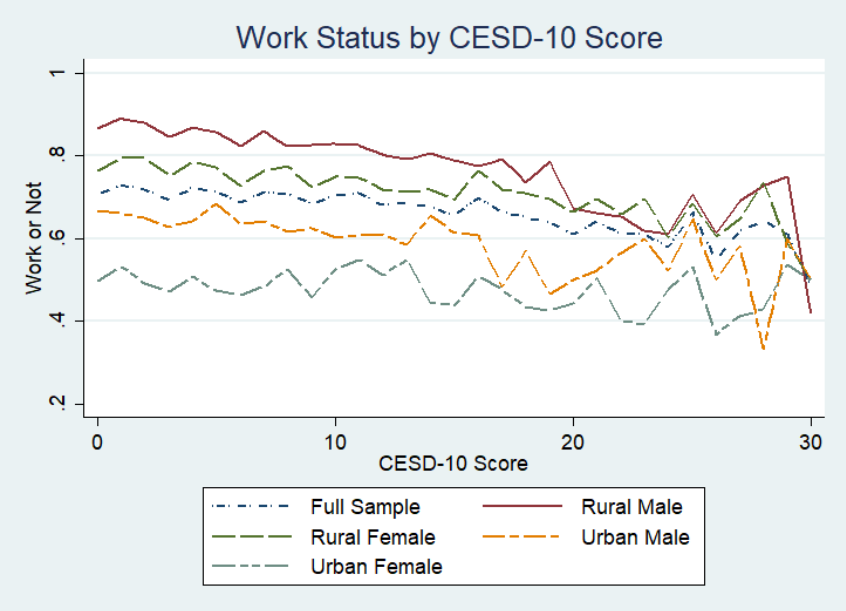
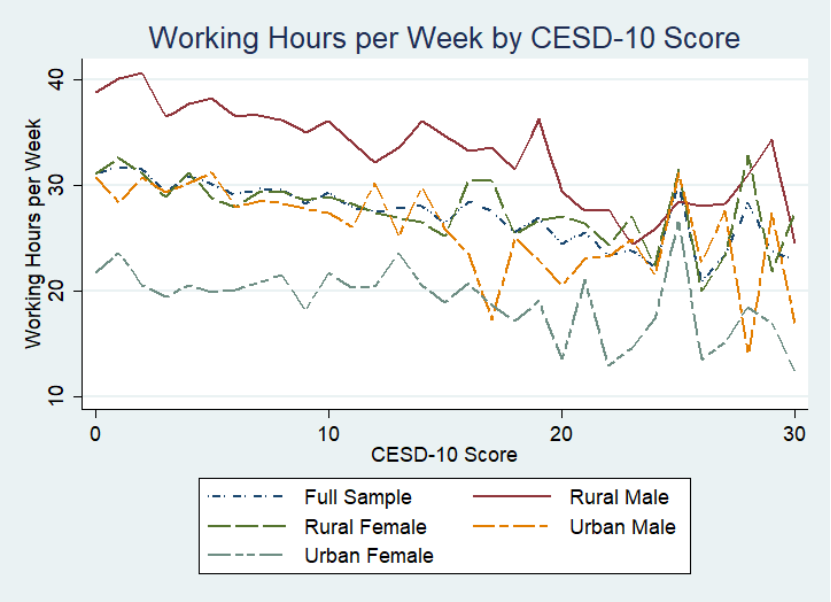


Figure 2 Working Hours per Week by CESD-10 Score



4. RESULTS

4.1 Logit Results

To analyze the effect of depression on the labor participation of the middle and old age group, we first use the Logit model. In this study, we use three phase panel data (wave 2011, 2013 and 2015). Considering that T is very small and N is very large, the fixed effect (FE) model may lose some freedom. For this reason, we choose the random effect (RE) panel model according to the data characteristics.

Table 3 displays the Logit results obtained by regressing labor participation on depression. The dependent variable is a dummy variable of labor participation, 1 indicates participation in labor market, while 0 indicates no participation. In columns (1) and (2), the independent variable of depression is a dummy variable which indicates whether there is depression tendency. If an individual has CESD-10 score larger than 10, then the person is coded as having a depression tendency. The regression in column (2) includes some control variables except for the dummy independent variable. In columns (3) and (4), we also report the results of regressing on the continuous variable which take the CESD-10 score as an independent variable of depression, while controlling for individual characteristics.

Table 3. Effect of depression on labor participation, Logit model with random effect.

Variable	(1)	(2)	(3)	(4)
Depression Dummy	-0.263***	-0.201***		
	(0.0420)	(0.0415)		
CESD-10			-0.0333***	-0.0246***
			(0.00340)	(0.00333)
Gender		1.603***		1.591***
		(0.0575)		(0.0575)
Age		-0.179***		-0.179***
		(0.00366)		(0.00366)
Rural Residence		2.058***		2.075***
		(0.0584)		(0.0585)
Education		-0.187***		-0.192***
		(0.0149)		(0.0149)
Married		0.669***		0.650***
		(0.0709)		(0.0709)
Number of Children		0.0438**		0.0452**
		(0.0184)		(0.0184)
Disease		-0.693***		-0.682***
		(0.0485)		(0.0485)
Constant	2.033***	10.53***	2.210***	10.70***
	(0.0385)	(0.241)	(0.0455)	(0.243)
Observations	51,411	47,376	51,411	47,376

Standard errors in parentheses

*** Effect of depression is significant at p<0.01, ** p<0.05, * p<0.1

From the regression results of Table 3, it is clear that the influence of depression on labor participation is significantly negative, whether we use depression tendency or CESD-10 score as independent variable. The negative impact is still significant after controlling for individual characteristics. From the perspective of gender, the labor participation rate of men is significantly higher than that of women, and the individual labor participation rate of rural residents is also significantly higher than that of urban residents. There is a significant negative effect of age, educational and major disease on labor participation, while living with spouse and the number of children have a significant positive influence on the labor participation.

4.2 Tobit Results

The continuous variable of working hours per week is also used to measure the length of labor participation. Because the working hours of no working individuals are 0, the data is left censored. In order to obtain a

consistent estimation, we use the Tobit model with random effect. Table 4 displays the results.

Table 4. Effect of depression on working hours per week, Tobit model with random effect.

Variable	(1)	(4)	(7)	(10)
Depression Dummy	-2.132***	-0.999***		
	(0.261)	(0.257)		
CESD-10			-0.229***	-0.109***
			(0.0210)	(0.0207)
Gender		10.08***		10.03***
		(0.316)		(0.317)
Age		-1.055***		-1.055***
		(0.0177)		(0.0177)
Rural Residence		7.099***		7.156***
		(0.320)		(0.321)
Education		-0.960***		-0.979***
		(0.0869)		(0.0870)
Married		3.542***		3.471***
		(0.442)		(0.442)
Number of Children		-0.0487		-0.0429
		(0.113)		(0.113)
Disease		-3.964***		-3.923***
		(0.295)		(0.295)
Constant	30.13***	83.88***	31.24***	84.51***
	(0.185)	(1.246)	(0.234)	(1.257)
Observations	50,641	46,713	50,641	46,713

Standard errors in parentheses

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

From the results of Table 4, we can see that both the depression tendency and the CESD-10 score have a significant negative impact on working hours per week, which is very significant both in the single variable model and the model including control variables. In the single independent variable model, individuals with depressive tendencies are less working for 2.13 hours per week, and the influence became smaller after adding control variables, but still significant. Men are working about 10.1 hours longer than women per week, and rural residents are working about 7.1 hours per week longer than urban individuals. Individuals living together with their spouses tend to work 3.5 hours per week longer than those of unmarried, divorced or widowed individuals, and the difference was significant. Age, education and major disease have negative effect on working hours per week. The number of children had no significant effect on the working hours per week.

4.3 IV Regression

Considering the reverse causal relationship between depression and labor participation, depression may be endogenous as an independent variable. We use lagged depression as an instrumental variable for the current depression to eliminate the impact of labor participation on the current depression situation. In the IV regression, we use IV-Probit and IV-Tobit regression with labor participation and working per week as dependent variables, respectively. Compared with the panel Logit regression, the exogenous hypothesis was rejected in the Wald test of the model with instrument variables. We also conduct the weak instrument variable test, and the result showed that the IV was reasonable.

Table 5. The effects of depression on labor participation and working hours per week.

(IV estimation)

Variables	On labor participation		On working hours per week	
	IV-Probit		IV-Tobit	
	（1）	（2）	（3）	（4）
Depression (Yes=1, No=0)	-0.147*** (0.056)		-1.504 (1.549)	
The Score of CESD-10		-0.013*** (0.00307)		-0.148* (0.865)
Gender (Male=1, Female=0)	0.503*** (0.020)	0.500*** (0.019)	16.001*** (0.544)	15.943*** (0.536)
Age	-0.059*** (0.001)	-0.059*** (0.001)	-1.786*** (0.033)	-1.786*** (0.033)
Hukou (Rural=1, Urban=0)	0.676*** (0.019)	0.681*** (0.019)	14.307*** (0.545)	14.360*** (0.541)
Education	-0.070*** (0.005)	-0.072*** (0.005)	-1.766*** (0.150)	-1.787*** (0.149)
Living with spouse	0.230*** (0.026)	0.223*** (0.026)	8.852*** (0.810)	8.756*** (0.809)

Number of children	0.007	0.007	-0.200	-0.191
	(0.007)	(0.007)	(0.204)	(0.204)
Have Disease	-0.269***	-0.265***	-7.462***	-7.402***
(Yes=1, No=0)	(0.018)	(0.018)	(0.520)	(0.518)
Constant	3.639***	3.713***	110.372***	111.193***
	(0.089)	(0.091)	(2.464)	(2.515)
Observations	27,382	27,382	26,937	26,937

Source: Authors' calculation from CHARLS data.

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

From the results in table 5, we can see that depression tendency and CESD-10 score have significant negative effects on labor participation, which is consistent with the results of panel Logit estimation. However, in terms of the impact on working hours of working individuals, the impacts are not significant, and only the impact of CESD-10 score is significant at the 10% level. Besides, the influences of control variables estimated here are mostly consistent with previous results in panel Logit regression.

4.4 Heterogeneity Analysis: Rural and Urban Areas

Due to the large differences between rural and urban areas, there are great heterogeneity between rural and urban samples in terms of labor participation and working hours. In this section, we consider the heterogeneity of the urban and rural residents in order to verify the robustness of the results and the differences in urban and rural samples. The rural and urban sample here refer to the permanent residence, not the household registration. In Table 6, columns (1) and (2) are the effects of rural samples and urban samples on labor participation; (3) and (4) are the impact of rural and urban samples on the length of working.

Table 6. Effect of depression on labor force participation (rural and urban residence).

	Labor Participation		Working Hours Per Week	
Variable	Rural	Urban	Rural	Urban
Depression Dummy	-0.237***	-0.176**	-1.185***	-0.813*
	(0.0502)	(0.0709)	(0.325)	(0.415)
Gender	1.157***	2.055***	8.696***	11.31***
	(0.0711)	(0.0956)	(0.415)	(0.494)
Age	-0.133***	-0.240***	-0.876***	-1.265***
	(0.00427)	(0.00655)	(0.0234)	(0.0270)
Education	-0.0290	-0.326***	-0.349***	-1.446***

	(0.0200)	(0.0233)	(0.121)	(0.126)
Married	0.802***	0.475***	5.111***	1.371**
	(0.0836)	(0.125)	(0.566)	(0.699)
Number of Children	-0.0845***	0.211***	-0.683***	0.647***
	(0.0219)	(0.0325)	(0.144)	(0.183)
Disease	-0.693***	-0.667***	-4.199***	-3.388***
	(0.0597)	(0.0805)	(0.381)	(0.460)
Constant	9.642***	14.25***	79.76***	97.75***
	(0.288)	(0.422)	(1.567)	(1.881)
Observations	28,882	18,494	28,475	18,238

Standard errors in parentheses

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

The results show that, regardless of the rural sample or the urban sample, the depression tendency has a significant negative impact on labor participation and working hours. The negative influence on working hours is greater. For urban samples, the gender difference on labor participation and working hours is higher than that in rural samples. Marriage has a positive impact on labor participation and labor length, while impact on working hours per week is especially larger in rural samples than that in urban. One thing to be noted is that the impact of the number of children is very different from the previous regression, and the results of rural samples and urban samples are totally different. For rural samples, having more children is correlated with lower labor participation and working hours per week. However, the case is reversed in urban samples.

4.5 Gender Heterogeneity Analysis

This paper further analyzes the heterogeneity of male and female samples, as shown in Table 7. The (1) and (2) columns show the impact of depressive tendencies on labor participation separated by gender, and (3) and (4) display the different impact on working hours per week.

Table 7. Effect of depression on labor force participation for both gender

	Labor Participation		Working Hours Per Week	
Variable	Women	Men	Women	Men
Depression Dummy	-0.0642	-0.423***	-0.176	-2.021***
	(0.0522)	(0.0676)	(0.337)	(0.394)
Age	-0.154***	-0.212***	-0.913***	-1.213***
	(0.00464)	(0.00596)	(0.0244)	(0.0255)
Rural Residence	2.012***	2.146***	7.486***	6.903***
	(0.0771)	(0.0895)	(0.445)	(0.460)
Education	-0.188***	-0.182***	-0.744***	-1.186***

	(0.0198)	(0.0226)	(0.120)	(0.126)
Married	0.591***	1.012***	2.935***	5.962***
	(0.0887)	(0.119)	(0.569)	(0.718)
Number of Children	0.0217	0.0538*	-0.135	-0.0390
	(0.0245)	(0.0279)	(0.156)	(0.165)
Disease	-0.637***	-0.812***	-4.288***	-3.811***
	(0.0638)	(0.0744)	(0.403)	(0.430)
Constant	9.095***	13.91***	75.18***	102.5***
	(0.312)	(0.413)	(1.740)	(1.873)
Observations	25,032	22,344	24,701	22,012

Standard errors in parentheses

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

It can be seen from Table 7 that depression tendencies have a significant negative impact on the labor participation and working hours for men, which is consistent with the results of the whole sample. But for women, the impact of depression is not significant. On the influence of labor duration, the negative effect of depression tendency is larger for men, compared with the previous full sample regression. In terms of the influence of control variables, age, educational and major diseases have significant negative effects on labor participation and working hours per week, and there is not a big difference among men and women. However, living with spouses has a positive impact on labor participation and labor length, while impact is larger for men than women.

5. Conclusion

We use the micro-survey data of CHARLS in 2011, 2013 and 2015 to analyze the influence of depression of middle-aged and older people over 45 years old on their labor participation and working hours per week. Using the panel data, we conducted the panel Logit, panel Tobit, IV-Probit, and IV-Tobit regressions. The results show that the depression has a statistically significant negative impact on labor participation and working hours per week. The results of IV estimation are consistent with panel regressions.

In addition, we analyzed the heterogeneity of the sample by place of residence and gender. The influence of depression on labor participation and labor duration is negative for both urban and rural area, but the influence of depression on labor participation of urban sample is only significant at the level of significance of 10%. For working hours per week, the negative impact of rural sample is greater. As for gender differences, depression has a significant negative impact on male sample's labor participation and working hours per week, which is

consistent with the full sample. For the impact on working hours, male sample was more negatively affected. However, for female sample, the influence of depression on their labor participation and working hours per week is not significant.

Our analysis shows that there is a significant negative correlation between labor participation, labor duration, and depression in middle-aged and older people in China. More than one-third of our sample are depressive at different level, which is more than the proportion of major diseases (at least one of cancer, hypertension, or diabetes). Depression has become one of the important factors for labor participation of middle-aged and older people in China. To improve the situation of labor supply and the quality of life of middle-aged and old people, it is necessary for the government to pay attention to the mental health of middle-aged and older people, and to provide more support for medical insurance and social security for mental health.

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