IZA DP No. 10037

Does Money Relieve Depression? Evidence from Social Pension Expansions in China

Xi Chen
Tianyu Wang
Susan H. Busch

July 2016

Does Money Relieve Depression?
Evidence from Social Pension
Expansions in China

Xi Chen
Yale University and IZA

Tianyu Wang
Renmin University of China

Susan H. Busch
Yale University

ABSTRACT

Does Money Relieve Depression?
Evidence from Social Pension Expansions in China[*]

We estimate the impact of pension enrollment on mental well-being using China's New Rural Pension Scheme (NRPS), the largest existing pension program. Since its launch in 2009, more than 400 million Chinese have enrolled in NRPS. We first describe plausible pathways through which pension may affect mental health. We then use the national sample of China Family Panel Studies (CFPS) to examine the effect of pension enrollment on mental health, as measured by CES-D and self-reported depressive symptoms. To overcome the endogeneity of pension enrollment or of income change on mental health, we exploit geographic variation in pension program implementation. Results indicate modest to large reductions in depressive symptoms due to pension enrollment; this effect is more pronounced among individuals eligible to claim pension income, among populations with more financial constraints, and among those with worse baseline mental health. Our findings hold for a rich set of robustness checks and falsification tests.

Corresponding author:

Tianyu Wang
School of Labor and Human Resources
Renmin University of China
E-mail: tianyuwang@ruc.edu.cn

---

1. Introduction

Many countries have recently adopted or reformed social pension programs to better support the needs of the elderly. Improved understanding of the income-health gradient may lead to the development of more effective pension programs as well as retirement policies.

Although the income-health gradient has long been an important topic of investigation, existing research is not conclusive. While early studies found a strong income-health gradient (e.g. Dohrenwend 1975; Belle 1990; Marmot 1994), few incorporated a study design that would demonstrate a causal relationship (Marmot 2002; Smith 1999; Deaton 2002). Findings also conflict. For instance, Snyder and Evans (2006) find that higher pension income leads to higher mortality, while others find that higher pension income leads to better health status (Case 2001) and lower mortality (Jensen and Richter 2004).

Credibly establishing a causal pathway between socioeconomic status (SES) and health has proven difficult. First, there is concern over reverse causality. If the gradient arises primarily because of causal pathways from health to income (i.e. good health leads to higher productivity and income), then strategies directly targeting health behavior may be most effective. If, on the other hand, the gradient arises primarily because higher income causes improvements in health, policies to make more economic resources available may be most efficient in promoting public health. Second, unobserved factors, such as genes or social trust, may affect both income and health, leading to biased estimates. Third, compared to conventional policy outcomes, such as physical health, cognitive ability or economic behavior, mental health status may be more subjective and often transient, indicating that measurement errors likely exist.

In this paper, we provide new evidence and contribute to the relatively limited literature on the causal impact of pension provision on mental well-being. Mental health is an important component of overall health status. Mental disorders are among the most common causes of low quality of life, disability and death (Fiske et al. 2009; Byers et al. 2012) and account for a large share of lost disability-adjusted life years and therefore the overall global burden of disease (Collins et al. 2011). In addition, mental health plays an important role in maintaining physical health.[2] The rapid aging

---

[2] Mental illnesses, such as depression and anxiety, often affect physical health through delinquent

of the world population further raises the importance of improving mental health at older ages, because older adults have both high rates of mental illness (WHO 2017) and among the highest suicide rates of all age groups (Case and Deaton 2015; US CDC 2016).

This paper also provides some of the first causal evidence of pension provision on mental health in the developing context. The literature on the causal impact of income on mental health, especially in old age, has been limited to the developed country context (Golberstein 2015). However, more than 80 percent of the world's 2 billion older individuals will be living in low- and middle- income countries (LMICs) by 2050 (Suzman et al. 2014). LMIC Populations have more than twice the rate of depressive symptoms, mood disorders, and anxiety disorders compared to their U.S. counterparts (U.S. Department of Health and Human Services 1999; Byers et al. 2010), and lose four times more disability–adjusted life years (DALYs) due to depression than people in high-income countries (Mathers et al. 2008). Despite the staggeringly high costs, investment in mental illness prevention and treatment remains low in LMICs (Collins et al., 2011).

In attempts to identify the causal impact of income on mental health, studies have used quasi-experimental study designs and examined the effects of a financial crisis (Friedman and Thomas 2008), moving to higher living standards (Stillman et al. 2009), job displacement (Sullivan and Wachter 2009), winning the Nobel Prize (Oswald and Rablen 2008),[3] lottery winning (Smith 1999; Lindahl 2005; Gardner and Oswald 2007; Kuhn et al. 2011; Apouey and Clark 2015; Cesarini et al. 2014),[4] and receiving an inheritance (Meer et al. 2003; Kim and Ruhm 2012).[5] Besides issues with these strategies that may plague empirical identifications, most of these shocks are in the form of a lump-sum transfer, which may affect mental health differently

---

behavior, suicide, substance use, and limit one's ability to participate in health-promoting behaviors (Lando et al. 2006; National Research Council and Institute of Medicine 2009).

[3] The mental health consequences of such events can be confounded by changes in other covariates unrelated to income per se. In fact, Stillman et al. (2009) argue that changes in income contributed little to the improvement of mental health from migration. Cesarini et al. (2014) further suggest that non-pecuniary mechanisms are likely at work.

[4] People who purchase lottery tickets may demonstrate quite different risk preferences than the general population, which may threaten the generalizability of the findings. Moreover, this causal interpretation also relies on the strong assumption that lottery success is not directly correlated with mental health.

[5] People who receive inheritance have presumably lost a loved one and may therefore have different mental health outcomes than the general population, which violates the exclusion restriction. In many cases, inheritance may also be anticipated by the recipients, meaning that it is less of a shock. These possibilities may dampen any effects on mental health and explain why Kim and Ruhm (2012) find no significant effect of inheritance income on depression.

than an annuity, due to a violation of fungibility (Thaler 1990).

To overcome these issues, a few studies explore exogenous changes in income, such as state unemployment rate (Ettner 1996),[6] the German reunification for East Germans (Frijters et al. 2005), the New Jersey-Pennsylvania Negative Income Tax Experiment (Elesh and Lefcowitz 1977), the Earned Income Tax Credit (EITC) in the U.S. (Evans and Garthwaite 2010), the Child Benefit System in Canada (Milligan and Stabile 2011), and the Social Security Notch (Golberstein 2015). However, while some of the existing studies find positive causal linkages between income and mental health, many fail to find compelling evidence (Adams et al. 2003; Frijters et al. 2005; Adda et al. 2009; Stowasser et al. 2011), and a few even report small negative effects (e.g. Snyder and Evans 2006). More empirical evidence is required to better understand the potential causal effects.

In this paper, we consider the largest pension program in the world – China's New Rural Pension Scheme (hereafter NRPS). The gradual roll-out of China's rural social pension by county (2009-2012) provides exogenous variations in pension enrollment and receipt, which allows us to identify their effects on mental health using an instrumental variable (hereafter IV) approach. Our identification strategy relies on the timing of pension rollout, which is an important predictor of enrollment at the individual level.

We use the 2012 China Family Panel Studies (hereafter CFPS) to examine these effects. To our knowledge, the 20-item full version of Center for Epidemiologic Studies Depression Scale (CES-D) (Radloff 1977) in the CFPS provides the most comprehensive measures of mental health among all the available national samples in China. The CES-D enables us to measure changes in a continuous measure of mental health as well as dichotomous changes in depressive symptoms.

We are among the first to distinguish older persons who are eligible to claim pension benefits from younger adults who are eligible for pension enrollment, but do not yet receive payments. Our results suggest that pension enrollment generates modest to large improvements in mental health for the former group, but the latter group experiences no such benefit. These effects hold under a set of robustness checks, falsification tests, and IV estimations with individual fixed effects (IV-FE).

---

[6] The instrument variables employed, (e.g. state unemployment rate), may directly affect mental health and therefore not satisfy the exclusion restriction.

This impact is unevenly distributed. Specifically, pension disproportionally improves mental health of those in the lower segment of SES and in worse mental health.

The rest of the paper is organized as follows. Section 2 provides the institutional details of the new pension program NRPS. Section 3 discusses our conceptual framework for this analysis; Section 4 describes the data and the estimation strategy. Section 5 presents the main results, including interpretations and robustness, and heterogeneous effects of pension. Finally, section 6 concludes the study and discusses policy implications.

2. China's New Rural Pension Reform

Against the backdrop of rapid economic growth, an increasing life expectancy and a declining fertility rate (following the introduction of the One-Child Policy in the 1970s) has led to an acceleration of demographic aging in China. However, there was little formal social safety net for the rural elderly population prior to 2009. To provide a more robust system of old-age support, in 2009 China launched a pension program for residents who hold rural registration. By 2012, the NRPS covered more than four hundred million individuals, among whom almost ninety million were greater than 60 years of age. The NRPS provides both a noncontributory (or basic) pension and an individual account (based on contributions). Both are paid to participants when they reach age 60. First, the basic pension financed by the collective fund is available to all residents and is independent of past work history and extended family composition(Chen et al. 2017a).

While the NRPS was rolled out at the county level, the level of pension payments is set at the provincial level. Many provinces set 55 CNY[7] per month as the basic pension benefit, although a few wealthier provinces (e.g., Beijing, Tianjin) set the benefit at up to 360 CNY per month (or 4,320 CNY per year). Second, the NRPS provides for an individual account, although the provisions differ by age at NRPS roll out. Adults below age 45 at roll out must contribute for at least 15 years to be eligible. Contributions accumulate in the individual account and are drawn down beginning when the individual reaches age 60. Those ages 45-59 when the NRPS was implemented in their county may contribute for any length of time to be eligible for the individual account payment. Individuals ages 60 or above at NRPS roll out have

---

[7] 1 U.S. Dollar (USD) $\approx$ 6 Chinese Yuan (CNY) in 2012.

no option for an individual account (limiting them to the basic pension).

According to the guidance released by the State Council of China, there are five categories of premiums for individual accounts: 100, 200, 300, 400, and 500 CNY per year per person. While some provinces offer additional higher levels of individual premiums, a majority of participants choose to contribute 100 CNY (Lei et al. 2013). The total pension benefits, including basic pension and a possible individual account, are approximately 15 percent of China's average earned income.[8] Thus, the NRPS offers a modest payment compared to many other developing countries, such as South Africa (Lund 2007).

The financing of the full pension payment consists of three parts: the individual premium, a local government subsidy, and a central government subsidy. The basic (noncontributory) pension is financed by the central government and local government. For the individual account, individual premium is supplemented with subsidies from the local government. These subsidies start at 30 CNY, and depend on the individual premium contribution.

As previously noted, NRPS was rolled out gradually. As described in the official documents released by Ministry of Human Resources and Social Security, the first implementation group adopted in September 2009, and covered roughly 10 percent of counties; the second implementation started in August 2010, and increased the proportion of counties participating to 25 percent; the third group implemented since July 2011 with 60 percent of all counties covered. By the end of 2012, all counties had adopted the program. Figure 1a indicates roll-out timing at the county level.

The NRPS may demonstrate heterogeneous impacts due to large socioeconomic. For example, pension payment accounts for more than half of the income per capita for a household in the lowest 10th income percentile in China (Cai et al. 2012). That older individuals on average earn much less than younger individuals also may lead the NRPS to generate a larger impact, especially in regions that are lagging behind in economic growth (Zhang et al. 2013; Chen et al. 2017b).

3. Conceptual Framework

---

[8] Calculating using CFPS, earned income is net of deductions for transfer income (including transfer from government, friends, relatives, and other channels) and pension income from total income. The mean annual earned income deflated to 2010 constant price is 6,600 CNY in CFPS 2012. Pension beneficiaries on average receive 1096.1 CNY (column (6) of Table 1, 91.34*12= 1096.1 CNY).

The Grossman model of health capital (1972a, 1972b) provides a conceptual basis for analyzing the relationship between income and mental health.[9] The model makes a clear conceptual distinction between inputs in the mental health production and mental health outcomes. Even if mental health inputs are normal goods, so that increases in income cause a rising quantity of input demanded, the net effect of the income change could be negative if the income elasticity with respect to unhealthy goods (e.g. unhealthy behaviors and lifestyle) is sufficiently high.

It is worthwhile to think about channels through which pension may affect mental health investment and health outcomes and, in particular, which of these channels are likely to apply to the Chinese context studied here. Grossman's framework suggests that pension payments to *the older cohort* (those age 60 or greater) may affect mental health through at least three plausible channels: (i) changes to lifestyle factors, such as independent living, service consumption, leisure time, and connectedness with friends and communities; (ii) health investments, such as nutritional intake and medical treatment; and (iii) economic security leading to reduced financial stress.

First, elders who prefer to live independently and are able to do so likely have better mental health through channel (i). This is in part because these individuals have a greater sense of self-actualization. The atomization of extended families may also reduce family conflicts (The Economist 2014). Recent studies on the NRPS show that pension promotes older Chinese to live more independently (Cheng et al. 2018a), hire more services to relieve arduous household chores, and therefore enjoy more leisure time (Chen 2016), their children to move out or even migrate away from the home county (Chen 2017), grandparents to spend less time caring for grandchildren (Chen et al. 2017b). These changes in lifestyle are protective factors for mental well-being (Devoto et al. 2012).

Second, health care resources are often expensive in LMICs where individuals often rely on out-of-pocket medical care. Through channel (ii), pension income may improve mental health via reducing the relative cost of inputs for health. Recent studies on the NRPS show that pension promotes use of appropriate health care

---

[9] In this framework, mental health has both an investment benefit and a consumption benefit. The former makes people more productive, while the latter is a source of utility. The evolution of the mental health stock is determined endogenously in the model by agents optimizing the discounted sum of lifetime utility subject to resource and time constraints.

services, adherence to recommended treatment plans (Chen 2017; Chen et al. 2017b), and nutritional intake (Cheng et al. 2018b), with no apparent increase in unhealthy behavior, including smoking and alcohol drinking (Cheng et al. 2018b).

Third, pension income may improve mental health through channel (iii), i.e., reduced psychosocial stress and adverse moods associated with financial hardship as well as increased self-esteem and sense of control (Conger et al. 1994; Marmot 2005; Fernald and Gunnar 2009; Baird et al. 2013). While recent studies of the NRPS demonstrate higher probability of having sufficient financial support for daily expenses (Cheng et al. 2018b), more empirical studies are required to directly test mental stress in response to pension benefits.

For younger enrollees not yet eligible for pension benefits (those younger than age 60), knowing that their own contributions to the individual account are matched by sizable government subsidies may reduce fear of *future* financial problems due to a strong commitment to saving for older ages and therefore serve to improve mental health through channel (iii). Even channels (i) and (ii) may yield some benefits for the younger cohort if they predict future pension income can lead to less disability and longer life expectancy, resulting in changes in current investment decisions.

4. Methods
4.1 Data

We use the China Family Panel Studies (CFPS), a nationally representative longitudinal survey, collected by Peking University.[10] The baseline survey in 2010 included over 140 counties, 13,000 families and 30,000 adults in 25 out of 31 provinces in China. The 2012 follow-up wave successfully resurveyed more than 85 percent of the 2010 baseline sample. Since the NRPS was not yet introduced in most of the counties covered by the CFPS in 2010 and the mental health measures are not directly comparable across the two waves, only the 2012 survey is utilized in the main analysis. However, we use both 2010 and 2012 waves of the survey in robustness tests to remove individual heterogeneity.[11]

---

[10] See www.isss.edu.cn/cfps/EN for a more detailed introduction of CFPS.
[11] The 2010 wave CFPS included a 6-item CES-D and therefore not directly comparable with the 20-item CES-D in the 2012 wave CFPS. In a robustness check in Table 7 we calculate CES-D score percentile in each wave and follow the literature to define depressive symptoms as 6-item CES-D score>=10 in the 2010 wave (Andresen et al. 1994; Zhang et al. 2012). After merging 2010 wave and

We consider all adults above 45 years of age with rural registration (N=8,636) and divide into two groups (*age 45-59* versus ages *60 and above*) in our analysis due to the financing and benefit structure of NRPS we illustrated in Section 2. Specifically, prior to age 60 individuals pay a pension premium that is augmented by a government subsidy, while at ages 60 or greater individuals receive a payment. We therefore expect the effects of the introduction of the pension to differ for these two age groups. While people below age 45 are required to contribute for at least 15 years to be eligible for NRPS, those age 45-59 may choose to contribute for any duration of time. We therefore would expect different effects for these populations.

The CFPS survey collected rich information at the individual level, the household level, and the community level, including demographic characteristics, SES, NRPS enrollment, mental health status (as measured by the CES-D), and subjective well-being (SWB). The CES-D, originally developed by Radloff (1977), is one of the most common screening tests for the depression quotient of individuals. Among all Chinese national survey datasets, CFPS uniquely contains a standard 20-item CES-D measure for mental health conditions during the past week. These 20 questions describe a list of feelings, including 16 questions on negative feelings and 4 questions on positive feelings. The respondents were asked to indicate how often they had those feelings or behaviors from the four options - "almost never (less than one day)", "sometimes (1-2 days)", "often (3-4 days)", and "most of the time (5-7 days)". The four options correspond to 0, 1, 2, 3 in negative questions and 3, 2, 1, 0 in positive questions. The possible total score ranges from 0 to 60. In addition to total CES-D score, we consider two binary indicators – depressive symptoms and severe depressive symptoms – which are often used to diagnose depression. An individual is diagnosed with depression symptoms if the CES-D total score is greater than 15, and with severe depression symptoms if the CES-D total score is greater than 20 (Radloff 1977; Bailly et al. 1992). Figure 2 indicates the range and distribution of CES-D scores in the 2012 CFPS and suggests that a substantial proportion of respondents suffer from depressive

---

2012 wave into panel data, we estimate a longitudinal model with individual fixed effects. For counties in which the NRPS was not implemented by the time of interviews in the 2010 wave, we truncate the instrumental variable, i.e. duration of pension roll-out, at zero. Please refer to section 4.2 for the definition of this instrumental variable.

and severe depressive symptoms.

4.2 Estimation Strategy

The relationship between pension enrollment and mental well-being can be identified in the following equation:

$$Y_i = \alpha_0 + \tau Pension_i + \sum_{j=1}^{k} \alpha_j Age_i^{j} + X_i'\beta + C_i'\gamma + \delta P_i + \varepsilon_i \tag{1}$$

where Y_i denotes mental health. τ identifies the effect of $Pension_i$, denoted by a dichotomous variable whether the individual reported pension enrollment at the time of the survey and a continuous variable indicating self-reported pension income in the past month. We control for the polynomial (order $k = 3$) of age, other individual characteristics X_i, baseline county characteristics C_i, and provincial fixed effects P_i. X_i includes gender, ethnicity, cadre and party membership status, years of education, marital status, whether having chronic diseases, and if insured by a main type of health insurance – New Cooperative Medical Scheme (hereafter NCMS).[12] C_i includes the county's rollout year of the NCMS, NCMS enrollment rate, income per capita, and average years of schooling. Similar to Ayyagari and Frisvold (2016), we cluster estimates at the county level where the NRPS rolled out to accounts for correlations among individuals within each county.[13]

The key empirical challenge in identifying the causal effect of the pension (or more generally income) on mental health is that income changes can be endogenous. First, mental health may have a non-negligible impact on income. Second, unobserved factors omitted from the model, such as character, life experiences and social network, may affect both mental health and income and therefore can bias our estimations.

To avoid reverse causation and omitted variable bias and obtain unbiased and consistent estimates, similar to Cheng et al. (2018a), we measure NRPS roll-out

---

[12] NCMS is the main medical insurance in rural China initiated since 2003 and gradually covered all rural areas by the end of 2008. The program has been highly subsidized by government. All residents with rural registration are eligible to enroll. The enrollment rate have been more than 90 percent.
[13] Our results are robust to clustering at the household and year-of-birth level, which accounts for correlations within households and birth cohorts..

duration as the number of months between pension roll-out in a county and the month of survey administration. We use this variable to instrument for actual pension enrollment status and pension income.[14] As previously described, the NRPS was first implemented in 2009 in a relatively small group of counties and gradually expanded to the rest of counties in 2010-2012. Figure 1b plots the distribution of variable *duration* that varies substantially from almost 0 to 48 months.

The computational method we use to identify our IV estimates is two-stage least-squares (2SLS). The corresponding first stage equation of the 2SLS estimations is:

$$Pension_i = \beta_0 + \lambda Duration_i + \sum_{j=1}^{k} \beta_j Age_i^j + X_i'\phi + C_i'\varphi + \mu P_i + e_i \qquad (2)$$

where $Duration_i$, an instrument for $Pension_i$, is described above. $Duration_i$ must be strongly correlated with the endogenous explanatory variable $Pension_i$, conditional on other covariates.

In the meantime, $Duration_i$ can only be correlated with mental health through its impact on pension enrollment or pension receipt. Though this exclusion restriction condition is not directly testable, we carry out a test to mitigate concerns about possible correlations between NRPS roll-out timing (set by the Ministry of Human Resources & Social Security) and unobservable county-level factors that may have a direct influence on mental health. Merging by county id and year, we regress county-level NRPS roll-out duration on a rich set of county-level characteristics as well as a rich set of characteristics of mayors and party secretaries. The set of county characteristics include demographic factors (proportions of elderly and middle-aged persons respectively, population size, geographic size), economic factors (GDP per capita, industrial composition, county-level government annual spending and fiscal revenue), and public health facilities (number of hospital beds per capita). The rich database on mayors and party secretaries include a county's connections with the central government (if any major leaders of the central government were born or worked in the county) and demographic characteristics of mayors and party secretaries (age, gender, ethnicity, years of education, major). The finding of no significant association (Table A3 and Table A4) bolsters our confidence that NRPS

---

[14] More than 90 percent of the CFPS 2012 survey were implemented during the summer break (July and August) when college students were recruited to conduct interviews. Therefore, variations in *duration* mostly come from differences in the county level roll-out timing.

timing is not independently correlated with mental health (except through pension enrollment).

5. Empirical Results

5.1 Main Results

Table 1 shows descriptive statistics of pension status, mental health, and covariates in the analysis. Comparing pension enrollees and non-enrollees, the former on average reported better mental health status in both older and younger cohorts. Meanwhile, the gap in mental health between pension enrollees and non-enrollees is larger for the older cohort than for the younger cohort. Next, we conduct more rigorous regression analyses to disentangle the effect of pension from other confounders.

In the first stage estimation we examine the correlation between county-level pension roll-out duration and individual pension enrollment, including the likelihood of pension enrollment (Table 2 & Table 4) and pension benefit size (Table 3). Results for the older cohort (age 60 and above) indicate that one additional month of pension roll-out increases the probability of enrollment by 1.2 percentage point (Table 2 column 1) and pension income by 1.74 CNY (Table 3 column 1). As expected, results indicate enrollment was slower among individual between age 45 and age 60 who were required to deposit money into their individual account upon enrolling. Results presented in Table 4 (column 1) show that one more month of pension roll-out increases enrollment rate by 0.7 percentage point in the younger cohort. Consistent with Cheng et al. (2018a), these results indicate that duration of pension rollout at the county level is a strong instrument for both pension enrollment and pension benefits.

In the second stage, the effects of pension enrollment (Table 2) and pension income (Table 3) on mental health for the older cohort Indicate that pension significantly improves mental health (as measured by the CES-D score), depressive symptoms, and severe depressive symptoms. The CES-D score of pensioners is, on average, 1.982 points lower than that of non-pensioners in the OLS regression, while it is 6.202 points lower in the IV estimations. The rates of depressive symptoms and severe depressive symptoms are 17.5 and 25.3 percentage points lower among pensioners, respectively. The salient difference between the IV estimates and the OLS estimates indicates the importance of using the IV strategy to resolve the endogeneity of pension enrollment. The magnitude of these results indicate that a 10 CNY rise in

monthly pension income decreases depressive symptoms and severe depression symptoms by 1 percentage point and 2 percentage point respectively.

Considering that the lowest pension payment in the NRPS is 55 CNY per month and that pension beneficiaries on average receive 91 CNY (column (6) of Table 1), the total effect of monthly pension benefits on depression is sizable. On average, receiving pension reduces the prevalence of depressive symptoms by 21.3 percent (0.001*91/0.427). To put this in context, one clinical trial found that treatment, either by medication or therapy, may reduce the prevalence of depression by 70.0 - 93.5 percent in low- and middle-income countries (Patel et al. 2007).

Our main findings in Table 2 also show that pension receipt decreases CES-D, depression symptoms and severe depression symptoms by 0.70, 0.35 and 0.59 standard deviations, respectively. This impact is similar in size to that of a divorce or being widowed in Britain (Gardner and Oswald 2006), a medium size lottery win in Britain (Gardner and Oswald 2007); the impact is half of that created by the immigration from Tonga to New Zealand (Stillman et al. 2009).

The effects of pension on younger enrollees are shown in Table 4. Although enrolling in pension may help the participants ensure against risks in old ages, the effects of NRPS are insignificant in the IV estimations and smaller in size than the effects on the older cohorts. On average, enrolling in the NRPS decreases CES-D score by 2.705 in the IV estimation. The rate of depressive symptoms and severe depression respectively decrease by 9.4 and 14.9 percentage points.

5.2 Robustness

In this section, a series of robust checks are described to provide reassurance that the main estimation results hold, especially for the older cohort.

First, we consider the subsample of urban residents who have no rural registration and therefore are ineligible to enroll in the NRPS. If the impact of pension enrollment is causal, and not driven by confounding factors, we should find no effect for these urban residents. As there is no actual pension enrollment for urban residents, we use a reduced form model and test the direct impact of NRPS rollout duration. We find the impact is nearly zero and insignificant for both the older and younger cohorts (Table 5), suggesting confounding factors are not driving our results.

Additional falsification tests examine the effect of pension enrollment on 6-item CES-D score at the 2010 survey (for counties without pension roll-out) and height at

the 2012 survey, respectively. The intuition is that pension enrollment should affect current mental health, rather than pre-determined mental health or long-term health status (which was determined before the NRPS expansions). If an individual's past mental health is associated with future pension enrollment, this indicate individuals' characteristics other than pension were driving the change in mental health status. The IV results are shown in Table 6. None of the coefficients on pension enrollment are statistically significant.

Although CES-D in CFPS 2010 only has 6-items and is not perfectly comparable with the more comprehensive measures of depression collected in CFPS 2012, we implement an IV fixed effect estimation following Cheng et al. (2018a) to remove individual heterogeneity and predict the *change* in CES-D score percentile and depressive symptoms within individuals over time. Table 7 shows that for the older cohort pension enrollment is associated with 11.8 and 16.8 percentage points decline in CES-D score and the rate of depressive symptoms, respectively. This magnitude is similar to the main results presented in Tables 2 and 4.

5.3 Heterogeneous Effects

In this section, we discuss the heterogeneous effects of pension on mental health of older persons by mental health status, income, education, and the mental health measure. First, Table 8 shows results from the IV-quantile regression (IVQR) models. Except at the 10th quantile of the CES-D score, the point estimates are larger for higher quantiles (or worse mental health status).

Second, pension payment may account for a larger share of income for the poor, leading to heterogeneous impacts by income. We divide the sample of older cohort by income. Though the effects are less precisely estimated due to the smaller sample size, Panel A of Table A1 shows that pension enrollment and pension income mainly improve mental health of the lower income groups. This result indicates that pension benefits may release binding financial constraints for the poor segment.

Third, nearly one third of the rural respondents in the CFPS national sample are illiterate or semi-illiterate, defined as not completing primary education. To determine whether the effect we find differ by educational background, we divide the older cohort sample into three groups, including individuals who are illiterate or semi-illiterate, who completed only primary education, and those who completed secondary education. Panel B of Table A1 shows that pension income is the most effective in

reducing depressive symptoms for the least educated group, which is consistent with recent evidence in the U.S. (Ayyagari 2015).

Finally, looking into the composition of CES-D, Table A2 illustrates that a large proportion of all 20 items are significantly improved by pension enrollment and pension income, and several effects are sizable, such as "I had trouble keeping my mind on what I was doing.", "I thought my life had been a failure", "My sleep was restless", "I talked less than usual", "My sleep was restless", and "I felt lonely". Since many existing studies use various subsets of the full version of CES-D scale we use in this study, our results provide a cautious note that the specific basket of CES-D questions one includes may affect the impact identified.

6. Conclusions and Discussion

The NRPS offers a modest but potentially important source of income to older populations in China. Employing a well-designed IV strategy, this paper provides new evidence of a positive causal relationship between income and mental health in old age, especially for those with educational, financial or health constraints. No such evidence was found for younger enrollees who have yet to receive pension income.

A financial gain may generate more detectable improvement in subjective measures of health than in physical health in a short period of time (Finkelstein et al. 2012; Ludwig et al. 2013; Baicker et al. 2013; Haushofer and Shapiro 2013; Cesarini et al. 2014). Since CFPS were conducted shortly after NRPS roll-out, its potential impact on physical health may take longer to observe.

Our findings have rich policy implications. First, they justify broad policy interventions that promote public health through increasing the availability of economic resources. Second, we demonstrate that mental health is an important component of research on the efficacy of welfare interventions. As such, mental health should be increasingly measured, reviewed, and addressed in policy recommendations, particularly in developing contexts where mental disorders have received less attention and where resources for improving mental health are most limited. Third, policymakers in China, as well as those in many other developing countries, are seeking to improve health of disadvantaged groups. The heterogeneous effects identified in this paper provide a reference in developing contexts. Fourth, this research draws attention to the poor mental health of the older population and social pensions that can lead to gains in this domain.

Our findings suggest that even a relatively modest pension may help improve the mental health of the Chinese population. Given that the cost of mental health treatment in LMICs amounts to 500-1000 USD per averted disability-adjusted life-year, commensurate with treatment and prevalence of diseases such as diabetes and HIV/AIDS (Patel et al. 2007), policies that offer people more income as a means of preventing mental illness might prove more cost-effective.

The NRPS had achieved universal coverage at the county level in 2012, thus providing a nationwide, subsidized old-age support system to the older population in rural China. Since then, China has been rapidly implementing a social pension program for all eligible urban residents and has set an ambitious plan to integrate the rural and urban social pensions into one system, establishing a national pension system with the goal of providing wide coverage, basic security, multi-level options and sustainability. Once completed in 2020, this unified pension system is expected to serve more than 800 million residents in China. Our future work includes evaluating this more comprehensive and growing pension system.

REFERENCES

Adams, P. Hurd, M. McFadden, D. Merrill, A. Ribeiro, T. 2003. Healthy, wealthy, and wise? Tests for direct causal paths between health and socioeconomic status. *Journal of Econometrics* 112(1): 3-56.

Adda, J. Banks, J. von Gaudecker, H. 2009. The Impact of Income Shocks on Health: Evidence from Cohort Data. *Journal of the European Economic Association* 7(6): 1361-1399.

Andresen, E. M., Malmgren, J. A., Carter, W. B., & Patrick, D. L. (1994). Screening for Depression in Well Older Adults: Evaluation of. *Prev Med*, *10*, 77-84.

Apouey, B., Clark, A. E. 2015. Winning big but feeling no better? The effect of lottery prizes on physical and mental health. *Health economics* 24(5): 516-538.

Ayyagari, P. Evaluating the Impact of Social Security Benefits on Health Outcomes among the Elderly. *CRR WP 2015-25*, Boston College.

Ayyagari, P. and D. Frisvold. 2016. The impact of social security income on cognitive function at older ages. *American Journal of Health economics* 2(4): 463–488.

Baicker K , Taubman SL, Allen HL, Bernstein M, Gruber JH, Newhouse JP, Schneider EC, Wright BJ, Zaslavsky AM, and Finkelstein AN. 2013. The Oregon Experiment - Effects of Medicaid on Clinical Outcomes. *The New England Journal of Medicine* 368: 1713-1722.

Bailly D, Beuscart R, Collinet C, Alexandre JY, Parquet PJ. 1992. Sex Differences in the Manifestations of Depression in Young People. A Study of French High School Students Part I: Prevalence and Clinical Data. *European Child and Adolescent Psychiatry* 1(3): 135-145.

Baird, S. de Hoop, J., B. Özler. 2013. Income Shocks and Adolescent Mental Health. *Journal of Human Resources* 48 (2): 370-403.

Belle, D. 1990. Poverty and women's mental health. *American psychologist* 45(3): 385-389.

Byers, A. L., Yaffe, K., Covinsky, K. E., Friedman, M. B. and Bruce, M. L. 2010. High occurrence of mood and anxiety disorders among older adults: The National Comorbidity Survey Replication. *Arch Gen Psychiatry* 67: 489-96.

Byers, A.L., Covinsky, K.E., Barnes, D.E. and Yaffe, K. 2012. Dysthymia and depression increase risk of dementia and mortality among older veterans. *Am J Geriatr Psychiatry* 20:664-72.

D Cesarini, E Lindqvist, R Östling, B Wallace. 2014. Estimating the causal impact of wealth on health: Evidence from the Swedish lottery players. working paper.

Cai, F., Giles, J., O'Keefe, P., Wang, D. 2012. *The elderly and old age support in rural China*. World Bank Publications.

Case, A. 2001. Does Money Protect Health Status? Evidence from South African Pensions. *NBER Working Paper 8495*.

Case, A., & Deaton, A. (2015). Suicide, age, and wellbeing: an empirical investigation. In *Insights in the Economics of Aging*. University of Chicago Press.

China Insurance and Social Security Research Center. 2015. China Mayor and Party Secretary Database 2000-2013. Fudan University.

Chen X. 2016. Old-Age Pension and Extended Families: How is Adult Children's Internal Migration Affected? *Contemporary Economic Policy* 34(4): 646–659.

Chen, X. 2017. Old Age Pension and Intergenerational Living Arrangements. *Review of Economics of the Household* 15(2): 455-476.

Chen, X., L. Hu. and J. Sindelar. 2017a. "Leaving Money on the Table? Pension Enrollment Decisions in China", *NBER Working Paper 24065*.

Chen, X., A. Sun., K. Eggleston. 2017b. The Impact of Social Pensions on

Intergenerational Relationship: Comparative Evidence from China. Forthcoming in *Journal of the Economics of Aging*.

Cheng, L., H. Liu., Y. Zhang., Z. Zhao. 2018a. The Heterogeneous Impact of Pension Income on Elderly Living Arrangements: Evidence from China's New Rural Pension Scheme. *Journal of Population Economics* 31(1): 155–192.

Cheng, LG., Liu, H., Zhang, Y., and Z. Zhao. 2018b. The Health Implications of Social Pensions: Evidence from China's New Rural Pension Scheme. Journal of Comparative Economics 46(1): 53-77.

Collins, P. Y., Patel, V., Joestl, S. S., March, D., Insel, T. R., Daar, A. S., Bordin, I. A., Costello, E. J., Durkin, M., Fairburn, C., et al. 2011. Grand challenges in global mental health. *Nature* 475(7354): 27-30.

Conger, Rand D., Xiaojia Ge, Glen H. Elder, Frederick O. Lorenz, Ronald L. Simons. 1994. Economic Stress, Coercive Family Process, and Developmental Problems of Adolescents. *Child Development* 65 (2):541–61.

Deaton, A. 2002. Policy Implications of the Gradient of Health and Wealth. *Health Affairs* 21(2): 13-30.

Devoto, Florencia, Esther Duflo, Pascaline Dupas, William Parienté, and Vincent Pons. 2012. Happiness on Tap: Piped Water Adoption in Urban Morocco. *American Economic Journal: Economic Policy* 4(4): 68-99.

Dohrenwend BP. 1975. Sociocultural and social-psychological factors in the genesis of mental disorders. *Journal of Health and Social Behavior* **16**(4): 365-392.

Elesh, D., & Lefcowitz, M. J. 1977. The effects of the New Jersey-Pennsylvania Negative Income Tax Experiment on health and health care utilization. *Journal of Health and Social Behavior* 18(4): 391-405.

Ettner SL. 1996. New evidence on the relationship between income and health. *Journal of Health Economics* **15**(1): 67-85.

Evans, W. N., & Garthwaite, C. L. 2010. Giving mom a break: The impact of higher EITC payments on maternal health (NBER working paper w16296). National Bureau of Economic Research.

Fernald, L. and MR. Gunnar. 2009. Effects of a Poverty Alleviation Intervention on Salivary Cortisol in Very Low-Income Children. *Social Science and Medicine* 68(12): 2180–89.

Finkelstein, A. Taubman, S. Wright, B. Bernstein, M. Gruber, J. Newhouse, J. Allen, H. Baicker, K. 2012. The Oregon Health Insurance Experiment: Evidence from the First Year. *The Quarterly Journal of Economics* 127(3): 1057-1106.

Fiske, A., Wetherell, J. L. and Gatz, M. 2009. Depression in Older Adults. *Annual Review of Clinical Psychology* 5: 363-89.

Friedman, J, and D. Thomas. 2008. Psychological Health Before, During, and After an Economic Crisis: Results from Indonesia, 1993–2000. *World Bank Economic Review* 23(1):57–76.

Frijters, P., Haisken-DeNew, JP., & Shields, MA. 2005. The causal effect of income on health: Evidence from German reunification. *Journal of Health Economics 24*(5): 997-1017.

Gardner J, Oswald AJ. 2006. Do divorcing couples become happier by breaking up? *Journal of the Royal Statistical Society. Series A (Statistics in Society)* **169**(2): 319-336.

Gardner J, Oswald AJ. 2007. Money and mental wellbeing: A longitudinal study of medium-sized lottery wins. *Journal of Health Economics* **26**(1): 49-60.

Golberstein, E. 2015. The Effects of Income on Mental Health: Evidence from the Social Security Notch. *Journal of Mental Health Policy and Economics* 18: 17-27.

Grossman, M. 1972a. *The Demand of Health: A Theoretical and Empirical Investigation*. Columbia University Press.

Grossman, M. 1972b. On the Concept of Health Capital and the Demand for Health. *Journal of Political Economy* 80(2): 223-255.

Haushofer, J. Shapiro, J. 2013. Household Response to Income Changes: Evidence from an Unconditional Cash Transfer Program in Kenya. MIT working paper.

Depression Scale (CES-D). *Archives of internal medicine*, *159*(15), 1701-1704.

Jensen, R. and K. Richter. 2004. The Health Implications of Social Security Failure: Evidence from the Russian Pension Crisis. *Journal of Public Economics* 88 (1): 209–236.

Kim B, Ruhm J. 2012. Inheritances, health and death. *Health Economics* **21**(2): 127-144.

Kuhn, P. Kooreman, P. Soetevent, A. Kapteyn, A. 2011. The Effects of Lottery Prizes on Winners and Their Neighbors: Evidence from the Dutch Postcode Lottery. *American Economic Review* 101(5): 2226-47.

Lando J, Marshall Williams S, Sturgis S, et al. 2006. A logic model for the integration of mental health into chronic disease prevention and health promotion. *Prev Chronic Dis.* 3(2): A61.

Lei X, C. Zhang and Y. Zhao 2013. Incentive problems in China's new rural pension program." *Research in Labor Economics* 37: 181-201.

Lindahl M. 2005. Estimating the effect of income on health and mortality using lottery prizes as an exogenous source of variation in income. *Journal of Human Resources* **40**(1): 144-168.

Ludwig, Jens, Greg J. Duncan, Lisa A. Gennetian, Lawrence F. Katz, Ronald C. Kessler, Jeffrey R. Kling, and Lisa Sanbonmatsu. 2013. Long-Term Neighborhood Effects on Low-Income Families: Evidence from Moving to Opportunity. *American Economic Review* 103(3): 226-31.

Lund, F. 2007. State social benefits in Social Africa. *International Social Security Review* 46(1): 5–25.

Marmot, M. 1994. Social Differentials in Health within and Between Populations. *Daedalus* 123: 197-216.

Marmot, M. 2002. The Influence of Income on Health: Views of an Epidemiologist. *Health Affairs* 21(2): 31-46.

Marmot, M. 2005. *The Status Syndrome: How Social Standing Affects Our Health and Longevity*. Times Books.

Mathers, C. D., Fat, D. M., and Boerma, J. 2008. *The global burden of disease: 2004 update*. World Health Organization.

Meer, J. Miller, D. Rosen, H. 2003. Exploring the health-wealth nexus. *Journal of Health Economics* 22(5): 713-730.

Milligan, Kevin, and Mark Stabile. 2011. Do Child Tax Benefits Affect the Well-Being of Children? Evidence from Canadian Child Benefit Expansions. *American Economic Journal: Economic Policy* 3(3): 175-205.

National Research Council and Institute of Medicine, Committee on the Prevention of Mental Disorders and Substance Abuse among Children, Youth, and Young Adults. 2009. *Preventing mental, emotional, and behavioral disorders among young people: Progress and possibilities*. O'Connell ME, Boat T, Warner KE, editors. Washington: National Academies Press.

Oswald, A. Rablen, MD. 2008. Mortality and Immortality: The Nobel Prize as an Experiment into the Effect of Status upon Longevity. *Journal of Health Economics* 27(6): 1462-1471.

Patel, V., Araya, R., Chatterjee, S., Chisholm, D., Cohen, A., De Silva, M., Hosman, C., McGuire, H., Rojas, G., and van Ommeren, M. 2007. Treatment and prevention of mental disorders in low-income and middle-income countries. *The Lancet* 370 (9591): 991-1005.

Radloff LS. 1977. The CES-D scale: A self-report depression scale for research in the general population. *Applied Psychological Measurement* **1**(3): 385-401.

Smith JP. 1999. Healthy bodies and thick wallets: the dual relation between health and economic status. *Journal of Economic Perspectives* **13**(2): 145-166.

Snyder, S. and W. Evans. 2006. The Effect of Income on Mortality: Evidence from the Social Security Notch. *Review of Economics and Statistics* 88: 482-495.

Stillman S., McKenzie D., Gibson J. 2009. Migration and mental health: Evidence from a natural experiment. *Journal of Health Economics* **28**(3): 677-687.

Stowasser, T. Heiss, F. McFadden, D. Winter, J. 2011. "Healthy, Wealthy and Wise?" Revisited: An Analysis of the Causal Pathways from Socioeconomic Status to Health. NBER Chapters, in: *Investigations in the Economics of Aging*. 267-317 National Bureau of Economic Research, Inc.

Sullivan, D. Wachter, TV. 2009. Job Displacement and Mortality: An Analysis Using Administrative Data. *Quarterly Journal of Economics* 124: 1265-1306.

Suzman, R., Beard, J., Boerma, T. and S. Chatterji. 2014. Health in an ageing world— what do we know? *The Lancet*. pii: S0140-6736(14)61597-X.

Thaler, R. 1990. Anomalies: Saving, Fungibility, and Mental Accounts. *Journal of Economic Perspectives* 4(1): 193-205.

The Economist. 2014. Back from the edge. Jun 28.

U.S. CDC. 2016. Fatal Injury Reports 1999-2015, for National, Regional, and States. Centers for Disease Control and Prevention. National Center for Injury Prevention and Control.

U.S. Department of Health and Human Services. 1999. Mental Health: A Report of the Surgeon General. Rockville, MD: U.S. Department of Health and Human Services, Substance Abuse and Mental Health Services Administration, Center for Mental Health Services, National Institutes of Health, National Institute of Mental Health.

World Health Organization. 2017. Depression and Other Common Mental Disorders: Global Health Estimates.

Zhang C., Giles J., Zhao Y. 2013. Evaluation of new rural pension program: income, poverty, consumption, subjective well-being and labor supply. *CCER working paper No. C2013003*.

Zhang, W., O'Brien, N., Forrest, J. I., Salters, K. A., Patterson, T. L., Montaner, J. S., ... & Lima, V. D. (2012). Validating a shortened depression scale (10 item CES-D) among HIV-positive people in British Columbia, Canada. *PloS one 7*(7), e40793.

Figure 1a. Rollout of New Rural Pension Scheme in China
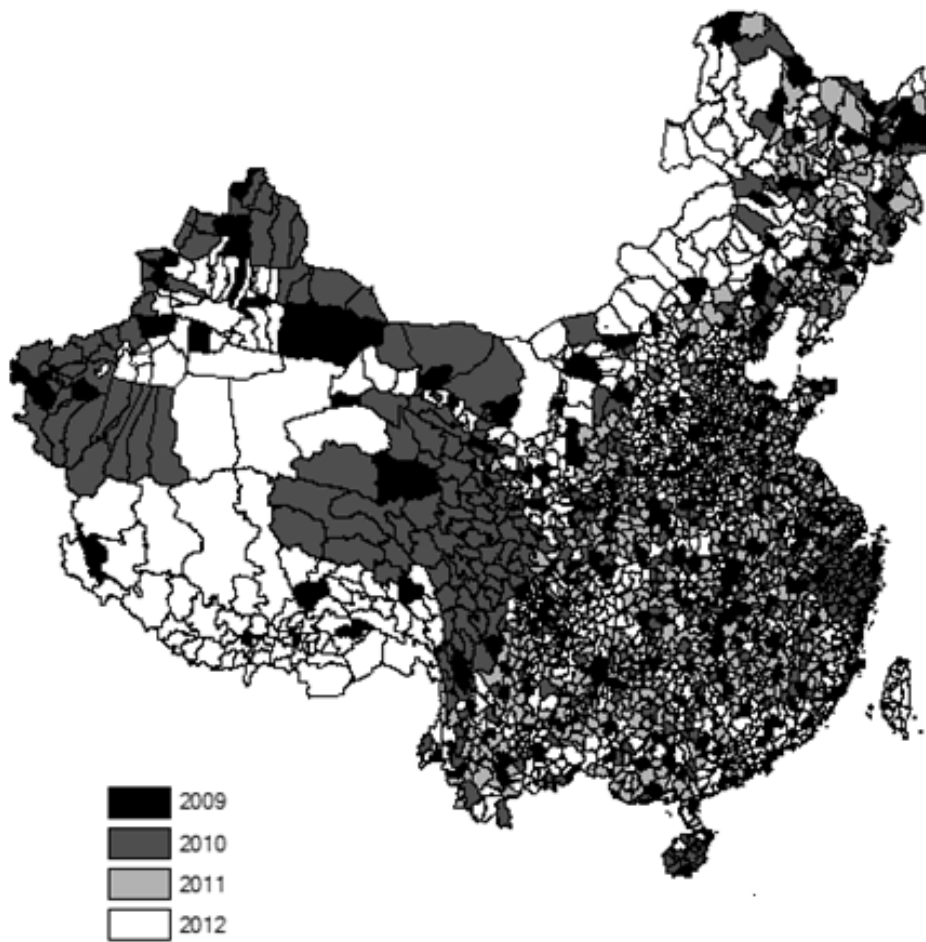
Notes: The NRPS was rolled out nationwide at the county level during 2009-2012.

Figure 1b. NRPS roll-out duration (number of months since the NRPS rollout in the county)
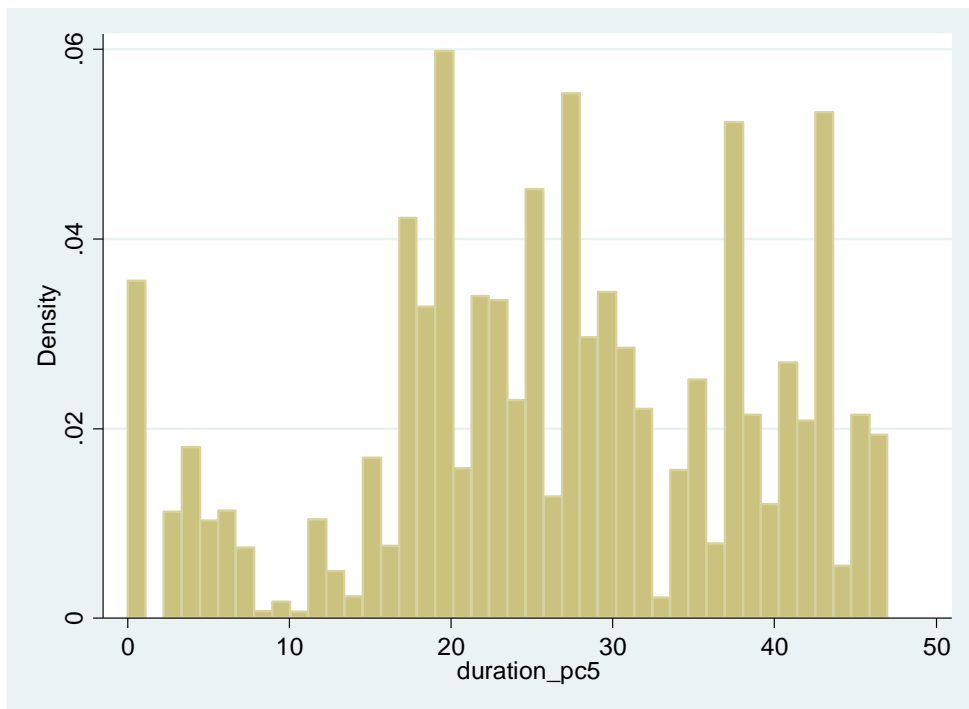
Source: CFPS 2012 survey

Note: NRPS duration is defined as number of months between the date of pension roll-out in the individual's county and the individual's survey month.

Figure 2 Density of CES-D score
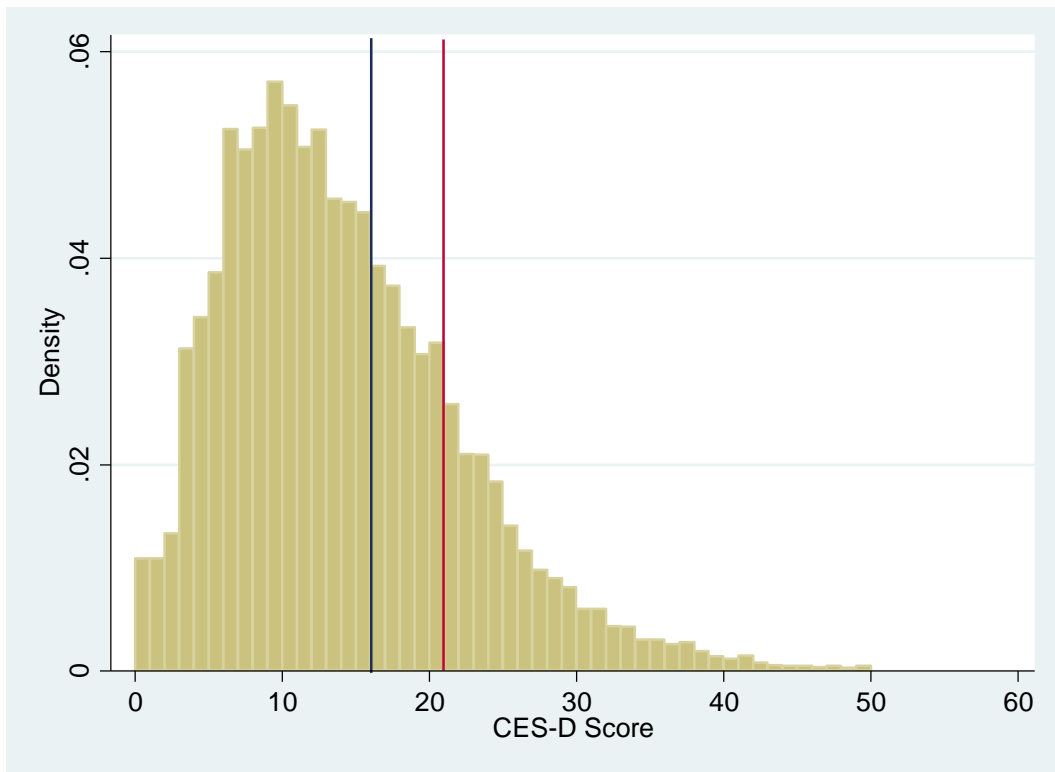
Notes: The blue line represents the threshold for depressive symptoms (CES-D score 16 or greater) and the red line represents the threshold for severe depression (CES-D score 21 or greater).

Table 1 Summary Statistics

dependent variable	All age groups	Age 45 to 60			Age 60 or greater		
		All	NRPS participants	NRPS non-participants	All	NRPS recipients	NRPS non-recipients
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CES-D							
total score of CES-D	14.53	14.14	13.77	14.53	15.35	14.53	16.85
	(8.622)	(8.500)	(8.249)	(8.735)	(8.820)	(8.443)	(9.286)
depressive symptoms	0.396	0.382	0.367	0.397	0.427	0.389	0.495
	(0.489)	(0.486)	(0.482)	(0.489)	(0.495)	(0.488)	(0.500)
severe depression	0.222	0.210	0.192	0.227	0.249	0.220	0.301
	(0.416)	(0.407)	(0.394)	(0.419)	(0.432)	(0.414)	(0.459)
Pension							
pension enrollment	0.551	0.506	1	0	0.645	1	0
	(0.497)	(0.500)			(0.479)		
monthly pension income	18.86	0	0	0	58.93	91.34	0
(CNY)	(67.80)				(109.6)	(125.1)	
NRPS duration in the county	26.87	27.26	28.89	25.58	26.04	29.12	20.46
	(11.77)	(11.78)	(9.881)	(13.25)	(11.69)	(8.749)	(14.06)
Covariates at individual/family level							
Age	57.11	51.99	52.33	51.63	67.98	68.20	67.59
	(9.054)	(4.536)	(4.517)	(4.530)	(6.196)	(6.028)	(6.476)
male	0.489	0.476	0.464	0.488	0.518	0.519	0.515
	(0.500)	(0.499)	(0.499)	(0.500)	(0.500)	(0.500)	(0.500)
Han	0.913	0.914	0.916	0.912	0.911	0.910	0.915
	(0.281)	(0.280)	(0.277)	(0.284)	(0.284)	(0.287)	(0.280)
CCP membership	0.0585	0.0482	0.0484	0.0480	0.0803	0.0830	0.0755
	(0.235)	(0.214)	(0.215)	(0.214)	(0.272)	(0.276)	(0.264)
married	0.890	0.943	0.951	0.936	0.777	0.780	0.772
	(0.312)	(0.231)	(0.216)	(0.245)	(0.416)	(0.414)	(0.419)
year of education	4.566	5.428	5.433	5.422	2.735	2.778	2.655
	(4.195)	(4.260)	(4.263)	(4.256)	(3.395)	(3.403)	(3.379)
NCMS	0.909	0.911	0.971	0.849	0.906	0.945	0.836
	(0.287)	(0.285)	(0.168)	(0.358)	(0.292)	(0.228)	(0.371)
chronic disease	0.150	0.135	0.137	0.133	0.183	0.184	0.181
	(0.357)	(0.342)	(0.344)	(0.339)	(0.387)	(0.388)	(0.385)
total assets (10,000 CNY)	23.13	24.39	22.27	26.56	20.44	17.92	25.03
	(56.02)	(54.77)	(31.73)	(70.95)	(58.50)	(30.70)	(88.89)
migration ratio	0.112	0.129	0.128	0.131	0.0767	0.0738	0.0819
	(0.184)	(0.192)	(0.189)	(0.194)	(0.160)	(0.158)	(0.163)
Covariates at county level							
NCMS start year	2005.7	2005.7	2005.7	2005.7	2005.7	2005.7	2005.8
	(1.229)	(1.230)	(1.202)	(1.256)	(1.228)	(1.189)	(1.294)
NCMS enrollment ratio	0.896	0.892	0.908	0.875	0.904	0.906	0.898
	(0.106)	(0.111)	(0.0819)	(0.132)	(0.0968)	(0.0817)	(0.119)
Income per capita (CNY)	10205.3	10333.0	10033.2	10640.3	9934.1	9828.9	10125.4
	(3418.8)	(3526.2)	(2977.1)	(3988.9)	(3162.3)	(2909.6)	(3569.9)
Years of education	5.577	5.684	5.685	5.683	5.349	5.470	5.131
	(1.442)	(1.448)	(1.308)	(1.580)	(1.402)	(1.212)	(1.672)
N	8636	5747	2869	2878	2889	1834	1055

Source: CFPS 2012

Notes: N is sample size. Standard deviations are reported in the parentheses.

Table 2 Main Results: The Effect of NRPS enrollment (above 60-year-old)

VARIABLES	First Stage	Second Stage					
	Pension enrollment	Total Score of CES-D		depressive symptoms		Severe depression	
		OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Pension enrollment		-1.982***	-6.202***	-0.079***	-0.175*	-0.069**	-0.253**
		(0.588)	(2.377)	(0.030)	(0.097)	(0.028)	(0.104)
NRPS duration in the county	0.012***						
	(0.002)						
Personal characteristics							
Age	1.574***	9.109	15.727**	0.471	0.623*	0.519*	0.793**
	(0.316)	(5.628)	(6.467)	(0.349)	(0.358)	(0.293)	(0.322)
Age^2	-0.021***	-0.123	-0.212**	-0.006	-0.008*	-0.007*	-0.011**
	(0.004)	(0.077)	(0.088)	(0.005)	(0.005)	(0.004)	(0.004)
Age^3	0.000***	0.001	0.001**	0.000	0.000*	0.000*	0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	0.000	-1.414***	-1.396***	-0.051**	-0.050**	-0.060***	-0.058***
	(0.014)	(0.310)	(0.298)	(0.021)	(0.021)	(0.016)	(0.016)
Han	0.003	0.177	0.173	-0.111	-0.111	-0.016	-0.014
	(0.060)	(1.233)	(1.176)	(0.075)	(0.072)	(0.063)	(0.056)
CCP membership	0.012	-1.606***	-1.436***	-0.036	-0.033	-0.100***	-0.095***
	(0.023)	(0.524)	(0.531)	(0.034)	(0.034)	(0.023)	(0.023)
Married	0.017	-2.193***	-2.042***	-0.116***	-0.114***	-0.095***	-0.090***
	(0.020)	(0.397)	(0.389)	(0.019)	(0.019)	(0.020)	(0.020)
Years of education	-0.002	-0.285***	-0.304***	-0.014***	-0.015***	-0.010***	-0.010***
	(0.003)	(0.055)	(0.055)	(0.003)	(0.003)	(0.003)	(0.003)

NCMS	0.276***	0.046	1.236	0.019	0.046	-0.006	0.046
	(0.040)	(0.630)	(0.859)	(0.031)	(0.041)	(0.030)	(0.039)
Chronic disease	0.004	2.415***	2.407***	0.103***	0.108***	0.124***	0.126***
	(0.027)	(0.502)	(0.493)	(0.028)	(0.027)	(0.027)	(0.027)
Family characteristics							
Total assets	-0.000	-0.008***	-0.009***	-0.000**	-0.000**	-0.000***	-0.000***
	(0.000)	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)
Migration ratio	-0.013	1.421	1.419	0.206***	0.199***	0.003	0.002
	(0.068)	(1.130)	(1.205)	(0.063)	(0.065)	(0.061)	(0.064)
Regional characteristics (county level)							
NCMS start year	-0.023	0.364	0.210	0.020	0.017	0.012	0.006
	(0.025)	(0.249)	(0.245)	(0.014)	(0.013)	(0.011)	(0.011)
NCMS enroll rate	0.200	-9.097**	-8.750**	-0.531**	-0.523**	-0.304*	-0.284*
	(0.368)	(4.018)	(3.688)	(0.232)	(0.220)	(0.164)	(0.146)
Income per capita	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Average school years	-0.008	-0.712**	-0.569*	-0.041***	-0.038***	-0.032**	-0.028**
	(0.021)	(0.304)	(0.297)	(0.014)	(0.014)	(0.012)	(0.013)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	7.575	-922.947*	-775.422	-51.455*	-48.114*	-36.160	-29.534
	(51.224)	(537.435)	(525.124)	(28.907)	(28.296)	(22.321)	(22.960)
Observations	2,764	2,608	2,585	2,608	2,585	2,608	2,585

Notes: [1] F-tests for "NRPS duration at the county level" is 25.97 for Column (1), which can reject the null hypothesis that the instrument variable is weak. [2] ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are reported in the parentheses. [3] All the standard errors are clustered at the county level.

Table 3 Main Results: The Effect of NRPS income (above 60-year-old)

VARIABLES	First Stage	Second Stage					
	Monthly Pension income(Yuan)	Total Score of CES-D		depressive symptoms		Severe Depression	
		OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Monthly Pension income(Yuan)		-0.003	-0.042**	-0.000	-0.001*	-0.000	-0.002**
		(0.002)	(0.019)	(0.000)	(0.001)	(0.000)	(0.001)
NRPS duration in the county	1.737***						
	(0.395)						
Personal characteristics							
Age	69.713	5.887	7.828	0.346	0.400	0.404	0.471
	(57.476)	(5.662)	(6.105)	(0.347)	(0.346)	(0.292)	(0.296)
Age^2	-0.906	-0.080	-0.104	-0.005	-0.005	-0.006	-0.006
	(0.776)	(0.078)	(0.084)	(0.005)	(0.005)	(0.004)	(0.004)
Age^3	0.004	0.000	0.000	0.000	0.000	0.000	0.000
	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Male	0.512	-1.422***	-1.401***	-0.051**	-0.050**	-0.060***	-0.058***
	(4.362)	(0.318)	(0.337)	(0.021)	(0.022)	(0.017)	(0.017)
Han	15.240	0.194	0.805	-0.109	-0.093	-0.016	0.011
	(9.576)	(1.287)	(1.350)	(0.077)	(0.078)	(0.066)	(0.063)
CCP membership	-15.007**	-1.703***	-2.161***	-0.041	-0.053	-0.102***	-0.124***
	(6.438)	(0.529)	(0.626)	(0.034)	(0.036)	(0.023)	(0.027)
Married	8.512*	-2.199***	-1.818***	-0.116***	-0.108***	-0.096***	-0.081***
	(4.732)	(0.401)	(0.424)	(0.020)	(0.020)	(0.020)	(0.020)
Years of education	0.445	-0.275***	-0.272***	-0.014***	-0.014***	-0.009***	-0.009***
	(0.666)	(0.055)	(0.062)	(0.003)	(0.003)	(0.003)	(0.003)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
NCMS	26.910**	-0.439	0.603	0.001	0.028	-0.024	0.021
	(12.585)	(0.633)	(0.916)	(0.032)	(0.040)	(0.030)	(0.041)
Chronic disease	-5.433	2.394***	2.143***	0.102***	0.100***	0.123***	0.115***
	(5.598)	(0.517)	(0.547)	(0.028)	(0.029)	(0.027)	(0.029)
Family characteristics							
Total assets	-0.052	-0.008**	-0.011**	-0.000*	-0.000**	-0.000**	-0.000**
	(0.060)	(0.003)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)
Migration ratio	-23.760**	1.395	0.567	0.204***	0.175***	0.002	-0.032
	(11.554)	(1.123)	(1.270)	(0.063)	(0.064)	(0.060)	(0.067)
Regional characteristics(county level)							
NCMS start year	-4.973	0.417	0.146	0.022	0.015	0.014	0.003
	(3.799)	(0.267)	(0.285)	(0.014)	(0.014)	(0.011)	(0.012)
NCMS enroll rate	-17.522	-9.459**	-11.452**	-0.547**	-0.599***	-0.315*	-0.394*
	(93.022)	(4.338)	(5.133)	(0.242)	(0.230)	(0.179)	(0.211)
Income per capita	0.006**	-0.000	0.000	0.000	0.000	-0.000	0.000
	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Average school years	-8.771**	-0.760**	-0.879**	-0.043***	-0.047***	-0.033**	-0.041***
	(3.893)	(0.323)	(0.364)	(0.014)	(0.015)	(0.013)	(0.015)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	8,110.866	-952.076*	-460.131	-52.148*	-39.210	-37.633	-16.689
	(7,869.202)	(574.143)	(623.283)	(29.724)	(30.476)	(23.053)	(26.173)
Observations	2,764	2,608	2,585	2,608	2,585	2,608	2,585

Notes: [1] F-tests for "NRPS duration at the county level" is 19.33 for Column (1), which can reject the null hypothesis that the instrument variable is weak. [2] ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are reported in the parentheses. [4] All the standard errors are clustered at the county level.

Table 4 Other Results: The Effect of NRPS enrollment (between 45 and 60-year-old)

	First Stage	Second Stage					
VARIABLES	Pension enrollment	Total Score of CES-D		depressive symptoms		Severe depression	
		OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Pension enrollment		-0.668*	-2.705	-0.020	-0.094	-0.030**	-0.149
		(0.343)	(3.070)	(0.018)	(0.168)	(0.015)	(0.108)
NRPS duration in the county	0.007***						
	(0.002)						
Personal characteristics							
Age	-0.940	-12.421	-12.602	0.100	0.095	-0.263	-0.298
	(0.790)	(12.790)	(12.849)	(0.734)	(0.727)	(0.647)	(0.664)
Age^2	0.019	0.247	0.252	-0.002	-0.002	0.006	0.006
	(0.015)	(0.245)	(0.247)	(0.014)	(0.014)	(0.012)	(0.013)
Age^3	-0.000	-0.002	-0.002	0.000	0.000	-0.000	-0.000
	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Male	-0.024**	-2.129***	-2.203***	-0.110***	-0.114***	-0.088***	-0.093***
	(0.011)	(0.246)	(0.250)	(0.014)	(0.014)	(0.012)	(0.012)
Han	0.044	-0.391	-0.284	-0.032	-0.029	0.021	0.027
	(0.061)	(0.754)	(0.779)	(0.042)	(0.041)	(0.025)	(0.028)
CCP membership	0.001	-0.986**	-1.091**	-0.064**	-0.070***	-0.041**	-0.044**
	(0.031)	(0.440)	(0.436)	(0.027)	(0.026)	(0.020)	(0.020)
Married	0.055*	-4.151***	-3.969***	-0.193***	-0.185***	-0.154***	-0.147***
	(0.029)	(0.510)	(0.561)	(0.025)	(0.028)	(0.024)	(0.026)
Years of education	0.002	-0.245***	-0.241***	-0.011***	-0.011***	-0.009***	-0.008***
	(0.002)	(0.035)	(0.035)	(0.002)	(0.002)	(0.002)	(0.002)

NCMS	0.335***	-0.659	0.004	-0.044*	-0.018	-0.033	0.005
	(0.031)	(0.464)	(1.145)	(0.026)	(0.061)	(0.022)	(0.041)
Chronic disease	-0.004	3.707***	3.657***	0.157***	0.156***	0.156***	0.153***
	(0.020)	(0.349)	(0.346)	(0.018)	(0.018)	(0.017)	(0.017)
Family characteristics							
Total assets	-0.000	-0.013***	-0.013***	-0.001***	-0.001***	-0.000**	-0.000***
	(0.000)	(0.004)	(0.004)	(0.000)	(0.000)	(0.000)	(0.000)
Migration ratio	-0.004	2.247***	2.137***	0.060	0.056	0.095***	0.091***
	(0.052)	(0.743)	(0.739)	(0.039)	(0.039)	(0.030)	(0.031)
Regional characteristics(county level)							
NCMS start year	-0.031	0.518**	0.435*	0.033***	0.030**	0.022***	0.017**
	(0.023)	(0.210)	(0.228)	(0.011)	(0.012)	(0.007)	(0.009)
NCMS enroll rate	0.312	-1.073	-0.753	-0.042	-0.035	-0.035	-0.010
	(0.365)	(3.238)	(3.743)	(0.155)	(0.173)	(0.096)	(0.123)
Income per capita	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Average school years	-0.042**	0.151	0.098	0.006	0.004	0.006	0.002
	(0.021)	(0.235)	(0.274)	(0.012)	(0.014)	(0.008)	(0.010)
Province FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	77.244	-812.217*	-644.889	-68.069***	-61.861**	-39.243**	-29.371
	(46.793)	(479.241)	(522.179)	(25.487)	(28.282)	(17.227)	(20.673)
Observations	5,543	5,447	5,421	5,447	5,421	5,447	5,421

Notes: [1] ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are reported in the parentheses. [2] For the cohort younger than age 60, pension enrollment means contributing pension premium. [3] All the standard errors are clustered at the county level. [4] This Table includes all respondents below age 60 who are eligible to enroll in the NRPS (i.e., above age 16, not in school, with rural registration).

Table 5 Placebo Tests: Impact of NRPS duration on mental health in urban area

	VARIABLES	Total Score of CES-D	Depressive symptoms	Severe depression	N
		(2)	(3)	(4)	
45 to 60-year-old	NRPS duration in	0.008	-0.000	0.001	1411
	the county	(0.027)	(0.001)	(0.001)	
above 60-year-old	NRPS duration in	0.004	0.001	0.000	1234
	the county	(0.030)	(0.001)	(0.001)	

Notes: [1] The covariates are same as above except excluding NCMS**.** [2] ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are reported in the parentheses. [3] All the standard errors are clustered at the county level.

Table 6 Placebo Tests: Impact of pension enrollment on pre-determined health outcome and long-term health status

	CES-D score in 2010		Height (cm)	
VARIABLES	[45-60)	60+	[45-60)	60+
	(1)	(2)	(3)	(4)
pension enrollment	-1.484	-0.761	6.923	-1.282
	(1.549)	(1.308)	(14.000)	(16.220)
N	5,487	2,701	5,543	2,764

Notes: [1] All results are using the same IV as above. [2] The covariates are same as above**.** [3] ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are reported in the parentheses. [4] All the standard errors are clustered at the county level.

Table 7 Robustness: Impact of NRPS on mental health
(IV-FE using 2010-2012 Panel)

	CES-D score percentile		Depressive symptoms	
Outcome	[45,60)	60+	[45,60)	60+
	(1)	(2)	(3)	(4)
pension enrollment	0.037	-0.118***	0.040	-0.168***
	(0.072)	(0.035)	(0.127)	(0.062)
N	10,651	4,939	10,651	4,939

Notes: [1] CES-D score percentile measures the relative ranking of CES-D score within each wave. [2] Depressive symptoms is defined as CES-D score>=10 in 2010 wave following Andresen et al. (1994) and Zhang et al. (2012). However, the results should be treated with caution since the CES-D in Andresen et al. (1994) and Zhang et al. (2012) has same total score but different number of items compared to CFPS 2010. [3] The covariates are same as in Table 2**.** [4] ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. [5] All the standard errors are clustered at the county level.

Table 8 Heterogeneous effect on CES-D Score (IV quantile regression)

	10th quantile	25th quantile	50th quantile	75th quantile	90th quantile
NRPS					
above 60-year-old	-3.786**	-2.773*	-5.165***	-8.647***	-11.534***
	(1.500)	(1.489)	(1.739)	(2.173)	(3.218)
Pension Income (CNY)					
above 60-year-old	-0.025**	-0.019*	-0.035***	-0.058***	-0.077***
	(0.010)	(0.010)	(0.012)	(0.015)	(0.022)

Notes: [1] The 10th quantile for CES-D score points to better mental health than the other four quantiles. [2] ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are reported in the parentheses.

Online Appendix

Table A1 Heterogeneous Effects of Pension on Mental Health
(2SLS Estimates)

	Pension enrollment (0/1, 60+ age cohorts)			Pension income (CNY, 60+ age cohort)		
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: by three income groups					
dependent variable	low	middle	high	low	Middle	high
total score of CES-D	-6.891**	-6.248*	-3.921	-0.079*	-0.050*	-0.016
	(3.206)	(3.307)	(3.587)	(0.041)	(0.029)	(0.016)
depressive symptoms	-0.158	-0.189	-0.082	-0.002	-0.002	-0.000
	(0.138)	(0.166)	(0.153)	(0.002)	(0.001)	(0.001)
severe depression	-0.371***	-0.258*	-0.041	-0.004**	-0.002	-0.000
	(0.141)	(0.155)	(0.188)	(0.002)	(0.001)	(0.001)
N	826	847	852	826	847	852
	Panel B: by education					
	illiterate	primary edu	secondary edu	illiterate	primary edu	secondary edu
total score of CES-D	-8.867***	-2.599	-3.523	-0.080***	-0.012	-0.015
	(2.742)	(2.972)	(5.487)	(0.030)	(0.015)	(0.022)
depressive symptoms	-0.285***	-0.022	-0.230	-0.003**	-0.000	-0.001
	(0.110)	(0.162)	(0.320)	(0.001)	(0.001)	(0.001)
severe depression	-0.354***	-0.029	-0.531*	-0.003**	0.000	-0.002**
	(0.113)	(0.160)	(0.314)	(0.001)	(0.001)	(0.001)
N	1,430	800	355	1,430	800	355

Notes: 2SLS estimation results are reported. Panel B uses income information collected during the 2012 wave, adjusted to 2010 constant prices. Other notes follow Table 2.

Table A2 The Effect of Pension on Mental Health
(by Each Item in the CES-D Scale, 2SLS Estimates)

	Pension enrollment (0/1,60+ age cohort)		Monthly pension income (CNY)	
	Coef	SE	Coef	SE
CES-D questions				
1. I was bothered by things that usually don't bother me.	-0.189	0.160	-0.001	0.001
2. I did not feel like eating; my appetite was poor.	-0.172	0.163	-0.002*	0.001
3. I felt that I could not shake off the blues even with help from my family or friends.	-0.222	0.177	-0.002	0.001
4. I felt that I was just as good as other people.	-0.166	0.316	0.000	0.002
5. I had trouble keeping my mind on what I was doing.	-0.414***	0.159	-0.003**	0.001
6. I felt depressed.	-0.260*	0.157	-0.002**	0.001
7. I felt that everything I did was an effort.	-0.316*	0.182	-0.002*	0.001
8. I felt hopeful about the future.	0.110	0.309	-0.000	0.002
9. I thought my life had been a failure.	-0.434**	0.215	-0.003*	0.002
10. I felt fearful.	-0.266	0.181	-0.002	0.002
11. My sleep was restless.	-0.450**	0.177	-0.003**	0.002
12. I was happy.	0.232	0.310	-0.001	0.002
13. I talked less than usual.	-0.605***	0.211	-0.004***	0.002
14. I felt lonely.	-0.371***	0.143	-0.002*	0.001
15. People were unfriendly.	-0.283*	0.165	-0.003**	0.001
16. I enjoyed life.	0.062	0.266	-0.001	0.001
17. I had crying spells.	-0.164	0.147	-0.002*	0.001
18. I felt sad.	-0.134	0.133	-0.001	0.001
19. I felt that people disliked me.	-0.186	0.149	-0.002*	0.001
20. I could not get "going."	-0.134	0.205	-0.002*	0.001

Notes: 2SLS estimation results are reported. The response scale is reversed for four positive questions (4, 8, 12, 16), so that they have the same sign as those negative questions. 0 represents the best situation, 3 represents the worst situation. Other notes follow Table 2.

Table A3 Summary Statistics for County-Level Characteristics

	Dependent variable					
Variable	**Description**	**Obs**	**Mean**	**SD**	**Min**	**Max**
Time	Number of years since roll-out	2032	1.757874	0.95823	0	3

	Independent variables (census data in 2010)					
Variable	**Description**	**Obs**	**Mean**	**SD**	**Min**	**Max**
elderly	Proportion of residents aged > 60	2016	0.121858	0.02741	0.044787	0.245302
primeage	Proportion of residents aged 45-59	2016	0.182595	0.0336	0.084766	0.281767

	Independent variables (China Data Center, averaged from 2006 to 2008)					
Variable	**Description**	Obs	Mean	SD	Min	Max
population	Population with local Hukou (10,000)	2032	46.96807	34.68808	0.673333	221.4667
gdppc	GDP per capita (10,000)	2098	1.3671	1.338048	0.158216	17.55029
vaddedprim	Proportion of primary industry added value in GDP	2032	11.72115	9.843006	0.126667	58.84
netrevenue	Net revenue per capita of the local government (10,000)	2032	-0.13074	0.121803	-1.48527	0.209573
bed	Number of beds per 10,000 people in hospitals and orphanages	2052	36.98728	19.73719	3.465704	210.4423

	Independent variables (Party secretary characteristics)					
Variable	**Description**	**Obs**	**Mean**	**SD**	**Min**	**Max**
ifhometown	If it is the birth city	2198	0.040902	0.198145	0	1
age	Age	2123	54.07195	3.494404	43	62
age50	Age below 50	2123	0.119379	0.324366	0	1
age54	Age 50-53	2123	0.253475	0.435179	0	1
age58	Age 54-57	2123	0.46852	0.499212	0	1
ageover58	Age above 58	2123	0.158626	0.365477	0	1
Gender	Gender	2129	0.980472	0.138428	0	1
ifminority	Minority or not	2111	0.072667	0.259697	0	1
College	highest degree = B.A	2161	0.265246	0.441627	0	1
Master	highest degree = M.A	2161	0.595151	0.491043	0	1
Phd	highest degree = PhD	2161	0.139603	0.346702	0	1
partyschool	Graduated from the Party School or not	2184	0.364161	0.481368	0	1
major_agri	Major in agriculture	2138	0.069506	0.254409	0	1

Variable	Description	Obs	Mean	SD	Min	Max
major_humss	Major in humanities / social science	2143	0.818317	0.385726	0	1
major_tech	Major in science or technology	2139	0.291262	0.454513	0	1
major_medicine	Major in medicine	2138	0.002242	0.047315	0	1
Independent variables (other sources)						
Variable	**Description**	**Obs**	**Mean**	**SD**	**Min**	**Max**
Ifpoor	National poverty-stricken county	2032	0.283957	0.451027	0	1
Auto	Autonomous county, state or region	2032	0.30561	0.460779	0	1

Data sources: 1) county-level statistics (other than demographic characteristics) were drawn from the China Data Center at University of Michigan http://chinadatacenter.org/; 2) county demographic characteristics were drawn and averaged from China's census data in 2000 and 2010; 3) prefecture-level Party secretary characteristics spanning from 2000 to 2010 were compiled by researchers at Fudan University; 4) the national poverty-stricken county list in 2009.

Table A4 County-Level Determinants of Years of NRPS Roll-out

Variables	Number of years since initial roll-out in China		
	(1)	(2)	(3)
county demographic characteristics			
Proportion of residents aged > 60	-1.0912	-1.7857	0.7350
	(1.4380)	(1.6366)	(2.5520)
Proportion of residents aged 45-59	2.6473	2.2985	3.3090
	(1.6512)	(1.7937)	(2.7339)
Population with local Hukou (10,000)	0.0008	0.0009	0.0012
	(0.0009)	(0.0013)	(0.0013)
Autonomous county, state or region	-0.0682	-0.0708	-0.0867
	(0.0853)	(0.0855)	(0.1997)
county economic and social characteristics			
National poverty-stricken county		-0.0567	0.0429
		(0.0565)	(0.0923)
GDP per capita (10,000)		0.0129	0.0467
		(0.0261)	(0.0406)
Proportion of primary industry added value in GDP		-0.0049	-0.0077
		(0.0045)	(0.0055)
Net revenue per capita of the local government (10,000)		0.3892	-0.3473
		(0.4447)	(0.5908)
Number of beds per 10,000 people in hospitals and orphanages		-0.0023	-0.0014
		(0.0015)	(0.0030)
party secretary of CCP background			
Born in this municipality			-0.2310
			(0.1629)

Age 50-53			0.2303
			(0.1591)
Age 54-57			0.1247
			(0.1556)
Age above 58			0.2120
			(0.1759)
Male			0.3716
			(0.2371)
Minority			-0.0995
			(0.1598)
highest degree = M.A			0.0864
			(0.1059)
highest degree = PhD			0.0400
			(0.1237)
Graduated from the Party School			-0.0156
			(0.0972)
Major in agriculture			0.1191
			(0.1389)
major_medicine			-0.0058
			(0.1598)
Major in humanities / social science			0.1490
			(0.1343)
Major in science or technology			0.1289
			(0.1038)
Province FE	Yes	Yes	Yes
N	2011	2009	1928
Adjusted R-sq	0.1171	0.0976	0.1901

Data sources: same as Table A3

Notes: [1] Column 1 presents results with county demographic characteristics. Column 2 adds other economic and social characteristics. Party secretary background variables are further included in Column 3. [2] Constants are omitted for saving space. [3] ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively. Standard errors are reported in the parentheses. [4] All the standard errors are clustered at the county level.